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RECONNAISSANCE GEOLOGY

of the

PINE NUT MOUNTAINS, NEVADA

Robert L. Christiansen

Utah Construction Company
October, 1957

FORM U. C. 102 REV. 9-30-52

INTER-OFFICE CORRESPONDENCE

TO: Weston Bourret

DATE: November 18, 1957

FROM: R. L. Christiansen

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SUBJECT: Iron - Nevada - Pine Nut Mountains reconnaissance

REFERENCE: Enclosed Report

Dear Mr. Bourret:

Enclosed is my report "Reconnaissance Geology of the Pine Nut Mountains, Nevada." It covers the work on which I was engaged with the assistance of Peter Dunn from mid-June to mid-September 1957.

The area described extends generally southward from the Dayton iron deposit for about 40 miles. The work did not include any systematic prospecting. It was rather an attempt to set up in a previously unmapped area a usable framework that would serve as a basis for prospecting for iron deposits by surface and geophysical means.

A number of areas are mentioned as suitable for iron exploration, especially in the event the company wishes to develop its Dayton property. Specific recommendations are included in the report.

Respectfully submitted,

Robert L. Christiansen

Robert L. Christiansen

RLC:md

Enclosure

C O N T E N T S

I L L U S T R A T I O N S

P L A T E S

F I G U R E S

SUMMARY

The Pine Nut Mountains, southeast of Carson City, Nevada, are a west-tilted fault block with a core of folded lower Mesozoic metamorphic rocks intruded by an upper Mesozoic granitic batholith. They are partly capped by Cenozoic volcanic rocks and lacustrine sediments.

Large and small bodies of massive iron ore minerals are widely distributed and of two types. One group is associated with the contacts of granitic intrusive masses, and the other comprises open space vein fillings.

Two groups of iron prospects are recommended for ground magnetometer (or at least dip needle) surveys: the McTarnahan group and the Wellington prospect. A more extensive magnetic survey for an area south and southeast of the McTarnahan prospects is also recommended. In this area a long contact of the granitic batholith is buried by poorly consolidated Tertiary sediments. An area about 7 miles by 3 miles should certainly be examined, at least by a series of reconnaissance ground magnetometer traverses. If costs could be minimized, an area 20 miles by 5 miles along this contact should be flown with an airborne magnetometer.

Additional possibilities for open-pit mining operations in the area would include tungsten, gypsum, and bentonite. These might be profitable if the company were to begin mining its Dayton iron deposit or some other of the iron deposits of the region. The bentonite might be especially valuable if a pelletizing operation is started for the iron ores.

