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MOLYBDENUM DISTRIBUTION IN SOILS AND TREES AT THE PINE NUT MOLYBDENUM DEPOSIT, DOUGLAS COUNTY, NEVADA

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INTRODUCTION

The Pine Nut molybdenum deposit is situated in the western foothills of the Pine Nut Mountains in Douglas County, Nevada, about 20 miles southeast of Carson City (Figure 1).

The topography in the vicinity of the deposit is moderate, ranging in elevation from 5,800 to 7,000 feet, with low rounded hills and moderately steep slopes. Most of the area is forested with pinyon (Pine Nut) and juniper trees. Where the tree cover is sparse, sagebrush is the most abundant plant species.

GEOLOGIC SETTING

The molybdenum deposit is spatially associated with the southernmost of three small Cretaceous(?) quartz monzonite porphyry bodies that intrude interbedded volcanic and carbonate units of the Triassic Oreana Peak Formation (Figure 2). The southern intrusive is a slightly unroofed stock that at depth has a diameter about ten times that of the surface exposure. The other two exposed intrusives are smaller and dikelike in form.

The volcanic units are dominantly pyroclastics of intermediate composition. The carbonate units are dominantly recrystallized dolomitic limestones. The Oreana Peak Formation is regionally tilted to the west and was subjected to low-grade regional metamorphism prior to intrusion of the quartz monzonites (Noble, 1962). Near the intrusive bodies the host volcanic and carbonate rocks were contact-metamorphosed to hornfels and skarn. Hydrothermal alteration and mineralization further affected the host rocks.

A north-trending system of normal faults separates the Triassic rocks and younger intrusives on the west from pediment gravels of Quaternary and/or Tertiary age on the east and north. A steep, east-dipping normal fault bounds the molybdenum deposit on the east and appears to have displaced a minor amount of the mineralization.

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THE DEPOSIT

The extent of molybdenum mineralization in bedrock is shown in Figure 3. The dashed and dotted line is a projection of the 100 ppm Mo boundary from subsurface to the plane of the map. A small amount of molybdenum mineralization occurs at the surface near the center of the area outlined. The mineralization is related in time and space to the quartz monzonite stock. About 25 percent of the mineralization is in the intrusive, 65 percent is in the volcanic rocks, and 10 percent is in carbonate rocks.

Molybdenite is the primary molybdenum mineral, occurring in quartz veins with or without pyrite. The sulfide minerals are oxidized to varying degrees. Locally the zone of oxidation extends 200 feet below surface. The molybdenum oxide is partially leached, especially near the center of the deposit where the 100 ppm Mo boundary reaches surface. At least half of the original molybdenum has been removed in the near-surface portion of the mineralized zone. Enough molybdenum remains, however, to be detected by geochemical analysis of residual soils.

GEOCHEMISTRY -- SOILS

The molybdenum concentration in residual soil samples is shown in Figure 4 by the shaded pattern, which represents 10 ppm Mo or more. Samples of the residual soils were collected in the "B" horizon wherever possible, and the minus 35 mesh fraction of each sample was analyzed colorimetrically for molybdenum.

The shaded pattern indicates anomalies in the soil over each of the three exposed intrusives. The largest anomaly is over the southern intrusive and the central portion of the deposit. The anomalies over the middle and northern intrusives are confined to soils on volcanic and intrusive rocks, except for one anomalous sample on carbonate soil and one on gravel. The Mo anomaly over the deposit is centered where bedrock mineralization is near surface or exposed at the surface. The area of the soil anomaly is considerably smaller than the projected area of the underlying deposit primarily because the mineralization slopes rapidly downward at the margins of the deposit. However, the extent of the soil anomaly is limited on the eastern margin by two additional factors: 1) the post-mineral gravels, which are barren, and 2) the erratic behavior of molybdenum in the carbonate soils as shown by the very irregular outline of the eastern edge of the anomaly.

A comparison of soil molybdenum concentration, rock type, and subsurface mineralization is shown graphically in section A-A' (Figure 5). The upper boundary of 100 ppm Mo in bedrock is shown by the dashed and dotted black line. The boundary is relatively flat and near surface in the center of the deposit, but slopes rapidly downward at both margins. This geologic section is typical, except that the quartz monzonite stock is not shown because it does not extend as far north as section A-A'.

Strongly anomalous molybdenum concentrations in the soil occur in volcanics over the near-surface mineralization. In the adjacent carbonate rocks the molybdenum concentration in soil drops abruptly. West of the volcanics, the first soil sample is only weakly anomalous; further west, all values are background. This poor soil response in carbonate rocks to the west is largely due to the increased depth of the mineralization at the margins of the deposit, as shown on the geologic section. In the carbonate rocks east of the volcanics, however, the soils are weakly anomalous even though the 100 ppm Mo boundary is relatively close to the surface. The primary reason for the poor soil response is an abrupt decrease in the intensity of bedrock mineralization where carbonate rocks are present.

Drill hole data show that at the contact of mineralized volcanic rock with overlying carbonate rock, the mineralization is from four to fifteen times stronger in the volcanic rock; in other words, carbonate rocks severely restrict the movement of molybdenum-bearing solutions. Where weakly anomalous molybdenum does reach the surface through carbonate rocks (as on the east side of this section), the carbonate strata are relatively thin and the ground is highly fractured, allowing penetration by scattered quartz veins. As shown previously on Figure 4, carbonate rock in some areas has so restricted underlying molybdenum mineralization that it is not detected by soil geochemistry, even though close to the surface.

GEOCHEMISTRY -- TREES

Tree biogeochemistry was not used on the Pine Nut prospect until after the molybdenum deposit had been outlined by drilling. It was then that the disparity between the size of the soil anomaly and the underlying deposit became apparent. The soil anomaly covers only 40 percent of the mineralized area delineated by drilling.

The biogeochemical concentration of molybdenum in certain tree species such as mesquite has been used to detect some porphyry copper deposits in the southwestern U.S. (Huff, 1970; Chaffee, 1976). At Pine Nut, the extensive pinyon and juniper cover over much of the prospect area made biogeochemical sampling attractive.

Before any detailed sampling was undertaken, an orientation traverse was run across the northern end of the deposit, along Line A-A', to determine whether molybdenum values in the trees were comparable to soils. Samples of juniper and pinyon were collected at locations 200 feet apart. The samples consisted of second-year twigs and needles from the largest trees. The tree parts were oven dried, ashed, and analyzed colorimetrically for molybdenum. The analytical results are compared with soils in profile in Figure 6. The ash of pinyon needles and twigs contained nearly identical molybdenum concentrations, so the average of the two plant parts is shown as a single line. The highest pinyon values occur at the same sites as the high soil values, but individual pinyon values are lower than soil in nearly all cases. Pinyon samples, therefore, were not as sensitive as soils in detecting molybdenum.

In contrast, the molybdenum concentrations in the ash of juniper needles and twigs are significantly different from the soils and from each other. The needle values are always greater than the values in twigs from the same tree. Likewise, the needle values are always greater than the corresponding soil values, commonly by a factor of six to ten. A comparison of rock type, mineralization, and molybdenum concentration in both juniper needle ash and soil is shown for section A-A' in Figure 7. The threshold for juniper needles is 75 ppm and for soil is 10 ppm, as shown by the thin horizontal lines on the upper illustration. The highest molybdenum concentrations in juniper needles, as expected, are over mineralized volcanics. But the needles are also anomalous in the carbonate rock to the east and show a greater range of values than the soils. In the carbonate rocks to the west, where soils are only at background level, the juniper needle analyses detected an isolated anomaly.

Based on these favorable results, a detailed program of juniper needle sampling was carried out, with the results as shown in Figure 8. The biogeochemical anomalies are shown by a superimposed stippled pattern bounded at 75 ppm Mo. The soil anomalies in the shaded pattern have been retained

from Figure 4 for comparison. The most obvious difference in the molybdenum distribution between juniper and soil samples is a "new" anomaly to the northwest of the deposit. The anomalous values found in juniper needles in the western part of the orientation traverse along line A-A' were only the "tail" of a fairly large anomaly that is entirely in carbonate rocks.

For comparative purposes, soils from this area were sampled after the juniper results proved anomalous. The soils also proved to be anomalous, as shown by the smaller shaded pattern bounded at 10 ppm Mo.

The presence of both a tree and soil anomaly in this area is intriguing because the lower carbonate sequence is over 400 feet thick and essentially barren. Underlying strata of the lower volcanic unit are weakly mineralized by quartz-molybdonite veins and pyrite. No intrusive rock was encountered by drilling. Tentatively, the anomaly is ascribed to local occurrences of thin, molybdenum-bearing jasperoid veinlets and silicified breccia. These features are not widespread and were not encountered in drilling. The source of these molybdenum-bearing structures and the molybdenite veining in the lower volcanic rocks has not been found.

The northern juniper and soil anomaly is directly related to mineralization in and near the small quartz monzonite intrusive. The elongation of the anomaly north of the intrusive may be due to ground water dispersion or physical transport along a wash that cuts the area. This anomaly is the only one in which soil samples are locally anomalous where tree samples are not.

The juniper anomaly related to mineralization in and near the middle intrusive is connected to the anomaly over the deposit along a narrow "corridor" between carbonate rocks to the west and gravels to the east. Between the middle intrusive and the northern end of the deposit, molybdenum mineralization is largely controlled by pre-mineral structures, some of which are shown on Figure 8. Drilling in this area did not encounter any large underlying intrusive. The juniper anomaly trending northeast of the middle intrusive, in the post-mineral gravels, straddles two washes that drain the middle intrusive area. Molybdenum that has been leached from the mineralized intrusive and transported by ground water is probably the cause of this anomaly. Possibly, a paleo-stream channel lies beneath the gravels. Soil geochemistry did not detect molybdenum in these gravels.

The juniper anomaly over the deposit is larger than the corresponding soil anomaly and defines the deposit more precisely than the soils. This must be due in part to the ability of the juniper roots to penetrate deep enough to intersect better grade mineralization. The broad area sampled by the root systems is probably also a factor. How deep the root systems extend and whether they actually penetrate beneath some of the carbonate layers into underlying, better mineralized volcanics is not known. Near the outer margins of the deposit, the upper boundary of mineralization is too deep to detect by either soil or biogeochemical techniques.

CONCLUSIONS

Subsurface molybdenum mineralization was detected by both soil geochemical and biogeochemical sampling methods. Molybdenum is most concentrated in the minus 35 mesh fraction of the "B" soil horizon and in the ash of juniper needles. Biogeochemical sampling is preferable to soil geochemistry at Pine Nut for the following reasons:

1. Juniper needle samples detected molybdenum more consistently than soil samples in all rock types, including post-mineral gravels; and they are far more effective than soils as a sampling medium over carbonate rocks.

2. Molybdenum is generally concentrated to higher levels in juniper needles than in corresponding soils.

3. Molybdenum anomalies in juniper needles extend over a larger area than anomalies in soils; therefore, fewer biogeochemical samples are needed to define an anomalous area.

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Huff, L. C., 1970, A geochemical study of alluvium-covered copper deposits in Pima County, Arizona, with a section on Analytical methods, by A. P. Marranzino and H. M. Nakagawa: U.S. Geol. Surv. Bull. 1312-C, 31 p.

Noble, D. C., 1962, Mesozoic geology of the southern Pine Nut Range, Douglas County, Nevada: Stanford Univ. PhD. Diss., 200 p.

