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GEOLOGIC REPORT NO. 6

Geology and Mineral Deposits of the Ahtell Creek Area, Slana District, Southcentral Alaska

By

Donald H. Richter

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GEOLOGY AND MINERAL DEPOSITS OF THE AHTELL

CREEK AREA, SLANA DISTRICT, ALASKA

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INTRODUCTION

This report and accompanying geologic map is a preliminary progress report of geologic investigations undertaken in the Slana district of southcentral Alaska during the summer of 1963. A comprehensive report on the area will be published subsequent to further field work planned for 1964.

The term "Slana district", as used herein, refers to the relatively isolated mountainous area that lies north of the Copper River and between the Chistochina and Slana Rivers in the eastern part of the Alaska Range (Figure 1). Field work in 1963 was confined principally to the Ahtell and Porcupine Creek drainages in the southeast part of the district.

Much of the Slana district has been prospected, and since 1898 a number of base metal-silver vein deposits and gold placers have been found. However, there has been no known lode production from the district, and the amount of placer gold produced has been minor. Some of the mineral deposits in the district have been described by Moffit (1929, 1938), who conducted a reconnaissance study of the Slana-Tok district between 1929 and 1936 for the U.S. Geological Survey, and by Thorne (1946), who examined mineral occurrences in the area for the U.S. Bureau of Mines critical and essential minerals program in 1945.

The southeast part of this district is readily accessible by trails leading north from the Glenn Highway and southwest from Mentasta Lake. Rock exposures are poor on the heavily wooded slopes and valley bottoms below 3,000 to 3,500 and fair to good, depending on the topography, above 3,500 feet.