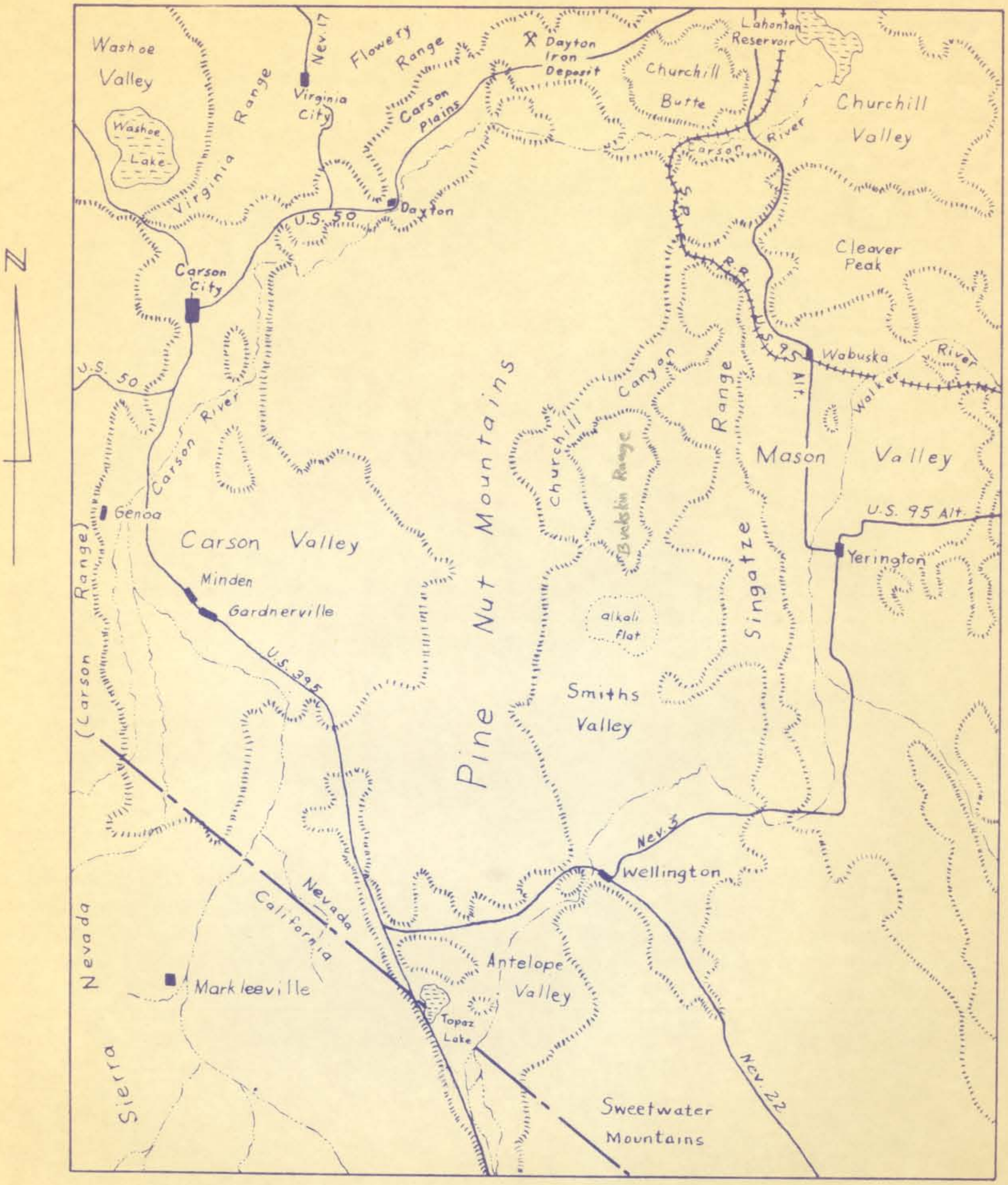
INTRODUCTION

General Information

The work on which this report is based was undertaken to determine the geologic potentialities for economic mineral deposits in the Pine Nut Mountains of west-central Nevada. That range is immediately east and southeast of Carson City and extends from U. S. Highway 50 south for about 40 miles to the town of Wellington, Nevada. Its maximum east-west width is about 20 miles (see figure 1). It is flanked on the west by Carson and Eagle Valleys, on the north by the narrow basins through which Highway 50 has been built, on the east by Churchill Canyon and Smith's Valley, and on the south by Antelope Valley. Its southwest corner is separated from the Sierra Nevada by only a low pass.

Good paved highways extend along the north, west, and south sides of these mountains, and another runs north-south about 20 miles east of them. Dirt roads passable by automobile lead into the range from the west, and many poor dirt roads throughout the range can be traversed with a jeep or pickup. The nearest rail transportation is a spur of the Southern Pacific line which comes in along the northeast corner of the range (see figure 1). It connects with the main line at Hazen, Nevada, 40 miles east of Reno.

The Pine Nut Mountains are a rather typical Great Basin range in appearance and geology. They have a steep eastern scarp rising from a partially alluvium-



Scale

0 5 10 15 20

Miles

Location Map for the
Pine Nut Mountains, Nevada

filled basin to a crest on the east edge of the range. Flanking this high spine (that rises to about 9,500 feet) is a belt of rugged country into which steep narrow canyons have been eroded. On the western side this terrain merges with a sloping belt of gentle relief that descends gradually to another alluviated basin, the Carson Valley.

The range has long been considered a "mineralized" area, and many small lead-silver and gold-silver lodes have been prospected in it. In the southern part of the range several of these produced small quantities of ore; in the north only one group of mines was operated to any significant extent, the Como district. None of these mines has been active in recent years. Small showings of copper are common throughout the range in small quartz veins and minor shear zones, but none of these has proved to be of value. Tungsten mineralization, on the other hand, is widespread and noteworthy; several tungsten mines have operated recently. Small magnetite and specularite bodies have also been known in the range but never studied.

In view of the proximity of this area of potential value for mineral deposits to the Dayton iron properties owned by Utah Construction Company, a regional geologic reconnaissance was undertaken to estimate more carefully the mineral possibilities of the region, with special reference to iron. The field work involved mostly mapping of large, fairly well defined units on 15 minute topographic quadrangle maps and cursory examination of many mineral properties. The results of the work are presented in a geologic map on the scale of 1/48,000 (4,000 feet to the inch) and this accompanying report.

Regional Geology

West-central Nevada is characterized by block faulted ranges in part covered by Cenozoic volcanic rocks, and deep adjacent basins partly filled with alluvium. The basement of the ranges is in most cases a more or less complex group of early Mesozoic, slightly metamorphosed geosynclinal rocks intruded by quartz-rich late Mesozoic granitic rocks. Smaller high level granitic intrusions of Tertiary age are also scattered throughout the region.

Bonanza type gold-silver deposits in the region generally occur in the Cenozoic volcanic rocks and are associated with hot spring activity that has continued to the present time (see, for example, Thompson, 1956). The large "porphyry copper" being mined by Anaconda at Yerington is associated with an altered granitic dike that intrudes the late Mesozoic batholith (Knopf, 1918). Tungsten mineralization is common in the contact metamorphic aureoles of the late Mesozoic granitic intrusions, and where the wall rocks are limey some minable deposits have been formed. Small iron deposits are also fairly common throughout the region, and some larger ones are mined (see Reeves, 1955). These also appear to be genetically related to the Mesozoic granitic intrusive rocks.

AREAL GEOLOGY OF THE PINE NUT MOUNTAINS

Pre-batholith Rocks

The oldest rocks of the Pine Nut Mountains are a group of sedimentary and volcanic rocks that had been tightly folded and regionally metamorphosed at very low grade before intrusion of the late Mesozoic batholith. Three rather distinct assemblages of rocks can be recognized, although they are not specifically shown on the map accompanying this report. One of these is a metaconglomerate-metagraywacke-slate-metachert (?) group; another is a quartzite-siltstone-argillite-limestone group; and the third is a group of greenstones derived from basaltic and andesitic flows and pyroclastic deposits. The relative ages and exact structural relations between these groups have not been accurately determined. For the purposes of this work these factors are of little importance except in so far as they affect the distribution of favorable host rocks for mineralization. This matter is discussed in the section on economic geology.

