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GEOLOGICAL RECONNAISSANCE

GILLIS AND WASSUK RANGES

WALKER RIVER RESERVATION

SCHURZ NEVADA

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INTRODUCTION

This report supplements the geologic maps which have been prepared by me on the area investigated. The mapping was done at a scale of 1"= 1000' and consisted of traversing the more prominent ridges and some of the intervening canyons. The work was not an academic mapping exercise but was of a reconnaissance nature looking for evidence of metallic mineralization which could be of economic interest.

Much of the area traversed is inaccessible except by horse or on foot. Outcrops make up 70% to 80% of the uplands and less than 1% of the lowlands. The uplands comprise about two-thirds of the area mapped. Very little of the lowland between the ranges was traversed since it is either blow sand or alluvial debris.

Except in two small areas no attempt was made to unravel the Excelsior formation nor to delve into the so-called Excelsior problem. Limestone blocks larger than one square mile in areal extent were arbitrarily assigned to the Luning formation with the knowledge that there are limestone units within the Excelsior and that the Sunrise formation has also been recognized in the area.

Based on a rough field estimate of their composition, volcanic units were lumped into three subdivisions: felsic, intermediate and basic. Mapping was done on air photos in the southern part of the Gillis Range and the data transferred to topographic maps in the office when the new topographic sheets became available. The remainder of the work was done on a topographic base blown up to 1"= 1000'.

I had hoped to do a structural analysis of the area from the air photos and the geological data acquired from my mapping; however, time did not permit this to be done.

GEOLOGY

General

The reader is referred to Nevada Bureau of Mines Bulletin 58, "Geology and Mineral Deposits of Mineral County, Nevada," by Donald C. Ross, for detailed descriptions of the various rock types and regional settings. My remarks, so as to eliminate repetitious reporting, will be confined to the prospects and geological observations not contained in the literature.

All of the time-rock units dealt with in this report are Triassic or younger in age. The bulk of the rocks are intrusives or extrusives. There are some limestone and shales present; nowhere are they particularly abundant.

The oldest rocks in the area are those of the Excelsior ← oldest formation followed in ascending order by the Luning formation, ← next oldest quartz monzonite, extrusive felsic volcanics, intrusive and extrusive intermediate and basic volcanics, and the latest alluvial and lacustrine deposits. Structurally the area is very complex, having been involved in thrust faulting as well as local and regional block faulting.

If one subscribes to the mineral belt thesis advocated by Roberts and others, the west side of the reservation is included in the Walker Lane. ← The so-called "Iron Belt" is drawn well north of the reservation; however, if the Calico deposit proves to be a major deposit the belt will have to be extended southward. I find it difficult to give much credence to these mineral belts since they encompass only known mines and prospects which are almost all in outcrop areas. Deposits such as the Calico lead one to inspect the relationship of the covered areas and the proposed mineral belts. It is quickly apparent that the mineral belts are given their shape by post-mineral cover.

Within the area traversed there are seven mineralized areas whose importance are roughly in decreasing order, as follows: (1) Black Mountain Copper (Granite-Mountain View District), (2) Copper Hill, (3) Skarn zone west of Copper Hill, (4) Wild Horse Canyon, (5) White Mountain precious metal district, (6) Schurz prospects, and (7) the Gillis Canyon scheelite. These prospects are weighted in respect with each other only.

The best of the seven is not a particularly high priority target as mineralized targets go. However, there is an old saying that "mines are made and not found" and there is considerable truth to this. Mine development history is replete with innumerable cases of repeated attacks of exploration on a mineral deposit before commercial production is achieved. Therefore, it becomes a matter of company policy as to the character and types of targets that are to be examined. None of us have been blessed with X-ray vision or extra-sensory ore-finding tingling so all we can do is rate prospects by comparison with each other.

The quartz monzonite of the Gillis and Wassuk Ranges are thought to be satellitic bodies of the great Sierra Nevada intrusives to the west. The Wassuk intrusive differs in several ways from the quartz monzonite of the Gillis range. There is evidence that it is a multiple intrusive; also its composition ranges from alaskite to diorite although the bulk of it is quartz monzonite. The alaskite is found in several large masses and as dikes throughout the range. It probably represents the last phase of differentiation of an originally basic magna. ? maybe?

The Excelsior formation into which the quartz monzonite was intruded and which now occurs as large roof pendants in the quartz monzonite, has been more or less assimilated and is metamorphosed throughout. Locally this assimilation has brought about compositional changes in the quartz monzonite.

ROCK UNITS

Excelsior Formation (Triassic)

The rocks in this very controversial formation are well represented in both the Gillis and Wassuk Ranges, although nowhere is there a complete section exposed. Several authors place the units occurring on the reservation into a separate formation called the Gillis formation; however, for the sake of convenience I have retained the Excelsior designation. In general the rocks are light gray to black, are dense, occasionally hard and brittle and very siliceous. Usually the lighter colored, siliceous units have considerable iron staining associated with them. Locally this particular unit forms caps on ridges and, in places. stands up as hard, siliceous, iron-stained ribs and knobs. These siliceous members are usually highly fractured and are characterized by prominent scree slopes such as those seen near Black Mountain in the Wassak Range. The formation in this area is extremely variable but consists mostly of felsic and intermediate volcanics with some diorite and limestone.

