University of Nevada, Reno

# GEOLOGY OF THE CHUKAR FOOTWALL MINE, MAGGIE CREEK DISTRICT, CARLIN TREND, NEVADA

A Thesis submitted in partial fulfillment of the

requirements for the degree of Master of Science in

Geology

By

Juan Antonio Ruiz Párraga

Dr. Tommy Thompson, Thesis Advisor

May, 2007

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	Entitled
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	be accepted in partial fulfillment of the requirements for the degree of
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$-\mathcal{O}$	Tommy B. Thompson, Ph.D., Advisor
Rich	me a Clivenkur
Ricl	hard A. Schweikert, Ph. D., Committee Member
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Victor	Vasquez, Ph.D., Graduate School Representative
	much VI Starl
Marsha	H. Read, Ph. D., Associate Dean, Graduate School
	May, 2007

# ABSTRACT

The Chukar Footwall mine forms part of the NW striking Carlin trend in northern Nevada, and lies beneath the southwest highwall of the Gold Quarry, a world-class deposit with total 1999 reserves, resources, and mineral inventories in excess of 24M oz gold. The Chukar Footwall orebodies are hosted in the planar to wispy silty limestone and calc-silicates of the Silurian-Devonian Roberts Mountains Formation (SDrm). The Devonian Popovich Formation (Dp), a micritic package locally hosting economic gold mineralization, structurally overlies the SDrm. The Raven dike intrudes the DSrm at several mine levels along northwest- trending structures. The dike is composed of abundant dark green, millimeter sized subhedral-anhedral phenocrysts in a light colored aphanitic groundmass. It is altered to clay and pyrite, but does not appear to be an ore fluid feeder structure. The time of the Raven dike emplacement into NNW-trending structures has been determined by U-Pb zircon geochronology, producing an age of 200.3±5.1 Ma (early Jurassic). Apatite separates from the Raven dike yielded a fission track pooled age of 17.7±3.7 Ma for a thermal event that may have been associated with mineralization at Chukar Footwall; however, initial cooling began at 26.2±5.5 Ma.

These rocks were probably deformed during the Antler orogeny, generating the Chukar anticline, a northeast trending open structure with a subhorizontal plunge. High gold grades are commonly situated along the hinge and the southeast limb and in small parasitic folds. A conjugate system of

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structures is represented by northwest and northeast striking faults, where the former cuts the latter.

Kinematic indicators denote predominantly oblique normal slips for both fault sets.

The Chukar Footwall mine exhibits the hydrothermal alteration assemblages typical of Carlin-type gold deposits: (a) decalcification, (b) dolomitization, (c) silicification, (d) argillization, and (e) baritization. The uniqueness of this deposit relative to the more typical Carlin-type is the (1) sharp boundaries between fresh and altered rocks, and (2) presence of abundant visible gold. Gold mineralization is spatially related with strong decalcification in the vicinity of intersections of northeasterly structures with the Chukar anticline. Coarse, visible gold occurs in decarbonatized silty limestone along fractures of all orientations as well as along bedding planes. Also, visible gold is present in late barite veinlets, coprecipitating with the latter phase.

Stable isotope transects reveal systematic  $\delta^{18}$ O and  $\delta^{13}$ C shifts in wall rocks where approaching structures and/or changes of intensity of hydrothermal alteration. At a mine scale, these shifts define a generalized trend toward lighter oxygen and heavier carbon values for the wallrocks from the higher to the deeper mine levels, with a negative correlation between oxygen and carbon. Late stage calcite veins  $\delta^{13}$ C values lie within the values of the nearby altered limestone, suggesting the carbon could have been derived from the wallrocks. Isotope and fluid inclusion data point to gangue precipitation from interaction between meteoric water and the wallrocks.  $\delta^{34}$ S from sulfides and sulfates are consistent

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with a sulfur derivation from sedimentary sources. A correlation has been found between the presence of visible gold and the isotopic signature of barite. Barite precipitated from meteoric water as it descended into open structures.

Microthermometric data from late stage barite±gold veins indicate significant variation in both homogenization temperatures and salinities with depth. Mean salinities and mean homogenization temperatures from the deeper mine levels range from 3.03 to 3.18 wt % NaCl equiv and between 183.2° and 179.7° C. In contrast, lower salinities (~1.16 wt % NaCl equiv) and homogenization temperatures (177.3°C) were recorded in samples from shallower levels. Similarly, recorded data from late calcite yielded very low salinities (up to 0.71 wt % NaCl equiv) and low homogenization temperatures (between 87.6° to 117° C). Neither CO<sub>2</sub> nor CH<sub>4</sub> were detected in calcites. These data suggest the participation of, at least, two contrasting fluids.

The Chukar Footwall orebody forms part of the Gold Quarry gold system to which same basic genetic ideas may apply. The metallogenic evolution of the Chukar Footwall deposit began with a significant pre-ore episode of dissolutioncollapse breccia between the Roberts Mountains Formation and the Popovich Formation that formed a semi-impermeable cap for later hydrothermal fluids. During ore-stage, ore fluids were channelized along major active NE-striking structures, and probably micron-size Au and base metals precipitation took place as a result of sulfidation and a shift toward higher pH values. During Late Miocene extension, NW-striking faults were open for descending cool, weakly saline meteoric fluids and ascending relatively hotter, more saline hydrothermal

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fluids, possibly producing metal remobilization and visible gold precipitation along structures. It seems that the common link among the Gold Quarry gold systems is its structural relation to the Deep Sulfide Feeder and Chukar Gulch faults, which served as a major conduits for hydrothermal fluids.

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¡ Salud a todos!

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What was once baffling is now clear, what seemed absurdly important is now simply childish, yet still the journey is unfinished. Simon Conway Morris, *Life's Solution*, 2003

# GEOLOGY OF THE CHUKAR FOOTWALL MINE, MAGGIE CREEK DISTRICT, CARLIN TREND, NEVADA

# **1. INTRODUCTION**

The discovery in 1995 of the Chukar Footwall orebody beneath the southwest highwall of the Gold Quarry mine brought out the potential to explore for deep blind deposits along the Carlin trend in northeastern Nevada (Fig. 1). The Carlin Trend is a north-northwest trending belt with a mineral endowment of more than 50 million ounces gold produced between 1965 and 2002 (Teal and Jackson, 2002). After a period of near-surface exploration, current exploration projects are focused on deeper, blind orebodies through both direct and indirect methods. No geological data about the blind orebodies can be inferred from surface outcrops, thus the structure and geochemistry of the orebody is deduced from drill data (i.e., West Leeville, Chukar Footwall).

The detailed stratigraphy, structure, and metallogeny of the Carlin trend are well known at both regional scale and deposit scale. The tectonic evolution of this area indicates a complex scenario through time involving widespread Early Silurian to Late Devonian-Mississippian shallow to deep water carbonate depositional environments deposited onto the Cordilleran passive margin; traditionally this package of rocks



FIGURE 1. Location map of the Carlin trend in northeastern Nevada, a NNW- trending series of gold deposits hosted in Paleozoic carbonate rocks and mined by open pits and underground methods. The Chukar Footwall underground mine is located beneath the southwest highwall of the Gold Quarry pit.

has been referred to as miogeoclinal strata. Coeval eugeoclinal strata were deposited further west from the margin, and thrust over the miogeoclinal sequences during the Late Devonian-Early Mississippian Antler orogeny along the Roberts Mountains thrust (Roberts et al., 1958; Cook and Corboy, 2002). During pre-Tertiary times, this region underwent several compressional phases giving rise to large WNW to NNW trending folds (i.e., Post anticline, Tuscarora anticline, and Betze anticline) with associated minor structures (Lewis, 2001). Dioritic, guartz-dioritic, and granodioritic bodies and associated sills and dike swarms were emplaced at 158 Ma and 106 Ma (Evans, 1980; Emsbo et al., 1996) producing significant contact metamorphism and metasomatism in the host lithologies. Tectonic history is mainly represented by the (1) reactivation of older structures, (2) emplacement of Eocene dikes, which are interpreted to be contemporaneous with gold mineralization in some districts, and (3) Miocene Basin and Range extension (Emsbo et al., 1996; Henry and Ressel, 2000; Arehart, 1996).

The Carlin Trend displays several general metallogenic characteristics (Roberts, 1960; Hofstra and Cline, 2000; Thompson, 2000): (1) the host rocks are lower plate Paleozoic carbonates, which are exposed along an north-northwest alignment through several tectonic windows; however, some orebodies occur in different lithologies; (2) temporally and spatially linked with gold orebodies, the hydrothermal alteration assemblages are represented by decarbonatization±

dolomitization  $\pm$  silicification  $\pm$  argillization  $\pm$  sulfidation and baritization  $\pm$ alunitization and supergene processes; and (3) gold occurs as submicroscopic grains disseminated along arsenian rims on iron sulfides minerals. Common ore and gangue mineralogies are represented by barite, calcite, quartz, stibnite, iron sulfides, fluorite, realgar, and orpiment.

There are currently several competing models attempting to explain the genesis of the Carlin-type gold deposits. Central to this controversy is the question of the metal source and heat mechanisms: (1) fluids and metals were derived during regional metamorphism of crustal rocks during an Eocene extensional event (Seedorff, 1991), (2) meteoric fluids were heated and convected during rapid crustal extension during Basin and Range extension (Ilchick and Barton, 1997), (3) due to the spatial association of some Carlin-type deposits with igneous rocks some authors suggested a magmatic provenance of fluids and metals (Arehart et al., 1993, Radke, 1985, Thompson, 2000), and (4) recently, Johnston and Ressel (2004) suggested the possibility that Carlin-type deposits may be interpreted as distal and shallow expression of a deeper magmatic system(s) underlying the trend due to their temporal coincidence with regional Eocene magmatism.

### **PURPOSE AND OBJECTIVES**

The purpose of this study is to gain a better understanding of the geology and metallogeny of the Chukar Footwall underground mine, an unoxidized, deep-seated sedimentary rock-hosted disseminated gold deposit, through systematic studies on the geochemistry, wallrock alteration, stable isotopes, paragenesis, and fluid inclusions to propose a metallogenic model. Consequently, this research will focus on key issues like: (1) What are the main geological parameters that control gold mineralization? (2) Is there any spatial and/or temporal relationship between wallrock alteration and gold grades? (3) What was the nature and evolution of the ore fluids? (4) What is the age of gold mineralization at Chukar Footwall? and (5) What is the geochemical and isotopic signature of mineralized rocks? The main objectives of this research were to develop a geological framework of the Chukar Footwall mine through specific projects such as:

- Geological mapping of all mine levels that were accesible during the field component of this research.
- Petrographic analyses to identify and characterize mineral paragenesis and hydrothermal alteration assemblages.
- Geochemical and stable isotopic studies to identify possible zonation patterns and fluid flow paths.

- Fluid inclusion analyses on late stage minerals provide constraints on temperature and salinities of hydrothermal fluids.
- Fission-track dating on apatite from the Raven dike may provide data about the timing of hydrothermal alteration that is assumed to be related to gold deposition.

### METHODOLOGY

Underground mapping and sampling, combined with laboratory studies, were conducted from June, 2004 to May, 2005 to generate the body of data that is presented in the following chapters. Underground mapping of levels 4770, 4740, 4730, 4720, 4710, 4680, 4650, 4610, 4590, and Tracker Decline was done at 1:240 scale. About two hundred samples were collected. Forty-two were selected for petrographic descriptions, and fifty-two samples were analyzed for 32-elements by ICP-MS by Newmont at the Gold Quarry lab. Additionally, about ten kilos of dike rocks were collected from the 4580 level for both apatite-fission and U-Pb zircon dating and submitted for analysis to Donelick Analytical labs. Finally, sixty-seven stable isotopic analyses for sulfur, sulfate, carbon, and oxygen were performed at the Nevada Stable Isotope Lab by Dr. Simon Poulson.

The underground mapping was digitized into CAD and blended with Newmont's cartography. Extraction of structural data from cartography was done using SpheriStat 2.2, with the help of Mike Robinson, to define possible structural

domains and fold geometry, and to record the strike and dip of bedding planes, faults, joints, and veins (Appendix A).

#### **PREVIOUS WORK**

Since the combined works of Rota (1991), Heitt (1992), Williams (1992), Sha (1993), Cole (1995), Sagar (2000a,2000b), Harlan et al. (2002), and Johnston and Arehart (2003) for Gold Quarry-Chukar Footwall orebodies, the geological framework of both deposits has been well defined. In general terms, all the data suggest a protracted period of tectonism and hydrothermal activity since Eocene times responsible for the formation of the Quarry Main, Chukar Footwall, Deep West, and Deep Sulfide Feeder gold systems. Mainly on the basis of drillhole data from Chukar Footwall, Sagar (2000a) described the Popovich Formation as consisting of silty limestone, massive calcarenite, and micrite, from top to bottom. The underlying silty limestone of the Roberts Mountains Formation hosts the economic orebodies at structural intersections. The micron-size gold is hosted in the sooty sulfides, although visible gold is also found along fractures and bedding planes in unoxidized silty limestones of the Roberts Mountains Formation.

Similarly, Johnston and Arehart (2003) made available wallrock alteration data in conjunction with  $\delta^{18}$ O and  $\delta^{13}$ C isotopic analyses and carbonate staining from core samples from the upper levels of the Chukar Footwall deposit. The body of data has led to the author's conclusions that (1) the Chukar Footwall deposit is similar in many aspects to other Carlin-type orebodies, (2) carbonate

staining along with another techniques (e.g., oxygen stable isotopes) could be used as exploration tools due to the observed correlation between the intensity of purple stain and gold grades, and (3)  $\delta^{18}$ O data suggest a widespread hydrothermal alteration of the host rocks due to interaction with meteorichydrothermal solutions, which also led to the formation of the Chukar orebodies.

# 2. PHANEROZOIC GEOLOGICAL EVOLUTION OF NORTH-CENTRAL NEVADA

This chapter outlines the complex geological evolution of north-central Nevada since the Paleozoic, with special emphasis on tectonic history, magmatism, and metallogeny. Figures 2, 3 and 4 provide a general view of the major geological elements and the stress regime that characterize the tectonic realm in the region since middle Paleozoic.

The first general synthesis on the geology of the region was provided by Roberts et al. (1958) and Roberts (1960), who produced important sedimentological and structural interpretations of certain key sections in northcentral Nevada. One of the conditioning factors for such a synthesis was the recognition of the Antler orogeny and the nature of the Roberts Mountain allochthon since this ensures that coeval sediments are being compared and fitted into the overall paleogeographical settings for the region. Modern contributions on the geology and metallogeny of north-central



FIGURE 2. Generalized tectonic setting and depositional environments of north-central Nevada, which shows the extent of the Roberts Mountains, Golconda, and Fencemaker-Luning thrusts. Also, major tectonic windows are shown, whereby the Carlin trend lies in the Lynn-Maggie Creek window. The miogeoclinal strata, mostly silty carbonates, were deposited on the continental shelf. Coeval sedimentation in the continental slope, however, deposited deep-water siliciclastic sediment interbedded with volcanic rocks. When both facies interfinger, the term transitional facies is used (after Stewart, 1980; Ettner, 1989)

Nevada have been discussed by Stewart (1980), Madrid (1987), Hofstra and Cline (2000), Lewis (2001), Teal and Jackson (2002), Cook and Corboy (2002), and Dickinson (2006) among others. The geological history of northcentral Nevada began with passive margin sedimentation during most of the lower Paleozoic along the western margins of Laurentia shortly after a margin rifting event took place between 800 and 500 Ma (Burchfiel et al., 1992). In general, lower Paleozoic miogeoclinal rocks (eastern facies) consist of carbonates, siltstone, quartzite, chert, and shale deposited in trangressive conditions in both deep and shallow marine environments. During the Ordovician and Silurian periods, shallow to deep carbonate sedimentation formed a continuous sequence of silty carbonates with interbedded shales and cherts, as opposed to the dominant siliciclastic Cambrian sequences (Stewart, 1980; 1991).

The coeval lower Paleozoic eugeoclinal rocks (the western facies), exposed within the Roberts Mountains allochthon (RMA) in north-central Nevada, were deposited outboard of the passive margin of Laurentia in outer shelf areas. These time-equivalent eugeoclinal rocks clearly differ from those of the miogeoclinal sequences in (1) chert and argillite lithologies predominate over clastic, carbonate, and mafic ones and (2) these rocks are highly deformed (Madrid, 1987). Clearly, these differences indicate that both eastern and western facies formed two separate parts of the Laurentian continental margin and have been juxtaposed into the present geographical configuration

along the RMA (Roberts et al., 1958; Ketner, 1991). Further, the isotopic boundary of the Precambrian continental margin, as defined by the Sr initial ratio of 0.706, suggest that the eastern facies was deposited on continental crust whereas the western package was deposited on oceanic crust (Madrid, 1987; Graugh et al., 2003). In north-central Nevada, the allochthon stratigraphy is represented by thick sequences of strongly deformed Cambrian through Devonian rocks, structurally emplacing older- overyounger formations (Roberts et al., 1958; Stewart, 1980). In the Independence Range, a significant occurrence of eugeoclinal rocks (seamount facies in association with turbidites) during the Ordovician reflects a continental slope environment during the deposition of the Valmy Group (Watkins and Browne, 1989).

It is generally agreed that the Antler collisional event during the late Devonian to late Mississippian resulted from the collision and complex interaction between the western passive margin of Laurentia and an islandarc system wherein the eugeoclinal strata were obducted eastward onto the Cordilleran margin about 145 km (Stewart, 1980). This short lived orogeny has been recognized in northern California, Nevada, Kootenay Arc, and in other several sectors of the Canadian Cordilleran (Gehrels and Smith, 1987; Turner et al., 1989). Its evolution may had been similar to the actual plate tectonic configuration in southeast Asia whereby the Indian-Australian plate is being overriden by the Eurasian plate (Carpenter et al., 1994). Metamorphism in both the allochthon and autochthon is essentially synkinematic with greenschist grades, whereas the thermal metamorphism is related to plutonic intrusions (Madrid, 1987; Speed et al., 1988; Boskie, 2001). Structural features related to the Antler event are NNE- trending folds and thrusts formed by the E-WNW directed shortening of the RMA. In the Tuscarora Mountains, D<sub>1</sub> deformation produced NNE-trending concentric folds in the allochthon (Evans and Theodore, 1978). Deformation of the autochthon package, however, has undergone a polyphasic deformational history, with three deformational phases having been recognized in the Osgood Mountains (Evans, 1980; Madrid, 1987, Boskie, 2001). Finally, crustal thickening due to thrust stacking has been estimated by Madrid (1987) to be around 4,500 m.

Shortly after the emplacement of the RMT, by late Mississippian time, the Antler overlap siliciclastic assemblage, an autochthonous sedimentary sequence, disconformably overlies the autochthonous package. Sedimentary basin analyses in the Osgood Mountains and Battle Mountain by Saller and Dickinson (1982) allowed characterization of the Pennsylvanian to early Permian depositional evolution of north-central Nevada. Regional stratigraphy exhibits a local marine transgression during the late Paleozoic characterized by the development of a continental siliciclastic package (Battle Formation) conformably overlain by shallow marine carbonates (Etchart Formation). The temporal and spatial relationships between these lithological

units documented a progressive marine transgression recording a transition between deltaic to shallow marine environments in a quiescent tectonic period (Saller and Dickinson, 1982) until it ended in response to a major tectonic event, the Sonoma orogeny. In addition, the data of Gehrels and Dickinson (2000) demonstrate that U-Pb ages of detrital zircons from the overlap sequences are similar to these of the eugeoclinal rocks, thus identifying the RMA as the source area for detritus.

The post-Antler geodynamic evolution of north-central Nevada can be divided into the following four main stages: (1) Late Paleozoic deformation, (2) the Sonoma Orogeny, (3) Mesozoic back-arc magmatism and deformation, and (4) Cenozoic magmatism and extensional regimes. In addition to these major geological divisions, the occurrence of at least two distinctive mineral trends (e.g., the Battle Mountain-Cortez and Carlin trends) provide insights into the relationships among the inherent regional fabric and the mechanical and thermal state of the lithosphere during gold mineralization.

Recent reinterpretation of the geodynamic evolution of central Nevada has stemmed from the recognition of several deformation events during the late Paleozoic (Trexler et al., 2004). These authors documented three early Mississippian through early Permian deformation phases at Carlin Canyon, near Elko. The principal structures are north-east trending mesoscopic folds, imbricate thrusts, and normal faults. This has led Trexler et al. (2004) to

propose that some Antler structures might be ascribed to late Paleozoic deformation, which requires a new understanding of the the timing for the Antler orogeny as well as the geodynamic evolution of Western North America during late Paleozoic times.

A late Paleozoic to early Triassic deformational event, the Sonoma orogeny, seems to have started during the Permian, related to obduction processes similar to the mid-Paleozoic Antler orogeny (Speed et al., 1988; Dickinson, 2006). The effects of this orogeny are recognizable in a number of areas of the Western Cordillera, notably in California, Nevada, and Oregon. In Nevada, this deformation is characterized by eastward thrusting of Pennsylvanian-Permian deep marine sediments along the Golconda thrust onto the parautochthonous Antler overlap sequence and RMA (Speed, 1971; Stewart, 1980). The Golconda allochthon has been divided into two structurallithostratigraphic assemblages, the Schoonover and Havallah sequences, that are highly deformed and disrupted by east verging folds, shearing, and thrust faults as a result of a polyphase deformation (Gabrielse et al., 1983). According to Riley et al. (2000), the Golconda allochthon was deposited in a backarc basin near its present location, receiving detritus from both a Sierra terrane to the west and the RMA to the east based on systematic studies on detrital zircon geochronology from sandstones (Figures 2 and 3).

Post-Sonoma geology is reflected by a magmatic arc and backarc environments related to changes of the angle of subduction of the Mezcalera



Figure 3. Map and crustal section showing the different Sr isopleths that define the continental crust (western edge of the basement). The Sr= 0.706 and Sr=0.708 lines are from Carpenter et al. (1994) and Farmer (1983), respectively. The NW-SE crustal and upper mantle section is based on Catchings and Mooney (1991) model (from Campbell et al., 2005). The E-W section is along the 40th parallel between Sierra Nevada and north-central Nevada (from Speed et al., 1988)

plate along the western margin of North America (c.f. Dickinson, 2006; Fig.6). In north-central Nevada, intrusive rocks associated with Jurassic backarc magmatism are predominantly granodiorites to monzogranites formed by crustal melts in contrast to the mantle-derived Mesozoic quartz-diorites and tonalites in the Klamath Mountains, suggesting a relationship between the petrological and geochemical signatures of the plutons and that of the nature of the basement (Farmer, 1983). Examples include the Jurassic Goldstrike stock, the late Cretaceous Richmond Mountain stock, and Jurassic-Cretaceous two-mica granites and monzogranites in the Ruby Mountains. A metamorphic aureole surrounds the plutonic intrusions and gives rise to marbles and calc-silicate hornfels (Walck, 1989; Heitt et al., 2003; Mariño, 2003).

Middle to late Jurassic strata in northeastern Nevada and northwestern Utah were deformed in the Elko or Nevadan orogeny (Schweickert et al., 1984; Thorman et al., 1992; Dickinson, 2006). The WSW-ENE stresses transmitted during this deformation produced regional NNW and WNW-trending folds (Post , Betze, Tuscarora, Alta, and Rain anticlines) and faults (Good Hope and Dillon deformation zone) (Lewis, 2001) and the intrusion of several granitic stocks. Schweickert et al. (1984) , in the Sierra Nevada region, constrained this short lived deformation at ~155 Ma as a result of another collisional episode between an island arc and the western margin of the North America Cordillera. Finally, evidence of late Jurassic-early Cretaceous folding and thrusting were reported by

Ketner and Smith (1974) in the Adobe and Piñon Ranges producing mesoscopic NNE-trending structures such the Adobe syncline.

Additional deformation events in north-central Nevada are represented by both the Luning-Fencemaker and Willow Creek allochthons (Oldow, 1984; Speed et al., 1988). A number of allochthonous assemblages structurally overlying the Golconda allochthon occur in the so-called Winnemucca deformation belt. These lithotectonic units contain basinal sediments and magmatic rocks deposited in a back-arc basin environment that were folded and thrust during late Jurassic through early Cretaceous. Major structures associated with thrusts include NEtrending folds and synkinematic intrusions (Oldow, 1984). In central Nevada, structures related to the Luning-Fencemaker fold-thrust belt have been described by Wyld et al. (2003). In this domain, D1 macrostructures are represented by tight to isoclinal fold related to Early Jurassic shortening. Crustal thickening during D1 induced a regional metamorphism under temperatures of 400 °C . By contrast, D2 structures are localized in the eastern portion of the belt, and metamorphism was absent during D2 shortening.

The geodynamic evolution of north-central Nevada during the Sevier orogeny is manifested by a thin-skinned tectonic style, characterized by crustal thickening, thrust faulting, regional metamorphism, and plutonism (Thorman et al., 1991). The structural patterns of the Sevier deformation are dominated by similar Elko phase structures of NNW and WNW-trending folds and NNW and WNW-striking faults (Mariño, 2003). On the basic of their orientation with respect to the SE-directed Sevier shortening, Hofstra (1994) described N-to-NE-trending folds and E-to-NW-striking faults in the Independence Mountains, NNW of Elko. Pulses of regional metamorphism and plutonism occurred at ~ 110 Ma, 75 Ma, and 50 Ma (Thorman et al., 1991).

Late Mesozoic to Early Cenozoic tectonics in north-central Nevada was controlled by the kinematic interactions among the North America, Pacific, and Farallon plates. The tectonic regime within the region switched from contractional to extensional by the beginning of Tertiary times (Lewis, 2001; Dickinson, 2006). Dickinson (2006) recognized two successive phases of extension in the Great Basin related to different geodynamic settings: (1) pre-middle Miocene extension and formation of metamorphic core complexes due to back-arc deformation, and (2) post-middle Miocene extension linked to the development of the San Andreas transform zone. Similarly, Muntean et al. (2001) and Henry et al. (2001) discussed and presented data on the Tertiary extensional regimes in northcentral Nevada. According to these authors, by late Eocene times there was a west-northwest extensional regime operating in eastern and north-central Nevada, with a peak of ~ 50 % extension during the Eocene-Oligocene that declined to about 10 % in the Miocene. Subsequently, shortly after the formation of Carlin-type deposits during late Oligocene, high to moderate extensional rates may have obliterated or displaced the original geological configuration of these deposits. However, the overall extensional patterns in north-central Nevada during Basin and Range extension are dissimilar to those elsewhere in Nevada.
They are distinguished by more extreme extension from 100 % near Las Vegas to about 75 % in central Nevada (Leeman and Harry, 1993). In more detail, Bogen and Schweickert (1985) estimated the E-W extension along the 40<sup>th</sup> parallel to be 178±33 km (Fig. 4).

Extension in the Basin and Range was accompanied by extensive volcanism, minor plutonism, and the contemporaneous formation of Carlin-type deposits, porphyry Cu-Au, and skarns (Silberman et al, 1976; Henry et al., 2001; Johnston, 2005). Widespread volcanic activity developed in Nevada from 43 to 6 Ma characterized by a definable temporal and spatial distribution of volcanic rocks thought to be related to the relative motions of the Pacific, Farallon, and North America plates and the development of the San Andreas transform system (Silberman et al., 1976; Dickinson, 2006).



FIGURE 4. Geological framework of the north and south areas of the Carlin trend showing the Lynn and Maggie Creek-Carlin windows, which host gold mineralization of Eocene age. Main strain fields, denoted by color arrows, record significant Jurassic shortenning, and Tertiary polyphasic extensional regime with probable fault reactivations (Modified after Moore, 2001; Lewis, 2001). In the context of Tertiary volcanism in north-central Nevada, the works of Henry and Ressel (2000), Ressel et al. (2000), Henry et al. (2001), and Ressel and Henry (2006) are important. According to these authors, most of the Carlin-type orebodies are spatially and temporally linked to Eocene magmatism, ranging from dikes to lavas of silicic to intermediate composition. Thus, the presence of widespread Eocene igneous rocks and the possible genetic linkage with Carlin-type deposits suggest that deep-seated plutonic complexes were emplaced along the Carlin trend (cf. Ressel and Henry, 2006).

After the onset of Eocene silicic volcanic activity, a rifting event took place about 16.5 and 14.7 Ma with abundant episodes of bimodal basalt-rhyolite volcanism hosting epithermal Au-Ag deposits (e.g., Midas, Mule Canyon). The northern Nevada rift trends north-northwest and is part of a regional middle Miocene rift zone, the Nevada-Oregon lineament, that may have been controlled by an ancient, deep fracture zone. This rifting episode was the result of a WSW-ENE extension during the middle Miocene (Stewart et al., 1975).

In summary, the geological evolution of north-central Nevada, part of the Great Basin region, is complex and broadly related to the following sequence of events (Fig. 5):

I. Rifting of Laurentia c. 800-500 Ma. Development of passive margin sedimentation of clastic and carbonate strata onto the Precambrian basement during the lower Paleozoic.

II. Short-lived Paleozoic orogenies (Antler, Sonoma) were produced as island-arcs accreted to the western margin of North America. Regional thrust sheets were emplaced eastward, placing eugeoclinal strata onto miogeoclinal rocks.

III. End of passive margin settings by Triassic time. Widespread back-arc plutonism resulting from the development of a Cordilleran magmatism arc due to the subduction of the Farallon plate. Two major orogenic events are recognizable in north-central Nevada: Nevadan-Elko and Sevier phases.

IV. By early Tertiary extension began within the Basin and Range realm. Coevally, extension-related magmatism swept southward through Nevada. Intensive Eocene magmatism is spatially and temporally associated with some of the Carlin-type deposits. Finally, Oligocene metamorphic core complexes developed in areas of high extension rates.

PERIO	D	REMARKS									
		WNW-ESE extension									
TERTIARY	65-1.8 Ma	Basin and Range extension and magmatism. Formation of Carlin-type deposits.									
CRETACEOUS	144 Ma	<b>SEVIER OROGENY</b>									
JURASSIC											
	206 Ma	NEVADAN OKOGENY (Luning-rencemaker I hrust)									
TRIASSIC		Subduction (active margin)									
	248 Ma	SONOMA OROGENY (Golconda Thrust)									
PERMIAN	290 Ma										
	N 202 Ma										
MISSISSIPPIAN	354 Ma	ANTLER OROGENY (Roberts Mountains Thrust)									
DEVONIAN	417 Ma										
SILURIAN	443 Ma	Cordilleran micgeocline eugeocline (shelfal and basinal sedimentation									
ORDOVICIAN	490 Ma	in a passive margin)									
CAMBRIAN											
	543Ma										
Figure 5. Cl Nevada (af	hronostra ter Speed	tigraphic chart showing the timing of major events in north-central l et al., 1988; Dickinson, 2006)									

# 3. LITHOSTRATIGRAPHIC SETTING OF THE CHUKAR FOOTWALL DEPOSIT

The Chukar Footwall deposit lies beneath the southwest highwall of the Gold Quarry mine in the footwall of the Chukar Gulch fault (Fig. 6), a NE striking fault dipping 60° SE that may be interpreted as a structural domain boundary for the deposit (Sagar, 2000b). The Gold Quarry deposit have mainly been described by Rota and Hausen (1991), Williams (1992), Sha (1993), Cole (1995), and Harlan et al. (2002). The stratigraphic sequence at Chukar Footwall is comprised of silty carbonates of the miogeoclinal facies wherein the economic orebodies, outlined by a 0.20opt Au cutoff, are hosted in the Silurian-Devonian Roberts Mountains Formation.

The presence of NNW-trending magnetic anomalies in the northern and central parts of the Carlin belt has been interpreted as plutonic intrusions of various ages, sizes, shapes, and depths of emplacement (Ressel and Henry, 2006). Regarding the prominent positive magnetic anomalies and the extensive contact metamorphic aureole southwest of the Gold Quarry / Chukar Footwall deposits, they are thought to be related to large multiple-intrusive plutonic masses emplaced at relatively deep crustal levels (Chakurian, 2001; Ressel and Henry, 2006). In addition, there are several small lamprophyre dikes in the Gold Quarry and Chukar Footwall, emplaced along high angle NW-striking faults that may be related in space and time with these igneous rocks.



FIGURE 6. Simplified geologic map of the Chukar Footwall mine at the 4650 level. The Silurian-Devonian Roberts Mountains Formation (SDrm) is the main host rock for disseminated gold mineralization. The geometry of the Contact Zone, interpreted in this study as a mixed zone of dissolution-collapse breccias and low to high fault density, is still poorly constrained along the crest and west limb of the Chukar anticline. The Devonian Popovich Formation (Dp2,Dp3) is a monotonous package of massive, dark to grey micrites. Toward the deeper mine levels (not shown), these units were afected by a metasomatic metamorphism characterized by diopside hornfels (Modified from Newmont, 2003).

Metasomatic metamorphism gave rise to gray-green diopside hornfels (exoskarn), locally generating coarse mottled textures along former bedding planes. Drill hole data from Chukar Footwall suggest an intrusive body toward the WNW, because the metamorphic thermal effects increase with the appearance of new mineral phases. This setting is similar to the one observed in rocks of the nearby Mike (Soap Creek) deposit described by Norby and Orobona (2002), wherein the Cretaceous Richmond stock was responsible for the thermal event and associated base metal-Bi-W-Mo mineralization. Likewise, the exoskarn observed at Chukar Footwall deposit may be the result of Jurassic metamorphism correlative with a deep-seated plutonic body to the west of Gold Quarry.

# SILURIAN-DEVONIAN ROBERTS MOUNTAINS FORMATION

The Roberts Mountains Formation (SDrm) consists of thin to relatively thick-bedded to laminated silty limestone of middle Silurian-early Devonian age (Evans, 1980; Mullens, 1980). Regionally, the SDrm has been interpreted as basinal to slope sediments sharing many of the characteristics of carbonate turbidites as well as deep water environments (Cook and Corboy, 2004; Wilson, 1969). Ettner (1989) described several ichnofossils in the Tuscarora Mountains, which interpret bathymetry and paleoecological conditions during the sedimentation of the SDrm. Mullens (1980), based on the presence of pyrite,

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carbonaceous material, and absence of fossils, hypothesized that during the deposition of the silty limestone that the pH was about 7.9-8.2 and the Eh was close to -0.3. Conodont data from the Carlin mine indicates an episodic temperature spike between 350-450°C (Armstrong et al., 1987) that may be related to Jurassic intrusions.

At Chukar Footwall (Fig. 7), as elsewhere in the Carlin trend, the SDrm has been divided in four informal gradational units (Sagar, 2000a, 2002b; Harlan et al., 2002). The basal unit, SDrm<sub>4</sub>, is approximately 220 m of monotonous, planar, silty limestone similar to the upper unit SDrm<sub>1</sub>. Samples from this unit only come from deep cores that did not intercept the underlying Ordovician Hanson Creek Formation, the ore host of the Murray mine in the Jerritt Canyon district (Hutcherson, 2002).

The SDrm<sub>3</sub>, with an approximate thickness of about 66 m, is a silty limestone unit easily recognizable due to the presence of quasi-rhythmic centimetric calcarenite beds.

The next 52 m, SDrm<sub>2</sub>, consists of a silty limestone with erratic, thin calcarenite beds with laminae to locally wispy textures. Brassy or sooty pyrite is commonly found along or around the wisps and/or zones of carbonaceous matter. The wispy textures have generally been thought of as a product of bioturbation (Armstrong et al., 1998).

The upper unit, DSrm<sub>1</sub>, is a minimum of 27 m of monotonous silty limestone with some erratic calcarenite beds toward the base.

The medium-dark gray to light gray colors of these units appear to be the result of the degree of hydrothermal alteration, content of carbon, and bleaching by ground waters. Several sedimentary structures have been recognized during underground mapping and from core logging. Load cast structures are somewhat common on the calcarenite beds and can be followed for a few meters until they pinch out with the silty limestone. Also, small sedimentary boudinage, diagenetic structures formed due to the degree of sediment competence during compaction, were noted in a calcarenite bed near the hinge line of the Chukar anticline. The presence of minute flute marks on the sole of the SDrm2 unit (4680 level) records turbidity current movements to the SW/SSW; however, a paleocurrent analysis was not undertaken due to the scarcity of these types of structures in mine exposures. From cores, soft-sediment deformation is common, with a range in thicknesses between a few centimeters up to tens of centimeters.



FIGURE 7. Generalized tectono-stratigraphic section of the Chukar Footwall mine. The contact between the Silurian-Devonian Roberts Mountains Fm. and Devonian Popovich Fm. (Dp3) is along a complex zone of dissolution-collapse breccia and fault(s). The Early Jurassic Raven dike was emplaced along NNWtrending structures, and it has been locally brecciated due to later fault reactivation. Metasomatic metamorphism, which increases to the SW, is characterized by calc-silicate lithologies (cshf) that overprint the original carbonate mineralogy.

### **DEVONIAN POPOVICH FORMATION**

Structurally overlying the SDrm Formation is the Devonian Popovich Formation (Dp), where only the lower section (Dp<sub>3</sub>) can be characterized in 3 mine levels. Along the Carlin trend, this formation exhibits different facies attributes and thicknesses as a result of the environments of deposition and later diagenetic processes. Furthermore, the boundary between SDrm and Dp units is in dispute (Evans, 1980; Radtke, 1985; Ettner, 1989; Armstrong et al., 1998; Harlan et al., 2002; Mariño, 2003). Regarding the age of the Popovich Formation, an Early Devonian-Late Devonian interval has been assumed by Evans (1980), Ettner (1989), and Armstrong et al. (1998), whereas Cook and Corboy (2004, Fig. 2) place this formation in the Middle Devonian.

Ettner (1989) reported sections between 210 m thick at Tuscarora Spur ( 4 kms NW of the Carlin West pit) and 70 m thick in the Carlin mine. Harlan and others (2002) divided this formation into three informal gradational units at Gold Quarry mine, with a thickness of 360 m. The basal unit, Dp<sub>3</sub>, consists of micrite with beds of silty limestone, calcarenite and bioclastic limestone. The overlying Devonian units consist of a thin succession of calcarenite, bioclastite, silty limestone (Dp<sub>2</sub>) and brecciated silty limestone (Dp<sub>1</sub>).

As mentioned above, at Chukar Footwall the contact between SDrm unit and the Dp<sub>3</sub>, where it has been mapped during this study, is along a variable width zone of dissolution-collapse breccias referred in this study as the Contact Zone (Contact Fault Zone; Newmont, 2003). As identified from cores and mine exposures, the Dp<sub>3</sub> is a monotonous package of massive, dark to grey micrites

with abundant carbonaceous material, pyrite and calcite veins. Also, the unit is further characterized by zones of crackle -to matrix- supported breccias and local shearing obliterating the rock fabric.

The Dp<sub>3</sub> does not host economic grade mineralization at Chukar Footwall mine (Joe Sagar, personal communication, 2004).

# STYLOLITES

In zones of decarbonatization, stylolites developed sub-parallel to and at high angles across bedding at both microscopic and macroscopic scales. Four stylolite forms have been observed in hand samples (rectangular, wave-like, smooth-type, and sharp-peak; Guzzetta, 1984), with a thickness of about 1mm filled with both carbonaceous matter and calcite. At leas two phases of stylolitization have been observed in thin sections, whose time of formation has been established on the basis of crosscutting relationships: (a) an early, pre-ore event associated either with diagenesis or D1 deformation, and (b) a syn- or post-ore stylolitization (pyrite stylolites). In general, the stylolites are deflected by quartz grains and rarely they crosscut or truncate carbonate veinlets and grains. In strongly decarbonatized intervals the high density of stylolites imposed two distinctive fabrics upon the SDrm and Dp<sub>3</sub> lithologies, stylolaminated and stylobreccia (Evans, 2000). From thin section observations, the former fabric is characterized by parallel trends of very thin carbonaceous stylolites. On the other hand, the latter fabric occurs where breccia clasts are bounded by stylolites or where an intensive stylolitization produced and bounded fragments.

## **METASOMATISM: DIOPSIDE HORNFELS**

Both the SDrm and Dp units at Chukar Footwall are partially affected by a progressive metasomatism of possible Early-Middle Jurassic age connected with a plutonic intrusion. Locally, the Raven dike produces a zone of about 6 m wide of weak thermal alteration on the host lithologies. In general, samples from different depths are composed of carbonates± Mg silicates- K-feldspar that may have formed within the hornblende hornfels in the SDrm/Dp units.

Although the lack of systematic sampling due to mine exposures makes it impracticable to define isograds, some generalization can be made from the available samples. In the SDrm/Dp units affected by the thermal aureole, the exoskarn mineralogy indicates a spatial zoning due to its proximity to the intrusive body. The mineralogical zonation may suggest that an underlying intrusion lies to the WNW-to-SSW of the deposit. This inference is drawn from the occurrence of vesuvianite at deeper depths (e.g., hole CFU-137), wherein visible vesuvianite porphyroblasts define a weak preferred orientation (S<sub>1</sub>). The pyroxene hornfels in the SDrm units are characterized by prograde assemblages of : (AI) calcite± dolomite± quartz± biotite/phlogopite± K-feldspar± tremolite, and (AII) calcite± quartz± diopside± vesuvianite± K-feldspar± tremolite. The appearance of diopside from assemblage AII, the most proximal to the intrusion, suggests a temperature range between 400-600 C<sup>o</sup> (Walck, 1989; Bucher and Frey, 2002). Formation of phlogopite in assemblage AI could represent an early

K-metasomatism episode. Finally, retrograde exoskarn alteration, controlled by structures and mineralogy, occurs as fibrous phyllosilicate front (talc?) and fine grained carbonates, preferentially replacing vesuvianite.

# **BRECCIA BODIES: THE CONTACT ZONE**

Breccia bodies are ubiquitous features in the Carlin trend, but their nature and interpretation within the deposit stratigraphy and their relationship with gold deposition have not been conceptualized until recent years, even though such bodies host the main mineralization at the Meikle, Deep Star, Post, and Rain deposits (Emsbo et al., 2003; Heitt et al., 2003; Evans, 2000; Williams, 1992). At the Gold Quarry mine, Williams (1992) described collapse and fault breccias. Texturally, the collapse breccias consist of angular monolithic clasts of SDrm in a matrix of calcite, barite, and quartz. Breccia geometries range from funnel to tabular to irregular shapes, and are spatially related to strongly decalcified rocks. Geochemically, these bodies are enriched in Au, As, Hg, and Sb relative to the surrounding SDrm units. With respect to fault breccias, Williams (1992) characterized both NNE and NNW trending structures displaying fragment zoning and tabular geometries. These structures record several episodes of brecciation, mineral deposition, and element enrichment which indicate they were feeder structures (Williams, 1992).

The contact between SDrm and the Dp (the Contact Zone, CZ) along the Tracker Decline and in the 4610 level is characterized by zone with high fracture and fault density with little or no gouge, dissolution-collapse breccias, and calcite

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veins and calcite flooding. During a pre-ore event, intense fracturing in the SDrm limestone resulted in the formation of multistage white calcite veins and localized calcite flooding (stage 1). Stage 2 is characterized by the development of dissolution-collpase breccias due to strong decarbonatization that resulted in the collapse of the section by carbonate removal. In general, the breccias (Fig. 8) consist of angular-to- subrounded, poorly sorted and decarbonatized SDrm-Dp clasts exhibiting a range of sizes (mm to cm in the same hand sample) and a crude coarsening-upward fabric. The breccias are matrix-supported, mostly composed of fine, anhedral nonferroan vuggy, wavy-banded calcite as indicated by their pinkish-reddish staining. Contacts between clasts and the matrix are sharp, and commonly the clasts are crosscut by late calcite±quartz veinlets.

Moderate to high rotation of breccia clasts suggests minor to large movements within the collapse breccia body. Lastly, pyrite grains may be abundant along the edges of clasts. Usually, the breccias display cockade and minor crackle textures.

Isotopic and fluid inclusion data from calcite veins (ST-1 and ST-2 stages) suggest that much of the fluid responsible for this stage was meteoric. Through time, fluid changes produced a silicification event that is characterized by the patchy introduction of silica and kaolinite±sericite as a flooding and veinlets. Abundant multistage veins (< 1mm) of quartz±barite±saddle dolomite cut across the breccia. The lack of carbonaceous debris and the presence of residual materials in the matrix further characterize this body. Late-stage calcite veins cut both stages 1 and 2. The next recognizable stage (stage 3) is characterized by

low angle normal NE-striking faults due to volume loss of the limestone. The fault breccias, volumetrically small, contain angular to subangular fragments of strongly decarbonatized and silicified SDrm, whose structural fabric has been somewhat obliterated by later hydrothermal events and fault reactivation (s).

Geochemically, the CZ dissolution-collapse breccias are characterized, relative to mineralized rocks by (1) ~ zero Au values, (2) irregular low AI, Fe, Sb, Se, TI values, and (3) variable, high Ba, Ca,,Mg, and Zn values. The geometry and stratigraphic location of these tabular bodies of dissolution-breccias were strongly constrained by rheological factors between SDrm and Dp rocks. The thin to medium-bedded silty limestone of the upper SDrm units, in contrast of the massive Dp<sub>3</sub> micrites, were the main locus of decalcification and silicification during an early hydrothermal event thus creating a semi-impermeable barrier for subsequent ore fluids. Tentatively, the formation of these dissolution-collapse breccias is interpreted to have been a pre-ore event. Silicification eliminated the pore space and prevented the introduction of later hydrothermal, gold-enriched fluids (Joe Sagar, personal communication, 2004).

In the SDrm, breccias are a common feature, especially in the SDrm<sub>1-2</sub> units. In the Dp<sub>3</sub> unit, however, breccia is much less pervasive than in the underlying units due to the massive fabric of the micrites and/or lower

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FIGURE 8. Weakly silicified dissolution-collapse breccia from the Contact Zone, along the Tracker Decline. This matrix-supported monolithic breccia contains decalcified clasts with earlier thin calcite veins. Minor to moderate rotation of breccia clasts indicates small movements. The breccia body acted as a cap for later hydrothermal fluids. Schematic cross-section, not to scale. 36

5 cm

concentration of fractures and joints, which channeled the fluids responsible for the chemical dissolution of the rocks.

Additional dissolution-collapse breccia bodies have been recognized in the 4610 and Tracker Exploration Drift mine levels. One such body has a vertical, funnel shape (Fig. 9) about 4 m high and 2 m wide, and is composed of poorly sorted, angular monolithic clasts ranging from millimeters to several centimeters in size and consisting of decarbonatized and silicified SDrm1 embedded in a calcite matrix. Internal sedimentary fabrics are absent; however, there is a crude preferred orientation of the clasts' long axes that may be interpreted as being parallel to former bedding planes. The fragment orientation appears to be the result of in-situ brecciation. The spatial position of this breccia body relative to a NNW-trending fault zone supports the interpretation that the latter structure served as a pathway for hydrothermal fluids. Briefly, the breccia sample shows enrichment in Au, Ag, As, Sb, and Ti; and depletion in Ba, Cr, and Mg relative to adjacent SDrm host rocks.

Finally, centimetric to millimetric bodies of bedding-parallel collapse breccias occur in decarbonatized SDrm rocks. These breccias are monolithic, matrix supported, and fragments are mostly angular. In thin section, the density of stylolites within fragments is greater than the surrounding rock.



FIGURE 9. Funnel-shaped dissolution-collapse breccia in the 4610 level (hammer for scale at the upper right). The breccia is monolithic and matrix-supported with angular to sub-angular clasts of the Roberts Mountains Fm. Sample 131 yielded 0.0951 opt Au.

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### **INTRUSIVE ROCKS: THE RAVEN DIKE**

A wide variety of dikes have been reported in the Carlin trend, including lamprophyre, monzonite porphyry, latite, dacite, rhyolite, and granodiorite to diorite (Radtke, 1985; McComb, 1993; Altamirano, 1999; Tretbar , 2000; Chakurian, 2001; Jackson et al., 2002; Heitt et al., 2003; Mariño, 2003) . Available radiometric data suggest at least two main peaks of intrusive activity related with both the emplacement of the Goldstrike stock at about 159 Ma, and the Richmond stock at 106 Ma (Evans, 1980; Moore, 2001; Norby and Orobona, 2002). Similarly, Evans (1980) reported a radiometric age of 37 Ma for a small quartz monzonite intrusion, the Welches Canyon stock, and related dikes in the Lynn window. Dikes are characterized by (1) facts that they were emplaced along high angle faults with sharp contacts, (2) host economic gold mineralization (e.g. the Beast dike, Ressel et al., 2000), and (3) show extensive hydrothermal alteration that makes it difficult or impossible to determine the original fabric and geochemistry in most cases.

Several NNW- trending lamprophyre dikes showing a high degree of alteration have been exposed in the Gold Quarry pit showing a high degree of alteration (McComb, 1993; Ressel and Henry, 2006). Although no age constraints exist yet, these dikes have been tentatively assigned Jurassic-Cretaceous ages in Newmont's cartography, and they pre-date the main gold mineralization period (Harlan et al., 2002). In addition to these dikes, a prominent intrusion known as the Raven dike is exposed in several underground levels in Chukar Footwall. Dike emplacement was along NW-to-NNW trending faults, with

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steep SW to NE dips. The Raven dike has been slightly offset and rotated by some NE-trending faults (e.g., Magpie fault). It shows local intense brecciation toward its borders due to later fault reactivation.

The Raven dike shows sharp contacts with the SDrm and Dp units, producing a visible, metric scale thermal effect on either side characterized by intense bleaching and recrystallization of carbonates. The dike ranges from a few centimeters up to a meter in width, and is up to 220 m in length at the 4650 level (Newmont, 2003). The Raven dike was emplaced along NNW-trending faults (e.g. Raven Dike fault at the 4580 and 4590 levels). In the 4580 level, the dike has been brecciated to angular to subangular centimetric fragments embedded in a matrix of calcite and clay gouge. Furthermore, the dike may locally be mineralized (Joe Sagar, personal communication, 2004).

At outcrop scale, the dike is easily recognizable by its greenish, gummy clay that produces a perceptive, irregular alteration halo. Although the dike is completely altered, it shows a homogeneous texture. In thin-sections (Fig. 10), the dike is characterized by inequigranular, glomeroporphyritic textures of relic phenocrysts of feldspars, hornblende, and biotite in a fine groundmass totally altered to sericite, kaolinite, anhydrite, quartz, and unidentified opaques. Plagioclase is altered to microcrystalline masses of sericite, quartz, and kaolinite. Similarly, biotite is replaced by iridescent sericite and chlorite. Sulfide minerals, pyrite and marcasite, comprise up to 10 vol. % of the rock and they partially or completely pseudomorph mafic phenocrysts. Pyrite, the main sulfide mineral,



occurs as anhedral to subhedral grains locally replacing mafic phases, forming late veinlets, and in discrete grains overgrown by marcasite. From deep hole samples (QRC1489@1040'), there is an greater abundance of pyrite veinlets, altered to malachite, relative to samples from mine exposures. Late barite and fluorite veins crosscut the dike. Anhedral to euhedral discrete purple fluorite grains are distributed along barite cleavages and fractures, and fluid inclusions are abundant. Finally, prismatic hydrothermal apatite phenocrysts (~ 40 to  $60\mu$ m in size) were observed within the dike groundmass, forming part of the alteration assemblage.

The above petrographic description, coupled with data by McComb (1993) and Ressel and henry (2006), indicates the Raven dike appears to be a lamprophyre showing an advance degree of hydrothermal alteration (quartzkaolinite-sericite-pyrite).

# 4. U-Pb ZIRCON GEOCHRONOLOGY AND APATITE FISSION- TRACK DATING OF THE RAVEN DIKE: RESULTS AND INTERPRETATION

One dike sample (215) from the 4580 level was selected for both zircon U-Pb geochronology and apatite fission-track dating. These measurements were performed at Apatite to Zircon, Inc. using 23 LA-ICPMS spot analyses on 9 zircon grains (Appendix 2). The zircon grains were isolated from pyrite crystals and their morphology suggests that they are magmatic (Ray Donelick, personal communication, 2005). The concordia diagram for the Raven dike is shown in Fig. 11.



FIGURE 11. LA-ICPMS zircon analyses from the Raven dike (4580 level, sample 215) on the concordia diagram. The U-Pb zircon data yield an Early Jurassic age for the emplacement of the Raven dike at Chukar Footwall.

The concordia plot of the U-Pb zircon data yields an age of 200.3±5.1 Ma (Early Jurassic) for the emplacement of the Raven dike at Chukar Footwall.

Apatite crystals from the same sample were isolated for apatite fission track dating (AFT). These yielded a pooled fission-track age of  $17.7\pm3.7$  Ma, representing the cooling through ~135 to  $110^{\circ}$  C (Green et al., 1989)

In the region, radiometric ages range from ~ 186 Ma for the Bald Mountain area, ~ 158 Ma for the Goldstrike intrusion, to ~35.4 Ma for the Target Hill rhyolite, near Eureka (Mortensen et al., 2000). In addition to these magmatic bodies (Fig. 12), abundant rhyolitic to dacitic dikes of Eocene age (42 to 36 Ma) occur, and are thought to be temporally and spatially associated with Carlin-type deposits (Henry and Ressel, 2000; Henry et al., 2001; Ressel and Henry, 2006). Regarding ages for gold mineralization, Arehart (1996) summarized all reported radiometric data for Carlin-type deposits in the Great Basin ranging from 152 Ma to 8 Ma. However, some radiometric ages remain poorly constrained given the fact that they are from minerals unrelated to gold mineralization (Arehart, 1996; Teal and Jackson, 2002; Tommy Thompson, personal communication, 2005).



250

150

100

-150

nanotesla

FIGURE12. Inferred igneous bodies from aeromagnetic contour data. A large, concealed Jurassic plutonic body is inferred from the extensive exoskarn in the deeper levels of the Chukar Footwall mine (Aeromagnetic data from Wright, 1993). AFT pooled age data (Fig. 13) indicate the time of a thermal event at  $17.7\pm3.7$  Ma that could possibly be linked to a local scale reset of apatite fission-track ages associated with Tertiary volcanism and extension (Chakurian et al., 2003; Tommy Thompson, personal communication, 2006). This suggestion can be tentatively supported by the combined observations by Rota (1989), who reported stibnite in the Carlin Formation (14.4 to 15.1 Ma, Fleck et al., 1998), and an AFT age of  $18.6\pm4.5$  Ma from the East Carlin deposit ,interpreted as a result of Miocene extension and volcanism in the Tuscarora Mountains (Chakurian et al., 2003).