The age of these rocks is indicated, at least in part, by several fossil localities in the region, only two of which, however, are in the Pine Nut Mountains proper. Most of the fossils from these localities indicate a late Triassic age, some indicate an early Jurassic age (see Gianella, 1936; Knopf, 1918). Fossils from one locality found during this work have been identified by S. W. Muller (1957, personal communication) as upper Triassic. Thus it seems that these rocks are generally of early Mesozoic age, although it is possible that some of the metamorphosed rocks from which fossils are not known may be Paleozoic.

Three groups of metamorphic rocks are shown on the accompanying geologic map (Plate I), but the boundaries between them are in many cases only roughly located. The units shown are metavolcanic rocks, metasedimentary rocks, and limestone (including coarse-grained marbles and calc-silicate tactites). The areas shown are not all simple, well defined groups of these rocks but rather areas in which one type predominates. This was the only feasible sort of breakdown within the scope of this work.

Adjacent to the late Mesozoic granitic intrusive masses these older regionally metamorphosed rocks have been altered by a strong contact metamorphism. These effects are noticeable in all the wall and roof rocks near the contact. The contact metamorphic rocks include coarse-grained mica schists, pure white quartzites, coarse-grained marbles, and massive hornfelses. The contact effects are most prominent in limey country rocks. The minerals characteristically formed in such rocks are brownish-red garnets, epidote, orthoclase, calcite, and chlorite. Along with these minerals magnetite, scheelite, and a variety of ferriferous sulfides (pyrite, chalcopyrite, bornite) have been introduced. In some cases the granitic rocks too have been altered by the transformation of biotite and hornblende to chlorite, and the addition of epidote.

Mesozoic Intrusive Rocks

The core of the Pine Nut Mountains is a leucocratic granitic batholith. Rock types present in this intrusive mass range from true potash granite to quartz-free diorite. Only a few varieties within this range, however, have any significant areal extent. The most common rock type is an adamellite (quartz monzonite). It is leucocratic, quartz-rich, and characterized by an abundance of deep pink or purplish orthoclase feldspar. Next most common variety in the batholith is a porphyritic granite in which 1 to 1 1/2 inch white orthoclase crystals are abundant. This latter rock type occurs principally in the northwestern part of the batholith, i.e., the area around McTarnahan Hill and Prison Hill.

The age of this batholith has not been directly ascertained, but the intrusion is certainly linked with the Sierra Nevada composite batholith. Recent radioactive measurements on High Sierra granitic rocks indicates a Cretaceous age (Garniss Curtis, 1957, personal communication).

No particular association of mineral deposits with any one rock type within the batholith was noted during this work, and the granitic rocks have accordingly been mapped together. In any further work in this region, however, it might be wise to seek out such associations more carefully since they are known elsewhere in this general province (see, for example, Bateman, 1957) and would be of value in prospecting.

Cenozoic Volcanic Rocks

Roughly a quarter of the surface of the Pine Nut Mountains is underlain by volcanic rocks. These rocks include both volcanic flow units and pyroclastic deposits. The basal unit over a large part of the area is a compacted and commonly welded rhyolite tuff; locally it is several hundred feet thick. The most abundant rock type is andesite, which makes up the bulk of the volcanic section. Andesite flows occur along some of the highest crests and peaks of the range indicating that most or all of the range was once covered by them. Andesite breccias are also widespread and seem to have formed about simultaneously around various centers in the range. Some of the vents can be recognized now by plugs of columnar andesite surrounded by the coarse, poorly sorted breccias. Basalts, some of them with abundant olivine, are the latest members of the volcanic series.

Volcanic units can be easily recognized, especially in the north part of the range, that correspond to those mapped in the Virginia City quadrangle immediately north (Thompson, 1956). The age of the volcanic rocks in the Virginia City quad ranges from probably Oligocene to Recent, and the same ages are represented in the Pine Nut Mountains.

In comparison to some volcanic rocks of the ranges to the north, the corresponding rocks of the Pine Nut Mountains are relatively little altered. Some have been propylitized, but few show the effects of bleaching and clay formation that characterize the mineralized areas of the Comstock, Silver City, and Ramsey gold-silver districts of the Virginia and Flowery Ranges. Correspondingly, such rich vein deposits are not known in the Pine Nut Mountains.

Cenozoic Sedimentary Deposits

From the standpoint of this work perhaps the most important sedimentary deposits are a group of poorly consolidated tuffaceous shales and sands of probable late Tertiary (early Pliocene?) age. These are both underlain and overlain by andesites. Large areas of these sediments have been exposed by arid cycle erosion processes, and local pediments have been cut on their surfaces. The pediment gravels commonly hide these deposits and their critical contacts.

The stratigraphic position and lithologic character of these sediments indicate that they belong to the Truckee formation which has been mapped into the Virginia City quadrangle by Thompson (1956). The beds are commonly of moderate thickness (1 to 5 feet) and generally continuous over wide areas where exposed in canyons. The continuous nature of the bedding, good sorting, characteristically fine grain size, and general absence of cross bedding, current bedding, or erosion channels in these deposits indicate that much of the material is of lacustrine origin. There are, however, pebbly beds and local channels that indicate the existence of streams in these areas from time to time during formation of the deposits.