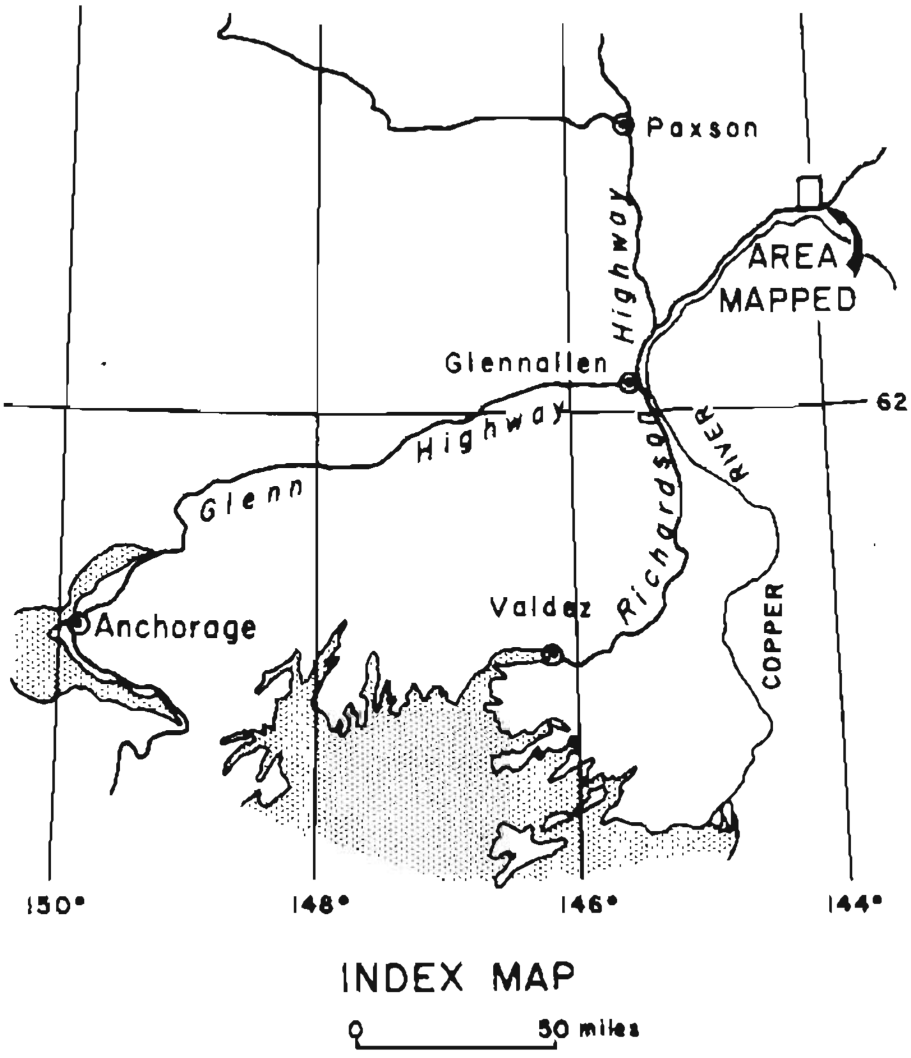


Figure 1. Index map of a part of southcentral Alaska showing Ahtell Creek area.

GEOLOGY

Setting

The Slana district is composed of a central core of igneous intrusive rocks surrounded on the east, south, and probably the west by interbedded sediments, volcanic flows, and tuffs. Although the district is physiographically part of the Alaska Range, the structural grain of the bedded rocks does not appear to be related to the northwest trend of the Alaska Range but evidently has been controlled by local intrusive activity within the district itself. Based on the geological reconnaissance of Moffit (1938), who dates the youngest bedded rocks as Permian in age, and the regional tectonic synthesis of Payne (1955), the Slana district has remained a positive element along the north edge of the Talkeetna geanticline since the end of the Paleozoic. Intrusive igneous activity probably began during Jurassic time and continued intermittently until early Tertiary. Quaternary glaciation modified much of the land surface, and relatively extensive glaciofluvial deposits floor the main stream valleys and their larger tributaries.

Bedded Rocks

Approximately 2,000 feet of interlayered sediments, volcanic flows, and tuffs are present in the Ahtell Creek area. Sedimentary rocks appear to be predominant in the upper part of this bedded rock sequence, whereas volcanic rocks are more abundant in the lower part. According to Moffit (1938) these rocks are Permian in age. They are probably correlative with the Mankomen formation (Mendenhall, 1905), exposed in the mountains north of Mankomen Lake, 15-20 miles northwest of Ahtell Creek. In the map area, however, volcanic rocks are considerably more abundant than in the type Mankomen section described by Mendenhall. It is also possible that the volcanic rocks are equivalent to the Nikolai Greenstone of Middle or Late Triassic age, which if so, would make the conformably overlying sedimentary rocks considerably younger than Permian.

The sedimentary rocks are generally thin-bedded and consist of buff to pink coarse sandstone, grit, and arkosic conglomerate with subordinate fine-grained sandstone, siltstone, and impure limestone. Interbedded sediments in the lower, dominantly volcanic section are darker in color and consist of dense impure sandstones or sandy tuffs that form massive homogeneous layers tens of feet thick. No fossils were observed in any of the sediments. Best exposures of the sedimentary rocks in the mapped area are in the mountains east of Porcupine Creek and on the northwest side of the 3,500-foot mountain southeast of Willow Creek.

The volcanic rocks are largely basaltic in composition. Massive porphyritic, amygdaloidal, and fine-grained basalts and basic volcanic agglomerates are the predominant rock types. Thin basic dikes and sills were observed but are not shown on the geologic map.

At the portal of the small adit at locality 8 on Ahtell Creek a serpentinized olivine-rich ultramafic is exposed, however, no criteria were observed to speculate on the intrusive or extrusive origin of this rock.

Dense, fine-grained, light to dark gray, relatively thin strata scattered throughout the bedded rock sequence are believed to represent original tuffaceous rocks. In thin section these rocks are seen to consist almost entirely of fine-grained quartz with minor white mica, chlorite, and feldspar; no relict shards or textures indicative of a tuffaceous origin have been preserved.

Intrusive Rocks

At least four types of intrusive igneous rock are exposed in the Ahtell Creek area. Three of these, hornblende quartz monzonite, porphyritic biotite quartz monzonite, and biotite diorite occur as intimately associated intrusive masses that probably represent the east margin of a large complex composite stock. The other type, a hornblende grandodiorite porphyry gradational to hornblende diorite porphyry is apparently restricted in occurrence to dikes and irregular elongate bodies. The intrusives occupy most of the west half of the map area with the dikes largely concentrated in the Upper Grubstake Creek drainage.