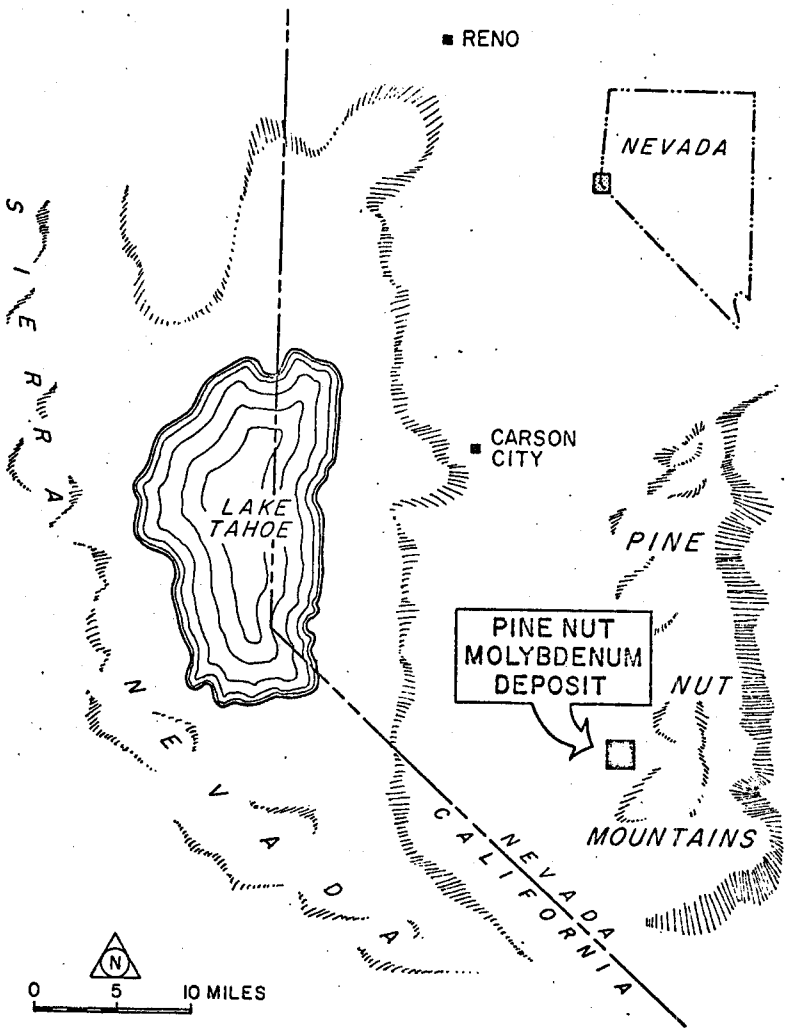

FIGURE I. LOCATION MAP

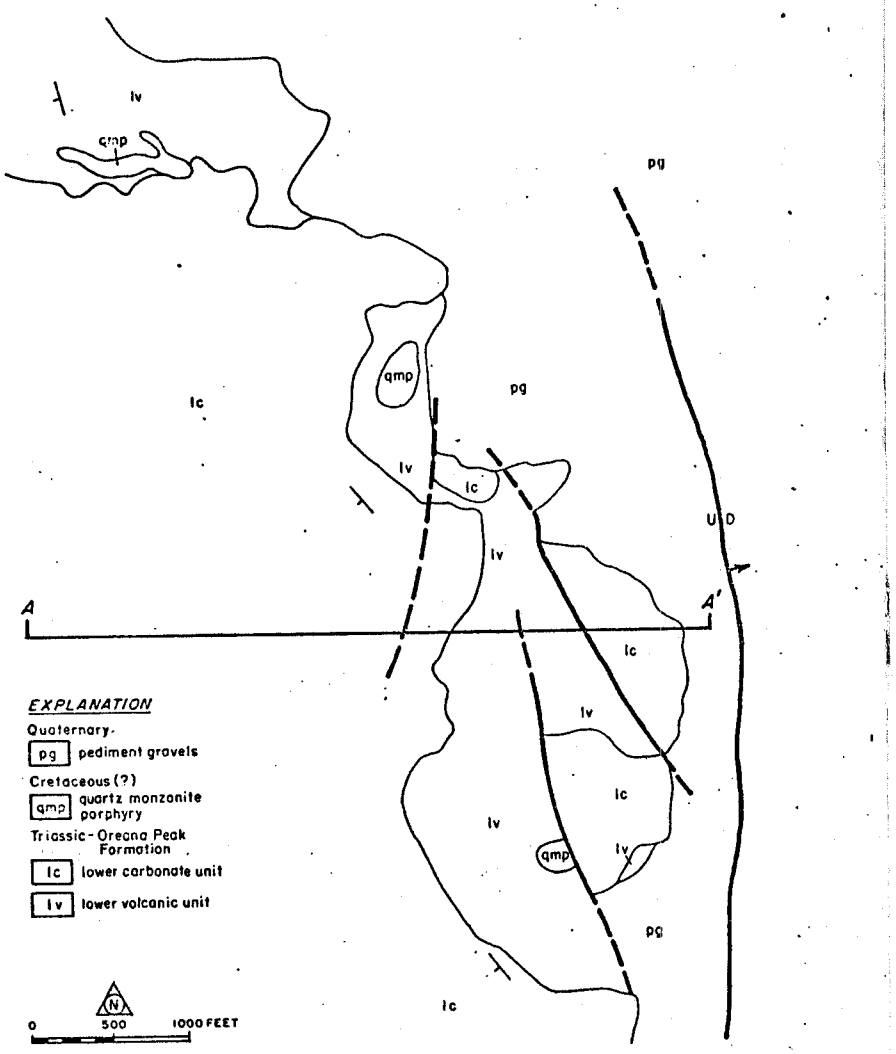

FIGURE 2. GEOLOGIC MAP

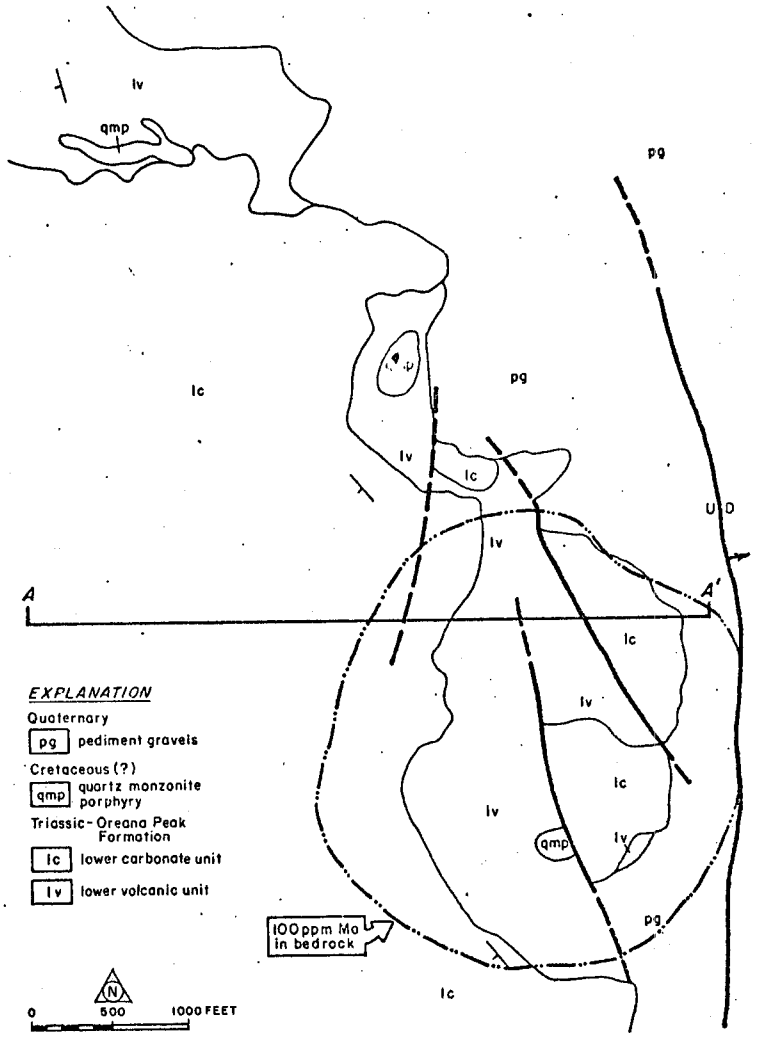

FIGURE 3. OUTLINE OF 100 PPM MOLYBDENUM IN BEDROCK (PROJECTED TO SURFACE)

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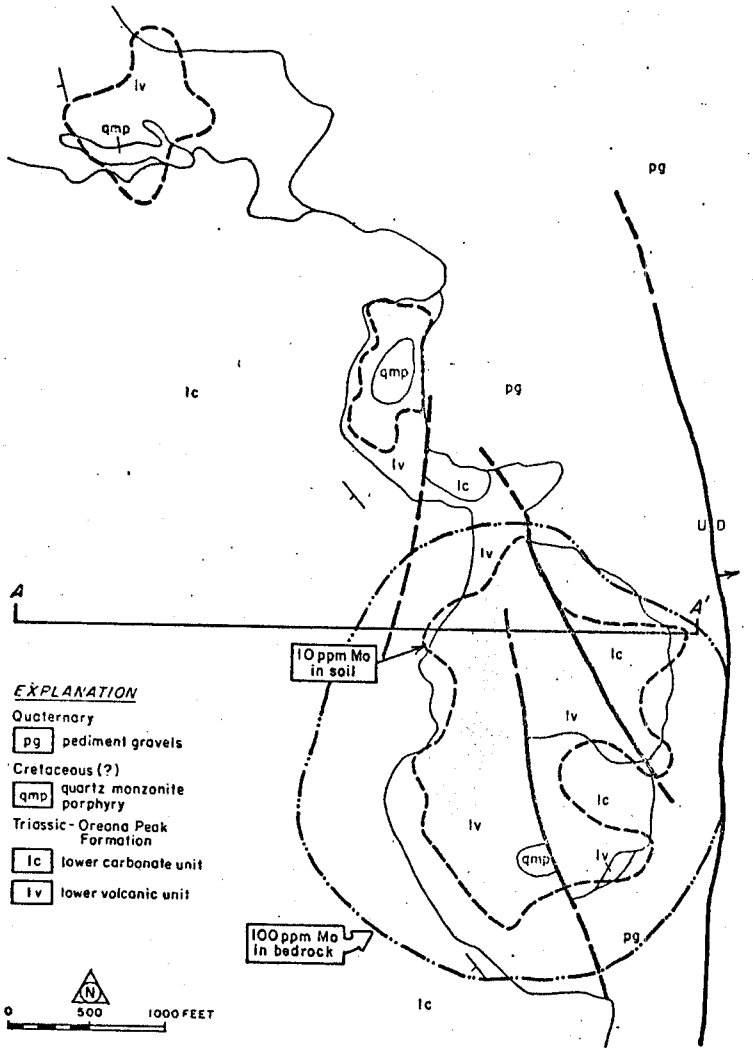

FIGURE 4. DISTRIBUTION OF MOLYBDENUM IN SOIL

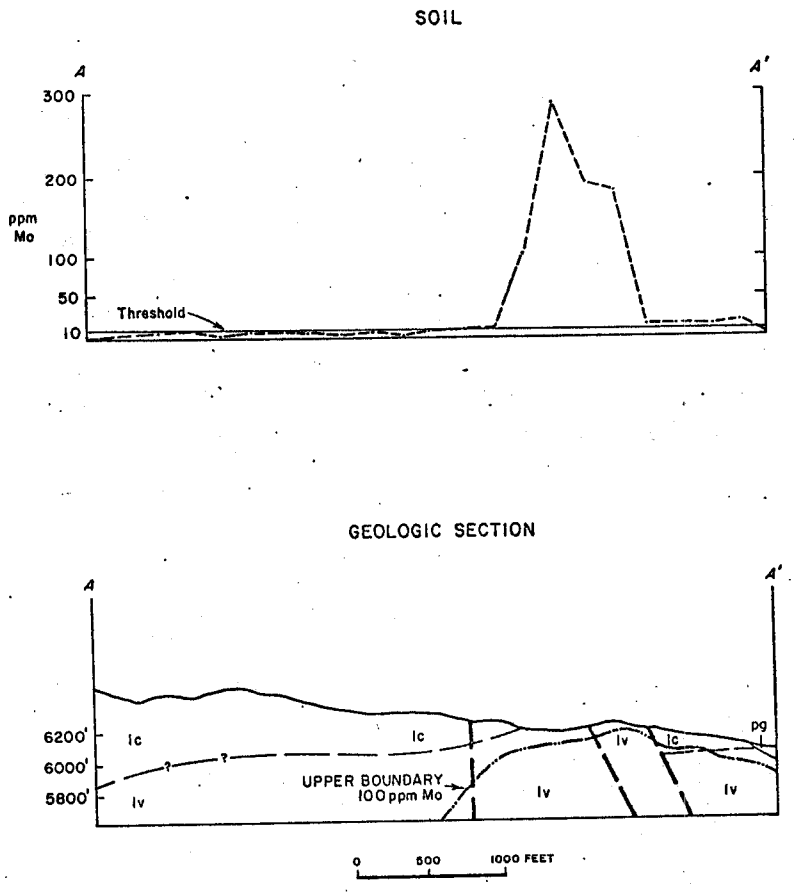

FIGURE 5. GEOLOGIC SECTION AND PROFILE OF MOLYBDENUM IN SOIL

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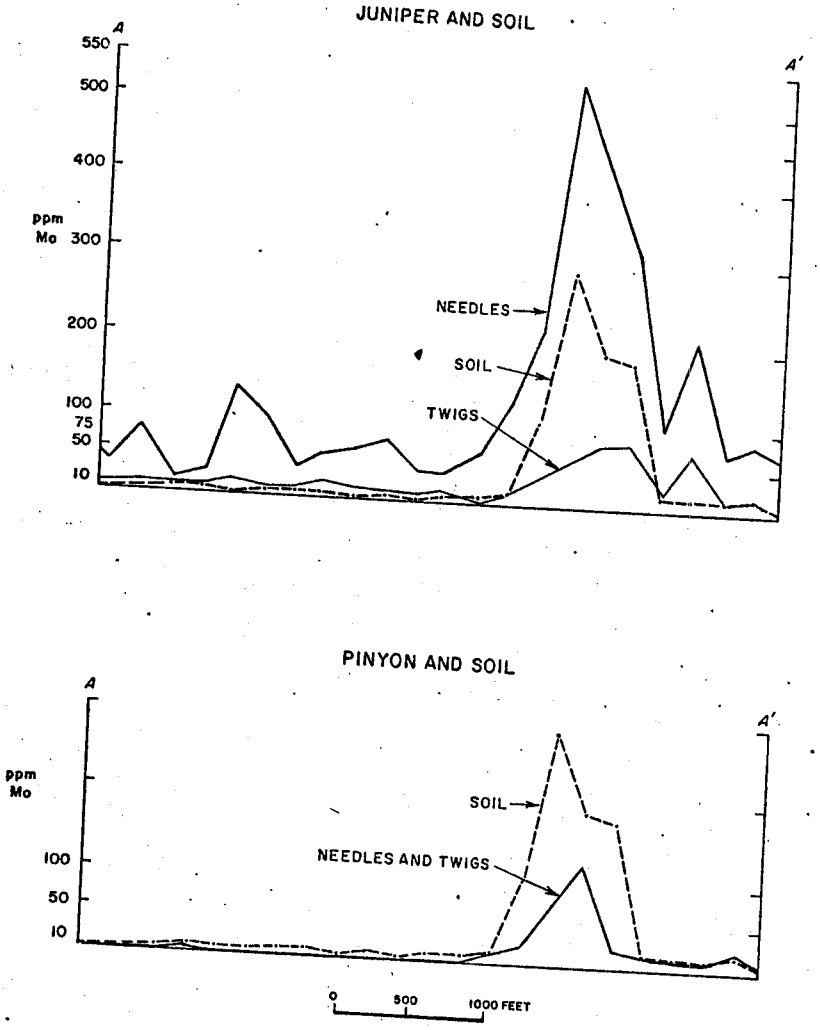