The Tertiary sediments were deposited on an irregular floor that had been previously block faulted and partly eroded. They overlie or interfinger with some of the andesites near the upper part of the volcanic column but also lie on metamorphic and granitic rocks in the west part of the range. Deformation was probably active before deposition of these lacustrine beds and continued along with volcanism during the time of their formation. The deposits are tuffaceous throughout their areal extent.

The thickness of these deposits could not be determined from the information gathered during this work. Their stratigraphic thickness is certainly at least several hundred feet, but the total depth of this material in the area on the west flank of the range may not be excessive since parts of the irregular floor on which the deposits were laid occur on the surface.

Smaller patches of conglomerates, sandstones, and shales occur within the Tertiary volcanic section at various horizons. On the map included with this report those that are mapped are shown by the same symbol as the thicker lacustrine deposits just described.

Overlying the Tertiary lake bed sediments and all but the most recent volcanic rocks is a thick accumulation of bouldery gravels. These gravels are unconsolidated and badly weathered, distinctly more so than the alluvium of the present erosional cycle. The stratigraphic position and degree of weathering of the gravels make it seem that their age would be late Tertiary or early Quaternary. Gold, both as fine dust and as nuggets, has been washed from these gravels in past years, but the shortage of water has hindered development of placers.

Basins adjacent to the range have been filled to great depths by Quaternary alluvium and some wind-blown sand.

GEOLOGIC STRUCTURE

Mountain Range Structure

In general perspective the Pine Nut Mountains display classic Basin Range structure. They are a tilted fault block uplifted most strongly along one edge (the eastern edge) and rotated in such a manner that strata which were essentially horizontal during the Tertiary period now dip gently or moderately west. Strata that previously had been tightly and vertically folded (i.e. the lower Mesozoic metamorphic rocks) now dip steeply or moderately eastward. The important result of this movement pattern in connection with mineral deposits exploration is the belt-like distribution of the various rock groups with which specific types of mineral deposits tend to be associated in the range. Thus the east edge of the range is underlain by granitic rocks that have been uplifted and unroofed; the west flank of the range is underlain by metamorphic wall rocks of this batholith; gently dipping Tertiary sediments overlie large parts of the west flank, covering much of the important granite-wall rock contact.

This simple picture is modified by the complicating but easily understood factors described in the two following sub-sections of this report.

Major Internal Structures of the Range

Two sets of faults dominate the structure of these mountains. One of them trends north-south and is exemplified by the boundary fault of the range, the fault along the east side of Pine Nut Valley, and the series of faults northwest of Pine Nut Valley. A second set of faults trends northeast-southwest and is exemplified by the Churchill Canyon fault, the fault that displaces the range front east of Oreana Peak, and the fault south of Mount Como. All of these faults have steep but undetermined dips.

On the accompanying geologic map (Plate I) these faults are somewhat generalized and many smaller faults with little displacement are not shown. In addition there are numerous folds in the Cenozoic rocks about north-south axes, but more individual attitude measurements would be necessary to show these completely.

Differential North-South Uplift

The southern end of the Pine Nut Mountains appears to have been uplifted farther and more deeply eroded than the northern end. This is indicated by the much thicker and areally more extensive cover of volcanic rocks on the northern end and, more importantly, by an apparently higher level of the Pine Nut batholith exposed in the northern areas. This seems to be shown in the McTarnahan Hill area by the complexly recurving contact of the batholith, the abundance of aplitic material (both as dikes and larger, irregular bodies), the numerous reentrants and pendants of roof and wall rocks, and perhaps by the more silicic character of the granitic rocks than to the south.

This concept may have a significant bearing on the matter of iron mineralization and is mentioned in the section on economic geology.

ECONOMIC GEOLOGY

Iron

Occurrences of iron oxide minerals are numerous in the Pine Nut Mountains and the surrounding region. They are generally closely associated with contacts between granitic and metamorphic rocks, but exceptions to this also exist. Presently known iron occurrences in the range are listed on the geologic map (Plate I). Descriptions of the more significant ones follow.

Dayton Iron District

The geology of the Dayton district (number 1 on Plate I) is discussed in two company reports by Atchley (1955a, b). Geology and origin of the iron deposits are discussed by Harder (1909), Butler (1945), and in a company report by Christensen and Hanson (1949). Tonnages, grade, and other economic factors bearing on the deposit are discussed by Christensen and Hanson and by Geehan (1949). Ore consists of magnetite bodies, apparently tabular in form, in chlorite schists, limestones, and quartzites adjacent to a granite mass. Associated minerals include pyrite, garnet, epidote, and chlorite. Harder and Butler each classed the orebodies as contact deposits, but Christensen and Hanson considered them to be tabular replacement bodies. Both interpretations are actually quite similar in meaning if not in exact terminology. In general, one can say the bodies are replacements in the wall rocks formed by late stage emanations from the granite magma and are localized in the contact aureole.

Carson River Area

About 2 miles directly west of Dayton, Nevada (number 5 on Plate I) is a group of thin parallel magnetite-apatite veins. They are typical fissure veins that have been re-opened and re-filled repeatedly. Long white apatite crystals have grown inward from the fissure walls and are perpendicular to those walls. The veins are small, averaging 2 to 4 feet across and about 50 feet in length. They crop out in a small ravine. Wall rock is metavolcanic greenstone exposed beneath the surrounding cover of rhyolite tuffs. Ore would probably have a high phosphorous content but possibly could be beneficiated to a grade suitable for marketing. Total reserves would be so small, however, as to be of little direct interest to the company.