There are two occurrences of the Excelsior in the Gillis Range which are quite different lithologically. One is Wild Horse Canyon and the other is Copper Hill. Those rocks in Wild Horse Canyon are mostly basic to intermediate volcanics with small discontinuous interbeds of non-fossiliferous limestone. Those near Copper Hill are composed of felsic volcanics, dioritic rocks and non-fossiliferous limestones. In both areas the rocks have been more or less metamorphosed and structurally contorted.

The lime units in both areas exhibit interesting and puzzling contrasts. Some of them have been recrystallized to a white, medium to coarse-grained, marble of practically pure $CaCO_3$, while others retain the more normal black to gray color, are fine-grained and appear to have carbonaceous impurities associated with them and are unmetamorphosed. Why such closely associated lime units within the same formation have been selectively metamorphosed, is not clear. If, on the other hand, these beds are found to be of a different formation, which I suspect might be the case, and if faulting is invoked, particularly at Copper Hill, the situation is not as puzzling.

The dioritic rocks near Copper Hill which have been arbitrarily assigned to the Excelsior, are massive and without the bedding and flow banding commonly associated with Excelsior units. Limestone units in contact with them are locally bleached and marbelized but are nowhere found as inclusions. These same limestones dip under the diorite bodies and actually appear to floor them. It is suggested that these dioritic bodies are Excelsior and have been thrust in position above the limestones rather than having been intruded into them.

For some unaccountable reason the quartz monzonite in the Gillis Range, which makes up the core of the range and which was intruded into the Excelsior, failed to assimilate much of the Excelsior. There are a few small patches of Excelsior partially assimilated near Copper Hill and in the canyon west of there and also in the vicinity of Gillis Canyon. This is in complete contrast with the same intrusive situation in the Wassuk range where wholesale assimilation of the Excelsior rocks took place and produced significant compositional changes within the quartz monzonite.

The Excelsior, with only local exceptions, dips into the quartz monzonite. In the case of the northern part of the Wassuk Range, it's as though the quartz monzonite intruded a syncline without doming or changing the dip of the beds.

Thin sections made of the Excelsior in the Wassuk Range confirm that it is mostly extrusive volcanics. In the Black Mountain area they are mostly silicified felsic volcanics of quartz monzonite composition. Very little of the Excelsior on the reservation is mineralized; however, most of the mineralization in the area mapped is in close proximity to it.

Luning Formation (Triassic)

The massive gray limestones of the Luning formation are found at and near Copper Hill and north of Gillis Canyon.

Black, arenaceous, carbonaceous, argillites are present west of Copper Hill which are also thought to be part of the Luning. A similar assemblage exists in the Northern Lights area of the Wassuk Range and for reasons not given in his Mineral County Report, Ross assigned them to the Excelsior. I tend to favor positioning them both in the Luning, particularly when they are so closely associated with large blocks of massive gray limestone; however, this would be strictly an empirical assignment. The Luning is mineralized at Copper Hill and in the Northern Lights area. Mineralization in both areas seems to be confined to fissures and small replacement bodies.

The black shales of this formation give spectacular I.P. responses in both areas. At Copper Hill the response, according to Emil Winniski, was the largest ever recorded in the field by McPhar. It is assumed that the carbonaceous material in the shales is causing the response. This, of course, is by no means a proven fact and these anomalies must be considered to be valid I. P. targets until sufficient testing has been done to pinpoint the cause of the response.

West of Copper Hill on the range front a block of gray limestone has been silicated and silicified and locally has patches of malachite in it. This is the only skarn development noticed in the mapped area. A silicified lime containing blebs and patches of galena and barite exists in Wild Horse Canyon but little or no skarn has developed.

In an area where igneous rocks, both intrusive and extrusive, make up the bulk of the rocks, one would think that some contact effects would be noted in the limestones. Clearly igneous rocks which were implaced in close proximity to the limes must have been fairly "dry" during their intrusive period, suggesting that the volatiles so necessary in the formation of ore deposits were not particularly abundant, or for some reason or another were denied access to the limestones.

Gillis 15
Copper Hill

Quartz Monzonite (Cretaceous)

The literature is replete with detailed analysis of the typical Sierra Nevada type intrusives which those of the Gillis and Wassuk Ranges are supposed to be. To date, intrusives of this type and age in the eastern California-western Nevada region have not been spectacular producers of mineral deposits. With the possible exception of the Black Mountain area very little mineralization was encountered in these rocks on the reservation as I traversed them.

In the Gillis Range, north of Wild Horse Canyon, the quartz monzonite is found in three places, the most important of which is on the west range front between Gillis Canyon and Copper Hill. It outcrops in the form of a football elongate in a northwest direction. It is intrusive on the north and south [illegible] rocks of the Excelsior and Luning formations, and is covered [illegible] flank by post intrusive volcanics. Only in a few places did the quartz monzonite assimilate the rocks into which it was intruded and is quite uniformly quartz monzonite or granodiorite in composition.

