PRELIMINARY GEOLOGIC MAP OF THE JERRITT CANYON MINING DISTRICT, ELKO COUNTY, NEVADA John L. Muntean and Christopher D. Henry

Surface mine facilities Includes structures, tailings pond, roads, ore stockpiles, and dumps. Insufficient information to interpret underlying geology.

QIs Landslide deposits

Playa deposits (Quaternary) A small (~150 m diameter) closed depression along the downthrown side of a northeast-striking fault north of Taylor Canyon in Vater Pipe Canyon Quadrangle is filled with soft clay. The depression is filled with

Qmy Active medial drainages Can include numerous closely spaced channels.

Qsv Young spring deposits

Young alluvial fans Qfy2 is active alluvial fans. Qfy1 refers to a distinct young Qfy₂ alluvial fan that shed off the east side of Independence Mountain. Both units are poorly incised and tend to have distributary drainage patterns.

Intermediate-age alluvial fans Tend to have surfaces 1-3 m above younger between channels that have tributary patterns. Qfi1 occurs along a higher Qfi₁ elevation surface than Qfi₂. Older alluvial fans Deeply incised old fans with ridge and valley morphology mostly on the east side of the Independence Mountains with relief greater than

Gravel (Miocene?) Poorly indurated, massive to poorly bedded, conglomerate,

conglomeratic mudstone, and mudstone overlie older rocks with variable angular conformity. Consists mostly of well-rounded, generally clast-supported clasts of Paleozoic quartzite and chert and lesser Tertiary volcanic rocks to about 25 cm diameter in a muddy matrix. Well exposed only in artificial cuts. Occurs mostly as a lag of rounded Basalt lava (Miocene?) Brown-weathering, black on fresh surface, massive to

as a lag of angular to subrounded boulders with little to no interstitial soil. The lack of massive flow outcrop suggests the deposits are either flow breccias or are reworked. Appears to overlie poorly exposed Eocene deposits with angular unconformity. Occurs only north of Taylor Canyon in the Water Pipe Canyon Quadrangle. Trut Tuffaceous sediments (Miocene) Very poorly indurated, white weathering, tuffaceous sandstone, siltstone, mudstone, and minor tephra and conglomerate. rops out and commonly covered by colluvium from topographically higher units.

Exposure consists mostly of light-colored, clay-rich soil with scattered chips of variably silicified platy siltstone. Recognized only near Taylor Canyon in the southwestern part of the Waterpipe Canyon Quadrangle. The presence of white to silvery tephra composed of variably altered glass shards is diagnostic of Miocene deposits. Andesite dike (Eocene?) A glassy, black, flow-banded andesite or dacite dike cuts along the contact between basal Tertiary conglomerate (Tcg 1) and

limestone (TIs) south of Taylor Canyon in the Water Pipe Canyon Quadrangle. The dike is about 300 m long and up to 5 m wide. The dike and flow bands strike northwest and dip moderately northeast, approximately parallel to bedding. The rock contains phenocrysts of Quartz monzonite dikes (Eocene) Holocrystalline quartz monzonite dikes up to 20 m wide with northeast strikes. Contain fine-grained (less than 2 mm),

hic plagioclase, hornblende, biotite, potassium feldspar, quartz and accessory

magnetite. Occur in Rocky Canyon and Smith Creek areas. Dike in Smith Creek contains a 1- to 3-m wide rind of diopside-potassium feldspar hornfels. 40Ar/39Ar date: 39.2±0.1 Ma, hornblende, Smith Creek, Hofstra (1994). Basalt dikes (Eocene) Northeast-striking basalt dikes, less than 2 m wide, that contain 1-3 mm phenocrysts of olivine and pyroxene in felted matrix of plagioclase. ⁴⁰Ar/³³Ar date: 41.1±0.1 Ma, whole-rock, West Generator open pit, Hofstra

(1994). K-Ar dates: 37.2±1.2 Ma, whole rock, Burns Basin open pit; 37.9±1.2 Ma, whole rock, 2.5 km southwest of Burns Basin pit; 34.6±1.2 Ma, whole-rock, West Generator open pit, J. Margolis, written commun. (2005). Tst Tsc Tsg Sedimentary sequence of Pie Creek (Eocene) A thick sequence of poorly to rarely moderated indurated, commonly uffaceous sandstone, conglomerate, and siltstone crops out extensively near Pie Creek and around Taylor Canyon. The sequence is divided into three units based on dominant type: siltstone and minor sandstone (Tst), sandstone and conglomerate (Tsc), and conglomerate (Tsg). All of the sequence was mapped as siltstone (Tst) around Taylor Canyon, where it is particularly poorly exposed, although all rock types are present. Siltstone is massive to finely laminated and commonly silicified, especially south of Taylor