In Brunswick Canyon there is a notable iron property (number 6 on Plate I). It is similar to the veins just described in that it is an open space filling. The body is tabular in form and has an average thickness of about 6 feet. It is essentially vertical and strikes north. The principal ore mineral is specular hematite, and it is admixed with apatite in fairly large crystals. Apatite content is, however, variable from place to place in the vein. The vein is a breccia filling in meta-dacite. In addition, specularite in the middle of the vein has replaced the breccia fragments as well as filled the spaces between them. As a result the vein is solid ore at its center. The vein is located on the west wall of Brunswick Canyon. It pinches out visibly on the south end, but the north end does not crop out. A rough estimation of the tonnage in this body down to creek level in Brunswick Canyon is about 290,000 tons.

The waste material has been stripped away from part of the orebody to a depth of about 40 feet and a loading chute built at the bottom of that excavation. Little ore has been actually shipped by the owner, Mr. Jack Ross of Carson City.

Peacock Copper Mine

Two abandoned shafts on the margin of a slightly altered granodiorite are owned by Peacock Copper Company (number 7 on Plate I). The wall rock is granodiorite with abundant chlorite and epidote. Magnetite, specularite, and chalcopyrite have been introduced with a vertical quartz vein, and at the surface have been partly oxidized to hematite and chrysocolla. Surrounding these shafts are several very small magnetite-chalcopyrite pods, both in the granodiorite and the metavolcanic wall rocks.

McTarnahan Prospects

In this report the iron deposits in the general area south of McTarnahan Hill are referred to as the McTarnahan prospects (numbers 8, 9, and 10 on Plate I). All of the prospects in this group are closely associated with the contact of a granite intrusive body with metasedimentary wall rocks. The central group is shown on a detailed geologic map (Plate II).

The deposits are quite similar to those in the Dayton district. They are generally elongate in plan and probably tabular in overall form. Their true extent and thickness are not directly observable because the area is somewhat obscured by alluvium and wind-blown sand. From surface observations it appears that there may be two sets of these tabular bodies, one about north-south and the other about east-west. Some are at least 6 to 8 feet thick, but most cannot be seen completely. The mineralogy of the orebodies and the associated rocks as well as their structure are similar to the situation at the Dayton deposit. A typical assemblage of contact metamorphic rocks has been intruded by a true granite and partly replaced, perhaps along fractures by massive magnetite bodies. Minor sulfides can be observed in a few areas and specularite in some. The bodies occur both in the metasedimentary wall rocks and the granite but are restricted to the contact zone. On the basis of the available information no tonnages could be estimated.

The area is about 10 miles from U. S. Highway 50 by the present dirt road in Brunswick Canyon; this road would have to be rebuilt to be used by ore trucks. The railroad is another 37 miles east on Highway 50.

Several claims, staked in the late summer of 1956, cover the area in which the magnetite is exposed. They are owned by three Carson City people, a Mr. Hagland, Mr. Dial, and Mrs. Forbush. A number of bulldozer excavations have been made around some of the outcrops (see Plate II).

Wellington Area

Two claims owned by Mr. James Compston of Wellington, Nevada (number 12 on Plate I) were examined by Frank Atchley, myself, and Peter Dunn and have been reported on by Atchley in two company memos (July 9, 1957 to W. B. Nelson and September 10, 1957 to Weston Bourret). Ore of beneficiation grade was collected from these claims; according to Atchley's September 10 memo samples showed 42 to 45 percent Fe and were beneficiated to 56 to 58 percent Fe at 65 mesh with 97 percent recovery. Cu, S, and P were well within limits, and insolubles were only 3 to 4 percent. Some magnesian minerals appear to be present in the ore.

The actual extent of the orebody cannot be accurately judged from surface information. It has a north-south strike and appears to dip gently or moderately east (45°?). The body is located at the top of a steep west-facing hillside, so it dips into the hill. Being on the crest of the ridge, the overburden should be small. It is a contact metamorphic band on the contact of an adamellite (quartz monzonite) intrusive mass with magnesium-bearing wall rocks. Contact metasomatism has produced copper sulfides, green biotite, garnet, epidote, etc. in nearby localities. The orebody appears to have formed in a magnesian limestone, but elsewhere on the same contact with limestones no iron occurs at the surface. It is, thus, difficult to extend the geologic potential for ore laterally. A few ground magnetometer traverses over the dipping body should serve to indicate whether the ore extends anywhere beyond its outcrop band.

Transportation from this orebody, were it developed, would present some problems. The final approach to the property is steep and at present is accessible only by jeep. A truck road would have to be graded about 4 miles to Nevada Highway 3. Only about half of it, however, would be difficult grading. The railroad at Wabuska would be about 45 miles by paved road from the point at which the highway was joined.

Minnesota Mine

This mine (number 15 on Plate I) is located about 20 miles northeast (west) of Yerington, Nevada. It was first operated for copper, but a large magnetite replacement in limestone was developed in 1917. The body was not actually exploited, however, until 1943. It is currently being operated in an open pit by Standard Slag Company, the ore being sold in Japan (Nevada State Journal, Reno, September 6, 1957, page 1).