The larger intrusives have not severely deformed the marginal bedded country rock and were evidently emplaced passively. A gradational contact zone, as much as 1,000 feet wide, generally separates fresh-appearing igneous rock and unaltered country rock. Schistose and metamorphosed country rock inclusions up to hundreds of feet long are common in the intrusive rocks near the contact. The inclusions lose their identity across the poorly defined contact zone, gradually merging with massive country rock that contains irregular injections of intrusive rock. The inclusions and country rock in the contact zone have been metamorphosed to a hornblende-hornfels which in turn passes into a quartz-epidote-chlorite rock in the outer contact aureole. Primary structures are lacking in the hornblende-hornfels but become discernible in the quartz-epidote-chlorite rocks. Where observed, the contact between the intrusive rocks is similarly diffuse and consists of a zone of hybrid rock that is generally finer-grained and richer in hornblende than the parent intrusives.

Modal analyses of the four intrusive rock types are given in Table 1 and are plotted on the triangular classification diagram (Figure 2) by recalculating the quartz, plagioclase feldspar, and orthoclase

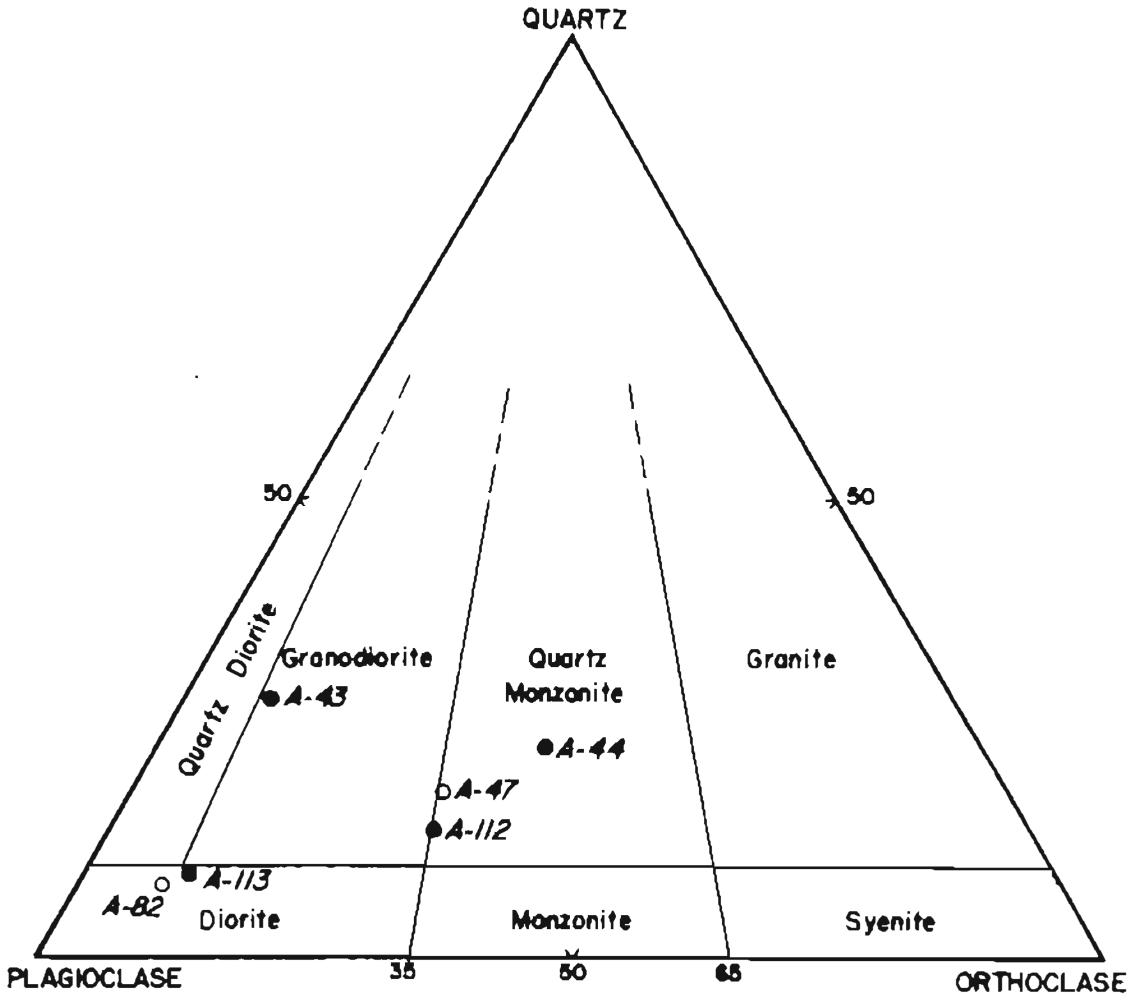


Figure 2. Composition of Ahtell Creek rocks plotted on basis of 100 percent modal quartz, plagioclase, and orthoclase. Solid circles refer to modally analyzed rocks shown in Table 1. Modal analyses for open circle rocks (A-47, hornblende quartz monzonite; A-82, hornblende diorite porphyry) are not given.

feldspar to 100 percent.

Hornblende quartz monzonite (A-44, Table 1) forms the largest intrusive rock mass in the area. It is best exposed in Grubstake Creek and on the 4,000-foot mountain immediately north of Grubstake Creek. The rock is holocrystalline, medium-grained (average grain size, 2 mm) and on fresh surfaces has a characteristic pink color mottled with light to dark green splotches. Plagioclase, orthoclase, and quartz with minor hornblende and epidote, set in a subhedral-granular texture, are the principal constituents. Biotite and clinopyroxene are conspicuously absent. The plagioclase (An_{38-30}) has been partly replaced by white mica and epidote, and the hornblende by a fine-grained mixture of chlorite, epidote, and carbonate. The quartz and orthoclase are unaltered.