Canyon. Thin- to thick-bedded, planar bedded sandstone is composed of quartz, plagioclase, and sanidine and volcanic rock fragments, probably all dominantly reworked from underlying ash-flow tuffs. Conglomerate makes moderately continuous layers and distinct channels as much as 8 m deep. Clasts in conglomerate are mostly subrounded to subangular, ash-flow tuff and andesite up to 5 cm and locally 25 cm in diameter. Paleozoic rocks are generally a minor constituent but locally abundant and no more than 3 cm in diameter. Haynes (2003) reported a zircon U-Pb age of 38.8±0.5 Ma on a "water-lain, airfall tuff, interbedded with volcaniclastic rocks in the Pie Creek area," which is probably from Andesite lava (Eocene) Porphyritic andesite lava and breccia crops out south

of Pie Creek in the Mahala Creek West Quadrangle and more extensively south

massive to vesicular, and crystalline to vitrophyric blocks of andesite in a rarely exposed matrix of finer andesite clasts. Haynes (2003) reported a zircon U-Pb age of 39.8±0.3 Ma on possibly correlative dacite from the "Pie Creek area." Tx Megabreccia (Eocene) Coarse breccia composed of blocks, mostly of tuff of Big Cottonwood Canyon and Nelson Creek, crops out extensively near Pie Creek and in a small area north of Taylor Canyon. Clasts are commonly up to 3 m and locally to 20 m across and range from angular to rounded. Areas of abundant clasts can be

rounded pebbles and cobbles in similar deposits elsewhere in northeastern Nevada. Tuff of Big Cottonwood Canyon (Eocene) Poorly to moderately welded, devitrified, rhyolitic ash-flow tuff containing ~20% phenocrysts of subequal amounts of smoky quartz, sanidine, and plagioclase with lesser biotite is the youngest major ash-flow tuff in the area. Contains abundant pumice up to 4 cm long that have undergone extensive vapor-phase crystallization. Erupted from the Big Cottonwood Canyon caldera ~25 km to the west. *Ar/**Ar dates from caldera area: 39.92±0.12 Ma, sanidine and 39.92±0.10 Ma, sanidine, from two samples: Henry and Boden (1998),

Dacite intrusion (Eocene) Two thick dikes or small plugs of porphyritic, flowbanded dacite cut Paleozoic rocks and the tuff of Nelson Creek north of Taylor Canyon in the Water Pipe Canyon Quadrangle. The southern dike is elongate westnorthwest and ~100 m long by 20 m wide. The northern plug is about 200 m in diameter and has a thick breccia surrounding a massive core. Flow bands in both bodies strike west-northwest and are nearly vertical. Both bodies contain about 15% phenocrysts, mostly of plagioclase with ~2% biotite, and are highly silicified.

Tdt Tdd Tdl Tdv Dacite tuff and lava(?) (Eocene) Abundantly porphyritic dacite containing 30 to 50% phenocrysts of plagioclase, hornblende, biotite, orthopyroxene, clinopyroxene, and magnetite makes up most of the volcanic rock of the Millsite volcanics. The dacite ranges from poorly welded, abundantly pumiceous ash-flow tuff (Tdt), through densely welded tuff (Tdd), to lava-like rock (Tdl) for which a primary pyroclastic origin is, at best, obscure. The pyroclastic origin of the densely welded tuff is demonstrated by the presence of light-colored streaks marking dense 2. Bratland, C.T., 1982, Winters Creek Geology, 1:6000 scale, Freeport Exploration, pumice and scattered rock fragments of porphyritic andesite. Densely welded shards and pumice are apparent in thin section. The densely welded tuffs commonly also have a thin, poorly welded base. Lava-like rocks lack the light-colored streaks and rock fragments and do not have poorly welded bases, but thin sections show faint suggestions of very densely welded shards. The distinctly tuffaceous rocks also locally contain sparse to abundant glassy magma lumps or very densely welded dacite, indistinguishable from host dacite, that also show faint suggestions of very densely welded shards. Vent areas (Tdv) are marked by concentrations of large (up to 55 cm diameter) lumps that comprise as much as 80% of the rock in a dense, pumiceous matrix. In the best example of a vent for a poorly welded tuff in the southwest part of the Millsite volcanics, the size of lumps in the tuff increases progressively toward the mapped vent. ⁴⁰Ar/³⁹Ar dates: 40.4±0.1 Ma, hornblende