During the work no study of the deposit could be made, but the bodies do occur in limestone. Their relation to any intrusive contact is not known, but Knopf's map of the Singatse Range to the southeast shows that large granitic bodies underlie much of the Tertiary volcanics that cap that range near the Minnesota mine.

Summary

The iron deposits of the Pine Nut region may be classed into two broad categories: (1) more or less irregular bodies closely associated with the contacts of granitic intrusive bodies; and (2) fissure fillings in metamorphic rocks. The deposits of the latter group (Iron Blossom, Carson River, Brunswick Canyon) are mostly small, isolated, and contain abundant apatite. Prospecting for them could not be very systematic and probably would not be profitable.

Bodies associated with the contacts of granitic masses are the largest orebodies in the region. They too, though, appear to be of different types. Some are simple pyrometasomatic ("contact metamorphic") deposits of characteristic sort formed by the granite magma at its contact during its emplacement. Such deposits (e.g. the Wellington prospect) lie very near the contact, are controlled by its attitude, and are highly dependent on the lithology of the wall rocks. Prospecting for them can be systematic and the results fairly easily interpreted. Others of the "contact" deposits are not of direct pyrometasomatic origin but are hydrothermal replacement bodies localized near the margins of the magma bodies that produced the ore-bearing fluids (e.g. the Dayton orebodies, the McTarnahan prospects, and (?) the Minnesota mine). They may be irregular in shape and may be controlled by fractures and lithologic contacts more than by the rock type of the replaced material. They are scattered about within localized areas.

It should be noted that two of the possibly most important iron orebodies of the region, the Dayton deposits and the McTarnahan prospects, are associated with extremely complex granite contacts where there are numerous reentrants of the older metamorphic rocks. They would seem to be at high levels of exposed granite intrusions.

Recommendations for Exploration

In view of the considerations summarized in the previous section, several areas may be set up as areas of potential for undeveloped iron orebodies.

(1) Seemingly the area of greatest promise would be in general along the western contact of the Pine Nut batholith. This area is especially noteworthy in this respect because it extends for a distance of about 30 miles along the west flank of the range. About one-third of this contact is exposed, and several iron deposits are associated with it including some of the more promising ones visited during this study. Across the rest of its extent this contact is overlain by poorly consolidated Tertiary sediments. Undiscovered deposits could well be associated with the buried contact, and there may also still be additional possibilities on the exposed parts of the contact. The southern end especially has not been walked out in detail.

The first step in exploring this contact should be a series of ground magnetometer traverses over the McTarnahan iron deposits (or dip needle traverses if necessary). The purpose of these would be to establish whether the known bodies there are continuous under areas of float, whether they extend under the adjacent alluvium, and whether they are larger than their outcrops. A second step should be a magnetic survey of the area extending south from the prospects, the extent of the survey depending on whether costs of the survey could be minimized. An area about 7 miles long and 3 miles wide would be most promising, especially if only a ground reconnaissance were authorized. If possible, however, the entire contact overlain by lake beds extending about 20 miles southeast from the McTarnahan Hill should be surveyed. The greatest uncertainty involved in this project is the thickness of the Tertiary sediments overlying the contact of interest. The rocks are, for the most part, poorly consolidated and could be easily removed with a minimum of blasting. Any bodies large enough to be of economic significance and that would register good anomalies from an airborne survey should be at reasonable depth. A few drill holes would quickly determine the feasibility of stripping them.

Another property along the west contact of the batholith that should be investigated by a ground survey is the Wellington property of James Compston. As mentioned on page 9 of this report the geologic situation looks favorable, but one can't tell from surface observations whether the orebody has any continuity beyond its outcrop. A few simple magnetometer (or dip needle?) traverses across the top of the ridge along the prospect would be enough to determine the advisability of drilling there.

(2) A second area worth consideration is the Red Canyon area and north. A tongue of metamorphic rocks is nearly surrounded by granitic rocks there. Only traces of iron mineralization are known in this area (e.g. that on the north side of Oreana Peak). The northern part of the area has a number of small magnetite-ilmenite pods, but most of them are very small and associated with inclusions in the granitic batholith. No immediate prospecting is recommended, but the area should be reconsidered if the company does begin to operate any deposits in this area.

(3) The third area in which undeveloped iron orebodies might be found would be the Churchill Canyon area, but this belt has probably been pretty well explored by Standard Slag Company since they began operating the Minnesota mine. Probably only an aerial survey could detect unexposed orebodies there, and the expense is probably not justified in view of the current mining operations.

Tungsten

Next to iron the geologic possibilities for metallic mineral deposits would be greatest for tungsten. Tungsten mines have operated in the Pine Nut Mountains during recent years, some successfully, but none are now active. These mines are principally located along the west and south contacts of the Pine Nut batholith. They are contact metamorphic orebodies in which scheelite along with garnet, epidote, other calcium-bearing silicates, and some sulfides have replaced limestone. The largest group of mines is in the southeast part of the range centering around a mill owned by Metallurgical Development Company. Ores from many parts of western Nevada and eastern California were treated at this mill for 11 years following World War II.

Many calc-silicate skarn zones are present in all areas where granite-limestone contacts are known throughout the range. Many of the deposits could be worked in open cuts.

Should the tungsten situation become more favorable than it currently is and expecially if Utah were operating other properties in the region, these areas should certainly be prospected carefully for tungsten deposits. The most favorable localities would be the area of the McTarnahan iron prospects, the south-western contact of the batholith, and the Red Canyon area.