Porphyritic biotite quartz monzonite (A-112, Table 1), which may be a phase of the hornblende quartz monzonite, is well exposed over a length of 1½ miles along the ridge tops west of Ahtell Creek opposite Grubstake Creek. In contrast to the hornblende quartz monzonite this rock is medium to coarse-grained (2 to 5 mm) with conspicuous phenocrysts of orthoclase, as much as 2 inches long, and contains biotite as the principal mafic mineral together with both hornblende and clinopyroxene. The orthoclase and quartz content of the porphyritic quartz monzonite (A-112) is less than that of the hornblende quartz monzonite (A-44) placing it near the granodiorite-diorite field on the triangular compositional diagram. The rock is only slightly altered. Plagioclase (An_{35-30}) shows the effects of weak sericitization, and the biotite may, in part, be secondary after hornblende.

Biotite diorite (A-113, Table 1) is exposed along the southern border of the porphyritic quartz monzonite and probably extends south, across Flat Creek, to Silver Creek. A smaller mass of biotite diorite occurs one mile southwest of Indian Pass Lake in the northeast corner of the area. The biotite diorite is medium-grained and generally light to medium gray in color. In thin section, zoned plagioclase (An_{45-35}) constitutes as much as 62 percent of the rock. Orthoclase and quartz occur as late interstitial material. Three mafic minerals, biotite, hornblende, and clinopyroxene (diopsidic augite) are present in approximately equal amounts. Weak sericitization of the plagioclase is the only alteration observed.

In the vicinity of Locality 9, on Silver Creek, the diorite is darker colored and contains more hornblende than in the biotite diorite exposed elsewhere in the area. Although the accompanying geologic map indicates a continuous unit of biotite diorite from north of Flat Creek to Silver Creek, the geology in this area may well be considerably more complex, with the light and dark diorites representing distinct intrusives.

TABLE 1

Modal analyses of intrusive rocks in the Ahtell Creek area

	A-44 Hornblende quartz monzonite	A-112 Porphyritic biotite quartz monzonite	A-113 Biotite diorite	A-43 Hornblende granodiorite porphyry
quartz	20	11	7	21
plagioclase 1/	35 (An_{38-30})	45 (An_{35-30})	62 (An_{45-35})	47
orthoclase	31	24	8	6
hornblende	8 2/	7	6	8
biotite	--	8	8	--
clinopyroxene	--	2	6	--
opaques	1	2	3	1
apatite	tr	tr	tr	--
sphene	tr	1	--	--
carbonate 3/	tr	--	--	10
chlorite 3/	tr	--	--	5
epidote 3/	4	tr	--	2
Color Index	13	20	23	

1/ Plagioclase in all samples contains varying amounts of secondary white mica.