FIGURE 6. PROFILES OF MOLYBDENUM CONCENTRATION IN JUNIPER AND PINYON TREES VS SOIL

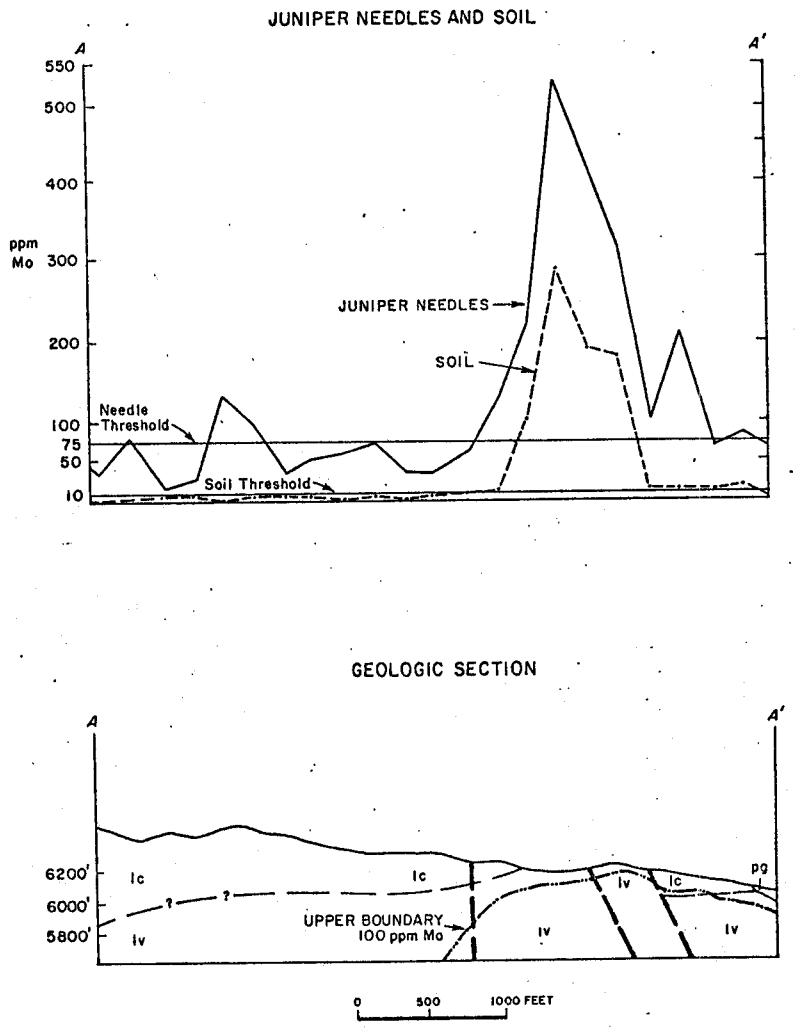

FIGURE 7. GEOLOGIC SECTION AND PROFILE OF MOLYBDENUM CONCENTRATION IN JUNIPER NEEDLES AND SOIL

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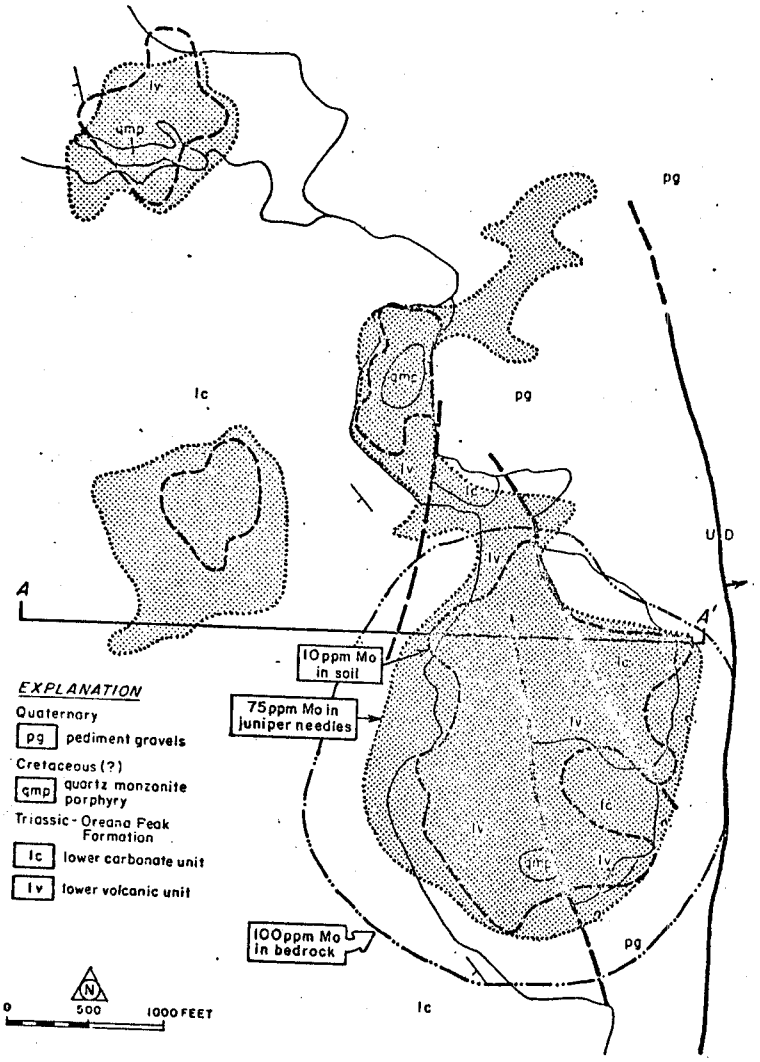

FIGURE 8. DISTRIBUTION OF MOLYBDENUM IN JUNIPER NEEDLES AND SOIL

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A REVIEW OF THE PINE NUT, NEVADA MOLYBDENUM PROSPECT

By

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January 13, 1967

SUMMARY AND CONCLUSIONS

A broad zone of molybdenite mineralization has been encountered at Pine Nut and four holes have significant intersections of .1% grade. Molybdenite occurs in a stockwork of quartz veins and is associated with pyrite and tungsten mineralization and sericite-K feldspar alteration. A biotite quartz monzonite stock is present at shallow depth in part of the prospect area and mineralization has a general but imperfect spatial relationship to the stock.

Good molybdenite intersections in the eastern-most holes, IP and magnetometer anomalies near Pine Nut Creek, and the presence of favorable structures make the ground east of the present drilling a target area. The mineralization and alteration is the Climax-type and is favorable for the occurrence of mineralization over a large area.

I recommend that 3,500 to 4,000 feet of additional drilling be done in three or four holes located east of the present drilling.

INTRODUCTION

The Pine Nut Prospect is located in Douglas County, Nevada about 45 miles south of Reno and 10 miles southeast of Gardnerville. It is situated in the western foothills of the Pine Nut Mountains and is easily accessible by a secondary road that branches from State Highway 395.

AMAX became interested in the property in 1963 when anomalous molybdenum was found in soil and rock samples collected during a reconnaissance survey in the old Pine Nut tungsten mining district. As a result of this survey, eleven claims were staked in 1964 and geologic mapping on a reconnaissance scale began that same year. The only work done in 1965 was additional soil sampling. In 1966 twenty-nine additional claims were staked and two groups of claims were optioned from the Alpine Mining Company. The geologic mapping was completed in detail that year and brief magnetometer and IP surveys were made. Ward Carithers has been in charge of the project from its beginning.

With the exception of two short rotary holes drilled for claim validation purposes in 1964, the drilling was all done from March to October, 1966. Ten diamond drill holes totalling 4,897 feet and nine rotary holes totalling 1,311 feet have been drilled to date.

The Climax Division was asked to review the Pine Nut Prospect in December 1966, and this report is the conclusion of this review. The information that was available included a project report by Ward Carithers, a report by Tom Moore, and a folio showing the results of the drilling,

geologic mapping, geochemical sampling, and magnetometer survey. In addition, we were given a box of representative core from drill hole PN 3 and had a chance to briefly review the results of the IP survey. Mr. Towle and I also talked to Ward Carithers about the property for about two hours. During the AMAX annual exploration meeting in Denver last week, John Hansuld discussed oxidation and leaching of Mo in the zone of weathering at Pine Nut.

The property is now covered with snow, and we have not visited it nor seen the drill core that is stored there. Also, we have not seen the detailed drill logs nor examined any material petrographically.

GEOLOGY

Rocks

The majority of the rocks that crop out in the prospect area are Triassic metavolcanics and metasediments. Although six units have been recognized, the Alpine formation and the Divide limestone are dominant. The Alpine formation is oldest and consists of interbedded tuffaceous shale, pyroclastics, and thin limestones. The Divide limestone overlies the Alpine formation and consists of massive fine-grained limestone with shaly interbeds.

The metavolcanics and metasediments are cut by several dikes of medium-grained biotite quartz monzonite and by small dikes of aplite and rhyolite. Five drill holes intersected biotite quartz monzonite for considerable distances, and apparently a stock underlies part of the area at a shallow depth.

Drilling shows that the stock contact dips off to north between drill holes PN 9 and PN 6 and dips off to the south between holes PN 3 and PN 11. Quartz monzonite dikes near holes PN 1 and 2 and PR 1 and 2 suggest that the stock may again be near surface in this area. The contact appears to be nearly flat in an east-west direction but lack of outcrops and drilling, especially to the east, limit this interpretation.

Late Tertiary or early Quarternary gravels cover much of the prospect area and seriously limit the geologic interpretations, particularly in the critical area east of the drilling.

Structure

The most obvious structure in the area is a regional anticline whose axis locally trends north-south. The Alpine formation and the Divide limestone crop out along the eroded core of the anticline.

Bedding in the prospect area is very erratic, but in many places it trends nearly east-west and there is some evidence that east-west trending flexures cross the regional structure at nearly right angles.

Several faults or shear zones exist but the control for determining their position or amount of displacement is not good. There is evidence that a fault cropping out just south of hole PN 12 has displaced the sedimentary and volcanic rocks as much as 1,000 feet, but along the projection of the fault to the south the stock contact does not appear to be significantly offset. Another large fault is shown along Pine Nut Creek but outcrops on both sides of the fault indicate there is no major displacement.

GEOCHEMISTRY AND GEOPHYSICS

Several molybdenum soil anomalies exist in the area but they are confined largely to the non-limestone portions of the Alpine formation. John Hansuld presented evidence at the recent Denver exploration meeting, using Pine Nut as an example, that an alkaline environment and the presence of Ca makes molybdenum highly mobile in the oxide zone. This probably explains the lack of molybdenum in the soils over the limestones, even in areas of known mineralization. For this reason, the soil anomalies cannot be used as reliable drilling guides.

The magnetometer survey shows a general north-south magnetic trend that is coincident with the trend of the regional anticlinal structure. A broad north-south trending high exists in the vicinity of hole PR 1 and Ward Carithers has interpreted this as an intrusive body at a relatively shallow depth. If this is so, the intrusive is not as strongly altered as the quartz monzonite stock to the south.

An interesting magnetic low anomaly shows up east of holes PN 6 and 9 and may indicate a zone of strong hydrothermal alteration. There is some suggestion that if the traverses had been continued further east the anomaly would have shown greater closure.

The most definite anomaly shown in the brief IP survey is also east of holes PN 6 and 9 and is generally coincident with the magnetic low anomaly. Presumably this indicates a zone with high sulfide content, even higher than that encountered in the drilling. Another interpretation is that the IP anomaly is caused by clays in a fault zone, but the coincidence of an IP anomaly and a magnetic low anomaly makes the area interesting.

MINERALIZATION AND DRILLING RESULTS

The molybdenite mineralization occurs in a stockworks of quartz and quartz-pyrite veins accompanied by sericite and quartz-K feldspar alteration. Scheelite is present in the area in skarn-type deposits and a black mineral identified as huebnerite is present with pyrite in some of the core for PN 3. The limestones in the area are commonly recrystallized and silicated but it is uncertain how much of this is due to regional metamorphism, contact metamorphism from the quartz monzonite intrusive, or hydrothermal alteration.

The mineralization occurs in the Alpine formation and in the biotite quartz monzonite. A very sharp drop in assays across the stock contact in holes PN 5 and 8 suggests that some of the quartz monzonite may be post-mineralization. The aplites are also mineralized but at least one aplite dikelet in the core from hole PN 3 cuts across quartz veins.

The sulfide mineralization has been oxidized to a depth of 170 to 210 feet and there is evidence that leaching has removed some of the molybdenum in the oxide zone.

Ten diamond drill holes and nine rotary holes have been drilled and most of the holes intersected molybdenum mineralization. The .0X% mineralization extends for a distance of 3,000 feet in a north-south direction but it has not yet been limited in the east-west direction.

Significant .1% mineralization was intersected in four holes; the footage and grade of these intersections are as follows:

Hole	From	To	Feet	% MoS_2
PN-4	280	470	190	.170
PN-9	190	600	410	.124
PN-6	250	550	300	.128
PN-7	180	380	200	.112

These intersections can be correlated as a single +.1% zone; it is limited to north and south by drilling but it is still open to the east and west. PN 6 and PN 9, the easternmost diamond drill holes, have the best intersections and, in fact, were still in .1% mineralization at the bottom of the holes. PR 4, which is an 85 foot rotary hole located about 400 feet southeast of PN 9, may be above the same zone. The interval from 30 to 70 feet was assayed and averages .165% total equivalent MoS_2; this is considerably higher than any other hole in the oxide zone.

ANALYSIS OF INFORMATION

Although I can add little to the observations that Ward Carithers made in his project report, there are several points that should be emphasized. The occurrence of molybdenite in a zone of stockwork-type quartz and quartz-pyrite veins is typical of Climax-type molybdenum deposits, and it is not unreasonable to expect the mineralization in deposits of this nature to extend over a large area.

The association of a black tungsten oxide and a complex igneous history are also typical of this type of deposit, and there is evidence that both of these exist at Pine Nut. Although the scheelite in skarn-type deposits in the area may be related to contact metamorphism, the huebnerite that occurs in the core from hole PN 3 is probably related to the hydrothermal event. The quartz monzonite stock, the possible post-mineral or intra-mineral quartz monzonite in holes PN 5 and 8, and the aplite that cuts across veining in PN 3 are evidence for at least three ages of intrusive events at Pine Nut. This suggests that exploring for additional ore will not be quite as simple as following the known intrusive contact; interior contacts may have influenced the deposition of ore.

Although the mineralization in a general way is related to the known quartz monzonite, there are significant departures from this generality. For example, .1% mineralization occurs at some distance from the stock in hole PN 7, adjacent to the stock contact in hole PN 4, and within the stock in hole PN 9. Mineralization in the .0X% range occurs as far away as 3,600 feet from the quartz monzonite in hole PN 12, but in hole PN 11, which is less than 3,000 feet from the quartz monzonite, the mineralization is almost nil.