dominantly of plagioclase, with lesser biotite, quartz, hornblende, and sanidine. The single cooling unit grades from a poorly welded base into a thick densely welded top. The tuff contains sparse small pumice up to 3 cm long and a few porphyritic andesite clasts to about 1 cm. Composite thickness is at least 120 m, most of which is the upper densely welded part. 40Ar/39Ar date from a sample in the Tuscarora Quadrangle just west of Taylor Canyon: 40.18±0.11 Ma, sanidine, H97-30, Henry and others (1999).

Tuff of Nelson Creek (Eocene) Poorly to densely welded, devitrified,

abundantly porphyritic rhyolite ash-flow tuff containing 30 to 35% phenocrysts,

Upper conglomerate (Eocene) Poorly indurated, poorly exposed, boulder to 1. Foo, E. and 9 others, Wright Window Geologic Map, 1:6000 scale, Freeport Exploration, ebble conglomerate consisting of subangular to subrounded clasts of quartzite to 1.5 m, chert to 50 cm, and chert-quartzite pebble conglomerate to 20 cm. Similar to lower conglomerate (Tcg1) but overlies the plagioclase-biotite ash-flow tuff (Tt) in the northern part of the Millsite volcanic area. A clay matrix for pebble conglomerate was seen only in a cut along the haul road. Generally occurs as a lag of boulders to pebbles in a 4. Muntean, J.L., 2006, aerial photograph interpretation, this study.

Rhyolite tuff (Eocene) Low-silica rhyolite to high-silica dacite ash-flow tuff, commonly with a basal vitrophyre (Ttv), which is mapped separately where possible. Mostly densely welded, although a lower poorly welded glassy zone is extensively exposed along the ridge southeast of Winters Creek. An upper poorly welded zone is rarely exposed. Contains 25 to 30% phenocrysts consisting mostly of plagioclase, lesser biotite, and minor hornblende, clinopyroxene, orthopyroxene, and magnetite. Also contains a few percent pumice up to 5 cm long and sparse fragments of porphyritic andesite and lesser quartzite up to 2 cm in diameter. Bedded tuff is exposed at the base in a few artificial cuts. ⁴⁰Ar/³⁹Ar date: 41.9±0.1 Ma, biotite, Hofstra (1994). Pre-volcanic Sedimentary Rock

Shale, calcareous shale (Eocene) White-weathering, brown on fresh surfaces, very finely laminated, fissile, "paper" shale. Thin interbedded channel deposits of fine sandstone. Contains leaves and leaf impressions of metasequoia. Rarely crops out; occurs mostly as clay-rich soil with a lag of abundant to sparse, platy chips.

Limestone (Eocene) Limestone overlies and is locally interbedded with the upper part of the lower conglomerate (Tcg₁) in all areas of Eocene outcrop. The kest deposits, up to about 100 m, are in the Pie Creek and Taylor Canyon areas, which are probably formerly continuous parts of a paleovalley that trended east across what is now the Independence Mountains. Mostly white to cream to light gray, thick-bedded to less commonly, finely laminated micrite is most common. More finely laminated deposits commonly contain ostracods and oolites, a few gastropods (Lymnaid), and possible reed fragments. Upper parts of the lower conglomerate are locally calcite-cemented in the Pie Creek area. Massive rock composed mostly of tubes up to 3 mm in diameter and 2 cm long of unknown origin and abundant ostracods is an unusual facies in the Millsite volcanic

interbedded with conglomerate (Tcg1) near Taylor Canyon. The light-colored tuff ntains about 10% phenocrysts, mostly of altered feldspar, with 2% biotite and sparse quartz. The tuff contains a few percent, clay-altered pumice fragments to 5 mm and a similar amount of argillite clasts to 3 mm. The tuff may be more widely distributed, but the nonresistant unit rarely crops out and is mostly exposed in roadcuts in Taylor Canyon. Haynes (2003) reported a zircon U-Pb age of 40.8±0.6 Ma from the tuff in a roadcut. Lower conglomerate (Eocene) Poorly indurated, poorly exposed, boulder to pebble conglomerate composed of well-rounded to subrounded clasts of white to dark gray quartzite to 1.5 m, chert to 50 cm, and chert-quartzite pebble conglomerate to 30 cm, probably in a sandy-muddy matrix. Occurs almost entirely as a lag of pebbles to boulders in a clayey soil. Similar to upper conglomerate (Tcg2) but rests directly on Paleozoic rocks and underlies plagioclase-biotite ash-flow tuff (Tt).