2/ Includes 4% chlorite, 2% white mica, and 1% epidote as secondary alteration minerals.

3/ Secondary alteration minerals with no obvious primary mineral parent.

Localities:

A-44 - Top of 4000-foot hill, ¼ mile north of Grubstake Creek

A-112- Elevation of 3500 feet, 1-3/4 miles north of Flat Creek.

A-113- Elevation of 4000 feet, 1 mile north of Flat Creek.

A-43 - At main fork of Grubstake Creek.

The dikes of hornblende-bearing granodiorite-diorite porphyry (A-43, Table 1) in the Upper Grubstake Creek Drainage appear to be very closely related genetically to the biotite diorite. Apophyses off the south end of the biotite diorite intrusive near Indian Pass Lake are hornblende porphyries, and within the border zone of the biotite diorite west of Ahtell Creek segregation (?) bands of hornblende diorite are present. In the elongate intrusive body northeast of Grubstake Creek the texture of the rock varies from porphyritic to equigranular with the equigranular phase very similar in physical appearance to the biotite diorite. The dike rocks are generally light gray and medium-grained and contain phenocrysts of both hornblende and plagioclase feldspar as much as one inch long. Although the dike rocks appear relatively fresh in hand samples, they show the effects of profound alteration when examined under the microscope. The hornblende phenocrysts are almost completely replaced by an intimate mixture of white mica, chlorite, and zoisite, and the plagioclase feldspar by a cloudy mass of white mica. In the groundmass, patches of carbonate and chlorite and blebs of epidote are abundant.

Contact relationships indicate that the monzonite rocks are early and have been intruded by the more basic diorite. The dikes of hornblende diorite and granodiorite porphyry appear to represent the end state of plutonic igneous activity in the area.

Metamorphism

With the exception of the broad contact aureole surrounding the larger intrusive masses, the country rocks are relatively unmetamorphosed. Zeolite minerals and minor chlorite were observed in some of the flow rocks, but the sediments appear quite fresh. Most of the rocks, however, are carbonatized and locally pyritized, presumably due to metasomatic replacement by emanations from the intrusives.

Around the intrusives, contact metamorphism as high as the hornblende-hornfels facies has affected the rocks. The basic volcanics exhibit the development of hornblende, plagioclase, and minor biotite whereas the more siliceous sediments have been altered to assemblages of quartz-hornblende-plagioclase-microcline. Impure limestone, where present in the contact zone, generally contains large diopside crystals in a matrix of quartz, tremolite and calcite. Rocks of the hornblende-hornfels facies grade into rocks of the albite-epidote-hornfels facies in the outer limits of the contact aureole.

Structure

The structure of the bedded rocks in the map area is not complex. In general the rocks dip away at angles varying between 15 and 45 degrees from the central intrusive core of the district. Local reversals and minor variations of this quaquaversal pattern are attributed to faulting. Faulting, however, has not been pronounced - or perhaps not too recognizable - within the area. A number of normal faults with small displacement radiate from the vicinity of Grubstake Creek and a few, generally in association with quartz veins, have been observed elsewhere. No evidence of a fault, which according to Moffit (1938) has controlled the course of Grubstake Creek, was observed.

Regionally, the structural relationship between the Slana district and the major part of the Alaska Range is not well understood. The district is bounded on the north by the Windy Pass-Shakwak fault, which forms part of a major trans-Alaskan-Canadian structural lineament extending in an arcuate course from Togiak Bay in western Alaska into Canada. The straight southern front of the Slana district may also be fault-controlled. It is postulated that a continuation of the Cooper Pass fault (Moffit, 1954) in the Chisana-Nabesna area, or an unmapped structure to the south (Caribou Creek-Jack Creek area), extends up along the southern border of the Slana Mountains and westward forming the northern border of the Copper River basin.