#### KNOWN PARAMETERS AND ASSUMPTIONS

Client Sample Number DAI Sample Number Kinetic Parameter Modeled Stratigraphic Age (Ma) Present-day Temperature (°C) Timing of Uplift/Cooling (Ma)

Chukar Dike 672-01 Dpar (µm) not provided 10°C assumed cooling-only assumed

#### IMPLICATIONS OF THE FISSION TRACK DATA

Age of Oldest Fission Track (Ma) Timing of Initiation of Uplift/Cooling (Ma) Dpar=1.40 µm: 26.2±5,5 Ma Dpar=1.40 µm: 26.2±5.5 Ma

Client Sample Name	A2Z Sample Number	Grains (dmais)	Dpar (µm)	Dper (µm)	N, (tracks)	Area Aaalyzed (cm <sup>2</sup> )	Σ(PΩ) (cm²)	iσΣ(PΩ) (cm²)	ξaes	lo Ç <sub>MB</sub>	<sup>8</sup> Ca (apatite) <sup>30</sup> Si (zircon) bkg:sig (dmak)	<sup>291</sup> U bkg:sig (dinali)	Q (dmais)	Pooled Fission-Track Age (Ma)
Apatite														
Age Standards														
Durango	DR06	492	1.86	0.42	3512	2.88E-02	9.0328E-04	1.7093E-06	16.2121	0.2753	2.5655E-02	2.1668E-03	0.6239	31.4+/- 0.8
Durango	DROIE	40	1.80	0.41	288	2.44E-03	8.0065E-05	6.1208E-07	16.3888	0.4091	1.9723E-02	5.5396E-03	0.1212	29.4+/- 1.9
Fish Canyon Tuff	FCOIE	40	2.32	0.60	233	1.24E-03	6.8115E-05	5.5964E-07	16.3975	0.4060	2.5514E-02	1.1584E-02	0.2763	28.0+/- 2.0
672-Series														
Chukar Dike	672-01		1.42	0.62	23	1.13E-04	9.6300E-06	1.8275E-07	14.8794	0.3716	1.4591E-02	1.6066E-03	0.1037	17.7+/- 3.7

Analyst: apatite=RAD

FIGURE 13. Apatite Fission-track data from the Raven dike, sample 215 (672--1). The apatite cooling modeling suggest a thermal event/uplift that began at 26.2 $\pm$ 5.5 Ma, with a pooled age of apatite grains producing an age of 17.7 $\pm$ 3.7 Ma. Regional AFT data from Chakurian et al. (2001) may suggest a short-lived thermal episose during Miocene times.

# 5. STRUCTURAL GEOLOGY OF THE CHUKAR FOOTWALL DEPOSIT

The structural settings of the Gold Quarry-Chukar Footwall deposits are a direct consequence of tectonic events since the Antler orogeny. Cress (1972) recognized four tectonic phases in the Carlin-Maggie Creek window, from earliest to latest: (1) NNE- trending folds related to the Antler orogeny; (2) NNW-trending open folds, and NW- trending tight folds, possibly correlated to Antler deformation; (3) pre-mineralization NW- striking reverse faults (Good Hope fault) and ENE- striking normal faults, and (4) Basin and Range normal faults.

Similarly, Cole (1995) established four generations of structures at Gold Quarry deposit: (1) folds related to the Roberts Mountains thrust, (2) wrench, reverse, and normal faults, (3) normal faults due to collapse during decarbonatization, and (4) normal faults that moved during the Tertiary extensional regime.

Gold mineralization and wallrock alteration were strongly controlled by major and minor structures. The most important ore-controlling feature is the structural intersection of the Chukar anticline with northeast-striking faults ( Joe Sagar and Kevin Creel, personal communication, 2005). On the other hand, minor structures (fractures and joints) are also of great importance in controlling and localizing gold pods by increasing the amount of open space in the host rocks whereby the ore fluids were able to move farther, both vertically and horizontally from major fluid conduits.

### FOLDS

The Chukar anticline is the main macroscopic feature observable underground (Fig. 6 and Plate 11). This fold, at outcrop scale, does not exhibit any penetrative fabrics within the thin-to-massive bedded silty SDrm units nor in the Dp<sub>3</sub> lithologies. Adjacent and subparallel to the NE-striking Chukar Gulch fault, the Chukar anticline (Fig. 14A) is a northeast-trending open fold that plunges at shallow angles to the southwest. Small scale parasitic folds are present in the northwest and southeast limbs of the anticline, with hingelines trending WNW and NE and plunging 10° and 14°, respectively. The hingeline of the Chukar anticline has been offset up to 22 m by the NW-striking Sagehen fault (Joe Sagar, personal communication, 2005), and bedding attitudes in both limbs indicate an asymmetric, non-cylindrical structure because all the poles are not homogenously distributed along a great circle. The anticline is a fairly simple structure, showing greater bed thickness (~1 m) at the anticline hinge relative to the limbs (~ 14 cms), typical of similar folds (Ramsay and Huber, 1987). On the basis of its orientation, the Chukar anticline could be related either to the Antler, late Paleozoic, or Sonoma orogenies (Evans and Theodore, 1978; Trexler et al., 2004).



FIGURE 14. Poles to bedding (A), to joints (B), and poles to calcite veins (C) from all mine levels. Contoured by the method of Kamb using Stereonet 6.3.2x (Data from Newmont and this study).

### FAULTS

Brittle deformation is represented by two dominant fault trends throughout the deposit (Fig. 15): (1) a WNW / NNW-trending system represented by major structures such as the Jay, Pheasant, Antelope, Sagehen, Raven Dike, Mallard, and Crow faults, and (2) NNE-NE striking faults represented by the Contact Zone (CZ), Magpie, and Chukar Gulch faults. Both fault systems record multiple sets of slip indicators due to later fault reactivation thus producing incoherent cross-cutting relationships.

Faults of the **WNW/NNW**-striking fault system commonly have both moderate and steep dips to the NE and to the SW. In general, they are unhealed structures up to 2 meters wide, with clay, breccia, and friable gouge. Kinematic indicators such as calcite crystal fibers, grain striations, and fault mullions point out multiple senses of displacement in both fault systems due to later reactivation(s). Sub-horizontal to sub-vertical rakes were recorded on fault planes discerning a general trend of (1) an oblique dextral normal slip, which rakes between 10 to 70 degrees to the northwest, and (2) strike-slip faults with subhorizontal slickenlines. The intrusion of the Raven dike along NNW-striking faults may suggest that these structures formed prior to about 200 Ma.

The **Crown fault** (320°, 69° SW; Plate 10), only exposed along the Main Decline near the Trucker Exploration Drift, cuts the SDrm pyroxene hornfels and is defined by several curvilinear slip surfaces in a 90-100 cms wide damage zone. The fault breccia is composed of angular to subangular fragments cemented with calcite, which also forms small veinlets parallel to the fault. Iron



FIGURE 15. Kamb contours of poles to (A) faults at Chukar Footwall, and (B) Magpie fault. Ore controlling (NNE, ESE) and post-ore (WNW, NE) structures form a conjugate set with an angular separation of 85 degrees (Data from Newmont and this study).

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sulfide grains (pyrite and marcasite) are present rimming breccia clasts and filling open spaces. Fracture density (up to 3 fractures per meter) increases toward the fault in an asymmetric fashion. This fault cuts a 55°, 74° SE small fault delineating a structural intersection zone that may have served as an important ore fluid pathway. Kinematic indicators were not found along the fault.

The **Sagehen** and **Antelope** faults (Fig. 6) are well exposed in the 4720, 4740, 4770, 4580, 4600, and 4650 mine levels. The average attitudes of the Sagehen fault are:  $300^{\circ}$ , 74° SW at the 4720 level;  $300^{\circ}$ , 78° SW at the 4740 level;  $305^{\circ}$ , 70° SW at the Chukar North Decline;  $303^{\circ}$ , 80° SW at the 4580-4600 level; and ~310°, 68° SW at the 4770 level. Similarly, the Antelope fault has the following average attitudes:  $285^{\circ}$ , 73° NE at the 4740 level;  $303^{\circ}$ , 70° NE at the Chukar North Decline;  $303^{\circ}$ , 70° NE at the Chukar North Decline;  $303^{\circ}$ , 70° NE at the 4740 level;  $303^{\circ}$ , 70° NE at the 4740 level;  $303^{\circ}$ , 70° NE at the 4740 level;  $303^{\circ}$ , 70° NE at the Chukar North Decline;  $303^{\circ}$ , 70° NE at the 4740 level;  $303^{\circ}$ , 70° NE at the Chukar North Decline;  $303^{\circ}$ , 70° NE at the 4740 level;  $303^{\circ}$ , 70° NE at the Chukar North Decline;  $303^{\circ}$ , 70° NE at the 4770 level.

Observations from the 4720 mine level characterize the Sagehen fault as a damage zone of about 2 m width with multiple subparallel slip planes producing a weak to intense breccia along the contact with the SDrm<sub>1</sub> unit. The decarbonatized breccia clasts (up to 10 cm long) are supported by a friable calcite± clay (kaolinite) matrix. Subparallel to the master fault, in the hangingwall section, a high density fracture zone of about 5 m defines the Sagehen fault zone, characterized by an strongly-developed breccia. Close to the Sagehen fault, the Antelope fault is defined by a 1 m wide zone of decarbonatized breccia clasts from the SDrm<sub>1</sub> units. The gouge, less than 10 cms thick, consists of dark, gray clay, and calcite veins are absent along the fault. Kinematic indicators were observed only along the Sagehen fault at the 4770 level where fault grooves rake

70° NW indicating a dextral-oblique slip component. Locally, in the central portion of the 4740 level, normal displacement of both the Sagehen and Antelope faults produced a small horst with an up-throw of about 25 m in the SDrm<sub>2</sub> units (Joe Sagar, personal communication 2004). This structure could be linked to the last episode of extension that has been documented for Late Miocene times during Basin and Range normal faulting, when older structures were reactivated as a normal faults in the study area (Cole, 1995).

The northwest striking faults were reactivated sometime during the Eocene to Miocene extensional regime, thus serving as pathways for meteoric fluids that scavenged metals and possibly interacted with contrasting ore solutions leading to the formation of late stage barite and sulfide veins with visible gold mineralization.

The conjugate of the WNW-NNW faults is a system of high to low angle NNE/NE-striking faults, which are normally cut and offset by the former structures. These faults are characterized by breccia, variably silicified and decalcified gouge with abundant crosscutting calcite± barite veins.

The **Magpie fault** (Fig. 6 and 15B), a major feeder structure at Chukar Footwall, hosts a discontinuous calcite±barite± stibnite breccia zone along dilational jogs. Stibnite deposition postdates movements on the structure due to lack of crystal deformation. Further, late stage fractures through the fault zone controlled mineral deposition that includes orpiment, realgar, and barite. The Magpie fault at the 4720 level has average attitudes from 30°, 64° NW to 12°, 50° W. This change in attitudes may have triggered dilatation thus explaining the
drop in gold grades where the fault changes in direction. Slickensides show variable rakes of 30°WNW and 65°NW, with the steeper rake measured in the shallower dipping portion of the fault. This fault also is well exposed at the 4590 level, where it strikes 35° and dips about 70° SE. The fault is marked by a  $\leq$  20 cms wide, clay-poor gouge, and both weak silicification and decarbonatization around the host SDrm<sub>2</sub> units. Open spaces around the SDrm<sub>2</sub> clasts are filled with calcite± barite± stibnite. Moreover, thin sections from these faults at the 4720 level show cockade textures (reflecting dilatational, low temperature fault environments), wherein fragments of altered limestone are surrounded by fine grained quartz, calcite, and barite.

The **Contact Zone** (CZ) (Fig. 6 and 16) is a somewhat complex zone of dissolution-collapse breccias and high density of faults and veins. In the Tracker Decline, where well exposed, the CZ separates the Popovich Fm. in the hangingwall from the Roberts Mountains Fm. in the footwall. The CZ is characterized here by a ~ 26 m wide zone with several sigmoidal, subparallel splays with patchy silicification and decarbonatization in the diopside hornfels packages although some slivers of SDrm<sub>1</sub> and Dp<sub>3</sub> rocks are also present. It is regarded as an ore-controlling feature that caps gold mineralization at Chukar Footwall (Joe Sagar, personal communication, 2004). The main characteristic of the CZ is the continuous



TRACKER DECLINE: detail of the CZ showing brecciation stages (ST-1 and ST-2) and normal faulting (ST-3)

4610 LEVEL: dissolution collapse-breccia formed between the Roberts Mountains Fm. and the Popovich Fm.



FIGURE 16. Contact Zone (CZ) at Tracker Main Decline and 4610 level. Note the attitudes of the calcite veins (yellow) in both the footwall and hangingwall sections of the CZ.

presence in the hangingwall section of a thick apron of collapse breccias with a minor component of fault breccias, and a high density of calcite veins; however, some of these attributes may be absent in some exposures thus characterizing the CZ as a small, faint structure. The CZ fault, in the Tracker Decline, contains little gouge and is locally silicified and coated with later carbonate veins and red clays. The extent of the CZ is still unknown as is illustrated in Figures 2 and 6. Several sets of orientations for the CZ faults were measured at the Tracker Decline (80°, 39° SW), 4650 level (32°, 30° SE), and the 4610 level (70°, 45° SE). The genesis of these structures seems to be linked spatially to carbonate dissolution and collapse processes during an early hydrothermal event within the the Roberts Mountains Formation (cf. Bakken, 1990; Williams, 1992; Cole 1995; Mariño, 2003).

In general, underground observations suggest that displacement along faults is rather small, a few meters at most. Faults similar to these at Chukar Footwall have been described along the Carlin trend (cf. Evans, 1980; Lewis, 2001); thus, the relative timing of folding and faulting can be constrained. The NE-trending Chukar anticline is difficult to interpret because it differs from the general NW-trending anticlinal folds along the Carlin trend. Evans (1980) described similar NE-trending folds in the Lynn Window as a result of eastward to southeastward emplacement of the Roberts Mountains allochthon during the Antler orogeny. According to Mariño (2003) and Lewis (2001) WSW-ENE shortening during the Sonoma orogeny developed multiscale regional NNWtrending anticlines such as the Post and Tuscarora anticlines. Finally, 2 main

sets of faults have been distinguished within the Chukar Footwall deposit based on cross-cutting relationships, from older to younger (Fig. 17): (1) NE-striking faults, and (2) NW-striking faults. During the Tertiary extensional regime (cf. Lewis, 2001) reactivation of these fault sets produced contradictory crosscutting relationships and oblique slip, particularly on the NW-striking structures.



FIGURE 17. Crosscutting relationships among sets of faults at the Tracker Decline. Most of the NW-striking faults cut and offset older NE -striking faults. However, during Cenozoic extension, fault reactivation was widespread thus producing contradictory crosscutting relationships and extensive breccia. Dp3h: calc-silicate rocks.

#### STRUCTURAL SYNOPSIS

Stereonet data were plotted to visualize possible structural domains through mine levels (Appendix A). From these data sets, all mine levels are practically homogeneous with respect to each other, and thus the deposit statistically behaves as a single tectonic domain. From data in Appendix A several fundamental observations can be drawn: (1) The dominant fault attitudes are about 306°, 87° SW and 41°, 43° ESE-SE forming a conjugate set intersecting at 85°, and (2) It appears that faults, joints, and veins are kinematically related to a common period of stress conditions due to their spatial relationships. Firstly, during underground mapping, density in fractures and veins with similar attitudes increases toward the primary fault. And secondly, joint and vein pattern analyses revealed two dominant attitudes, which are coplanar with the major fault systems: NNE and NW-trending joints and veins with almost vertical dips.

# 6. GEOCHEMICAL SIGNATURES OF THE CHUKAR FOOTWALL DEPOSIT

Geochemical data were obtained from 53 samples collected during underground mapping and from a data set of mineralized intervals provided by Newmont (holes QRC 1636, QRC 1657, and QRC 1664; Apendix 6). Samples were analyzed for 31 multi-elements by ICPMS at the Newmont lab. The

selected samples were taken perpendicular to and at measured intervals from structures such as faults, joints, and veins to determine possible ore fluid pathways and to make geochemical comparisons between mine levels. Also, the geochemical data have been utilized in identifying hydrothermal alteration signatures.

Four correlation matrices of elements (Table 1,2,3, and 4) were produced using Microsoft Excel<sup>™</sup> to contrast the geochemical signatures between the entire deposit and selected mineralized intervals within the deposit. The symbol "±" indicates that the preceding element shows variable r<sup>2</sup> values in the correlation matrices generated during this study. Finally, silver was deleted from the geochemical database as most of the samples have virtually nil Ag values.

As outlined by Craig and Wakefield (1991) and Rota (1991), the geochemical signatures of the Carlin trend and the Gold Quarry mine are generally depicted by a gold suite of elements (Au-As-Sb-Hg-Tl) and a base metal suite (Ag-Cd-Cu-Pb-Zn), which have been interpreted to represent several synkinematic deposit-scale mobilizations of metals from the host rock lithologies into structures (Sha, 1993).

Geochemical data from the Chukar Footwall deposit show some differences compared to those described for the Carlin trend. At the deposit scale (n= 86), Au correlates weakly ( $r^2 = \le 0.700$ ) with As, Co, Cu, Fe, Hg, and Te. Ba and Sb, reflected in the ore mineralogy as barite and stibnite, show no correlation with Au. This observation, may tentatively be explained by the post-ore nature of Ba and Sb in Carlin-type deposits (Harris and Radtke, 1976; Radtke, 1985; Sha,

1993; Arehart, 1996; Heitt et al., 2003; Mariño, 2003). On the basis of their strong correlation ( $r \ge 0.700$ ), four element suites are represented at the deposit scale by the association of (i) As-Hg, (ii) Bi-Sn-Te,(iii) Ca-Zn, and (iv) Sn-Te. However, the geochemical signature of relatively high gold grade intervals from QRC 1636, QRC 1657, and QRC 1664 holes shows that (1) Au correlates well ( $r \ge 0.700$ ) with Cu-Hg-Tl± As± Zn, and As and Te correlate weakly with gold, (2) another elemental association is depicted by the suite of As±Sb-Te-Tl. The good correlation between As and Tl (hole QRC 1657) could be attributed to the presence of arsenic-thallium sulfosalts in the ore.

The high grade samples show a general enrichment in AI, As, Cr, Cu, Fe, Sb, Hg, Pb, Ti, and TI and a depletion in Ba, Ca, Sr, Mo, and Zn relative to low grade/unmineralized samples. Finally, a systematic incompatible behavior pattern between AI and Ba has been noticed: as AI increases/decreases, Ba decreases/increases.

Averages for selected elements, from non-mineralized to weakly mineralized (<0.1 opt Au) wallrock samples collected during this study, are as follows: Ag (1.3 ppm), Al (2025 ppm), As (428 ppm), Ba (1385 ppm), Cu (6.3 ppm), Hg (0.8 ppm), Pb (52.2 ppm), Sb (41.9 ppm), Se (13.7 ppm), Tl (64 ppm), and Zn (265.9 ppm). Similarly, element averages (analyzed by Chemex Labs) of high grade intervals from QRC cores are: Al (2927 ppm), As (1103 ppm), Ba (294 ppm), Cu (18.2 ppm), Hg (4.9 ppm), Pb (5.8 ppm), Sb (31.5 ppm), Se (0.42 ppm), Tl (20.6 ppm), and Zn (49.1 ppm). The average As, Cu and Hg contents from cores are higher relative to the entire deposit average. However, the low

average values of the rest of the elements contrasts with the relatively higher average values obtained from the entire deposit. From an exploration standpoint, a spike in As, Cu and Hg relative to the elemental averages of the surrounding host rocks could be used as a pathfinders for targeting blind mineralized shoots.

The results of the geochemical distribution of some selected elements (As, Ba, Fe, Sb, and Tl) within the entire deposit show an overall random behavior; however, the spatial distribution of elements appears to form a continuum reflecting the influence of host rock lithology, the degree of wallrock alteration, and the relative proximity to faults. First, the SDrm rocks have heterogeneous geochemical features as is reflected by their gradational lithologies, diagenetic histories, and effects from thermal events thus introducing random or unclear geochemical distribution patterns. Second, the results of hydrothermal alteration across faults show a tabular zonation of elements. For example, transect data perpendicular to the Magpie fault on the 4720 level indicate a strong concentration of Au, As, Fe, and Sb close to the fault; away from the fault there is a sharp decrease in these elements, accompanied by an increase in Zn, and erratic behavior of Ba.

In summary, the geochemical signatures of the Chukar Footwall deposit are characterized by (1) two correlative elemental suites of Au-Cu-Hg-Tl± As± Zn and As±Sb-Te-Tl, and (2) wallrock alteration and faults are significant factors controlling tabular, metric-scale element zonations.

	Aq	A	As	Au	Ba	Be	<u> 6</u> i	Ça	Cd	Co	Cr	Çu	Fe	Hg	U.	Ma	Mo	Mo	Na	Ni	Pb	Ρ	Sb	Se	Ŝa	\$r	Ţ.	ħ	Va	Zn.
Ag	1																												-	
Ai	-0.13286	1																												
As	0.07131	0.18249	1																											
Au	-0.059209	0.113029	0.52543	1																										
Ba	0.182142	-0.419359	-0.145969	-0.180501	1																									
Be	0.330475	0.306363	0.109361	-0.159949	-0.279533	1																								
Bi	-0.032784	-0.349245	-0.14587	-0.06572	-0.078996	-0.199258	1																							
Ca	0.044096	-0.309282	-0.25634	-0.243893	-0.16644	0.266105	0.196367	1																						
Cd	-0.014746	-0.225971	-0.095625	-0.115355	-0.144268	-0.211069	0.746989	-0.020651	1																					
Co	-0.114406	0.111679	0.087886	0.392617	0.018465	-0.237112	-0.161959	-0.263689	-0.095872	1																				
Gr	0.145687	-0.234706	-0.1166/2	-0.200303	0.605614	-0.261187	-0.008221	-0.497596	0.215706	-0 002832	1																			
Cu	0.24255	-0.085182	-0.050237	0.254083	-0.091632	0 180816	0.25043	-0.166439	0.372704	0.13025	0.125026	1																		
Fe	-0.015223	0.5/1116	0.541862	0.340255	-0.294018	0.110185	-0.177597	-0.467452	-0.039578	0.04661	-0.080902	0.128226	1																	
719	-0.04601	0.160347	0.885194	0.443096	-0.114537	-0.034377	-0.092252	-0.23/73	-0.065624	-0.029795	-0.058592	-0.05817	0.53086	1																
u	-0.078453	0.590219	-0.100112	-0.049616	-0.13/5//	0.190995	-0.155069	0.08/2/1	-0.138937	-0.0355.34	-0.133559	-0.013584	0.053547	-0.064436																
Mg	0.110951	-0.20936	-0.1/3348	-0.157791	-0.170202	0.282013	0.338856	0.515632	0.061542	40.340164	-0.356816	-0.066086	-0.340162	-0.220832	-0.0/4/31	0 600000														
MI	0.2999977	-0.363107	-0.136536	-0.210005	-0.010602	0.200490	0.640637	0.413602	0.327079	-0.234703	-0.04829	0.134676	-0.302113	-0.1656/6	-0.112215	0.302326	0.446500													
NO	0.301342	0.079219	0.029041	-0.104049	-0.080012	0.120039	0.32092/	0.100371	0.000919	-0.140010	0.040298	0.309111	0.013/32	0.004091	-0.13/35/	0.324025	0.440099	0 04267												
NG#	0.03930	0.016316	0.0530031	0.047710	0.01002	0.140110	0.00001	0.103103	-0.003308	0.032627	0.003031	0.043552	0.023236	0.136036	0.010210	0.033436	0.16101	0.04207	0.0000000											
De	0.027241	0.186474	0.0000000	-0.047710	-0.0/6233	0.907247	-0.105409	0.123478	0.097703	-0.02.3098	0.053823	.n 196421	0.0040	0.010659	0.000374	0 173270	0.16191	-0.112030	-0.000022	.0 024708	•									
5	.0.026252	0.245687	0.070045	0.010066	-0.011000	0.009087	0.204815	0.156223	0.282695	0.066363	-0 110/11	D 409757	0.476634	-0.019000	0.090168	0.070115	0.000487	0 168343	.0.069513	0.582008	.0 0.0000									
Sh.	-0.000451	0.217201	0 732307	0.437002	-0.051359	-0.015468	£ 151558	.0 324113	-0 105033	.0.014521	-0.001463	0.03339	0.585128	0 772541	-0.081148	-0.070113	.0 213044	-0.015665	-0.024525	0.138158	0.099954	-0.019255	1							
<u>~</u>	0 15974	0 437507	0 46 396	0.202678	-0.007649	0 423293	-0 528437	-0 146608	-0.50384	-0.049862	-0.076088	-0.020157	0.686112	0.416789	0.007845	A 099537	0 176111	-0 142895	0 078265	0.527765	D 288359	D 144828	0 49595	1						
So	-0 07015	-0.329921	-0 141376	-0.04941	-0 123071	-0 29008	0.826528	0 152554	0734946	-0 144365	-0.055565	0.261768	-0 156001	-0 103098	-0 184501	0 230744	0.307149	0.34891	0 079252	-0.029084	-0 188115	0 232973	-0.175296	-0.66405	1					
Sr	0.133455	-0.019152	-0 288956	-0.353014	0.333439	0 117477	-0 127773	0.5099	-0 198434	0.080503	-0.00738	-0 171522	-0 318411	-0 243303	0.385648	0 117212	0 13433	-0.017397	0.155809	-0.056159	0.370783	-0 162571	-0 277526	0.052531	-0 208552	1				
Ti	-0.009619	0 753018	-0.043246	-0 131934	-0 202164	0.361952	-0 133099	0.016652	-0.07274	-0.093597	-0 109679	-0.083254	0 188154	-0.03291	0.807398	-0.016609	-0.099553	-0.001186	-0.00157	0 126568	0.096439	0.083698	-0.045231	0 217015	-0.166895	0 285139	1			
Ť	-0.032695	0.201528	0.703348	0.269502	0.023233	0.053559	-0.360756	-0.03275	-0.316109	0.019018	-0.042946	-0.359894	0 278757	0.69848	0.043733	-0.134499	-0.190696	-0.063698	-0.116112	-0.135709	0.173046	-0.368939	0.542176	0.511513	-0.419343	0.065115	0.173281	1		
Va	0.364184	-0.135242	0.008992	-0.176499	-0.100111	0.573152	0.421737	0.162111	0.393453	-0.222098	-0.024611	0.560324	-0.047866	-0.070439	-0.07403	0.375229	0.509572	0.637802	0.075956	0.518091	-0.117224	0.222033	-0.073274	-0.019696	0.317918	-0.003256	0.082611	0.234877	1	
70	D 104663	0.018371	-0.128853	0 256089	-0.214205	0 44855	-0 211916	0.770199	-0 155041	-0 195271	-0.35083	-0.175634	-0 206318	-0.130996	0 226396	0 262958	0.206067	0.068903	-0 18121	0.015952	0 443973	-0 159165	-0 175597	0.25104	-0.32441	0 5238	0 226178	0.191882	0.064785	1

TABLE 1. Correlation matrix produced for this study. Strong correlations are in yellow.

	Au	AI	As	Ba	Be	Bi	Ca	Cd	Čo	Cr	Cu	Fe	Ha	Li	Ma	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Te	Ti	TI	Zn
Au	1																										
Al	-0.109669	1																									
As	0.190024	-0.741109	1																								
Ba	-0.043473	-0.287965	-0.19428	1																							
Be	-0.265314	0.956296	-0.818881	-0.031068	1																						
Bi	-0.112668	-0.367806	-0.297775	0.341753	-0.285714	1																					
Ca	-0.698353	-0.26667	0.532596	-0.230202	-0.220156	-0.320757	1																				
Cd	0.266734	-0.449467	0.926947	-0.332205	-0.565383	-0.624897	0.500897	1																			
Co	-0.487746	0.784561	-0.462745	-0.640355	0.701057	-0.280423	0.232296	-0.269343	1																		
Cr	0.701989	-0.546574	0.139518	0.534859	-0.52362	0.464387	-0.641717	-0.03356	-0.879792	1																	
Cu	0.951497	-0.394323	0.45429	0.008468	-0.532153	-0.084366	-0.504431	0.460511	-0.666673	0.762687	1																
Fe	-0.335695	-0.663178	0.853196	-0.237189	-0.677633	-0.160386	0.859776	0.724404	-0.155055	-0.234084	-0.059745	1															
Hg	-0.048273	0.015051	-0.095407	-0.662676	-0.15954	0.476183	-0.065366	-0.218502	0.398833	-0.138905	-0.087358	0.055205	1														
u –	0.407595	0.338798	-0.668582	-0.029618	0.263181	0.559259	-0.868248	-0.703526	0.086102	0.39066	0.197269	-0.788547	0.499486	1													
Mg	-0.232952	0.477874	-0.93588	0.490157	0.632458	0.508574	-0.523016	-0.970471	0.184161	0.074508	-0.430078	-0.779667	-0.020437	0.617612	1												
Mn	-0.730937	0.321114	0.100585	-0.329368	0.356348	-0.579066	0.82193	0.253609	0.641206	-0.926413	-0.704182	0.445082	-0.155311	-0.697518	-0.234475	1											
Мо	0.410596	0.038925	-0.393919	0.821995	0.188982	0.188982	-0.690487	-0.393648	-0.556447	0.670744	0.326231	-0.657731	-0.602543	0.348155	0.56065	-0.589256	1										
Ni	0.176263	-0.447811	0.931544	-0.441309	-0.579771	-0.579771	0.578987	0.986253	-0.17071	-0.127407	0.375312	0.791671	-0.081552	-0.700935	-0.992306	0.316357	-0.536875	1									
Pb	-0.226555	0.577897	-0.953527	0.477536	0.731925	0.365963	-0.508953	-0.931695	0.239457	0.004046	-0.443329	-0.813519	-0.119594	0.561833	0.987333	-0.152145	0.580948	+0.965394	1								
Sb	0.359187	-0.771706	0.98137	-0.1589	-0.866575	-0.229388	0.361883	0.897814	-0.568129	0.306329	0.609796	0.752192	-0.072789	-0.532154	-0.90736	-0.084769	-0.283221	0.887847	-0.934406	1							
Se	0.550738	0.375649	-0.112945	0.269023	0.380617	-0.618502	-0.426652	0.160766	-0.186784	0.215155	0.429382	-0.484297	-0.728315	-0.014608	0.039087	-0.118678	0.629386	0.016091	0.162507	-0.052816	1						
\$n	-0.697813	-0.183903	0.477681	-0.124274	-0.107143	-0.428571	0.979767	0.49099	0.222001	-0.655118	-0.522419	0.783869	-0.246921	-0.921132	-0.466736	0.868599	-0.566947	0.543535	-0.426956	0.301602	-0.261674	1					
Sr	-0.63721	-0.387337	0.620641	-0.243767	-0.355626	-0.249497	0.989158	0.550209	0.143149	-0.550659	-0.415639	0.922068	-0.00027	-0.850676	-0.590415	0.734982	-0.714294	0.632848	-0.594628	0.463958	-0.492353	0.946785	1				
Te	-0.285506	-0.544752	0.848551	-0.424061	-0.611933	-0.269665	0.851482	0.773432	-0.016966	-0.333371	-0.04052	0.978713	0.145627	-0.754746	-0.846877	0.49803	-0.76835	0.852377	-0.867943	0.746348	-0.458258	0.767509	0.906675	1			
Т	-0.150841	0.439394	0.229999	-0.447946	0.367806	-0.956296	0.500005	0.541403	0.495766	-0.700298	-0.180453	0.246111	-0.341148	-0.609837	-0.462206	0.779649	-0.389249	0.537373	-0.326637	0.117243	0.408314	0.58849	0.416099	0.363168	1		
TÌ	0.324643	-0.741514	0.968679	-0.14173	-0.825128	-0.304824	0.409688	0.927605	-0.548495	0.255917	0.575864	0.767062	-0.148705	-0.602717	-0.919589	-0.01311	-0.2781	0.911827	-0.933466	0.995174	-0.002334	0.365264	0.501134	0.760846	0.19485	1	
Zn	0.916709	-0.475106	0.438068	0.17725	-0.566413	0.002563	-0.515979	0.405023	-0.780641	0.850061	0.984526	-0.066757	-0.177241	0.180603	-0.354946	-0.75439	0.440762	0.306844	-0.376429	0.596272	0.429059	-0.522843	0.425635	-0.083362	-0.277145	0.563471	

TABLE 2. Correlation matrix for hole QRC 1636. Strong correlations are in yellow.

	Au	AI	As	Ba	<u>Be</u>	Bi	Ça	Cd	<u></u>	<u>Cr</u>	Cu	Fe	Hg	<u> </u>	Ma	Mn	Mo	Ni	<u>Pb</u>	Sb	Se	Sn	_Sr	<u>te</u>	<u> </u>		Zn
Au	1																										
AI	0.028945	1																									
As	0.413752	0.6973	1																								
ва	-0.25265	-0.409567	-0.212406	1																							
ве	-0.241/15	0.816869	0.508482	-0.414644	1																						
ы	-0.519697	0.083844	0.020243	-0.043369	0.526637	1																					
Ca	-0.62/343	0.176732	0.169218	0.158138	0.581877	0.914296	1																				
Cd	0.297869	0.807788	0.474031	-0.517571	0.493441	-0.435005	-0.360933	1																			
0	0.44513	0.813876	0.631151	-0.300866	0.601103	-0.191267	-0.133555	0.838858	1																		
Cr	0.222196	-0.608913	-0.262125	0.267089	-0.889191	-0.63949	-0.612395	-0.300135	-0.5628	1																	
Çu	0.640402	0.188169	0.7394	-0.219264	-0.014255	-0.177429	-0.195644	0.188198	0.41176	0.076011	1																
Fe	0.405025	0.692625	0.622754	-0.392239	0.713492	0.061615	0.102999	0.665251	0.899141	-0.718692	0.457107	1															
Hg	0,881434	0.21384	0.403008	-0.430905	0.099486	-0.362723	-0.459491	0.486258	0.658024	-0.164981	0.712833	0.725259	1														
Li .	-0.585927	0.408663	0.30706	0.104049	0.715271	0.78019	0.937876	-0.069825	0.12873	-0.71691	-0.154194	0.316619	-0.341978	1													
Mg	-0.02648	-0.306627	-0.125817	0.02505	0.021086	0.567353	0.340959	-0.609205	-0.363621	-0.120029	0.009994	-0.201468	-0.12088	0.031678	1												
Mn	-0.343396	0.203212	0.178267	-0.33445	0.673172	0.883607	0.791093	-0.226272	-0.056288	0.86071	-0.054206	0.256128	-0.126099	0.661035	0.618963	1											
Mo	-0.053976	0.162816	0.543404	0.140363	0.263744	0.007485	0.301324	0.029339	0.028198	0.039591	0.217627	0.172054	-0.044619	0.314713	-0.00471	0.248072	1										
Ni	0.215622	0.107155	0.118961	0.533166	-0.086246	-0.352335	-0.153652	0.243224	0.476733	-0.104184	0.147268	0.358577	0.285885	0.069681	-0.573257	-0.55091	-0.074727	1									
Pb	0.582135	-0.117655	0.244535	0.045644	-0.364998	-0.752217	-0.569684	0.310385	0.225141	0.446156	0.483312	0.217798	0.545904	-0.404929	-0.621479	-0.616849	0.321365	0.491206	1								
Sb	0.416451	0.512256	0.660955	0.311204	0.281027	-0.204102	-0.004262	0.438583	0.767033	-0.301218	0.508967	0.654957	0.457119	0.207534	-0.330644	-0.24228	0.237933	0.781836	0.375694	1							
Se	0.05982	-0.407391	-0.017494	0.498741	-0.413796	0.023635	0.004735	-0.587905	-0.455921	0.485008	0.078692	-0.523314	-0.301067	-0.256393	0.665179	0.00913	0.255479	-0.279136	-0.21709	-0.083259	1						
Sn	0.610139	0.107295	0.077049	0.004812	0.568662	0.967305	0.973356	-0.406585	-0.212018	-0.612202	-0.216556	0.065988	-0.429323	0.866858	0.458362	0.885335	0.217747	-0.329302	-0.645744	-0.182364	-0.003576	1					
Sr	-0.660011	0.296491	0.197851	0.065422	0.665108	0.843275	0.968309	-0.183127	-0.025563	-0.667412	-0.229573	0 200248	-0.423947	0.963078	0.119286	0.731808	0.299644	-0.074548	-0.471875	0.031308	-0.219804	0.92908	1				
Te	0.274879	0.587228	0.788022	-0.331534	0.614401	0.499133	0.474692	0.210957	0.512256	-0.579636	0.6588	0.632795	0.360122	0.539224	0.144149	0.520787	0.150068	0.001799	-0.142677	0.457518	-0.170355	0.456048	0.473427	1			
Ti	-0.222116	0.817778	0.405102	-0.298043	0.966497	0.463024	0.491935	0.519751	0.679947	-0.922019	-0.099359	0.716977	0.11383	0.633562	0.034488	0.556261	0.094682	0.054358	-0.430079	0.371368	-0.376852	0 464209	0.560837	0.523649	1		
TI	0.616237	0.490301	0.762224	-0.437476	0.191594	-0.42083	-0.384627	0.653066	0.717087	0.049786	0.853994	0.688672	0.833381	-0.197466	-0.355287	-0.197057	0.210876	0.260034	0.626986	0.586909	-0.2837	-0.419861	-0.307296	0.54279	0.128151	1	
Zn	0.167737	-0.216207	-0.123973	0.715446	-0.527092	-0.664201	-0.450758	0.052318	0.091475	0 437241	-0.021745	-0.142812	0.022594	-0.32239	-0.524741	-0.847483	-0.014238	0.808193	0.563053	0.503838	0.101407	-0.617339	-0.4222	-0.456796	0.381272	0.047116	

TABLE 3. Correlation matrix for hole QRC 1657. Strong correlations are in yellow.

	SiQ2	A/203	Fe	MgO	CaO	K20	TiO2	P205	QTZ	DOL	CAL	ILL	PYR	RUTL
SiO2	1													
AI203	0.049054	1												
Fe	0.218172	0.975554	1											
MgO	-0.547055			1										
CaO	-0.60843			0.959171	1									
K2O	-0.187834	0.969443	0.914998	-0.703627	-0.657196	1								
TiO2	-0.161061	0.975792	0.907419	-0.736454	-0.655282	0.990925	1							
P2O5	-0.425258	0.882971	0.779097	-0.520514	-0.440443	0.965428	0.960784	1						
QTZ	0.937794	-0.20698	-0.007161	-0.277518	-0.413907	-0.408158	-0.415657	-0.631933	1					
DOL	-0.698476	-0.744164		0.981128	0.962332	-0.559547	-0.592835	-0.347524	-0.455196	1				
CAL	0.343542	0.945042	0.953892			0.836813	0.868575	0.697097	0.05461	-0.91177	1			
LL		0.364771	0.159312	0.082695	0.255756	0.530945	0.558462	0.730297	-0.975441	0.266485	0.138842	1		
PYR	0.483298	0.885049	0.917617			0.743945	0.781121	0.57735	0.199007	-0.963087	0.987878	0	1	
RUTL	-0.425258	0.882971	0.779097	-0.520514	-0.440443	0.965428	0.960784	1	-0.631933	-0.347524	0.697097	0.730297	0.57735	1

 TABLE 4. Semiquantitative X-Ray Fluorescence Analysis correlation matrix for hole QRC-1664

 (high grade intervals). Strong positive and negative correlation in yellow and blue, respectively.

## 7. HYDROTHERMAL ALTERATION

The Chukar Footwall mine exhibits hydrothermal alteration assemblages typical of Carlin-type gold deposits: (a) decarbonatization, (b) silicification, (c) dolomitization, (d) argillization, and possibly (e) baritization. Arehart (1996) evaluated the hydrothermal alteration in the Carlin trend and concluded that there is a general spatial pattern of wallrock alteration that can be characterized by distal, volumetrically extensive decarbonatization that envelopes silicified and argillized zones adjacent to the gold mineralization. With regard to temporal relationships between these alteration types, recent work by Harlan et al. (2002) summarized wallrock alteration paragenesis in the Maggie Creek district typified, from oldest to youngest, by decalcification  $\rightarrow$ dolomitization- sericitization $\rightarrow$  argillization $\rightarrow$  sulfidation $\rightarrow$  supergene weathering.

At Chukar Footwall, the hydrothermal alteration was initiated by a **decarbonatization** event(s) along faults, faults zones, joints, and bedding planes. Such structures fully control the extent of decalcification producing sharp boundaries between altered and fresh rocks, a distinctive trademark of this deposit relative to the Carlin mine and other deposits (Mike Robinson, personal communication, 2004). The degree of decarbonatization is accompanied by variations in the amount of calcite veins and stockworks, stylolites, and brecciation. Multistage white calcite veins range from a

millimeter up to a meter wide, and they are usually concentrated within the hangingwall of structures and along bedding planes.

Following decarbonatization, a selective, fracture controlled hydrothermal dolomitization and silicification took place within the SDrm and Dp units (Fig. 18). The spatial extent of this alteration event is unknown; however, stained carbonate samples document a volumetrically small dolomitization stage on the deposit scale. Transitions from calcite to ferroan calcite to ferroan dolomite are either fracture controlled or selective; typically, the dolomitized rocks are cut by calcite or barite veinlets. District wide dolomitization has been ascribed to form as hydrothermal fluids were focused along major and minor structures diffusing throughout the rocks and producing a dolomitization front of limited extent (e.g. Stenger et al., 1998). **Silicification**, much easier to detect than dolomitization, represents the second main hydrothermal alteration stage characterized by microcrystalline silica flooding replacing the silty limestones units (jasperoids) and breccia bodies with variable degrees of silica content. Quartz veinlets are common, and they crosscut at a high angle the stratigraphy and earlier calcite veins. Silicification processes are volumetrically important toward the deeper levels of the mine, associated with the CZ and NE-striking structures. Similar precipitation mechanisms responsible for silica precipitation in Gold Quarry were also operating in Chukar Footwall as determined by analogous mineralogical patterns at Gold Quarry characterized by an early



SDrm1h@0.080 Au opt.



#### FIGURE 18.

Fracture-controlled hydrothermal ferroan dolomite (light color) exhibiting veinlets cutting calcite (dark pink). Stained samples from the Tracker Exploration drift (18583E,15638N), near a high-angle NE-striking fault. Pyrite grains are abundant along and near the fractures (arrows). microcrystalline silica replacement, followed by barite precipitation in small veinlets (Harlan et al., 2002). Similarly, silicification is structure-controlled, and there is evidence for multistage events of hydrothermal quartz. For example, sample 169 from the 4680 level was taken in the hangingwall section of a 50°, 70° SE structure producing strong decalcification and patchy silicification in the SDrm<sub>2</sub> host rocks. In thin section, cockade textures with clasts of SDrm<sub>2</sub> are common in a matrix of dolomite±fine sericite±barite. Two silicification events surround the clasts: qtz<sub>1</sub> presents granular texture, while qtz<sub>2</sub> occurs in jigsaw texture.

Argillization has only been observed in the 4720 level, in the vicinity of the Sagehen fault zone, and in the Raven dike in both the 4590 and 4710 levels. It is a localized type of alteration due to its structural control, and is difficult to identify during underground mapping in the SDrm units. In thin section, kaolinite±dickite± sericite overprint the SDrm matrix. In some intervals, the dike presents strong argillization occurring as a pale-green gummy oxidized mass. In less altered samples, phenocrysts are replaced by kaolinite and sericite.

The final main stage of alteration is represented by a widespread barite flooding and veining, apparently associated with subparallel NNW marcasitepyrite and calcite veinlets. What is striking about this late stage is the presence of abundant, visible gold flecks associated with late barite veinlets on the 4730 level. Associated with this late stage, hydrothermal **dedolomitization,** the replacement of dolomite by calcite, has been reported by Williams (2002) in samples from the 4730 level as calcite incipiently replaces diagenetic or hydrothermal dolomite.

## 8. PETROGRAPHY AND PARAGENESIS

All the mine levels and specific core intervals were sampled to obtain material for petrography, geochemistry, stable isotopes analyses, and fluid inclusion microthermometry. Petrographic studies of 50 thin sections and several hand-sample specimens were conducted to (1) identify and quantify the major ore phases, (2) document the spatial and temporal relationships among mineral phases, and (3) describe the alteration paragenesis. Finally, petrography was augmented through XRD and SEM analyses of selected samples, and thin section billets were stained with a solution of alizarin red S stain and potassium ferricyanide stain for rapid carbonate identification.

In general, the paragenetic sequence at Chukar Footwall involves three main paragenetic stages (Fig. 19), where ore textures reflect crystallization in open spaces mainly consisting of comb, cockade, and vug filling textures. Also, decarbonatization and brittle movements produced extensive breccia textures (Appendix 6)

The first stage is characterized by both diagenetic sulfides (pyrite) and a metasomatic suite as a result of the emplacement of a hitherto unknown blind plutonic body and the Raven dike producing an aureole of diopside hornfels (exoskarn) in the SDrm



#### GENERAL PARAGENETIC SEQUENCES OF MINERAL DEPOSITION FOR CHUKAR FOOTWALL MINE

FIGURE 19. Paragenetic sequence of mineral deposition for Chukar Footwall Mine. Note that micron gold was not identified during petrographic studies and therefore not included in the paragenetic sequence.

and Dp units. This exoskarn assemblage is composed of biotite/phlogopite ± clinopyroxene± vesuvianite (idocrase) ± tremolite±quartz±calcite±K-feldspar. These minerals are in most of the samples replaced by fine phyllosilicates and clays.

The second, third, and fourth stages represent ore hydrothermal events dominated by ore stage quartz±carbonates±sericite/clay±barite±pyrite±Sb and As minerals. A late-ore stage (stage V) is characterized by sulfides±calcite±barite ±visible gold±quartz and small oxidation products.

### PETROGRAPHY OF METASOMATIC METAMORPHIC ROCKS

The exoskarn assemblage (diopside hornfels, Figs. 20 and 21) is characterized by both a fine to medium grained granoblastic texture and porphyroblastic texture. In hand samples, these rocks are gray to greenish in color. In same cases, a weak fabric is produced by vesuvianite porphyroblasts, and later hydrothermal events produced a moderate overprinting alteration on the exoskarn mineralogy.

**Diopside** (5-25 %) occurs as an anhedral, interlocking grains in a granoblastic texture making up the matrix with granoblastic calcite, phlogopite (?), K-feldspar, and opaques. In most of the cases, **vesuvianite** (1-15 %) is present as (1) euhedral laths, (2) radiating aggregates,(3) and subhedral-euhedral porphyroblasts producing a visible fabric of light green millimetric porphyroblasts. Vesuvianite is altered pervasively to grid texture phyllosilicates and carbonates. **Tremolite** (3-10 %), locally abundant, occurs as individual laths and bow-tie

textures. In the same way as vesuvianite, tremolite is also altered to either phyllosilicates or clays. **Calcite** (20 %) forms fine to medium grained anhedral grains that make up the matrix of the pyroxene hornfels. Also making up the matrix mineralogy, anhedral **K-feldspar** grains ( $\leq$  1 %) with ragged boundaries occur as interstitial grains, showing normal to undulose extinction.



FIGURE 20. Photomicrographs of the diopside hornfels exoskarn. (A) Porphyroblast of vesuvianite, a calcium magnesium aluminosilicate hydroxide, altered to talc and chlorite, (B) Radiating aggregates of vesuvianite. Crossed nicols. FOV: 0.21 mm.



FIGURE 21. Photomicrographs of the diopside hornfels exoskarn. (A) Diopside hornfels containing equant anhedral grains disseminated in calcite and K-feldspar, (B) Radiating crystals of tremolite postdating the skarn matrix mineralogy, (C) Fibrous phyllosilicates and chlorite overprinting the pyroxene hornfels as a result of a low temperature hydrothermal episode (retrograde metamorphism). Crossed nicols. Field of view: 0.21 mm.

#### CARLIN-STYLE ORE FABRICS

**Pyrite** (Figs. 22 and 23) is the most common sulfide in the deposit, making up to ~ 4 volume percent of the rock. It occurs as (1) aggregates of euhedral to subhedral grains, (2) poikiloblastic, ragged, ratty grains, and (3) disseminated grains within stylolites (pyrite stylolites) and wispy textures on the SDrm. Framboidal pyrite, however, was not identified petrographically. SEM analyses of several pyrite grains indicate that this sulfide is rather homogenous in composition regardless of morphology and paragenetic stage; no zonation was recognized within crystals. Also, SEM examination failed to detect any submicron arsenian-rich rims and gold particles in pyrites. On the other hand, most pyrite grains contain minute inclusions of quartz±zircon± opaque minerals producing distinctive growth patterns.

At least three generations of pyrite may be distinguished on the basis of occurrence and optical properties. Py-I occurs as euhedral (Fig. 23A) to subhedral cubic aggregates disseminated in carbonaceous stylolites or along the margins of stylolites (Fig. 23C) and wispy-textured silty limestone. Commonly euhedral, brassy pyrite cubes define bedding-controlled sulfide laminae in the SDrm lithologies. These observations indicate that Py-I could be a product of an early (diagenetic) sulfidation event. Py-II, in contrast, exhibits large inequigranular, disseminated euhedral to anhedral grains (Fig. 23B). Two subtypes of pyrite may be observed: relatively older, high reflectivity pyritohedron grains, and relatively younger subhedral to anhedral, low reflectivity, and porous pyrite grains. In addition, euhedral to



FIGURE 22. Reflected light polished sections of pyrite. (A) anhedral pyrite grains in an atoll structure; (B) Pyrite grain displaying a ratty-texture in strongly altered SDrm; (C) Anhedral pyrite grains from high ore grade sample displaying arsenopyrite lamellae; (D) Pyrite grain partially enclosing realgar; (E) Ratty-texture of pyrite. Note the sulfide association with carbonaceous matter (dark); and (F) Euhedral pyrite grain partially fragmented due to its proximity to a later calcite vein. FOV:0.21 mm. Reflected light.



FIGURE 23. Common modes of pyrite occurrence : (A) Isolated diagenetic pyritohedron with abundant inclusions (Py-I), (B) Late subhedral cube replacing iron-poor sphalerite (Py-II), and (C) Pyrite stylolites consists of anhedral, pitted grains of pyrite associated with carbonaceous matter along the stylolite. Reflected light. FOV: 0.67 mm.

subhedral Py-II grains replace sphalerite. This stage may represent the ore stage on the basis of (1) the spatial relationship with quartz+sericite+pyrite alteration (i.e., Sha, 1993; Leach, 1999); and (2) some Py-II idioblasts are fractured and filled with late carbonate veinlets. Finally, Py-III is relatively coarse, euhedral to anhedral, and present in veinlets cross-cutting earlier minerals and bedding. This late-ore stage is also observed associated with marcasite along some WNWstriking structures and veinlets suggesting mild oxidizing conditions during Py-III deposition.

Marcasite (Fig. 24) occurs as ≤3 mm botryoidal aggregates in open spaces on WNW-striking structures (i.e., Crown fault and the Sulfide vein at the 4730 level). This sulfide is rare at deposit scale (< 1 %), but it may be abundant locally in the exoskarn as bladed idioblasts replacing sphalerite.

Arsenopyrite (Fig. 24) was observed as idioblasts associated with veinlets of sphalerite, marcasite, and pyrite in the exoskarn. It appears as pseudo-rhombic crystals disseminated in the veins and host rock, making up ≤1 volume percent of the rock. Relatively late to pyrite or cogenetic with it, arsenopyrite also occurs as replacement lamellae in Py-I grains. Also, this sulfide occurs as corroded star-like shapes associated with the base metals mineralization (Aspy-I) and late-ore mineral (Aspy-II) with barite+calcite+visible gold at the 4730 level.



FIGURE 24. Sulfide occurrences at Chukar Footwall: (A) Late-stage starlike arsenopyrite crystals from the 4730 level, (B) Marcasite blades partially replacing sphalerite (base metal suite), and (C) Pseudo-rhombic disseminated arsenopyrite crystals from the ore-stage base metal suite. B and C from the 4400 level. Reflected light, FOV: (A) 2.5 mm, (B) and (C) 0.67 mm. **Orpiment and Realgar** (Fig. 25) are rare minerals at Chukar Footwall. Limited material from a NE-striking structure with Sb and As sulfides at the 4600 level was donated by Joe Sagar for examination. Both orpiment and realgar occurs macroscopically as fine grains in veinlets in decarbonatized SDrm. Orpiment is cut and partially replaced by a later realgar veinlet. Away from the veinlets, interstices between the grains are filled with very fine realgar. Due to the inaccessibility of this level, no crosscutting relationships between these sulfides and stibnite can be made.

**Sphalerite** (Fig. 25) is a major ore mineral observed in the exoskarn (~ 25 volume percent of the total sulfide), where it occurs as isolated tetrahedrons and small fine-grained veinlets within other sulfides. Sphalerite is replaced by minute inclusions of **tennantite**, **galena**, and **geocronite-guettardite** (Pb<sub>14</sub> (Sb,As)<sub>6</sub> S<sub>23</sub>, Pb (Sb,As)<sub>2</sub> S<sub>4</sub>) as observed in SEM photomicrographs (Fig. 26). Sphalerite exhibits a zonal distribution of Fe poor and rich layers. It's rimmed and partially replaced by euhedral-subhedral pyrite (e.g., some pyrite idioblasts contains relics of sphalerite).

**Stibnite** (Fig. 26) is relatively abundant (up to 25 % of the ore) in the 4590 and 4740 mine levels, spatially associated with NE-striking structures. Under the microscope, stibnite occurs as anhedral, highly anisotropic grains filling voids in brecciated zones commonly showing lamellae extinctions and undulose extinction.



FIGURE 25. Sulfide ocurrences at Chukar Footwall: (A) Sphalerite dislaying iron poor and rich growth layers. Note extensive late fractures filled with quartz (base metal suite, 4400 level) Crossed nicols, FOV: 0.67 mm (B) Stratiform orpiment in SDrm rocks. Late realgar veins cut and partially replace orpiment.