Contact metamorphic effects are not widespread, particularly additive effects such as silication and silicification. The post intrusive skarn development is on the range front west of Copper Hill. X

The picture is quite different in the Wassuk Range the Excelsior is suspended on the intrusive as roof pendants. Assimilation of the Excelsior rocks by the quartz monzonite is widespread and has been complete enough in places to produce major compositional changes. In fact in several localities where diorite has been mapped it is not at all certain whether diorite has been intruded into the quartz monzonite or whether it is an area in which assimilation of Excelsior rocks has been almost complete. Interestingly enough, limestones east and north of the Northern Lights area in close proximity to this same quartz monzonite, show little or no contact effects.

There is no doubt that the igneous core of the Wassuk Range is a multiple intrusion. Compositionally it ranges from an alaskite to a granodiorite and possibly diorite. Two of the intrusive phases are quite distinct from the main quartz monzonite mass. One is a medium to fine-grained, gray granodiorite (?). The other is a medium to coarse-grained gray to pinkish, alaskite which is found as a large mass at White Mountain and as dikes in the Excelsior and quartz monzonite. It is probably the youngest intrusive in the complex. The small precious metal district in the Excelsior immediately west of White Mountain is probably genetically related to it.

North of the basic volcanics on Black Mountain the quartz monzonite is slightly altered. The alteration appears to decrease outward from the volcanic cover, a phenomenon which I am quite confident is not related to the volcanics. The alteration is patchy and consists of silicification, albitization and minor argillization. It is present in the quartz monzonite along the ridge extending north from Black Mountain to the Mountain View mining district. None of these patches are of significant size and none appear to be related to mineralization. There are, however, prospects and old tunnels lower down on the western face of the ridge. Also attempts were made to mine gold and silver on an eastward extending spur of the same ridge on farther north.

South and east of Northern Lights, approximately midway down the range face, there are three distinct igneous units which I believe are "hybrid" rocks as a result of assimilation of Excelsior by the quartz monzonite. One is a medium to coarse-grained, dark gray, diorite porphyry composed of from 50% to 60% hornblende. Another is a medium to coarse-grained, dark gray, diorite porphyry composed of from 50% to 60% augite. These two Units seem to border Excelsior blocks and are rarely more than 100' wide. The third unit is much more widespread and is composed of large euhedral crystals of orthoclase up to one inch long which give it a porphyritic texture. It has up to 30% biotite in it and is medium-grained, dark gray to black in color, and may or may not be associated with the above-mentioned diorite porphyries.

None of these have any economic mineralization associated with them and their descriptions are given merely to illustrate the variability of the igneous rock types in this part of the range.

Volcanics - (Tertiary)

These rocks are mostly rhyolite, quartz latite tuff, and welded tuffs. They overlay most of the Gillis Range within the reservation and are found on the north end of the Wassuk Range in large sheets and small patches.

Well over 50% of the area mapped was covered by these rocks which in some places occur only as a thin cap on older formations and in other areas as multiple flows which could easily attain a thickness of several thousand feet. They were traversed with the hope that mineralized windows of older rocks might be discovered or possibly the presence of alteration within the volcanics themselves might be found that would suggest the presence of mineralization. Nowhere did I encounter mineralization in them and the alteration noted was of a deuteric nature.

Basalts (Quaternary)

These rocks are chiefly basalts and latites. In the Gillis Range they were found as plugs and in several instances as dikes. In the Wassuk Range, where they are much more abundant, they occur as dikes and flows. Most of the imposing peak known as Black Mountain is capped by basalt, as is the west side of the range in the vicinity of Reese River Canyon.

These rocks, except for the alluvial deposits, are the youngest in the area. Nowhere were they found to be mineralized or genetically related to mineralization. There is a remote possibility that they cover mineralized quartz monzonite on Black Mountain; however, even that remains to be seen. The flows on Black Mountain appear to be less than 200 feet thick on their eastern and northern edges. On the west and south flanks of the mountain it is difficult to estimate their thickness since the flows have cascaded down the slopes. These slopes are covered by great blocky piles of volcanic talus which obscure any contact and make traversing exceedingly difficult.

STRUCTURE

The regional structural setting is given in Ross (Nevada Bureau Mines Bulletin 58). Briefly the northwest trending Gillis and Wassuk Ranges are immediately west of a northwest trending line which separates the north-south trending ranges of the Basin and Range province from those trending northwest. Knowledge of the structure of the Gillis and Wassuk Ranges is at best limited.

The valley between the two ranges contains the very deep Walker Lake. The mean elevation of this valley floor is approximately 1,000 feet below that of the valley immediately west of the Wassuk Range. The precipitous, deeply incised, high, rugged eastern face of the Wassuk Range contrasts greatly with that of the adjacent west face of the Gillis Range. I attribute the difference in elevation of these valleys to regional faulting of major proportions. If it is assumed that it is a normal fault which strikes north-south and dips toward the east at a rather steep angle, any flat-lying beds on the hanging wall side would have a steep westerly dip. Moreover, the horizontal displacement of the beds would be eastward. As a matter of speculation it would be interesting to know the direction and degree of dip of the bedding in the Calico deposit.