Enough drilling has been done in the area to establish a pattern to the mineralization, and it appears that the best mineralization may extend east of the present drilling. Drill holes 6 and 9 have the best mineralized intersections in the sulfide zone and hole PR 4, although it did not penetrate the sulfide zone, had better grade in the oxide zone than any other hole.

There are also some geologic considerations that suggest mineralization may underlie the area east of the present drilling:

1. A magnetometer low anomaly is coincident with an IP anomaly in the vicinity of Pine Nut Creek.

2. East-west folding that crosses the regional anticlinal structure at right angles may reflect some structural controls for the mineralization in this direction.

3. Intersections in the easternmost holes indicate the quartz monzonite stock contact is flat or coming up to the east.

4. Faulting apparently complicates the geology to the east but little is known about the location, age, or amount of displacement of the faults. If they are pre-mineral, they may have provided a favorable structural control for mineralization.

The most salient fact is that drilling has established a zone of .1% mineralization and this zone is very much open to the east. This, in my opinion, is justification for continuing the exploration effort.

RECOMMENDATIONS

I concur with Ward Carithers' recommendation that additional drilling be done but would enlarge his proposed program to a total of 3,500 to 4,000 feet in three or four holes to be drilled to the east and southeast of the presently known better grade zone.

Ward estimated the cost of a 700-foot drill program to be $12,000; the cost of an additional 3,300 feet of drilling would raise this total to $45,000.

Neil Muncaster

Neil Muncaster

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Memo
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Reno
June 14, 1966

To. H. T. Schassberger
From Ward Carrhes
Subject Pine Nut project

Four core drill holes recently completed on this project ~~found~~ made intersections in three of the holes of 50 and 90 feet averaging more than 0.20% MoS2 in a metavolcanic rock, and another 50 feet of 0.19% MoS2 in granitic rock. These intersections coupled with the geology are considered sufficiently Encouraging to warrent another phase of drilling to further test this prospect.

The best mineralization found so far is in an original linear tuff, here called the Alpine formation, which is locally considerably metamorphosed. This unit has just barely been exhumed by Erosion along the axis of an anticline that trends northwestward through the prospect area. ~~It~~ As shown on plates 4, 5 and 6 the Alpine unit is exposed intermittantly between

the Alpine Mill [redacted] and Camp Sectors and the Cherokee sector and, where not obscured by overlying beds of limestone and limey alluvium, it reflects a geochemical molybdenum anomaly. It is probably also anomalous [redacted] and mineralized beneath these obscuring beds. The formation extends still farther northwest from the Cherokee, but it has not yet been mapped in detail. Geochemical results of soil samples taken [redacted] in the north, as shown on Plate II, are not encouraging except for a slight anomaly associated with an outcrop 2,000 feet [redacted] northwest of the Cherokee.

Granite rock has a small outcrop in the Alpine Mill sector and a suballuvial outcrop of perhaps an acre or so as exposed by mantle rock, this is known as the "South Stock". [redacted] Another exposure of similar granite rock is 3,000 feet north at the old Cherokee mine (formerly called the north stock) and mantle rock here indicates a probable dike or lens 75 feet wide and 300 or so feet [redacted] long. It is possible that this granite rock

underlies the area between these two exposures, occupying the trend of the anticline beneath the alpine formation.

Granitic rock of quartz monzonite to granite composition underlies the area drilled so far, and was found in fault contact with the alpine formation in three of the drill holes at depths ranging from 80 to 483 feet (see Plate II). The rock is strongly argillized and nearly barren just beneath its contact in holes 3 and 5, but at greater depths in hole 3 and 4 it is only weakly argillized and shows quartz veining, silicification and potassium silicate flooding. These features appear to increase with depth, so hole PN-5 might have found more favorable alteration if it had continued.

The molybdenum content of the deeper sections of the granitic rock average 0.066% MoS_2 in holes PN3 and 4; this includes the 50-foot interval in PN3 which averages 0.19 e MoS_2.

In section, downward toward the granite [redacted] rock, the Alpine also displays a zonal alteration pattern which is apparently related to the mineralization. The upper 200 to 300 feet of the unit is highly sericitized and is essentially a light grey to greenish grey sericite-chlorite schist laced by a few quartz veins. It contains clean pyrite and minor molybdenum — up to about 500 ppm — and is the rock that produces the geochemical anomalies ~~at~~ in the Alpine Mill and Cherokee sectors. This sericitization diminishes downward and the rock grades to a siliceous biotite-chlorite schist containing thin zones of hornfels and skarn. As so far found, the best molybdenite mineralization is in this siliceous zone occurring ~~along~~ [redacted] the borders of quartz veins together with .5 to 5% disseminated pyrite, and a little epidote. This "ore" contains less than .1% copper, trace amounts of gold and silver, and only

a very minor amount of scheelite. None are in sufficient quantity to be a possible by-product — though all have been produced from nearby small mines.

As shown on plates 4, 5 and 6 there are several faults in the Pine Nut area, the most profound being along the east edge of the Alpine centerline when perhaps a thousand or more feet of displacement is indicated. Other smaller faults exist in the prospect area but, though imperfectly known as yet, they do not appear to severely interrupt the lines of the mineralization. Therefore it appears possible that the well mineralized siliceous biotite schist horizon of the Alpine formation [redacted] extends between the Alpine [redacted] Hill sector and the Cherokee as a sub-surface blanket-like lode. If so, there is a potential zone at least 3000 feet long, 600 feet wide and at a depth of, say, less than 500 feet. If mineralized [redacted] test a grade of, say,

.20% Mo. The report [illegible] 6
have a potential for an open pit
Molybdenite mine.

Claims that are held and optioned by AMAX control most, but not all, of the potentially mineralized ground at the Pine Nut, but we have staked an additional 30 claims to the north to protect a possible north extension. However, probably mineralized ground to the east and southeast is under private land held under two different ownerships, Dangberg Land and Livestock Co. and Stoddard Jacobsen. These lands are shown together with other ownerships in the district on Plate 1. Stoddard Jacobsen lives near Gardnerville. Dangberg is a Minden, Nevada firm and is managed by Graham Stanford of Minden. At least one of the Dangbergs is an AMAX stockholder.

Part of the land in which we are interested is patented, covering both surface and mineral, so any deal on this should be straightforward with Dangberg, the owner. Other land, however, is "State Selection" and the owners hold only the surface. The minerals, withheld originally for the U.S., were disclaimed

in 1962 by the Federal Government, so they are now "in limbo" until decided upon by court action. We will therefore wish to seek out some method by which we can obtain a clear title or base of these mineral rights.

Conclusions and Recommendations

The possible mineralized zone at the Pine Nut prospect, if continuous and of a grade of 0.20% MoS_2 or so, would have a potential for an open pit molybdenite operation. [redacted] The structural environment and the alteration features are believed to be favorable for the existence of such a deposit, so in order to further test for this possibility, the following is recommended:

Property

(1) Location work should be done on at least 30 of the 32 claims we have staked north and south of our present holdings. This work must be completed and Certificates of Location filed by July 5. We would expect to utilize a rotary air drill, at least in part, to fulfill this work, and gather ~~soil~~ geochemical prospecting samples.

(2) We should open negotiations with Dauphin Land and Jerritt Canyon Company and with Stoddard Jacobsen for options on their privately owned property adjacent to our drilling area, and, while we are at it, for their lands just west of our claim holdings. (See plate 1)

(3) As part of these lands are so called "State Selection" land underwhich the ownership of minerals is in question, we should seek ~~the~~ advise from our legal department as to what steps to take to acquire title to the minerals.

Drilling

Nine holes totalling 5400 feet are proposed for this project as follows.

(1) In the present drilling area (Mill and Camp sectors – plates 4 and 5) four fences of vertical holes would be constructed to cross the trend of the mineralized formation at intervals of 800 feet. In each fence the holes would be 400 feet apart and, utilizing present holes, the four fences would require 8 holes to cover a length of 2400 feet along the zone.

2) At least one hole would be put down in the Cherokee sector (Plate 6) 3000 feet north of the present drilling area, in order to test this portion of the mineralized zone. A geochemical anomaly here ranges from 100 to 200 ppm Mo.

The scheduling of this drilling would approximate the following - subject to land acquisitions:

Fence 35 North: Complet hole PN-7, now underway and, if favorable, drill at site A.

Fence 27 North: Drill at sites B and C (C only after the Jacobsen property is acquired). These are essentially offsets of favorable hole PN-4.

Fence 19 North: Drill D, E, and F (E and F after the Jacobsen property is acquired).

Fence 11 North: Drill at sites G and H after the Dangberg property is acquired.

~~Fence~~ 47 North: One hole at site I would be put down to test this northern part of the ~~favorable area~~ geochemically anomalous alfine formation.

The holes are expected to average about 600 feet in depth for a total footage of 5,400 feet. One permanent senior geologist and two temporary field assistants are anticipated for the job for three months. It is estimated that the cost of the proposed project is as follows:

Salaries and Fring. Temporary	$ ~~48,000~~ ~~3500~~
Drilling 5400 feet at $9.00	48,600
Bulldozer rental	450
Property option payments	4000
Property Claim work	3200
Equipment maint.	750
~~Assaying~~	1800
Camp and Board	3500 ~~2800~~
Misc, Telephone and general	~~700~~
Total	$ 68,000

Our expenditure forecast is attached.

Ward Carter

(36)

Item 1

EXECUTIVE OFFICES
1270 AVENUE OF THE AMERICAS, NEW YORK, N.Y. 10020
PLAZA 7-9700

AMERICAN METAL CLIMAX, INC.
EXPLORATION AND MINE DEVELOPMENT DIVISION
1845 SHERMAN STREET, DENVER, COLORADO 80203 · 266-3843

December 16, 1966

Mr. R. I. Davis
New York Office

Re: Report on Pine Nut - 237
Douglas County, Nevada

Dear Bob:

Enclosed are copies 1 and 3 of a report by Ward Carithers on Pine Nut.

I do not concur with Ward that additional work is warranted but instead, recommend that we drop the property. Our agreement with Alpine Mining Company requires notice by December 25 if we are to avoid making the payment of $2400 due on January 25, 1967. I recommend that they be so notified.

Because Tom Moore, in his memorandum of October 24, adequately covers the geologic reasons why no further work is warranted at Pine Nut, I'll not repeat these but say only that I am in full agreement that Pine Nut has been adequately tested.

Best regards.

Sincerely,

Ted

H. T. Schassberger

HTS:pa

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Arrowhead Section X" = 10b'

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Alpine Mill " "

Cherokee " "

Navajo " "

Hopi " "

Divide East " "

Divide West " "

Picnic " "

Cross Sections 1"=50'

Section 11N 1" = 50' showing Hole PN-11

" 19-20N " " showing Hole PN-3

" 27N " " " Holes PN-5, 8, PR-4

" 31N " " " " PN-4, 9, PR-6

" 35N " " " " PN 6, 7

" 39N " " " " PN 10

" 47N " " " " PN 12

" 52N " " " " PN 1, 2

(22) PINE NUT Project-237
(22) Douglas County, Nevada
(31) 1966

~~PINE NUT REPORT~~

SUMMARY (30)

During 1966, ten diamond drill holes totaling 4897 ft were put down on the Pine Nut prospect to test molybdenum mineralization found here earlier by geochemical prospecting. Seven rotary holes totaling 1095 ft were also drilled; two of these made a shallow test of a small geochemical anomaly found a mile northwest of the drilling area, and the others were put down through the oxidized zone in the drilling area for later extension by diamond drilling.

The molybdenum mineralization is associated with and spacially related to a stock of altered biotite quartz monzonite which intrudes a metavolcanic unit called the Alpine formation. The Alpine is the lowest exposed unit of a thick series of Triassic metavolcanics, metasediments and limestones which have been intruded and regionally metamorphosed by plutons of the Sierra Nevada batholith, one of which is about three miles [redacted] east of the prospect. The Triassic rocks have been locally folded into a northwest-trending anticline, then faulted and breached by erosion to barely expose the South stock as well as two other intrusives of biotite quartz monzonite within the anticline. One of these is a dike at the Cherokee prospect, 3000 ft northwest of the south stock; the other is a group of dikes in the Divide East Sector, 5200 ft northwest. Both of these localities have much lower geochemical molybdenum anomalies than at the south stock, and also display weaker alteration at the surface and in shallow drill holes. Part of the prospect area is overlain by late Tertiary or Quaternary alluvium; this also obscures the bedrock for about three miles to the east.

The hydrothermal alteration at the Pine Nut consists of an aureole of sericitization and quartz veining in the Alpine formation, K-feldspar

and quartz veining and flooding in the South stock intrusive, and argillization, sericitization and calcite veining in broken and brecciated zones through both rocks. Presumeably this alteration is related to the intrusion of the South stock biotite quartz monzonite, but there is evidence that some of the quartz monzonite, as dikes and possibly as part of the South stock also, was emplaced prior to the alteration stage.

Molybdenite together with a little pyrite and epidote occurs in some of the quartz veins and in quartz-K-feldspar veining and flooding. These are in both the quartz monzonite and the intruded Alpine formation; but in most of the holes drilled, the ~~better~~ best molybdenite mineralization is in the Alpine. ~~The only exception is in PN-9 where the MoS_2 grade ratio between the Alpine and the intrusive is about 1 to 1.~~

In drilling, Hole PN-3 was put down into the south stock outcrop in section 20N (2000 ft north of baseline), and Holes PN4 through PN-10 were drilled to the north of the stock in sections 27N, 31N, 35N and 39N. Hole PN-11 is at 11N, south of the mineralized zone, and Hole PN-12 is in section 47N close to the Cherokee. The drilling, as well as the geology, indicates that the top of the stock slopes downward on the north, south and west sides, but there is no evidence as to what its attitude is toward the east except that it may have been downdropped somewhat by faulting.

not a new paragraph

~~At least a little molybdenite was found in each hole, and~~ Several intersections of plus 0.20% MoS_2 were ~~made~~ cored. ~~in PN-3, 4, 6, 7 and 9.~~ However, these ~~be[illegible]~~ sections are so erratic that it is not possible to block out any continuous zones of this grade. There does, however, appear to be at least one fairly large low-grade zone between Holes PN-4, 9, 7 and 6. This zone is 190 to 410 ft thick, lies under 180 to 280 ft of overburden and ranges in average grade from 0.11 to 0.17% MoS_2;

is indicated for

~~It would have~~ a potential of perhaps 8 to 10 million tons grading about 0.13% MoS_2. The zone is closed to the north and to the south by drill holes, and is expected to pinch out toward the west. It is open toward the east, but an important structure feature might downdrop the zone in that direction.