Dikes (Pennsylvanian) Porphyritic to phaneritic dikes of basaltic composition that are less than 7 m wide. K-Ar and 40Ar/39Ar dates from three of these dikes ndicate emplacement at about 320 Ma (Hofstra, 1994; Phinisey and others, 1996). In most places, these dikes crosscut folds and thrust faults. Rocks of the Roberts Mountains Allochthon

McAfee Quartzite (Ordovician) Fine-grained, white to light gray, cliff-forming massive quartzite. Minor shale and chert. Appears to conformably overlie the Snow Canyon Formation. The unit is about 305 m thick. Snow Canyon Formation (Ordovician) Consists of a basal sequence of limestone, chert and greenstone (metabasalt), a middle unit of chert, argillite, siltstone, shale, and local bedded barite, and an upper unit of primarily poorly bedded

Mwc Waterpipe Canyon Formation (Mississippian) Consists of a basal graywacke with interbedded carbonaceous shale, chert pebble conglomerate, and bedded chert. The upper part is argillaceous sandstone interbedded with quartz siltstone and finegrained graywacke. Attains a maximum thickness of about 330 m.

Eastern Facies Limestone (Devonian) Medium to dark gray thin-bedded silty limestone that is commonly fossiliferous and locally turbiditic. Thickness is approximately 10-50 m. Early Middle to early Late Devonian conodonts. DSrm Roberts Mountains Formation (Devonian and Silurian) Laminated, carbonaceous calcareous to dolomitic siltstone. A 10- to 15-m-thick, laminated to thin-bedded silty limestone is present near the base. Thickness is at least 100-200 m and may be greater than 300 m in some places. DSrm hosts a significant amount of the gold

SOhe SOhe SOhe Hanson Creek Formation (Silurian and Ordovician)

Divided into five members. Attains a maximum thickness of about 230 m. The uppermost member, SOhc1, is a 3- to 40-m-thick sequence of rhythmically interbedded black chert and carbonaceous limestone. Bedding thickness averages 5 cm. It is well-exposed because of common pervasive silicification. SOhc2 is up to 30 m thick and is a gray limestone composed of thick-bedded, fine-grained limestone, thin-bedded to nodular limestone, oolitic limestone, and wavy laminated limestone. The unit is commonly fossiliferous and dolomitized. SOhc₃ is up to 90 m thick and consists of interbedded carbonaceous micritic limestone, 2.5 to 5 cm thick, and carbonaceous argillaceous dolomitic limestone, generally less than 2.5 cm thick. Minor chert is locally present. Commonly does not crop out. SOhc₃ hosts a significant amount of the gold ore in the Jerritt Canyon district. SOhc₄ averages about 75 m thick and is a carbonaceous. medium to coarse-grained limestone, commonly with pods and lenses of black chert. The limestone beds average about 5 cm thick. A basal fifth member has been recognized in drilling and has been mapped locally in the past, though not in a sufficiently consistent manner. It is 5 to 30 m thick and consists of chert, limestone, and laminated calcareous siltstones. It has been combined with SOhc₄ on this map Eureka Quartzite (Ordovician) Medium-grained, light gray to white, cliffforming massive quartzite. Approximately 200 to 300 m thick.

Op Pogonip Group (Ordovician) Composed primarily of dark gray fossiliferous limestone and interbeded calcareous shale with lesser amounts of dolomite. ert nodules and lenses are locally abundant. The limestone weathers to a light gray and is typically coarse grained. Shale interbeds occur as stringers and discontinuous lenses that weather to yellowish brown and give outcrops a wavy appearance. A thick-bedded sequence of gray dolomite occurs near the top. The overlying contact zone with Eureka Quartzite is marked by a bed of poorly sorted sandstone with chert fragments. Thickness Note: All 40 Ar/39 Ar ages have been recalculated to an assigned age of 28.02 Ma for the Fish Canyon sanidine monitor (Renne and others, 1998).