The bedding noted in the Excelsior that surrounds the Wassuk Range on the north and east, in general dips into the range. Locally these beds are highly contorted and dip direction is sometimes difficult to determine. These inward dipping beds suggest that the intrusive of the Wassuk Range was quietly implaced in a large north trending southwest plunging syncline of Excelsior rocks. Practically all of the significant mineralization in the Wassuk Range north of Reese River Canyon is near the north end of this proposed syncline. I have little evidence to support this thesis but nevertheless do consider the concept worth pursuing and feel that it could be helpful in future exploration activities if found to be true.

The volcanics in the Gillis Range appear to be warped into a broad, slightly east of north, trending anticline whose axis is either through the Copper Hill area or slightly east of it. This anticline has been breached along its axis in many places and has been cross-cut and eroded by streams in such structures (?) as that which forms Gillis Canyon. At this point in our knowledge of the area there is nothing of economic significance that can be related to this structure other than the possibly fortuitous occurrence along the axis of the scheelite near Gillis Canyon, the mineralization at Copper Hill, and maybe that at Wild Horse Canyon.

I have not followed the practice of recording as faults all of the straight line phenomena which are commonly seen in photos of volcanics for I believe many of these to be flow features and not truly faults. If a structural analysis were made of the area these features should be considered. In fact such an analysis could well prove to be helpful in exploration for new deposits and help explain many of the puzzling facets of the already known deposits.

PROSPECTS

General

The prospects in the area mapped have been known for years. None of them are what you would call exciting. All have had some work done on them in the past, mostly in the form of pits and tunnels and none has ever produced more than a few hundred tons of ore.

On the north end of the Wassuk Range, radiating outward, and particularly to the north from Black Mountain, there is successively copper; copper, lead and zinc; lead and silver; silver and gold; the last being present in the area immediately west of White Mountain. Like so many other things in this area where so much remains to be done, the relationship is not at all a positive thing and may not be real or significant. Additional work would have to be done in order to decide if the relationship really existed, and if it did, what exploration significance it might have.

The individual prospects are described in order of their relative merits as compared with each other. Company policy must determine whether the additional work recommended on them is to be done since none of them are thought to have much promise of being a truly large deposit. Several of them do have the potential of becoming small operations. Be it clearly understood here and now that I cannot see any further under the surface than the next man and that my assessment of these occurrences is based on comparison with other prospects and deposits that I have visited. The practice of economic geology is still as much of an art as it is a science and what one man might consider as worthless modern art another may treasure as a masterpiece.

Black Mountain Copper (Granite - Mountain View District)

This area has had sporadic mining activity since about 1906. Copper has been the commodity of primary interest over the years. Title to the area is not clear cut and should be researched. Many claims were staked between 1906 and 1918, a large percentage of them by two or three people. Many of them were assigned to corporations, many were not, some were sold by corporations who had no title of record to them. All of the corporations involved have gone out of existence, having had their charters revoked. If there was ever an assignment of the assets of these corporations, it is not of record. Assessment work has not been kept current so for all practical purposes they have been abandoned. However, because of our mining laws they can still be resurrected so they do constitute a cloud on the title.

The surface rights to this area were given to the Piaute tribe in 1936 but the mineral rights were reserved to the federal government and declared open for acquisition under the mining laws. A provision was made in the statute for the Secretary of the Interior to draft regulations whereby the Indians would be paid for damages from mining activity on these lands. The regulations were never drafted and the mineral rights were given to the tribe in 1961. The U.S.B.L.M. takes the construction that the failure of the secretary to prescribe the regulations kept the area closed to mineral entry; others are not quite so positive, i. e., the B.I.A.

In 1956, part of the area was staked again. If the ground was open for location these claims would be valid and would invalidate the older claims, at least as far as the records are concerned.

Bear Creek Mining Company has staked from the western reservation boundary between the Black Mountain Copper area and the Northern Lights area westward over Black Mountain. They are now drilling very near the west boundary of the reservation. If they are successful in this exploration and are unsuccessful in acquiring Walker-Martel's interest on the reservation, they undoubtedly will attempt to resurrect whichever claims that appear to have the best title. It is my feeling that Walker-Martel should at least provide the B.I.A. and the U.S.B.L.M. with sufficient title information for them to start a quiet title action. If Bear Creek discovered that such action was being taken by the Federal agencies on behalf of the Tribe, I doubt seriously that they would attempt to contest it unless some one presented them with an airtight case.

The geology here is mostly concealed. Basicly it consists of felsic Excelsior volcanic pendants in quartz monzonite with quaternary basalts overlapping it from the west. The quartz monzonite, except for an area south and a little east of the southwesternmost workings and patches along the ridge north from Black Mountain, is not altered. The alteration in these two areas consists of silicification, destruction of the mafic minerals, some albitization and locally the addition of potash feldspars.

One of the Excelsior (?) units in the vicinity of the prospects is quite distinctive. It is iron-stained, very siliceous, brittle, highly fractured, light tan to brown in color, and caps most of the ridges and peaks. There are pits and trenches throughout this unit, all of them associated with shears which contain copper oxides and variable amounts of limonite.