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**Boulangerite,**  $Pb_5Sb_4S_{11}$ , was noted during SEM examination partially replacing a stibnite grain (sample 23, 4590 level). Also, stibnite is locally abundant in the 4590 level, forming thin veinlets in decarbonatized SDrm. It is partially oxidized to a yellowish coating of **stibiconite**,  $Sb^{+3}Sb_2^{+5}(OH)$ .

**Barite** can occur as prismatic, rhombohedral crystals associated with silica stages within fractures and veins (Ba-I stage). The other barite stage (Ba-II) is associated with Fe sulfides, carbonates, and visible gold. It may be locally abundant (up to 5 %) as subhedral to anhedral crystals filling veins and vugs. On the 4730 level, barite appears as massive to millimetric tabular crystals containing visible **gold**, suggesting that both minerals are cogenetic. Cross-cutting relationships suggest that Ba-I precipitated earlier than stibnite in the Magpie fault (sample 203, 4740 level).

**Carbonates**, in general, consist of **calcite** and **dolomite** (Fig. 27), which are locally abundant (up to 20 %). Calcite occurs as a major constituent in the exoskarn mineralogy, wherein it has been recrystallized producing equigranular coarse-grained calcite grains showing typical triple junctions between grains. On the scale of the deposit, calcite occurs as multistage veins and veinlets crosscutting decarbonatized SDrm and Dp units. Calcite grains range from fine to coarse sizes that exhibit intense and colorful twin lamellae. Rarely, some calcite grains from the exoskarn have kinked twin lamellae as a result of local shearing phenomena. Calcite rhombs are generally observed as clusters of coarse aggregates with inclusion zoning. Macrocrystals of calcite are typically honey to



FIGURE 26. High resolution photomicrographs of ore asemblages from Chukar Footwall: (A) Base metal suite with sphalerite, quartz, and a grain of geocroniteguettardite partially replacing sphalerite (4400 level), (B) Pyrite-II grain with abundant quartz inclusions (4590 level), (C) Vesuvianite porphyroblasts (Hole CFU-137), and (D) Boulangerite, a lead antimony sulfide, replacing stibnite along fractures (4590 level)

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greenish in color, filling open fractures and vugs, exhibiting distinct form types such as the obtuse rhombohedron crystals. From several samples (e.g. 4610 level and CZ-Tracker Decline), it seems that Ba-II stage and calcite are cogenetic wherein the former occurs as small (≤2 mm) subhedral inclusions that, under short wave UV, produced an intense yellowish fluorescent light. Calcite peaks from XRD analyses reveal a low Mg content (up to 5 mole percent). Finally, dedolomitization has been reported from some samples from the 4730 level (Williams, 2002).

Dolomite commonly occurs as fine to coarse crystalline grains in veinlets and coarse, individual rhombs in veinlets associated with quartz±sericite±Py-II and carbonate flooding. Two major types have been observed: (a) medium to coarse equigranular, interlocking saddle (baroque) dolomite that is very distinct under the microscope due to their curved faces, strong undulose extinction, mottling, and hypidiotopic textures of Friedman (1965); and (b) sparsely distributed inequigranular rhombic crystals that lack zoning under the microscope. This dolomite type could be classified as having idiotopic textures (i.e., inequigranular fabric wherein the carbonate grains are mostly euhedral; Friedman, 1965).

Staining and XRD analyses from Chukar Footwall reveal that most of the carbonate mineralogy could be the result of partial solid solutions between ferroan dolomite (ferrodolomite) and zincian dolomites (minrecordite, CaZn(CO<sub>3</sub>)<sub>2</sub>) in the system CaCO<sub>3</sub>-MgCO<sub>3</sub>-MnCO<sub>3</sub>-FeCO<sub>3</sub>-ZnCO<sub>3</sub> (Rosenberg and Champness, 1989). Numerous authors have mentioned and described

dolomitization along the Carlin Trend. For example, Arehart (2001) examined several lines of interpretation which call into question the distribution and origin of dolomites in Carlin-type deposits. Leach (1999) observed a spatial zonation of carbonates composition through depth at the Deep Post mine with Mn-Mg carbonates at shallow depths and Mg-Ca carbonates at deeper levels. Dewitt (1999) drew attention to the presence of hypogene zinc carbonates at the SSX mine (Jerritt Canyon district) and their spatial relationships with NE-trending structures.

At Chukar Footwall, carbonate peaks shown an overall presence of both dolomite and minrecordite in the analyzed samples. These carbonates are hydrothermal in origin due to their spatial occurrence in veins and carbonate flooding suggesting an Mg and a relatively later Zn metasomatism on the carbonate lithologies on the basis of petrographic observations, SEM analyses, geochemical evidence, and the data presented by Zabinski (1980) and Rosenberg and Champness (1989). Furthermore, geological mapping showed that the overall distribution of samples with the above mineralogical characteristics are spatially related to both northeasterly and northwesterly trending faults which have an extended history of reactivation thus allowing circulation of hydrothermal and meteoric fluids.

Quartz (≤ 65 %) exhibits a variety of textures such as xenomorphic, granular, cockscomb, jigsaw, comb, and replacement (jasperoids). Quartz in multistage veins is mottled and anhedral with abundant submicron fluid inclusions. When specifically replacing dissolution breccias or the whole rock



FIGURE 27. Photomicrographs showing carbonates at Chukar Footwall. Rhombohedral and prismatic forms of calcite with abundant inclusion zoning (A and E). Multistage calcite veins on micrite host rock (B). Dolomite commonly occurs as saddle (baroque) aggregates (D and F) and rhombic grains associated with brassy pyrite in the Magpie fault (C). Crossed nicols, FOV: 0.67 mm.

matrix, quartz occurs as a medium to fine grained jigsaw or xenomorphic textures. Quartz also formed during the late-ore stage as millimetric doubly terminated crystals ("herkimer diamond") in open spaces in a calcite vug on the 4730 level. Chalcedony was observed as botryoidal bands in sample 203 from the Magpie fault at the 4740 mine level.

SEM analyses and XRD data indicate that the dominant **clays** from healed and unhealed structures and hydrothermally altered samples are represented by muscovite-illite (detritical?), illite-1M, and kaolinite-dickite. The latter phase occurs as very fined, light to dark brown grains typically associated with quartz, sericite and Py-I in veins and also as late flooding(s). Regarding the **sericite** (~ 5 to 15 %), its cross-cutting relationships observed in thin-sections suggest three sericite alteration stages, the youngest one possibly related to the contact metamorphism event, and two later sericite stages possibly linked to hydrothermal events. In general, sericite occurs as a fine grained material in veinlets, groundmass, and carbonate-sericite flooding. Coarse sericite has been observed only locally associated with dolomite rhombs and stibnite in samples from the Magpie fault at the 4740 level, and it has been replaced locally by chlorite.

Although micron-size **gold** was not observed from SEM analyses, visible gold (Fig. 28) is somewhat abundant in the shallower mine levels (the 4730 and 4770 levels are the only areas where visible gold has been found). Geological mapping from these mine levels show that the occurrence of visible gold is along fractures of all orientations near major NW-trending structures (Sagehen fault,

4770 level; Pheasant fault, 4730 level). The majority of the visible gold occurs as (1) millimetric flakes, masses, or grains intergrown with Ba-II in calcite±sulfides veinlets, (2) along fractures, or (3) commonly found along bedding planes in decarbonatized, gritty SDrm<sub>1</sub> rocks. Finally, SEM analyses of gold flakes showed that gold contains silver.



FIGURE 28. Late-stage visible gold from the 4730 mine level. Gold occurs in fractures of all orientations near major NW faults in strongly decalcified (gritty texture) SDrm rocks.

### **PARAGENETIC STAGES**

Based on crosscutting relationships observed in thin-sections and hand samples, five general paragenetic stages are observed (Fig. 19): (I) diagenetic sulfides, (II) quartz± dolomite± sericite± pyrite± barite± fluorite (III) quartz±barite± calcite±base metals  $\rightarrow$  (IV) quartz±carbonates±sericite±barite±As-minerals± stibnite $\rightarrow$  (V) pyrite+marcasite±arsenopyrite±calcite±barite+visible gold± quartz.

Associated with the ore stage, stages II through IV are characterized by quartz± sericite and quartz± dolomite± sericite± barite ±pyrite veinlets and flooding. As and Sb sulfides are ubiquitous during the waning ore stage, occurring as discrete veinlets, sealing interstitial voids around the matrix quartz grains, and vug fillings. Stage III is volumetrically small relative to the others. It began with quartz, barite, and calcite precipitation in veinlets and open spaces followed with a minor deposition of low iron sphalerite, arsenopyrite, pyrite, and Sb sulfosalts. This stage cuts the ore stage II and it may have been genetically related to the latest stages of the main mineralization. Finally, stage V marks the late-ore stage at Chukar Footwall characterized by calcite±barite±visible gold± sulfides±quartz veins in zones of strong hydrothermal alteration. Quartz represents the last phase that may have precipitated in the deposit.

# 9. STABLE ISOTOPE STUDIES OF THE CHUKAR FOOTWALL MINE

Systematic studies of stable isotopes of  $\delta^{18}$ O,  $\delta^{13}$ C, and  $\delta^{34}$ S in the Carlin trend and elsewhere have shown consistent isotopic changes recorded in both fresh rocks and mineralized host-rocks thus demonstrating that there have been significant ore fluid-rock interactions. For example, Stenger et al. (1998) documented haloes of low  $\delta^{18}$ O values on rocks surrounding the orebodies relative to unmineralized, more distal rocks in Twin Creeks, Nevada. Similarly, Pinckney and Rye (1972) carried out a study of the relationships among  $\delta^{18}$ O,  $\delta^{13}$ C, and limestone textures in the Hill Mine, in the fluorite district of southern Illinois. They reported variations in the isotopic ratios of  $\delta^{18}$ O and  $\delta^{13}$ C as the Mississippian limestone was repetitively altered, suggesting a textural and mineralogical control on the  $\delta^{18}$ O and  $\delta^{13}$ C values. With regard to the potential of stable isotopes studies for mineral exploration for blind, deep orebodies, this methodology have been used as a rapid and preliminary step to delineated areas of former hydrothermal activity that may host mineralization (cf. Schmauder et al., 2005).

This chapter addresses several fundamental questions regarding the isotopic signature at Chukar Footwall: (1) Is there any relationship among structures, degree of hydrothermal alteration, and isotopic values? (2) Is there any isotopic zonation? (3) What is the isotopic signature, if any, of the late-stage barite+gold veins relative to the other veins? and (4) Does the Chukar Footwall deposit exhibit unique isotopic features? In order to answer these questions,
several isotopic transects were made perpendicular to major structures and a total of 64 hand-specimens were selected for whole-rock and vein carbonate isotope analyses. Additionally, 14 powder samples were obtained from sulfides and sulfates for sulfur and oxygen analyses to evaluate the possible sources of the sulfur.

The  $\delta^{13}$ C  $-\delta^{18}$ O relationships of whole-rocks and carbonates are shown on Figure 29, and the  $\delta^{34}$ S and  $\delta^{18}$ O data for sulfides-sulfates are shown in Figure 30. The  $\delta^{18}$ O and  $\delta^{13}$ C values are reported relative to V-SMOW and V-PDB, respectively (Table 5).

## CARBON AND OXYGEN STABLE ISOTOPE DATA

## $\delta$ $^{18}O$ and $\delta$ $^{13}C$ ISOTOPIC TRANSECTS

Carbon and oxygen isotope analyses were performed on samples of latestage calcite veins and wallrocks of the Roberts Mountains Fm. along perpendicular transects to the Magpie fault, Sagehen fault zone, Antelope fault, Pheasant fault, and several structures in the 4610 level (Figs. 31, 32, and 33) to determine whether the wallrocks around structures exhibit isotopic shifts due to the degree of hydrothermal alteration and/or the proximity to faults or joints.

The Magpie fault, a major NNE-striking feeder structure at Chukar Footwall, at the 4720 level shows a lack of relationships between  $\delta^{18}$ O and  $\delta^{13}$ C along the transect (Fig. 34; samples 210,211,212, and 213 on Figure 32) that could be interpreted as different competing processes dominate both the





carbon and oxygen isotope signature. The  $\delta^{13}$ C values show little variation between the footwall and hangingwall section; in the footwall the  $\delta^{13}$ C values increase toward the structure, then decrease in the hangingwall. The  $\delta^{18}$ O values, however, show somewhat greater variations but with an opposite behavior.  $\delta^{18}$ O values decrease toward the hangingwall. It is noteworthy that the respective maximum and minimum values of carbon and oxygen coincide with the Magpie fault. Finally, this behavior is complemented by a small transect perpendicular to the structure (samples 63 and 70 on Figure 32) whereby the maximum and minimum ratios, respectively, for  $\delta^{13}$ C and  $\delta^{18}$ O values also coincide with the fault.

Concerning the  $\delta^{18}$ O and  $\delta^{13}$ C isotopic patterns along the Sahegen fault zone, a WNW- striking fault, at the 4720 level (samples 53, 57,58, and 111 on Figure 32), they exhibit somewhat similar ratios to these adjacent of the Magpie fault. The overall  $\delta^{13}$ C pattern is characterized by a decrease in the footwall, then increasing toward the hangingwall. However,  $\delta^{18}$ O values increase in the footwall and then decrease toward the hangingwall portion of the structure (Fig. 35). Another WNW-striking structure, the Antelope fault, at the 4740 level shows minimal isotopic variations along the hangingwall section (samples 21,25,26,27, and 28, Fig. 31) and it displays similar  $\delta^{13}$ C and  $\delta^{18}$ O patterns to those of the Magpie and Sagehen faults, with a tendency to higher  $\delta^{13}$ C and lower  $\delta^{18}$ O values toward the fault (Fig. 36).

Isotopic transects on the 4730 and 4610 levels (Fig. 33) display very different  $\delta^{13}$ C and  $\delta^{18}$ O patterns from to those described above. The spikes in



FIGURE 30.(A) Oxygen and sulfur isotope data from barites. Two populations are defined on the basis of their isotopic signatures. Note the enrichment in both sulfur and oxygen from samples from deeper mine levels (population B). Numbers denote samples.(B) Histogram of sulfur values in sulfides and sulfates in Chukar Footwall. Py=pyrite, sb= stibnite, sph= sphalerite,as=realgar and orpiment.

both  $\delta^{13}$ C and  $\delta^{18}$ O values in Figures 37 and 38 might be controlled by the intense fracture density that served as pathways for late-ore hydrothermal fluids, which significantly change the original isotopic wallrock signature. This observation is supported by petrographic, geochemical, and fluid inclusion data that suggest a late-ore stage hydrothermal event associated with NW-striking structures with mobilization of metals into these structures and the formation of barite+gold+sulfides veinlets.

In summary, the carbon and oxygen patterns of the Roberts Mountains Fm. from several perpendicular transects to major structures record (1) isotopic haloes around structures are spatially associated with a specific degree of hydrothermal alteration, and (2) although the  $\delta^{13}$ C and  $\delta^{18}$ O patterns in structures from the 4730 and 4610 levels are difficult to explain by isotopic systematics, petrographic and fluid inclusion data reveal interaction of late-ore hydrothermal fluids with already isotopically altered wallrock.

# $\delta^{13}C$ and $\delta^{18}O$ SYSTEMATICS OF CARBONATE ROCKS AND CALCITE VEINS

The  $\delta^{18}$ O values of the Roberts Mountains Fm. range from 0.8 to 18.2 ‰. Samples from the 4730 level (7.4 to 18.2 ‰) are the least altered among samples from different mine levels. Thus, these limestones clearly do not represent unaltered rocks when compared to the  $\delta^{18}$ O values for unmineralized Roberts Mountains Fm. limestone near the Carlin mine, which range from 21.2 to 23.0 ‰ (Radtke et al., 1980). The  $\delta^{13}$ C values of the same samples range from -

2.6 to 6.3 ‰. The range of these values overlaps those from the Carlin mine (-1.9 to 0.8 ‰, Radtke et al., 1980).

In a plot  $\delta^{13}$ C vs.  $\delta^{18}$ O (Fig.29) the data display a trend with a slope that reflects a negative correlation between carbon and oxygen isotopes. This may suggest that both isotopic signatures were governed by different processes (e.g., fluid/rock ratios, pH, oxygen fugacity), which shifted the carbon and oxygen isotopic values independently during decarbonatization.

When cross-cutting relationships are present (Fig. 39), temporal oxygen and calcite isotopic variations exist. For example, a late multistage calcite vein parallel to Sahegen fault (sample 19 on Figure 31, 4740 level) has  $\delta^{18}$ O and  $\delta^{13}$ C values ranging from 5.5 to 8.9 ‰ and 0.4 to 0.9 ‰, respectively. The fluids shifted toward heavier  $\delta^{18}$ O values while the  $\delta^{13}$ C values become progressively lighter. The calcite  $\delta^{13}$ C values are close to those of the nearest limestone analyzed (samples 14 and 16, 4740 level) and the local SDrm limestones, which suggest that the carbon may have been derived from dissolution of carbonate minerals and organic carbon from the wallrocks. With regard to the oxygen isotopic signature, the earlier  $\delta^{18}$ O value is substantially lower than the surrounding wallrocks, but becomes heavier later. A meteoric fluid could have produced this trend toward heavier  $\delta^{18}$ O values as the degree of water-rock exchange fluctuated through time. Furthermore, fluid inclusion data from similar late stage calcite veins shown low homogenization temperatures (< 115° C) and very low salinities indicating and supporting the oxygen isotopic data that much of the late fluid was meteoric in origin.



Figure 31. Location map (4740 level) showing location of samples taken for stable isotope analyses (Chukar Footwall coordinates). Green line represents the isotopic transect (see Fig. 36).



FIGURE 32. Location map (4720 level) showing location of samples taken for stable isotope analyses. Green lines represent transects (see Figures 34 and 35). Chukar Footwall coordinates.



FIGURE 33. Location maps (4610 and 4730 levels) showing location of samples taken for both stable isotope and fluid inclusion analyses. Green lines on the 4730 map are late calcite+sulfides+ barite veins. Au= visible gold. Chukar Footwall coordinates. CZ= Central Zone.



FIGURE 34. Spatial variation of stable isotopes and gold along transect 4720A, perpendicular to the Magpie fault (see Figure 5). FW= footwall, HW= hanging wall. Blue numbers denote wallrocks samples.



FIGURE 35. Spatial variation of stable isotopes and gold values along transect 4720B perpendicular to the Sagehen fault zone. HW= hangingwall, FW= footwall. Blue numbers denote wallrocks samples.



FIGURE 36. Spatial variation of stable isotopes and gold values perpendicular to the Antelope fault (4740 level). HW= hangingwall. Blue numbers denote wallrock samples.



FIGURE 37. Spatial variation of stable isotopes and gold values perpendicular to the Pheasant fault (4730 level). Blue numbers denote wallrock samples. HW: hangingwall, Vg: visible gold.



FIGURE 38. Spatial variation of stable isotopes and gold values along a transect in the 4610 level (see Figure 33). Vertical lines are faults. Blue numbers denote wallrock samples. CZ= Contact Zone.

Similar temporal variations in  $\delta^{18}$ O and  $\delta^{13}$ C values are recorded in sample 86 (4650 level, Fig. 39C). This sample is a typical dissolution-collapse breccia produced by decarbonatization reactions (cf. Williams, 1992). The earliest wavy calcite possibly precipitated from meteoric waters interacting with wallrocks, which is supported by the oxygen and carbon isotope data ( $\delta^{18}$ O: 2.9 ‰,  $\delta^{13}$ C : 2.1‰). In contrast, a late calcite vein crosscuts the massive, wavy earlier calcite. It was deposited from a fluid with heavier  $\delta^{18}$ O and lighter  $\delta^{13}$ C signature ( $\delta^{18}$ O: 7.9 ‰,  $\delta^{13}$ C : 0.4‰) relative to the earliest calcite.

Using the fractionation factors compiled by Friedman and O'Neil (1977) for the CaCO<sub>3</sub>-H<sub>2</sub>O pair at a temperature of 100° C, the  $\delta^{18}$ O range for the water in isotopic equilibrium with late-stage calcite veins is 1.3 to -17.6 ‰. This range in  $\delta^{18}$ O values is typical of meteoric water (Taylor, 1997).

In summary, I interpret the oxygen and carbon isotopic data from wall rocks and calcite veins as follows: (1) both  $\delta^{18}$ O and  $\delta^{13}$ C values in the wallrocks correlate fairly well with the degree of decarbonatization thus suggesting that this mechanism was responsible for these spatial isotopic shifts during decarbonatization, (2) the overall shift toward lighter  $\delta^{18}$ O values in the wallrocks is a result of interaction with hydrothermal fluids responsible for gold deposition, (3) the  $\delta^{13}$ C signature of calcite veins suggests that the carbon was derived from the carbonate mineral and organic carbon in the SDrm limestone. The relatively  $\delta^{13}$ C low values in calcite may suggest (a) a strong organic carbon component through time and (b) CO<sub>2</sub> degassing (Zheng, 1990), and (4) the temporal



isotopic values coupled with fluid inclusion studies suggest a shifting interaction between meteoric waters and the host rocks. Thus, meteoric fluids underwent an isotopic exchange with the wallrock decreasing the  $\delta^{18}$ O values for the earlier precipitates. At time progressed, lower water-rock ratios and temperatures took place producing carbonate veins with progressively heavier  $\delta^{18}$ O signatures and lower  $\delta^{13}$ C signatures. Consequently, the temporal shifts in isotopic values of the calcite veins may reflect differences in temperature, fluid composition, and loss of CO<sub>2</sub> (Rye and Ohmoto, 1974; Zheng, 1990).

## **CARBON-OXYGEN ISOTOPIC MODELING**

Quantitative modeling of the carbon-oxygen isotopic data of late-stage calcite veins has been carried out to identify the dominant carbon species involved in their precipitation. For the purpose of comparison, both CO<sub>2</sub> and HCO<sup>-</sup><sub>3</sub> fractionation curves were calculated using the best fitting initial water values ( $\delta^{18}$ O: 2 ‰,  $\delta^{13}$ C: -4 ‰), and then compared to the calcite vein array at Chukar Footwall (Fig. 40), which shows decreasing  $\delta^{13}$ C and increasing  $\delta^{18}$ O values along the calcite array and a decrease in temperature through time.

In this case, the theoretical  $CaCO_3 - HCO_3^-$  fractionation curve approximates the some slope as the calcite vein array, a likely indication that  $HCO_3^-$  was the dominant carbon species in the hydrothermal fluid.

## TABLE 5. δ13C and δ18O VALUES FORCARBONATE WALLROCKS AND VEINSFROM CHUKAR FOOTWALL MINE

(See Fig. 29 for plot of data)

SAMPLE	LEVEL	δ <sup>ιs</sup> C	δ <sup>18</sup> Ο	Au, opt	REMARKS	
14L	4740	-0.8	10.9	0.67	D	
16L	4740	0.2	6.3	0.073	D	
25L	4740	0.4	9.3	0.342	D	
26L	4740	-0.2	9.2	0.226	D	
27L	4740	1.9	9.4	0.221	D	
20L	4/40 4740	0.2	9.0 5 5	0.15	D	
19-20	4740	0.5	8,9	0.000		
19-3C	4740	0.4	8	0.066		
218L	4740	1.2	4.6	0.129	D	
93L	4730	0.3	7.4	0.11	D	
94L	4730	U.3 _0.4	9.8 15 3	0.38	D	
956	4730	-0.7	10.6	0.10	D n	
971	4730	0.8	9.4	0.029	D+VG	
98L	4730	-0.1	14	0.1	D	
100-1L	4730	-0.7	9.3	0	D	
100-2C	4730	-2.1	17.2	0		
100-3C	4730	-2	18.3	0		
137	4/30	-2.0	18.2	0.004	UNALTERED	
53L	4720	1.4	5.7	0.567	D	
57L E91	4720	-1.4	7.2	0.221	UNALTERED	
50L 60C	4720	2.5	-0.6	0.207	U n	
63L	4720	1.4	4.5	0.264	0	
64C	4720	4.4	0.5	0.363	D	
64L	4720	6.3	5.7	0.363	D	
69C	4720	1.3	6.7	0.363	D	
69L	4720	1.8	4.1	0.363	D	
70L	4720 4720	2.5	1.8	0.264	D	
71	4/20	0.1	6	0.249 0.249	U 7	
111-1L	4720	2.2	2.8	0.245	D+ARG	
111-3C	4720	1.4	2.3	0.008	D	
210L	4720	0.6	5.6	0.005	D	
211L	4720	2.2	1	0.021	D	
212L	4720	1	9.5	1.069	D	
213L	4720	-1.4	8.4	0.007	D	
29	4710	-2.2	9 E 1	0.02	UNALTERED	
30-20	4710	0.1	3.1 8 2	0.044	U n	
48L	4710	0	7.6	0.203	D	
48AL	4710	-0.8	7.9	0.203	D	
86-1C	4650	2.1	2.9	0.058	CZ BX	
86-2C	4650	0.4	7.9	0.058	CUTS 86-1C	
86-3L	4650	2.4	6.3	0.058	D+BX	
73-1C	4610	2.1	1.8	0.038	Dp3	
73-20	4610	2.5	1.3	0.038	Dp3	
1300	4010	-0.4	4.1 8.8	0.029		
131-1C	4610	1.4	1.4	0.075		
131-2L	4610	0.9	10.3	0.1	D	
131-3L	4610	2.6	0.8	0.1		
131-4C	4610	1.7	1.1	0.075		
132-1C	4610	0.3	8.1	0.102		
132-20	4010	1 0 3	3.4 8 1	0.102		
134-20	4610	0.2	7.8	0.075		
134-3L	4610	0	10.7	0.029	D	
143L	4610	0.3	11.2	0.098	-	
145C	4610	0.5	-0.4	0.029		
146-4-1C	4610	2.2	1.1	n/a	CZ BX	
146-4-2L	4610	2.4	1.4	n/a	cz	
140-4-3C	4010	۷.۹	1.2	n/a	CZ	
D= altered lin	mestone	•	CZ BX= $Cor$	ntact Zone		
ARG= argilli	zed sam	ıple	(dissolution collapse preccia)			
L= limestone C= calcite vein			VG= visible gold			



Zheng (1990) pointed out that the calcite veins at the Kushikino gold mines (Kyushu, Japan) precipitated under equilibrium conditions with a hydrothermal fluid in which the dominant carbon species was  $HCO_3^-$  under low temperatures ( $\leq 180^\circ$ C) and increasing pH. In this respect, the calcite array at Chukar Footwall may suggest similar characteristics of calcite precipitation. First,  $CO_2$ -bearing fluid inclusions were not detected in late-stage calcite veins because either they are absent or the  $CO_2$  content of the inclusions is very low. Probably, decalcification was nonexistent during the late-stage thus significant amounts of  $CO_2$  were not being released into the system.

### SULFUR ISOTOPE DATA

Sulfur isotope data were obtained on sulfide and sulfate samples from different mine levels. The data are shown in Figure 30B and Table 6. The  $\delta^{34}$ S values from sulfides (pyrite, sphalerite, orpiment+realgar, and stibnite) range from – 8.5 ‰ (pyrite) to 10.1 ‰ (pyrite), whereas the  $\delta^{34}$ S values from barite range from 18.1 ‰ to 30.2 ‰.

#### SULFIDES

The  $\delta^{34}$ S clustering for sulfides observed in Figure 30B may suggest a common origin for the sulfur in these samples. For example, one sample of lateore orpiment and realgar (sample 4580As) has similar  $\delta^{34}$ S values for both minerals. Similarly, the values  $\delta^{34}$ S (1.2 ‰for syn-ore sphalerite and pyrite from

sample CFU 199-118 are 9.2‰ and 8.0 ‰, respectively. Another observation that can be made regarding this narrow range of  $\delta^{34}$ S values in these sulfide minerals is that H<sub>2</sub>S in the fluid was highly fractionated by sulfide precipitation. Thus, according to Ohmoto (1986) during isotopic equilibrium the amount of H<sub>2</sub>S must exceed the amount of metals (Pb, Zn, Cu, Fe) in the fluid, and the precipitation of these phases was controlled by the original metal content of the ore fluid.

The textural relationships between sphalerite and pyrite from sample CFU-199, suggest they were precipitated under equilibrium conditions; however the calculated isotopic equilibrium temperature using the pyrite-sphalerite fractionation factors ( $\Delta$  <sup>34</sup>S<sub>py-sph</sub> values (1.2 ‰) of Ohmoto and Rye (1979) yielded a temperature of 360° C. This temperature greatly exceeds microthermometric data obtained in this study and those of other Carlin-type deposits (Hofstra and Cline, 2000).

Low positive to negative  $\delta^{34}$ S values are also present in post-ore stibnite (4.5 ‰, sample 203) and pyrite (-8.5 ‰, sample 111-2). Thus, sulfide mineral precipitation proceeded under non-equilibrium conditions.

## SULFATES

The  $\delta^{34}$  S values of late-stage barite range from 18.1 ‰ to 30.2 ‰. The heavier and the lighter samples come from veins of the 4500 and 4730 level, respectively. There is a spatial correlation among isotopic values, depth, and

presence of visible gold; gold has only been found in the upper mine levels (Population A, Fig. 30A).

On the basis of their  $\delta^{34}$ S and  $\delta^{18}$ O values, two populations of late-stage barite are recognized. Population A represents samples from the shallower mine levels, and visible gold is present in all the analyzed barites. The  $\delta^{34}$ S and  $\delta^{18}$ O values range from 18.1 to 29.1 ‰ and from -0.5 to 4.1 ‰, respectively. In contrast, barites from population B were collected from deeper levels and visible gold was not detected. Relative to population A, B samples show heavier  $\delta^{34}$ S and  $\delta^{18}$ O signatures with  $\delta^{34}$ S values that range from 28.1 to 30.2 ‰ and  $\delta^{18}$ O values ranging from 11.3 to 14.6 ‰. Anomalously, one sample from the shallow levels with visible gold plots within this population. These isotopic differences in both populations may have been derived by either fluctuations during fluid mixing of two or more fluids or the involvement of several sulfate sources.

Using the fractionation factors compiled by Friedman and O'Neil (1977) for the BaSO<sub>4</sub>-H<sub>2</sub>O pair at a temperature of 200<sup>O</sup> C, the  $\delta^{18}$ O range for the water in isotopic equilibrium with late-stage barite veins is 8 to -7.1 ‰. This range in  $\delta^{18}$ O values is indicative of formation waters (Taylor, 1997), suggesting mixing conditions either between meteoric waters and the wallrocks, or between two contrasting fluids.

## TABLE 6. $\delta^{34}$ S and $\delta^{18}$ O VALUES FOR SULFIDES AND SULFATES FROM CHUKAR FOOTWALL DEPOSIT (See Fig. 30 for plot of data)

SAMPLE	LEVEL	õ <sup>34</sup> S	ō <sup>18</sup> O	REMARKS
4580As	4600	7.3		Realgar
4580As	4600	7		Orpiment
111-2	4720	-8.8		Pyrite-III
203	4720	4.5		Stibnite from Magpie fault
99	4730	10.1		Sulfide vein on Fig. 48
CFU-199@118'		8		Brassy pyrite
CFU-199@118'		9.2		Sphalerite
98	4730	29.2	4.1	Barite-II
98	4730	30.1	14.6	Barite-II with visible gold
99	4730	18.1	2.3	Barite-II with visible gold
CFU-199@118'		28.5	11.3	Barite-I
CFU-58@146'		26.7	-0.5	Barite-II with visible gold
CFU-141@142'		28.1	13.7	Barite-II veinlet
4500	4500	30.2	14.3	Barite-II veinlet

## SOURCE OF SULFUR

Sulfur from sulfides and sulfates can basically be derived from several sources: (1) a magmatic source, (2) an organic source, (3) a sedimentary source/sulfate reservoir, and (4) any combination of the above (cf. Ohmoto, 1986). Due to the low number of sulfur analyses for this study (n= 7), the following suggestions are primarily based on published data on Carlin-type deposits in Nevada.

The  $\delta^{34}$ S mean from sulfides from Chukar Footwall is about 5.4 ‰, which may suggest a significant contribution from a sedimentary source. Thus, the hydrothermal fluid may have obtained the H<sub>2</sub>S from the host rocks or by the dissolution of early magmatic sulfides. Finally, the strong negative  $\delta^{34}$ S value of a pyrite vein (sample 111-2), interpreted as a late-stage product, could be explained by the generation of some sulfur species during the final stages of mineralization (Hofstra and Cline, 2000).

The high  $\delta^{34}$ S values from barites, with a mean around 27.3 ‰, argue that the sulfate was not derived from the oxidation of sulfides (Ohmoto, 1986). Regional data from sulfates by Arehart (1998) and from this study point toward a sulfate reservoir (sedex barite) as a main source for the H<sub>2</sub>S in the sulfate. In the surrounding area, beds and veins of barite are hosted in several formations from both the upper and lower plates (Papke, 1984) that appear to be the most likely source. Hence, barites from Chukar Footwall deposit show  $\delta^{34}$ S values similar to Paleozoic barites in north-central Nevada (Rye et al., 1978; Radtke et al, 1980; Arehart, 1998).

## **GOLD GRADES VERSUS ISOTOPIC COMPOSITIONS**

Plots of Au vs.  $\delta^{13}$ C and  $\delta^{18}$ O (Fig. 41) show no spatial correlation between the metal and the stable isotopic signature of the host rocks. Previous work on Carlin-type deposits has suggested that the lack of correlation may be due to the intrinsic characteristics of the fluids (Hutcherson, 2002), and Au precipitation and C isotopic fractionation are governed by different and independent mechanisms (Hofstra and Cline, 2000).

Assuming that gold precipitation and isotopic fractionation are, indeed, contemporaneous processes, the above characteristics may suggest that during gold deposition, possibly due to mixing or involvement of two or more isotopically unique fluids, the non-equilibrium precipitation of sulfides and lack of gold correlation with wallrock and calcite veinlet isotopic ratios suggests they operated independently at slightly different times. Furthermore, the final isotopic signature generated by the combination of multiple ore fluids can also be influenced by later hydrothermal fluids or any other geological mechanisms able to produce an isotopic resetting. Obviously, if the host rocks underwent later events (i.e., latestage argiilization, interaction with ground waters), there would be a lack of linear correlation between gold and stable isotope ratios.



FIGURE 41. Plots of gold grades vs. $\delta^{18}$ O and  $\delta^{13}$ C of selected mine levels at Chukar Footwall. The number next to the plot indicates the mine level. Au values in opt.

## **10. FLUID INCLUSION MICROTHERMOMETRY**

Microthermometric data from both late-stage calcite and barite veins at Chukar Footwall are summarized in Table 7 and Figure 43. Although numerous fluid inclusions were observed both in quartz and carbonates of earlier stage(s), their sizes were too small for microthermometric analyses. Therefore, only primary or pseudo-secondary fluid inclusions observed in late-stage veins (barite, calcite, and barite±gold) were used to obtain the minimum homogenization temperatures ( $T_h$ ) and final melting temperature of ice ( $T_m$ ). Simultaneously, salinities were calculated from  $T_m$  as wt % NaCl equiv. Raman spectrographic analyses have not been carried out during this study.

Most of the fluid inclusions from these late-stage veins at room temperature are liquid+vapor types with varied L:V ratios due to the numerous sizes and geometrical shapes of the inclusions (Fig. 42). A small proportion of one phase (H<sub>2</sub>O?), empty looking fluid inclusions were also observed in barite, probably the result of necking. The sizes of the fluid inclusions were in the range of 5 to 20 $\mu$ . In general, fluid inclusions from late-stage barite veins are elongate to oval-shape defining planar trends and clusters in contrast to the equant to tabular shape, isolated inclusions of the late-stage calcite veinlets. In all fluid inclusions no daughter minerals were observed nor was CO<sub>2</sub> detected.



FIGURE 42. Fluid inclusions are found in both late-stage barite and calcite. Primary inclusions contain liquid and vapor. (A) Mean homogenization temperatures and salinities of fluid inclusions from Ba-II are 180.2°C and <1.1 wt % NaCl equiv, respectively. Visible gold coprecipitated with Ba-II (4730 level). (B) Fluid inclusions from Ba-II (4400 level). They homogenized to a liquid phase at an average temperature of 190°C, with salinities up to 3.2 wt % NaCl equiv. (C) Fluid inclusions from a late-stage calcite vein (CZ). This sample (CZ-3) yielded a homogenization temperature of 92.3°C and salinities around 0.7 wt % NaCl equiv. FOV: 0.500 mm.



FIGURE 43. Salinity-Th diagram for fluid inclusions data in late-stage barite and calcite from Chukar Footwall.  $\Box = 4730$ -BARITE,  $\blacksquare = 4500$ -BARITE,  $\bullet = 4400$ -BARITE, \* =CFU141-BARITE, X = CFU143-BARITE, + = CZ-CALCITE,  $\bigcirc = 4730$ CALCITE.

### FLUID INCLUSION DATA FROM LATE-STAGE BARITE±GOLD VEINS

Fluid inclusion microthermometric data from late-stage barite veinlets were obtained from cleaved barite crystals from samples collected in the 4730, 4400, and 4500 levels. Additionally, fluid inclusion analyses from selected core intervals, CFU-141 and CFU-143, were conducted to document if significant differences of  $T_h$  and salinities are present in the deposit (Fig. 43).

Two fluid inclusion types have been recognized (Kuehn, 1989; Kuehn and Rose, 1995): type 1C are one-phase (H<sub>2</sub>O?), empty looking, high relief fluid inclusions. This unusual type occurs as isolated fluid inclusions, far from cleavages or fracture planes suggesting that they are primary. During freezing runs, type 1C inclusions usually nucleated a bubble allowing us to interpret with confidence that the entrapped phase is liquid H<sub>2</sub>O (Roedder, 1984; Kuehn, 1989). In contrast, type 2D fluid inclusions are two-phases generally distributed along trails on cleavage planes, fractures, and in isolated clusters. Thus, 2D inclusions are considered here both primary and pseudosecondary. During microthermometric runs, neither CO<sub>2</sub> nor clathrates were observed in type 2D inclusions.

From Figure 43, it appears that significant variations among fluid inclusions exist in terms of their salinities and  $T_h$ . Mean salinities and mean  $T_h$ from the deeper levels (4400 and 4500 levels) range from 3.03 to 3.18 wt % NaCl equiv and between 183.1° and 179.3° C, respectively. However, mean salinities and  $T_h$  from the 4730 level is around 1.16 wt % NaCl equiv and 177.3° C,

respectively. Additional microthermometric data from cores (CFU-141@142' and CFU 143@447') exhibit mixed mean salinities and mean  $T_h$  values that range from 3.0 to 2.3 18 wt % NaCl equiv and between 142.2° and 172.3° C, respectively.

## FLUID INCLUSION DATA FROM LATE-STAGE CALCITE VEINS

Fluid inclusion microthermometric data from late-stage calcite veins were obtained from the CZ along the Tracker decline, and from both 4400 and 4730 levels. The paucity of data is due to the scarcity of inclusions and problems with decrepitation during the heating runs.

Only isolated 2D type fluid inclusions were observed. Inclusions are oval to trapezoidal. Mean salinities and mean  $T_h$  values range from 0.55 to 0.70 wt percent NaCl equiv and between 87.6° to 117.0° C, respectively. Finally, no CO<sub>2</sub> or CH<sub>4</sub> were observed during the analyses.

## DISCUSSION OF THE MICROTHERMOMETRIC DATA

Abundant fluid inclusion microthermometric data from the Carlin trend are now available to present a brief synthesis: Kuehn and Rose (1995) modeled the evolution of the hydrothermal system based on fluid characteristics from the Carlin mine during the main and late gold stage from quartz, calcite, and barite veins. During the main gold stage, the hydrothermal fluids were gas rich (CO<sub>2</sub> and H<sub>2</sub>S), with salinities around 3 % NaCl equiv. Throttling conditions were

## TABLE 7. FLUID INCLUSION DATA FROM LATE-STAGE BARITE AND CALCITE VEINS FROM CHUKAR FOOTWALL DEPOSIT (See Fig. 43 for plot of data)

Sample	Т,(°С)	wt % NaCi equiv.		
4730-1	74.8	1.6		
4730-2	134.6	1.2		
4730-3	170.6	1		
4730-4	173.5	0.7		
4730-5	181.6	0.9		
4730-6	186.6	1		
4730-7	203.3	1.4		
4730-8	211.5	1.7		
4730-9	241.6	0.9		
4730-10	125.2	n/a		
4730-11	137.2	n/a		
4730-12	161.3	n/a		
4730-13	241.6	n/a		
4730-14	223	n/a		
4730-15	191.6	n/a		
4730-16	178.6	n/a		
4400-1	164.3	3.8		
4400-2	198.8	4.2		
4400-3	204	3.5		
4400-4	205.2	1		
4400-5	212.9	3.4		
4400-6	154.4	n/a		
4400-7	168.6	n/a		
4400-8	181.7	n/a		
4400-9	208.5	n/a		
4400-10	166.1	n/a		
4400-11	176.9	n/a		
4400-12	140.4	n/a		
4400-13	198.8	n/a		
4400-14	164.3	n/a		
4400-15	196.9	n/a		
4400-16	158.3	n/a		
4400-17	170.5	n/a		
4400-18	204	n/a		
4400-19	140.4	n/a		
4500-1	152	3.2		
4500-2	207.9	2.7		
4500-3	218	3.2		
4500-4	170.7	n/a		
4500-5	167.1	n/a		
CFU 143	118.2	3.2		
CFU 143	118.5	3.2		
CFU 143	118.3	3.4		
CFU 143	118	3.4		
CFU 143	157.8	1.2		
CFU 143	192	3.4		
CFU 143	197.7	n/a		
CFU 143	130.1	n/a		
CFU 143	129.3	n/a		
CFU-141	157.8	1.2		1
CFU-141	157.8	1.1		
CFU-141	192.3	3.3		
CFU-141	192	3.4		
CFU-141	119.5	n/a		
CFU-141	215	n/a		
CFU-141	128.7	n/a		
CFU-141	215	n/a		
4730-1	74.8	0.7		
4730-2	77.6	0.4		
4730-3	77.6	0.3		
4730-4	94	n/a		
4730-5	117.8	0.7		
4730-6	127.7	0.5		
4730-7	130.9	1.4		
4730-8	141.5	1.1		
4730-9	145.5	0.5		
CZ-164-1	74.2	0.4	Cuts the CZ	(Fig. 16)
CZ-164-2	74.2	0.4	Cuts the CZ	(Fig. 16)
CZ-164-3	92.3	0.7	Cuts the CZ	(Fig. 16)
CZ-164-4	92.3	0.7	Cuts the CZ	(Fig. 16)
CZ-164-5	115.4	0.4	Cuts the CZ	(Fig. 16)
CZ-164-6	154.2	n/a	Cuts the CZ	(Fig. 16)
CZ-164-7	161.6	0.7	Cuts the CZ	(Fig. 16)
CZ-164-8	172	n/a		
CZ-164-9	116.6	n/a		
4400-1	80.7	n/a		
4400-2	84.1	n/a		
4400-3	90.1	n/a		
4400-4	95.6	n/a		

responsible for gold mineralization. On the contrary, the hydrothermal fluids during the late stage were gas poor, and with low salinities (~1.5 % NaCl equiv). The P-T conditions were estimated by the authors assuming lithostatic conditions at  $215^{\circ}\pm30^{\circ}$  C and  $800\pm400$  bars for the main gold stage, and a temperature range between  $175^{\circ}$  and  $250^{\circ}$  C during the late gold stage.

In a similar study, fluid inclusions from multistage barite, calcite, and quartz veins at Gold Quarry were studied by Sha (1993), who recognized and modeled four distinct fluids during the hydrothermal event responsible for the gold and base metal mineralization. The fluid evolution at Gold Quarry began with a low salinity and moderate temperature fluid rich in CO<sub>2</sub>. Through the main stage, CO<sub>2</sub> is still the main component during the mixing of meteoric fluids with connate fluids. Finally, a fluid with low salinity, low temperature, and CO<sub>2</sub> deficient represents the last episode of a collapsing hydrothermal system. Gold and base metals mineralization, according to Sha (1993), are associated with decalcification and fluid mixing during the early and main stages, respectively. Fluid mixing during the late stage produced a further cooling and oxidation of the fluid. The P-T conditions during the later hydrothermal stages were modeled by Sha (1993) at 230±20°C and 870±220 bars (early stage), 200±50°C and 850±300 bars (main stage), and 160±20°C and 100±50 bars (last stage).

In the same way, Lamb (1995) documented and compared fluid characteristics from the Meikle and Post/Betze deposits. Major features of this study are as follow: three hydrothermal stages are defined in both orebodies, starting with an early stage with salinities up to 20 wt % NaCl equiv. This was followed with a gold stage with lower salinities,  $\leq 10$  wt % NaCl equiv, and T<sub>h</sub> modes between 200° to 225 °C (Meikle, Purple Vein) and 150° to 210°C (Post/Betze). A late ore stage is represented by low P-T phases typical of supergene oxidation. Both deposits formed from H<sub>2</sub>O-CO<sub>2</sub> fluids, causing gold precipitation at interpreted depths of about 3 kilometers.

In contrast, Groff et al. (2002) conducted fluid inclusions analyses from late-stage phases at the Betze and Carlin mines. Homogenization data from paragenetically late orpiment±calcite range from  $108^{\circ}$  to  $182^{\circ}$  C, with relatively moderate salinities in the range from 1.7 to 5.4 wt % NaCl equiv. This suite is followed paragenetically by a realgar±barite association with significant differences in both T<sub>h</sub> and salinities relative to the latter suite. Low salinity fluids, 1.1 to 2.9 wt % NaCl equiv, are characterized with a T<sub>h</sub> between 110° to 300° C implying mixing conditions. In addition, one of the more important results from this work is the evidence that reequilibration of fluid inclusions in the realgar±barite veins is due to geological and analytical factors that lead to overestimated the T<sub>h</sub> temperatures (Groff et al., 2002).

As stated earlier, fluid inclusion microthermometric studies have been undertaken on late-stage barite and calcite veins to contrast both the hydrothermal fluid temperatures and salinities throughout mine levels and to provide further information on the late-stage barite±gold mineralization. Thus, the P-T-X conditions during late-stage veining at Chukar Footwall can be constrained through the data generated during this study and by comparison of this deposit

to the deposits briefly described above, revealing some similarities in terms of fluid evolution during the late-stage veining.

Most of the primary and pseudosecondary fluid inclusion data in barite and calcite yield two main field ranges of salinities and temperatures (Fig. 43): a relatively moderate temperature, low salinity group represented by barite veins from the deeper levels (e.g., 4400, 4500, and core holes CFU-141@ 142' and CFU-143@447') in contrast of a lower temperature, lower salinity group of both barite and calcite veins from shallower levels (e.g., 4730 and CZ). Such representation in the salinity- $T_{\rm h}$  diagram could be interpreted in terms of cooling and mixing conditions. Hence cooling in both groups is interpreted as a decrease in temperature of the hydrothermal fluid through time or with decreasing depth, triggering the precipitation of paragenetically late sulfides (pyrite± marcasite±bournonite?) and quartz as observed petrographically in the late-stage veins. Conversely, the differences between both groups' salinities could be explained by mixing phenomena whereupon cold, oxidizing meteoric waters migrated downward along active NW-trending structure networks during Tertiary times interacting with the host rocks and/or with hotter, more saline fluids. Therefore, mixing could explain these salinity and temperature differences between groups and the late-stage barite±gold±sulfides mineralization in the upper levels of the Chukar Footwall deposit. Barite and gold solubilities could have been affected by a decrease in salinity and increasing oxidizing conditions, respectively, due to the mixing conditions that were operating in the shallower mine levels (Sha,

1993; Arehart, 1996; Rimstidt, 1997). In addition, the presence of marcasite in the veins argues for a fairly acidic environment with the later barite+gold precipitation.

Compared with some other Carlin-type orebodies, such as the nearest Carlin or Gold Quarry deposits, the Chukar Footwall deposits shows a relatively similar fluid evolution during the late-stage hydrothermal event. Fluid composition seems to be  $H_2O$ -dominant with low salinities (0.4 to 4.2 wt % NaCl equiv). This coupled with the absence of  $CO_2$  in the fluid inclusions and petrography suggest (1) the involvement of meteoric waters, (2) the lack of both decalcification and supergene weathering, and (3) the formation of contemporaneous calcite veins by fluid mixing. With regard to the depth of formation, given the brecciated and open-space fillings nature of the veins, the absence of gas-rich inclusions, and the lack of a supergene mineralogy (e.g., jarosite, goethite, or alunite) a shallow depth of about 1 km is suggested when constrained with data from Sha (1993), Groff et al. (2002) and Cline et al. (2005). Finally, the age of these veins may be constrained between the disemminated gold mineralization and the deposition of the Carlin Formation due to the presence of abundant stibnite in the Tertiary sediments (Rota, 1989).

In summary, the late-stage calcite and barite+gold veins record relatively low temperatures, and low salinities due to cooling and mixing of at least two different fluids. The H<sub>2</sub>O rich-fluid was controlled by active NW-trending structures during late Tertiary extension. Likewise, extension may also have allowed the upward migration of hotter, more saline fluids from the deeper structural levels which may have produced a continuous and gradual record of
P-T-X conditions during mixing.

## **11. OREBODY FEATURES**

The Chukar Footwall mine is currently mined by longhole-stope and cutand-fill methods. It has produced about 146,000 ounces of gold with an average grade of 0.288 opt Au from unoxidized ore since underground operations began in 1996 (Joe Sagar, written communication, 2005).

The deposit consists of irregular stratabound orebodies within the SDrm units with a strong structural control. Figure 44 shows trace element concentrations with gold grades along a geochemical transect across the NNE-striking Magpie fault at the 4740 level, and the geochemical dispersion of elements near the Pheasant fault (4730 level) . Decreases in Au, As, Fe, and Sb away from the fault clearly reinforce that the Magpie fault acted as a feeder structure, channeling the hydrothermal fluids toward the anticline east limb. However, data from a geochemical transect from the CZ, a zone with dissolution-collapse breccias and low angle ENE- striking structures, revealed erratic, low gold values compared to those adjacent to the Magpie fault; thus, this structure, and possibly all ENE-striking ones, may be considered as barren structures. In addition to this structural control, a gradethickness map generated by Newmont (2004) (Fig. 45) demonstrates that (1) gold orebodies form two main sub-parallel trends running approximately NNE, one along the southeast limb of the Chukar anticline and one parallel to the Magpie fault; and (2) brittle deformation (e.g., NNE-striking structures and joints and shear fractures) played an important role in focusing ore fluids toward the Chukar anticline hinge and limbs, resulting in the formation of economic orebodies. A regional comparison on structural control of the Chukar Footwall with other deposits in the Carlin trend suggests late Eocene to Oligocene wrench tectonics, which accommodated extension at both local and regional scales, produced large-scale fractures with dilatant zones that led to the channeling and ultimately the deposition of gold and other metals (Cole, 1995; Tosdal and Nutt, 1999).

High grade gold mineralization at Chukar Footwall mine correlates well with strong decarbonatization and relatively high sulfide content (up to 3 vol. percent sulfides; Joe Sagar, personal communication, 2004). Silicification and dolomitization do not appear to be controls on gold grades. Another metallogenic characteristic of Chukar Footwall is that gold mineralization is hosted in both limestone and calc-silicate hornfels (exoskarn), reinforcing the concept pointed out by Thompson (2000) that carbonate lithologies are not the exclusive hosts for gold mineralization on the Carlin trend (Fig. 46). Geochemically, the economic gold orebody at Chukar Footwall exhibits anomalous concentrations, relative to unmineralized fresh rocks, of As, Fe, and Sb, with As and Fe as excellent pathfinders.

#### 4720 LEVEL



Au: 0.005 opt, As: 66.47 ppm, Fe: 15401 ppm, Sb: 23.38 ppm, Ba: 785.8 ppm, Zn: 255.4 ppm
 Au: 0.021 opt, As: 141.0 ppm, Fe: 3901 ppm, Sb: 12.46 ppm, Ba: 2018 ppm, Zn: 258.1 ppm
 Au: 1.069 opt, As: 5527 ppm, Fe: 35692 ppm, Sb: 431 ppm, Ba: 379.5 ppm, Zn: 177.5 ppm
 Au: 0.007 opt, As: 80.29 ppm, Fe: 12487 ppm, Sb: 16.05 ppm, Ba: 92.58 ppm, Zn: 519.0 ppm
 4730 LEVEL



FIGURE 44. The Magpie fault-vein (4720 level), a NNE-striking fault, served as a pathway for ore fluids with As, Au, Fe, and Sb values decreasing away from the structure. Late, euhedral to subhedral stibnite and barite were deposite in open spaces within the fault breccia (4720 level). Decarbonatization and silicification are code as weak (dec1, si1) or strong (dec3,si3). Geochemical dispersion of elements near the Pheasant fault (4730 level), a NW-striking structure. Descending fluids circulated into the fault and fractures produced a lateral zonation of elements due to small scale remobilization, and allowing coprecipitation of abundant, visible gold with barite.



FIGURE 45. Grade thickness map of the Chukar Footwall mine. Approximate trace of the structures at the 4650 ft. elevation. Gold orebodies form two main sub-parallel linear trends: (1) the Chukar anticline trend and (2) the Magpie trend. The spatial distribution of gold orebodies relative to NE-striking faults and the east limb of the anticline shows a strong structural control on the Chukar Footwall deposit (Contour map from Newmont, 2004).



FIGURE 46. Core logs from drill-holes QRC-144 (west limb) and QRC-1636 (east limb) showing ore grades and associated hydrothermal alteration. Note high grade mineralization hosted in calc-silicate hornfels in hole QRC-144, a good example that carbonate rocks are not the exclusive host-rocks for hosting Carlin-type orebodies (Core log data from Newmont, 2004).

# 12. THE METALLOGENIC EVOLUTION OF THE CHUKAR FOOTWALL DEPOSIT

Notwithstanding uncertainties reflected by both the lack of isotopic and fluid inclusion data from ore stage minerals and the geological data from the new, deeper mine levels, the body of data presented in this work allows some interpretations on the deposit's geological (Table 8) and metallogenic evolution as a proposal for a genetic model for the Chukar Footwall deposit. Figure 47 is a conceptual sketch showing the metallogenic model of the Chukar Footwall deposit.