A preliminary I.P. survey was run on three lines, ~~19-20N, 27N and 34N~~ and a ground magnetic survey was made over the general area. The I.P. disclosed a distinct anomaly about 600 ft east of holes PN-6 and 9 at a depth of 400 to 600 ft. It coincides with an anomalous magnetic "low".

CONCLUSIONS AND RECOMMENDATIONS (17)

65-31-2[3]4-17

The drilling ~~that we have so far done on the Pine Nut project~~ has demonstrated that the molybdenite mineralization associated with the hydrothermal activity in and around the South stock is too low in grade to constitute ore. Some favorable features are present, but if there is any better grade mineralization in the area, it will likely have to be in an igneous environment or in a structural situation different from that ~~we have been drilling~~ so far drilled.

None is known, but there is one possibility; if the magnetic "low" to the east of Holes PN-9 and 6 is ~~actually~~ indicating a hydrothermally altered zone ~~from which iron is removed~~, and if the coincidental I.P. anomaly is ~~actually~~ indicating sulfides, then there might be a deposit here of better grade molybdenite. The possibility must be considered a wildcat, however, for the geophysical data might, instead, simply be reflecting structural conditions. But, I think it is worth one more drill hole about 700 ft deep ~~another hole~~ to find out

If another drill hole to test this possibility is acceptable, we will need to negotiate for the land overlying it held by Dangberg Land and Livestock Company and by Stoddard Jacobsen, and we should continue to hold the Alpine claim group. In drilling, ~~it is suggested that~~ we should rotary drill ~~down~~ until interesting rock is found, then continue the

hole NC size until we are sure that the ground is firm enough for NX size. Total cost for the project will be about $12,000 as follows:

Land acquisition (options)	$1,200
Alpine option annual payment	2,400
Drilling 700 ft	7,000
Other, transportation, assay, etc.	1,400
TOTAL	$12,000

65
12
03

INTRODUCTION

Anomalous molybdenum in soil and rock near the old tungsten mines of the Pine Nut district was found in 1963 while doing reconnaissance work in the area. As the "showing" appeared to be significant, eleven claims were staked in early 1964 to cover open ground adjacent to Alpine Mining Company, who hold several key claims, and negotiations were then opened with this Company for an option. A deal was finally completed two years later in January, 1966. During 1964, the prospect and environs were geologically mapped by reconnaissance and in 1965, additional geochemical sampling was done. Reports and memoranda covering this pre-1966 work are included in the reference list at the end of this report.

Diamond drilling was started on March 22, 1966 by Boyles Bros. Drilling Company and it continued until October 27, chiefly on a two-shifts per day, six-day week basis. A rotary rig was also employed for a short period in July.

In addition to the drilling during 1966, twenty-nine new claims were staked and validated, and the entire prospect area was geologically mapped on a scale of 1 inch equals 100 feet. Geochemical samples lines were extended for about a mile to the north and a half a mile to the south and a ground magnetic survey was made over the prospect. I.P. preliminary I.P. survey was made by a McPhar crew who ran three lines across the drilling area.

During May, 1966, the writer was assisted in the field by R. J. Lickus of the Denver office and during the summer months by two graduate students, John L. McGillis of the University of Nevada and James O. Guthrie of the University of Arizona. In general, McGillis was occupied mostly in surface mapping and Guthrie in core logging and splitting, but all jobs overlapped.

LOCATION AND PHYSICAL FEATURES

The Pine Nut prospect is situated in the western foothills of the Pine Nut Mtns about 10 airline miles southeast of the town of Gardenerville, Douglas County, Nevada (see Figure 1). The district is easily accessible by a secondary road which branches from State Highway 395, 2.3 miles south of Gardenerville and leads 10 miles east and south into the area of interest.

Altitudes range from about 5900 to 6300 ft. ~~Locally,~~ Within the prospect area, the hills are rolling and relief is not great. However, a hill just west of the prospect rises steeply to more than 7000 ft and Mt. Siegel, 3½ mi east, rises ruggedly to 9450 ft (see Plate I).

The climate of the region is typical of western Nevada with pleasant dry summers and cool winters. Precipitation normally amounts to about 6 inches annually. Snowstorms occur throughout the winter, but snow rarely exceeds a foot or two in depth. Much of the district is covered by a growth of pinyon pine and juniper trees.

The area is drained by Pine Nut Creek, a north-flowing intermittent stream of about 1 or 2 cubic ft per second during the spring and early summer. Permission to use the water for drilling was granted to us by the owner, Dangberg Land and Livestock Company. However, when this stream dried up in late June, a small spring was developed on adjacent land by the permission of its owner, Stoddard Jacobsen, and this was barely sufficient to supply the drill. The nearest alternate supply is at Gardenerville.

PROPERTY AND OWNERSHIP

As shown on the property map (Plate VI), the drill holes ~~that we have so far put down~~ are within claims held by AMAX (Climax Molybdenum Company of Michigan) and by Alpine Mining Company. Alpine is a California corporation from which we have an option to purchase two groups of claims: the Watercress group in section 25, T12N, R21E and the Divide group in section 23, T12N, R21E. The agreement gives AMAX

a 7-yr option with annual payments of $2400 for four years, then annual payments of $35,000, $35,200 and $60,000, making a total price of $139,800. A second payment is due ~~in~~ January 25, 1967 if AMAX continues to hold the option; a 30-day prior notice of termination is required if we do not.

Affidavits for assessment work done during the year ending September 1, 1966 have been filed with the Douglas County Recorder for the Alpine claims as well as the Climax claims. Sufficient work was also done during September and October of this year to satisfy assessment requirements for the year ending September 1, 1967. Affidavits for this work will be filed, thus holding the claims until September 1, 1968.

Privately-owned land lies just east of the drilling area and as [redacted] holes PN-6 and 9 near the border show as much as 400 ft of low-grade mineralization, these adjacent lands are probably also underlain [redacted] in part by similar mineralization. The land is of two general categories: 1) fee land held by Dangberg Land and Livestock Company and 2) State Selection land held by Dangberg and by S. Jacobsen. The fee land holds both the surface and minerals so the small overlapping portion of the Alpine group is probably invalid as mining claims. The State Selection land, on the other hand, was originally sold by the State of Nevada with mineral rights reserved to the United States. Until 1962, the minerals under the lands could be staked as any mining claim, with the locater being responsible to the surface owner for any damages thereon. In 1962, the U.S. Congress disclaimed any interest in the mineral rights of Nevada Selection lands, leaving the minerals "in limbo". However, the State of Nevada did not disclaim possible rights; so in an effort to clear the matter, the Nevada legislature in 1963 passed laws which, in effect, allows the owner of State Selection land to bring action against the State of Nevada to determine if the State

has any right to the mineral. If it is found that the State does, the owner will then have a year's option to purchase the said mineral rights for 15¢ per acre. It would appear, therefore, that an owner of any State Selection land has had control of the mineral rights under his land since 1963. However, as the Alpine claims were staked in the 1930s, prior to the passage of these current laws, it would seem probable that the claims which overlap State Selection land would remain valid.

This land matter is academic at the present time, for whether the claims are valid or not, a deal with the surface owners should be made in the event any drilling is ever done to test the ground under the State Selection or Fee lands. Discussions were had with both Dangberg and Jacobsen during the summer of 1966, but nothing was consummated. With Jacobsen a tentative proposal was made for a 5-yr option period at $600 per year after which his land could be purchased for $1500 per acre with payments of not less than $10,000 per year. This price per acre is more than twice the going rate for acreage in the region, but the long-term payment schedule is not bad.

No terms were reached with Dangberg, but it seemed likely that they would require a royalty schedule on any land that was sold for mining purposes.

GEOLOGY

The rocks encountered in the Pine Nut prospect area include a stratigraphic section of metavolcanics and metasediments which are intruded by at least two kinds of igneous rocks. These are overlain unconformably by a mid-Tertiary volcanic sequence and also by late Tertiary and/or Quaternary lake beds, fanglomerates and gravels. The principal lithologic characteristics of these rocks are summarized in Table 1.

(2)

Pre-intrusive Rocks

The preintrusive rocks locally comprise a section at least 4000 ft thick of volcanic clastics, limestone and sediments chiefly derived from volcanic rocks. They are believed to be a part of a thicker sequence of metavolcanics and metasediments called the Excelsior formation which has been extensively mapped in Mineral County, 30 to 70 mi east and southeast of the Pine Nut (D. C. Ross, 1961). The rocks are ~~It is~~ considered to be of Triassic age.

Six stratigraphic units of the Excelsior (?) have been given informal names in the Pine Nut prospect area. These range from the Alpine formation, the lowest recognized unit, upward through the Divide limestone, Red Hill formation, Ridge limestone and into the Buffalo formation. Another unit, the Ruby Hill sandstone, has been mapped but due to faulting, its position in the stratigraphic column is obscure; it is probably post-Buffalo.

The Alpine formation consists mostly of pyroclastics and sediments, but it also contains a 10-to 40-ft bed of limestone about 100 ft below the top and another limestone 300 to 400 ft below the top; these are partly tactized. In general, the upper 300 ft of the Alpine is, in addition to ~~besides~~ the limestone, chiefly fine-grained tuff and shale, ~~in origin~~ and the section below is largely volcanic breccia and agglomerate (or conglomerate ~~in origin~~. But alteration, faulting and brecciation have made any correlation of particular units from hole to hole, practically impossible in the drilling area.

As shown by geologic maps in the Pine Nut Atlas, the Alpine formation and successively higher units have been mapped in detail for about two miles northwestward from the prospect. They continue on through the hills beyond, but have not been [redacted] shown separately.

Post-intrusive Rocks

A fanglomerate deposit and a gravel deposit of late Tertiary or early Quaternary age lie along the eastern and southeastern edge of the

prospect area. ~~and obscure a considerable amount of important geology.~~ The fanglomerate is probably the older; it contains only rocks of the Divide, Red Hill, Ridge and probably Buffalo formations, so it had its source from the hills to the west. It is ~~however~~ perched on top of ridges and is essentially a pediment that has been raised and tilted in fairly recent time. ~~Drill Hole PN-12 penetrated 165 ft of this alluvium and found it to be~~ The fanglomerate is weakly cemented by calcium carbonate near the bottom, ~~of calcium carbonate~~.

The great pile of gravel that is shown on Plate I to the east of the Pine Nut prospect (after J. Moore, 1961) contains boulders and gravel ~~made~~ composed of the rocks to the southeast and east. ~~It~~ The gravel is said to contain a little fine gold, and a plant for its recovery is presently being build just north of the prospect area (sec. 13, T12N, R21E).

Intrusive Rocks

Medium-grained biotite quartz monzonite crops out as the "South stock" in the Alpine Mill sector and also as dikes in the Cherokee and Divide East sectors. The rock is also intersected by drill holes PN-3, 4, 5, 8 and 9 which show it to be a hydrothermally altered stock or cupola that underlies several thousand square feet of the sector at a relatively shallow depth. Drilling also indicates that the contact between the granitic rock and the intruded Alpine formation slopes off toward the north and the south. It is expected to also slope off to the west, but the attitude of the contact toward the east might be nearly flat. The quartz monzonite is similar to and is probably connected with the Mt. Siegel quartz monzonite to the east. The nearest outcrop is about 3 mi away, but as the intervening area is obscured by gravels, the connection could be much closer.

The biotite quartz monzonite dikes in the Cherokee and Divide East sectors are altered to a lesser degree than the rock at the South stock. ~~It is speculated that~~ These dikes might be ~~are~~ upward expressions of other, deeper stocks.

TABLE 1

Table I — ROCK FORMATIONS AT THE PINE NUT PROSPECT
DOUGLAS COUNTY, NEVADA

Age	Formation or Unit	Approx. Thickness	Character
Quaternary and/or Late Tertiary	Fanglomerate and stream alluvium (Qal)	0-300'	Gravel, sand and silt; the fanglomerate is a raised pediment gravel with a source from the west. It is being reworked to recent stream alluvium.
Same	Gravels (Qg)	0-400(?)	Gravel, sand and silt containing large boulders. In the prospect area, its source is from the east & south. Also being reworked.
Same	Lake beds (QTs)	0-100?	Sand, silt and clay. Lacustrine sediments north of the prospect area.
	unconformity		
Mid-Tertiary	Volcanics (Tv)	0-500?	Volcanic agglomerate, tuffs and ignimbrite southeast of the prospect area.
	unconformity		
?	fine-grained intrusive	---	Dikes and sills of rhyolitic and aplitic composition.
?	Granitic intrusive	---	Grey, medium-grained biotite qtz monz with a few phenocrys of orthoclase; altered at places by qtz and K-feldspar.

Age	Formation or Unit	Approx. Thickness	Character
	intrusive contacts		
	Buffalo formation	2000+	Grey to green colored tuff, tuff breccia, shaley tuff and mudstone.
	Ridge limestone	250-400	Grey, fine-grained, thin-bedded limestone.
Triassic	Red Hill formation	1000±	Dark greenish-gray, medium to coarse, gritty tuff inter-bedded w/coarse, recrystall-ized limestone.
	Divide limestone	1200-1600	Grey, medium bedded to massi fine-grained limestone w/thi shaley interbeds.
~~Triassic~~	Alpine formation	1000+	Green to grey tuff and tuff-aceous shale w/two limestone units in upper 300± ft; gree to grey, partly silicified tuff and pyroclastic below about 300'.
	probable fault contact		
?	Ruby Hill sandstone		Brown, fine-grained sandston w/occasional crossbeds. Position uncertain in the stratigraphic column.