I was not at all sure whether this was a "cap" of altered quartz monzonite or part of the Excelsior. I had thin sections made of samples from six different locations for study. All were described as being more or less altered, "acid" volcanics. All apparently have had silica added to them for their silica content is quite high. Considerable secondary sericite (muscovite) is present as well as andalusite, chlorite, minor epidote and some hematite, goethite and jarosite.

It is possible that the unit is a "cap" but instead of being a "leached" cap it is an impervious "cap." Any solutions which invaded the area would only be able to penetrate the open fractures of this rock. If this did occur, the possibility of the underlying quartz monzonite being mineralized is certainly enhanced.

The deeply incised canyon, with its many tributary arroyos which drain the area, exposes the underlying quartz monzonite about a half mile north of the mine area. At this point the quartz monzonite is crushed and largely decomposed. In a very short distance on down the canyon it is covered and where it again appears it is fresh, at least from a megascopic examination it appears to lack alteration. Due east and northeast of the mine area where it outcrops, it is also fresh appearing.

Malachite and chrysocolla in minor amounts are quite widespread and were the only copper minerals observed. In several of the old workings these same minerals are present along fractures several feet wide. I did not get very far into the underground workings nor did I map and sample them but this should be done. I had requested that the ridges in the mine vicinity be sampled and geochemically assayed; however, this was never done. I would recommend that at least some widespread sampling be done to see if there is a build up of copper around the mine or peripheral to the overlying Excelsior.

If mapping and sampling the underground workings and sampling the ridge areas produces encouraging results, or is not completely discouraging, I.P. might be considered although the area is so limited in areal extent that it might be practical to forego the expense of additional geophysics at this time and drill several holes instead. Also, and possibly prior to the I.P. or drilling, but after the sampling, the area should be geologically mapped at a scale of at least 1"= 500' and preferably at 1"= 200'.

Copper Hill

Geologically, the Copper Hill prospect is thought to be part of a block of Triassic Excelsior (?) formation which has been overthrust from the west to the east onto the Triassic Luning (?) formation. Then during Cretaceous time a quartz monzonite of at least stock proportions intruded the area and further complicated an already complicated situation. During the Cenozoic era these units were covered by a great pile of felsic volcanics which have since been eroded in such a manner as to expose an arcuate pattern of Triassic rocks on the north, east and west sides of the quartz monzonite. It is only at Copper Hill which is along the southeastern contact between the quartz monzonite and the Triassic sediments that metallic mineralization of any consequence is encountered.

The Luning (?) at Copper Hill, if indeed it is the Luning, is quite variable. North of Gillis Canyon, which is the northern segment of the exposed quartz monzonite arc, the Luning is a medium to dark gray massive limestone, whereas to the south, in the vicinity of Copper Hill and west to the range front, it consists of three distinct units, in what appears to be a top and bottom sequence, as follows: a medium gray, massive limestone locally marbellized; a black, somewhat areanaceous limestone which has an interbedded tuff, and a black locally calcareous, arenaceous shale. In the black limestone unit, there are linear, lense-like bodies or beds that appear to have been bleached.

The entire Luning sequence at Copper Hill, except for the gray limestone, is highly fractured, actually shattered in places, has divergent strikes and dips, is probably folded, faulted, and is somewhat altered adjacent to small apophyses of quartz monzonite that are exposed within it. The presence of these small apophyses of quartz monzonite well within the outcrop area of the Luning (?) suggests that the Luning (?) probably is underlain throughout at shallow depths by the quartz monzonite. The moderate amount of metamorphism exhibited by these sedimentary units even close to the contact with the quartz monzonite, is disturbing. The rocks around most large intrusives are generally characterized by abundant alteration, particularly in the vicinity of the large "porphyry" type mines. However, this lack of alteration does not necessarily rule the area out from further exploration.

McPhar Geophysics, in their report on Copper Hill, reiterated my warning about the possibility of carbonaceous material or graphite affecting their I.P. data and recommended correlating the data with the geology. There are at least two separate anomalies at Copper Hill, and possibly a third, which are interesting. The anomaly near the shaft area, which is recorded on lines B2W, B, B2E, B4E, C, and B6E is, in all probability, a legitimate sulfide anomaly. It resembles a veined type situation rather than widespread disseminated mineralization. This anomaly should be tested by drilling. The anomaly on the SE end of line 24W which coincides with the black carbonaceous looking sediments of the Luning (?) formation should be treated cautiously as there is a high probability of its being caused by graphite. This possibility should be thoroughly checked before much additional work is done.

The anomaly on the SE end of line C which is well over the diorite and reportedly is at a depth of 500 feet, just might be reflecting a buried segment of the same black Luning sediments. Obviously this could be a sulfide anomaly; however, the odds are that it is not. Wilson points out in his assessment of the situation that the two anomalies (line 24W and the SE end of Line C) differ in their resistivity pattern with that on 24W having very low resistivities of 1.5 ohm feet and on line C averaging 40 ohm feet. This can be misleading since the response of all geologic units in the vicinity is received simultaneously and additively at the observation point and the distribution of any element diminishes with distance, and therefore we are provided with a smoothed-over or average type of response. This is an unusual situation and you should proceed with that in mind. In my opinion, your first step, at least as far as the anomaly on the SE end of lines 24W and C are concerned, should be toward determining what is giving the I.P. effects. This should be done as cheaply as possible, and a good start would be a diamond drill hole just SE of 15SE on line 24W after checking a suite of rock samples in the laboratory for I.P. characteristics.