Thick Paleozoic packages of shallow-to-deep water carbonates and siliciclastic rocks in the Tuscarora Mountains area were deformed during the Antler orogeny and intruded by several stocks and myriad of mafic dikes since Early Jurassic (cf. Evans, 1980). At Chukar Footwall, the host units (SDrm and Dp<sub>3</sub> packages (although the Dp<sub>3</sub> does not host economic mineralization) were folded into a northeast-trending anticline (D<sub>1</sub>) during the Antler event or late Paleozoic orogenesis. Metasomatic metamorphism developed in the deeper mine levels and gave rise to diopside hornfels. This aureole could be linked to a blind Early Jurassic plutonic intrusion, which may lie buried toward the southwest of the Chukar Footwall deposit. At about 200 Ma lamprophyre dikes were emplaced along NNW-trending structures. Although the Raven dike is not a feeder structure, it is mineralized on some mine levels.

### TABLE 8. TEMPORAL DIAGRAM OF THE TIMING OF GEOLOGICAL EVENTS AT CHUKAR FOOTWALL MINE AND SURROUNDINGS

TIME	EVENT	REMARKS
Antler/late Paleozoic /Sonoma orogenies	Chukar anticline (D1)	Trexter et al. (2004)
	NE-striking faults	Carbonates+clay+qtz+ barite±Sb
	NW-striking faults	Unhealed structures Intruded by Jurassic dikes Barite± visible gold
~200 Ma Early Jurassic	Plutonic intrusion Metamorphic aureole Raven dike	Blind, deep seated pluton(s) Pyroxene hornfels. QSP altered.
	Contact Zone	Dissolution-collapse breccias
40.9±4.0 Ma	Mineralization at Carlin East mine	Chakurian et al. (2003)
~ 37 Ma	Welches Canyon stock	Emplaced at shallow depths.Weak metamorphic aureole
~27 Ma	Alunite ( late ore event) at Gold Quarry	Heitt (1992)
26.2±5.5 Ma	Initial cooling began at Chukar Footwall	AFT modeling data from the Raven dike (Fig. 13)
~20 Ma	Reactivation of structures due to Basin and Range extension	Muntean et al. (2001)
17.7±3.7 Ma	Latest thermal event at Chukar Footwall	AFT pooled age data from Raven dike
~15-14 Ma	Stibnite occurrence in the Carlin Fm. at Gold Quarry	Rota (1989)

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Sometime between the intrusion of the Raven dike and the gold mineralization, a noteworthy pre-ore collapse breccia body formed during an early decarbonatization episode from metals-barren hydrothermal fluids as inferred from their geochemical signature. Combined  $\delta^{16}$ O and  $\delta^{13}$ C data and fluid inclusion microthermometric studies from these breccias suggest a significant component of meteoric waters. Further, the development of this breccia mass led to the formation of a structural and stratigraphic cap that may have prevented further upward migration of ore fluids into the overlaying Dp<sub>3</sub> unit.

Ore and late-ore forming events are spatially and temporally related to Eocene-Miocene hydrothermal systems that led to the formation of the Chukar Footwall orebodies, among other Carlin-type deposits, suggesting a relatively protracted period of hydrothermal activity and ore forming processes. However, it is not known if the micron-size gold, during the ore stage, was introduced in a single or multistage event. In such a scenario, the presence of visible, late-ore gold in the highest mine levels may imply that the ore-stage gold could have been remobilized by oxidized, circulating meteoric fluids along open NNWtrending structures and subsequent precipitation probably controlled by temperature, of visible gold with sulfates, carbonates, and sulfides at a redox boundary. The age of this mineralization event may possibly be loosely constrained as being Miocene, based on paragenetic similarities with other Carlin-type deposits (e.g., Chakurian et al., 2003; Emsbo and Hofstra, 2003), and in terms of the reactivation effects of older structures during the Miocene extension, although this extensional regime seems to be minor at Chukar

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Footwall relatively to other areas of higher extensional rates in north-central Nevada.

The Chukar Footwall orebodies show many similarities to those along the Carlin trend and Jerritt Canyon district. These features include host-rock, mineral assemblages, and structural controls of the (a) hydrothermal alteration, (b) geochemical and isotopic signatures, and (c) mineralization. Significant differences at Chukar Footwall are (a) the paucity of As-bearing minerals, and (b) presence of abundant, visible gold.

Major and minor high angle northeast-trending structures were responsible for the upward migration of hydrothermal fluids during the ore stage that, together with other factors such as degree of hydrothermal alteration and fracture density of the SDrm units, control the location of the orebodies. Furthermore, the structural intersection between the later system and the Chukar anticline produced small-sized structural traps for upwelling ore fluids that defined a sub-parallel trend along the anticline axial surface. Finally, AFT age data from the altered Raven dike could suggest the age of the latest thermal event at about Early-Middle Miocene.

With regard to the youngest fault system, the high angle northwesttrending structures, a complex reactivation history is recorded by localized fault breccias and superimposed slickensides. Apparently, during Miocene extension,

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FIGURE 47. Schematic geologic cross section showing the metallogenic evolution of the Chukar Footwall orebody. It is possible to visualize a continuous evolution of the Gold Quarry hydrothermal system during Tertiary times. The common link among the gold systems at Gold Quarry are their relation to NE-striking structures and decarbonatization events. As a whole, the different mineralization styles present in Gold Quarry might be indicative of a continuum in ore forming processes related in space to the Deep Sulfide Feeder and Chukar Footwall faults. Tentatively, the Magpie fault is interpreted to be a splay off the nearby Chukar Gulch fault with its apparent structural control on orebodies at Chukar Footwall. The presence of late barite and visible gold in Chukar Footwall suggest precipitation under cool, low salinity, oxidizing conditions near the surface ( Section from Bulletin 111, Gold Deposits in the Cartin Trend, Plate 3). these structures were open to allow downward penetration of meteoric fluids that interacted with the SDrm units, allowing small scale metal remobilization (Fig 47). Thus, mineral precipitation along northwestern systems took place via cooling or fluid mixing processes at relatively low temperatures (< 200° C). Although this structural system may be regarded as a secondary ore-grade/control at mine scale, geological data reveals that these structures were also responsible for chanelizing ore-fluids due to the spatial relationship among structures, wall-rock alteration, and ore-grade distribution as observed, for example, in the 4770 level (Sagehen and Antelope faults) and the structural intersection between the Crown fault and northeast-trending structures near the Trucker Exploration drift. In this context, it is worth noting that (a) The possibility to envisage either a synmineralization event during Miocene extensional regime or (2) Most likely the Chukar Footwall mineralization could be linked to a huge, long-lived hydrothermal system(s) developed during the Eocene-Miocene throughout northcentral Nevada wherein ore fluids upwelled along NE and NW-striking faults and interacted with meteoric fluids, and (3) These structures should be evaluated during mine exploration.

Finally, the metallogenetic evolution of the Chukar Footwall deposit has to be understood in terms of both local and regional geological settings. Ore (main stage) and post-ore paragenesis were modeled for the Betze deposits by Woitsekhowskaya and Peters (1998). According to this model-derived mineral assemblage, the paragenetic sequence of Carlin-type deposits in Nevada could be explained in terms of cooling, mixing, pH fluctuations and mineral solubilities

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when hydrothermal fluids interact with the carbonate host rocks. Briefly, changes from acid to more alkaline fluid conditions due to decarbonatization reactions would trigger both silica and gold precipitation. Gold deposition is envisaged as a sulfidation process thus consuming the available Fe to form As-pyrite and -marcasite followed by As (orpiment and realgar) and Sb (stibnite) sulfides. The observed mineral assemblage and hydrothermal alteration patterns at Chukar Footwall are comparable and allow extension of the geochemical model for the Betze deposit. Furthermore, mineralogical and geochemical studies could suggest that iron for sulfidation was ultimately derived from hydrothermal ferroan dolomite, although other sources for iron from nearby igneous and skarn bodies could be expected. One final point worthy of note is the significant paucity of As minerals relative to other deposits suggesting that the H<sub>2</sub>S was almost used up by earlier sulfides.

A key factor in the formation and localization of the Chukar Footwall deposit is its spatial association, regardless of age or type of mineralization, within the Gold Quarry gold systems (Main Quarry, Deep West, and Deep Sulfide Feeder, Fig. 47). The distribution of these gold systems shows a clear pattern consisting of successive NE-trending mineralized zones mainly between the Chukar Gulch fault and the Deep Sulfide Feeder fault. Early fluids were focused along these NE-striking structures and reactive rock packages, producing major collapse breccia bodies due to decarbonatization and gold and base metals deposition (Williams, 1992; Sha, 1993; Cole, 1995). As the Gold Quarry hydrothermal system evolved through time, later ore fluids encountered

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the Deep Sulfide Feeder breccia zone that acted as a cap thus deflecting the upwelling fluids toward the footwall section of the Chukar Gulch fault and the hangingwall portions of the Magpie, Les, and Barstow faults. Later extension resulted in the activation of NW-striking structures and the downward movement of meteoric fluids that probably scavenged metals from the surrounding rocks. Fluid inclusion data suggest fluid mixing between two contrasting fluids that shifted the redox boundary producing the deposition of late-stage visible gold that is intergrown with sulfates and carbonates during the waning stages of the Gold Quarry hydrothermal system.

### **13. CONCLUSIONS**

The major conclusions and results drawn from this study are:

- The main host rocks at Chukar Footwall mine are the variable hydrothermally altered silty limestone of the Roberts Mountains Formation and calc-silicates (pyroxene hornfels). However, the micrites of the Popovich Formation and the Raven dike may host economic gold mineralization.
- 2. The dominant fault sets are NE and NNW-striking high angle structures forming a conjugate system with an angular separation of 85°. A small number of kinematic indicators from these systems reveal predominant right oblique normal slip and minor normal and strike-slip movements developed in a homogenous kinematic domain for the entire deposit. Fault reactivation, linked with late Tertiary extension, is relatively common in both systems producing openings and brecciation along the NNW structures that channalized fluids responsible for a late-ore mineralization event characterized by sulfides, barite, and visible gold.
- Steeply dipping dikes intruded along NNW-striking structures, produced a weak thermal alteration within the surrounding rocks. Their age is constrained at 200±5.1 Ma by U-Pb dating on zircon.
- 4. In the deeper mine levels, calc-silicate rocks are represented by hornblende hornfels affecting both the SDrm and Dp units. The presence of diopside suggests a peak temperature range between 400-600 °C.

- The geochemical signatures are characterized by typical Carlin-type deposits pathfinders. Gold correlates well with Cu, Hg, Tl, As, and Zn. Another elemental suite of elements is represented by the association of As, Sb, Te, and Tl.
- 6. Decalcification reactions in the host rocks, which are spatially related and controlled with major and minor structures, was the leading mechanism for both the  $\delta^{13}$ C and  $\delta^{18}$ O isotopic shifts observed along perpendicular transects on major structures. Hence, depleted  $\delta^{18}$ O values occur near the structure where decalcification is stronger while relatively enriched  $\delta^{18}$ O values are generally observed further from it.
- 7. The clustering of  $\delta^{34}$ S values from several sulfides suggests a common source for sulfur. This observation may explain the paucity of late phases such as realgar and orpiment at Chukar Footwall due to depleted H<sub>2</sub>S by precipitation of earlier sulfides phases.  $\delta^{34}$ S isotopic differences between sulfides and sulfates can be attributed to different sources and temperatures. Sulfur isotope data of sulfides may indicate leaching from the host rocks. However, sulfate isotope data from barites probably represent derivation from Paleozoic sedex barite and sulfide deposits.
- 8. Apatite fission-track data indicate a thermal event at 17.7±3.7 Ma interpreted as a regional age reset of apatite ages due to (1) volcanism and extension or (2) local scale hydrothermal event in the vicinity of Gold Quarry. Furthermore, initial cooling of the Chukar Footwall system began at 26.2±5.5 Ma with cooling below 125°C at 17.7±3.7 Ma (Fig. 13).

- 9. Microthermometric data from late stage mineralization barite± calcite± sulfide± visible gold veins revealed evidence of fluid mixing during this late event. Additionally, the δ<sup>18</sup>O data on carbonate rocks indicate ore fluid mixing with high level oxidized meteoric fluids. During Late Tertiary extension meteoric fluids flowed into open NW-trending structures, producing gold and sulfate coprecipitation along a paleo-redox boundary. Also, extension allowed the ascension of hotter, more saline fluids thus producing the observed continuum in salinities and temperatures through the deposit. Tentatively, in the absence of absolute ages, the age of this latest hydrothermal event is no younger than 17 Ma.
- 10. The Chukar Footwall orebody forms part of the Gold Quarry gold system to which the same basic genetic ideas may apply. The metallogenic evolution of the Chukar Footwall deposit began with a significant pre-ore episode of dissolution-collapse breccia between the Roberts Mountains Formation and the Popovich Formation that formed a semi-impermeable cap to later hydrothermal fluids. During ore-stage, ore fluids were channelized along major active NE-striking structures, and probably micron-size Au and base metals precipitation took place as a result of sulfidation and a shift toward higher pH values. During Late Miocene extension, NW-striking faults were open for descending cool, weakly saline meteoric fluids and ascending relatively hotter, more saline hydrothermal fluids producing metal remobilization along and visible gold

precipitation along structures. It seems that the common link among the Gold Quarry gold systems is its structural relation to the Deep Sulfide Feeder and Chukar Gulch faults, which served as major conduits for hydrothermal fluids.

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## **APPENDIX 1**

# STRUCTURAL DATA FOR THE CHUKAR FOOTWALL DEPOSIT

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B3         D         Ledden perf         1952 (1952)         1957 (1953)         1957 (1954)         1957 (1955)         1957 (1954)	AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION REMARK	-	AZIMU GH	DIP	STRUCTURE	EASTING	NORTHING	FLEVATION	REMARK
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10         10         10         10         10         10         100	51	- 21	joint inint	19535	3 18713	4772		124	10	raut	19495	1662/	4748	1
9         7         10         10         17         10 <td>96</td> <td>76</td> <td>shear fracture</td> <td>19556</td> <td>16685</td> <td>4772</td> <td></td> <td>142</td> <td>77</td> <td>fault</td> <td>19517</td> <td>16642</td> <td>4/40</td> <td></td>	96	76	shear fracture	19556	16685	4772		142	77	fault	19517	16642	4/40	
20         6         7         10         15         16         1000         1700         100	96	76	shear fracture	19556	16685	4772		193	17	fault	19481	16839	4748	í
130         8.8         Full         1957         195         7.6         1957         1960         196	282	47	fault	19565	5 16698	4771		138	76	fault	19471	16645	4748	i i
11         9         fund         1575         4771         200         9         bedrag         1568         1560 </td <td>330</td> <td>83</td> <td>· fault</td> <td>19561</td> <td>16692</td> <td>4771</td> <td></td> <td>115</td> <td>75</td> <td>fault</td> <td>19468</td> <td>16646</td> <td>4748</td> <td>)</td>	330	83	· fault	19561	16692	4771		115	75	fault	19468	16646	4748	)
120         4         6         100         107         100	171	69	fault	19546	16715	4771		200	6	bedding	19488	16609	4748	3
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111         72         baseficial         10547         10524         4760         1242         20         baseficial         4768           110         77         Guid         10534         10533         4769         1270         53         baseficial         10533         4769           126         1         baseficial         10534         10533         4769         1270         53         baseficial         10533         4769           126         1         baseficial         10534         10534         4769         171         13         baseficial         10571         4766           125         1         baseficial         10530         4769         1271         13         baseficial         10571         4766           125         1         baseficial         10501         40585         4779         1271         13         baseficial         1271         13         baseficial         1271         1358         1272         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271         1271 <td>171</td> <td>78</td> <td>shear fracture</td> <td>10547</td> <td>18734</td> <td>4770</td> <td></td> <td>260</td> <td>30</td> <td>bedding</td> <td>19331</td> <td>18544</td> <td>4748</td> <td></td>	171	78	shear fracture	10547	18734	4770		260	30	bedding	19331	18544	4748	
347         73         fmat         1933         1957         4769         277         28         1932         1932         1933 <th1933< th=""> <th1933< th="">         1933<td>171</td><td>78</td><td>shear fracture</td><td>19547</td><td>16724</td><td>4770</td><td></td><td>230</td><td>20</td><td>bedding</td><td>10349</td><td>10027</td><td>4/48</td><td></td></th1933<></th1933<>	171	78	shear fracture	19547	16724	4770		230	20	bedding	10349	10027	4/48	
288         77         Run         19854         19853         476           286         77         Run         19854         19853         476         200         50         Leading         19835         19835         16434         476           285         1         Leading         19836         19835	347	73	fault	19533	16673	4769	1	247	23	bedding	19382	16513	4748	
280         77         no.4         1954         1955         1954         1955         1955         1955         1955         1955         1955         1955         1955         1955         1955         1956         1955         1956         1955         1956         1956         1956         1956         1956         1956         1956         1957         1957         19	286	- 77	fault	19554	16653	4769		220	50	bedding	19353	16533	4748	
34         14         bedding         1987.0         47.8           215         14         bedding         1987.0         47.9         214         23         bedding         1987.0         47.9         214         25         bedding         1987.0         47.9         210         35         bedding         1987.0         47.9         210         35         bedding         1987.0         1988.0         17.4         17.8         17.9         1989.0         1987.0         1988.0         197.0         47.8         210         35         bedding         1987.0         1988.0         197.0         47.8         17.4         1988.0         197.0         47.8         17.4         1988.0         1987.0         1988.0	286	77	fault	19554	16653	4769		220	25	bedding	19348	16543	4748	
12.10         9         Desching         193.00         193.10         478         171         2.5         becking         193.21         154.10           21.5         19         50         50.55         157.5         159.5         150.25         160.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25         150.25         170.25	345	14	bedding	19548	16870	4769		90	90	bedding	19307	16469	4748	<b>;</b>
1         1	215		bedding	19558	16/34	4769	1	211	25	bedding	19300	16473	4748	•
244         70         mm         1957         17574         17564         1756         17564         1756         17564         17564         17564         1756         17564         1756         1756         17564         17564         17564         17664         17664         17664         17664         17664         176644 <th17664< th=""> <th17664< th=""></th17664<></th17664<>	215		bedding	19040	100/0	4/69		212	40	bedding	19295	16475	4748	
12         26         print         19574         1706         4709         2210         500         basis         1728         1505         15050         1728         1505         15050         1728         1505         15050         1728         1505         15050         1728         1505         15050         1728         1505         1728         1505         1728         1505         1728         1505         1728         15050         1728         1728         15050         1728         1728         1728         1728         1728         1728         1728         1728         1728         1728         1728         1728	244	70	inint	19520	16685	4789		219	- 20	bedding	19274	10400	4/48	
12         26         pmrt         19574         1970         4769         776         776         1960         19602         4768           341         15         bedding         1983         16710         4788         123         17         pmrt         19603         4764           277         38         pmrt         19603         16710         4788         123         17         pmrt         19603         4764           277         38         pmrt         19603         16713         4768         116         80         pmrt         19842         4764           285         16         bedding         1973         16751         4765         110         80         pmrt         19842         4764           285         15         bedding         1973         16751         4764         115         80         pmrt         19842         19842         19842         1765         1776           137         76         fmrt         19747         4764         175         pmrt         19842         1683         4764           137         76         fmrt         19847         16764         175         pmrt         19824	12	58	joint	19574	16704	4769		210	30	bedding	10205	16458	4740	
341         15         badding         1983         167:10         4788         17         27         68         part         1982         4746           201         35         part         1980         167:10         4788         12         67         part         1980         168:10         4748           201         35         part         1980         167:13         4768         12         67         1984         1984         1984         4748           205         15         badding         1978         16753         4768         110         60         part         1984         1464         1464         1985         1985         1985         1476         1476         1476         1984         1984         1476         1476         1476         1984         1984         1476         1476         1476         1476         1476         1476         1476         1476	12	56	joint	19574	10704	4769		232	70	o.nt	19501	16602	4748	
341         15         beding         1983         10710         4788         123         7         pert         19420         10511         4748           207         38         pert         19420         10540         10711         10800         10711         10800         107111         10711         10711 <td< td=""><td>341</td><td>15</td><td>bedding</td><td>19583</td><td>16710</td><td>4768</td><td></td><td>37</td><td>88</td><td>oint</td><td>19489</td><td>16829</td><td>4748</td><td></td></td<>	341	15	bedding	19583	16710	4768		37	88	oint	19489	16829	4748	
207         38         pint         19500         19716         4788         105         00         pint         19477         16627         4748           207         37         Decking         19500         1977         1476         1500         1977         16627         4748           205         16         becking         1977         1673         4766         115         50         pint         1947         1554         4748           205         16         becking         1978         1675         4768         115         50         pint         19357         1555         4748           205         20         pint         1947         1676         115         50         pint         19357         1555         4748           100         20         pint         1940         1650         4746         15         75         pint         19321         1552         4748           111         1940         1650         4748         150         7         pint         19321         1552         4748           111         1940         1650         4748         150         7         pint         19321	341	15	bedding	19583	\$ \$6710	4768		123	87	joint	19499	16831	4748	
207         38         pint         1937         1978         4788         44         50         pint         1947         1652         4748           105         75         beding         1977         1973         4768         115         50         pint         19417         1652         4748           265         10         beding         1977         1673         4768         115         50         pint         19347         15545         4748           205         82         pint         19437         15575         110         80         pint         19354         1555         4748           203         28         bedsing         1947         15661         4764         15         5         pint         19331         1553         4748           210         bedsing         1940         10674         1744         4764         15         5         pint         19331         15532         4748           211         1057         1074         4764         15         5         pint         19321         16468         474           213         bedsing         19415         16734         47644         4764	207	38	joint	19590	16716	4768		105	90	joint	19470	16647	4748	1
100         1/7         Bit         1000         pmt         1030         1476           255         16         bedding         1975         1075         1476         115         50         pmt         10335         15555         4748           255         17         bedding         1947         15545         4748         110         50         pmt         19356         15555         4748           137         26         pmt         19356         15555         4748         110         50         pmt         19356         15555         4748           139         19         bedding         16911         1777         4764         15         50         pmt         19358         15555         4748           139         19         bedding         16911         1777         4764         175         50         pmt         19328         16464         4748           139         19         bedding         16911         1777         4764         4703         200         ppt <tt1938< td="">         16464         474         175         55         ppt&lt;1938</tt1938<>	207	38	joint	19590	0 16716	4768		45	90	joint	19477	16652	4748	•
bit         bit<	265	14	Taut	19493	16642	4767		90	90	joint	19461	16828	4748	
1         9         4         1041         10541         1055         110         800         ppmt         19525         19525         4748           137         44         fault         19520         19539	203	18	bedding	19970	10/03	4/00		115	85	joint	19338	16562	4748	
28         82         pint         19641         19651         1705         110         80         pint         19556         1552         1746           103         70         fault         19470         19647         4764         115         78         pint         19364         16510         4748           103         70         fault         19470         4764         15         5         pint         19364         16510         4748           110         100         bodding         10641         10747         4764         5         5         pint         19356         16520         4748           110         105         10511         10747         4764         100         70         pint         19288         16462         4748           115         75         105         10747         4764         100         70         pint<19288		54	ioint	19476	16641	4765		115	- 90	joint	19345	18545	4748	
137         84         fput         1950         7764         110         80         port         1953         1051         1           100         70         fput         19470         19647         4764         5         5         port         19342         19510         4764           101         73         bedding         19440         19564         4764         5         5         port         19342         19522         4764           318         90         vestige         19511         10564         4764         15         75         port         19322         16422         4764           46         87         shaar factue         19518         16743         4764         68         72         port         19387         16459         4764           27         61         faut         19567         16758         4763         1228         16469         4747           21         23         15         bedding         19671         16758         4763         1228         16469         4747           24         25         16         bedding         19673         4763         1228         56         port	265	82	joint	19481	16651	4765		1 110	80	pint	19356	16525	4748	
103       70       Inult       19440       19647       4764       115       78       pprint       19364       19500       4748         113       Bedding       19641       19657       4764       5       5       pprint       19343       16520       4748         319       19       Bedding       19641       1747       4764       175       75       pprint       19328       16452       4748         318       50       wen       13474       16527       4764       16027       pprint       19288       16454       4748         48       67       shaar fracture       13618       16743       4764       300       50       pprint       19288       16459       4748         233       15       bedding       14643       16743       4764       300       50       fpuit       19360       16444       4747         233       15       bedding       19457       16753       4763       127       80       fpuit       19362       16464       4747         245       83       pprint       19364       1933       4763       225       66       fpuit       19364       16464       4	137	84	fault	19502	2 16650	4764		110	80	joint	19359	16519	4748	
228         28         bbd/sig         1948         1560         4774         5         85         pint         19341         1652         4746           39         19         bbd/sig         1551         11056         4744         15         5         5         pint         19332         16333         4746           319         90         vent         19347         4744         15         5         5         pint         19332         16333         4746           48         87         pharf racture         19516         16743         4764         300         50         pint         19328         16444         4748           48         87         pharf         19697         16469         4743         300         80         pint         19328         16464         4744           213         15         backing         19497         16469         4773         122         80         fault         19328         16464         4747           22         315         backing         19467         16676         4773         122         80         fault         19326         16646         4747           22         backing <td>103</td> <td>70</td> <td>fault</td> <td>19470</td> <td>16647</td> <td>4764</td> <td></td> <td>115</td> <td>78</td> <td>jaint</td> <td>19364</td> <td>16510</td> <td>4748</td> <td></td>	103	70	fault	19470	16647	4764		115	78	jaint	19364	16510	4748	
3         1.5         DBCONG         19510         19526         4/74         5         3         point         19323         16322         4/74           318         90         with         19211         1977         4/74         15         05         point         19323         16332         4/74           46         87         Phear facture         19616         16743         4764         150         75         point         19328         16442         4748           46         87         Phear facture         19616         16743         4764         150         75         point         19328         16442         4748           47         Phear facture         19630         16674         4763         300         80         fault         19327         16469         4747         ANT           215         18         Boding         19671         16753         4763         125         60         fault         19327         16464         4747           22         19540ing         19621         16753         4763         225         16         1664         4747           23         19560         19621         16753         4	226	28	bedding	19480	16682	4764		5	85	joint	19342	16520	4748	1
13         19         Doubling         1911         1014         412         102         1933         1	1	13	bedding	19510	16656	4764	1	5	5	joint	19341	16522	4748	
13         90         1974         1975         1974         1975         1974         1975         1974         1975         1974         1975         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1975         1975         1975         1975         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         1974         197	319	19	bedding	1901	18747	4/04			30	joint	19335	16535	4748	
68         87         abart fracture         19616         19743         4764         300         500         1928         1464         474           48         87         abart fracture         19616         19743         4764         300         500         point         1928         14548         474         Avt           155         82         fault         19340         15666         4747         Avt	318	90	vera	19474	16827	4784		160	70	ionot	19292	18483	4/40	
46         87         star fracture         19618         197.3         4764         340         90         cm         13285         1455         478           155         82         fault         19483         10674         4763         295         70         fault         19349         16474         477         Ar7           218         7         bedding         19467         10668         4763         125         66         fault         19340         16414         477         X47           23         bedding         19417         10758         4783         127         80         fault         19286         1644.4         477         X47           23         bedding         19417         10753         4763         127         80         fault         19286         1644.4         477           24         5484         fault         19281         10753         4763         127         80         fault         19351         1646         477           196         53         sharf facture         19451         10753         4763         127         123         143         1647         477         477           196	48	87	shear fracture	19616	16743	4764		68	72	toioi	19285	16484	4748	
227         61         fault         1953         10673         4763         200         80         80         77         Art         Art           218         7         bedding         19487         10678         4763         125 68         fault         19349         15600         477         Art           218         7         bedding         19615         1675         4763         125 68         fault         19340         16600         477         Art           218         bedding         19617         10758         4763         125 80         fault         19326         16460         477           22         bedding         19347         16460         4773         225         1937         16469         477           126         appint         19325         16460         477         477         477         477           126         appint         19325         19460         477         477         477         477         477           126         bedding         19315         1673         478         178         1335         1660         477           231         bedding         19319         1777	48	87	shear fracture	19616	16743	4764		340	90	oint	19289	16459	4748	
155         62         fault         19483         19679         4763         2285         70         fault         19349         15036         4777         ArT           238         15         bedding         19515         16674         4763         127         60         fault         19248         16440         4777         ArT           24         23         bedding         19675         4763         127         60         fault         19268         16440         4777         ArT           25         13         bedding         19671         16753         4763         2246         55         point         19325         16400         4777           158         68         iperit         19621         16753         4763         225         55         point         19322         16400         4777           236         shearf inclure         19510         16680         4783         70         75         point         19327         16424         4738           231         28         bedding         19413         16640         4757         236         24         138         4738           1110         60         point	297	61	fault	19503	16874	4763	1	300	80	fault	19387	16496	4747	ANT
218       7       bodding       1997       18626       4763       125       66       fault       19240       16414       477       547         23       badding       1917       1075       4783       122       60       fault       19286       16400       4777         23       badding       1917       1075       4783       122       60       fault       19280       16444       4747         23       badding       1917       10753       4783       126       55       port       19337       16460       4777         126       68       port       19221       16733       4783       126       65       port       19337       16453       4777         126       58       abreat fracture       19592       16457       4747       16457       4747         305       77       fault       19465       16689       4757       2236       24       bedding       19180       16742       4738         231       126       bedding       19167       4747       4738       19180       16724       4738         231       126       bedding       19187       16875       211	155	82	fault	19483	16876	4763		295	70	fault	19349	16508	4747	ANT
2.3         13         Desking         193-3         107.5         4.0.3         127         80.7         80.17         19260         477           2.5         13         bedding         19477         10750         4783         224         55         pint         19326         10744         477           2.6         10         bedding         1947         10753         4703         226         55         pint         19326         10404         477           126         83         inert         19921         10753         4703         226         55         pint         19325         10400         477           126         Stater fracture         19910         10600         4783         70         75         pint         19327         1047         477           2305         7         7         bedding         19413         10640         4757         236         24         1930         1724         473           231         28         bedding         19191         16535         4750         236         24         1738         473           135         bedding         19191         19224         4738         191910	218		bedding	19497	16668	4763		125	68	fault	19340	16414	4747	SAG
255         1.3         Dubberty         1014         1012         11         12         20         184.1         12.26         184.1         12.26         184.1         12.26         184.1         12.26         184.1         12.26         184.1         182.67         184.3         147.7           20         36         period         19621         10753         4783         246         55         period         198.26         194.69         4747           20         58         period         19821         10753         4783         225         50         period         198.27         198.57         198.57         198.57         198.57         198.57         198.57         198.57         198.57         199.57         226         24         bedding         191.99         197.2         473.7           231         28         bedding         191.93         197.2         473.5         175         228         24         bedding         191.99         197.2         473.6           231         29         port         193.23         1665.3         475.0         211.69         port         191.99         197.2         473.8           20         port         193.21 </td <td>233</td> <td>20</td> <td>bedding</td> <td>19515</td> <td>16675</td> <td>4763</td> <td></td> <td>127</td> <td>60</td> <td>fauit</td> <td>19288</td> <td>16460</td> <td>4747</td> <td></td>	233	20	bedding	19515	16675	4763		127	60	fauit	19288	16460	4747	
2         2         a moding         10817         10758         4183         246         55         point         10324         10824         10771           126         88         point         10821         10753         4183         225         85         point         19347         16433         4747           126         88         point         19347         16433         4747           196         65         sheaf facture         19910         16660         4783         70         7         point         19312         16457         4747           205         7         fault         19453         16640         4757         238         248         640ng         19140         16742         4738           215         17         bedding         19137         16659         4750         238         2         point         19189         16724         4738           110         66         point         19312         16664         4750         211         89         joint         19189         16724         4738           117         73         fault         19468         16644         4749         1919         pint	255	18	bedding	10484	16640	4763	1	245	66	Taux	19266	18460	4/4/	
128       88       pmin       19521       16753       4783       220       50       pmin       19525       16477       777         139       65       shear fracture       19492       16673       4783       125       55       pmin       19325       16450       4747         305       77       fault       19485       10669       4782       213       15       56       pmin       19325       16450       4747         305       77       fault       19485       10669       4782       213       15       56       pmin       1939       16742       4738         221       128       bedding       1938       16733       4750       213       155       56       pmin       1939       16742       4738         110       60       pmin       19328       16663       4750       214       69       jmin       19186       16742       4738         43       50       point       19371       16655       4750       214       69       jpint       19186       16742       4738         20       point       19372       16657       4749       21       67       jpint	2	23	bedding	19617	16758	4783	1	245	55	joint	19358	16465	4747	
128       88       jont       19921       10733       4763       225       265       jont       19327       19433       4773         199       65       sheaf facture       19910       10660       4763       70       jont       19325       16460       4747         205       77       fault       19465       10660       4763       70       jont       19322       16457       4747         231       28       bedding       19413       10640       4757       236       24       bedding       19180       18738       4738         255       17       bedding       1927       10679       4750       236       24       bedding       19106       18738       4736         100       60       jont       19312       10678       4750       268       2       jont       19186       16742       4738         45       65       jont       19313       10654       4750       211       89       joint       19186       16742       4738         260       76       fault       19468       16673       4749       19       67       joint       19196       16742       4738	126	88	pint	19621	16753	4763		270	90	pint	19353	16447	4747	
19       65       sheaf facture       19492       10873       4783       145       85       joint       19325       16660       4747         305       77       fault       19485       16889       4762       213       15       bedding       1919       1742       4747         231       22       bedding       19115       15       bedding       19140       18742       4738         231       28       bedding       19131       16535       4750       213       15       bedding       19196       16742       4738         43       90       joint       19328       16663       4750       211       69       joint       19186       16742       4738         90       90       veint       19312       16664       4750       211       69       joint       19186       16742       4738         206       78       fault       19460       16701       4749       98       2       joint       19186       16742       4738         210       29       bedding       19467       19167       19186       16742       4738         210       20       1681       16701	126	88	joint	19621	16753	4763		225	85	ont	19347	16433	4747	
B6         53         sheaf fecture         19510         16680         4783         70         gunt         19312         16457         4747           231         28         bedding         19413         16640         4757         236         24         bedding         1919         16742         4738           235         17         bedding         19277         16879         4750         236         24         bedding         19199         16742         4738           110         60         joint         19327         16679         4750         236         24         bedding         19198         16724         4738           45         65         joint         19312         16674         4750         96         2         joint         19198         16724         4738           266         76         fault         19486         16793         4749         19         67         joint         19186         16742         4738           270         76         fault         19488         16684         4749         207         20         joint         19186         16742         4738           270         5         bedding	119	65	shear fracture	19492	16873	4763		145	85	joint	19325	16460	4747	•
305         77         fault         19485         16889         4782         213         15         bedding         19139         10742         4733           251         17         bedding         19131         16603         4757         238         24         bedding         19139         10742         4733           255         17         bedding         19135         16535         4750         233         15         bedding         19130         10742         4733           43         30         joint         19322         16663         4750         211         89         joint         19186         10742         4738           30         90         vent         19312         16665         4750         119         67         joint         19186         10742         4738           206         78         fault         19460         16701         4749         98         2         joint         19186         10742         4738           210         29         bedding         19480         16701         4749         20         20         joint         19186         10742         4738           210         26	66	53	shear fracture	19510	16660	4763		70	75	joint	19312	16457	4747	•
231       23       23       24       bedding       19130       16323       4757         235       17       bedding       19121       16535       4750       231       15       bedding       19199       16724       4738         110       60       joint       19327       16679       4750       236       24       bedding       19189       16724       4738         43       90       joint       19312       16674       4750       96       2       joint       19189       16724       4738         90       90       vein       19313       16654       4750       211       69       joint       19186       16742       4738         226       76       fault       19488       16673       4749       19       67       joint       19186       16742       4738         210       29       bedding       19343       16684       4749       212       70       fault       19441       16740       4736         210       29       bedding       19331       16684       4749       212       70       fault       19241       16742       4738         210       29	305	77	fault	19485	16689	4782		213	15	bedding	19199	16742	4738	
1/2       1	231	28	bedding	19413	16640	4757	1	236	- 24	bedding	19180	18738	4738	
110         60         point         1222         100/2         4750         220         221         82         percurg         19180         107.8         4738           43         90         point         13012         18078         4750         38         2         jent         19186         19720         4738           44         65         point         13313         16654         4750         38         2         jent         19186         19720         4738           206         rs.uit         13464         16079         4749         139         82         jent         19186         16742         4738           210         29         bedding         13484         16079         4749         139         87         jent         19186         16742         4738           210         29         bedding         13484         16684         4749         212         70         fault         19441         16740         4736           210         29         bedding         13341         16647         4749         212         70         fault         19741         16740         4736           210         20         be	200	80	bedding	19613	10333	4/50		213	15	bedding	19199	18742	4738	
43         50         20<	110	60	ioiot	19328	16643	4750		230	- 49	bedaing	19180	10738	4/38	
45         65         joint         19312         10685         4750         119         67         joint         1936         19742         4728           208         78         fault         19460         16701         4749         98         2         joint         19186         16722         4738           216         78         fault         19460         16701         4749         98         2         joint         19186         16722         4738           210         220         bedding         19370         16827         4749         207         82         joint         19180         16713         4737           210         23         bedding         19332         16653         4749         217         70         fault         19241         16740         4738           200         20         bedding         19358         16643         4749         211         270         fault         19241         16740         4738           225         35         bedding         19358         16643         4749         214         24         bedding         19168         1711         4738           215         bedding	43	90	ioint	19312	16676	4750		98	2	joint	19189	16720	4738	
90         90         von         19313         10654         4750         211         89         jont         19196         10724         4738           266         78         fault         19468         16701         4749         196         2         jont         19196         16724         4738           276         60         fault         19468         16679         4749         197         67         jont         19196         16742         4738           270         29         bedding         19348         16686         4749         207         82         jont         19196         16713         4737           270         5         bedding         19341         16647         4749         212         70         fault         19241         16740         4736           283         5         bedding         19351         16643         4749         212         70         fault         19248         16453         4735           300         50         bedding         19315         16629         4749         217         64         fault         19248         1652         4735           300         50         bedd	45	65	joint	19312	16665	4750		119	67	joint	19186	16742	4738	
298         78         fault         19480         16701         4749         98         2         joint         19189         16720         4738           117         73         fault         19380         16827         4749         19         67         1918         16720         4738           210         29         bedding         19321         16827         4749         207         82         joint         19180         16713         4737           200         20         bedding         19321         16653         4749         212         70         fault         19241         16740         4736           200         20         bedding         19358         16645         4749         214         24         bedding         19160         16711         4736           215         32         bedding         19372         16827         4749         217         70         fault         19244         18754         4735           225         35         bedding         19372         16827         4749         118         75         fault         19244         18752         4735           230         50         bedding	90	90	ven	19313	16654	4750		211	89	joint	19196	16724	4738	
117       73       fault       19488       16879       4749       119       97       pint       19198       16742       4733         276       60       fault       19270       16827       4749       207       82       pint       19190       16713       4737         270       29       bedding       19381       16683       4749       207       82       pint       19100       16713       4737         270       5       bedding       19341       16647       4749       212       70       fault       19241       16742       4735         225       35       bedding       19341       16647       4749       212       70       fault       19241       16742       4736         245       50       bedding       19341       16647       4749       217       70       fault       19248       1652       4735         300       50       bedding       19313       16582       4749       215       53       bedding       19227       16468       4732       4734         226       50       bedding       19313       16584       4749       215       60       bedding	296	78	fault	19460	0 16701	4749		98	2	jaint	19189	16720	4738	1
210     B0     FB-1     193/0     1082/     4749     207     82     pint     19180     197/3     4737       210     20     bedding     1932     10633     4749     207     82     pint     19180     197/3     4737       200     20     bedding     1932     10633     4749     212     20     fault     19241     167/40     4736       200     20     bedding     19355     10645     4749     214     24     bedding     19166     17711     4738       215     25     bedding     19355     10645     4749     217     7     fault     19248     10523     4735       256     bedding     19315     10629     4749     119     75     fault     19248     10524     4735       200     50     bedding     19315     10529     4749     217     64     fault     19248     10524     4735       200     50     bedding     19313     15552     4749     215     04     bedding     19324     10524     4735       204     40     bedding     19327     15654     4749     215     04     bedding     19328     4	117	73	fault	19468	16879	4749		119	67	joint	19186	16742	4738	•
210       23       bedding       19485       10000       4/43       20/7       20       parkt       1973       4/37         200       20       bedding       19341       10647       4/48       212       70       fault       19241       10740       4/38         200       20       bedding       19341       10647       4/48       212       70       fault       19241       10740       4/38         220       20       bedding       19365       10643       4/49       214       24       bedding       1166       1711       4/38         215       bedding       19315       10629       4/49       217       64       fault       19248       10752       4/35         206       50       bedding       19315       10629       4/49       237       64       fault       19248       10752       4/35         206       50       bedding       19315       10529       4/49       215       60       fault       19248       10752       4/35         208       50       bedding       19325       10564       4/49       215       60       bedding       19329       16564       4/3	2/0	50	raut	19370	16827	4749		207	82	point	19180	10713	4737	
200         200         ibiding         19341         10740         4736           225         35         bedding         19364         14746         211         16         1916         19710         4738           245         35         bedding         19366         16843         4749         211         12         13         12         12         13         13         13         15         12	270	5	bedding	19332	16441	4749	1	217	70	joint facilit	19180	16740	4734	
225         35         bedding         19358         16845         4749         214         24         bedding         19168         1711         4726           215         32         bedding         19372         16827         4749         214         24         bedding         19168         1711         4726           215         32         bedding         19372         16827         4749         118         75         fault         19248         18752         4735           300         35         bedding         19307         16592         4749         217         64         fault         19248         18752         4735           300         35         bedding         19318         16592         4749         217         64         fault         19248         1652         4735           208         36         bedding         19318         16571         4749         40         14         synchre         1927         16464         4749           218         35         bedding         19317         16830         4749         145         95         joint         1927         16472         4734          210         80	200	20	bedding	19341	16647	4749		212	70	fault	19241	16740	4736	
145       35       bedding       19368       1643       4749       214       bedding       19108       19711       4738         215       35       bedding       19315       16629       4749       214       214       bedding       19212       4735         300       35       bedding       19315       16629       4749       217       64       fault       19248       16752       4735         300       35       bedding       19313       16582       4749       135       35       bedding       19228       16452       4735         288       36       bedding       19313       16582       4749       135       35       bedding       19228       16452       4735         288       36       bedding       19329       16584       4749       215       60       bedding       19327       16440       4734         210       60       point       19339       16850       4749       145       90       point       19275       16473       4734         210       60       point       19339       16850       4749       135       90       point       19275       16472 <td< td=""><td>225</td><td>35</td><td>bedding</td><td>19358</td><td>16645</td><td>4749</td><td>1</td><td>214</td><td>24</td><td>bedding</td><td>19166</td><td>16711</td><td>4738</td><td></td></td<>	225	35	bedding	19358	16645	4749	1	214	24	bedding	19166	16711	4738	
215       32       bedding       19372       10827       4749       118       175       fault       19228       14453       4735       536         226       50       bedding       19307       16932       4749       217       64       fault       19248       16752       4735         300       35       bedding       19307       16592       4749       217       64       fault       19248       16752       4735         208       36       bedding       19318       16571       4749       40       14       synchre       19227       16488       4735         218       35       bedding       19327       16561       4749       40       14       synchre       1927       1647       4734         216       50       point       19327       16561       4749       145       90       point       1927       16474       4734         210       60       point       19343       16830       4749       95       90       point       19377       16477       4734         105       90       joint       19379       16844       4749       30       75       joint       <	145	35	bedding	19365	16643	4749	1	214	24	bedding	19166	16711	4738	1. j.
283       50       bedding       19315       10629       4/49       217       64       fault       19248       10752       4/35         300       50       bedding       13015       16562       4/49       135       35       bedding       19252       4/35         208       30       50       bedding       13313       16562       4/49       135       35       bedding       19229       16462       4/35         228       30       bedding       13929       16564       4/49       215       80       bedding       19329       16440       4/74         216       80       bedding       19329       16564       4/49       215       80       bedding       19327       16477       4/74         216       80       bedding       19329       16564       4/49       145       90       pint       19277       164/77       4/74         210       60       point       19339       16630       4/49       135       90       pint       19267       164/34       4/74         105       50       pint       19339       16644       4/749       300       75       pint       19328 <td>215</td> <td>32</td> <td>bedding</td> <td>19372</td> <td>16627</td> <td>4749</td> <td>1</td> <td>118</td> <td>75</td> <td>fault</td> <td>19256</td> <td>18453</td> <td>4735</td> <td>SAG</td>	215	32	bedding	19372	16627	4749	1	118	75	fault	19256	18453	4735	SAG
	295	25	Deading	19315	10829	4749	1	217	64	fault	19248	18752	4735	
298         36         bedding         19318         16937         4749         1623         1623         16222         4733           224         40         bedding         19327         16554         4749         215         60         4733           224         40         bedding         19327         16554         4749         215         60         4733           246         35         bedding         19327         16559         4749         145         90         bedding         19327         16473         4734           246         82         pint         19338         16859         4749         145         90         pint         19275         16473         4734           210         60         pont         19338         16850         4749         135         90         pint         19275         16473         4734           105         50         pint         19338         16844         4749         135         90         pint         19377         16473         4734           105         50         pint         19385         16444         4749         30         90         pint         19328         164	300	- 50	bedding	10313	16592	4749	ł	21/	26	hoddion	19248	10/52	4/35	
224         40         bedding         19329         16584         4749         215         80         bedding         19327         16591         4749         215         80         bedding         19327         1640         *724           245         82         joint         19475         16659         4749         145         90         joint         19275         16479         +724           210         80         joint         19339         16850         4749         135         90         joint         19275         16478         4724           210         80         joint         19339         16850         4749         135         90         joint         19275         16472         4724           105         90         joint         19385         16844         4749         300         75         joint         19328         16438         4734           105         90         joint         19385         16844         4749         308         80         joint         19328         16438         4734           105         90         joint         19433         16444         4749         308         80         joint	298	38	bedding	19318	16571	4749	1	40	14	syncing	19200	16468	4735	
218         35         bedding         19327         16551         4749         145         90         joint         19277         17477         4734           245         82         joint         19377         16659         4749         145         90         joint         19277         16477         4734           210         60         joint         19343         16830         4749         95         90         joint         19229         16482         4734           210         60         joint         19379         16844         4749         20         50         joint         1929         16482         4734           105         90         joint         19379         16844         4749         20         75         joint         19357         16428         4734           105         90         joint         19391         16844         4749         308         80         joint         19325         16438         4734           105         joint         19433         16844         4749         308         90         joint         19318         16444         4734           210         90         joint	224	40	bedding	19329	16584	4749		215	60	bedding	19318	16440	4734	
245         82         joint         19475         19659         4749         145         95         joint         19275         19478         4734           210         60         joint         19339         16630         4749         135         90         joint         19275         19473         4734           210         60         joint         19339         16630         4749         135         90         joint         19377         19473         4734           105         90         joint         19385         16644         4749         30         75         joint         19328         16438         4734           100         90         joint         19385         16644         4749         300         75         joint         19328         16438         4734           100         90         joint         19338         16644         4749         308         60         joint         19333         16444         4734           200         90         joint         19398         16830         4749         308         16440         1633         4734           200         85         joint         19398	218	35	bedding	19327	16591	4749	-	145	90	joint	19277	16477	4734	
210         60         point         19343         16830         4749         95         90         point         19229         164e2         4734           210         60         point         19339         16830         4749         95         90         point         19229         164e2         4734           105         90         point         19379         16644         4749         20         75         point         19357         16420         4734           105         90         point         19358         16644         4749         20         75         point         19328         16436         4734           100         70         point         19391         16644         4749         140         90         point         19328         16438         4734           100         70         point         19391         16644         4749         120         90         point         19325         16443         4734           100         70         point         19318         16649         4749         120         90         point         19325         16441         4734           200         85         point	245	82	pint	19475	i 16659	4749		145	85	joint	19275	16478	4734	
AUD         GU         point         19339         16830         4749         135         90         joint         19367         16417         4734           105         90         joint         19358         16644         4749         30         75         joint         19327         16447         4734           105         90         joint         19385         16644         4749         30         75         joint         19328         16438         4734           100         70         joint         19385         16644         4749         30         75         joint         19328         16438         4734           120         90         joint         19433         16644         4749         308         80         joint         19338         4734           200         85         joint         19438         16643         4749         308         80         joint         19335         1734           200         85         joint         19398         16830         4749         48         16         fault         19404         16533         4733           250         80         joint         19376         16828	210	60	joint	19343	16630	4749	1	95	90	joint	19269	16482	4734	
105         90         joint         19379         10644         4749         20         75         joint         19357         16420         4734           105         90         joint         19391         10644         4749         330         75         joint         19325         16420         4734           110         70         joint         19391         16644         4749         140         90         joint         19325         16438         4734           120         90         joint         19333         16644         4749         130         90         joint         19325         16438         4734           115         90         joint         19313         16644         4749         120         90         joint         19325         16438         4734           200         85         joint         19390         16829         4749         120         90         joint         19328         16470         4734           200         85         joint         19390         16830         4749         125         78         fault         19414         16552         4733           200         joint <td< td=""><td>210</td><td>60</td><td>joint</td><td>19339</td><td>16630</td><td>4749</td><td></td><td>135</td><td>90</td><td>joint</td><td>19367</td><td>16417</td><td>4734</td><td></td></td<>	210	60	joint	19339	16630	4749		135	90	joint	19367	16417	4734	
No.         Point         19328         10439         4749         35.0         point         19328         10439         4734           110         70         joint         19328         10439         4749         140         90         joint         19328         10439         4734           120         90         joint         19333         16444         4749         308         90         joint         19333         16444         4734           115         50         joint         19438         16644         4749         308         90         joint         19328         16444         4734           270         85         joint         19398         16830         4749         120         90         pint         19328         16444         4734           260         85         joint         19398         16830         4749         126         78         fault         19444         4553         4733           260         85         joint         19376         16628         4749         125         78         fault         19444         16554         4733           315         90         joint         19413	105	90	joint	193/9	10644	4749	1	20	75	joint	19357	16420	4734	
120         30         joint         1932         1934         1933         1944         4734         1934         1935         1933         1944         4734         1935         1935         1935         1935         1935         1935         1935         1935         1933         1944         4734         1935         1	110	70	joint	19303	16844	4749	1	330	13	joint	19328	10430	4734	
115         30         joint         19418         16829         4749         120         90         joint         1925         1044         1944           270         85         joint         1939         16830         4749         48         120         90         joint         1925         10447         473           280         85         joint         19398         16830         4749         48         61         fault         19404         7653         4733           280         85         joint         19398         16830         4749         125         78         fault         19404         7653         4733           280         80         joint         19378         16028         4749         125         78         fault         19404         7653         4733           315         80         joint         19413         16646         4749         259         21         fault         19404         16554         4733           30         78         joint         19321         16565         4749         228         20         fault         19404         16553         4733           125         90	120	90	joint	19433	16644	4749	I I	304	80	joint	19343	16444	4734	
270         85         pont         19398         16830         4749         126         pont         1240         1010         134           260         85         joint         19390         16830         4749         126         78         fault         19406         15555         4733           260         85         joint         19390         16830         4749         125         78         fault         19404         *5531         4733           260         80         joint         19413         16645         4749         125         78         fault         19404         *5553         4733           115         90         joint         19413         16645         4749         259         19414         19558         4733           35         90         joint         19413         16645         4749         252         1941         19552         4733           90         78         joint         19331         16578         4749         258         20         bedding         19433         16560         4733           125         90         joint         19320         16567         4749         258         2	115	90	inini	19418	16829	4749	1	120	90	juint	10288	16470	4734	
260         85         joint         19390         16830         4749         126         78         fault         19404         *6531         4733           250         80         joint         19317         16624         4749         125         78         fault         19415         16523         4733           115         80         joint         19413         16645         4749         259         21         fault         19404         16553         4733           35         90         joint         19413         16646         4749         232         22         fault         19404         16552         4733           90         78         joint         19313         16576         4749         232         22         fault         19404         16552         4733           90         78         joint         1931         1657         4749         238         20         badding         19403         15604         4733           125         90         joint         19321         16565         4749         244         0         badding         19425         16548         4733           125         90         joi	270	85	joint	19398	16830	4749	1	48	61	fauit	19406	16535	4733	
250         80         joint         19376         16628         4749         125         78         fault         19445         16523         4733           115         90         joint         19413         16648         4749         259         21         fault         19444         16554         4733           35         90         joint         19413         16648         4749         252         22         fault         19394         16552         4733           90         78         joint         19321         16565         4749         252         20         bading         19403         15650         4733           125         90         joint         19321         16565         4749         244         20         badding         19433         16548         4733           125         90         joint         19321         16565         4749         244         20         badding         19325         16548         4733           349         80         joint         19307         16590         4749         250         20         contact         19414         16562         4733	260	85	joint	19390	16630	4749	1	126	78	fault	19404	16531	4733	
110         90         joint         19413         15645         4749         259         21         fault         19404         16558         4733           35         90         joint         19413         16645         4749         232         22         fault         19343         16558         4733           90         78         joint         19331         16578         4749         258         20         bedding         19403         16550         4733           125         90         joint         19320         16567         4749         244         20         bedding         19395         16535         4733           125         90         joint         19320         16567         4749         197         13         bedding         19425         16548         4733           125         90         joint         19320         16567         4749         197         13         bedding         19425         16548         4733           349         80         joint         130/7         16560         4749         250         20         contact         19414         16562         4733	250	80	joint	19378	16628	4749	1	125	78	fault	19415	16523	4733	
35         50         joint         19413         10049         4/49         232         22         fault         19334         16552         4733           90         78         joint         19331         16578         4749         258         20         bedding         19403         16560         4733           125         90         joint         19321         16565         4749         244         20         bedding         19325         16513         4733           125         90         joint         19320         16565         4749         244         20         bedding         19425         16548         4733           349         80         joint         19307         16590         4749         250         20         contact         19414         16562         4733	115	90	joint	19413	16645	4749	1	259	21	fault	19404	16558	4733	
Los         Jorni         Itable         Itable         208         200         Debding         19403         15560         4733           125         90         joint         19320         16567         4749         244         20         bedding         19395         16553         4733           125         90         joint         19320         16567         4749         197         13         bedding         19395         16553         4733           349         80         joint         19307         16590         4749         250         20         contact         19414         16562         4733	35	90	joint	19413	16646	4/49	1	232	22	fault	19394	16552	4733	
125         30         joint         1925         10545         1737         197         1937         1935         10535         4/33           125         30         joint         19307         16567         4749         197         13         bedding         19425         10548         4733           349         80         joint         19307         16560         4749         250         20         contact         19414         18562         4733	126	90	joint	19331	103/8	4740	1	258	20	bedding	19403	10500	4733	
349 80 point 19307 16590 4749 250 20 contact 19414 16562 4733	125	- 90	inio) touoi	19320	16587	4749	1	107	13	bedding	10425	CLCD) 04,781	4/33	
	349	80	joint	19307	16590	4749	1	250	20	contact	19414	16562	4733	
						·····	-							

AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK	
115	85	joint	19343	16447	4733		
35	90	joint	19308	16438	4/33		
48	78	jaint	19410	16550	4733		
31	78	joint	19423	16543	4733		
120	82	joint	19398	16543	4733		
109	75	fauit	19413	16595	4732		
254	25	fault	19378	16542	4732		
23	23	bedding	19339	16463	4732		
228	30	bedding	19376	16555	4732	1	
240	22	contact	19386	16548	4732		
330	90	joint	19400	10385	4732		
308	81	fault	19465	16722	4730	PHE	
293	61	fault	19531	16878	4730	PHE	
257	21	bedding	19473	10099	4730		
223	29	bedding	19494	16711	4730		
255	31	bedding	19474	16692	4730		
242	20	contact	19516	16674	4730		
90	90	joint	19344	16489	4730		
5	90	joint	19345	16490	4730		
40	82	joint	19429	16/34	4730		
222	90	vein	19448	16727	4730		
222	90	vein	19436	16715	4730		
210	90	. vein	194/9	16728	4/30		
143	73	fauit	19349	16535	4729		
207	81	fault	19336	16740	4729		
135	75	fault	19388	16740	4729		
207	81	fault	19338	18740	4729		
135	63	fault	19388	18740	4729		
236	20	fault bedding	19410	18718	4729		
238	10	bedding	19373	16511	4729		
232	20	bedding	19311	18745	4729		
228	31	bedding	19329	16744	4729		
248	18	bedding	19308	16691	4729		
248	20	bedding	19374	16734	4729		
209	41	bedding	19395	16757	4/29	- 1	
224	20	bedding	19240	10754	4729		
232	20	bedding	19311	18745	4729		
228	33	bedding	19329	18744	4729	- 1	
248	18	bedding	19308	16691	4729		
248	20	bedding	19374	16734	4729		
209	41	bedding	19390	16757	4729		
224	20	bedding	19240	16754	4729		
221	66	10101	19377	16514	4729		
35	85	joint	19396	16711	4729		
299	87	joint	19405	16714	4729		
313	83	joint	19322	16693	4729		
104	70	joint	19303	16698	4729		
35	81	joint	19395	16748	4729		
290	82 56	inioi,	192/8	16735	4729		
154	64	joint	19304	18724	4729		
99	51	joint	19253	18737	4729		
75 284	76	joint joint	19232	16756	4729		
46	78	joint	19204	16737	4729		
114	78	joint	19160	16693	4729		
270	63 85	joint ioint	19344	16721	4729		
299	87	joint	19405	18714	4729		
313	83	joint	19322	16693	4729		
13	. 20	joint	19309	16698	4729		
35	81	joint	19395	16748	4729		
290	82	joint	19278	18735	4729		
154	50 64	joint	192/9	10747	4729		
99	51	joint	19253	16737	4729		
75	78	joint	19232	18758	4729	1	
∠85 46	78	joint Ioint	19230	16738	4729		
114	78	joint	19160	15693	4729		
228	25	shear	19389	16719	4729		
285	70	snear fauit	19389	16499	4/29 4728	ANT	
285	78	fault	19535	16680	4728		
190	40	bedding	19367	16513	4728		

224         19         bedding         19340         19510         4728           251         19         bedding         19407         19750         4728           251         19         bedding         19407         19750         4728           252         49         point         19306         19505         19720         4728           28         66         point         19505         19726         4728           28         66         point         19535         16686         4727           28         66         point         19536         16686         4727           28         70         fault         19535         16686         4727           28         70         fault         19522         10714         4728           132         76         fault         1952         10709         4728           132         86         fault         1942         10758         4728           132         86         fault         1942         10706         4724           132         86         fault         1942         10706         4724           132         86 <td< th=""><th></th><th>ÐP</th><th>STRUCTURE 8</th><th>ASTING N</th><th>ORTHING ELI</th><th>EVATION REMARK</th></td<>		ÐP	STRUCTURE 8	ASTING N	ORTHING ELI	EVATION REMARK
225         8         bedding         19407         105750         4728           251         19         bedding         19407         10750         4728           251         19         bedding         19407         10750         4728           352         24         joint         19404         10739         4728           212         70         fault         19514         10706         4727           228         66         fault         19521         10714         4728           194         79         fault         19521         10714         4728           194         19521         10714         4728         4728           194         19607         10759         4723           194         19607         10759         4724           295         fault         19261         10769         4724           295         fault <td>224</td> <td>19</td> <td>bedding</td> <td>19394</td> <td>16532</td> <td>4728</td>	224	19	bedding	19394	16532	4728
251         19         bedding         19407         16750         4728           251         19         bedding         19007         16750         4728           282         86         point         19908         18078         4728           283         86         point         19904         18078         4728           285         86         point         19905         18078         4728           285         96         point         19905         18078         4728           285         96         point         19925         18084         4727           286         1990         19452         10704         4728           287         1940         19521         10704         4726           187         fault         19522         10704         4726           186         fault         19409         10709         4724           187         64         1909         10706         4724           1914         89         joint         19428         10706         4724           1914         89         joint         19428         10706         4724           1917	235	8	bedding	19401	16510	4728
23         19         Debding         1940/         187.00         4728           332         24         point         1940/         187.39         4728           332         24         point         1940/         187.39         4728           335         64         point         1940/         187.39         4728           335         64         point         1940/         187.39         4728           332         76         fault         19351         1606/         4727           332         76         fault         19321         107.44         4728           332         68         fault         19422         107.49         4726           332         68         fault         19428         107.69         4724           332         68         fault         19428         107.69         4724           332         68         fault         19428         107.66         4724           235         18         bedding         19428         107.66         4724           235         18         bedding         19428         107.76         4723           236         88 shartrachre	251	19	bedding	19407	16750	4728
132         24         point         19404         10739         4728           252         84         point         19404         10739         4728           252         84         point         19404         10739         4728           257         75         full         19505         10739         4728           257         76         full         19521         10714         4728           258         86         full         19421         10753         4728           258         86         full         19422         10759         4728           252         75         full         19521         10714         4728           252         74         full         19522         10709         4724           251         16         full         19409         10709         4724           251         16         full         19428         10709         4724           251         16         full         19428         10706         4724           251         16         full         19428         10706         4724           253         16         full         19428 </td <td>132</td> <td>97</td> <td>bedding .</td> <td>19407</td> <td>16750</td> <td>4728</td>	132	97	bedding .	19407	16750	4728
20         88         pint         19003         19703         4728           128         70         fault         19514         19706         4727           128         70         fault         19513         16664         4727           128         70         fault         19521         19754         4728           129         80         fault         19521         19774         4728           120         75         fault         19521         19779         4728           121         86         fault         19421         19738         4728           121         86         fault         19407         16679         4725           121         86         fault         19407         16679         4725           121         86         fault         19407         16769         4724           122         86         fault         19429         10769         4724           123         16         fault         19429         10274         4724           123         16         fault         19421         10274         4724           123         16         fault <t< td=""><td>352</td><td>84</td><td>joint</td><td>19404</td><td>16739</td><td>4728</td></t<>	352	84	joint	19404	16739	4728
352         84         joint         19404         19739         4728           128         70         fuult         19543         166864         4727           129         80         fuult         19423         166864         4727           129         80         fuult         19422         16753         4728           128         88         fuult         19521         16776         4728           132         86         fuult         19521         16776         4728           1312         86         fuult         19457         16687         4725           1312         86         fuult         19428         16769         4724           1312         86         fuult         19428         16769         4724           1312         81         fuult         19428         16769         4724           1312         81         fuult         19478         16768         4724           187         95         joint         19430         16764         4724           187         95         joint         19450         16714         4722           207         45         bedding	28	88	joint	19505	16708	4728
120         70         fault         19516         106680         4727           281         18         bedding         19543         10664         4727           281         18         bedding         19543         10664         4727           283         86         fault         19521         10714         4728           121         76         fault         19521         10709         4728           122         86         fault         19421         10759         4728           121         86         fault         19407         10679         4725           122         86         fault         19407         10679         4724           122         81         fault         19407         10769         4724           132         86         fault         19407         10769         4724           132         86         fault         19407         10769         4724           133         70         fault         19479         10521         4722           134         76         jaunt         19421         10274         4722           145         bedding         19449 <td>352</td> <td>84</td> <td>joint</td> <td>19404</td> <td>16739</td> <td>4728</td>	352	84	joint	19404	16739	4728
132         76         fault         19536         16684         4727           299         86         fault         19423         16684         4728         PHE           132         76         fault         19521         16778         4728         PHE           132         86         fault         19521         16779         4728           132         86         fault         19528         16709         4728           134         80         fault         19457         16749         4725           135         80         fault         19409         16769         4725           135         80         fault         19428         18768         4724           135         91         fault         19428         18768         4724           135         91         fault         19428         18776         4723           236         93 hear (math         19428         18776         4723           236         93 hear (math         19531         18726         4723           237         95 hear (math         19543         18211         4721           237         95 hear (math         19	128	70	fault	19514	16706	4727
281         18         bedding         19543         1728         4727           299         86         fault         19521         18714         4728           132         76         fault         19521         18776         4728           132         76         fault         19521         18776         4728           132         76         fault         1942         1874         4728           132         86         fault         1942         1878         4723           132         86         fault         1942         18769         4723           132         81         fault         1942         18769         4724           132         81         fault         1942         18770         4724           137         81         fault         1942         18770         4724           137         85         bedding         19449         10559         4724           137         85         bedding         19449         10551         4722           148         7         fault         1942         10211         4722           149         7         4721         472	132	78	fault	19536	16688	4727
299         86         fault         19422         16758         4726           132         86         fault         19521         16714         4726           132         75         fault         19520         16709         4728           132         86         fault         19520         16709         4728           1312         86         fault         19520         16709         4723           1312         86         fault         19647         16769         4723           1312         86         fault         19649         16769         4724           232         81         fault         1928         103799         4724           232         81         fault         1928         103799         4724           2331         86         fault         19476         17726         4723           2345         89         fault         19479         16221         4722           235         95         point         19553         4722           236         89         point         19554         16721         4722           237         45         bedding         19449	261	18	bedding	19543	16684	4727
120         89         180/14         4/28           121         152         160/14         192/21         187/29         4/28           144         19         fault         192/21         187/29         4/28           144         19         fault         192/21         187/29         4/28           144         19         fault         192/29         187/29         4/28           1312         96         fault         194/29         187/29         4/22           1312         91         fault         194/29         187/29         4/24           1312         91         fault         194/29         187/29         4/24           1312         91         fault         194/29         187/29         4/24           1312         91         fault         194/29         187/21         4/224           1317         95         194/29         185/59         187/21         4/224           1317         95         194/49         185/59         187/22         120/7         4/22           1318         97         191/49         18221         4/22         121         4/22           1318         98<	299	86	fault	19422	16758	4726 PHE
1.1.4         1.9 </td <td>120</td> <td>78</td> <td>fault</td> <td>19521</td> <td>16/14</td> <td>4726</td>	120	78	fault	19521	16/14	4726
246         24         bedding         19457         17249         4725           112         80         fault         19409         1709         4725           118         80         fault         19409         1709         4725           114         80         fault         19409         16799         4725           112         81         fault         19428         16799         4724           112         81         fault         19428         16769         4724           127         81         fault         19428         16769         4724           127         85         point         19429         16771         4724           128         16         fault         19474         16751         4724           129         78         bedding         19449         16559         4722           129         76         bedding         19449         16521         4722           1207         45         bedding         19449         16521         4722           130         7         point         19454         16377         4721           141         7421         16217	144	79	Fault	19522	16705	4720
312         88         fault         19407         16697         4725           312         86         fault         19407         16697         4725           312         86         fault         19409         18769         4725           312         81         fault         19428         18769         4724           253         16         bedding         19439         16768         4724           253         16         bedding         19478         167748         4724           209         78         sh fracture         19540         16774         4724           209         78         bedding         19474         16776         4722           207         45         bedding         19449         16221         4722           207         45	245	24	bedding	19457	16749	4726
118         60         fault         19409         16799         4725           132         66         fault         19409         16799         4725           132         81         fault         19428         16799         4724           132         81         fault         19428         16799         4724           132         81         fault         19428         16769         4724           187         85         pint         19439         16706         4724           2017         85         pint         19470         16712         4724           321         86         fault         19470         16712         4724           321         86         fault         19479         16559         16700         4723           207         45         bedding         19449         16559         4722           207         45         bedding         19449         16521         4722           30         gint         19456         16502         4722           318         63         pint         19456         16571         4721           320         46         pint	312	88	fault	19409	16769	4725
312         86         feult         19409         19709         4725           312         81         feult         19428         18769         4724           233         16         feult         19428         18769         4724           233         16         bedding         19439         18764         4724           233         16         bedding         19478         187744         4724           209         78         brint         19531         187726         4723           216         69 sher fracture         19474         16761         4723           217         5         bedding         19439         16221         4722           207         45         bedding         19449         16211         4721           207         45         bedding         19442         16217         4721           207         45         bedding <td>118</td> <td>80</td> <td>fault</td> <td>19547</td> <td>16697</td> <td>4725</td>	118	80	fault	19547	16697	4725
194         89         joint         19539         16666         4725           312         81         fault         19420         16769         4724           312         81         fault         19420         16769         4724           317         81         fault         19420         16769         4724           317         85         joint         19473         16776         4724           321         86         fault         19470         16712         4724           321         85         fault         19470         16714         4723           323         66         star fracture         19931         16253         4722           207         45         bedding         19449         16354         4722           207         45         bedding         19449         163521         4722           30         joint         19452         16321         4722           31         goint         19452         16321         4722           324         7         fault         19564         16714         4721           335         45         joint         19364         167	312	66	fault	19409	16769	4725
312         81         fault         19420         10769         4724           253         16         bedding         19443         10776         4724           253         16         bedding         19443         10776         4724           209         78         sh fracture         19940         10712         4723           216         66         fault         19953         10700         4723           216         69 shear fracture         19944         10555         4722           217         5         bedding         19449         10524         4722           207         45         bedding         19449         10221         4722           207         45         bedding         19449         10221         4722           3         55         ven         19142         10217         4722           3         55         ven         19142         10217         4721           228         65         ven         19142         10217         4721           238         45         point         19256         1221         4721           241         72         fauit	194	89	joint	19539	16696	4725
312         9         1940         1940         1970         4724           325         16         bedding         19476         19766         4724           187         95         punt         19476         19776         4724           221         95         facult         19470         19712         4724           221         95         facult         19470         19712         4723           226         95         hear factore         19349         19251         4722           236         95         hear factore         19349         19251         4722           237         45         bedding         19149         19251         4722           237         45         bedding         19149         19221         4722           237         45         bedding         19149         19221         4722           237         45         bedding         19142         19217         4722           238         85         rewin         19142         19217         4721           238         45         joint         19562         167714         4721           238         45         <	312	81	fault	19426	16769	4724
107         103 <th103< th=""> <th103< th=""> <th103< th=""></th103<></th103<></th103<>	312	18	hadding	19420	16/69	4/24
200         78         sh fractura         19540         16712         4724           31         96         fout         19540         1674         1772         4723           99         78         pint         19559         19700         4723           216         95 ber fracture         19559         19726         4723           217         45         bedding         19149         10221         4722           207         45         bedding         19149         10221         4722           207         45         bedding         19149         1021         4722           207         45         bedding         19149         1021         4722           207         45         bedding         19142         10217         4722           208         60         fault         19545         10737         4721           214         71         fault         19545         10737         4721           228         16         fault         19562         10714         4721           234         79         fault         19562         10714         4721           235         fault	187	85	iont	10478	16748	4724
321         88         fout         19474         19754         4723           99         78         point         19559         1700         4723           219         15         bedding         19449         10555         4722           207         45         bedding         19449         10521         4722           207         45         bedding         19449         10521         4722           98         83         point         19456         10562         4722           5         55         ven         1942         10217         4722           208         6         fault         1942         10217         4722           209         86         fault         19455         1077         4721           144         71         fault         19455         1077         4721           144         72         fault         1962         10713         4721           200         53         fault         19062         10714         4721           201         53         fault         19056         10714         4721           202         10         fault         1905	209	78	sh. fracture	19540	18712	4724
99         78         point         19559         18700         4723           216         06 shear fracture         19631         10726         4723           217         45         bedding         19449         10555         4722           207         45         bedding         19149         10221         4722           207         45         bedding         19149         10221         4722           207         45         bedding         19142         10217         4722           3         37         joint         19551         10717         4721           3         87         joint         19542         10217         4721           248         86         fault         19541         10714         4721           236         86         fault         19562         16774         4721           236         16         fault         19562         16714         4721           237         7         joint         19641         16714         4721           238         7         fault         19625         4721           239         joint         19469         16574	321	88	fault	19474	16761	4723
236         69 shear fracture         1933         10726         4723           219         15         bedding         19149         10221         4722           207         45         bedding         19149         10221         4722           207         45         bedding         19149         10221         4722           98         83         joint         19456         10554         10714         4722           5         55         vem         19142         10217         4722           200         86         fault         19452         10217         4722           200         86         fault         19453         10277         4721           144         71         fault         19561         10714         4721           228         70         fault         19562         10713         4721           200         53         fault         19052         18714         4721           201         53         fault         19058         10230         4721           202         53         fault         19058         10234         4720           203         45         faul	99	78	point	19559	18700	4723
219         15         bedding         19449         10555         4722           207         45         bedding         19149         10221         4722           207         45         bedding         19149         10221         4722           207         45         bedding         19149         10221         4722           13         87         joint         19554         10714         4722           5         55         vem         19142         10217         4722           290         86         fault         19545         10551         4721           144         71         fault         19564         10714         4721           281         79         fault         19562         16709         4721           281         79         fault         19562         16714         4721           200         55         fault         19678         16220         4721           10         77         joint         19368         16225         4721           203         5         fault         19473         16562         4720           204         5         joint	238	69	shear fracture	19531	16726	4723
207         45         bedding         19149         19221         4722           98         83         joint         19459         19221         4722           98         83         joint         19454         19524         4722           5         55         viewn         19142         19217         4722           209         85         featull         1942         19217         4722           200         85         featull         1942         19217         4722           200         85         featull         19453         1977         4721           144         71         featull         19641         19714         4721           224         16         fault         19963         19730         4721           235         70         fault         19963         19730         4721           236         53         fault         19945         19525         4721           239         45         joint         19136         19225         4720           202         23         bedding         19675         19524         4720           202         23         joint	219	15	bedding	19449	16555	4722
207         40         bedding         19149         10221         4722           13         87         joint         19854         10562         4722           13         87         joint         19854         10714         4722           13         87         joint         19854         10714         4722           15         55         view         19142         10217         4722           200         86         fault         19842         10217         4722           144         71         fault         19842         10217         4721           220         86         fault         19964         10714         4721           221         16         fault         19962         10705         1220         4721           238         97         fault         19962         10718         4721         1077         10713         4721           339         45         joint         19139         10225         4721         1073         4721           153         1621         4720         10239         4720         10239         4720           2020         96         53	207	45	bedding	19149	16221	4722
ses         point         19854         10542         4722           13         87         point         19854         10542         4722           3         55         view         19142         18217         4722           206         65         read         19142         18217         4722           206         95         read         1942         18217         4721           144         71         fault         1945         1837         4721           144         72         fault         19645         18374         4721           145         73         fault         19642         18770         4721           145         79         fault         19645         18574         4721           153         45         point         19136         18225         4721           160         7         fault         19459         18574         4720           288         65         fault         19475         18582         4720           202         31         bedding         19479         18239         4720           203         80         runt         19458         18	207	45	bedding	19149	16221	4722
b         μ	98	83 #7	joint	19458	16582	4722
5         5         Ven         15-74         162.17         47.22           280         90         fault         1942         163.17         47.21           141         72         fault         1942         163.17         47.21           141         72         fault         19454         103.14         47.21           141         72         fault         19454         103.14         47.21           144         72         fault         19561         107.16         47.21           1254         70         fault         19562         107.13         47.21           135         45         joint         19461         15568         47.21           139         45         joint         19136         162.25         47.21           288         7         fault         194.79         1657.4         47.20           288         65         fault         194.79         162.29         47.20           202         231         bedding         194.79         162.29         47.20           202         23         joint         19149         162.29         47.20           203         joint	13	55	joint	19147	18217	4/22
200         86         fault         10652         1027         4121           144         71         fault         19564         1027         4121           144         71         fault         19564         1027         4121           128         16         fault         19564         102714         4221           128         17         fault         19562         10714         4221           128         17         fault         19562         10713         4721           10         77         pmt         19138         16225         4721           339         45         pmt         19138         16225         4721           339         45         pmt         19138         16225         4721           339         45         pmt         19138         16225         4721           202         88         Fault         19467         16552         4720           202         88         Fault         19475         16524         4720           202         88         fault         19475         16524         4720           202         88         fault         19475 </td <td></td> <td>55</td> <td>ven1</td> <td>19142</td> <td>16217</td> <td>4722</td>		55	ven1	19142	16217	4722
144         71         fault         19545         19737         4721           141         72         fault         19564         19714         4721           228         16         fault         19561         19714         4721           281         79         fault         19562         19779         4721           281         79         fault         19562         19773         4721           285         70         fault         19562         19733         4721           10         77         joint         19461         19556         4721           339         45         joint         19136         19225         4721           288         70         fault         19479         16225         4720           288         85         fault         19479         16229         4720           202         81         bedding         19679         16224         4720           202         31         bedding         19673         16224         4720           203         53         joint         19149         16229         4720           204         53         joint	298	66	fault	19452	16581	4721
141         72         fault         19564         10714         4721           228         16         fault         19561         10711         4721           235         70         fault         19562         10709         4721           206         53         fault         19562         10773         4721           206         53         fault         1975         10225         4721           339         45         joint         19136         10225         4721           339         45         joint         19136         10225         4721           201         70         fault         19461         10554         4720           202         88         Fault         19467         10552         4720           202         88         Fault         19475         10552         4720           202         88         Fault         19475         10523         4720           202         89         50         joint         19149         10229         4720           203         20         wein         19149         10229         4720          132         88         fault	144	71	fault	19545	18737	4721
228         16         fault         19581         10711         4721           284         70         fault         19582         10709         4721           281         70         fault         19582         10713         4721           281         70         fault         19582         10713         4721           10         77         joint         19461         16568         4721           339         45         joint         19138         16225         4721           339         45         joint         19138         16225         4721           288         5         fault         19475         16562         4720           288         5         fault         19475         16562         4720           202         31         bedding         19070         16232         4720           203         50         joint         19149         16239         4720           204         53         joint         19149         16239         4720           205         50         vim         19145         16241         4720           205         50         boding <t< td=""><td>141</td><td>72</td><td>fault</td><td>19564</td><td>16714</td><td>4721</td></t<>	141	72	fault	19564	16714	4721
3354         70         fault         19562         19779         4721           200         53         fault         19662         19713         4721           200         53         fault         19075         15230         4721           339         45         joint         19138         15225         4721           339         45         joint         19138         15225         4721           201         70         fault         19461         15562         4720           202         35         fault         19475         15652         4720           202         35         fault         19475         15652         4720           202         35         joint         19149         16239         4720           203         80         raut         19670         16232         4720           203         80         joint         19149         16239         4720           133         88         fault         19573         16723         4719           204         21         bedding         19631         16524         4719           207         21         bedding	228	16	fault	19561	16711	4721
28         79         fault         19662         16713         4721           206         53         fault         19676         16220         4721           10         77         joint         19461         16568         4721           339         45         joint         19138         16225         4721           339         45         joint         19138         16225         4721           288         76         fault         19475         16562         4720           288         85         fault         19475         16562         4720           202         31         bedding         18070         16323         4720           203         30         joint         19149         10239         4720           204         33         joint         19149         10239         4720           205         30         joint         19149         10239         4720           205         30         joint         19149         10234         4720           205         205         bedding         19473         10234         4719           205         205         bedding	354	70	ault	19562	16709	4721
Loo         3.3         Taulin         19/76         16/20         4/21           13         77         point         19/36         16/268         4/21           339         45         point         19/36         16/268         4/21           339         45         point         19/36         16/254         4/21           231         70         point         19/36         16/254         4/21           231         55         fault         19/36         16/254         4/21           232         96         53         point         19/45         10/214         4/20           202         91         bedding         19/45         16/214         4/20           150         80         vein         19/45         16/214         4/20           150         80         vein         19/45         16/214         4/20           150         80         vein         19/45         16/214         4/20           212         82         bedding         19/45         16/24         4/19           226         10         bedding         19/23         16/24         4/19           207         21 <td>281</td> <td>79</td> <td>fault</td> <td>19562</td> <td>16713</td> <td>4721</td>	281	79	fault	19562	16713	4721
130         45         port         1 1905         1225         421           339         45         port         1945         10225         421           339         45         port         1945         10225         421           339         45         port         1945         10224         420           288         85         part         1945         10574         420           202         95         fault         1956         10224         420           202         95         fault         1956         10239         470           202         96         53         port         19149         10239         470           96         53         port         19149         10239         470           150         80         vein         19145         10241         470           212         1845         10241         470         179         270           226         18         bedding         19401         1673         4719           239         20         bedding         19401         1674         4719           207         21         bedding	200	22	raun	19070	18230	4/21
130         45         point         19138         19225         4721           281         70         full         19499         15574         4720           288         85         full         19475         15582         4720           288         85         full         19475         15582         4720           202         86         full         19475         15582         4720           202         203         bedding         19070         10232         4720           96         53         joint         19149         10239         4720           96         53         joint         19145         10241         4720           150         80         vein         19145         10241         4720           152         86         four         191573         10723         4719           282         12         bedding         19453         10272         4719           207         21         bedding         19128         10246         4719           208         20         bedding         19128         10246         4719           202         20         bedding	339	45	joint	19401	10008	4/21
291         70         fault         19469         16574         4720           288         85         fault         19475         15522         4720           302         86         fault         19475         15522         4720           302         88         fault         19566         16716         4720           302         81         bedding         19479         18239         4720           96         53         joint         19149         18239         4720           150         80         vein         19145         18241         4720           132         88         fault         19573         16733         4719           226         16         bedding         19453         16241         4720           239         26         bedding         19405         16776         4719           247         2         bedding         19123         16248         4719           207         21         bedding         19123         16248         4719           209         20         bedding         19123         16248         4719           202         12         bedding <td>339</td> <td>45</td> <td>joint</td> <td>19138</td> <td>18225</td> <td>4721</td>	339	45	joint	19138	18225	4721
288         85         fault         19475         15582         4720           202         86         fault         19456         16716         4720           202         231         bedding         19070         18232         4720           96         53         joint         19149         18239         4720           96         53         joint         19149         18239         4720           96         53         joint         19149         18239         4720           96         53         joint         19145         18241         4720           150         80         viein         19145         18241         4720           152         86         fault         1973         16723         4719           262         12         bedding         19463         16354         4719           203         20         bedding         19128         16246         4719           202         20         bedding         19128         16246         4719           203         20         bedding         19128         16246         4719           204         0         viein	291	70	fault	19469	16574	4720
302         86         fault         19566         19716         4720           202         31         bedding         19707         16232         4720           96         53         joint         19149         16239         4720           96         53         joint         19149         16239         4720           150         80         veim         19145         16241         4720           150         80         veim         19145         16241         4720           132         88         fault         19573         16723         4719           226         16         bedding         19405         16724         4719           282         12         bedding         1953         16722         4719           207         21         bedding         19123         16224         4719           202         21         bedding         19123         16246         4719           202         21         bedding         19123         16246         4719           202         21         bedding         19124         16244         4719           202         21         bedding <td>288</td> <td>85</td> <td>fault</td> <td>19475</td> <td>16582</td> <td>4720</td>	288	85	fault	19475	16582	4720
202         31         bedding         19070         18232         4720           96         53         joint         19149         18239         4720           96         53         joint         19149         18239         4720           96         53         joint         19149         18239         4720           150         80         vein         19145         18241         4720           260         16         bedding         19431         16352         4719           233         26         bedding         19431         16246         4719           207         21         bedding         19723         16246         4719           202         20         bedding         19723         16246         4719           203         20         bedding         19724         16244         4719           204         64         50	302	86	fault	19566	18716	4720
96         53         joint         19149         18239         4720           96         53         joint         19149         18239         4720           150         80         veim         19145         18241         4720           150         80         veim         19145         16241         4720           132         88         fault         19573         16773         4719           226         16         bedding         19453         16273         4719           282         2         bedding         19633         16955         4719           207         21         bedding         19123         16224         4719           207         21         bedding         19123         16224         4719           202         21         bedding         19123         16246         4719           202         21         bedding         19123         16246         4719           202         21         bedding         19124         16244         4719           202         21         bedding         19025         16244         4719           203         bedding         191	202	31	bedding	19070	16232	4720
99         33         point         19149         10239         4720           150         80         vien         19145         10241         4720           128         81         bedding         19453         16352         4719           226         15         bedding         19433         16352         4719           207         20         bedding         19123         16252         4719           208         20         bedding         19123         16254         4719           209         20         bedding         19123         16264         4719           202         21         bedding         19123         16246         4719           202         21         bedding         19123         16264         4719           202         21         bedding         19124         16244         4719           203         0         vien	96	53	joint	19149	16239	4720
100         00         viewn         19145         10241         4220           150         80         viewn         19145         10244         4220           132         88         fault         19573         16773         4719           226         16         bedding         19963         16575         4719           228         2         bedding         19963         16732         4719           207         21         bedding         19078         16228         4719           207         21         bedding         19723         16226         4719           202         21         bedding         19723         16246         4719           203         0         viewn         19724         16244         4719           47         77         viewn         19055         16242         4718           201         66         faut </td <td>96</td> <td>53</td> <td>joint</td> <td>19149</td> <td>16239</td> <td>4720</td>	96	53	joint	19149	16239	4720
132         88         full         19273         19723         179           236         16         bedding         19633         16555         4719           236         15         bedding         19633         16723         4719           237         25         bedding         19633         16724         4719           237         25         bedding         1973         1223         4719           207         21         bedding         19123         1223         4719           207         20         bedding         19123         1223         4719           202         21         bedding         19123         1223         4719           202         21         bedding         19123         1223         4719           202         21         bedding         19123         1224         4719           202         21         bedding         19124         1244         4719           203         62         vin         19124         1244         4719           46         60         vin         19124         1244         4719           215         26         fut	150	80	VEID	10145	10241	4720
256         16         bedding         1943         16595         4719           282         12         bedding         1943         1672         4719           239         25         bedding         1943         16776         4719           207         21         bedding         1940         16776         4719           209         20         bedding         19123         16226         4719           209         20         bedding         19123         16226         4719           209         20         bedding         19123         16226         4719           202         21         bedding         19128         16226         4719           202         21         bedding         19128         16226         4719           50         vein         19124         16246         4719           64         80         vein         19124         16242         4718           201         64         four         1903         16242         4718           203         20         bedding         19101         16242         4718           203         20         bedding         19101	132	88	fault	19573	16723	4719
282         '2         bedding         19/93         10/73         4719           207         21         bedding         19/90         10778         4719           207         21         bedding         19/23         10/23         4719           207         21         bedding         19/23         10/23         4719           209         20         bedding         19/23         10/24         4719           202         21         bedding         19/24         10/24         4719           47         77         vin         19/24         10/24         4719           48         0         vin         19/24         10/24         4719           215         58         bedding         19/05         15/25         4718           201         66         fault         19/25         12/24         4718           203         30         beddin	256	16	bedding	19483	16595	4719
239         29         bedding         19490         10776         4719           207         21         bedding         1978         16224         4719           209         20         bedding         19723         16236         4719           209         20         bedding         19723         16236         4719           209         20         bedding         19723         16236         4719           202         21         bedding         19723         16246         4719           202         21         bedding         19728         16246         4719           150         90         vein         19534         16244         4719           64         80         vein         19124         1624         4718           201         66         fourt         19095         16242         4718           201         30         bedding         19101         1624         4718           203         30         bedding         19101         1624         4718           203         30         bedding         19101         1624         4718           203         30         bedding	282	12	bedding	19583	16732	4719
207         21         bedding         19078         1923         1223         4719           209         20         bedding         19123         1223         4719           202         21         bedding         19123         16246         4719           202         21         bedding         19124         16244         4719           47         77         vein         19085         16242         4718           201         66         fourt         19124         16244         4719           201         66         fourt         19124         16244         4718           203         30         bedding         19055         15262         4718           203         30         bedding         19101         16242         4718           203         30         bedding         19101         15271         4718           203         3	239	28	bedding	19490	16776	4719
209         20         bedding         19123         16226         4719           202         21         bedding         19123         16226         4719           209         20         bedding         19123         16226         4719           202         21         bedding         19128         16226         4719           150         90         ven         19554         16744         4719           46         80         ven         19124         16248         4719           64         80         ven         19124         16244         4719           201         66         fourt         19095         16224         4718           201         66         fourt         19095         16242         4718           203         30         bedding         19101         16245         4718           203         30         bedding         19109         16242         4718           203         30         bedding         19109         16242         4716           203         30         bedding         19109         16270         4716           203         30         bedding <td>207</td> <td>21</td> <td>bedding</td> <td>19078</td> <td>16262</td> <td>4719</td>	207	21	bedding	19078	16262	4719
Liva: 21         bedding:         19123         1923         4218           209         20         bedding:         19123         1923         4219           202         21         bedding:         19123         1923         4219           202         21         bedding:         19124         1924         4719           47         77         ven:         19083         16244         4719           47         77         ven:         19124         16244         4719           48         80         ven:         19124         16244         4719           201         66         fault         19095         16252         4718           207         30         bedding:         19101         16245         4718           203         30         bedding:         19101         16242         4718           203         30         bedding:         19128         16271         4718           203         30         bedding:         19127         16272         4718           203         30         bedding:         19128         16272         4718           203         30         bedding:	209	20	bedding	19123	16236	4719
Low Low         Desding         19123         10236         4719           202         21         bedding         19128         10246         4719           150         90         veim         1954         16246         4719           47         77         veim         1953         16246         4719           64         80         veim         19124         16244         4719           64         80         veim         19124         16244         4719           201         66         fault         15065         4718         4718           215         28         bedding         19107         16245         4718           207         30         bedding         19107         16245         4718           203         30         bedding         19107         16245         4718           203         30         bedding         19125         12720         4718           16         80         veim         19572         12720         4718           178         B0         veim         19572         12720         4718           203         80         veim         19572	202	21	bedding	19128	16246	4719
cv.z.         -         Decomp         19'40         10244         4/19           150         90         van         190854         10744         4/19           47         77         van         19083         10244         4/19           47         77         van         19083         10244         4/19           48         80         van         19124         10244         4/19           201         66         fault         19095         10222         4/18           201         56         fault         19095         10245         4/18           201         50         fault         19095         10245         4/18           201         50         fault         19101         10245         4/18           203         50         beddong         19101         10245         4/18           203         50         beddong         19101         10245         4/18           203         50         beddong         19101         10245         4/18           203         50         fault         195/28         10278         4/17           18         80         van	209	20	bedding	19123	16236	4719
17         10         10         10         10         10           47         57         vein         1023         10248         4719           64         60         vein         19124         10248         4719           201         66         vein         19124         10244         4719           201         66         vein         19124         10242         4718           201         55         28         bedding         19605         10245         4718           207         30         bedding         19101         10245         4718           203         80         vein         19572         10728         4718           18         80         fault         19572         10742         4718           18         80         fault         19572         10742         4717           180         28         bedding <td>150</td> <td>90</td> <td>ocoung</td> <td>19554</td> <td>18744</td> <td>4/15</td>	150	90	ocoung	19554	18744	4/15
64         80         van         19124         10244         4715           64         80         van         19124         10244         4715           215         65         faut         19057         10242         4718           215         28         bedding         19007         10765         4718           215         28         bedding         19007         10765         4718           207         30         bedding         19103         16245         4718           203         30         bedding         19103         16245         4718           203         30         bedding         19103         16242         4718           203         30         bedding         19103         16242         4718           203         20         vien         13978         16727         4718           203         20         vien         13978         16727         4718           138         64         fault         19572         16727         4717           203         24         fault         19572         1677         4717           204         20         bedding	47	77	vein	19083	16248	4719
84         80         vein         19124         1224         4719           201         66         fuut         19095         1224         4718           215         28         bedding         19095         12245         4718           207         30         bedding         19101         12245         4718           203         80         vein         19572         16723         4718           18         80         vein         19572         16727         4718           18         80         fault         19572         16742         4717           18         82         fault         19572         16742         4717           206         30         bedding         19112         16279         4717           200         30         bedding	64	80	ven	19124	18244	4719
201         66         fputt         19095         10262         4718           215         28         bedding         19101         16245         4718           207         30         bedding         19109         16245         4718           203         30         bedding         19128         16270         4719           18         80         Raventake         19226         4717           130         54         fedding         19118         16276         4717           140         paint         19127	64	80	vein	19124	18244	4719
215         28         bedding         19607         18765         4718           207         30         bedding         19101         16245         4718           203         30         bedding         19109         16245         4718           203         30         bedding         19101         16245         4718           203         30         bedding         19101         16242         4718           203         30         bedding         19101         16242         4718           203         20         vein         19572         16738         4718           18         80         vein         19572         16727         4718           18         80         fault         19572         16724         4717           204         29         bedding         1912         16276         4717           205         30         bedding         1912         16279         4717           205         30         bedding         19107         16281         4717           200         30         bedding         19107         16281         4717           200         30         beddi	201	68	fault	19095	18282	4718
207         30         bedding         19101         16245         4718           203         30         bedding         19109         16242         4718           207         30         bedding         19109         16242         4718           203         30         bedding         19109         16245         4718           203         30         bedding         19109         16242         4718           203         30         bedding         19109         16242         4718           203         30         bedding         19109         16242         4718           203         82         vein         19572         16774         4718           18         82         Ravendike         19125         16270         4718         dista           18         84         fault         19112         16276         4717           205         54         fault         19112         16276         4717           196         29         bedding         1907         16261         4717           200         30         bedding         19107         16251         4717           200 <t< td=""><td>215</td><td>28</td><td>bedding</td><td>19507</td><td>18765</td><td>4718</td></t<>	215	28	bedding	19507	18765	4718
203         30         bedding         19103         19242         4718           207         30         bedding         19103         18245         4718           203         30         bedding         19103         18245         4718           203         30         bedding         19103         18242         4718           203         82         vien         19572         18738         4718           18         80         vien         19572         18727         4718           138         84         fauit         19572         18726         4717           205         54         fauit         1912         19276         4717           180         29         bedding         19112         19276         4717           206         29         bedding         19112         19276         4717           200         30         bedding         19107         15241         4717           200         30         bedding         19107         1525         4717           200         30         bedding         19107         1525         4717           217         40         joint </td <td>207</td> <td>30</td> <td>bedding</td> <td>19101</td> <td>18245</td> <td>4718</td>	207	30	bedding	19101	18245	4718
207         30         beddong         19101         18245         4718           203         30         beddong         19109         18242         4718           203         32         vein         19572         18728         4718           18         80         vein         19578         18277         4718           18         80         vein         19578         18272         4718           18         82         Ravendika         19126         18272         4718           18         84         fault         1912         18274         4717           235         54         fault         19112         16275         4717           195         25         54         bedding         1918         12274         4717           195         45         bedding         1918         1225         4717           196         29         bedding         19107         1221         4717           200         30         bedding         19107         1221         4717           200         30         bedding         19107         1221         4717           200         30	203	30	bedding	19109	18242	4718
cvs         sv         besong         19103         18242         4716           203         82         ven         19572         16728         4718           18         80         ven         19572         16727         4718           138         80         rearend&e         19728         1277         4718           138         84         fauit         19572         16742         4717           204         29         bedding         1912         12275         4717           180         29         bedding         1912         12275         4717           203         30         bedding         19107         12261         4717           200         30         bedding         19107         12261         4717           203         30         bedding         19107         12261         4717           200         30         bedding         19107         12261         4717           204         30         lastr         139137         18255         4717           214         40         joint         19131         18255         4717           214         40         joint <td>207</td> <td>30</td> <td>bedding</td> <td>19101</td> <td>18245</td> <td>4718</td>	207	30	bedding	19101	18245	4718
Loss         vein         15/14         16/15         4/18           18         807         16/17         4/18         4/18           148         82         Rayen dike         19/28         16/27         4/18           138         84         fault         19/28         16/27         4/18           138         84         fault         19/28         16/27         4/18           138         84         fault         19/28         16/27         4/17           138         24         fault         1912         16/27         4/17           138         25         fault         1912         16/27         4/17           139         25         fault         1912         16/27         4/17           195         45         bedding         1908         16/27         4/17           200         30         bedding         1907         16/21         4/17           200         30         bedding         19107         16/25         4/17           200         30         fault         1913         16/25         4/17           200         30         fault         1913         16/25	203	30	pegging	10522	18242	4/18
146         82         Raven dike         1572         1270         4718           136         82         fault         19572         1574         4717           136         84         fault         19572         1574         4717           136         84         fault         1912         15276         4717           136         84         fault         1912         15276         4717           136         85         bedding         1913         15279         4717           130         305         bedding         19107         15279         4717           203         30         bedding         19107         15279         4717           203         30         bedding         19107         15279         4717           204         90         bedding         19107         15255         4777           714         40         part         1913         15255         4777           204         90         yaut         19645         15728         4716           321         805         faut         19184         15278         4716           337         551         faut	18	80	vein	19578	18727	4718
136         64         fault         19572         1772           236         54         fault         1912         15272         4777           236         54         fault         1912         15275         4717           180         29         bedding         1916         15275         4717           180         29         bedding         1908         15275         4717           193         45         bedding         1908         15279         4717           200         30         bedding         19107         16281         4717           201         60         fault         1913         16255         4717           216         60         fault         19586         16738         4716           321         65         fault         19151         16228         4716           35         51         fault         19151	148	82	Raven dike	19126	18270	4718 dika
236         54         fault         1912         1927         4717           186         25         bedding         1916         1227         4717           195         45         bedding         1918         1227         4717           195         45         bedding         1908         1227         4717           200         30         bedding         19107         1221         4717           200         30         bedding         19107         1221         4717           200         30         bedding         19107         1225         4717           71         40         paint         1913         1225         4717           714         40         paint         1913         1225         4717           216         60         fault         1948         1072         4716           321         65         fault         1948         1072         4716           37         53         fault         1915         1225         4716           37         53         fault         1915         1225         4716           36         53         fault         1915	138	84	fault	19572	18742	4717
180         29         bedding         1916         10275         4717           195         45         bedding         19088         16279         4717           200         30         bedding         19107         16281         4717           200         30         bedding         19107         16281         4717           714         40         joint         1913         16255         4717           304         90         var.         19635         16733         4717           304         90         var.         19687         1674.2         4716           316         80         fautt         19681         1673.3         4716           32         85         fautt         19647         1674.2         4716           32         85         fautt         19161         16271         4716           33         73         fautt         19151         16284         4716           35         fautt         19161         16271         4716           36         fautt         19161         16224         4716           37         53         fautt         19161         16224	238	54	fault	19112	16276	4717
195         45         bedding         19088         19279         4717           200         30         bedding         19107         16281         4717           200         30         bedding         19107         16281         4717           200         30         bedding         19107         16281         4717           714         40         joint         19133         16255         4777           714         40         joint         19133         16255         4777           206         0         vaint         19485         16753         4777           216         60         fault         19487         16742         4716           321         85         fault         19488         16738         4716           35         53         fault         19151         16224         4716           37         53         fault         19151         16224         4716           47         63         fault         19161         16224         4716           30         fault         19161         16224         4716         16243           30         fault         19180	180	29	bedding	19116	18275	4717
Lvu         su         bedding         19'07         1021         47'17           200         30         bedding         19'07         1021         47'17           171         40         joint         19'13         10225         47'17           304         90         van         19'03         10225         47'17           304         90         van         19'067         10'24         47'16           311         19'07         10'24         47'16         47'16         10'24           321         80         fault         19'687         10'74         10'27'1         47'16           321         80         fault         19'161         10'27'1         47'16         10'26         47'16           325         7         fault         19'161         10'27'1         47'16         10'16'16'16'1'14'16'16'16'16'16'16'16'16'16'16'16'16'16'	195	45	bedding	19088	18279	4717
Ave         Description         1910/1         10201         4717           171         40         joint         19113         10225         4717           171         40         joint         19113         10225         4717           174         40         joint         19113         10225         4717           214         90         vaint         19565         1673         4717           216         90         /autit         19587         16742         4716           321         85         fault         19587         167742         4716           35         51         fault         19151         10228         4716           36         71         fault         19151         10228         4716           45         48         fault         19151         10224         4716           39         31         fault         19161         10224         4716           39         31         fault         19188         1024         4716           39         31         fault         19188         1024         4716	200	30	bedding	19107	18261	4717
point 1915 1265 4777 304 90 ven 1903 1255 4777 324 90 ven 19067 1873 1255 4777 326 95 faut 19067 13742 4716 327 95 faut 19061 19738 4716 337 35 faut 19151 19271 4716 45 46 faut 19151 1928 4716 45 48 faut 19151 1828 4716 47 8 faut 19161 1828 4716 47 9 31 faut 19161 1824 4716 47 9 31 faut 19161 1824 4716 47 9 31 faut 19161 1824 4716	200	30	peading	19107	10201	4717
June         June <thjune< th="">         June         June         <thj< td=""><td>171</td><td>40</td><td>joint</td><td>19113</td><td>18255</td><td>4797</td></thj<></thjune<>	171	40	joint	19113	18255	4797
216 80 raut 19587 10742 4716 321 85 faut 19587 10742 4716 33 57 faut 19181 10271 4716 33 55 faut 19181 10271 4716 34 56 faut 19151 10258 4718 45 68 faut 19174 10254 4718 45 69 faut 19161 10254 4718 47 60 faut 19188 10254 4718 47 60 faut 19188 10254 4718	304	90	yein	19565	16753	4717
321         85         fault         19586         18736         4716           36         71         fault         19161         16221         4716           37         53         fault         19161         16228         4716           45         48         fault         19151         16228         4716           45         48         fault         19174         16254         4716           39         31         fault         19161         16254         4716           39         31         fault         19188         16243         4716           39         31         fault         19188         16243         4716	216	80	fault	19587	16742	4716
36         71         fputt         19161         16271         4716           37         53         fault         19151         16226         4716           45         48         fputt         19174         16266         4716           45         43         fputt         19174         16266         4716           39         31         fputt         19181         16224         4716           39         31         fputt         19188         16243         4716	224	85	fault	19588	18738	4718
37         53         fault         19151         10258         4718           45         48         fault         19174         16268         4718           47         63         fault         19161         16254         4716           39         31         fault         19181         16243         4716           39         31         fault         19188         16243         4716	261	71	fault	19161	16271	4716
45 45 fault 19174 18266 4716 47 63 fault 19161 18254 4716 39 31 fault 19188 18243 4716 32 33 fault 19188 18243 4716	36			10161	18259	4718
•r v3 18011 19101 18254 4716 39 31 fault 19188 18243 4716 32 33 fault 19198 18243 4716	36 37	53	fault	19131	102.00	47.0
30 33 foult 10100 10243 4/10	36 37 45	53 48	fault fault	19174	16266	4716
UN UN 10111 10100 10717 A/18/EF	36 37 45 47 30	53 48 63	fault fault fault	19174 19161	16268 16254	4716 4716 4718

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AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION REMARK	
33	48	fault	19211	18258	4716 CFZ	1
293	65	fault	19209	10202	4/16	
273	21	fault	19120	16247	4716	
202	35	bedding	19148	16277	4716	L
35	17	bedding	19156	162/4	4/16	
190	32	bedding	19131	16285	4718	
12	15	bedding	19182	18284	4718	
303	23	bedding	19138	16258	4/15	
177	30	bedding	19104	18283	4716	
205	35	bedding	19080	16261	4716	
205	- 35 60	Dedding	19080	16261	4716	
207	60	joint	19135	18270	4716	
272	66	joint	19139	16283	4716	
310	90 57	ven shear fracture	19569	16758	4716	
115	78	shear fracture	19188	10261	4716	
286	70	fault	19193	16266	4715	
39	43	fault	19141	16198	4715 CFZ	L
314	82	fault	19138	16221	4715	L
87	48	fault	19132	16227	4715	l
253	24	bedding	19438	16839	4715	
253	37	bending bending	19438	16839	4715	
194	29	bedding	19144	16217	4715	1
209	38	bedding	19151	16243	4715	1
68	30	bedding	19183	16200	4715	1
207	30	beddina	19143	16302	4715	
48	34	bedding	19162	18301	4715	
180	25	bedding	19087	16272	4715	
92	77	ioint	19087	16272	4/15	
177	30	joint	19128	16258	4715	
106	80	joint	19097	18214	4715	
144	58 77	joint	19099	16220	4715	
85	65	pint	19139	18300	4715	ŀ
138	80	joint	19146	16297	4715	
203	85	joint	19102	16273	4715	1
136	80	joint	19139	16300	4715	
203	85	joint	19102	16273	4715	
226	39	shear	19151	18299	4715	
131	84	vein	19575	16763	4715	
40	47	fault	19218	16265	4714 CFZ	ł
198	39	fault	19131	18250	4714	L
198	37	fault bedding	19113	16313	4714	
234	62	bedding	19127	16220	4714	1
223	42	bedding	19128	16305	4714	
197	43	bedding	19095	16292	4714	1
95	84	ioint	19580	16765	4714	1
130	75	joint	19545	16761	4714	
259	88	joint	19125	16307	4714,	ł
228	50 55	joint joint	19127	16304	4/14	1
82	90	joint	19127	16304	4714	
228	55	joint	19091	16281	4714	1
110	74	Vêin Raven dike	19598	18750	4714 4714 dike	L
259	74	fault	19599	16752	4713	L
31	43	fault	19225	16279	4713	L
73	45	fault boddian	19152	16238	4713	
259	30 70	bedding	19514	18/84	4/13	1
224	30	bedding	19112	16311	4713	
224	30	bedding	19112	16311	4713	
- 38	/6 78	joint Joint	19453	16851	4713	
70	80	joint	19521	16781	4713	Ĺ
35	80	joint	19527	18777	4713	
125	80	joint	19530	18775	4713	
135	85	joint	19550	10758 18748	4713	
221	88	joint	19161	16239	4713	
332	74	joint	19131	16217	4713	
283	35 85	joint	19139	16210	4713	
159	85	joint	19121	16308	4713	
190	33	shear	19110	10308	4713	
134	82 82	VEIN	19463	16844	4713	
107	58	shear fracture	19148	16248	4713	
226	88	fauit	19604	16761	4712	
105	68	fault	19804	18757	4712	

AZIMUTH	OIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK
226	88	fault	19604	18761	4712	
53	53	fault	19604	16/5/	4712	
52	62	fault	19211	18309	4712	
254	18	bedding	19527	18755	4712	
220	20	bedding	19510	10/05	4712	
26	21	bedding	19208	16310	4712	
10	5	bedding	19197	16268	4712	1
254	42	bedding	19166	16238	4712	
254	42	bedding	19095	16314	4712	
180	90	joint	19523	16761	4712	
130	72	joint	19514	16765	4712	
125	72	joint	19111	16316	4712	
348	77	Raven dike	19148	18218	4712	dike
138	78	fault	19608	16761	4/11	
206	79	fauit	19608	16759	4711	
138	78	fault	19608	18761	4711	
241	18	bedding	19472	16871	4/11	CHZ
241	18	bedding	19472	16871	4711	
325	.7	bedding	19494	18777	4711	
228	45	bedding	19503	16/62	4/11 4711	
256	45	bedding	19093	16319	4711	
130	90	joint	19489	16773	4711	
234	70	joint	19505	16764	4711	
208	50	joint	19108	16328	4711	
208	50	joint	19108	16328	4711	
235	88	sh fracture	19604	18766	4711	
217	88	sh fracture	19604	18766	4711	
141	83	fault	19613	18765	4710	
139	84	fauit	19515	16729	4710	
141	83	fault	19613	16765	4710	
204	90	fauit	19602	16773	4710	
23	31	raux fauit	1919/	16216	4710	CFZ CFZ
124	75	fault	19066	16329	4710	
124	75	fault	19086	18329	4710	
233	50	bedding	19520	16735	4710	
204	55	joint	19104	16336	4710	
204	55	plint	19104	18338	4710	
355	70	fault	19197	16197	4709	CFZ
309	80	fault	19101	16350	4709	
309	30	fault bedding	19101	18350	4709	
248	32	bedding	19086	16341	4709	
43	85	joint	19471	18758	4709	
114	80	joint	19096	16349	4709	
4	18	vein	19622	18770	4709	
4	18	vein	19822	16770	4709	
139	83	sh fracture	19617	16765	4709	dike 1
139	83	sh fracture	19617	18765	4709	
298	75	sh fracture	19103	16335	4709	
148	81	fault	19609	16789	4708	
168	49	fault	19504	16718	4708	
198	76	fault	19603	16791	4708	
243	28	bedding	19502	16714	4708	
227	20	bedding	19468	18753	4708	
224	50	bedding	19505	18718	4708	
254	10	bedding	19081	16357	4708	
254	10	bedding	19081	18357	4708	
200	70	joint	19508	16/00	4708	PHE
295	70	fauit	19504	16696	4707	PHE
290	61	fault	19097	16352	4707	
306	75	rault fault	19080	16367	4/07	
269	16	bedding	19615	18792	4707	ļ
269	18	bedding	19615	18792	4707	
285	18	bedding	19096	18366	4707	
285	18	bedding	19096	16366	4707	
35 108	90 85	joint	19502	16595	4707	
327	68	joint	19078	16361	4707	
108	85	joint	19091	16372	4707	
308	_90	yeint vein	19464	16883	4707	