Fine-grained intrusive rocks occur widely in the Pine Nut area as indicated mostly by float, but they are not particularly abundant. Most are narrow dikes or lenses of aplitic rock of rhyolitic material that is almost glassy. Mafics are rare, but drill hole intersections show that most--probably all--of the dikes are related to the biotite quartz monzonite intrusion.

Sill-like bodies of rhyolitic rock occur in the Red Hill formation west of the prospect area and also in a gully just north of Hole PN-10. They are banded with alternating light and dark zones, and they look like irregular beds of rhyolitic tuff. However, cross-cutting relations were reported by Lovejoy and Barnard (1964) and by Guthrie this year, so they are tentatively mapped as intrusives.

Structure

In general, the structure of the Triassic strata appears to be an anticline with an axis trending about N10°W through the prospect area. The west limb is simple with the Divide limestone and successively higher beds dipping fairly regularly toward the southwest for several miles. The east limb, however, has been downdropped and distorted by faulting, and is considerably obscured by alluvium. The core of the anticline consists of Alpine formation intruded by the south stock and dikes which were probably guided in their emplacement by the structure.

Several faults exist at the Pine Nut prospect and one of the largest trends northwestward from about 21N, 12E in the Alpine Mill sector to Hole PN-12 (47N, 6E) in the Cherokee sector. This fault is exposed in a bulldozer cut just south of PN-12 where steeply dipping Red Hill formation is in contact with the Alpine showing a displacement of at least 1000 ft. Just east of Holes PN-6 and 9 the fault cannot be seen but nearly vertical beds of Divide limestone are on the east, and gently dipping beds of Alpine are on the west (see section 35N). Although gouge occurs in the fault in PN-12 and in the nearby bulldozer cut, this fault may be pre-intrusive

--at least in part--for the Divide limestone east of PN-9 is cut by a dike and is also generally crackled and tactized, suggesting that an intrusive is not far below the surface.

The fault that is shown to extend more or less northward along Pine Nut Creek is taken from J. Moore's regional Map (1961) which shows major downdropping on the east side. Some uplifting of the fanglomerate on the west, relative to the east side, appears to be evident--possibly 100 ft or so--but visible evidence of any profound displacement.

The fault that extends northward through the South stock appears to have downdropped a block on the east by 200 or 300 feet; this is evidenced by outcrops of upper Alpine or lower Divide limestone on the east (see section 20N). This fault is postulated to extend north on through the old tungsten pit where a fault is exposed, but the extension beyond the pit is speculative.

Faulting, brecciation, crushing and gouge zones, which confounded the drilling operation at times, were found in all of the drill holes. These features were noted chiefly in the Alpine formation, but occur also in the intrusive granitic rock. Some of the crushing suggests thrust faulting. In this extent, the Alpine formation, an incompetent rock compared to the overlying Divide limestone, would have taken up most of the stress and strain during adjustment, and would be the most y sheared and broken.

Alteration and Mineralization

Two general stages of alteration are recognized at the Pine Nut prospect: 1) a regional metamorphism related to intrusives of the Sierra Nevada batholith, which underlie a large portion of the Pine Nut Range (i.e., Mt. Siegel) and 2) a local hydrothermal stage which is apparently confined to the prospect area and is related to either a late differentiate of the Sierra Nevada pluton or another, younger intrusive.

The regional metamorphism is well expressed in the limestone units by considerable recrystallization and also by the development of tactite zones in limey units of the Alpine formation and along the base of the Divide limestone. Tremolite and another acicular mineral (actinolite?) are also widely disseminated in the Divide and Ridge limestones. In the volcanic units, particularly in the Alpine formation, there is general chloritization and more or less silicification and biotitization, together with disseminated pyrite, pyrrhotite and a little magnetite and chalcopyrite. Andalusite also occurs disseminated in an argillaceous schist phase of the Alpine in Hole PN-11.

This contact metamorphism and accompanying mineralization is widespread throughout the region. It has not been found to be economicall important at the Pine Nut prospect, but is significant at several iron-copper deposits east of the Pine Nut Range (U.S. Steel's Lyon deposit, Walker-Martel's Calico deposit and Standard Slag's Minnesota mine) and also at a prospect 12 miles north of the Pine Nut where U.S. Smelting Company is presently drilling.

The hydrothermal stage of alteration and accompanying mineralization by molybdenite is expressed at the Pine Nut prospect by (1) quartz-K-feldspar flooding in the igneous rock underlying the area around the south stock; (2) an aureole of sericitization and quartz veining which roughly corresponds in plan to the geochemical molybdenum anomaly in the Alpine formation; (3) argillization and sericitization in highly broken and faulted zones in igneous rock underlying the prospect area; and (4) thin calcite veining in brecciated and crackled zones in the Alpine formation and granitic rock. Silicification may have also developed during this stage, but as this feature is also regional, it is not possibl to tell its extent locally. It might not be great.

The quartz-K-feldspar flooding is chiefly in the quartz monzonite intrusive--at depth in Holes PN-3, 4, 8 and 9 and in the mantle rock over

a small area near the collar of PN-3. The "flooding" is not a profound feature and rarely makes up more than a few percent of the rock in any one section. More often it exists as envelopes extending two to four inches out from the walls of quartz veins. Only a minor amount of K-feldspar flooding was observed in the Alpine formation. However, at depths of 400 to 600 ft in Holes PN-4, 6, 7 and 10, most of the veins consist of quartz and K-feldspar, and commonly contain MoS_2 as well as pyrite and a little epidote. These coincide with the best grade of molybdenite mineralization in the Alpine, and, presumably, they are high temperature emanations from the nearby intrusives, and give way to lower temperature quartz veins (with less feldspar and less MoS_2) farther away from the intrusive. The better grade molybdenite, therefore, has a spacial relationship to the intrusive contact.

The sericitization at the Pine Nut exists mostly in the upper part of the Alpine formation in the Alpine and Cherokee sectors, and all of the diamond drill holes penetrate this zone from the surface down to a depth of about 200 ft. The rock is chiefly an original, soft, fine-grained tuff and/or shale without much silicification and is in contrast with siliceous biotite schist and siliceous hornfels below. Possibly some of the bleaching (as has been suggested by Schassberger) is due to supergene weathering of pyrite, but as the sericitization (as well as the anomalous molybdenum content) fades out on strike toward the northwest and southeast, it is likely that this alteration is related to the hydrothermal activity in the prospect area and was selective in the bleaching of the non-siliceous rocks.

As mentioned previously, there is a considerable amount of faulting, brecciation and crushing in the rocks at Pine Nut, and all of the drill holes encountered these difficult conditions in at least part of their penetrations. In holes PN-5 and 8, which are possibly on a fault that

separates the two segments of the South stock mineralization, the granitic rock ~~found at depth~~ is strongly sericitized and, at places, somewhat argillized. Also, at several places where siliceous Alpine formation was found to be crushed and broken, tiny calcite veinlets exist as thin, almost filmy deposits along cracks. Some of the fragments of the crushed rock are mineralized, so it is suggested that at least part of the faulting and brecciation occured after the emplacement of the quartz monzonite and the mineralization, and that late mineralization and alteration persisted for sometime afterward. This feature is not, of course, particularly unusual.

As implied above, the molybdenite mineralization is chiefly in quartz and quartz-K-feldspar veins in the altered intrusive and in nearby intruded Alpine formation. A little molybdenite is also disseminated in a few K-feldspar flooded zones. The veining is not particularly intense in either of the host rocks and more than 5 or 6 per foot is rare. They are mostly 1/8 to 1/2 in. wide, at random and although the MoS_2 is finely crystalline, it commonly exists in blebs and "slugs" as well as thin films along the outside edges of veins. In the Alpine formation, epidote is a common accessory and, rarely, a pink zoisite, probably thulite. These were not found in the intrusive, apparently indicating an outward migration of calcium. Pyrite exists in all the rocks and in some veins.

Scheelite is rare in the drill core and appears to have no association with the molybdenum. However, it occurs widely in tactite deposits of the area and is thought to be related to the regional metamorphism rather than to the later hydrothermal-molybdenite stage. As much as .2% copper may occur in a few 10-ft sections, but analyses of composite samples from holes PN-3 and 4 show only 0.05 to .06 percent Cu. The copper occurs mostly as rare chalcopyrite blebs in veins.

Oxidation

During the drilling operations, the water table was found ~~at an elevation of 6000 to 6200 ft, and it was intercepted in most holes at~~ at depths ranging from 170 to 210 ft. Oxidation has penetrated to this depth, and molybdenite, as well as pyrite, is rare in this zone. As there is also not much oxide molybdenum--rarely more than 200-300 ppm Mo, even though as much as 0.20% MoS_2 may underlie the oxide zone--~~it has been speculated that~~ leaching may have removed a former greater amount. In order to investigate this possibility, a laboratory study of the effects of water table, rock types and pH has been started on samples of the Pine Nut rock and mineralization. The results will be reported by the geochemical research group, at a later time.

Geochemical Prospecting (21)

The previously-done detailed geochemical sampling at Pine Nut which delineated the molybdenum anomalies around the south stock and at the Cherokee, is shown on Plate V. To it has been added the results of a few other samples taken this year, all of which show that the anomalies are entirely confined to non-limestone portions of the Alpine formation and to the south stock. Apparently, the limestone was not a favorable host to the molybdenum mineralization and, furthermore, it maintains a high pH which is not conducive to the holding of any migrating molybdenum in its soil.

In 1966, the sampling was expanded by a grid along new claim lines to the north and northwest, part of which area is underlain by Alpine formation. Also, a few lines were sampled to the south of the prospect ~~area~~. The results are on Plate IV. No strong anomalies were found, but a weak one with a maximum of 32 ppm Mo and 160 ppm Cu was detected at a group of quartz monzonite dikes in the Divide East sector. Rotary drilling to depths of 145 and 260 ft in two holes found considerable pyrite at places ~~only~~ and a maximum of 32 ppm Mo and 480 ppm Cu (see

Figure 2).

Plate IV also shows the results of soil samples taken across the Buffalo formation a mile west of the Alpine Mill sector. The formation dips to the southwest, so about 1500 ft of stratigraphic section is represented in the 2800-ft traverse. As much as 12ppm Mo and 60ppm Cu were found in the soil over this [illegible] lightly chloritized and pyritized pyroclastic unit, but no important mineralization is indicated. A few rhyolitic sills exist in the underlying Red Hill formation; these contain as much as 12ppm Mo also, and perhaps they are responsible for the "breath" of molybdenum in the Buffalo.

center-Caps 1st order heading)

(23)

05/19/66

Geophysical Surveys

A reconnaissance ground magnetic survey was made over the Pine Nut prospect in June, 1966, using the portable Jaylander magnetometer from the Denver office. The results, contoured on a 100-gamma interval, are plotted on Plate III.

In general, the northwesterly grain of the country is reflected, but this is crossed by a north-trending, low order "high" along the line between sections 23 and 24 (T12N, R24E). This might indicate an intrusive body at a relatively shallow depth. A few dikes have been mapped near the center of this "high".

Another small but sharp "high" of more than 500 gammas exists in the northwest part of the surveyed area, and it trends roughly with the strike of bedding near the top of the Alpine formation. The source is possibly a small body of iron-rich material, probably magnetite or pyrrhotite, which are not uncommon in the region. The anomaly is on private land, and its small size is discouraging toward any exploration by AMAX.

The "low" that exists in the center of section 25 and trends northwest is just east of our drilling area. Although not completely delineated on the north and east, it apparently indicates a zone somewhat lower in iron than to the west where we have drilled. It might be due to alteration; it is coincident with faulting.

A brief I.P. and resistivity survey was made at the Pine Nut prospect in August, 1966, at which time three lines, 19-20N, 27N and 31N were run on 400-foot electrode spacings; line 19-20N was also run on 200-foot spacings. The results have been presented in a McPhar report (Hallof, 1966).

Several anomalous zones were found, the most definite of which is on line 31N at 14E and appears to extend south and north. According to Hallof (1966, p.3) the anomalous pattern

suggests a relatively narrow (less than 400 feet) tabular source as much as 400 to 600 feet in depth. This anomaly as well as the ones at 16E on line 27N and 14E on line 19-20N are coincident with the magnetic low mentioned above and with the postulated Pine Nut area fault.

Other weak anomalies found on the lines to the west are coincident with the top and the bottom of the Divide limestone where there is usually a little skarn and sulfide. They are not considered important. The rather low sulfide content of the rock in and around drill holes PN-4 and PN-3 is apparently reflected by weak anomalies.

Drilling Results

During 1966 a total of 4,897 feet of diamond drilling was completed in ten holes and 1,095 feet of dry rotary drilling in seven holes. This work, as well as the rotary drilling in PN-1 and 2 for claim validation purposes in 1964, is shown in Table 2.

TABLE 2 -

PINE NUT PROJECT DRILLING

DIAMOND DRILLING

Hole	Coordinates	From	To	Feet
PN-3	20.4N, 2.5E	0	496	496
PN-4	31.2N, 5.1E	0	607	607
PN-5	27.0N, 1.2E	0	324	324
PN-6	34.4N, 7.2E	0	550	550
PN-7	35.0N, 3.1E	0	622	622
PN-8	27.0N, 4.4E	170	452	282
PN-9	30.9N, 8.1E	170	626	456
PN-10	38.8N, 7.4E	75	547	472
PN-11	10.7N, 1.8E	0	497	497
PN-12	47.1N, 6. E	0	591	591
		TOTAL		4,897

TABLE 2 (Cont'd)

ROTARY DRILLING

Hole	Coordinates	Depth (feet)
PN-1	52.2N, 2.2E	140
PN-2	52.3N, 6.9E	76
PR-1	67.0N, 9.0W	145
PR-2	70.0N, 13.5W	260
PN-8 (PR-3)	27.0N, 414E	170
PR-4	27.0N, 7.9E	85
PN-9 (PR-5)	30.9N, 8.1E	170
PR-6	30.9N, 1.0E	190
PN-10 (PR-7)	38.8N, 7.4E	75
	Total PN 1 & 2	216
	Total 1966 Rotary	1095
	Total Rotary	1311 feet

All of the core and cuttings were split and analyzed for molybdenum except in hole PN-11 where intermittant splits were taken. The results of the analyses and averages appear on the section maps (sections measured by north coordinates) on which the major geologic features are also shown.