Skarn Zone West of Copper Hill

West of Copper Hill on the nose of the range is the westernmost exposure of the black limestone member of the Luning formation. At this location there has been developed in the limestone a small zone of calc-silicate minerals accompanied by some silicification.The rock is hard, rough-surfaced, and has a subdued yellowish-orange color. There are three or four short tunnels, as many shafts, and eight or ten prospect pits located in the zone. Copper carbonates are conspicuous on the dumps and constitute the only significant mineralization observed.

One I.P. line was placed so that it crossed and extended well beyond this zone during the summer of 1965. I do not have the results from that survey but understand that an anomalous response was received but that there are some questions about the validity of the anomaly. I would expect to receive a high response from the black shale area and a much lower response over the skarn. Any response over the skarn should be followed up with either additional I.P. or drilling.

The Wild Horse Canyon prospect is situated in the very rugged, steep-walled Wild Horse Canyon. It is in a block of the middle Triassic Excelsior formation. According to W. L. Wilson's report dated 12/27/65, the prospect is situated on the eastern edge of a large east-west trending magnetic low. The significance of this relationshop, if any, is not readily apparent.

The prospect itself is not particularly spectacular. The mineralization consists of pods and disseminations of galena with barite in a marbelized limestone. The greatest concentrations of mineralization are in the two main prospects in the small arroyo south of the main canyon that contains the most extensive workings. Throughout the canyon area there are small prospects that contain argentiferous galena. Immediately overlying the mineralized portion of the lime unit is a brecciated and silicified zone which might be used as a guide to the mineral-bearing zone.

The arroyo in which the main prospect occurs appears to be a major north-south structural feature. West of it the metavolcanics and interbedded lenses of limestone of the Excelsior strike generally northeast and dip strongly northwest. In this western area, the sequence is well-exposed and, if need be, could be measured for use in local structural interpretations. East of the arroyo the situation changes abruptly. The beds of the Excelsior strike in various directions, have flat dips, and are broken and contorted.

In this eastern block there is a light gray, poorly consolidated tuff bed that can be traced for some distance and is the only unit that gives any evidence of the attitude of the beds in this block. Using the tuff as a marker, there is a suggestion that this east block is folded into a gentle syncline that plunges to the southwest along its northeast-southwest axis.

The Excelsior in the Gillis Range is generally held to have been involved in the west-to-east movement attributed to the Gillis thrust. It is possible that Wild Horse Canyon is a large tear fault associated with the thrust and through later faulting has been down-dropped to the north. The arroyo in which the prospect is situated is thought to be the trace of a normal fault with a strike slip displacement that preceded the down-dropping of the Wild Horse Canyon fault, but which post-dates the period of thrusting. The intersection of two such faults could provide a loci for mineral deposition.

The geology from the hole that was drilled here by Walker-Martel on geophysical (I.P.) recommendations, correlated well with the surface geology. There are three distinct rock type changes noted in the hole. From 50 ft. to 70 ft. is a dark gray metavolcanic zone, probably Excelsior in age. Immediately below this and continuing to 128 ft., is a zone of highly crushed and bleached metavolcanics (?), also probably Excelsior in age. This, in turn, overlies a dark gray to black shale or slate zone, which is locally calcareous, probably graphitic, and which contains very fine hair-like seams of sulfides. The sulfides when looked at with the hand lens are predominantly pyrite with some chalcopyrite.

The 58 feet of bleached and crushed metavolcanics represents, in my opinion, a portion of the Excelsior formation which acted as a glide plane for the movement of the thrust. This unit contains considerable mylonite and could possibly, if saturated with water through what is known as membrane effect, produce an I.P. anomaly.

The black shale, which probably is graphitic, might also be considered as a source for the I.P. anomaly. However, unless the shales were steeply dipping, one would expect an anomaly of much broader areal extent than it actually is.

The I. P. anomalies, if not explained by tests on the core, are best explained as two en echelon fault or shear zones that are mineralized. The mineralization appears to "swell" and "pinch" along the zones, either from a widening or narrowing of the zone or from replacement of the wall rocks by the ore minerals. If it is a true sulfide anomaly as McPhar feels, and which they approximate to be 100 ft. wide, you are probably dealing with fairly large replacement bodies in limestone. If this is true, it is entirely possible for a hole to pass within inches of a mineralized block and with absolutely no indication of its presence. Exploration for bodies of this type, particularly if the area is covered and the trace of the structure is not visible on the surface, requires precision hole placement and persistence, for it is axiomatic that there will be a significant percentage of barren holes drilled.

It is interesting to note that the general trend of the I.P. anomaly is toward and roughly coincident in strike direction with a large air magnetic low west of it. One can always speculate that the Wild Horse Canyon prospect is peripheral to a much larger mineralized area which is represented by the magnetic low.