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19244 19238	18997	19254	10281	19285	ACZ61	19213	19227	19206	19257	19320	19272	19247	19191	11261	19203	19220	19183	19284	19324	19324	19222	19260	006481	19198	19239	19233	19277	19307	19268	19197	19209	19219	19219	19238	19155	19160	19176	10000	19311	19239	19250	19228	19207	10213	19198	19184	19180	19164	19261	19303	19271	19219	19219	19219	19210	19197	19231	19093	10001	19232	19187	19167	19305	19329	19233	19223	19218	100141	19130	19224	19113	19120	19139	19108	19111	19110	19122	19083	9004
16438	18188	18430	16127	10201	16243	16243	18229	16277	18278	18278	16303	16,104	18306	10178	16412	16174	18310	18369	16317	10346	18244	18244	18287	18251	18260	16264	18309	18289	18273	10121	18209	16182	16211	16193	16297	16316	1937	18335	16349	16226	18249	18239	18253	18259	16277	18276	16282	18296	16313	18292	16269	10296	18307	16334	18306	16312	16426	1622	14210	18189	18345	18309	16316	16334	1644	16446	18439	1810	1630/	10438	10225	18224	16211	18202	18208	16200	18218	10234	10200
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308         65         pint         19247         19442         460           319         78         fault         19054         16220         4659           219         30         beddingf         19248         16417         4659           229         30         beddingf         19248         16421         4659           220         67         fault         19159         19337         4658           320         fault         19159         19337         4658           33         62         fault         19228         19304         4658           33         62         fault         19229         19304         4658           33         62         fault         19227         19449         4658           330         63         point         19027         19401         4658           330         64         point         19207         19401         4658           320         70         badding         19103         19163         4657           203         24         badding         19103         16164         4657           203         25         fault         19220	AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION REMARK
147         64         fault         19015         19165         4659           199         63         fault         19230         10392         4659           229         30         beddinge         19253         10420         4659           220         62         fault         19167         16322         4659           220         67         fault         19167         16322         4658           230         62         fault         19227         16387         4658           210         25         bedding         19207         16164         4658           210         25         bedding         19202         16408         4658           220         5         bedding         19207         16408         4658           2210         25         bedding         19207         16408         4658           2210         5         bedding         19217         16408         4658           226         7         fault         19207         16408         4657           220         5         fault         19207         16439         4657           220         5         fault <th>308</th> <th>85</th> <td>ioint</td> <td>19247</td> <td>18442</td> <td>4660</td>	308	85	ioint	19247	18442	4660
13         78         Earli         19054         19220         4655           199         53         fault         19245         16427         4655           24         8         anticine         19253         16420         4655           24         8         anticine         19253         16421         4655           25         72         fault         19159         10337         4658           35         62         fault         19223         10390         4658           210         25         bedding         19275         164431         4656           210         25         bedding         19275         164451         4656           210         25         bedding         19277         16160         4656           210         25         bedding         19277         161601         4658           210         25         bedding         19014         16152         4658           211         19141         19217         16382         4657           212         36         fault         19227         16382         4657           212         36         fault         1923	147	84	fault	10015	16195	4659
190         0.5         1900         1900         1900         1900           190         0.5         0.6         1901         19167         19122         4659           220         0.7         Fault         19167         19122         4659           192         7         Fault         19167         19322         4658           192         7         Fault         19222         10307         4658           210         25         bedding         19222         10408         4658           217         60         65         joint         19027         16408         4651           217         60         joint         19227         16408         4657           2205         74         fault         19220         16408         4657           2205         75         fault         19221         10332         4657           2205	318	79	fault	10064	18220	4660
199         63         fault         1923         1932         4659           226         30         bedding         1923         19420         4659           23         30         bedding         1923         1932         4659           230         67         fault         19167         19332         4659           230         67         fault         1923         19330         4659           230         7         bedding         19238         19330         4659           230         7         bedding         19275         19411         4659           200         5         bedding         19275         19401         4659           201         5         bedding         19277         19401         4659           203         64         bint         19118         19173         4658           204         64         19287         19432         4651           202         7         fault         19227         19432         4657           203         28         bedding         1927         19432         4657           203         28         bedding         19190	310	10	- aun	19004	10220	4059
229         30         bedding/         19248         16417         4659           24         8         ankine         19253         16420         4659           250         67         fault         19159         19337         4658           122         73         fault         19228         19304         4658           250         72         fault         19228         19304         4658           210         25         bedding         19262         19406         4658           210         25         bedding         19262         19406         4658           2175         67         joint         19027         19406         4658           2176         63         joint         19027         19406         4658           320         70         shear facture         19033         19163         4658           320         70         shear facture         19032         16164         4657           203         26         fault         19220         16432         4658           203         28         bedding         19100         16249         4657           203         28	199	83	raun	19230	10392	4659
24         8         ambeline         19253         16420         4659           250         67         fault         19167         16322         4658           260         67         fault         19122         16387         4658           35         62         fault         19222         16387         4658           210         25         bedding         19202         16441         4656           210         25         bedding         19202         16443         4656           210         25         bedding         19202         16443         4656           210         26         bedding         19202         16443         4655           217         5         bedding         19103         16153         4655           217         5         bading         19037         16184         4657           218         bedding         19109         16224         4657           220         27         6         4657         16382         4657           220         28         bedding         19109         16224         4657           220         28         bedding         19114<	229	30	peddingf	19248	16417	4659
53         62         fault         19167         16122         4658           122         73         fault         19159         10337         4658           35         72         fault         19223         10390         4658           35         62         fault         19223         10431         4658           200         25         bedding         19275         16441         4656           200         5         bedding         19275         164451         4658           201         25         bedding         19277         16401         4658           203         64         joint         19014         16152         4658           203         64         joint         19287         16482         4658           203         70         sheef facture         192267         16482         4657           203         74         fault         19227         16382         4657           204         74         fault         19227         16382         4657           203         28         bedding         19107         16742         4657           204         74         fault	24	8	anticline	19253	16420	4659
296         67         Lauti         1919         19322         4653           122         73         Fauti         19222         19307         4653           210         25         bedding         19202         19430         4653           210         25         bedding         19202         19441         4656           210         25         bedding         19202         19441         4656           210         25         bedding         19202         19440         4658           210         25         bedding         19202         19404         4653           217         64         joint         19027         16405         4653           320         70         shart fracture         19030         16167         4653           2200         74         fault         19227         16382         4657           203         26         bedding         19100         16249         4657           203         28         bedding         19101         16249         4657           204         28         bedding         19101         16249         4657           204         28	53	62	fa H	19017	18142	4659
122         73         fault         1916/         1922/2         193307         4658           125         73         fault         1922/2         193307         4658           20         25         bedding         1927/5         194411         4658           200         25         bedding         1927/5         194411         4658           200         25         bedding         1927/5         194411         4658           200         25         bedding         19014         1912         4658           200         54         bint         19116         1917.4         4653           201         54         bint         19116         1917.4         4653           202         5         fault         19227         10328         4657           2020         7.4         fault         19227         10328         4657           2020         7.5         fault         19227         10328         4657           2020         25         bedding         19109         16224         4657           219         14         bedding         19116         16239         4657           220	200		fault	10017	10172	4030
122         73         fault         19159         18337         4658           35         62         fault         19228         18337         4658           213         55         fault         19229         18347         4658           210         25         bedding         19275         18441         4656           210         25         bedding         19275         18441         4656           210         25         bedding         19275         184401         4656           217         87         pintt         19207         18401         4658           218         sheer fracture         18003         18103         4653           220         75         fault         19227         18352         4657           220         28         bedding         19100         18148         4657           220         28         bedding         19128         16225         4657           220         28         bedding         19129         16224         4657           220         28         bedding         19129         16220         4657           220         28         bedding	590		aun	19107	10322	4058
55       72       fault       19222       10307       4656         225       37       bedding       19202       10431       4655         210       25       bedding       19202       10448       4655         210       25       bedding       19202       10448       4655         210       25       bedding       19202       10449       4655         210       25       bedding       19202       10449       4655         2178       65       pint       19027       16401       4655         218       pint       1918       16173       4655         320       70       sheet fracture       19020       10425       4657         2200       74       fault       19221       10432       4657         2201       74       fault       19221       10432       4657         2202       75       fault       19221       10424       4657         2203       75       fault       19221       10424       4657         2204       54647       19109       10225       4657         2205       55       bedding       19141       10	122	73	fauit	19159	16337	4658
35         62         fault         19236         16300         4656           210         25         bedding         19275         16431         4656           20         25         bedding         19275         16431         4656           20         35         bedding         19275         16401         4656           276         67         jpint         19207         16401         4656           277         64         jpint         19207         16401         4658           320         05         sheer fracture         19033         16167         4658           322         63         fsutt         19227         16352         4657           209         74         fsutt         19227         16352         4657           203         28         bedding         19109         16224         4657           219         34         bedding         19109         16224         4657           220         28         bedding         1911         16224         4657           220         29         bedding         19124         16224         4657           230         28	55	72	fauit	19222	16367	4658
229         37         bedding         19202         19408         4655           200         5         bedding         19202         19408         4655           200         5         bedding         19202         19408         4655           200         65         joint         19027         19401         4658           278         67         joint         19118         16173         4658           37         64         joint         19118         16173         4658           320         70         sheef facture         19030         16187         4658           3202         70         sheef facture         19030         16187         4653           2009         74         fault         19221         16382         4657           203         24         bedding         19100         16249         4657           203         24         bedding         19101         16229         4657           204         25         bedding         19121         16249         4657           203         25         bedding         19121         16249         4657           204         bedding <th>35</th> <th>82</th> <td>fauit</td> <td>19236</td> <td>16390</td> <td>4858</td>	35	82	fauit	19236	16390	4858
210         220         bedding         10075         10124         4655           300         5         bedding         10014         10124         4655           300         5         bedding         10014         10124         4655           301         67         pint         10027         161401         4655           371         64         pint         1013         4655           387         78         sheef facture         1003         10167         4653           300         70         sheef facture         10237         10432         4657           200         74         fault         19237         10336         4657           200         74         fault         19237         10336         4657           200         74         fault         19237         10338         4657           200         28         bedding         19109         10228         4657           200         28         bedding         19114         10227         4657           200         28         bedding         19141         10228         4657           200         29         bedding	220		haddaa	10007	40404	4050
20         25         bedding         192/5         18431         4658           20         5         bedding         192/5         18443         4658           20         5         bedding         192/5         18443         4658           20         55         bedding         19014         19152         4658           27         84         paint         19207         18401         4658           27         5         shear fracture         19013         19163         4658           200         74         faunt         19227         19432         4651           200         74         faunt         19227         19432         4657           200         74         faunt         19227         19432         4657           200         28         bedding         19129         19254         4657           200         28         bedding         19129         19259         4657           200         28         bedding         19296         16420         4657           200         28         bedding         19296         16425         4657           201         65         poi	22.9	31	Declang	19007	10104	4000
20         5         bedding         19282         19408         4658           333         61         joint         19027         16100         4658           373         64         joint         1927         16401         4658           373         64         joint         1918         16173         4658           320         70         sheer fracture         18030         16187         4658           322         73         sheer fracture         18020         16448         4657           200         74         fault         19220         16406         4657           201         75         fault         19221         16332         4637           2020         75         fault         19221         16332         4637           203         24         bedding         19100         16248         4637           210         25         bedding         19141         16220         4657           220         25         bedding         19298         16420         4657           220         25         bedding         19298         16425         4657           230         bedding	210	25	bedding	19275	16431	4658
339         61         joint         19014         16152         4658           276         65         joint         19207         16160         4658           277         64         joint         19217         16401         4658           38         78         shear fracture         19013         16167         4658           320         70         shear fracture         19227         16432         4653           2020         74         fault         19227         16332         4657           203         28         bedding         19109         16228         4657           203         28         bedding         19199         16228         4657           203         28         bedding         19191         16228         4657           203         28         bedding         19142         16278         4657           204         28         bedding         19141         16220         4657           204         28         bedding         19128         16425         4657           204         28         bedding         19289         16425         4657           204         28	20	5	bedding	19262	16408	4658
106         65         joint         19027         1910         1910         4950           276         joint         19116         19173         4653           37         50 sheet fracture         19030         19187         4653           320         70 sheet fracture         19237         16432         4653           320         70 sheet fracture         19280         16445         4657           200         74         faurt         19280         16406         4657           203         28         bedding         19100         16249         4657           203         28         bedding         19109         16249         4657           204         24         bedding         19130         16249         4657           204         28         bedding         19130         16249         4657           205         22         bedding         19130         16249         4657           204         28         bedding         19130         16249         4657           205         23         bedding         19142         16220         4657           205         206         19141         16221	339	61	inini	19014	16152	4658
100         65         jpint         192/2         1610         4658           275         64         jpint         1916         16173         4658           37         64         jpint         1917         1640         4658           37         64         jpint         1917         1640         4658           38         70         sheat fracture         19030         16142         4653           220         75         fault         19237         16385         4657           220         75         fault         19237         16385         4657           230         28         bedding         19109         16249         4657           230         28         bedding         19142         16278         4657           230         28         bedding         19141         16229         4657           230         29         bedding         19141         16229         4657           230         20         bedding         19289         16425         4657           230         20         bedding         19289         16425         4657           230         20         bedding	100		joens	40007		4030
273         67         pint         19287         16401         4658           37         50         sheer fracture         19013         16183         4658           38         73         sheer fracture         19287         16432         4658           320         70         sheer fracture         19287         16432         4653           200         74         fault         19227         16338         4657           203         76         fault         19227         16338         4657           203         28         bedding         19109         16228         4657           213         24         bedding         19109         16228         4657           214         bedding         19121         16228         4657           220         bedding         19121         16228         4657           230         bedding         19128         16420         4657           240         25         bedding         19128         16427         4657           230         15         5011         19121         1622         4657           231         65         point         19141 <td< td=""><th>100</th><th>80</th><td>joint</td><td>19027</td><td>16160</td><td>4658</td></td<>	100	80	joint	19027	16160	4658
37         64         joint         19118         16173         4658           38         78         sheef facture         19030         16187         4658           320         70         sheef facture         19220         16442         4658           320         70         sheef facture         19280         16446         4657           200         74         fault         19221         16352         4657           203         26         bedding         19100         16249         4657           203         26         bedding         19100         16249         4657           204         28         bedding         19129         16295         4657           203         28         bedding         19124         16249         4657           203         29         bedding         19124         16199         4657           204         28         bedding         19124         16199         4657           205         bedding         19124         16199         4657           204         5         point         19144         16221         4657           205         point         1	278	- 67	joint	19287	16401	4658
73         50         shear fracture         19013         19183         4653           70         shear fracture         19287         16432         4653           70         shear fracture         19287         16432         4653           70         shear fracture         19287         16432         4657           700         fault         19227         16338         4657           700         7         fault         19227         16358         4657           700         7         fault         19227         16358         4657           700         7         fault         19227         16253         4657           719         14         bedding         19109         16223         4657           7209         39         bedding         19142         16278         4657           7230         21         bedding         19141         16229         4657           7230         16         bedding         19128         16159         4657           7100         7         pint         19141         16124         4657           721         65         pant         19143         16228	37	84	igint	19118	16173	4658
10         70         attact instantion         10107         10107         4053           300         10         state instantion         100107         10107         4053           300         10         state instantion         100107         10107         4053           301         10         state instantion         100107         10107         4053           2020         25         feading         100107         10118         4057           2030         28         bedding         10100         10249         4057           2030         28         bedding         10111         10229         4057           2040         28         bedding         10111         10229         4057           2040         28         bedding         10141         10220         4057           2040         28         bedding         10249         10420         4057           2040         28         bedding         10241         10144         4057           2041         10041         10144         4057         214         4057           2040         28         point         10141         10222         4057	73		chase leach ra	10013	18182	1659
33         7.6         arter fracture         19230         10107         16432         4658           322         63         faunt         19280         16440         4657           320         7.4         faunt         19220         16440         4657           203         7.5         faunt         19221         16332         4657           203         2.5         bedding         19109         16223         4657           204         2.4         bedding         19121         16225         4657           209         2.9         bedding         19142         16226         4657           209         2.9         bedding         19141         16220         4657           230         2.0         bedding         19141         16220         4657           230         2.0         bedding         19289         16425         4657 <td< td=""><th></th><th></th><td></td><td>10073</td><td>10103</td><td>4008</td></td<>				10073	10103	4008
320         70         shear fracture         19287         16432         4653           322         63         fault         19237         16358         4657           200         74         fault         19237         16358         4657           203         28         bedding         19037         16178         4657           203         28         bedding         19109         16228         4657           219         34         bedding         19129         16225         4657           220         28         bedding         19142         16278         4657           220         22         bedding         19141         16229         4657           230         28         bedding         19124         16159         4657           231         28         bedding         1928         16425         4657           231         28         port         19145         16281         4657           232         35         port         19145         16221         4657           232         35         port         19145         16221         4657           232         35	38	/5	snear tracture	19030	16187	4658
322         63         fault         19280         16406         4657           209         7.5         fault         19251         16382         4657           203         2.6         bedding         19100         16178         4657           203         2.8         bedding         19100         16249         4657           203         2.8         bedding         19129         16254         4657           200         3.9         bedding         19129         16254         4657           203         2.8         bedding         19130         16249         4657           203         2.9         bedding         19131         16249         4657           213         2.2         bedding         19128         16420         4657           214         2.9         bedding         19141         16151         4657           214         5.5         paint         19141         16226         4657           214         6.5         paint         19141         16227         4657           224         paint         19141         16227         4657           225         paint         19141 <th>320</th> <th>70</th> <td>shear fracture</td> <td>19287</td> <td>16432</td> <td>4658</td>	320	70	shear fracture	19287	16432	4658
200         7.4         fauit         19237         19356         4657           200         7.5         fauit         19237         19356         4657           203         28         bedding         19109         16283         4657           219         34         bedding         19109         16283         4657           210         38         bedding         19142         16278         4657           220         28         bedding         19141         16229         4657           230         28         bedding         19141         16229         4657           230         23         bedding         19141         16229         4657           230         16         bedding         19289         16425         4657           230         18         19141         16169         4657           230         19145         16281         4657           24         65         point         19145         16281         4657           2100         73         pint         19145         16281         4657           221         65         point         19143         16224         4	322	63	fault	19280	16406	4657
200         7.9         fall         192.27         193.33         493.7           200         23         bedding         190.37         191.19         463.7           200         23         bedding         190.07         191.19         463.7           200         23         bedding         19129         192.25         463.7           200         23         bedding         19129         192.29         465.7           200         23         bedding         19130         192.29         465.7           230         23         bedding         19139         164.25         465.7           234         22         bedding         192.96         164.20         465.7           234         22         bedding         192.96         164.20         465.7           234         22         bedding         192.96         164.20         465.7           234         24         66         19143         192.27         465.7           231         65         point         19143         192.27         465.7           232         35         point         19143         162.21         465.7           232	200	74	to de	10227	10350	4067
203         7.5         fault         19251         16382         4857           203         224         bedding         19100         16249         4857           218         bedding         19100         16249         4857           218         bedding         19129         16254         4657           220         28         bedding         19129         16274         4657           230         29         bedding         19121         16274         4657           230         29         bedding         19129         16425         4657           230         18         bedding         19289         16425         4657           230         16         bedding         19289         16425         4657           230         16         bedding         19289         16425         4657           24         64         pont         19141         16121         4657           210         65         pont         19143         16224         4657           221         63         pont         19143         16227         4657           323         76         pont         19143 <t< td=""><th>209</th><th></th><td>raun</td><td>19237</td><td>10330</td><td>4037</td></t<>	209		raun	19237	10330	4037
203         28         bedding         1907         16178         4657           198         24         bedding         19109         16243         4657           219         34         bedding         19109         16253         4657           230         28         bedding         19142         16278         4657           230         29         bedding         19141         16229         4657           230         22         bedding         19141         16229         4657           230         23         bedding         19289         16425         4657           230         16         bedding         19289         16425         4657           230         16         bedding         19289         16425         4657           230         16         bedding         19289         16425         4657           230         7         point         19143         15214         4657           241         65         point         19143         15227         4657           323         76         point         19143         15217         4657           323         19         p	209	75	fault	19251	16382	4657
198         24         bedding         19100         16249         4657           219         34         bedding         19129         16295         4657           200         38         bedding         19129         16295         4657           200         39         bedding         19130         16249         4657           200         23         bedding         19130         16249         4657           230         23         bedding         19144         16220         4657           234         22         bedding         19296         16420         4657           234         22         bedding         19296         16420         4657           234         24         bedding         19296         16420         4657           234         24         point         19143         16227         4657           237         45         point         19143         16227         4657           232         28         shear         19135         16241         4657           337         63         point         19143         16227         4657           232         28         s	203	28	bedding	19037	16179	4657
24         Lessing         19109         16225         4657           200         39         bedding         19142         16225         4657           200         39         bedding         19142         16226         4457           209         39         bedding         19161         16229         4657           200         23         bedding         19161         16229         4657           230         23         bedding         19269         16425         4657           230         23         bedding         19269         16425         4657           230         16         bedding         19269         16425         4657           230         16         bedding         19269         16425         4657           230         7         point         19145         16221         4657           24         68         point         19149         16215         4657           323         76         point         19149         16215         4657           323         78         part         19134         16221         4657           337         63         part         191	198	24	bedding	19100	16749	4657
2:10         2:10         10:00         10:20:1         16:20:1         4657           2:30         2:8         bedding         19:142         16:27:8         4657           2:30         2:8         bedding         19:141         16:23:9         4657           2:30         2:8         bedding         19:161         16:23:9         4657           2:30         2:30         bedding         19:161         16:22:9         46:57           2:40         2:30         bedding         19:29:9         19:42:0         46:57           2:40         2:30         bedding         19:29:9         19:42:0         46:57           2:41         2:30         bedding         19:10:1         19:22:1         46:57           2:41         5:5         2:0:nt         19:14:1         19:22:1         46:57           2:42         6:5         :0:nt         19:14:3         16:21:1         46:57           2:42         :5:5         :2:0:nt         19:12:1         16:23:1         46:57           2:31         :5:5         :2:0:nt         19:12:1         16:23:1         46:57           2:32         :5:5         :2:0:nt         19:12:1         16:23:1	240		bade	10100	10249	4657
4:e         bedding         19129         16255         4657           200         39         bedding         19129         16276         4657           223         22         bedding         19130         16249         4657           230         23         bedding         19130         16249         4657           231         23         bedding         19144         16220         4657           231         23         bedding         19286         16420         4657           234         22         bedding         19286         16420         4657           234         23         bedding         19286         16420         4657           235         37         30         10914         16151         4657           2323         75         point         19143         16227         4657           233         35         point         19135         16215         4657           233         35         point         19137         16215         4657           234         26         point         19131         16224         4657           233         35         24         atcli	219	34	neoong	19109	10263	405/
209         39         bedding         19142         1017         10427         10437           229         bedding         19161         10239         4657           230         bedding         19161         10239         4657           230         bedding         19161         10239         4657           230         bedding         19289         16425         4657           230         bedding         19289         16425         4657           230         bedding         19244         16159         4657           230         bedding         19145         16281         4657           210         65         point         19145         16281         4657           211         65         point         19143         16227         4657           323         76         point         19149         16215         4657           323         78         point         19149         16227         4657           337         83         point         19143         16227         4657           333         78         Raven alke         19134         16227         4657           333 </td <th>230</th> <th>28</th> <td>beoding</td> <td>19129</td> <td>10295</td> <td>4657</td>	230	28	beoding	19129	10295	4657
229         22         bedding         19130         16249         4657           239         8         bedding         19144         16220         4657           230         23         bedding         19144         16220         4657           234         22         bedding         19296         16420         4657           234         20         bedding         19296         16420         4657           234         20         bedding         19296         16420         4657           234         20         bedding         19296         16420         4657           274         80         point         19141         16124         4657           231         65         point         19143         16227         4657           232         81         point         19143         16227         4657           337         63         point         19125         16241         4657           232         28         shear         19131         16227         4657           333         79         Raven d&e         19131         16221         4657           232         28         sh	209	39	bedding	19142	16276	4657
230         3         bedding         19161         16225         4657           230         23         bedding         19161         16225         4657           230         23         bedding         19289         16425         4657           230         16         bedding         19289         16425         4657           194         20         bedding         19124         16199         4657           100         73         point         19145         16281         4657           210         65         point         19144         16228         4657           221         65         point         19143         16227         4657           323         76         point         19149         16215         4657           323         76         point         19149         16227         4657           323         76         point         19149         16227         4657           333         78         part         19131         16227         4657           333         79         Raven dike         19130         16254         4657           333         76         Raven	229	22	bedding	19130	16240	4657
	220		hadding	10104	18110	1667
c-3         DeG0ing         19144         19220         4657           234         22         bedding         19296         16420         4657           230         16         bedding         19296         16420         4657           230         16         bedding         19296         16420         4657           234         20         bedding         19125         16154         4657           274         84         point         19110         16271         4657           231         75         point         19143         15227         4657           232         75         point         19143         15227         4657           233         75         point         19125         16241         4657           232         ahear         19125         16231         4657         4657           333         79         Raven dike         19130         16224         4657         464           2333         79         Raven dike         19131         16220         4657         464           333         77         Raven dike         19133         16173         4656           334	209		nendend	19101	10239	4037
z34         22         bedding         19289         16425         4657           230         16         bedding         19249         16159         4657           194         20         bedding         19144         16169         4657           100         73         point         19145         16281         4657           274         84         point         19145         16281         4657           21         65         point         19114         16226         4657           323         76         point         19143         16227         4657           42         66         point         19149         162215         4657           190         22         shear         191272         16393         4657           190         22         shear         19124         4657         4657           20         shear         19134         16227         4657         4647           21         shear         19134         16174         4657         4647           224         shear         19135         16174         4657         4646           224         shear         19145 </td <th>230</th> <th>23</th> <td>pecquig</td> <td>19144</td> <td>16220</td> <td>4657</td>	230	23	pecquig	19144	16220	4657
230         16         bedding         19296         19420         4657           194         20         bedding         19296         16120         4657           100         73         point         19941         16159         4657           274         8         point         19145         16221         4657           274         8         point         19110         16221         4657           216         65         point         19143         16227         4657           323         75         point         19143         16227         4657           337         83         point         19135         16241         4657           338         79         Raven dike         19130         16221         4657           333         79         Raven dike         19134         16227         4657           3332         78         Raven dike         19134         16227         4657           3333         79         Raven dike         19134         16227         4657           334         51         fault         19131         16224         4656           34         51411	234	22	bedding	19269	16425	4657
194         20         bedding         19124         16159         4657           100         73         point         19145         19281         4657           274         84         point         19145         19281         4657           276         point         19114         16228         4657           286         point         19114         16228         4657           42         66         point         19149         162215         4657           42         66         point         19149         162215         4657           337         63         point         19134         16227         4657           190         22         shear         19134         16227         4657           190         22         shear         19134         16227         4657           281         shear         19134         16227         4657         d457           303         79         Raven dike         19134         16227         4657         d48           294         77         Raven dike         19134         16227         4656           333         4         fault         19	230	16	beddina	19296	16420	4657
100         100         100         100         400           100         100         100         100         4657           274         87         port         10145         10281         4657           274         87         port         10145         10281         4657           210         87         port         10145         102217         4637           211         65         port         19143         102217         4637           323         65         port         19135         16211         4657           323         65         port         19135         16221         4657           335         73         articine         19171         16241         4657           336         79         Raven dike         19130         16244         4657           336         77         fault         19171         16244         4657         dike           335         34         fault         19173         16174         4656         dike           345         47         fault         19173         16244         4657         dike           345         47         fa	194	20	berding	19174	16160	4657
punt         19041         19164         6857           274         84         punt         19110         16271         4657           280         87         punt         19110         16271         4657           281         65         punt         19110         16221         4657           323         75         punt         19143         15227         4657           337         83         punt         19125         16241         4657           337         83         punt         19125         16241         4657           338         79         Raven dike         19124         16227         4657           338         77         Raven dike         19125         16241         4657           338         77         Raven dike         19126         16173         4657           338         77         Raven dike         19133         16174         4656           34         fault         19145         16171         4656           34         fault         19153         16171         4656           35         4         fault         19153         16171         4			infort		10100	46.5
d+         pent         19145         16231         4657           296         87         pent         19114         16226         4657           21         65         pent         19114         16226         4657           323         76         pent         19143         16227         4657           42         66         pent         19149         16215         4657           337         83         pent         19272         16393         4657           190         22         shear         19124         16227         4657           213         2         antean         19134         16227         4657           22         2         antean         19134         16227         4657           233         78         Raven dike         19130         16264         4657           234         71         Raven dike         19131         16124         4657           234         77         Raven dike         19151         16244         4656           234         74         fault         19145         10174         4656           234         74         fault         19241		/3	louit	19041	10104	4037
290         87         point         19110         16271         4657           21         65         point         19143         16227         4657           323         75         point         19143         16227         4657           323         75         point         19143         16227         4657           337         83         point         19135         16241         4657           337         83         point         19135         16241         4657           338         79         Raven dike         19130         16224         4657           338         79         Raven dike         19134         16227         4657           338         79         Raven dike         19134         16227         4657           338         77         Faven dike         19134         16244         4656           34         67         fault         19145         16171         4656           34         67         fault         19145         16170         4656           322         7         bedding         19241         16350         4656           322         7         be	274	- 84	point	19145	16281	4657
21         65         joint         19114         16226         4657           223         75         joint         19149         16215         4657           42         68         joint         19149         16215         4657           337         69         joint         19272         16393         4657           55         52         joint         19272         16393         4657           230         22         shear         19134         16227         4657           333         79         Raven dike         19130         16264         4657           333         79         Raven dike         19134         16227         4657           294         75         Raven dike         19134         16264         4655           33         34         fault         19171         16264         4656           33         34         fault         19171         16264         4656           34         fault         19171         16264         4656           35         34         fault         19171         16270         4656           36         fault         19153         16171<	298	87	point	19110	16271	4657
323         75         joint         19143         16227         4657           324         66         joint         19143         16215         4657           337         63         joint         19135         16241         4657           355         52         joint         19125         16231         4657           302         22         shear         19125         16231         4657           338         79         Raven dike         19130         16241         4657           3382         78         Raven dike         19134         16270         4657         dika           298         85         shear         19134         16270         4657         dika           299         85         shear         19134         16270         4657         dika           298         85         shear         19135         16170         4656         dika         4651           315         31         fault         19135         16170         4656         dika         4656         dika         4656         dika         4656         dika         19145         16171         4656         dika         4656	21	65	inint	19114	18278	4857
A2         Do         pinit         1914 D3         1924 P3         607           47         66         pinit         1914 D3         1924 C5         657           337         83         pinit         1915 16241         657           35         52         pinit         1925         16231         6657           302         22         shear         19125         16231         6657           303         7         Raven dike         19120         16284         4657           303         7         Raven dike         19128         16173         4657           304         Falven dike         19128         16173         4657         dike           314         fault         19153         16164         4656         dike           315         7         fault         19153         16164         4656           314         fault         19154         16233         4656           324         67         fault         19154         16333         4656           322         7         bedding         19175         16133         4656           323         68         abeding         19176	222	78	inint	10143	18007	4057
**         05         point         19149         16215         4657           337         65         joint         19222         16393         4657           190         22         shear         19122         16393         4657           190         22         shear         19122         16393         4657           212         28         shear         19134         16227         4657           233         27         Rarven dike         19130         16264         4657         dika           2337         78         Raven dike         19133         16173         4657         dika           234         77         Raven dike         19135         16173         4656         dika           234         77         fault         19135         16173         4656         dika         dika <th>323</th> <th></th> <td>lour</td> <td>13143</td> <td>10221</td> <td>4037</td>	323		lour	13143	10221	4037
337         63         point         19135         16241         4657           355         52         joint         1925         16231         4657           190         22         shear         19135         16231         4657           190         22         shear         19134         16221         4657           338         79         Raven dike         19130         16224         4657           338         79         Raven dike         19134         16270         4657           298         Sheat fracture         19128         16173         4657         dike           294         77         fault         19135         16164         4656           34         67         fault         19145         16171         4656           34         67         fault         19145         16171         4656           200         Bedding         19241         16350         4656           212         6         piont         19171         18227         4656           220         Bedding         19241         16337         4655         65           221         66         fault	42	66	joint	19149	16215	4657
55         52         joint         192/2         16393         4657           190         22         shear         19134         16227         4657           23         2         anteine         19134         16227         4657           23         2         anteine         191130         16224         4657           330         79         Raven dike         19130         16244         4657           232         78         Raven dike         19131         16274         4657           239         85         sheat fracture         19128         16173         4657           234         7         fault         19135         16156         4656           33         34         fault         19135         16156         4656           232         7         bedding         19226         16383         4656           230         6         bedding         1923         16170         4656           231         8         joint         13300         16413         4656           24         6         fault         19224         16331         4655           24         6         fault<	337	83	joint	19135	16241	4657
100         120         100 <th>55</th> <th>52</th> <td>inint</td> <td>19272</td> <td>18201</td> <td>4657</td>	55	52	inint	19272	18201	4657
new         new         rd/23         10/23         4637           222         28         shear         19/13         10/241         4657           330         79         Raven dike         19134         10/241         4657           330         79         Raven dike         19130         10/270         4657           333         76         Raven dike         19134         10/270         4657           298         85         shear fracture         19128         10/17         4657           294         77         fault         19171         16/294         4656           34         fault         19145         10/171         4656           292         85         bedding         19241         18350         4656           292         16         bedding         19241         18350         4656           293         8         bedding         19171         18227         4656           294         65         fault         19228         19332         4655           212         66         fault         19229         19374         4655           212         66         fault         1922	100	22		10172	10333	4057
c:4         28         snear         19134         16227         4657           53         2         anticibre         19171         16241         4657         de57           333         79         Raven dike         19130         16244         4657         de57           232         75         Raven dike         19130         16274         4657         de57           239         85         shear fracture         19128         16173         4657         de57           234         77         fault         19135         16156         4656         de56           33         4         fault         19135         16156         4656         de56           34         fault         19141         18350         4656         de56	100		214996	13123	10231	9037
53         2         anticline         19171         10241         4657           336         79         Raven dike         19130         10220         4657         dike           338         78         Raven dike         19134         10270         4657         dike           298         85         shear fracture         19128         16173         4657         dike           294         77         fault         19171         16294         4656           34         67         fault         19145         161171         4656           222         7         bedding         19241         16350         4656           222         7         bedding         19241         16350         4656           220         8         bedding         19241         16350         4656           316         63         joint         19171         16227         4656           322         66         joint         19205         16387         4656           33         72         fault         19226         16333         4655           46         6         fault         19222         16551         4655	232	28	shear	19134	16227	4657
336         79         Raven dike         19130         16264         4657         dike           332         78         Raven dike         19134         10270         4657         dike           299         85         sheat fracture         19128         10173         4657           294         7         fault         19173         10173         4657           34         67         fault         19135         10168         4656           222         7         bedding         19258         10383         4656           292         7         bedding         19258         10383         4656           209         8         bedding         19135         10170         4656           212         16         bedding         19135         10170         4656           216         68         heartin terr         12214         10307         4656           324         66         fault         19273         10372         4655           42         61         fault         19273         10372         4655           42         64         fault         19273         10373         4655	53	2	anticlina	19171	16241	4657
332         78         Raven dike         19134         19270         4657         dika           299         85         Shear fracture         19128         19171         16294         4650           294         77         fault         19171         16294         4650           315         314         fault         19135         16156         4656           34         67         fault         19145         16111         4656           222         7         bedding         19241         10350         4656           209         8         bedding         19241         10350         4656           212         66         joint         19171         16227         4656           31         83         joint         19171         16227         4656           32         66         fault         19225         10387         4656           33         7         fault         19221         16333         4655           46         6         fault         19222         16333         4655           47         20         fault         19252         16333         4655           47 <th>336</th> <th>79</th> <td>Raven dike</td> <td>19130</td> <td>16264</td> <td>4657 dike</td>	336	79	Raven dike	19130	16264	4657 dike
206         BS         haraf name         19/05         10/01         4657           206         BS         haraf name         19/12         19/17         16/24         4657           234         77         fault         19/17         15/24         4657           234         77         fault         19/12         19/17         4658           24         67         fault         19/12         19/17         4659           222         7         bedding         19/25         19/17         4659           222         7         bedding         19/25         19/17         4659           222         7         bedding         19/25         19/17         4659           223         68         pint         19/13         19/17         4659           224         66         pint         19/214         19/214         19/214         4655           236         66         fault         19/27         19/31         4655           242         67         fault         19/27         19/31         4655           246         66         fault         19/27         19/31         4655           2	333	78	Rause dike	10124	18370	4657 414
299         B5         Start Tracture         19/29         16/13         4657           294         77         fault         19/17         16/13         4657           35         34         fault         19/13         16/13         4656           35         34         fault         19/15         16/16         4656           34         fault         19/15         10/16         4656           35         07         fault         19/26         10/363         4656           202         7         bedding         19/21         10/363         4656           202         7         bedding         19/21         10/327         4656           209         8         bedding         19/21         10/327         4656           211         65         int         19/07         11/31         4656           221         65         int         19/27         10/327         4656           33         72         fault         19/27         10/327         4655           46         66         fault         19/27         10/327         4655           47         20         fault         19/27 <th>0.02</th> <th></th> <td>naten uno</td> <td>13134</td> <td>10270</td> <td>4037 UKE</td>	0.02		naten uno	13134	10270	4037 UKE
294         77         fault         19171         16294         4656           35         34         fault         19135         16156         4656           34         67         fault         19145         16171         4656           32         67         fault         19145         16171         4656           222         7         bedding         19241         16350         4656           209         8         bedding         19241         16350         4656           210         8         bedding         19241         16350         4656           210         6         bedding         19225         16387         4656           22         66         atrixt         19225         16387         4655           33         72         fault         19226         16333         4655           46         6         fault         19227         16351         4655           47         20         fault         19221         1655         4655           48         16         fault         19222         4655         4655           49         66         fault         192	299	85	shear fracture	19128	16173	4657
35         34         fault         19135         1916         4656           34         67         fault         19145         10171         4656           222         7         bedding         19258         10333         4656           292         18         bedding         19258         10333         4656           209         8         bedding         19135         10170         4656           209         8         bedding         19135         10170         4656           216         68         pint         19300         16413         4656           30         68         shear fracture         192216         10337         4655           24         66         fault         19223         10372         4655           46         61         fault         19273         10372         4655           46         66         fault         19273         10372         4655           47         20         fault         19273         10372         4655           203         30         bedding         19189         16232         4655           210         fault         19273 <th>294</th> <th>- 77</th> <td>fault</td> <td>19171</td> <td>16294</td> <td>4658</td>	294	- 77	fault	19171	16294	4658
34         67         fault         19145         16171         4556           222         7         bodding         19241         10350         4656           209         8         bodding         19241         10350         4656           209         8         bodding         19241         10350         4656           210         8         bodding         19171         16227         4656           311         83         joint         19171         16227         4656           326         66         shert fracture         19255         10387         4656           34         66         fault         19225         10333         4655           24         66         fault         19222         10333         4655           42         67         fault         19223         10351         4655           42         67         fault         19222         10531         4655           42         67         fault         19223         10531         4655           50         18         bodding         19251         10346         4655           20         fault         19255 <th>35</th> <th>34</th> <td>fault</td> <td>19135</td> <td>16156</td> <td>4658</td>	35	34	fault	19135	16156	4658
222         0         pedding         192.54         193.53         4656           192         16         bedding         191.15         193.54         4656           209         16         bedding         191.15         192.54         193.55         4656           209         16         bedding         191.15         192.14         193.55         4656           211         63         pint         191.15         191.14         4656         4656           226         66         pint         192.14         193.07         4655           24         67         fault         192.21         193.07         4655           24         67         fault         192.21         193.07         4655           42         67         fault         192.22         193.01         4655           42         67         fault         192.22         193.14         4655           42         66         fault         191.54         195.4         4655           42         7         fault         191.83         197.8         4655           209         191.84         191.54         191.44         4655	34	87	14.4	10146	18474	4656
222         7         Dedaing         1923         16333         4655           192         16         bedding         19135         16170         4655           209         8         bedding         19135         16170         4655           209         8         bedding         19135         16170         4655           211         6         john         19171         16227         4656           23         65         shear fracture         19305         164417         4656           23         65         shear fracture         19305         16333         4655           46         63         raut         19228         16331         4655           46         64         raut         19273         16331         4655           47         20         faunt         19273         16351         4655           40         66         raut         19035         16144         4655           202         30         bedding         19035         16144         4655           210         31         bedding         19132         16229         4655           323         78         ave			roun.	10140	10171	4030
192         18         bedding         19241         18350         4656           200         6         bedding         19241         18350         4656           311         83         joint         19171         18227         4656           30         66         joint         19371         18227         4656           30         72         fault         192255         16387         4655           24         66         fault         19226         16333         4655           24         66         fault         19227         16372         4655           46         61         fault         19228         16333         4655           47         20         fault         19228         16351         4655           40         65         fault         19252         16344         4655           202         30         bedding         19035         16144         4655           202         30         bedding         19122         16229         4655           203         30         bedding         19131         16243         4655           203         70         jaunt	~~~~		pedding	19529	16363	4656
209         8         bedding         19135         16170         4656           311         63         joint         19300         16413         4656           32         66         joint         19300         16413         4656           33         65         shear fracture         19214         16307         4655           34         66         fault         19227         16372         4655           46         61         fault         19223         16372         4655           46         66         fault         19223         16372         4655           46         66         fault         19223         16372         4655           47         20         fault         19223         16372         4655           48         66         fault         19143         16154         4655           202         33         bedding         19199         16124         4655           210         bedding         19191         16150         4655           223         38         bedding         19143         16171         4655           223         39         bedding         19154<	192	18	bedding	19241	16350	4658
311         63         joint         19171         18227         4656           22         66         joint         19255         16387         4656           39         72         fault         19255         16387         4656           39         72         fault         19226         16333         4655           44         66         fault         19227         16372         4655           44         66         fault         19228         16333         4655           42         67         fault         19252         16351         4655           44         66         fault         19252         16351         4655           50         18         bedding         19095         16144         4655           202         30         bedding         19192         16229         4655           320         70         joint         19192         16234         4655           321         78         aven dike         19143         16243         4655           323         80         shart facture         19259         16341         4655           323         80         shart factu	209	8	bedding	19135	16170	4656
22         66         print         193000         16413         4656           33         66         shear fracture         19214         16337         4655           33         76         faurt         192214         16337         4655           24         66         faurt         192214         16337         4655           24         61         faurt         19273         16331         4655           44         61         faurt         19273         16351         4655           44         66         faurt         19453         16374         4655           45         76         aut         19453         15376         4655           60         faurt         19454         19514         4655           229         30         bedding         19189         18144         4655           235         10         bedding         19152         18144         4655           335         10         bedding         19152         18239         4655           335         10         bedding         19154         18234         4655           335         10         bedding         19154	311	81	inint	10171	18337	4858
z.z         co         ppmin         15xx00         15413         4655           36         65         shear fracture         192214         16307         4655           37         fault         19224         16307         4655           46         61         fault         19223         16372         4655           46         61         fault         19223         16372         4655           46         61         fault         19223         16372         4655           47         62         fault         19223         16372         4655           48         65         fault         1923         16374         4655           49         66         fault         1918         16324         4655           202         33         bedding         19198         16232         4655           203         35         10         bedding         19192         16223         4655           203         30         bedding         19154         16171         4655           203         30         shear fracture         19261         16371         4655           213         55         she			Politi	40000	1022/	40.00
30         66         shear fracture         19255         16387         4656           39         72         fault         19226         16333         4655           44         66         fault         19226         16333         4655           44         66         fault         19227         16333         4655           44         61         fault         19252         16351         4655           46         66         fault         19252         16351         4655           47         20         fault         19145         16154         4655           50         16         bedding         19095         16144         4655           202         33         bedding         1911         1610         4655           210         30         bedding         19131         16144         4655           33         10         bedding         19131         16243         4655           333         10         bedding         19131         16243         4655           333         80         shear fracture         19226         16341         4655           333         80         sh		00	joint	19300	10413	4656
39         72         fault         19214         16307         4655           24         66         fault         19273         16372         4655           44         61         fault         19273         16372         4655           44         61         fault         19273         16372         4655           44         66         fault         19423         16151         4655           46         66         fault         19145         10154         4655           74         20         fault         19199         16232         4655           229         30         bedding         19199         16144         4655           223         30         bedding         19154         10171         4655           30         10         bedding         19154         10171         4655           310         bedding         19154         10211         4655         348           325         50         shar fracture         19261         16371         4655         348           325         51         shar fracture         19261         16176         4655           323         6	36	66	shear fracture	19285	16387	4656
24         66         fault         19226         16333         4655           46         61         fault         19273         16372         4655           42         67         fault         19252         16351         4655           42         66         fault         19252         16351         4655           42         66         fault         19145         10154         4655           74         20         fault         19083         15378         4655           50         18         bedding         19095         16144         4655           202         30         bedding         19192         16229         4655           323         10         bedding         19151         16171         4655           323         70         joint         19192         16229         4655           333         80         Raven dike         19143         16243         4655           333         80         Raven dike         19143         16243         4655           333         80         Raven dike         19143         16243         4655           333         80         Raven	39	72	fault	19214	16307	4655
-6         -1<	24	6Å	fault	19228	18333	4655
		A1	f~	10274	18373	4656
-c         or         Fault         192/2         18351         4655           -6         6         fault         19152         18151         4655           74         20         fault         19083         15978         4655           50         16         bedding         19198         18232         4655           220         33         bedding         19095         16144         4655           220         33         bedding         19111         1610         4655           220         33         bedding         19114         16171         4655           231         10         bedding         19121         16229         4655           231         70         joint         19192         16229         4655           232         78         Aven dike         19143         16243         4655           233         80         Aven dike         19143         16243         4655           233         80         Aven dike         19141         16344         4655           235         63         aven dike         19119         16134         4654           235         fault	+0		raun	17613	103/2	4000
46         66         fault         19145         10154         4655           74         20         fault         19145         15978         4655           70         20         fault         19189         16232         4655           229         38         bedding         19189         16144         4655           220         33         bedding         19111         16150         4655           235         10         bedding         19154         10171         4655           24         15         bedding         19154         10171         4655           23         70         joint         19153         16238         4655           323         66         Ravon dike         19143         10243         4655           332         80         sheaf fracture         19261         16371         4655           235         65         sheaf fracture         19154         16176         4655           333         69         fault         19191         16131         4654           45         32         fault         19119         16131         4654           345         32	42	87	rault	19252	18351	4655
74         20         Fault         19083         1578         4655           50         16         bedding         19198         16232         4655           229         38         bedding         19095         16144         4655           220         33         bedding         19075         16144         4655           220         33         bedding         19255         16348         4655           33         10         bedding         19255         16348         4655           34         15         bedding         19172         16229         4655           323         70         joint         19192         16229         4655           333         80         Raven dike         19143         16243         4655           333         80         shear fracture         19250         16341         4655           275         63         shear fracture         19250         16402         4654           333         80         fault         193020         16402         4654           45         12         bedding         13310         16380         4654           34         bedding<	46	66	fault	19145	16154	4655
50         16         bedding         19189         18222         4655           229         30         bedding         19013         1614         4655           201         33         bedding         19111         16150         4655           203         30         bedding         19154         16171         4655           48         15         bedding         19154         16171         4655           207         pint         19193         16238         4655         648           335         60         Raven dike         19153         16238         4655         648           335         60         Raven dike         19153         16238         4655         648           332         80         shear fracture         19261         16371         4655         648           333         65         shear fracture         19154         16176         4655         648           333         53         shear fracture         19154         16176         4655         648           345         37         fault         19119         16131         4654         654         654         654         654         <	74	20	fault	19083	15978	4655
229         36         besiding         19055         16144         4655           202         33         besding         19111         16150         4655           35         10         bedding         19111         16150         4655           35         10         bedding         19134         16171         4655           46         15         bedding         19134         16171         4655           29         70         joht         19132         16229         4655           33         66         Raven dike         19143         16243         4655           333         66         shear fracture         12621         16371         4655           275         65         shear fracture         19154         16176         4655           330         9         fault         19305         16442         4654           45         32         fault         19191         16131         4654           54         11         bedding         19173         16195         4654           26         12         19102         16128         4654         453           330         69	50	18	bedding	19189	18232	4655
	229	34	hedding	19004	18144	4855
aux         as         bedding         111         16150         4655           35         10         bedding         19154         16171         4655           48         15         bedding         19154         16171         4655           20         70         joint         19153         16228         4655           323         86         Raven d&e         19153         16228         4655           323         80         shear fracture         12261         16371         4655           323         80         shear fracture         12261         16371         4655           275         63         shear fracture         19261         16371         4655           233         50         shear fracture         19261         16371         4655           233         65         shear fracture         19261         16476         4655           235         shear fracture         19154         16176         4654           45         32         fault         19119         16131         4654           54         11         bedding         19173         16195         4654           263	243		Genoral	19095	10144	4030
33         10         bedding         19255         16346         4655           48         15         bedding         19154         16171         4655           20         70         joint         19192         16229         4655           221         78         Raven dike         19153         16224         4655         dke           333         80         Raven dike         19143         16243         4655         dke           333         80         Shear fracture         19250         16341         4655         dke           275         63         shear fracture         19250         16341         4655         dke           33         89         fault         19026         16402         4654         SAI+           45         32         fault         19119         16131         4654         SAI+           45         12         bedding         13310         16380         4654           36         4         bedding         13310         16380         4654           313         19         12777         16380         4654           329         50         point         19171	202	33	veoaing	19111	10150	4005
48         15         bedding         19154         10171         4655           20         70         joint         19192         16229         4655           323         78         Raven dike         19153         16238         4655           323         66         Raven dike         19143         16243         4655           335         66         Raven dike         19143         16243         4655           332         80         shear fracture         19261         16371         4655           233         65         shear fracture         19261         16371         4655           233         65         shear fracture         19154         16176         4655           233         65         shear fracture         19191         16131         4654           45         32         fault         19119         16131         4654           54         11         bedding         19173         16195         4654           24         12         bedding         19204         16128         4654           330         69         pint         19204         16120         4654           337	35	10	bedding	19255	16348	4655
29         70         joint         19122         18229         4655           323         78         Raven dike         19143         16243         4655         die           335         66         Raven dike         19143         16243         4655         die           332         90         shear fracture         12211         16371         4655         die           332         90         shear fracture         12261         16371         4655         die           215         65         shear fracture         12261         16371         4655         die           23         65         shear fracture         19154         16176         4655           33         69         raut         19119         16131         4654           45         32         raut         19119         16131         4654           54         11         bedding         19173         16195         4654           34         12         bedding         19102         16128         4654           350         9         joint         19204         16220         4654           330         69         joint         1	48	15	beddina	19154	16171	4655
1-2         1-2         Raven dike         19153         18228         4655         dike           335         60         Raven dike         19143         16243         4655         dike           335         60         Raven dike         19143         16243         4655         dike           335         80         Raven dike         19143         16243         4655         dike           335         80         shear fracture         16236         16371         4655         dike           235         65         shear fracture         19236         16341         4655         dike           236         shear fracture         19136         16176         4654         dike	20	70	inine	10100	18000	4855
construction         construction<	122	70	Course of the	10154	10223	1055 41.
3.33         bit         Bit <th>323</th> <th>18</th> <td>reaven dike</td> <td>19153</td> <td>10238</td> <td>4000 GIK</td>	323	18	reaven dike	19153	10238	4000 GIK
332         B0         shear fracture         18/261         16/371         46/55           275         65         shear fracture         19/56         16/374         46/55           233         65         shear fracture         19/54         16/176         46/55           133         69         fault         19/35         16/42         46/54         5/4           165         47         fault         19/19         16/131         46/54         6/54           45         32         fault         19/19         16/131         46/54         6/54           54         11         bedding         19/173         16/19/5         46/54         6/54           26         4         bedding         19/102         16/128         46/54         6/54           273         25         bedding         19/102         16/128         46/54         6/54           273         28         bedding         19/102         16/128         46/54         13/30           300         69         pint         19/073         16/153         46/54         4/83           3129         80         Raven dike         19/161         16/203         46/54	335	86	Raven dike	19143	18243	4655 dike
275         63         shear fracture         19256         16341         4655           23         65         shear fracture         19156         16176         4655           133         69         fault         19328         16402         4654         455           55         47         fault         19161         16181         4654         455           45         32         fault         19161         15183         4654         455           44         32         fault         19161         15184         4654         455         465	332	80	shear fracture	19261	16371	4655
23         55         shear fracture         19154         16176         4655           133         65         shear fracture         19154         16476         4654           54         17         fault         19131         16131         4654           45         32         fault         19173         16131         4654           45         32         fault         19173         16135         4654           45         32         fault         19173         16135         4654           80         4         bedding         19173         16136         4654           253         28         bedding         19102         16126         4654           37         12         bedding         19102         16126         4654           300         69         point         19073         16153         4654           329         85         point         19073         16153         4654           329         85         aven ake         19161         16209         4654           319         77         Raven ake         19160         16133         4654           214         70	275	81	shear fracture	1925A	18341	4855
	21	64	chaor fract	10164	18+74	4856
1.35         0.94         Taum         1932/26         16402         4654         SAI1           153         17         fault         19119         16131         4654           45         32         fault         19119         16131         4654           45         32         fault         19161         16168         4654           30         4         bedding         19310         16193         4654           253         28         bedding         19310         16193         4654           37         12         bedding         19217         16589         4654           30         65         joint         19207         16133         4654           309         65         joint         19207         16133         4654           329         80         Raven dike         19161         16220         4654           319         77         Raven dike         19160         16121         4654           214         70         sheaf fracture         19333         16405         4654           216         64         19160         16121         4654         4654           2256	23	00		19154	107/6	4035
65         47         fault         1919         16131         4654           45         32         fault         19161         16168         4654           54         11         bedding         13173         16195         4654           54         11         bedding         13173         16195         4654           253         28         bedding         19102         16128         4654           253         28         bedding         19102         16128         4654           37         12         bedding         19204         16220         4654           330         69         joint         19204         16220         4654           337         85         joint         19161         1623         4654           329         80         Raven dike         19161         1623         4654 dike           319         77         Raven dike         19160         1613         4654 dike           214         70         shear fracture         19333         16405         4654           214         70         shear fracture         19333         16405         4654      225         51	133	59	fault	19326	16402	4654 SAH
45         32         fault         19161         16168         4654           54         11         bedding         13131         16195         4654           80         4         bedding         13310         16195         4654           253         28         bedding         13277         16369         4654           37         12         bedding         13277         16369         4654           330         69         joint         13204         16220         4654           337         85         joint         19103         16153         4654           329         80         Raven dike         19160         16213         4654 dike           319         77         Raven dike         19160         16213         4654 dike           214         70         shear fracture         19333         16405         4654 dike           214         70         shear fracture         19333         16405         4654           215         64         shear fracture         19309         16399         4654           220         51         shear fracture         19309         16394         4654	65	47	fault	19119	16131	4654
54         11         bedding         19173         16195         4654           50         4         bedding         13310         16380         4654           253         28         bedding         19102         16126         4654           37         12         bedding         12077         16369         4654           330         69         pint         12024         16220         4654           337         85         pint         19073         16153         4654           329         85         rpint         19163         1654         4654           319         77         Raven dike         19161         16213         4654 dike           319         77         Raven dike         19160         16213         4654 dike           214         70         shear fracture         19333         16405         4654           214         70         shear fracture         19333         16405         4654           225         61         shear fracture         19309         16389         4654           220         51         shear fracture         19309         16389         4654           220	45	32	fauit	19161	16168	4654
	KA	14	hodrt-on	10173	18105	4864
ou         4         Descing         113310         163300         4654           253         28         bedding         19277         16039         4654           37         12         bedding         19277         16039         4654           30         69         joint         1919         16138         4654           307         65         joint         1919         16138         4654           307         65         joint         1919         16138         4654           329         90         Raven dike         19161         18209         4654 dike           329         83         Raven dike         19161         18209         4654 dike           319         77         Raven dike         19161         16103         4654 dike           214         70         sheaf fracture         19333         16405         4654           214         70         sheaf fracture         19333         16405         4654           225         61         sheaf fracture         19309         16339         4654           220         51         sheaf fracture         19309         16339         4654	54		naggauð	191/3	10192	4034
253         28         bedding         19102         16128         4654           37         12         bedding         19277         16369         4654           118         B8         joint         19204         16220         4654           330         69         joint         19119         16138         4654           337         85         joint         19073         16153         4654           329         80         Raven dike         19166         16213         4654 dike           319         77         Raven dike         19166         16213         4654 dike           319         77         Raven dike         19166         16213         4654 dike           214         70         shear fracture         19333         16405         4654           214         70         shear fracture         19333         16405         4654           225         64         shear fracture         19309         16389         4654           220         51         shear fracture         19309         16389         4654           220         51         shear fracture         19309         16389         4654 <th>80</th> <th>4</th> <td>bedding</td> <td>19310</td> <td>16380</td> <td>4654</td>	80	4	bedding	19310	16380	4654
37         12         bedding         19277         16389         4654           118         B6         joint         19204         16220         4654           330         69         joint         1919         16138         4654           337         85         joint         1919         16138         4654           329         80         Raven dike         19161         16209         4654 dike           319         77         Raven dike         19160         16213         4654 dike           219         83         Raven dike         19160         16198         4654 dike           319         77         Raven dike         19180         16105         4654 dike           214         70         sheaf fracture         19333         16405         4654           225         64         sheaf fracture         19309         16399         4654           220         51         sheaf fracture         19309         16399         4654           223         51         sheaf fracture         19309         16394         4654	253	28	bedding	19102	16126	4654
118         88         point         1920-4         16220         4465-4           330         09         point         19119         1918-4         445-4           337         85         point         19073         19153         4455-4           329         80         Raven dike         19161         19229         455-4         dike           319         77         Raven dike         19160         16213         4554-dike           214         70         shear fracture         19333         16405         4654-dike           225         64         shear fracture         19333         16405         4654-dike           225         51         shear fracture         19309         16389         4654-           226         51         shear fracture         19309         16389         4654-           220         51         shear fracture         19309         16389         4654-           223         63         shear fracture         19309         16389         4654-	37	12	bedding	19277	16349	4654
1.2         0.5         part         124.04         105.04         4055           330         69         pint         19119         16138         4654           337         85         pint         19073         16153         4654           329         80         Raven dike         19161         16209         4654 dike           319         77         Raven dike         19160         16213         4654 dike           214         70         sheaf fracture         19333         16405         4654 dike           215         64         sheaf fracture         19309         16309         4654           220         51         sheaf fracture         19309         16309         4654           223         63         sheaf fracture         19309         16394         4654	118	8.9	inini	10204	18220	AREA
Jorn         jorn <th< td=""><th>226</th><th>40</th><td>lough</td><td>19204</td><td>10220</td><td>405 -</td></th<>	226	40	lough	19204	10220	405 -
337         85         joint         19073         16153         4654           329         80         Raven dike         19161         16209         4654 dike           329         83         Raven dike         19166         16213         4654 dike           319         77         Raven dike         19160         16190         4654 dike           214         70         shear fracture         19333         16405         4654           215         64 shear fracture         19309         16394         4654           220         51         shear fracture         19309         16399         4654           223         53         shear fracture         19309         16394         4654	330	09	joint	19119	16138	4054
329         80         Raven dike         19161         16209         4654 dike           329         83         Raven dike         19166         16213         4654 dike           319         77         Raven dike         19160         16195         4654 dike           214         70         abert fracture         19303         16405         4654           215         64         sheart fracture         19309         16344         4654           225         51         sheart fracture         19309         16349         4654           220         51         sheart fracture         19309         16349         4654           220         51         sheart fracture         19309         16349         4654	337	85	joint	19073	16153	4654
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319         77         Raven dike         19180         16198         4654         dike           214         70         shear fracture         19333         16405         4654           285         64         shear fracture         19309         16309         4654           205         51         shear fracture         19309         16309         4654           220         51         shear fracture         19309         16399         4654           223         53         shear fracture         19209         16399         4654	329	83	Raven dike	19166	16213	4654 dike
214         70         shear fracture         19333         16405         4654           285         64         shear fracture         19318         19374         4654           205         51         shear fracture         19309         18389         4654           202         51         shear fracture         19309         18389         4654           223         63         shear fracture         19283         16339         4654	319		Raven dike	19190	16104	4654 dkc
205         64         sheat risclure         193/9         4054           220         51         sheat risclure         193/9         163/9         4654           223         63         sheat risclure         193/9         163/9         4654				10333	18405	4654
220 51 shear fracture 19309 103/4 4654 220 51 shear fracture 19309 16369 4654 223 63 shear fracture 19283 16339 4654		70	SOA31 (73/7*-/**		10403	4034
220 bit snear fracture 19309 16369 4654 223 63 shear fracture 19263 16339 4654	214	70	shear fracture	19999	10174	4054
223 63 shear fracture 19263 16339 4654	285	70 64	shear fracture	19318	16374	4654
	285 220	70 64 51	shear fracture shear fracture	19318	16374 16369	4654 4654

AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK
340	70	sh fracture	19086	15982	4654	
310	83 84	fault fault	19191	16190	4653	
38	74	fault	19185	16284	4653	
214	52 A3	fault	19183	16268	4653	
55	°9	bedding	19328	16363	4653	
35	18	bedding	19288	16363	4653	
349	9	bedding	19169	16147	4653 4853	
266	38	bedding	19074	16146	4653	
295	80	joint	19350	16400	4653	
194	80	joint	19166	16149	4653	
43	31	shear	19168	16139	4653	
281	84	sh fracture	19162	16140	4653	
315	73	fauit	19302	18383	4652	
292	72	fault fault	19092	15993	4652	
245	81	fault	19078	16144	4652	
78	19	bedding	19344	16363	4652	
7	13	bedding	19184	16164	4852	
215	87	joint	19358	18389	4652	
289	70 50	sh fracture sh fracture	19295	16357	4852	
132	87	fault	19364	16371	4651	SAH
133	85	fauit	19361	16365	4651	SAH
281	75	fault	19238	18289	4651	
235	38	fault	19082	16139	4651	
20	20	bedding	19368	16376	4651	
49	31	bedding	19188	18134	4651	
230	70	joint	19197	18160	4651	
324	70	shear sh fracture	19185	1612/	4651	
212	75	'ault	19350	16388	4650	
23	62 15	bedding	19186	16122	4650	
32	14	shear	19207	16181	4650	
214	5	anticline	19190	16123	4650	
245	- 53 - 41	sn.tracture fault	19346	16392	4650	
281	74	fault	19260	16168	4649	
50	33	autt	19103	16132	4649	
252	19	bedding	19156	16331	4649	
242	25	bedding	19171	16359	4649	
192	28	bedding	19196	16400	4649	
97	18	bedding	19072	16025	4649	
19	64	joint	19069	16215	4649	
317	87	joint	19108	16153	4649	
336	87	joint	19180	16374	4649	
115	72	ioint	191/8	16369	4649	
209	84	joint	19064	16231	4649	
291	82 74	joint	19045	16220	4649	
345	67	joint	19157	16318	4649	
324	78	joint	19101	16005	4649	
34	60	fault	19125	18124	4049 4648	
29	42	fauit	19076	16028	4648	
59	12	bedding	19221	16136	4648	
43	23	bedding	19103	16012	4648	
241	30	bedding	19087	16120	4648	
292	75	an. Inacture fault	1922/	16107	4048	
329	88	fauit	19181	16163	4847	
13	78	fauit	19232	16121	4847 ARA7	
288	53	joint	19227	16131	4847	
250	10	anticline	19077	16034	4647	
34	79	sh. tracture	19121	16101	4647	
30	63	sh fracture	19222	16116	4647	
83 340	24 84	fault fault	19126	16097	4648 4848	
64	9	bedding	19112	16024	4648	
326	69 73	joint sh frach re	19144	16114	4546	
80	83	sh fracture	19129	15092	4646	
28	71	fault	19289	16295	4845	
326	14	fault beddinm	19203	16150	4645	
32	54	fault	19257	18250	4644	
42	53	fault	19243	16222	4644	

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	AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK		AZIMUTH
	2/	19	bedding	19257	16217	4844			43
	290	72	shear tracture	19249	10213	4844			172
	205	/3	shear fracture	19140	10080	4644			172
	300	24	shear racture	19100	10115	4044			207
	1 103	50	fault	19203	16077	4043			207
	320		fault	10205	10077	4043			323
	330	78	fault	10210	18116	4643		1	201
	340	10	fault	19210	10113	4043			4
			hadding	10151	10099	4043			130
	24	22	bedding	19131	100/0	4043		l I	130
	200	20	Declarg	10007	10090	4043			164
	204	10	ineo!	19097	10049	4043			164
	224		notician	10173	10103	4043			
	1 55	- É	ebent fracture	10176	10111	4043			208
1	280	74	annone raciaria	10200	10097	4043			202
	222		fault	10203	18270	40-2			200
	286	20	fault	19295	18271	4847			1 204
	23	39	fault	19271	18240	4642			220
	29	40	fauit	19261	16215	4842			230
	25	46	fauit	19273	16206	4642			
	32	41	fault	19220	16105	4642			1 323
	31	46	fault	19236	16132	4642			50
	60	70	fault	19126	16049	4642			50
	78	74	fault	19100	16044	4642			289
	83	15	fault	19135	16070	4642			273
	76	31	fault	19112	16065	4842			295
	50	10	bedding	19122	16038	4642			31
	62	28	bedding	19104	16055	4642			31
	75	15	bedding	19112	16080	4642			335
	334	87	joint	19163	16070	4842			335
	84	15	vein	19140	16071	4842			104
1	52	70	shear fracture	19278	18224	4842			339
	76	33	fault	19097	16061	4641			224
	29	75	bedding	19093	16064	4641			224
	42	55	shear fracture	19187	16100	4641			67
	297	75	fault	19190	16076	4840			351
	32	44	fault	19197	16081	4840			359
	48	57	fault	19073	16060	4840			308
	30	- 4	bedding	19181	16082	4840			308
	13	28	bedding	19193	16084	4840			64
	288	78	joint	19196	16093	4640			210
	310	80	joint	19083	16061	4840			357
1	43	16	bedding	19093	16047	4839			209
	85	64	fault	18987	15999	4838			209
	220	25	bedding	18986	16009	4838			37
	343	75	joint	18985	16002	4638			37
	64	86	joint	18988	16007	4838			40
	319	- 77	fault	19011	16039	4637			45
	73	40	fault	19020	16018	4837			40
	300	72	fault	19030	16031	4637			45
	85	48	fault	19053	16031	4837			40
	61	71	fault	19048	16044	4837			224
	231	31	bedding	18999	16026	4837			40
	247	37	bedding	19008	16034	4637			224
	325		joint	19001	16021	4637			197
	297	55	fault	19143	15981	4638	MALL		190
	87	30	fault	19113	15960	4636	CFZ		49
	296	56	fault	19066	16012	4836			197
	292	62	tauk	19052	16019	4636			190
	244	29	seading	19044	16058	4636			49
	219	40	Degging	19024	16059	4636			297
	2/3	- 14	joint	19050	16028	4636	053		297
	40	20	Tault	19145	15987	4635	LF2		70
	143	70	becaling	19048	10016	4635			70
	23	70	juint	18890	15004	4035			29
	23	55	Journ	10030	10391	4033			200
	17	28	¥ <del>و</del> نا) (م. 4	10100	18030	4030	CE7		330
	242	22	hadding	10003	10030	4034	GF2		314
	105	20	beddies	10164	16047	4034			349
	155	80	Unuou triaj	19173	16034	4034			200
	30	70	inint	19112	16004	4814			120
	110	65	joint	10112	16097	4034			1,30
	155	85	ioint	19179	18030	4034			100
	81	66	pint.	19058	15904	4814			114
	124	77	inint	18814	15991	4474			140
	313	52	joint	18826	15982	4414		1 1	325
	124	77	idint	18815	15991	4614			200
	313	52	ioint	18824	159.97	4834			110
	55	45	yein	19097	16109	4414			150
	60	65	vein	19104	16102	4834			214
	332	83	fault	19049	15984	4833			215
	170	52	fault	18799	15994	4833			244
	170	52	fault	18799	15994	4833			248
	214	22	beddina	19050	15982	4833			272
	185	35	bedding	18804	15997	4833			180
	185	35	bedding	18804	15997	4833			103
	243	32	beddina	19025	15978	4832		1 I	201
	183	33	beddina	18806	15977	4832			82
	183	33	beddina	18808	15977	4832			249
	254	77	pint	19043	15972	4832			64
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244         23         bedding         1950         19602         4012           246         222         24         bedding         19283         16405         4612           199         19         bedding         19335         163399         4612           201         21         bedding         19234         16305         4612           201         21         bedding         19259         15369         4612           202         33         bedding         19259         15369         4612           203         bedding         19259         15369         4612         4612           204         35         bedding         19259         15369         4612         4612           205         35         port         19262         16439         4612         4612           207         75         port         19267         16233         4612         4612           206         6         antcline         19327         10371         4612         4612           217         75         port         19262         10371         4612         4612           216         20         antcline	AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK
-c         bedding         19241         10443         6612           222         24         bedding         19319         18377         6412           18         bedding         19231         18445         6412           201         21         bedding         19231         18445         6412           201         21         bedding         19241         1825         6412           202         33         bedding         19241         18254         6412           202         33         bedding         19249         15394         6412           202         33         bedding         19249         16432         6412           203         75         port         19249         16432         6412           204         6         antcline         19327         1838         6412           206         6         antcline         19327         18371         6412           206         6         antcline         19327         18371         6412           216         20         antcline         19327         18375         6412           217         74         sharer fracture         19327<	244	23	bedding	19190	16402	4612	
	246	22	bedding	19221	16443	4612	
1         2         bedding         10335         10425         4012           201         21         bedding         10239         10305         4012           246         9         bedding         19259         11229         4012           202         33         bedding         19259         15969         4012           202         33         bedding         19209         15969         4012           202         33         bedding         19209         15969         4012           203         35         bedding         19249         16432         4012           204         75         port         19257         10233         4012           207         75         port         19257         10331         4012           206         6         anbdine         19327         10371         4012           206         6         anbdine         19327         10371         4012           206         6         anbdine         19327         10373         4012           216         20         anbdine         19327         10375         4012           217         75         port </td <td>189</td> <td>18</td> <td>bedding</td> <td>19203</td> <td>10405</td> <td>4012</td> <td></td>	189	18	bedding	19203	10405	4012	
201         21         bedding         19291         19425         4912           249         9         bedding         19241         12205         4612           260         9         bedding         19291         12293         4612           202         33         bedding         19599         15941         4612           202         33         bedding         19909         15944         4612           159         19         bedding         19921         19444         4612           130         85         part         19210         16439         4612           30         75         part         192210         16439         4612           30         75         part         192210         16439         4612           206         6         antcline         19327         103371         4612           207         75         part         19221         103371         4612           216         20         antcline         19327         103371         4612           217         75         part         10337         10375         4612           217         75         part </td <td>71</td> <td>8</td> <td>bedding</td> <td>19335</td> <td>16369</td> <td>4012</td> <td></td>	71	8	bedding	19335	16369	4012	
82         3         pecking         19238         19235         4812           269         9         bedding         19259         15299         4612           202         33         bedding         19259         1599         4612           202         33         bedding         19928         1594         4612           202         33         bedding         19928         1594         4612           203         35         bedding         19924         16432         4612           204         75         pert         19257         16432         4612           277         75         pert         19257         16334         4612           276         6         antcline         19327         163371         4612           276         6         antcline         19327         163371         4612           276         6         antcline         19327         163371         4612           276         6         antcline         19327         16335         4612           276         6         antcline         19327         16335         4612           276         6         ant	201	21	beddina	19291	16425	4612	
249         9         bedding         19241         19255         4612           202         33         bedding         19599         15959         4612           202         33         bedding         19909         15964         4612           202         33         bedding         19909         15944         4612           203         bedding         199210         16439         4612           140         66         pmt         192210         16439         4612           30         75         pint         192210         16439         4612           30         75         pint         19221         16439         4612           206         6         antcline         19327         163371         4612           207         75         pint         19221         16336         4612           217         75         pint         19221         16337         4612           218         20         antcline         19327         16336         4612           217         75         pint         19257         16335         4612           218         20         antcline         1932	82	3	bedding	19238	16305	4612	
66         9         badding         19259         15289         4612           202         33         badding         19928         15914         4612           202         33         badding         19928         15914         4612           193         85         pert         19249         16328         4612           136         85         pert         19249         16328         4612           277         75         pert         19257         10283         4612           277         75         pert         19257         10283         4612           206         6         antoline         19327         10337         4612           207         6         antoline         19327         10337         4612           208         6         antoline         19327         10337         4612           216         20         antoline         19327         10335         4612           217         7.4         share fracture         19337         10335         4612           213         7.4         share fracture         19327         10335         4612           313         7.4	249	9	bedding	19241	16295	4612	
222         33         bedding         19091         15991         4612           202         33         bedding         19092         15994         4612           202         33         bedding         19093         15944         4612           193         95         bedding         19024         16439         4612           140         66         pert         12221         16439         4612           30         75         pert         12221         16439         4612           30         75         pert         12221         16236         4612           206         6         antoline         19327         18371         4612           207         75         pert         19221         18384         4612           208         6         antoline         19327         18371         4612           217         75         pert         18374         4812         4812           218         20         antoline         19327         18375         4812           218         20         antoline         19327         18375         4812           219         83         19297 <td>66</td> <td>9</td> <td>bedding</td> <td>19259</td> <td>16289</td> <td>4612</td> <td></td>	66	9	bedding	19259	16289	4612	
198         199         bedding         19228         15944         4612           1202         33         bedding         19928         15944         4612           138         85         pent         19249         16432         4612           140         86         pent         19249         16432         4612           277         75         pent         19257         16283         4612           277         75         pent         19249         16432         4612           200         6         antotine         19327         16331         4612           200         6         antotine         19327         16337         4612           216         20         antotine         19327         16335         4612           216         20         antotine         19327         16335         4612           217         7.4 shart fracture         19327         16335         4612           213         7.4 shart fracture         19327         16335         4612           213         7.5         pent         19327         16335         4612           213         7.5         shart fracture	202	33	bedding	18909	15969	4612	
cvc/c         33         bedding         19909         15991         4912           159         bedding         19210         16439         4912           140         B6         port         19210         16439         4912           130         75         port         19222         18384         4912           130         75         port         19221         18439         4912           140         B6         port         19222         18384         4912           277         75         port         19222         18384         4912           200         ambdine         19327         18371         4912           201         20         ambdine         19327         18371         4912           216         20         ambdine         19327         18374         4912           216         20         ambdine         19327         18355         4912           217         7.4         hear fracture         19292         16410         4912           2131         7.4         hear fracture         19292         16410         4912           2131         7.6         fauit         19926<	159	19	bedding	18928	15914	4612	
is         Descring         Parze         Tayle         4812           138         85         parkt         19249         16432         4612           140         86         parkt         19229         16336         4612           130         85         parkt         19257         16283         4612           138         85         parkt         19249         16432         4612           130         85         parkt         19249         16432         4612           200         6         ankdine         19327         18337         4812           201         6         ankdine         19327         18337         4812           201         20         ankdine         19327         18356         4812           211         21         ankdine         19327         18356         4812           211         74         #haref fracture         19327         18356         4812           213         74         #haref fracture         19327         18356         4812           213         75         fault         19928         18947         4811           213         75         fault	202	33	bedding	18909	15969	4612	
1-00         Do         pmin         120 0         10433         1043	109	19	cedding	10928	15914	4612	
30         75         joint         19221         19396         4912           170         86         joint         19210         16439         4612           140         86         joint         192210         16439         4612           300         75         joint         19262         16339         4612           200         6         antcline         19327         163371         4612           206         6         antcline         19327         163371         4612           216         20         antcline         19928         15948         4612           317         74         shear fracture         19297         16335         4612           317         74         shear fracture         19297         16335         4612           313         74         shear fracture         19297         16395         4612           313         74         shear fracture         19297         16395         4612           313         74         shear fracture         19297         4611         4512           313         75         fault         19526         4612         4511           213	140	85	, init	19249	16433	4012	
277         75         jord         19257         19283         4612           136         65         jord         19249         16432         4612           140         66         jord         19257         18336         4612           207         75         jord         19257         18331         4612           206         6         antcline         19327         18371         4612           206         6         antcline         19327         18375         4612           216         20         antcline         19327         18375         4612           317         74         sheaf fracture         19297         18395         4612           317         74         sheaf fracture         19297         18395         4612           317         74         sheaf fracture         19292         16410         4612           313         74         sheaf fracture         19292         16410         4612           313         74         sheaf fracture         19401         15925         4611           313         75         fault         19925         4611           213         86	30	75	ioint	19282	16396	4612	
138         65         jornt         19210         19439         4612           300         75         jornt         19282         16336         4612           207         75         jornt         19282         16336         4612           206         6         ankcline         19327         16371         4612           206         6         ankcline         19327         16371         4612           216         20         ankcline         19928         15944         4612           311         74         shear fracture         19297         16335         4612           331         75         fault         19261         15939         4611           233         76         fault         1926         15937         4611           233         77         fault         1926         4610         15925           236 <t< td=""><td>277</td><td>75</td><td>joint</td><td>19257</td><td>16293</td><td>4612</td><td></td></t<>	277	75	joint	19257	16293	4612	
140         68         jornt         19249         19432         4612           277         75         jornt         19257         19333         4612           206         6         anticline         19327         193371         4612           206         6         anticline         19327         193371         4612           216         20         anticline         19928         15948         4612           216         20         anticline         199297         16335         4612           317         74         shear fracture         19297         16335         4612           331         74         shear fracture         19297         16335         4612           331         74         shear fracture         19292         16410         4612           331         75         fault         19926         15997         4611           333         75         fault         19925         4691         19925           333         75         fault         19926         15957         4611           213         88         shear fracture         19931         15960         4611           213 <td>138</td> <td>65</td> <td>joint</td> <td>19210</td> <td>16439</td> <td>4612</td> <td></td>	138	65	joint	19210	16439	4612	
30         75         pint         19252         10336         4012           200         6         antcline         19327         10371         4612           200         6         antcline         19327         10371         4612           210         6         antcline         19928         15948         4612           211         20         antcline         19928         15948         4612           311         74         shear fracture         19297         16335         4612           313         74         shear fracture         19297         16335         4612           313         74         shear fracture         19297         16335         4612           313         75         shear fracture         19920         15447         4611           213         68         point         19934         15925         4611           213         68         shear fracture         19940         15925         4611           214         19846         15642         4610         312         70         fauit         19846         15642         4610           313         76         point         19840<	140	86	joint	19249	16432	4612	
277         75         pert         19257         19337         4912           206         6         antoline         19327         19337         4912           216         20         antoline         19327         19337         4912           216         20         antoline         19928         15948         4912           217         74         shear fracture         19297         16335         4912           313         74         shear fracture         19297         16335         4912           313         74         shear fracture         19337         18335         4912           313         74         shear fracture         19327         18335         4912           313         74         shear fracture         19327         18335         4912           313         74         shear fracture         19940         153957         4911           213         63         shear fracture         19941         15942         4910           214         19445         15842         4910         15925         4911           216         shear fracture         19941         15942         4910 <t< td=""><td>30</td><td>75</td><td>joint</td><td>19282</td><td>16396</td><td>4612</td><td></td></t<>	30	75	joint	19282	16396	4612	
200         6         anticine         19327         16371         4612           200         6         anticine         19928         15948         4612           216         20         anticine         19928         15948         4612           217         21         barr         16337         16335         4612           317         74         shear fracture         102297         10336         4612           317         74         shear fracture         10292         10345         4612           317         74         shear fracture         10292         10345         4612           317         falser fracture         10920         15957         4611           318         75         fault         19926         15957         4611           213         68         port         19934         15909         4611           213         68         port         19934         15925         4611           226         63         shear fracture         19940         15925         4611           227         70         fault         18843         15843         4610           232         76	277	75	joint	19257	16293	4512	
206         6         anbcine         1992/1         15948         4612           216         20         arbcine         19928         15948         4612           216         20         arbcine         19929         15948         4612           317         74         shear fracture         19237         18335         4612           331         74         shear fracture         19237         18356         4612           331         74         shear fracture         19237         18356         4612           331         75         shear fracture         19226         15957         4611           331         75         fault         19226         15957         4611           213         68         point         19934         15959         4611           213         68         point         19934         15925         4611           214         5844         15942         4610         1927         70         fault         19848         15842         4610           227         70         fault         19868         15847         4610           232         76         point         18843	206	8	anticline	19327	16371	4612	
<td< td=""><td>206</td><td></td><td>anticline</td><td>19327</td><td>16371</td><td>4612</td><td></td></td<>	206		anticline	19327	16371	4612	
1.1         2.1         102.02         102.02         102.02           311         7.4         these finacture         102.02         103.05         4012           311         7.4         these finacture         102.07         103.05         4012           311         7.5         faurit         102.07         103.05         4011           213         68         point         103.04         105.05         4011           213         68         point         103.04         158.42         4010           214         133.07         faurit         138.44         158.42         4010           214         135         bedding         158.44         4010         1310           212         7.6         point         188.43         158.41         4000	216 218	20	anticline	18928	15948	4512	
1.31         7.4         strate         10007         10007         4012           331         7.4         sheaf facture         10007         10007         4012           331         7.4         sheaf facture         10007         10007         4012           331         7.4         sheaf facture         10007         10007         4011           331         7.5         fault         10002         10007         4011           331         7.5         fault         10002         10007         4011           213         68         port         10004         15925         4011           216         68         sheaf facture         19940         15925         4011           220         63         sheaf facture         19940         15925         4011           327         70         fault         18848         15842         4010           321         70         fault         18843         15843         4610           310         76         port         18843         15843         4610           232         76         port         18843         15844         46002           310	317	74	shear fracture	10328	10946	4012	
331         74         pheer fracture         19202         19410         4912           337         74         sheer fracture         19297         10375         4912           333         74         sheer fracture         19297         10315         4912           331         74         sheer fracture         19292         10410         4912           333         75         fault         19928         19957         4011           213         68         port         19934         15909         4011           213         68         port         19934         15909         4011           296         63         sheer fracture         19940         15925         4011           327         70         fault         18849         15842         4010           327         70         fault         18845         15843         4010           232         76         port         18843         15843         4610           232         76         port         18845         15843         4603           310         76         port         18845         15843         4603           310 <td< td=""><td>331</td><td>74</td><td>shear fracture</td><td>19297</td><td>18395</td><td>4612</td><td></td></td<>	331	74	shear fracture	19297	18395	4612	
317         74         sheaf facture         19337         10335         4012           331         74         sheaf facture         19292         10410         4012           331         74         sheaf facture         19292         10410         4012           331         75         fault         19928         15957         4611           213         68         joint         19934         15909         4611           218         68         joint         19934         15909         4611           296         63         sheaf facture         19940         15925         4611           297         0         fautt         18848         15842         4610           327         70         fautt         18848         15842         4610           327         70         fautt         18843         4610         232           310         76         joint         18843         15843         4610           232         76         joint         18843         15344         4609           310         76         sheaf facture         1952         15344         4609           311         70<	331	74	shear fracture	19292	16410	4812	
331         74         sheaf facture         19297         10395         4012           331         74         sheaf facture         19297         10410         4012           331         75         fault         19920         15957         4011           233         75         fault         19923         15957         4011           213         68         joint         19934         15909         4011           213         68         joint         19934         15909         4011           296         63         sheaf facture         19940         15925         4011           327         70         fault         18846         15842         4010           327         70         fault         18846         15842         4010           232         76         joint         18843         15843         4010           233         70         joint         18845         15843         4003           310         78         joint         18845         15834         4003           310         78         fault         19226         16336         4603           221         56	317	74	shear fracture	19337	16375	4612	
331         74         shear fracture         19292         19410         4612           331         75         fault         19926         15957         4611           213         68         jornt         19934         15909         4611           213         68         jornt         19934         15909         4611           298         63         shear fracture         19940         15925         4611           298         63         shear fracture         19940         15925         4611           327         70         fault         19848         15842         4610           327         70         fault         19848         15842         4610           323         75         point         18843         15843         4610           331         76         point         18845         15844         4603           310         76         point         18845         15844         4603           311         76         shear fracture         19952         15964         4603           311         76         shear fracture         19952         15944         4603           321	331	74	shear fracture	19297	18395	4612	
331         75         fault         19225         19557         4611           213         68         joint         19934         15909         4611           213         68         joint         19934         15909         4611           213         68         joint         19934         15909         4611           296         63         shear fracture         19940         15925         4611           327         70         fault         18848         15842         4610           327         70         fault         18848         15842         4610           181         35         bedding         18866         15847         4610           232         76         point         18843         15843         4610           232         76         point         18843         15843         4600           310         76         point         18843         15843         4600           310         76         fault         19226         15334         4600           221         56         fault         19226         16336         4600           221         56         fault <td>331</td> <td>74</td> <td>shear fracture</td> <td>19292</td> <td>16410</td> <td>4612</td> <td></td>	331	74	shear fracture	19292	16410	4612	
3.31         7.9         Faunt         198/26         199/37         4611           213         86         point         19934         15909         4611           213         86         point         19934         15909         4611           298         83         shear fracture         19940         15925         4611           298         83         shear fracture         19940         15925         4610           327         70         faunt         18848         15842         4610           327         70         faunt         18846         15847         4610           232         77         point         18843         15844         4600           231         70         shaar fracture         19932         15844         4603           310         78         spinit         19932         15844         4603           311         70         shaar fracture         19932         15844         4603           3131         70         shaar fracture         19932         15844         4603           221         56         faunt         19276         10335         4608           221	331	75	fault	18926	15957	4611	
a.c.         part         193-3         1930/0         4811           218         83         shear fracture         1840         155/2         4811           228         83         shear fracture         1840         155/2         4811           228         83         shear fracture         1840         155/2         4811           229         70         fraut         1944         155/2         4811           127         70         fraut         1944         155/2         4810           121         75         bedding         156/4         4810         155/4         4810           232         76         port         18843         15843         4610         2331         70         shear fracture         19932         15964         4609         3311         70         shear fracture         19932         15964         4609         3311         70         shear fracture         19932         15964         4609         221         56         fault         19226         16333         4608         63         54         fault         19226         16337         4608         63         54         fault         19226         16337         4608	331	75	fault	18926	15957	4611	
	213	00 89	low	18934	15909	4611	
130         53         shear fracture         193/10         153/25         4011           137         70         fauit         193/46         158/42         4010           131         35         bedding         189/48         158/42         4010           181         35         bedding         189/48         158/47         4010           132         76         port         188/43         4010           232         76         port         188/43         4010           310         76         port         188/43         158/34         4000           310         78         port         188/45         158/34         4000           311         70         shear fracture         199/32         15964         4000           221         54         fault         192/26         193/70         4008           222         54         fault         192/21         193/84         4008           221         56         fault         192/21         193/70         4008           221         56         fault         192/21         193/70         4008           221         56         fault         1	208	83	shear fracture	18940	15909	4011	
327         70         fault         18848         15842         4410           327         70         fault         18848         15842         4410           181         35         bedding         18869         15847         4410           181         35         bedding         18869         15847         4410           232         76         port         18843         15843         4610           232         76         port         18843         15843         4610           310         76         port         18845         15834         4609           310         78         port         18845         15834         4609           221         56         fault         19250         16338         4608           222         54         fault         19250         16338         4608           221         56         fault         19272         16344         4608           221         56         fault         19272         16338         4608           221         56         fault         19272         16338         4608           221         52         fault	298	83	shear fracture	18940	15925	4811	
327         70         fault         19848         19842         4810           181         35         bedding         18808         15647         4610           181         35         bedding         18808         15647         4610           232         76         port         18843         15843         4610           232         76         port         18843         15843         4600           310         76         pint         18845         15834         4603           310         76         pint         18845         15834         4603           331         70         sheaf facture         19932         15964         4603           221         55         fault         19226         18338         4608           222         54         fault         19227         18346         4608           65         fault         19227         18348         4608           221         54         fault         19221         18337         4608           222         54         fault         19221         18337         4608           221         254         fault         19221 <td>327</td> <td>70</td> <td>fault</td> <td>18848</td> <td>15842</td> <td>4810</td> <td></td>	327	70	fault	18848	15842	4810	
181         35         bedding         18860         15847         4810           181         35         bedding         18808         15847         4810           232         76         port         18843         15843         4610           232         76         port         18843         15843         4610           232         76         port         18845         15834         4609           310         76         port         18845         15834         4609           310         76         port         18845         15834         4609           331         70         shear fracture         19932         15964         4609           221         56         fault         19250         16336         4608           222         54         fault         19272         16346         4608           65         54         fault         19272         16346         4608           221         56         fault         19272         16346         4608           210         32         bedding         19224         16357         4608           211         32         bedding <td>327</td> <td>70</td> <td>fauit</td> <td>19848</td> <td>15842</td> <td>4810</td> <td></td>	327	70	fauit	19848	15842	4810	
181         35         bedding         15864         15847         4610           232         76         port         15843         15843         4610           232         76         port         15843         15843         4610           232         76         port         15845         15834         4609           310         76         port         18845         15834         4609           311         70         sheaf facture         19932         15964         4609           221         55         fault         19226         19338         4608           222         54         fault         19227         19346         4608           220         54         fault         19221         19338         4608           221         54         fault         19221         19336         4608           221         54         fault         19221         19336         4608           221         54         fault         19227         19336         4608           221         54         fault         19227         19337         4608           240         19291         19337	181	35	bedding	18866	15847	4610	
232         76         point         18843         15843         4610           232         76         point         18845         15843         4610           310         76         point         18845         15843         4609           310         76         point         18845         15834         4609           310         76         point         18845         15834         4609           331         70         shear fracture         19932         15964         4609           221         55         fault         192250         16337         4608           60         65         fault         19227         16338         4608           221         56         fault         19226         16337         4608           221         56         fault         19227         16338         4608           221         56         fault         19227         16338         4608           221         52         fault         19227         16336         4608           210         32         bedding         19224         16337         4608           210         32         bedding<	181	35	bedding	18868	15847	4810	
c-ze         rs         pent         19843         19843         4610           310         76         pint         19845         15844         4609           310         76         pint         19845         15834         4609           311         70         sheaf recture         19992         15964         4609           221         55         fault         19226         18338         4608           222         54         fault         19226         18338         4608           222         54         fault         19227         18346         4608           260         65         fault         19227         18346         4608           221         54         fault         19226         18338         4608           221         54         fault         19206         18337         4608           221         54         fault         19206         18337         4608           201         52         fault         19202         18337         4608           210         40         bedding         19228         18334         4608           210         40         bedding <td>232</td> <td>76</td> <td>joint</td> <td>18843</td> <td>15843</td> <td>4810</td> <td></td>	232	76	joint	18843	15843	4810	
310         70         point         19845         15334         4609           310         70         shear fracture         19952         15964         4609           331         70         shear fracture         19952         15964         4609           221         55         fault         19226         15364         4609           221         55         fault         19226         16338         4608           80         65         fault         19272         18384         4608           60         54         fault         19226         18337         4608           221         56         fault         19272         1848         4608           221         56         fault         19272         18338         4608           221         56         fault         19272         18338         4608           210         32         bedding         19224         18337         4608           210         32         bedding         19288         18334         4608           210         32         bedding         19288         18334         4608           210         32 <t< td=""><td>232</td><td>76</td><td>joint</td><td>18843</td><td>15843</td><td>4810</td><td></td></t<>	232	76	joint	18843	15843	4810	
μmin         100-0         100-	310	76	joint	10045	15834	4609	
1.10         1.0000         1.0000         1.0000         1.0000           221         59         fault         1.0000         1.0000         1.0000           221         59         fault         1.0000         1.0000         1.0000           80         55         fault         1.0000         1.0000         4.000           80         55         fault         1.0000         1.0000         4.000           21         59         fault         1.0000         1.0000         4.000           21         59         fault         1.0000         1.0000         4.000           210         53         fault         1.0000         1.0000         4.000           80         54         fault         1.0000         1.0000         4.000           210         32         bedding         1.0000         1.0000         4.000           211         3         bedding         1.0000         1.0000         4.000           210         53         bedding         1.0000         1.0000         4.000           210         52         bedding         1.0000         1.0000         4.000           210         52	331	70	shear fracture	18933	15084	4009	
221         56         Fault         19255         19356         4608           222         54         Fault         19256         19356         4608           80         65         Fault         19272         19346         4608           80         65         Fault         19272         19346         4608           221         58         Fault         19256         19330         4608           222         54         Fault         19256         19330         4608           80         65         Fault         19272         16346         4608           210         32         bedding         19224         16375         4608           210         32         bedding         19222         10357         4608           241         16         bedding         19228         10334         4608           230         53         bedding         19289         16333         4608           230         53         bedding         19229         16334         4608           240         32         bedding         19229         16334         4608           241         16         bedding <td>331</td> <td>70</td> <td>shear fracture</td> <td>18932</td> <td>15964</td> <td>4609</td> <td></td>	331	70	shear fracture	18932	15964	4609	
222         54         fault         19208         19370         4008           80         65         fault         19291         19339         4008           85         54         fault         19291         19339         4008           221         56         fault         19261         19339         4008           222         54         fault         19269         19337         4008           80         65         fault         19271         19346         4008           80         55         fault         19271         19346         4008           80         55         fault         19271         19346         4008           210         32         bedding         19249         19357         4008           241         16         bedding         19281         19334         4008           207         35         bedding         19289         19333         4008           207         35         bedding         19281         19333         4008           210         40         bedding         19282         19357         4008           210         32         bedding	221	56	fault	19256	16358	4608	
B0         65         fault         19272         19346         4008           66         54         fault         19250         19338         4008           221         56         fault         19250         19338         4008           221         56         fault         19250         19338         4008           222         54         fault         19272         15346         4008           80         65         fault         19272         16337         4008           210         32         bedding         19224         16375         4008           244         16         bedding         19222         16337         4608           241         16         bedding         19282         16334         4608           230         53         bedding         19289         16333         4608           230         53         bedding         19289         16337         4608           240         7         bedding         19289         16337         4608           230         53         bedding         19289         16337         4608           241         15         bedding </td <td>222</td> <td>54</td> <td>fault</td> <td>19266</td> <td>16370</td> <td>4608</td> <td></td>	222	54	fault	19266	16370	4608	
65         54         fault         19231         19333         4008           221         56         fault         19260         19336         4008           222         54         fault         19260         19337         4008           222         54         fault         19272         19346         4008           80         65         fault         19221         19339         4008           210         32         bedding         19249         10357         4008           241         16         bedding         192278         10381         4008           210         32         bedding         19280         10333         4008           210         40         bedding         19280         10333         4008           210         40         bedding         19280         10333         4008           207         35         bedding         19282         10357         4608           210         40         bedding         19282         10357         4608           210         32         bedding         19282         10357         4608           210         40         bedd	80	65	fault	19272	16346	4608	
221         58         fault         19250         19358         4600           222         54         fault         19260         19370         4600           80         65         fault         19272         19346         4600           80         65         fault         19272         16346         4600           210         32         bedding         19224         16375         4600           241         16         bedding         19222         16357         4600           241         16         bedding         19222         16357         4608           241         16         bedding         19228         16334         4608           210         35         bedding         19289         16333         4608           210         35         bedding         19289         16334         4608           210         32         bedding         19289         16334         4608           210         32         bedding         19289         16334         4608           210         40         bedding         19289         16334         4608           210         40         bed	65	54	fault	19291	16339	4608	
2-24         >-9         Fault         132569         18370         4608           60         65         fault         132291         16339         4608           63         54         fault         132291         16339         4608           53         54         fault         19291         16339         4608           210         32         bedding         19249         16337         4608           241         16         bedding         19228         16331         4608           210         40         bedding         19228         16334         4608           210         40         bedding         19228         16334         4608           210         40         bedding         19209         16333         4608           210         35         bedding         19249         16357         4608           40         7         bedding         19249         16357         4608           210         40         bedding         19249         16339         4608           210         40         bedding         19249         16339         4608           210         40         b	221	58	fault	19256	16358	4609	
nu         nu<	222	54	raut	19268	16370	4608	
	80	65	lauit (a)	19272	16346	4608	
	210	24	Taut beddice	19291	10339	4608	
1         -	210	32	peddica	19224	103/5	4008	
284         7         beskin         9278         19381         4008           210         53         bedding         19289         19334         4008           200         53         bedding         19280         19339         4008           207         55         bedding         19280         19339         4008           207         55         bedding         19296         19339         4008           202         20         bedding         19296         19339         4008           212         20         bedding         19224         19375         4008           21         32         bedding         19224         19357         4008           24         18         bedding         19262         19357         4008           244         18         bedding         19289         19354         4008           240         40         bedding         19289         19334         4008           240         40         bedding         19289         19334         4008           240         7         bedding         19289         19334         4008           242         75 <td< td=""><td>241</td><td>18</td><td>bedding</td><td>19282</td><td>16357</td><td>4608</td><td></td></td<>	241	18	bedding	19282	16357	4608	
210         40         bedding         19289         19334         4008           200         53         bedding         19289         19333         4008           207         35         bedding         19289         19333         4008           49         7         bedding         19289         19334         4508           22         26         bedding         19249         19357         4608           241         13         bedding         19249         10357         4608           241         18         bedding         19249         10357         4608           244         18         bedding         19278         16351         4608           240         0.5357         4608         2608         2608         2608         2608           210         40         bedding         19280         16339         4608         207         35         bedding         19280         16339         4608         2207         25         bedding         19290         16329         4038         4608         222         71         pint         19201         16338         4608         222         71         pint         19208 <td>284</td> <td>7</td> <td>beddina</td> <td>19278</td> <td>16361</td> <td>4608</td> <td></td>	284	7	beddina	19278	16361	4608	
230         53         bedding         19280         19339         4008           207         35         bedding         19298         19339         4008           49         7         bedding         19298         19339         4008           22         26         bedding         19298         19339         4008           210         32         bedding         19224         19375         4008           241         18         bedding         19242         19357         4608           244         7         bedding         19262         19357         4608           244         7         bedding         19288         19354         4608           244         7         bedding         19288         19354         4608           230         55         bedding         19289         19338         4608           247         50         bedding         19284         19338         4608           222         71         pint         19318         16334         4608           222         71         pint         19204         19378         4608           222         71         pint<	210	40	bedding	19288	16354	4608	
207         35         bedding         19289         16333         4608           49         7         bedding         19316         16334         4608           22         26         bedding         19316         16334         4608           210         32         bedding         19249         16357         4608           241         18         bedding         19249         16357         4608           241         18         bedding         19276         16361         4608           241         18         bedding         19276         16351         4608           210         40         bedding         19280         16339         4608           207         35         bedding         19280         16339         4608           207         35         bedding         19280         16339         4608           207         35         bedding         19296         16339         4608           207         35         bedding         19290         16334         4608           212         26         bedding         19291         16334         4608           212         71	230	53	bedding	19280	18339	4608	
49         7         backing         19296         19329         4608           22         26         backing         19324         16375         4608           210         32         backing         19224         16375         4608           241         18         backing         19224         16357         4608           241         18         backing         19262         16357         4608           284         7         backing         19288         16354         4608           230         53         backing         19289         16334         4608           230         53         backing         19289         16333         4608           247         35         backing         19289         16334         4608           222         78         paint         19204         16378         4608           222         71         paint         19203         16373         4608           222         71         paint         19203         16373         4608           100         87         paint         19203         16373         4608           222         71         paint	207	35	bedding	19289	18333	4608	
x2         26         badding         19316         16334         4608           210         32         bedding         19249         16357         4608           54         9         bedding         19249         16357         4608           241         16         bedding         19249         16357         4608           244         7         bedding         19278         16361         4608           210         40         bedding         19280         16334         4608           201         40         bedding         19280         16339         4608           207         35         bedding         19298         16334         4608           207         35         bedding         19298         16334         4608           22         26         bedding         19310         16338         4608           22         27         1         joint         19238         19338         4608           235         73         joint         19238         19358         4608           47         60         joint         19238         19359         4608           325         74<	49	.7	bedding	19296	18329	4608	
xiu         3.2         bedding         112/24         113/35         4608           241         16         bedding         132/82         16357         4608           241         16         bedding         132/82         16357         4608           241         16         bedding         132/82         16351         4608           210         40         bedding         132/82         16354         4608           230         53         bedding         132/82         16333         4608           207         35         bedding         132/82         16333         4608           242         26         bedding         132/82         16334         4608           222         71         bedding         132/24         16378         4608           222         78         pint         132/24         16378         4608           230         78         pint         132/24         16378         4608           232         78         pint         132/24         16378         4608           232         77         pint         132/34         16358         4608           323         77	22	26	bedding	19318	18334	4608	
	<b>∡10</b>	32	bedding	19224	10375	4608	
	24	9 18	bedding	19249	10357	4608	
10         40         bestern         132.85         163.24         460.8           230         55         bedding         192.89         163.33         460.8           247         35         bedding         192.89         163.33         460.8           247         25         bedding         192.89         163.34         460.8           242         25         bedding         193.18         163.34         460.8           222         27         bedding         193.19         163.34         460.8           222         7.8         point         192.04         163.78         460.8           223         7.8         point         192.03         163.27         460.8           100         87         point         192.03         163.37         460.8           222         7.1         point         192.03         163.37         460.8           230         7.7         point         192.38         193.59         460.8           247         80         point         192.38         193.59         460.8           301         67         point         192.38         193.59         460.8           321 <td>241</td> <td>7</td> <td>bedding</td> <td>19274</td> <td>1035/</td> <td>4008</td> <td></td>	241	7	bedding	19274	1035/	4008	
230         53         bedding         19250         16339         4608           207         35         bedding         19298         16334         4608           49         7         bedding         19298         16334         4608           22         71         bedding         19298         16334         4608           222         71         bedding         19298         16334         4608           222         73         bedding         19298         16334         4608           222         74         bedding         19298         16334         4608           325         78         pint         19204         19378         4608           47         60         pint         19203         16373         4608           130         77         pint         19300         16338         4608           222         71         pint         19301         16338         4608           222         71         pint         19203         16358         4608           323         76         pint         19223         16358         4608           300         7         pint	210	40	bedding	19288	16354	4608	
207         35         bedding         19289         16333         4608           49         7         bedding         19318         16334         4008           22         26         bedding         19318         16334         4008           222         71         joint         19318         16334         4008           222         73         joint         19204         16378         4608           325         78         joint         19203         16378         4608           47         60         joint         19203         16373         4608           100         87         joint         19238         16358         4608           222         71         joint         19203         16373         4608           307         joint         19238         16358         4608           325         78         joint         19238         16358         4608           305         77         joint         19238         16358         4608           310         67         joint         19238         16359         4608           321         64         shear fracture         19291	230	53	bedding	19280	16339	4608	
49         7         bedding         19298         19299         19299         4909           22         26         bedding         19310         16334         4608           222         71         joint         19310         16334         4608           225         73         joint         19238         18358         4608           47         60         joint         19238         18359         4608           100         67         joint         19238         16334         4608           232         77         joint         19238         16359         4608           230         77         joint         19238         16359         4608           232         79         joint         19238         16354         4608           247         80         joint         19238         16354         4608           325         78         joint         19238         16354         4608           100         67         joint         19238         16354         4608           321         64         shear fracture         19291         16348         4608           321         64	207	35	bedding	19289	16333	4608	
22         25         bedding         19318         16334         4008           222         71         joint         19204         16378         4608           325         78         joint         19204         16378         4608           47         80         joint         19203         16373         4608           100         87         joint         19203         16373         4608           130         77         joint         19238         16358         4608           222         71         joint         19238         16358         4608           325         78         joint         19238         16358         4608           325         78         joint         19238         16358         4608           300         77         joint         19238         16359         4608           321         64         shear fracture         19291         16348         4608           321         64         shear fracture         19841         15970         4608           60         68         shear fracture         19841         15970         4608           203         25	49	7	bedding	19298	16329	4608	
222         /1         joint         19310         16338         4608           225         78         joint         19228         16358         4608           47         80         joint         19228         16358         4608           100         87         joint         19228         16359         4608           130         77         joint         19238         16359         4608           222         71         joint         19238         16359         4608           325         78         joint         19238         16358         4608           47         80         joint         19224         16378         4608           47         80         joint         19238         16358         4608           47         80         joint         19238         16358         4608           47         80         joint         19239         16334         4608           100         67         joint         19239         16336         4608           121         64         sheaf fracture         19291         16349         4608           1221         64         sheaf fracture	22	26	bedding	19318	16334	4608	
3-20         re         point         112/04         103/6         4608           47         80         jaint         122/3         163/3         4608           100         87         jaint         122/3         163/3         4608           130         77         jaint         122/3         163/3         4608           222         71         jaint         122/3         163/3         4608           325         78         jaint         122/3         163/3         4608           47         80         jaint         122/3         163/3         4608           100         67         jaint         122/3         163/3         4608           321         64         sheat fracture         122/1         163/4         4608           321         64         sheat fracture         122/3         163/9         4608           321         64         sheat fracture         129/31         163/4         4608           60         68         sheat fracture         198/41         15970         4608           203         25         bedding         198/34         15913         4608           203 <td< td=""><td>222</td><td>71</td><td>joint</td><td>19310</td><td>16338</td><td>4608</td><td></td></td<>	222	71	joint	19310	16338	4608	
ου         μμπ         τεχ.99         19.358         4608           100         67         μμπ         192.03         19.373         4608           130         77         μμπ         192.03         19.356         4608           222         77         μμπ         193.01         19.338         4608           325         77         μμπ         193.01         19.338         4608           47         80         μμπ         192.04         19.378         4608           100         67         μμπ         192.08         193.78         4608           100         67         μμπ         192.08         193.78         4608           321         64         shear fracture         192.01         193.46         4608           321         64         shear fracture         192.01         193.46         4608           60         68         shear fracture         192.01         193.46         4608           203         25         bedding         198.41         197.0         4608           203         25         bedding         198.41         199.01         4608           203 <td< td=""><td>325</td><td>78</td><td>joint</td><td>19264</td><td>16378</td><td>4608</td><td></td></td<>	325	78	joint	19264	16378	4608	
	47	80	jaint	19238	16358	4608	
	130	77	joint	19203	103/3	4008	
325         78         joint         19284         16378         4608           47         80         joint         19238         16359         4608           100         87         joint         19238         16359         4608           100         87         joint         19238         16359         4608           130         77         joint         19238         16359         4608           321         64         shear fracture         19291         16348         4608           60         68         shear fracture         19941         15970         4608           203         25         bedding         18834         15813         4606           203         25         bedding         18941         15970         4608           203         25         bedding         18941         15913         4606           203         25         bedding         18934         15913         4606           203         25         bedding         18934         15913         4606           203         25         bedding         18934         15913         4606           209         26	222	71	joint joint	19310	16334	4008	
47         80         joint         19238         19339         4608           100         67         joint         19238         1939         4608           130         77         joint         19238         1939         4608           321         64         shear fracture         19291         19346         4608           321         64         shear fracture         19291         19346         4608           60         68         shear fracture         19841         15970         4608           203         25         bedding         19841         15970         4608           203         25         bedding         19841         15971         4608           203         25         bedding         19840         15991         4606           203         25         bedding         19840         15991         4606           203         25         bedding         19840         15991         4606           203         26         bedding         19834         15813         4604           203         26         bedding         19854         15813         4604           203         26	325	78	idint	19264	16378	4608	
100         87         joint         19203         16373         4608           130         77         joint         19238         18349         4608           321         64         shear fracture         19291         16348         4608           321         64         shear fracture         19291         16348         4608           60         68         shear fracture         19841         15970         4608           203         25         bedding         19841         15970         4608           203         25         bedding         18941         15970         4608           203         25         bedding         18941         15971         4606           203         25         bedding         18943         15913         4606           203         25         bedding         18934         15913         4606           203         25         bedding         18934         15913         4606           203         26         bedding         18934         15913         4606           209         26         bedding         18934         15913         4606           269         <	47	80	joint	19238	18358	4608	
130         77         joint         19238         19369         4508           321         64 shear fracture         19291         16348         4608           321         64 shear fracture         19291         16348         4608           321         64 shear fracture         19291         16348         4608           60         68 shear fracture         19841         15970         4608           203         25         bedding         19849         15991         4608           203         25         bedding         19849         15991         4608           203         25         bedding         19834         15813         4606           203         26         bedding         19834         15813         4606           203         26         bedding         18934         15813         4606           209         26         bedding         18834	100	87	joint	19203	18373	4608	
321         64         shear fracture         19291         16348         4608           321         64         shear fracture         19291         16348         4608           60         68         shear fracture         19841         15970         4608           60         68         shear fracture         19841         15970         4608           203         25         bedding         19840         15991         4606           203         25         bedding         19844         15813         4606           203         25         bedding         19844         15813         4606           203         25         bedding         18934         15991         4606           203         25         bedding         18934         15991         4606           203         26         bedding         18934         15991         4606           209         26         bedding         18934         15913         4606           209         26         bedding         18934         15813         4606	130	77	joint	19238	16369	4608	
3/21         64         shear fracture         19/231         10/348         4600           60         68         shear fracture         19/841         15/970         4608           60         68         shear fracture         19/841         15/970         4608           203         25         bedding         19/841         15/971         4608           209         26         bedding         19/841         15/971         4600           203         25         bedding         19/841         15/971         4600           203         25         bedding         19/814         15/971         4600           203         26         bedding         19/814         15/971         4600           209         28         bedding         18/814         15/871         4600           160         37         bedding         18/814         15/871         4600	321	64	shear fracture	19291	16348	4608	
ov         ose         snear fracture         19941         13970         4608           60         68         shear fracture         18941         15970         4608           203         25         bedding         18940         15991         4606           209         26         bedding         18834         15813         4606           203         25         bedding         18834         15813         4606           203         25         bedding         18834         15813         4606           203         25         bedding         18834         15813         4606           203         26         bedding         18834         15813         4606           203         27         bedding         18834         15813         4606           209         26         bedding         18834         15813         4606	321	64	shear fracture	19291	18348	4608	
ov         os         arter tracture         19441         1547(J         4608           203         25         bedding         18844         15891         4606           209         26         bedding         18834         15813         4606           203         25         bedding         18834         15813         4606           203         25         bedding         18834         15913         4606           209         26         bedding         18834         15913         4606           209         26         bedding         18834         15913         4606           260         26         5913         4506         15813         4604	60	68	snear fracture	18941	15970	4608	
acc         acc         bedding         19940         15943         4606           209         26         bedding         18940         15913         4606           203         25         bedding         18940         15991         4608           209         26         bedding         18934         15813         4606           166         37         bedding         18934         15813         4604	200	00	Sinear fracture	18941	15970	4608	
203 25 bedding 19940 15911 4608 209 28 bedding 18834 15813 4608 166 37 bedding 18859 15813 4604	203	23	bedding	18834	15991	4606	
209 28 bedding 18834 15813 4606 166 37 bedding 18859 15813 4606	203	25	badding	18940	10013	4000	
166 37 bedding 18859 15813 4604	209	28	bedding	18834	15813	4604	
	166	37	bedding	18859	15813	4604	