In the drilling, hole PN-3 was collared in section 20N on the south stock outcrop, and holes PN-4 through 10 were then drilled from 700 to 1900 feet to the north on section 27N (PN-5 and PN-8), 31N (PN-4 and PN-9), Section 35N (PN-6 and PN-7) and Section 39 (PN-10). Hole PN-11 is in section 11, about 1000 feet south of the south stock, and PN-12 is in section 47N, about 600 feet southeast of the Cherokee.

The top of the south stock intrusive was intersected in section 27N at depths of 150 to 170 feet and in section 31N at 356 to 485 feet, but it was not found in 35N down to a depth of 622 feet in PN-7 nor in 39N to a depth of 547 ft. It was also not found to the south of PN-11 (in fact that hole displays very little alteration) nor in mine workings to the west, so it is evident that the south stock slopes downward on at least three sides. There is no information

~~on its attitude toward the east except that it probably is down dropped by faulting.~~

Other than in hole PN-11, which had only a little molybdenite in skarn at 89 ft, all of the holes ~~had at least some~~ intersected molybdenite in hydrothermal veins below the oxide zone. Several intersections of plus 0.20% were made in each of holes PN-3, 4, 6, 7 and 9, but as these better grade sections are not persistent between holes, it is not possible to delineate any zones of this grade. In the overall analyses, however, there does appear to be correlation of fairly thick, low grade intersections in holes PN-4, 9, 6 and 7 to form a continuous zone. It is 190 to 410 ft thick, lies beneath 180 to 280 ft of overburden and ranges in average grade from 0.11 to 0.17% MoS_2. This is indicated as follows:

	Hole	From	To	Feet	%MoS_2
Section 31 N	PN-4	280	470	190	.170
Section 31N	PN-9	190	600	410	.124
Section 35 N	PN-6	250	550	300	.128
Section 35 N	PN=7	180	380	200	.112
	Average	225 ~~500~~		275	.131

The zone is closed on the north and south by the low grade holes PN-10, PN10, 5 and 8 and it probably pinches out toward the west. ~~However~~ If this zone, ~~if it~~ maintains an average thickness of 275 ft under an area of, say, 600 x 650 ft, it would have a potential of 8 to 9 million tons averaging about 0.13% MoS_2. ~~Unfortunately this is not the case~~ A major fault exists to the east, but as this structure might be pre-intrusive and consequently pre-mineral in age, the mineralization is considered open in that direction

Wm Carlton

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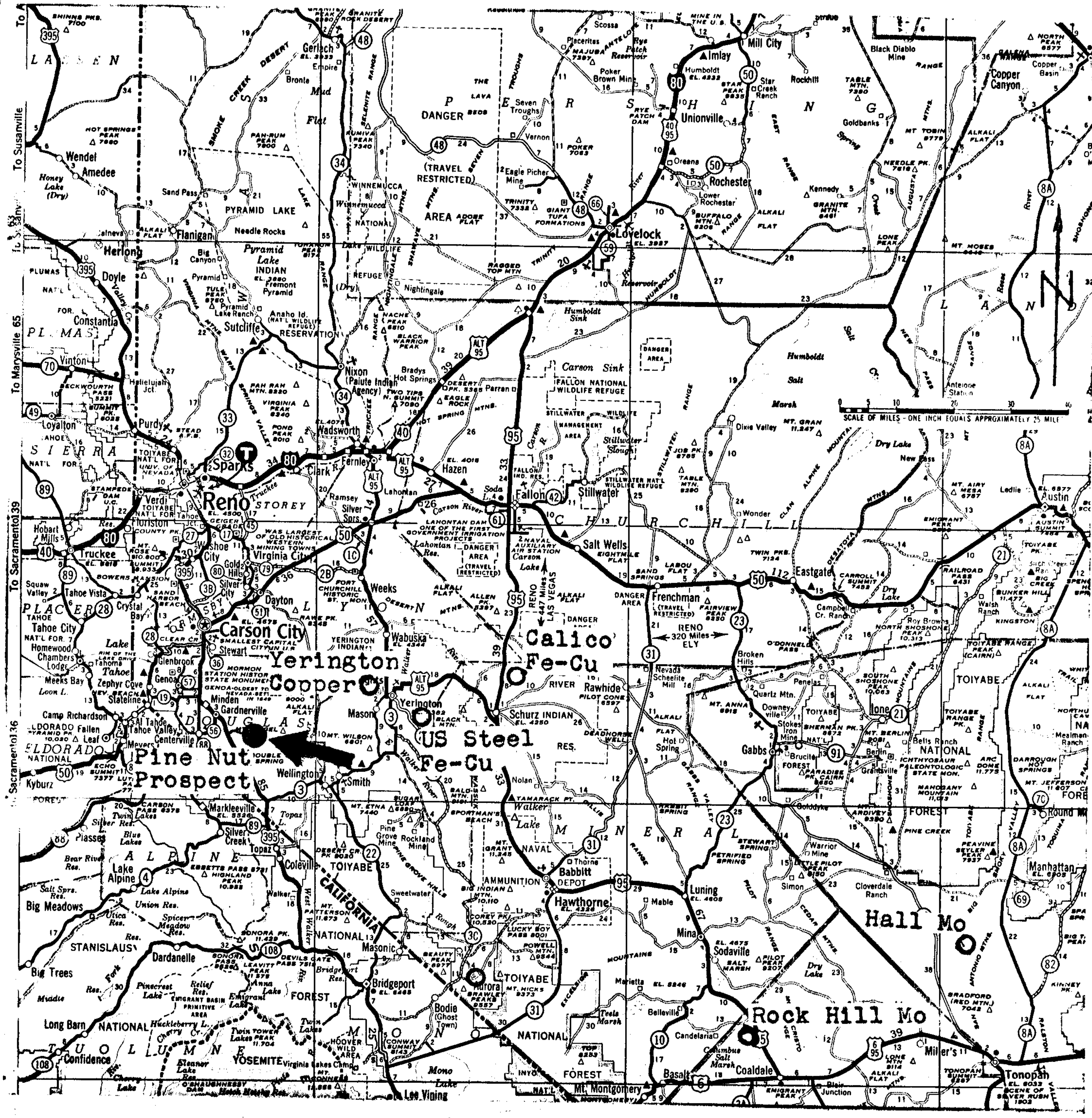

Figure 1. Road map of west central Nevada showing location of the Pine Nut prospect.

December 9, 1965
January 4, 1966 Ward Carithers (23)

PINE NUT MOLYBDENUM PROSPECT, 1965 (18)
DOUGLAS COUNTY, NEVADA (19)

SUMMARY (17)

The principal feature of exploration interest at the Pine Nut prospect is a fairly strong geochemical molybdenum anomaly which occurs in soil over an alteration zone in and adjacent to a small granitic intrusion called the "south stock". This anomaly is in two segments: one is coincidental with quartz veining and sericitization in the stock and in adjacent intruded rock of volcanic origin; the other, about 400 ~~feet~~ to the north, overlies quartz-veined and sericitized tuffaceous rock in which there are two or more narrow rhyolitic dikes. In both areas, each of which measures about 300 by 600 ~~feet~~, the soil contains from 200 to 700 ppm Mo and averages more than 300 ppm Mo; samples of the granite rock contain as much as 960 ppm Mo. The pH of the soil, reflecting a lime content, ranges from 6.5 to 9.0 and averages about 7.5.

No molybdenum mineral has been observed; the ~~Mo~~ molybdenum probably exists in the surface rock as an oxide obscured by a moderate to strong iron-oxide stain. Surface leaching has destroyed a former sulfide content of the rocks as evidenced by pyrite casts and pseudomorphs of limonite after pyrite, so it is possible that MoS_2 existed at one time.

The mineralized rock of volcanic origin, now locally metamorphosed to sericite schist, is a tuffaceous member of a thick series of limey volcanics, mostly pyroclastics, and limestones. These sediments dip eastward and westward away from the prospect and appear to be domed over the intrusive and area of mineralization. The anomaly is, therefore, in the lowest exposed horizon of the sedimentary group. Also, it is just a few feet stratigraphically below a 10-foot tactized limestone bed which is mineralized at places ~~by~~ with scheelite.

Geochemical prospecting has been carried on in the general Pine Nut region by stream sediment sampling and in the prospect area by extending a soil sample grid for about a mile over the area of interest. The anomaly at the south stock is obviously the most important one found. However, another small, less-altered intrusive exists about 3,000 feet north and a weak molybdenum halo of 100 to 120 ppm Mo occurs in overlying soil. Two shallow drill holes, put down in 1964, did not find interesting mineralization so no further work is planned there.

The south stock and accompanying mineralization lie within claims held by Alpine Mining Company and claims staked by AMAX. An agreement has been reached with Alpine, and an option agreement for their property is expected to be completed in January, 1966. Part of Alpine's claims and also a small part of the molybdenum anomaly is on property where the surface rights are privately held by others. The mineralization can be tested initially without being on this ground but in the event an ore discovery is made, a deal for the surface rights or an easement will required.

CONCLUSIONS

The molybdenum geochemical anomaly at the south stock of the Pine Nut prospect is a rather impressive one, particularly as it is coincidental with a zone of quartz veining and sericitization around an intrusive granitic stock. Furthermore, the two segments of the anomaly each cover sizeable areas, and if they are reflecting an underlying intrusive at a relatively shallow depth, a large tonnage potential may be present.

As the surface leaching at Pine Nut was apparently accomplished by alkaline water which would tend to remove molybdenum, it may be expected that the molybdenum content of the rock will be greater below the water table than above it. If it is, say, two or three times the average of surface specimens of granitic rock (636 ppm Mo) or five times

the average of overlying soil (312-325 ppm Mo), the grade would amount to .15 to .20 percent Mo (plus .25% MoS_2) and thus have commercial potentialities. The prospect is, therefore, considered worthy of at least two drill holes to test for these potentials.

RECOMMENDATIONS (23)

Owing to the climate, drilling can not normally be carried on efficiently at the Pine Nut until late March or April. It is, therefore, proposed that we move one diamond drill onto the property on or about April first, 1966. The first hole will be put down vertically in the southern segment of the anomaly at the edge of the granitic intrusive. This hole, marked "Z" on Plate III, should have a minimum depth of 500 feet. The second hole will be put down in the northern segment of the anomaly at about point "X" on Plate III. An effort should be made to reach the possible underlying intrusive, in which case, the hole may go as deep as 1,000 feet.

Concurrently with the start of drilling on the project (or before, if weather permits), we should amend a few of the AMAX claims so as to cover any possible "open" fractions.

It is estimated that an expenditure of $17,000 will be required on the project for the initial test as follows:

Labor and fringe benefits (3 months)	$1,500
Travel	700
Drilling 1500 ft. @ $7/ft.	10,500
Bulldozer work	200
Property payment	2,400
Option, misc. charges	700
Equipment operation	400
Assaying	400
Misc. charges (telephone, insurance, etc.)	200
TOTAL	$17,000

INTRODUCTION

The anomalous amount of molybdenum in the soil and rock near the old tungsten mines of the Pine Nut district was first recognized in late 1963. During the following year, eleven claims were staked by AMAX to cover open ground adjacent to Alpine Mining Company, who hold the most interesting property, and negotiations were opened with this Company for an option. During the summer of 1964, the prospect area was geologically mapped. This early work is covered by the following:

1. Ward Carithers report, November 27, 1963, Pine Nut Molybdenum prospect,
2. Ward Carithers memorandum, March 24, 1964 re Pine Nut claim staking and property situation,
3. E. M. P. Lovejoy and Fred Barnard report, July 24, 1964, Geology of the Pine Nut molybdenum prospect area.
4. Ward Carithers memorandum, October 14, 1964, Pine Nut Molybdenum prospect--Geochemical Surveys.

During the early spring of 1965, a grid was extended over the entire prospect area and geochemical soil and rock samples were taken at 100-and 200-foot intervals. This later work, as well as the entire project, is reviewed in this report.

LOCATION AND PHYSICAL FEATURES

The Pine Nut prospect is situated in the western foothills of the Pine Nut Mountains, about 10 airline miles southeast of the town of Gardenerville, Douglas County, Nevada. The district is easily accessible by a secondary road which branches from State Highway 395, 2.3 miles south of Gardenerville and leads 10 miles east and south into the area of interest.

Altitudes range from about 6,000 to 6,400 feet. Locally within the prospect area, the hills are rolling and relief is not great. However, a hill just west rises steeply to more than 7,000 feet and

Mt. Siegel, 3½ miles east, rises ruggedly to 9,450 feet (see Plate I).

The climate of the region is typical of western Nevada with pleasant dry summers and cool winters. Precipitation amounts to about 10 inches annually. Snowstorms generally occur throughout the winter but snow rarely exceeds a foot or two in depth. Much of the district is covered by a growth of piñon pine and juniper.

The area is drained by Pine Nut Creek, a north-flowing stream of about 1 or 2 cubic feet per second during late summer months. Dangberg Land and Livestock Co. holds the water rights on this stream, along with a considerable amount of the land in the area.

PROPERTY AND OWNERSHIP

As shown on Plate III, the anomalous area on and near the south stock is within claims held by Alpine Mining Co. and AMAX. Alpine is a California Corporation with which we have reached an agreement for an option, and a contract is expected to be executed by January, 1966. It gives AMAX (actually, Climax Molybdenum Company of Michigan) a 7-year option calling for annual payments of $2,400 for four years, then annual payments of $35,000, $35,200 and $60,000, making a total price of $139,800. In addition to these nine unpatented lode claims and one placer claim, the property includes the Divide group of two unpatented lode claims and two fractions which are a mile from the area of interest and hold no known exploration opportunity.