Copper

Oxidized copper minerals are common in most of the mineralized shear zones and veins that crop out in the region. Close examination, however, shows that there is generally very little primary copper in these shears and that the zones themselves are very small.

At the southeastern edge of the hills east of Churchill Canyon there is a mine, the Buckskin Mine, from which samples of fairly high grade sulfide ore have been produced. Quite a little development has been done in the mine, and it is open to a depth of about 100 feet where it is flooded. The owner is Mr. E. Schultz of Yerington, Nevada.

The porphyry being mined by Anaconda at Yerington is a hypabyssal dike, one of a swarm that cuts the batholithic rocks in the Singatze Range. There are similar dikes at only one place in the Pine Nut Mountains of which I am aware. These are in the granodiorite body northeast of the Peacock Copper Mine (number 7 on Plate I). Minor sericitization has been observed around these dikes locally. Anaconda has never investigated these dikes as potential copper porphyries.

Gold, Silver, and Lead

These commodities occur in quartz vein deposits in virtually every rock type represented in the range. The largest deposits of this sort in the region have been found in the Tertiary volcanic terrane (e.g. the Comstock lode, and the Como district of the Pine Nut Mountains). Many smaller veins have been mined from older rocks in all parts of the range (see, for example, Hill, 1915).

The primary ore minerals are sulfides, including pyrite, chalcopyrite, galena, and tetrahedrite. Free gold and silver halides occur in the oxidized portions of the veins, and the vein material in many cases is altered to clay. The lack of large alteration zones in the volcanic rocks of the Pine Nut Mountains together with the meagre record of discoveries and production in the range indicate that there would be little promise for precious metals in these mountains even if the market situation were better.

Non-metallic Deposits

A number of rather loose possibilities should be mentioned for the range in connection with industrial mineral deposits. None of them, in my opinion, rates special immediate attention, but if the company should become an operator in this region some of them could be of value. Most of them could probably be developed in open cuts.

In the area of Mound House, the junction of two abandoned railroads, there are low-grade gypsum deposits which were mined from 1913 to 1921 for plaster and fertilizer. Over $450,000 worth of material was shipped during that time. Periodically, small operators have produced some more of this material, but much is still left. The gypsum is interbedded in the Triassic metasedimentary rocks of the Virginia Range, and some has been reworked into the Quaternary deposits of the basin near Mound House.

Bentonite has been shipped continuously since 1936 from a deposit near abandoned Fort Churchill on the Carson River. The operator is the Industrial Minerals and Chemical Company of Berkeley, California. The deposits occur in tuffaceous Pleistocene Lake Lahontan sediments. These deposits are widespread throughout the region and are present only a few miles south of the Dayton iron district. Other clay deposits could probably be developed in them with little difficulty if a market could be found for the products. If the iron ores were to be pelletized, a bentonite binder could possibly be produced.

A small diatomite deposit was noted by Atchley (1955b) near the Dayton iron deposit.

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RECONNAISSANCE GEOLOGIC MAP
OF THE
PINE NUT MOUNTAINS, NEVADA
ROBERT L. CHRISTIANSEN
OCTOBER, 1957
SCALE
feet
miles
TRUE N
MAG.
18°
Index to mapped area
—EXPLANATION—
Quaternary
Tertiary
Cretaceous?
Triassic-Jurassic and older?
Qsu Surficial deposits
TQg Gravels
Tv Volcanic rocks
Tl Sediments dominantly lacustrine
gr Granitic rocks
mv Older metavolcanic rocks
ms Older metasedimentary rocks (lines = limestone)
Contacts (dashed where approximate, dotted where concealed)
Faults (dashed where approximate, dotted where concealed)
Strike and dip of beds or flows
IRON OCURRENCES
1. Dayton Iron Deposit
2. North Dayton
3. Black Eagle
4. Iron Blossom
5. Carson River
6. Brunswick Canyon
7. Peacock Copper Mine
8. McTarnahan Group
9. Southeast McTarnahan
10. Southwest McTarnahan
11. Mineral Peak
12. Wellington
13. Oreana Peak
14. Magnetite Mountain
15. Minnesota Mine
ALKALI FLAT
DAYTON
CARSON
VALLEY
Fish Spring Flat
Double Spring Flat
ALKALI FLAT
SMITHS
VALLEY
ALKALI FLAT
WELLINGTON

3040 0006

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
345 Middlefield Road, MS910
Menlo Park, California 94025-3591

May 6, 1997

David A. Davis
Geologic Information Specialist
Nevada Bureau of Mines and Geology
University of Nevada, MS 178
Reno, Nevada 89557-0088

Dear Mr. Davis:

Please accept my apology for this much delayed response to your letter of last December concerning my 1957 geologic map of the Pine Nut Mountains. I made that reconnaissance study as a Junior Geologist for Utah Construction Co. (later Utah International) as part of their interest in possible undiscovered small iron-ore deposits as they sought to develop their Dayton property. They later granted permission for a slightly generalized version of the map to be published as part of the Lyon-Douglas-Ormsby County Map by Jim Moore.