Pyrite and Carbonate Metasomatism

Pyrite is generally present in minor amounts in both the bedded and intrusive rocks in the area. Local zones of stronger pyrite mineralization, where pyrite may constitute up to 10 percent by volume of the rock, are common but are generally restricted to the bedded rocks near the hornblende quartz monzonite contact. Besides the disseminated deposit on The Dome (locality 1) where pyrite is associated with chalcopyrite and locality 5, where it occurs with quartz, pyrite zones are present from the upper Boulder Creek basin south to locality 6. In the Upper Grubstake Creek basin pyrite-rich zones are exceedingly numerous (not all shown on map) and occur indiscriminately in both bedded and intrusive rocks. The pyrite zones are all conspicuously marked by strong limonite staining.

Carbonization is widespread and apparently has affected most of the bedded rocks observed in the mapped area. Calcite and ankerite are the principal carbonate minerals present and constitute as much as 5 percent of the whole rock.

ECONOMIC GEOLOGY

A number of base metal-silver vein deposits and gold placers have been prospected and worked in the Ahtell Creek area. Some gold has been recovered from the placer operations, chiefly from the workings on Grubstake Creek, but no lode production of any ore is known from the area. During the course of this investigation a silver-lead occurrence and a strong geochemical anomaly were discovered. These discoveries and the old prospects in the area are described below.

Lode Prospects

Locality 1. A massive, light colored dense hornfels containing veins of quartz and calcite is exposed at an elevation of approximately 3,700 feet on the steep northeast flank of The Dome. The veins, as much as a foot thick, fill and are apparently controlled by a local joint system confined to the massive hornfels. Prominent joints strike N6°W and dip 59°W; weaker joints strike N72°W and dip 79°N. Veins exposed in two shallow prospect pits exhibit weak copper staining and contain a few small grains of chalcopyrite and galena. In thin section the hornfels is a compact anhedral-granular mass of quartz, which constitutes over 50 percent of the rock, and plagioclase feldspar that has been altered to white mica and carbonate. No orthoclase or mafic minerals were observed. Average grain size is about 1 mm, with some larger subhedral plagioclase crystals as much as 2 mm long. The rock is apparently a metamorphosed sediment along the contact of the hornblende quartz monzonite stock.

A few hundred feet southwest of this occurrence and extending over the top of The Dome is a zone of disseminated pyrite and minor chalcopyrite mineralization. The sulfide-bearing rocks are hornfelsic flows and possible tuffs, conspicuously altered to limonite on the surface. X-ray spectrographic analysis of a composite chip sample representing an area 400 feet long by 100 feet wide disclosed between 0.05 and 0.1 percent copper.

Locality 2. Described under gold placer section.

Locality 3. Pyrite with minor chalcopyrite occurs in a limonite-stained band of dark green metamorphic rock outcropping on the south side of the south fork of Grubstake Creek at an elevation of about 3,700 feet. A small pit dug into this band a few feet above creek level exposes weak copper-stained fractures trending N76°E and dipping 73°N. The metamorphic rock is an unassimilated volcanic rock inclusion in the hornblende quartz monzonite.