The work done on the core from the hole drilled here did not explain the anomaly; therefore, at least one more hole, and preferably two, should be drilled and positioned as close as posible to the recommendations made by McPhar. They should probably be angle holes since the target is evidently tabular and steeply dipping. It cannot be overemphasized that hole positioning in such a situation is extremely important and care should be taken to determine the most advantageous position for drilling. The only indication that we have as to a possible dip for the anomalous zine, if it exists, is that hole #1 missed mineralization completely. It can either dip south or steeply to the north. In any event the argument is strong for two holes angling toward each other normal to the strike of the zone being prospected.

<u>White Mountain precious metal area</u>

There are two parts to this so-called precious metal district: one immediately west of White Mountain and the other southwest of it, well into the volcanic province between White Mountain and the north end of the Wassuk Range.

There are many pits and a half dozen short shafts, none of which, judging by the size of their dumps, are very extensive. Some of the prospects contain very minor amounts of copper and very little else that can be identified. The rocks are all part of the Excelsior felsic volcanics. They are very fine-grained, brittle, highly fractured, actually shattered in places and usually a reddish-brown color. Near some of the larger prospects there is some bleaching but generally the rocks are unaltered.

Mineralization is apparently confined to the more prominent structures. Exploration would be a difficult and expensive proposition although I suspect that if you found something it would be worthwhile. There is always the possibility that these prospects represent the top of a Virginia City situation. Conversely, they could represent a situation similar to that at Rawhide where considerably more money was spent than was ever gained in mining; or it could be simply nothing.

The only recommendation I have on this area is before doing anything a day or two should be spent looking it over for ideas and maybe sampling some of the structures. I doubt that I.P. would be helpful unless you thought the mineralization represented an upward leakage of more extensive mineralization at depth.

Schurz Prospects

These are located west of Schurz in pendants of Excelsior. They consist of mineralized quartz veins in shears and faults which rarely exceed two feet in width and are more commonly less than a foot wide. The mineralization is usually chalcopyrite and malachite but in several locations consists primarily of galena.

Several minor attemps have been made to mine these occurrences; however, like most such occurrences they "pinch" and "swell" and thus they are usually discontinuous pods of mineralization with barren rock in between. None of these early mining attempts got much beyond the first "pinch." Maybe the "pinch occurred in the pocketbook simultaneous with that in the vein and operations ceased. No further work is recommended on these isolated occurrences.

Gillis Canyon Scheelite

This area which is also known as the Gentry Mine, is located on the east flank of the quartz monzonite intrusive of the Gillis Range, immediately south of where Gillis Canyon cuts the quartz monzonite.

There are four shallow shafts and three tunnels whose dumps indicate that there is probably three or four hundred feet of underground workings. The rock is probably Excelsior and is a brownish tan, brittle, felsic volcanic. There are also some interbedded limestones and black dense quartzites (?). In places the limestone has been marbleized and in others silicified and locally silicated. Between the Excelsior and the quartz monzonite there is a zone of dark, dense diorite which contains considerable biotite and hornblende, and which I believe is a hybrid rock. The mafics of this particular unit have been largely converted to chlorite.

The prospect appears to be a typical contact type situation of limited extent and it is extremely doubtful that much ore will ever be found. No further work is recommended.

VEKOL: VULTURE RANGE. Tucson Aug 18

Mr. Robert Redmond COPY to HOLT. WLW.

Dear Bob,

How is everything in Nevada? I hope all is going well.

The Arizona Bureau of Mines is preparing thin sections of the rock samples that I took in the Northern Lights area. It may be three weeks to a month before the samples are analyzed and the geochem reports are back on them. As soon as I get them back I'll forward the results. I hope the results in combination with Mr. Holt's mapping will be helpful.

Copper mineralization occurs as disseminated replacement grains in recrystallized, and locally brecciated, limestone. Copper minerals seen in hand specimen include chalcopyrite, bornite, and the "oxide" minerals malachite and cuprite (?) and chrysocolla. The copper

sulfides are accompanied in the places by [illegible].
The pyrite occurs frequently as subhedral crystals.

In addition to replacement in limestone, two other rock types containing pyrite alone and pyrite and chalcopyrite together, respectively are present. That containing pyrite alone is a meta-sediment, but its composition will have to be determined in thin section. It is silicified.

The rock containing "disseminated" pyrite and chalcopyrite will also have to be identified in thin section. This rock is strongly altered and outcrops in three places over a distance of slightly under one mile along a trend roughly N 10°-20°W from a point where the little side road cuts back sharply to the south going to the Northern Lights Mine. The rock appears to be strongly sericitized. It is heavily stained with hematite and contains a little malachite in places. Someone, probably Bear Creek, has dug pits in this material. While it is possible that these three outcrops are not the same rock unit, they are at least

very similar in appearance ... .
the thin sections may help greatly here.
the range over which this rock type occurs
coupled with its seeming position within
the metasediments tempts me to think it could
be a felsic unit of the Excelsior Fm (as shown
the area on the Mineral County geologic map).
It is possible, however, that it intrudes
the Excelsior. I saw no contacts.

The metasediments are cut by basic
dikes and quartz veins. Mineralization and
alteration is believed to be related at least
in part to these.