When I first received your letter, I attempted to contact anyone still connected to the old Utah Construction exploration group, which to my knowledge has long since disappeared. In waiting for any response, I must admit I let your letter lie unanswered until just coming across it again today under a stack of unfinished work. Meanwhile, I have had no success in trying to find anyone still connected with the old Utah Construction group. Since it seems fair to presume that there is no continuing proprietary interest in this map and report, I am forwarding it to you with this letter. Regrettably, my copy of the map is uncolored, making it difficult to interpret. Nevertheless, if you find it to be of any use or of possible archival interest, please feel free to keep it in the Bureau's files.

Sincerely yours,

Robert L. Christiansen
Geologist

NEVADA BUREAU OF MINES AND GEOLOGY

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12 May 1997

Dr. Robert L. Christiansen
U. S. Geological Survey
345 Middlefield Road, MS 910
Menlo Park, CA 94025-3591

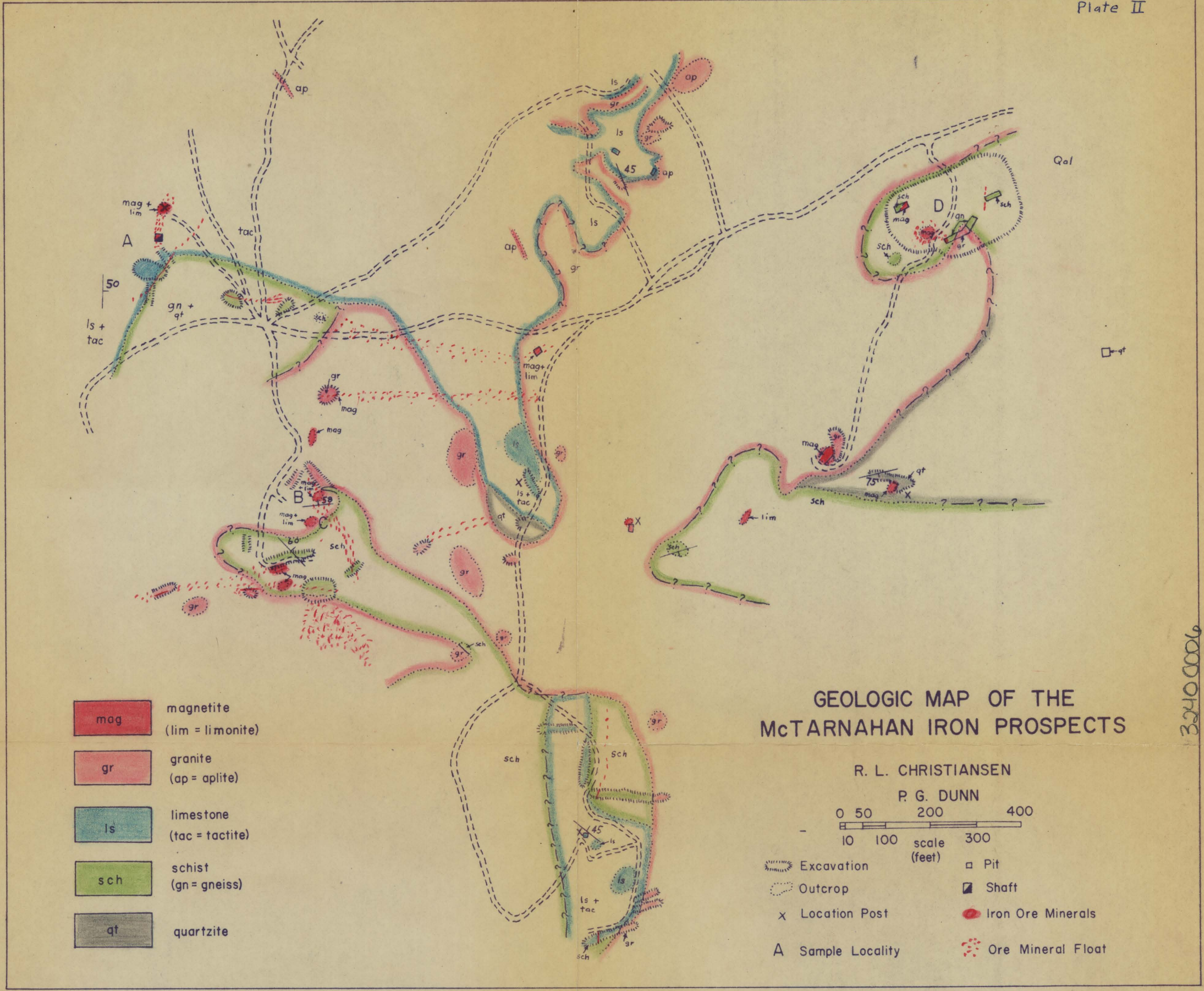
Dear Dr. Christiansen:

We just received your map and report on the Pine Nut Mountains, and I thank you for it. I have been compiling a map of the Mesozoic roof pendents in western Nevada, and your map covers part of that area. I put it in our mining district files. Thank you again.

Sincerely,

David A. Davis
Geologic Information Specialist

Plate II


GEOLOGIC MAP OF THE
McTARNAHAN IRON PROSPECTS
R. L. CHRISTIANSEN
P. G. DUNN
0 50 200 400
10 100 scale (feet) 300
mag magnetite (lim = limonite)
gr granite (ap = aplite)
ls limestone (tac = tactite)
sch schist (gn = gneiss)
qt quartzite
Excavation
Outcrop
Location Post
Sample Locality
Pit
Shaft
Iron Ore Minerals
Ore Mineral Float
Qal
A
B
C
D