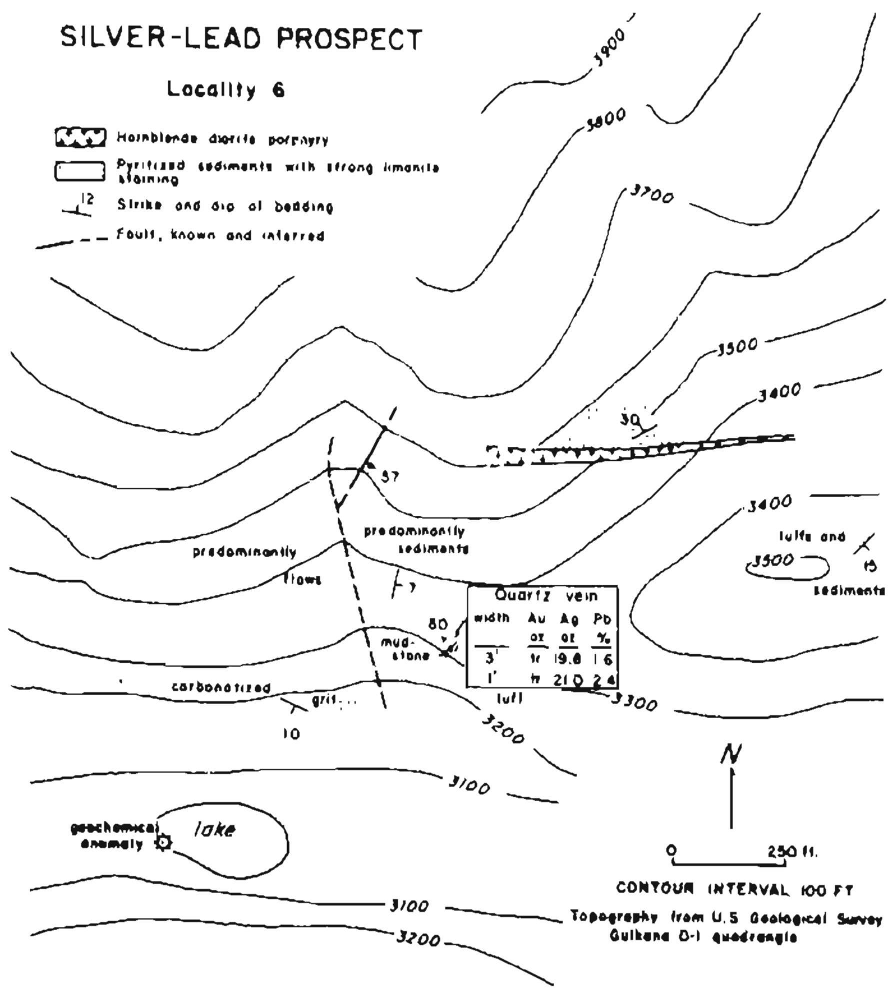
Locality 4. Small irregular and discontinuous quartz veins, as much as 6 inches wide, with minor pyrite and chalcopyrite have been exposed in a 10-foot adit and a number of pits high on the ridge, at an elevation of about 4,500 feet, due south of the placer workings on Grubstake Creek. The veins are in a dark chlorite-hornblende-rich band of metamorphic rock similar to the inclusion exposed at locality 3.

Locality 5. Massive pyrite associated with fine-grained quartz is poorly exposed on the west bank of Ahtell Creek about 200 feet north of the Grubstake Creek trail crossing. Both the pyrite and the quartz appear to be a hydrothermal replacement of an original sedimentary rock. A light-colored dense silicified rock similar to the hornfels exposed on The Dome and indicative of the hornblende quartz monzonite border zone, crops out a few feet away from the pyrite-rich rock.

Locality 6. An unprospected quartz vein containing minor galena but assaying relatively high in silver crops out on a steep hillside about 500 feet northeast and 200 feet above a small lake 2½ miles south of Grubstake Creek (Figure 3). The quartz vein, which trends northeasterly, is poorly exposed over a length of 10 feet, and has a width of at least 5 feet. The hanging wall, composed of reddish calcareous mudstone, strikes N52°E and dips 80°NW. A gray tuff (?) probably forms the footwall but the actual contact is covered by talus. A number of small, barren quartz veins are also present in the tuff (?) 10 to 20 feet east of the main vein. The vein is composed principally of limonite-stained massive milky quartz. Vuggy zones lined with quartz crystals are common and patches of coarse white calcity are occasionally present. Coarsely crystalline galena, the only sulfide mineral observed, appears to be restricted to a 2-foot zone along the hanging wall where it constitutes not more than 5 percent by volume of the vein material. A 3-foot channel sample across the galena-bearing part of the vein assayed 19.8 oz. silver and 1.6 percent lead; a 1-foot sample visibly containing more galena assayed 21 oz. silver and 2.4 percent lead. Both samples contained a trace of gold. Although silver-bearing tetrahedrite has been reported from the area, preliminary laboratory studies of the vein material indicate that the silver is present in the galena.

Two pyritized and limonite-stained areas also occur in the vicinity of the vein. A small outcrop of greenish-buff grit containing abundant pyrite is exposed on the west wall of a fault-controlled ravine and a larger area of pyritized sediments is exposed on the north side of a hornblende diorite porphry dike northeast of the vein.

Locality 7. Described under gold placer section.