At the present stage I can see
two possibilities for ore. One would be
contact metasomatic or larger replacement
deposits in the limestone. If copper
mineralization is related to the intrusion
of the plutonic rocks (granodiorite - quartz
monz, etc - Bull 58 Nevada Bureau of Mines)

is shown on the geologic map as ...
the bulk of the Wassuk Range, ...
for a fair-sized replacement deposit ...
be much better than if the mineral ...
is wholly related to the small dike ...
the latter is the case then chance ...
not good at all. Apparently small
development in the area did not open
up important replacement orebodies.
Samples seen on dumps did not indicate
good possibilities for major replacement
orebodies.

The second possibility for ore lies in the "sericitized" rock containing disseminated pyrite and chalcopyrite. I can't say much more here until I see the thin sections. Chances for an orebody would seem to be greater if the rock is intruded into the Excelsior Fm rather than being part of it. This rock unit appears to have attracted considerable Bear Creek interest.

EXPLANATION

Qal
Alluvium
Includes alluvial fan, bajada, talus, fluvial and lacustrine deposits

Qp
Recent playa deposits

Tvm/i
Basaltic andesite
Dark gray to black aphanitic flows and plugs containing oxidized hornblende phenocrysts in a groundmass of plagioclase and iron oxides

Ts
Sedimentary rocks
Includes Wassuk Group. Consists of thin-bedded pale-gray to pale greenish-gray and pinkish gray tuffaceous and diatomaceous silty sandstone to sandy siltstone interbedded with mafic flows and flow breccias (Tvm/I) overlying well reddish to yellowish-brown sandy pebble conglomerate

Tvm
Basaltic flow and tuffs

Tvi
Intermediate flows, plugs, and dikes
Medium to dark gray porphyritic to aphanitic lavas containing phenocrysts of plagioclase, hornblende, or pyroxene. Locally may be flow breccia

Tvf
Felsic flows, plugs, and dikes
Greenish gray dikes and plugs, dark to medium gray lava both containing hornblende phenocrysts

Td
Diorite
Medium gray, equigranular to porphyritic hornblende diorite

Ttf
Felsic Tuff
Includes Blue Sphinx Tuff, Singatse Tuff, Micky Pass Tuff, and Poinsetta Tuff, in addition to other vitric, rhyolitic, and dacitic tuff units

Ttfd
Dacite flows and intrusions

Tt
Felsic Flow Breccia and Ash Flows
Includes Ghost Dance Lava and Nugent Tuff in some areas

Thn
Nugget Tuff
Felsic to intermediate at ash flow tuff, tuff breccia, and tuffaceous debris flows

Tti
Intermediate Tuffs
Includes Petrified Spring Tuff

Km
Granodiorite, Quartz Monzonite, Monzonite

Kd
Diorite
Light to dark gray and greenish gray containing abundant hornblende and plagioclase

Kgd
Granodiorite of Hidden Wash
Light to medium gray containing feldspar, quartz, and biotite

Kg
Granite
Reddish brown to brownish gray

Jff
Dacite Porphyry
Greenish gray to pale lavender, abundant plagioclase, with minor quartz, biotite

Jm
Quartz Monzonite and altered Quartz Monzonite
Includes Gray Hills Pluton, pale to medium gray and pinkish white, consists of abundant plagioclase hornblende, and biotite. Alluvial quartz Monzonite consists of chalky white plagioclase and pale bluish-green mafic minerals with epidote and chlorite

Jg
Granodiorite
Includes Black Mtn. Pluton, medium gray to light greenish-gray to dark greenish-gray, consists primarily of plagioclase with subordinate amounts of orthoclase, hornblende, and quartz

Jd
Hornblende quartz diorite and quartz diorite breccia
Medium to dark gray, abundant plagioclase, subordinate quartz, orthoclase, hornblende, and biotite

Jgd
Brecciated porphyritic meta-andesite
Breccia intruded by dikelets of hornblende quartz diorite

Jif
Latite and quartz latite porphyry
Dark gray to black, porphyitic to aphanitic, abundant plagioclase and quartz

Ji
Undivided intrusives
Containing plagioclase, with or without quartz or hornblende

Js
Metasedimentary rocks
Light to medium gray, yellowish to orangeish brown, tine grained tuffaceous siltstone and very fine grained siliceous argillite. Siltstone is interbedded with limestone and limestone breccia

JTRms
Shale, slate, tuffaceous siltstone, sandstone and greywacke, metamorphosed

JTRv
Andesite breccia
Tuff and flows, basalt, and rhyolite with interbedded volcanic derived sedimentary rocks. Metamorphosed to green schist or higher facies

TRsg
Schistose Metamorphic Rocks
Medium to dark gray, foliated biotite rich, metasomatically altered sedimentary rocks

TRsh
Shale and Argillite
Dark grayish-brown thinly laminated shales, siltstones, and argillites

TRv
Undivided volcanic rocks
Volcaniclastic rocks, and interelated limestones, includes TRvi and TRtf

TRlm
Limestone
Dark gray, thin to moderately bedded, locally recrystallized to calcsilicate hornfels

TRvi
Meta-andesite
Bluish to greenish-gray, and greenish-black, contains subequal amounts of plagioclase and hornblende, minor biotite

TRtf
Meta-latitic pyroclastic rocks