Base map adapted from U.S. Geological Survey: Jacks Peak, California Mountain, Water Pipe Canyon, and Mahala Creek West 7.5' Quadrangles Projection: Nevada State Plane, East Zone, North American Datum 1983 (ft); modified for Jerritt Canyon locale by false northing of -2,000,000 (ft) Grid Lines: Universal Transverse Mercator, Zone 11, North American Datum 1983 (m);

Lithologic contact Solid where continuously exposed, such as in pit walls. Dashed where inferred between outcrops. Dotted where concealed. Dash-dotted where intraformational and inferred. Slippage contact Showing dip, teeth on upper unit. Commonly marked by breccia, smallscale fold and bedding discordance but overall offsets are minor. Solid where continuously exposed, such as in pit walls. Dashed where inferred between outcrops. Dotted where

Fault Arrow indicates dip direction. U and D refer to relative up and down. Balls indicate downthrown sides of normal faults. Solid where continuously exposed, such as in pit walls. Dashed where inferred between outcrops. Dotted where concealed. Thrust fault Showing dip, teeth on upper plate. Solid where continuously exposed, such as in pit walls. Dashed where inferred between outcrops. Dotted where concealed. Low-angle fault that places younger over older rocks Showing dip, teeth on upper plate. Low-angle fault that cuts out section. Commonly marked by breccia and small-scale folds. Range from bedding parallel to bedding discordant. Solid where continuously exposed, such as in pit walls. Dashed where inferred between outcrops. Dotted where

- 1 -----Anticline axial trace Dashed where inferred. Arrow indicates plunge direction.

← *** ----fans. They are more incised than the younger fans and have wide flat divides

Overturned anticline axial trace Dashed where inferred. Arrow indicates plunge direction. -------

> Syncline axial trace Dashed where inferred. Arrow indicates plunge direction. **←∩** -----Overturned syncline axial trace Dashed where inferred. Arrow indicates plunge direction.

Inclined Vertical scoriaceous, aphyric basalt or basaltic andesite lava or flow breccia. Exposed

> Area of mining disturbance, sufficient Outline of open-pit gold mine information from drillholes and predisturbance mapping to interpret the

Range province of the southwestern United States.

underlying geology Paleozoic geology was compiled by J. Muntean with the assistance of Yukon-Nevada Gold Corp., the current owner and operator of the gold mines at Jerritt Canyon. Yukon-Nevada Sold made available all previous data collected by themselves and previous operators of the mine, including Freeport Exploration Company, Independence Mining Corporation Inc. Anglo Gold, and Queenstake Resources Ltd. These data were utilized in the compilation. Starting points were previous compilations completed by William Daly in the late 1980s, James Wise in 1997, and John Hertel (for the south end of the district) in 2006. These compilations were then checked by going back to original maps completed by Freeport and ndependence that were done at scales of 1:6000 and larger. In addition, the geology from 000 holes that were drilled by Freeport, Independence, Anglo Gold, and Queenstake were utilized. The drill holes were especially useful in areas of poor surface exposure. Areas were prioritized for field-checking. Field checks were done using a Panasonic Toughbook computer with all the data loaded in ArcGIS. Muntean mapped some areas rom scratch, where previous mapping and data were insufficient. The resulting compile Paleozoic geology is significantly different than the previous compilations, especially in the areas of the open pits, where the previous compilations did not reflect the current geology exposed in those pits. By no means was all the Paleozoic geology on the map fieldchecked. Therefore, the Paleozoic geology should be considered preliminary and may very likely evolve with additional field checks. Previous mapping of the Tertiary rocks was not detailed and only a few holes have been drilled in the Tertiary rocks. Therefore, C.

Henry mapped the Tertiary rocks from scratch. Muntean and Henry mapped the

Quaternary deposits using aerial photographs. Units were broken out using the framework

for alluvial fan sequences developed by Christenson and Purcell (1985) for the Basin and

Index of Geologic mapping.

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List of mapping sources. The numbered areas referred to the numbers on the index map. The sources for each area are listed in order by the relative amount of information derived

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from it to compile the present map.

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> Contour Interval 40 feet

0 1000 2000 3000 4000 5000 feet

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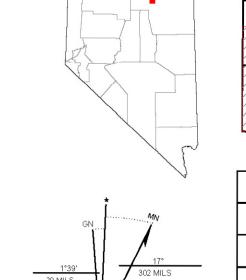
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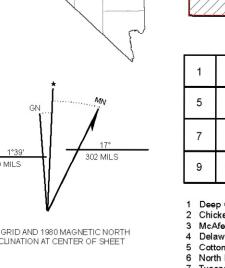
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