Some of the Alpine property overlaps privately owned ground, and, as shown on Plate IV, a small part of an anomaly does also. Most of this ground is "State selection land"--that is, land granted to the State of Nevada by the United States and later sold by the State. The sale of such lands were made subject to the reservation of all minerals to the U.S., and until recently, these mineral rights have been open to location under the mining laws. Within the last 3 or 4 years, this

situation has changed, for the U.S. has disclaimed their interest in the mineral rights and the question as to who now holds the minerals was referred to the courts by the Nevada Legislature. At any rate, these Alpine claims were staked in the 1930's prior to the enactment of the new rules so they ought to still hold the mineral rights. It will be possible to test the ground with the two initial holes without getting on the surface of the "State selection land". If we then find ore and decide on an expanded program, an option or an easement should be acquired. Also, Nevada law provides that private lands may sometimes be taken by condemnation for mining purposes, and we might consider that route.

GEOLOGY

The stratigraphic section at the Pine Nut prospect consists of a group at least 4,000 feet thick of limestones and volcanic clastics of Triassic and/or Jurassic age (see Plate II). The lowest exposed member of this series, the Alpine formation, is intruded by two stocks of quartz monzonite (?) which are barely deroofed; the important geochemical molybdenum anomaly of the prospect is associated with one of these intrusions.

The Alpine formation is chiefly coarse-grained tuff of about andesite original composition, but it includes thin units of volcanic breccia, agglomerate and argillite. About 200 feet is exposed in the prospect area. One 10-foot limestone bed is near the top of the formation and possibly others are elsewhere in the section. The tuff is normally dark grey to grey-green in color, but it is considerably sericitized near the intrusion where it is light grey in color and stained brown at places by iron oxide. The upper limestone bed is buff to grey in color and is partly replaced by silica and tactite. It has been extensively prospected and was mined at two places for scheelite. The grade was reportedly 1 to 2% WO_3 in narrow shoots.

The Alpine formation is overlain in the prospect area by about 1,200 feet of grey, medium to thin-bedded limestone intercalated with thin tuffaceous layers. This formation, called the Divide Limestone crops out boldly on a steep hill west of the prospect. Still farther west, the Divide limestone is overlain successively by about 1,150 feet of a limey pyroclastic unit called the Red Hill formation, about 300 feet of another limestone unit and then at least 1,000 feet of tuffaceous shales and mudstones.

In addition to the two quartz monzonite stocks that intrude the Alpine formation, there are several felsitic dikes and sills which are rhyolitic in composition. One of these, about 5 feet thick, is in the pit area of the prospect (30N, 3E on Plate II) and float or mantle rock from other dikes occurs elsewhere throughout the area. Several sill-like masses of felsitic intrusions 10 to 20 feet thick occur in limestone 2,200 feet west of the prospect and also at the Divide mine a mile to the northwest. At the latter place, they are spacially related to tremolitization and mineralization by scheelite; it is not known if they are also genetically related.

The north and south stocks, which are barely exposed on surface, show moderate to strong hydrothermal alteration, and they consist chiefly of quartz, cloudy to completely altered feldspar, and sericite. Phenocrysts are rare; quartz veining is moderate to intense with veins from a fraction of an inch to 1 inch constituting as much as 50 or 60 percent of the rock. Black biotite, probably secondary, occurs fairly abundantly in the north stock, but rarely in the south stock, and in general, the north stock appears much less altered than the south stock. This is true in the intruded tuffaceous rock as well. At the north stock, a sericitic alteration halo is about 100 to 200 feet wide around the intrusive; but at the south stock, the sericite zone is 500 feet wide and extends for at least 1,000 feet northward from the stock.

Much of this area coincides with the geochemical molybdenum anomaly, and it is speculated that it might be underlain by the granitic stock at a relatively shallow depth.

The main structural feature at the Pine Nut appears to be an anticline which is domed over the two stocks. This is suggested on Plate II by the Divide Limestone which dips southwestward on the west side of the prospect area and northeastward on the east side. Also on the east side, the older rocks may be down-dropped by a major north-trending fault obscured by late gravels. The doming over the south stock is suggested by the limestone bed in the upper Alpine formation which appears to partly curve around the stock and the geochemical anomaly. However, the structure is not as simple as this; there are several places where the beds are much distorted and faulted, and a lack of outcrops precludes unravelling the details at the present time. It does appear that the lowest exposed unit of the sedimentary sequence is coincidental with the geochemical anomaly.

GEOCHEMICAL PROSPECTING

Since ~~first recognizing~~ was first recognized the geochemical anomaly at the Pine Nut prospect in 1963, reconnaissance stream sediment and soil and rock sampling have been done over the general area. The results in the Pine Nut vicinity are shown on Plate I. Small amounts of molybdenum--as much as 9 ppm -- were detected only in the drainages immediately around the prospect area and not generally, so it appears that the molybdenum mineralization may be restricted to a relatively small area in and around the intrusive stocks.

Plate II shows the geochemical soil sampling (as well as geology) over and between the two stocks. As indicated, only a small low order (100 ppm Mo) anomaly was detected over the north stock, but a sizable area containing two segments of plus 100 ppm Mo in soil was found on and adjacent to the south stock. Plate III shows this anomalous area on

100-scale and includes the results of rock sampling and pH measurements as well as soil samples.

The two segments of the soil anomaly are about equal in size and also equal in intensity. The southern segment, which is associated with the granitic stock, averages 269 ppm Mo within the 100 ppm contour, and, probably more isgnificantly, 312 ppm within the 200 ppm contour; the northern segment averages 251 ppm Mo within the 100 ppm contour, and 325 ppm Mo within the 200 ppm contour. In rock samples, the greatest amount of molybdenum was found in the quartz-veined intrusive of the south stock. Analyses of five samples range from 320 to 960 and average 636 ppm Mo. The molybdenum content of the tuffaceous rock appears to be in proportion ~~with~~ to the intensity of sericitization--which is not unexpected. Green, weakly altered rock contains 8 to 20 ppm Mo, while iron stained, fractured sericite schist contains as much as 400 ppm Mo. Thirty rock samples taken from the north segment averaged 114 ppm Mo.

For some reason, the molybdenum values in soil are quite low over the southern part of the south stock. ~~Possibly~~ This may be due to a greater depth of soil here rather than to less molybdenum in the underlying rock. The soil is thin in the more anomalous areas, but in this sector of low values, much less granitic rock appears in the mantle rock and there might be dilution by hillside wash.

The copper analyses taken over the south stock and in a few samples in the north segment range from 12 to 640 ppm Cu. They are not particularly inpressive in themselves, but roughly follow the molybdenum in value. Tungsten is present but was not analyzed . A couple of small oreshoots were mined in the tactized limestone bed west of the old mill at one time, and another small highgrade lens was taken from the pit 1200 feet north of the mill. The edge of the molybdenum anomaly overlies the pit area, but other than this coincidence, there seems to be no spacial relatic between the molybdenum and the tungsten.

Four samples--three from the south stock and one from the north stock==have been analyzed for trace elements with the following results:

TRACE ELEMENT ANALYTICAL RESULTS IN PARTS PER MILLION (4)

	14741	21393	21394	15482
Mo	600-700	960	560-660	360
Cu	140-280	90	400	200
Rb	230	170	110	240
Sn	10	20	30	40
Ba	800	2500	2500	4500
Sr	125	200	400	900
Zn	17	n.d.	n.d.	n.d.
Mn	140	200	350	600
Ni	12	15	nil	10
Mg	n.d.	3500	5000	11000

14741: qtz-vn'd intrusive of south stock.
21393: qtz-vn'd intrusive of south stock
21394: qtz-vn'd intrusive of south stock
15482: qtz, monzonite (?) of north stock w/biotite

Sn, Zn, Mn, Ni, Ba, Sr, and Mg by spectrographic analysis.
Mo and Cu by colorimetric methods
Rb by X-ray fluorescence
n.d. = not determined

With the exception of sample 14741, the analyses show a relatively high Ba and Sr content and a low Rb and Sn which is not a ratio usually associated with significant molybdenum deposits. On the other hand, in sample 14741 this adverse ratio is not so great. It does not, of course, approach the high Rb-Sn and low Ba-Sr ratios at Climax or at Urad, but it is not dissimilar to analyses of intrusives at the Hall, Questa and Endako molybdenum deposits.

POSSIBILITIES (2)

The most favorable feature of the Pine Nut prospect is, of course, the geochemical molybdenum anomaly in the south stock area. The origin of this is admittedly not known, but there appears to be at least three possibilities.

1. The anomaly is simply a reflection of a partly leached molybdenite deposit which occurs in and around a granitic stock. Hopefully, the stock underlies the entire anomalous area and is mineralized well enough to be of ore grade. This concept is supported by

the fact that the alteration and quartz veining are coincidental with the anomaly. Also, the general high pH of the soil and rock lends support to the idea that the surface rock and soil may contain less molybdenum than the rock beneath.

2. The two segments of the molybdenum anomaly are each the result of molybdenum having been leached from small tungsten-molybdenum deposits in tactite and having become fixed in pyritized granitic rock and sericite schist which lies stratigraphically and topographically below. This concept is in agreement with the coincidence of alteration and the anomaly, but it appears that the pH of most samples is much too alkaline for the fixing of the high values obtained for molybdenum in soil and rock.

3. As the molybdenum anomaly appears to be in a single stratigraphic horizon that is barely exposed, it might be suspected that the Mo exists syngenetically in the tuff. If so, alkaline water from the limey environment might mobilize the molybdenum, which would become fixed at the surface of the pyritized igneous stock. This concept is not in accordance with the fact that the altered zone is coincident with the anomaly and the intrusive; it cannot be considered very seriously.

In late 1965, a suite of samples was taken from Pine Nut by John Hansuld for research. His study, now underway, may throw light on this unusual anomaly in an alkaline environment.

The possibilities at Pine Nut can be easily tested by simply putting down two drill holes. One hole should go down vertically at about point Z (Plate III) at the edge of the granitic stock. It would enter the igneous rock at a shallow depth and would probably be drilled to a depth of at least 500 feet. The water table is likely at a depth of 100 to 150 feet. The second hole would go down at about point X (Plate III) in the middle of the northern segment of the anomaly. It would hopefully intersect the granitic rock at depth and we should

expect it to go to a minimum depth of 1,000 feet.

Ward Carithers

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Item 1

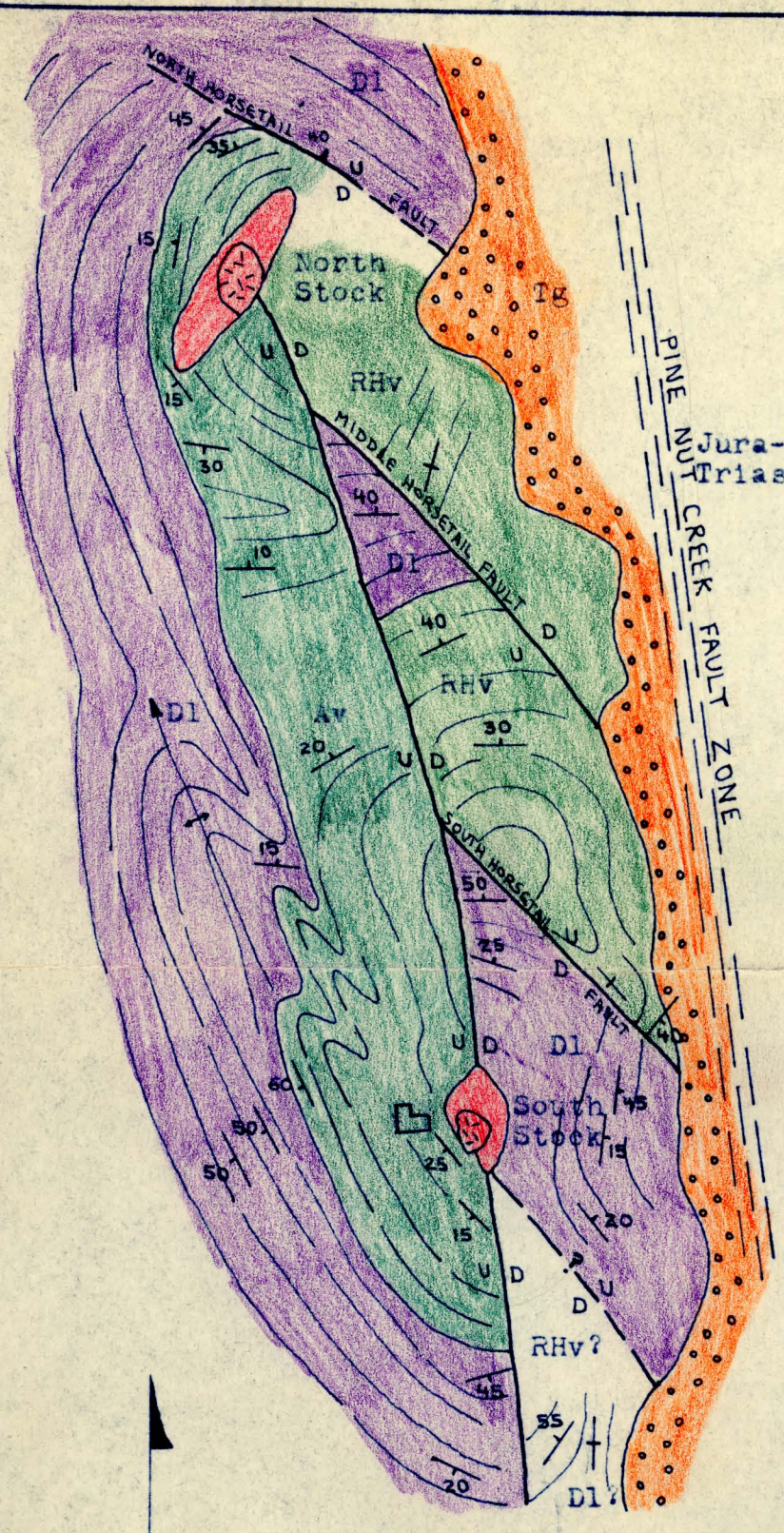

FIGURE 2

AMERICAN METAL CLIMAX, INC. EXPLORATION-DENVER	
SKETCH GEOLOGIC MAP OF THE ALPINE DOME	
SCALE	1 inch = 666 feet
BY	Earl M.P. Lovejoy & Fred Barnard
TO ACCOMPANY	Pine Nut Molybdenum Report 7/64