AZIMUTH	DIP :	STRUCTURE	EASTING	NORTHING	ELEVATION REMARK
196	35	bedding	18842	15795	4604
196	35	bedding ch tracture	18842	15795	4604
210	90	sh. fracture	16838	15801	4604
77	37	fault	18849	15788	4603 CFZ
217	38	bedding	18944	16005	4603
21/	38	bedding ch frachura	18944	15005	4603
329	81	fault	18960	15994	4603
329	81	fault	18960	15994	4602
63	48	fault	18870	15794	4801 CFZ
53	47	fault	18966	16002	4601
19	66	fault	18828	15808	4601
19	66	fauit	18828	15808	4601
187	24	bedding	18957	16020	4600
310	82	sh fracture	1895/	16020	4600
310	82	sh fracture	18965	16016	4599
258	77	joint	18813	15794	4598
258	77	joint	18813	15794	4598
218	33	bedding	19130	16304	4337
233	31	bedding	19168	16387	4597
50	82	joint	18804	15788	4597
50	82	joint	18804	15788	4597
45	48	sh fracture	191/6	16403	4597
142	80	sh.fracture	19176	16375	4597
324	65	fault	18907	15768	4596
17	/8 78	joint	18980	16035	4596
302	80	fauit	19163	16343	4595
333	74	fault	19074	16385	4595
354	77	fault	19071	16381	4595
321	/9 80	fault	19063	16384	4595
238	72	fault	18767	15818	4595
58	74	fault	18773	15811	4595
321	80	fault	18800	15773	4595
238	72	fault	18767	15818	4595
217	32	bedding	18981	16041	4595
225	32	bedding	19158	16342	4595
217	32	bedding	16981	16041	4595
216	20	bedding	18785	15794	4595
178	18	bedding	18769	15812	4595
216	20	bedding	18765	15794	4595
52	10	bedding	18778	15798	4595
218	28	shear	18/69	15812	4595
54	66	sh. fracture	19175	16325	4595
133	72	sh. fracture	19198	16318	4595
288	78	fault	19088	16396	4594
219	69	taun. beddoo	19008	15050	4594
219	69	bedding	19009	15950	4594
238	38	bedding	19174	16329	4594
237	33	bedding	19215	16330	4594
254	21	bedding	19215	16394	4594
208	22	bedding	19083	16404	4594
218	15	bedding	19215	16312	4594
293	89 70	joint	19004	16033	4594
293	89	joint	19004	1603.3	4594
339	87	joint	18752	15829	4594
339	67	joint	18752	15829	4594
339	48 28	shear	18998	16035	4594
234	30	shear	19213	16315	4594
224	24	shear	19145	16411	4594
339	48	shear	18998	16035	4594
234	5U 68	snear sh frach-re	19213	18315	4354
315	64	fault	18937	15785	4593
54	73	fault	19229	16306	4593
344	75	fault	19064	16406	4593
54	73	fault	19007	16404	4593
285	7	bedding	19157	16432	4593
182	15	bedding	18748	15826	4593
182	15	bedding	18748	15826	4593
328	00 65	joint	19005	15945	4593
337	72	joint	19070	16407	4593
273	86	joint	19112	16419	4593
202	25	shear	19235	16321	4593
214	24	shear	19125	16422	4593
308	40	anticlina	18988	16049	4593

AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK	
98	79	shear fracture	19144	18329	4593		]
314	66	shear tracture	19090	16415	4593		
107	26	fault	18928	15801	4592	CFZ	1
331	66	fault	18998	15932	4592		l
29	77	fault	19085	16428	4592		
220	28	fauit	19070	16417	4592		
227	24	bedding	19147	16441	4592		
220	28	bedding	18994	16055	4592		
192	18	bedding	18782	15760	4592		
5	90	joint	19069	15905	4592		
23	22	joint	19108	16426	4592		
209	34	shear	19125	16439	4592		
68	53	fault	18954	15800	4591		
332	66	fault	19007	15914	4591		
342	52	fault	18998	15928	4591		
284	82	fault	10130	16314	4591		
109	77	fauit	19016	16054	4591		
199	40	bedding	18941	15812	4591		
236	27	bedding	19125	18453	4591		5
207	20	bedding	19107	16441	4591		
358	83	sont	18996	15926	4591		
352	87	pint	18965	15932	4591		
250	70	jaint	18983	15927	4591		
327	83	joint	19131	16451	4591		
257	77	joint	18/08	15/72	4591		
320	82	fault	18964	15805	4590		
340	55	fault	19005	15904	4590		
297	63	fault	19008	16087	4590		
108	71	fault	19260	10305	4590		
284	62	fault	19122	16466	4590		
288	82	fault	19141	16461	4590		
274	79	fault	19260	16305	4590		
325	/8 68	1auit beddiog	19067	15888	4590		
235	78	bedding	18991	15917	4590		
80	27	bedding	16968	15925	4590		
198	12	bedding	18761	15766	4590		
209	70	beddingo	18986	15920	4590		
∠15 58	70	beddingo	18988	15917	4590		l
255	80	joint	19005	15911	4590		
41	49	joint	19014	16045	4590		
41	49	joint	19014	16045	4590		
223	75	13UR fault	18971	15812	4589		
302	83	fault	19269	16299	4589		
302	83	fault	19269	18299	4589		
223	61	bedding	18958	15823	4589		
103	45	bedding	18968	15919	4589		
203	33	bedding	19025	16089	4589		
250	35	bedding	19134	16301	4589		
225	23	bedding	19123	16482	4589		
268	85	joint	18974	15809	4589		
60	90	joint	19054	15916	4089		
ő	90	joint	19069	15873	4589		
350	67	joint	19133	18472	4589		
163	10	joint	18754	15761	4589		
295	63	vein	19065	15868	4589		
12	73	shear fracture	19033	16073	4589		
319	86	shear fracture	19128	16301	4589		
310	83	shear fracture	19138	16480	4589		
320	70	fault	18970	15904	4588		
30	70	fault	19050	15868	4588		
105	87	fault	19133	16493	4588		
224	70	bedding	18967	15904	4588		
285	62	bedding	18971	15897	4588		- A
175	25	bedding	18995	15888	4588		
183	71	joint	19043	16095	4588		
255	54 70	joint	19052	15086	4588		
37	90	joint	18763	15744	4588		
219	31	shear	19149	,18291	4588		
304	80	vein	19033	16094	4588		
34	58	snear fracture	19120	16486	4588		
24	28	fault	19039	16094	4587 ∡587		
27	34	fault	19163	16107	4587		
22	32	fault	19151	16080	4587		
104	74	fauit	19110	16499	4587		

AZIMUTH	OIP	STRUCTURE	FASTING N	ORTHING FU	
27	34	fauit	19163	16107	4587
22	32	fault	19151	16080	4587
310	80	fault	19150	16247	4587
316	60	fault	19113	16153	4587
312	60	fault	19109	16146	4587
45	55	bedding	18975	15885	4587
35	44	bedding	19150	16092	4587
38	50	bedding	19141	16118	4587
10	22	bedding	19190	16088	4587
48	23	bedding	19169	16063	4587
10	22	bedding	19190	16088	4587
48	23	bedding	19169	16083	4587
119	20	bedding	18757	15740	4587
89	90	bedding	18972	15/49	4587
17	80	joint	18975	15888	4587
118	83	joint	19198	16092	4587
193	58	joint	19192	16099	4587
118	93	joint	19198	16092	4587
193	58	joint	19192	16099	4587
127	90	joint	19138	18213	4587
258	80 70	joint	19110	16155	4587
218	80	ven	19215	16078	4387
30	77	vein	19164	16071	4587
218	80	vein	19215	16078	4587
225	77	vent	18994	15071	4587
315	50	fault	19052	15844	4586
125	79	fault	19129	16514	4586 SAH
291	89	fault	192/2	18278	4586
291	89	fault	19272	18278	4586
290	85	fault	19282	18269	4586
209	48	bedding	18972	15832	4586
235	72	bedding	18978	15875	4586
49	19	bedding	19295	16256	4586
49	19	bedding	19295	16256	4586
211	25	bedding	19106	16181	4586
295	68	joint	18995	15865	4586
242	45	joint	18995	15873	4586
18	86	joint .	19103	16514	4586
255	90	pint	19110	16184	4586
244	85	joint	19083	16123	4586
38	20	juen, shear	19302	18258	4588
38	20	shear	19302	18258	4588
200	67	sh. fracture	19290	18254	4586
200	80	sn tracture fault	19290	10204	4585
320	60	fault	18998	15858	4585
23	28	fault	19131	16104	4585
45	46	fault	19147	16112	4585
37	65	fault	19279	16229	4585
29	58	fault	19244	16248	4585
31	57	fault	19239	18235	4585
208	55	fault	19260	16239	4585
201	47	fault	19278	16213	4565
212	81	fault	19276	16214	4585
32	70	fault	19205	18283	4585
307	87	fault	19172	16274	4585
290	56	fault	19334	18282	4585
201	50 61	fault	19324	16249	4585
32	74	fault	19330	18244	4585
308	83	fault	19413	16321	4585 SAH
35	00 65	tault fault	19279	16229	4085
29	58	fault	19244	16248	4585
31	57	fault	19239	16235	4585
208	55	78U't fauit	19251	18239	4585
201	47	fault	19278	18213	4585
212	81	fault	19276	16214	4585
218	50 54	fault fau <sup>se</sup>	19285	16226	4585
201	58	fault	19324	18249	4585
230	61	fault	19333	18257	4585
32	74 83	fault fault	19330	16244	4585
335	75	fault	19038	15841	4585

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ZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK	
255	53 28	bedding	18979	15868	4585		
44	42	bedding	19291	18206	4585		
17	57	bedding	19276	16228	4585		
226	34	bedding	19241	16250	4585		
352	10	bedding	19184	18270	4585		
207	24	bedding	19128	16531	4585		
74	12	bedding	19414	16335	4585		
44	42	bedding	19291	16208	4585		
17	57	bedding	19276	16228	4585		
74	12	bedding	19414	18335	4585		
218	20	bedding	19088	16154	4585		
210	40	joint	19003	15858	4585		
173	80	joint	19242	16226	4585		
126	80	jaint jaint	19283	16233	4585		
281	85	jaint	19188	16291	4585		
69	85	joint	19206	18251	4585		
290	86	joint	19102	16528	4585		
58	57	joint	19311	16245	4585		
173	80 77	joint	19242	16226	4585		
129	80	joint	19298	16214	4585		
69	65	joint	19206	18251	4585		
147	90	joint	1931	16293	4585		
215	70	joint	19112	18200	4585		
328	75	joint	19109	16192	4585		
44	90	joint	19066	16108	4585		
217	44	vein	19290	16220	4585		
216	44	vein	19283	16209	4585		
304	75	vein	19397	18323	4585		
304	75	vein	19410	18315	4585		
218	44	vein	19283	16220	4585		
43	48	vein	19233	18241	4585		
304	75	vein	19397	16323	4585		
4	84	shear fracture	19213	16249	4585		
313	73	shear fracture	19308	18250	4585		
305	75	shear fracture	19310	162/9	4585		
56	54	shear fracture	19131	18245	4585		
313	84 73	shear fracture	19213	18249	4585		
285	73	shear fracture	19316	18279	4585		
305	75	shear fracture	19394	18319	4585		
30a 65	32	fault	19003	15821	4584	CEZ	
149	79	fault	19137	18276	4584	dike	
115	- 74	fault	19108	16533	4584	SAH	
283	67	fault	19349	10241	4584		
306	70	fault	19392	18314	4584		
306	69 53	fault	19384	16300	4584		
283	87	fault	19349	18241	4584		
306	70	fault	19392	16314	4584		
197	43	bedding	19013	15861	4584		
30	33	bedding	19127	16115	4584		
208	23 24	bedding bedding	19099	16203	4584		
234	25	bedding	19140	18251	4584		
230	31	bedding	19143	16260	4584		
298	25	bedding	19114	16253	4584		
211	35	bedding	19142	16317	4584		
345	52 77	joint	18981	15858	4584		
323	78	joint	19151	16282	4564		
52	68	joint	19122	16534	4584		
325	80 80	jaint iaint	19726	18269	4584		
151	80	joint	19121	16269	4584		
192	80	joint	19134	18284	4584		
27	65	joint	19068	16131	4584		
145	75	joint	19061	16133	4584		
212	70	joint	18738	15722	4584		
29	85	vein	19140	16214	4584		
329	90	VOID	19138	18208	4584		
20	71	shear fracture	19152	16275 16218	4584		

AZIMUTH	DIP	STRUCTURE	EASTING	NORTHING	ELEVATION	REMARK
328	78	sh fracture	19142	16243	4584	
187	42	sh fracture	19324	18262	4584	
304	91	sh fracture	19380	16295	4584	
304	81	sh fracture	19380	16295	4584	
67	45	fault	19042	15814	4583	CFZ
335	45	fault	19030	15818	4563	dika
139	70	fauit	19182	18204	4583	dike
50	17	fault	19223	16197	4583	
154	59	fault	19119	16507	4583	
278	76	fault	19388	18276	4583	
50	17	fault	19223	16197	4583	
278	76	fault	19388	16276	4583	
323	40	fauit	19059	15809	4583	
53	21	bedding	19082	16155	4583	
197	23	bedding	19153	18213	4583	
54	24	bedding	19166	16207	4583	
40	16	bedding	19191	162202	4583	
42	8	bedding	19193	16204	4583	
80	13	bedding	19381	16288	4583	
214	22	contact	19088	18233	4583	
91	80	pint	19208	18208	4583	
209	87	joint joint	19376	16269	4583	
209	67	joint	19376	16289	4583	
181	40	joint	19118	16271	4583	
216	7	anticline	19159	16212	4583	
218	82	sh fracture	19184	18221	4583	
58	65	fault	18974	15832	4582	
45	33	fault	19226	16178	4582	
24	88	fault	19245	16184	4582	
37	43	fault	19240	16238	4582	
25	41	fault	19402	10231	4582	
30	63	fault	19381	18258	4582	
34	47	fault	19208	16189	4582	
45	33	fault	19226	16178	4582	
49	18	fault fault	19245	16184	4582	
37	43	fault	19386	16236	4582	
25	41	fault	19402	16231	4582	
200	64	bedding	18991	15824	4582	
198	15	bedding	19138	16183	4582	
22	25	bedding	19273	16178	4582	
37	16	bedding	19375	16270	4582	
24	37	bedding	19413	18231	4582	
12	22	bedding	19273	161/8	4582	
37	16	bedding	19375	18270	4582	
24	37	bedding	19413	16231	4582	
198	68	joint	19252	16151	4582	
290	83	joint	19269	18167	4582	
19A	64 68	joint ioint	19252	16168	4582 4582	
290	83	joint	19269	16167	4582	
203	30	joint	19040	16146	4582	
218	5	anucline	19144	16185	4582	
340	55	vein	18993	15824	4582	
198	60 60	sh fracture	19283	16171	4582	
294	73	fault	19091	16159	4581	
41	73	fault	19127	16125	4581	
210	80 85	tault fault	19094	16284	4581	
23	40	bedding	19099	16110	4581	
23	51	bedding	19108	16146	4581	
36	81	bedding	19143	16156	4581	
149	18	bedding	18720	15710	4581	
35	11	anticline	19094	16145 16145	4581	
38	78	ven	19119	16125	4581	
58	83	vein	19128	16185	4581	
39	78	sh. fracture	19140	16135	4581	
335	65	fauit	18979	15814	4580	
298	79	fault fault	19098	16169	4580	
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			fa	10478	10110	4500	
	297	20		10000	10100	4500	l I
	234	23	contact	19000	10209	4580	1
	341	77	joint	18704	15724	4580	
	204	/ 3 AU	منعر	19101	18180	4580	
	258	AA	vein	19108	16176	4580	
	337	70	fault	18955	15810	4579	
	34	28	fault	19189	16151	4579	
	32	23	fault	19182	16140	4579	1
	208	90	fault	19075	18295	4579	
	34	28	fault	19189	16151	4579	1
	32	23	fault	19182	16140	4579	
	141	69	fault	18710	15706	4579	
	143	69	fault	18698	15722	4579	1
	207	30	bedding	16948	15813	4579	
	216	24	bedding	19099	18177	4573	I I
	18	33	bedding	19188	16161	4579	I I
	18	33	bedding	19168	16161	4579	
	194	20	bedding	19069	18298	4579	
	258	30	bedding	19083	18285	4579	
	147	18	bedding	18706	15702	4579	I.
	335	88	joint	19104	16195	4579	I I
	269	28	inint	19187	16129	4579	
	338	80	joint	19195	16136	4579	1
	269	78	point	19187	16129	4579	1
	334	en.	1000	19105	16128	4579	1
	115	70	ioint	19074	16294	4579	
	197	77	vain	19069	18299	4579	
	316	65	fauit	18940	15790	4578	1
	57	15	Fac it	19199	16130	4578	1
	327	79	faut	19214	16140	4578	1
	57	15	fault	19199	16130	4578	
	327	79	fault	19214	16140	4578	1
	133	83	fault	18682	15758	4578	1
	238	30	bedding	18939	15807	4578	
	70	14	bedding	19203	16121	4578	
	70	14	bedding	19203	18121	4578	1
	51	55	ioint	19062	16301	4578	
	348	65	ioint	19058	18289	4578	
	115	15	fault	18925	15797	4577 CFZ	
	136	86	fault	19226	16132	4577 dike	ŀ
	278	85	fault	19055	18313	4577	L
	298	71	fault	19088	16402	4577	1
	136	86	fault	19226	16132	4577 dike	1
	217	70	fault	19085	18399	4577	1
	43	85	fault	18673	15732	4577	
	217	54	beddina	19102	16412	4577	
	242	10	bedding	18879	15710	4577	
	241	14	bedding	18691	15694	4577	I
	318	72	ioint	19056	18321	4577	1
	121	75	ioint	19053	18312	4577	
	127	90	joint	19053	16317	4577	1
	52	90	idint	19053	16315	4577	I
	132	72	ioint	18685	15711	4577	
	118	30	(aut)	18935	15785	4578 CFZ	J
	317	85	fault	19253	18098	4578 dike	
	34	67	fauit	19033	16304	4576 MAG	
	22	64	fault	19091	16435	4576 MAG	1
	17	60	fault	19111	18485	4576 MAG	
	317	A5	fau /3	19263	16008	4576 dika	ł
	36	55	fault	19031	18301	4578	1
	143	85	اليانة: الأربيزا	18663	15769	4478 CRO	I
	106	- 22	baddin-	18838	15000	4578	1
	353	24	hedding	19248	18113	4578	1
	353	24	bedding	19246	16113	4578	
	200	20	bedding	19094	16450	4576	
	143	Ř	bedding	18664	15740	4576	1
	184	82	idint	19237	16110	4578	1
	184	82	inint	19237	16110	4578	1
	110	90	joint	19051	16323	4576	1
	314	82	ioint	18666	15688	4578	1
	270	81	joint	18696	15696	4578	I .
	140	70	junin inint	18657	15749	4576	1
	294	76	fault	19055	18382	4575	1
	160	73	fault	19071	16404	4575	I .
	310	68	fault	19055	16383	4575	I .
	253	80	fault	19055	18371	4575	1
	219	.27	beddina	19095	16464	4575	1
	178	10	bedding	19039	16347	4575	I .
	179	30	bedding	19031	16325	4575	ł.
	168	25	berding	19029	18315	4575	I I
	TAR	20	beddina	19050	16368	4575	I I
	203	20	bedding	19060	16390	4575	1
	204	20	heddoor	19080	16417	4575	1
	207	24	contant	19048	18350	4575	L
	334	84	inint	19098	16475	4575	I
	40	90	10178	19088	16473	4575	(
	38	80	joint	19064	18308	4575	1
	303	71	junit veja	19060	18,100	4575	1
	05	70	shear fracture	19091	18445	4575	1
	165	68	far in a culle	18684	15748	4574	1
	231	28	bending	19029	16327	4574	1
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## APPENDIX 2 U-Pb ZIRCON ANALYTICAL RESULTS

l		672-	01 (Isotopic Ra	atios)		
Anaiysis # 6721416	0 83122	Pb207/U235 (±15) 4.21289	Pb206/U238 -0.03037	Pb206/U238 (±1#) 0.00881	Pb207/Pb206	Pb207/Pb206 (±1s) 0.33071
6721414	-5 34199	6 55985	-0.00216	0.01417	9 14863	60 05181
6721A15	7 58182	8.90172	0.01767	0 00425	C 28411	C 33075
6721A25	0.22857	0.0026	0.02957	0.00027	0.05342	0.00061
6721A28	0.21446	0.00238	0.02983	0.00027	0.05056	0.00057
6721A26	0.21772	0.00223	0.02987	0.00027	0.05138	0.00054
6721A12	0.21351	0.00216	0.03005	0.00027	0.0495	0.00051
672142/	0.9022	0.00450	0.03005	0.00027	0 10856	0 0011
672143	0.21593	0.00282	0.03013	0.00027	0.04893	0.00056
6721A10	0.22255	0.00237	0.03017	0.00027	0.04929	0.00054
6721A9	0.22113	0.00238	0.0308	0.00027	0.04969	0.00055
6721A11	0.2208	0.00221	0.03128	0.00028	0.0492	0.0005
6721A23	0.22374	0.00251	0.03142	0.00028	0.0505	0.00057
572:A7	0.28876	0.00302	0 03154	0 00028	0 06234	0 00065
6721A24	0.22649	0.00232	0.03166	0.00028	0.05049	0.00053
6721A22	0.22081	0.00242	0.0317	0.00029	0.05001	0.00055
6721A6	0.23471	0.00253	0.03176	0.00028	0.05075	0.00055
6721A20	0.22169	0.00274	0.032	0.00029	0.04918	0.0006
6721A1	0.2314	0.00242	0.0321	0.00028	0.04948	0.00052
6721A21	0.23056	0.00253	0.03218	0.00029	0.05079	0.00056
6/21A1/	0.22466	0.00235	0.03253	0.00029	0.04938	0.00052
6721A2	0.23132	0.00245	0.03253	0.00029	0.0495	0.00052
677144	0.203/3	0.00277	0.032/1	0.00029	0.05735	0.00059
672143	0.23733	0.00259	0.0329	0.00029	0.04908	0.00051
6721419	0.23293	0.00253	0.03237	0.00029	0.03137	0.00055
6721A18	0.23705	0.00245	0.03325	0.0003	0.05106	0.00054
					0.00100	0.00034
[		672-	01 (Apparent A	lges)		]
Analysis_#	P6207/U235	96207/U235 (±Ma)	P6206/U238	Pb206/U238 (±Ma)	P6207/P6206	<u>Pb207/Pb206 (±Ma)</u>
6721A16	514 3	2335 99	-198.8	58 6	0.1	3258 34
6721A14	-NaN		-14	91 52	8000	0
6/21A15	2182 /	1053 23	112.9	26 96	3385 7	1157.86
0/21A25	209	2.15	187.9	1.68	346.7	25.47
6721420	197.3	1.99	169.5	1.69	220.8	25.65
6721412	196 5	1.00	109.7	1.66	258	23.78
6721A27	385.8	317	190.9	1.69	171.5	23.7
6721A5	205.6	2.17	191.3	1.67	144.4	26.82
6721A13	198.4	1.98	191.6	1.68	161.8	25.44
6721A10	204	2.05	194.5	1.7	199.2	25.45
6721A9	202.9	1.98	195.5	1.7	180.4	24.95
6721A11	202.5	1.84	198.6	1.72	157.5	23.61
6721A23	205	2.09	199.4	1.77	218.2	25.85
5721A7	257.5	2.38	200.2	1.74	685.7	22.2
6721A24	207.3	1.92	200.9	1.78	217.7	23.98
6721A22	202.6	2.01	201.2	178	105 6	16 20
0/21A6	** * *		201.2		193.0	23.39
6771820	214.1	2.08	201.6	1.75	229.4	23.39
	214.1 203.3	2.08	201.6 203.1	1.75	229.4 156.6	23.39 24.7 28.38
6721A1	214.1 203.3 211.4	2.08 2.28 2	201.6 203.1 203.7	1.75 1.81 1.76	229.4 156.6 170.6	23.39 24.7 28.38 24.3
6721A1 6721A21	214.1 203.3 211.4 210.7	2.08 2.28 2 2.09	201.2 201.6 203.1 203.7 204.2	1.75 1.81 1.76 1.81	229.4 156.6 170.6 231.5	24.7 28.38 24.3 25.28
6721A1 6721A21 6721A17	214.1 203.3 211.4 210.7 205.8	2.08 2.28 2 2.09 1.95	201.6 203.1 203.7 204.2 206.3	1.75 1.81 1.76 1.81 1.81	229.4 156.6 170.6 231.5 165.9	23.39 24.7 28.38 24.3 25.28 24.49
6721A1 6721A21 6721A21 6721A17 6721A2	214.1 203.3 211.4 210.7 205.8 211.3 742.5	2.08 2.28 2 2.09 1.95 2.02	201.6 203.1 203.7 204.2 206.3 205.4 205.4	1.75 1.81 1.76 1.81 1.81 1.81	229.4 156.6 170.6 231.5 165.9 171.5	23.39 24.7 28.38 24.3 25.28 24.49 24.57
6721A1 6721A21 6721A17 6721A2 6721A2 6721A8 6721A4	214.1 203.3 211.4 210.7 205.8 211.3 242.5 716.4	2.08 2.28 2 2.09 1.95 2.02 2.22 2.22	201.6 203.1 203.7 204.2 206.3 206.4 207.5	1.75 1.81 1.76 1.81 1.81 1.78 1.8 1.8	229.4 156.6 170.6 231.5 165.9 171.5 504.7	24.7 28.38 24.3 25.28 24.49 24.57 22.71 23.57
6721A1 6721A21 6721A17 6721A2 6721A2 6721A8 6721A4 6721A4	214.1 203.3 211.4 210.7 205.8 211.3 242.5 216.4 225.5	2.08 2.28 2.09 1.95 2.02 2.22 1.96 2.19	201.6 203.1 203.7 204.2 206.3 206.4 207.5 208.6 209.1	1.75 1.81 1.76 1.81 1.81 1.76 1.8 1.8 1.8	229.4 156.6 170.6 231.5 165.9 171.5 504.7 180.2 257.4	24.3 24.3 25.28 24.3 25.28 24.49 24.57 22.71 23.52 24.57
6721A1 6721A21 6721A21 6721A2 6721A2 6721A8 6721A4 6721A3 6721A3	214.1 203.3 211.4 210.7 205.8 211.3 242.5 216.4 225.5 216.4	2.08 2.28 2 2.09 1.95 2.02 2.22 1.96 2.19 2.08	201.6 203.1 203.7 204.2 206.3 206.4 207.5 208.6 209.1 210.5	1.75 1.81 1.76 1.81 1.81 1.78 1.8 1.8 1.8 1.81 1.81	195.0 229.4 156.6 170.6 231.5 165.9 171.5 504.7 180.2 257.4	23.39 28.38 24.3 25.28 24.49 24.57 22.71 23.52 24.57 25.29

Report 672 U-Pb zircon analytical results.

		672	-01 (Sorted Res	ults)		]
Analysis #	Best Age (Ma)	Best Age (±Ma)	Why Rejected	Analysis_#	Best Age (Ma)	Best Age (±Ma)
12141	203.7	1.76		6/21A25	187.9	1.68
0721M2	200.4	1.78		6721A28	189.5	1.69
5721A3	209.1	1.81		6721A26	189.7	1.68
5/21A4	208.6	1.8		6721A12	190.9	1.66
721A5	191.3	1.67		6721A5	191.3	1.67
5721A6	201.6	1.75		6721A13	191.6	1.68
721A7			d-scordance	6721A10	194.5	1.7
5721A8	207.5	1.8		6721A9	195.5	1.7
5721A9	195.5	1.7		6721A11	198.6	1.72
5721A10	194.5	1.7		6721A23	199.4	1.77
5721A11	198.6	1.72		6721A24	200.9	1.78
721A12	190.9	1.66		6721A22	201.2	1.78
5721A13	191.6	1.68		6721A6	201.6	1.75
721A14			d scordance	6721A20	203.1	1.81
721A15			discordance	6721A1	203.7	1.75
721A16			discordance	6721A21	204.2	1.81
721A17	206.3	1.81		6721A17	206.3	1.81
721A18	210.8	1.85		6721A2	206.4	1.78
721A19	210.5	1.86		6721A8	207.5	1.8
721A20	203.1	1.81		6721A4	208.6	1.8
721A21	204.2	1.81		6721A3	209.1	1.81
721A22	201.2	1.78		6721A19	210.5	1.86
721A23	199.4	1.77		6721A18	210.8	1.85
721A24	200.9	1.78		6721A7		
721A25	187.9	1.68		6721A14		
721A26	189.7	1.68		6721A15		
721A27			discordance	6721A15		
721A28	189.5	1.69		6721A27		

Analyses in red are considered unreliable: - grains <1.0 Ga due to >10% error or significant discordance - grains <1.0 Ga due to >20% discordance or >10% reverse discordance. All errors are shown at the 1-sigma level, and include only measurement errors. Systematic errors (mainly from fractionation correction) add -3% uncertainty (2-sigma) to all ages. Decay constants:  ${}^{(2)}$ U=9.8485x10<sup>(1)</sup> -  ${}^{(2)}$ U=1.55125x10<sup>(1)</sup> -  ${}^{(2)}$ U/M<sup>2</sup>U=137.88. Isotope ratios are corrected for Pb/U fractionation by comparison with standard zircon with an age of 564 ± 4 Ma (2-sigma).

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## **Relative probability**

#### **APPENDIX 3**

#### **SELECTED SAMPLES**

#### REMARKS

SAMPLE	LEVEL	Y	X	ICP	XRD	ISOTOPES	THIN SEC	ſ
14	4740	16445	19310		1			
16	4740	16438	19365					1
19	4740	16463	19267		1			Ī
25	4740	16497	19382					
26	4740	16502	19387					P
27	4740	16508	19395		1			1
28	4740	16519	19412		T			1
29	4710	16445	19049				•	F
30	4710	16423	19064		1			Ĩ
48	4710	16275	19088		1	<b>A</b>		٢
53	4720	16607	19149		1			Ş
57	4720	16574	19120		1			
58	4720	16568	19113		1			
60	4720	16543	19152		1			Ĩ
63	4720	16727	19184					٢
64	4720	16735	19190		1			ſ
69	4720	16728	19200		1			ſ
70	4720	16726	19196					Ī
71	4720	16707	19191					Î
73	4610	15822	19046		1		•	ſ
74	4610	15810	19055		1			Г
86	4650	15970	19136					ſ
93	4730	16705	19487		1			ſ
94	4730	16711	19496		1			ŕ
95	4730	16716	19504		1			
96	4730	16736	19521		1			F
97	4730	16751	19529		1		•	Ñ
98	4730	16725	19512					١
100	4730	16763	19504					Γ
111	4720	16555	19073		1			ĩ
130	4610	15838	19045					Ē
131	4610	15849	19055	•	1			-
132	4610	15868	19066				•	
134	4610	15854	19035	-				-

	LEVEL	SAMPLE
40	47	14
40	47	16
'40	47	19
'40	47	25
'40	47	26
'40	47	27
40	47	28
10	47	29
10	47	30
10	47	48
20	47	53
20	47	57
20	47	58
20	47	60
20	47	63
20	47	64
20	47	69
20	47	70
20	<u>47</u>	71
10	46	73
10	40	74
50	40	86
30	40	93
30	A7	33
30	A7	05
30	A7	95
30	A7	90
30	A7	
30	A7	100
20	A7	111
20	41	120
10	40	130
10	40	422
טוו	4n	1.32

-					 		
14	4740	16445	19310		<b></b>		Sahegen ft.
16	4740	16438	19365		<b></b>		Near sheated fractures
19	4740	16463	19267				HW section of the Sahegen ft.
25	4740	16497	19382		<b></b>		5 ft. from the HW section of the Antelope ft.
26	4740	16502	19387		<b></b>		11 ft. from the HW section of the Antelope ft.
27	4740	16508	19395		 <b></b>		20 ft. from the HW section of the Antelope ft.
28	4740	16519	19412		<b>A</b>		40 ft. from the HW section of the Antelope ft.
29	4710	16445	19049		<b>A</b>	•	Thermally affected by the Raven dike
30	4710	16423	19064		<b></b>		Magpie ft. zone with some stibnite
48	4710	16275	19088		<b>A</b>		
53	4720	16607	19149				Sagehen ft. zone
57	4720	16574	19120				Sahegen ft. zone
58	4720	16568	19113				Sahegen ft.zone
60	4720	16543	19152				Magpie ft. zone
63	4720	16727	19184				
64	4720	16735	19190				
69	4720	16728	19200				
70	4720	16726	19196				Magpie ft.
71	4720	16707	19191				Magpie ft.
73	4610	15822	19046			<b>♦</b>	
74	4610	15810	19055		<b></b>		
86	4650	15970	19136				Popovich Fm.
93	4730	16705	19487				Pheasant ft. Visible gold
94	4730	16711	19496				
95	4730	16716	19504		<b>A</b>		
96	4730	16736	19521		<b></b>		Barite veinlets with visible gold
97	4730	16751	19529		<b>A</b>	•	Visible gold on SDrm1 bedding plane
98	4730	16725	19512		<b>A</b>		Visible gold 3 ft. from a sulfide veinlet
00	4730	16763	19504		<b>A</b>		
11	4720	16555	19073				Late sulfide vein+calcite @ 310,90
30	4610	15838	19045		 <b>A</b>		
31	4610	15849	19055	•	<b>A</b>		
32	4610	15868	19066		<u>ــــــــــــــــــــــــــــــــــــ</u>	<b>♦</b>	
34	4610	15854	19035		<b></b>		

REMARKS

137	4730	16762	19474		
145	4610	15849	19054		
146	4610	15822	19062 •		Canal sampling from the Contact Fault Zone
191	Tracker D.	15702	19026 •		
192	Tracker D.	15718	19040 •		Central Fault Zone
193	Tracker D.	15725	19038 •		
194	Tracker D.	15630	18644 •	•	SDrm (exoskarn)
195	Tracker D.	15621	18645 •	•	SDrm (exoskarn)
196	Tracker D.	15613	18641 •	•	SDrm-Dp along the Contact Fault Zone at low angle
197	Tracker D.	15605	18652 •		Calcite stockworks along the Contact Fault Zone
198	Tracker D.	15598	18657 •		Calcite stockworks along the Contact Fault Zone
199	Tracker D.	15589	18664 •		Calcite stockworks along the Contact Fault Zone
200	Tracker D.	15589	18693 •		Calcite stockworks along the Contact Fault Zone
201	Tracker D.	15599	18683 •		Calcite stockworks along the Contact Fault Zone
202	Tracker D.	15604	18670 •	•	Breccia zone along the Contact Fault Zone
203	4720	16611	19150		Magpie ft. Mineralized breccia with Sb+barite
204	4720	16625	19158 •		
205	4720	16627	19159 •		
206	4720	16679	19165 •		
207	4720	16714	19193 •		
208	4720	16726	19198 •		
209	4720	16734	19188 •	•	
210	4720	16764	19235 •		Magpie ft.
211	4720	16766	19233 •		Magpie ft.
212	4720	16771	19228 •		Magpie ft.
213	4720	16773	19226		Magpie ft.
215	4580	16266	19136 •		Raven dike Sample for AFT
216	4580	16265	19133 •		SDrm3
217	4580	16265	19130		SDrm3
218	4580	16272	19136 •		Raven dike.
219	4580	16237	19157 •		Breccia along the Raven dike/fault due reactivation
224	4730	16750	19528 •		SDrm1. Strong decalcification
225	4730	16739	19523 •		SDrm1 with visible gold. Strong decalcification
226	4730	16735	19521 •		SDrm1 with visible gold. Strong decalcification
227	4730	16727	19515 •		SDm1
228	4730	16708	19491 •		SDrm1. Pheasant ft. Strong decalcification
229	4730	16763	19544 •		SDrm1. Strong decalcification
4580As	4600	16440	19126	٠	As-minerals with stibnite along a NE-trendind structure

	g a NE-trendind struc		163						
m1. Strong decelotification	minerals with stibnite alon	m2, 3dc	m2, 3dc. Next to semple	m2, 34c	m2, 3dc				
SD	•   <b>^</b> •		03		. SD				
		_	_			_		_	
19544 •	19126	19125	19129	19130	19133-				
16763	16440	16197	16174	16106	16146				
4730	8	0894	0994	0894	10891				
229	4580Ae	22	æ	21	822				

V

#### **APPENDIX 4**

#### **MULTI-ELEMENT GEOCHEMICAL**

#### **DATA FROM**

#### THE CHUKAR FOOTWALL DEPOSIT

o 5	1 5474	192	9 3816	7.0332	17.1406	5.8588	6.4641	36.84	7.8324	5 477	6.1847	4 8699	10.8572	5	1 9263	0.696	17 0748	4	14.5217	9 3321	2010 21	3 6994	4 0253	2.3013	4 1164	2.065	2,8935	7.662	2.2644	8 6457	0.0966	0.1009		11911	1 8582	0.1205	2,0296	1506	3.4729	1.6328	1.1598	0 708	3 741	0.4806	2.8083
n M	107.071	101149	296.9351	473.6762	1166.177	274 4587	442.7414	1227.103	302.077	702 5786	967 9656	299.6284	1102.913	712 7548	65.4539	462.428	2074-01/c	178 7813	66E.L 0CE	965.0118	947 1071	366.2041	309.4313	1274-708	1286.762	110.8509	ETT9 844	M2.7693	291.0251	171.100	285 2743	444 6841	364 3239	512./011 553.7096	448 2065	917 3129	74 6207	263.5685	22 5227	169.983	464 9435	6717 F17	564.9631	371 1224	9/90 223
M Bi	27000	00.08	20562.66	61800	20022 86	43600	42000	000205	23695 91	00009	55400	25695.87	45523.16	36572.36	15278.43	35499.33	25500.00	16183.2	115000	10,000	000511	31385.67	16718.56	37132.94	13611.08	51936.68	28041.22	56842.34	41076.16	0/45/.90	3/137.33	43583.41	28644.6	31455.14	83000	2597 556	21528 56	000001	1694.87	9741.356	34833 83	0./0001	44568 87	27273.43	17777 8
M G																			1.0654		2051										14 5245			0.7276		0 0634			0.9743	0 9014	3.1868	2.1955	3 3673	6 3032	3.1107
n a ma			0.7698		0.000	ec70 0			0 6331			0 6914														2 0640				73 6708							2.8928	D770'C	4 5683	0.1491					3 1198
a ma	7624 006	4379.875	20145.8	9386 467	5218.891	01 JUSE 21	10112 95	7034 442	13776.08	9667 689	6865 537	5421.056	12081.5	490.442	4593.402	7936.916	00.50001	2341,233	5621.423	4624 646	5/ /C/9	6006 864	7816.55	9748.353	12450.23	12030.19	9756.682	11440 84	15401.12	107-1065	12487.36	13069 73	43574.32	102194	7862 411	2641.239	17870 34	2396 376	12299 37	16223.68	10961.68	ADD COL	17827 15	9918 773	7145.403
1	e enn	1 2045	25,4533	9 6533	11.9493	2.3714	11.4956	10.0821	14 2136	18.0265	2 5467	8 3769	73.2596		•	••	5 0	0	•	•	•		0	0	•	0 000	0000	0	0	2 0		0	••	20		0	•		10.4725	39.6422	11 0262	2.0928	20 17 18	6.764	18 4781
Cr Dom	10 467	ACF7 BF	34 5179	131157	193.1208	266937	46.1882	30.8777	65 2669	3./309	42,2309	41 19	112 5453 77 4676	10 5948	102.8318	83.4472	12/2/4	128 039	30 4638	21.492		134 7678	39.964	77,3652	55 444	31.0488	65,3833	43.1519	53.1195	C4-C/	35,6396	36.2692	59 4388	20.000	23.8702	16.3161	56,5658	21 9998	83 2047	25.4076	30.2817	71 0000	25 50A1	32.0151	87.1561
8			9.018		06484		3 7815		2 8212			1.4866		8.0681				15.9404				13 5151	44 0649		13.1047					2 2817	3		7 1174	10/07					6 5195	31.8695	18.8906				29 5715
bpm bpm	137.4.0	D Teke	1.1875	0 5475	1 8857	0.2487	0 6343	0 8691	202	51 <b>0</b> 00	0 4462	03568																																	
S and	0.000	158000	37690.29	157000	46879.2	87800	118000	186000	45393 24	112000	98800	4732815	88939 59	358000	107689.5	65951 05	17 00400	51867.91	214000	198000		61099 99	60754 62	71638 41	25903.88	104477.8	54625 51	112812 3	79638 04	76261 52	189000	84560 42	55656.68	114151 8	174000	391000	41342 43	000281	3726.419	19938 95	63478.39	34010 36 56.40A 7	84192.16	159000	37952 93
Ri Pom	JOY 1	2225	5802.0	1.3812	1,699	222.0	1.0083	1 5517	0.6228	67C/1	0 7256	0.3338				_														-			_					_					_		-
Be mon	10.7764	04730	03531	0.2383	0.1581	010010	3 0247	9 06193	3 0.3747	200000	0.4253	5 0 4765	1575	0 1259	3 0.176	0200		0.0643	2 0.7695	1.0562		02139	0.3993	0.6507	0.4197	0.6847	0.41	1.4571	0.6837		1.0256	3 0.5616	0 7380		3 0.5978	1.0887	0.3962		0 1847	5 0.2374	0.466		0.787.0	0.5694	0.2363
and mode	.ar Utat - C		096.96	2062/06/ 8	2 1075.86	3 4539.42	679764	1 551.43	87,190	2 Fat 165	2 1165 81	2 246 623	9 2982 80	36056	6788.94	5 271 149	0/0007 6	5 10842.2	5 633.138	2 376.823	021011 8	4 5069 71	6 133.363	3 191.40	56.520	7 283.686	8 2861 53	7 451 495	5 785.763	2010.3/1	5 52.578	2 1726.36	2 542.882	954.054	5 1376.29	2 857.764	2888	1 403018	5 293.979	1 87.33	4 201.419	1991	4 191.286	1 17.398	8 1669.7
Au azñon	1000			6 0.080	0000		1 0.096	90000	3 0.427	0157 0157	3 0037	8 0160	1 0.022	8 0000	6 0.021	7 0.011		1000	4 0.006	3000		00010	3 0230	7 0.015	6 0.08	0.141	0476	9000	4			6 0.069	4		5 000	9 0014	2 0.121	4 0.016	10000	9 185	6 0,291		9 0,259	7 0.004	3 0.567
Au ozton	- W U		2	0029	2 0.005	0000	1 0.095	5 0.005	7 0431	10.0	6 0.037	1 0 15	17 0023 6 0023		6 0020	100 8		80000	8 0000	8000			5 0 228	1 0.016	980.0	2 0 42 0 42 0 42	N 0487	00	8000	1 000	20000	0.068	5 000		1	2 0.015	6.02		13 0.085	1 1.839	12 0.266		8 0.254	17 0.005	7 0.563
¥ mad		10 05 57	203410	2 256.333	6 51.337	600 600 600 600 600 600 600 600 600 600	9 242.113	8 185 071	2 388 740	194 057	88 72 062	M 255.135	237 238 237 238	29	6 65.072	8 156.485		17 19.478	39 218.682	28 348 460		190.574	2 1200 23	144.776	11 320.158	57 833.379 66 1709 60	52 USU 23	22 116371	66.472	141.UZ/ 13 5577.67	80.287	12 371 310	22 31541	5/5/12/12 01	28.2	1 29.240	201394 201394	70 100 00 92 92 90	251,090	23 552.302	4 276 302	226921 E	327.085	3 146.370	H 1326.97
M	2000	1000	224126	75 960.555	53 518660	328475 328475	08 915416	36 1118.28	07 2731.61	10/1401 M	1678 36	01 2451.84	36 1053 56	139.300	386.526	2195.26	17 880	356.584	1347.72	1340.2		1109.52	2540.66	3282.5	3033.26	2759.30	1087.35	2531.55	2752.4	10206/	7787.16	2741.3	2260	2 6/95	2074.25	297 680	3119.72		2806.1	2842.0	3237.1	14751	2949 4	3732.81	1519.27
E Ag		ة 0 0	• •	4 1.49	5.05		8 1.890	9 0.80	10 068	17 0.30	13	14 0.090	90 13.51		93 14 58	đ.	88	26	96	8	00 00 00		18	ą	8	86	5	8	2	Eŝ		4	15	82	81	61	88	36	18	24	22	85	28	8	30
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LEVEL	1		4	\$	\$	* *	.4	4	4 (	4 9	4	47			Trac			Lact	Trad			Tract	4	4	47	30	-	4	4	40	4	4	4	44	4	\$	4 3	¥¥	\$	4	4	4 9	:4	4	47

LEVEL	SAMPLE	in Dom	4a bou	a mod	ds mod	3	Sn Ppm	rs mdd	TI Dom	₽å	, mqq	uZ udd
0131	-	26 14 96	77 0003	06 1700	outouc	2004	anne t	0E 4077		0 0100	100.00	100 E' 4 4
		15 0446	0000 11 0000 11 0	20/1/06	0760.02	01/210	1212	7/64:00	7710.4	0010.0	29.80.44	400 0244
1010		1086 CE	23618	235,8189	44 6521	06101	1002 5	670 10	7 4141	13 0474	2011 IS	100 2632
4610	4	12,4558	48.8547		15.3603	2 1378	5 6227	93 742	6 1202	8.5211	23 9511	117.0528
4610	s	13.6669	50.978		18.0626	1.9402	3.9312	16.0766	4 114	4 2565	6.9918	296 1761
4610	ę	70.8758	31 2997	232 299	34.1703	5.2125	5 7012	66 2773	13.4004	6.934	121.9296	331.253
4610	2	4 4726			36416	2.7716	3.5795	42 6454	0.8616	3.5325	1.1826	104 8357
4610	æ	14.0778	42,8091		17.5846	2.2512	5.515	72 7243	5 6328	8,0939	25.9539	119 9763
4610	ς,	51.528	13,8939	82.0943	9.1222	3,8307	5 1294	64.048	12 9672	4.9913	109.663	216.3945
673	₽ ;	18 8697	45.9828	60.702	27.6606	0.50	4 7413		6677 6	12 7589	17.4455	81 4017
4/30	= \$	199.0	8126.72		2000.00	4.2218	5.1499	38 716		19466	0.0284	144 4152
1720	7 5	10 0540	12023	1160.00	10019	2011.2	1200.0	21 80, 84	0160 C	0001.7	0007 50	
878	2 7	16 000		1020 201	14 2507	19091	20476	0.07.04	0.010	10 0114	18 7138	77 8769
Tracker	- <u>6</u>	154.409	32 0633	115.7776	82 6493	32,3112		77 0638	8 2049		148 1076	288.2055
Tracker	191	32.0606	48.4026		7.784	12.615		75 1713	9 0807	115.7403	12.6774	446 3277
Tracker	192	1 0368	10.9131		c	14.0965		236 1611		95.1532		690 2298
Tracker	193	8.6307	77 1793		24 6427	11.674		133 5152	2.9872	49.0445		246.3252
Tracker	ş	11.405	29 6692		7.5033	12.5009		36.709	12 6135	40.3721	16 4322	211.015
Tracker	<u>8</u>	15.8146	50.4524		16.2384	15.5853		52 9988	11 1133	78.1195	11.7364	182,2769
I racker	8	32 0098	41,3508		/3.0508	13.3358		121.3961	6 9279	72 9659	5.9909	122 7339
Tracker	197	1 2081			0 1351	8.6554		178 5929	2.3061	92.7564		108 403
Tracker	<u></u>	221.62	S4./209	0,000	22 455A	18.1292		62/2 901	9 2166	100.85	25 9011	446.6/63
Truchar	Βş	3262.00	30 0021	566	11110			20141.20	1100 11		2000.95	LOCC PC
Tractor		53 6007	11/2 53		17 3627	10 2265		0/2 00	14 2166	616 64 10	20,000	10 2181
Tracker	202	17 3052			11,2919	11 7599		116 143	7 2567	109.852	1.5759	265 9343
4720	203	16 2577	78.6201		34 2812	12.258		29,3913	7 8049	92 0365	3 4716	190 0982
4720	Š	19 3435	65 3028		16.455	14,267		38 0367	15 6351	118.9611	16 5272	257 3957
4720	<u>2</u> 65	19.107	26.5716		42 2347	15.1819		15.3169	10 7575	120 4753	6.2846	135 4333
4720	206	20 3414	49.3562		26.969	16.981		37,1017	8.5057	49 2552	8.0645	262 531
4720	20	30 8275	74 4633		158 3436	32 8036		21.8785	7,4975	161 6112	6 0375	313.897
4720	800	15 0337	63 0183		86.2961	14.658		39 837	4 3962	111.5728	4 9622	153,5165
4720	8	23 2408	26.777		11.8488	16.931		28 1827	11.3241	8 4742	102.0926	309 0517
874	22	P0/0.02	10,8030		1995.57	/265.02		1009.09	2082.71	5 X X	1000 ZL	255 4156
2 A 2	5.2	01/102	2070711		0106.21	2002 81		10 7368	2 AUNA C	9/ 201	14 (050)	228.14.50
4720	213	18.0654	64.2264	41 0739	16 0477	18 9961		190.957	88 8272	122 2671	21.4877	519 0198
4720	214	152154	23 4841		23 0812	20.5961		52 6813	13.7716	102 7155	2 1615	254.0846
4580	215	165 994	60 8858	445 8954	59 5476	43 4469		55 2317	21.0326		1.1955	250.3976
4580	216	15.4943	123 8674		12,5331	15 9189		156.538	16.7592	65.5043	8.4175	380.229
4580	217	13.8871	88.2949		10.5137	13 6842		122 7574	14 7561	34.5283	0 2693	315.2054
4580	218	11.8966	45.1041		9 2827	17.3237		72 5521	15.2221	23.0582	12.3622	588.6532
4580	5.6	1000.4	67 3715		306.8555	18 8157		71,7482	CU20 U	57 / 57 69 / 57 69 / 57	0,0163	00C/ 90/
4680	12	43 2531	2905 42		125,2097	21972		6197.9	5 522	148 6763		242 0446
4680	8	9 832	78 0271		5.0588	11.3896		20.2646	4 3614	77 1655		423 0484
4680	83	24 0696			27.7647	8.3449		6 2737	9.9079		2.9018	61 7346
4730	224	26.2104	47 1124	100.1926	66.6233	13 1745		11.7084	5 431			130,1551
4730	8	20313		130.5365	26 473	10 7263		42.671	7.0208			223 9262
874	88	7.3618	5 8638	01 00 01 F	10 4497	9.0827		31,3991	11 6528			151 9218
0.74	ACC C	BOCD CI	66 1305	784 4706	47.6000	22.252		190610	2000.7		23 2585	CONC. C/ 1
4730	522	16051	116 5974		11 0396	13 1713		180.2209	11 6588			406 5428
4730	23	19 0146	48.1788		22600	12 8054		58 1738	2 4123			118,5815

# APPENDIX 5 SELECTED THIN-SECTIONS SHOWING TEXTURES, MINERALOGY, AND CROSS-CUTTING RELATIONSHIPS









#### **APPENDIX 6**

### LOCATION MAP OF THE QRC DRILL HOLES IN THE CHUKAR FOOTWALL OREBODY