SILVER-LEAD PROSPECT
Locality 6
Hornblende diorite porphyry
Pyritized sediments with strong limonite staining
Strike and dip of bedding
Fault, known and inferred
predominantly flows
predominantly sediments
mud-stone
carbonatized
grit
tuff
tuffs and sediments
Quartz vein
width Au oz Ag oz Pb %
3' tr 19.8 1.6
1' tr 21.0 2.4
geochemical anomaly
lake
3900
3800
3700
3500
3400
3300
3200
3100
CONTOUR INTERVAL 100 FT
Topography from U.S. Geological Survey Gulkana D-1 quadrangle
0 250 ft.
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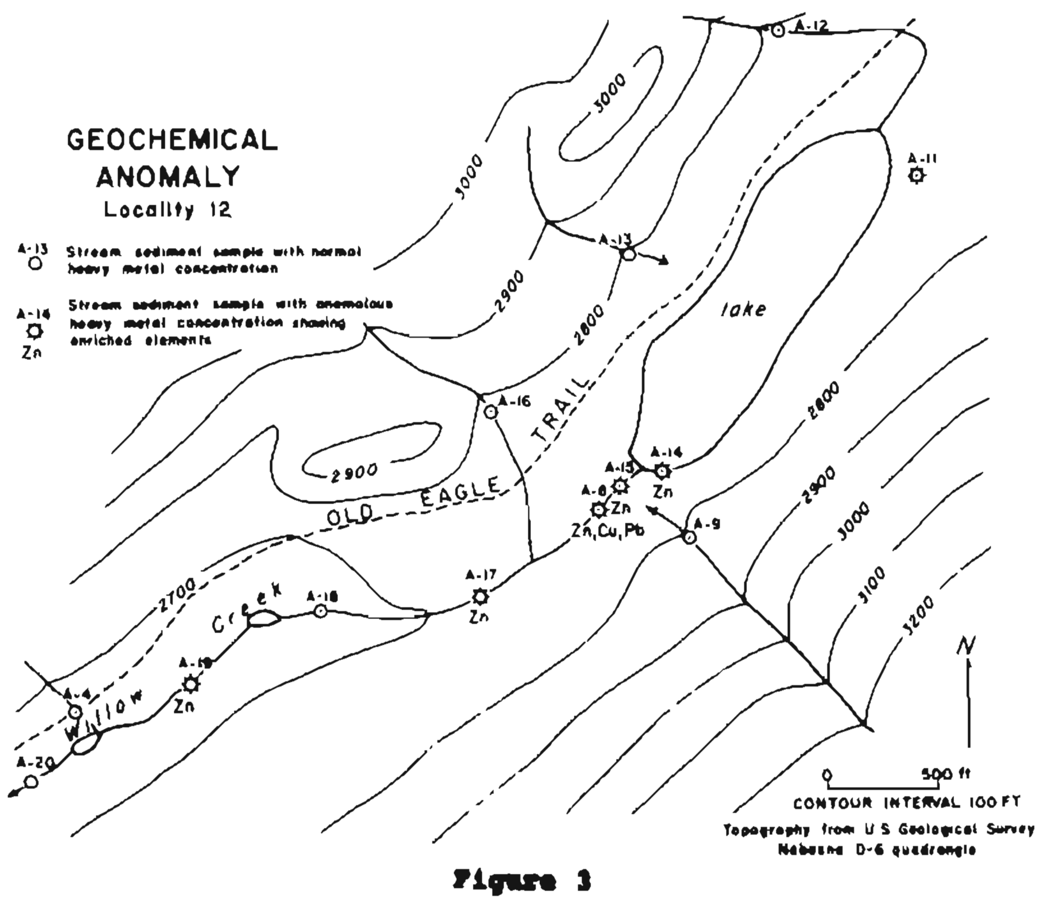

GEOCHEMICAL ANOMALY
Locality 12
Stream sediment sample with normal heavy metal concentration
Stream sediment sample with anomalous heavy metal concentration showing enriched elements
OLD EAGLE TRAIL
Willow Creek
lake
Zn, Cu, Pb
3000
2900
2800
2700
3100
3200
CONTOUR INTERVAL 100 FT
Topography from U.S. Geological Survey Nabesna D-6 quadrangle
0 500 ft
N

Figure 3

Locality 8. The Bronnicke Gold-Quartz prospect on the north bank of Ahtell Creek about ½ mile west of the confluence of Willow Creek has been examined by Jasper (1956) of the State Division of Mines and Minerals. The prospect is on a quartz-carbonate vein that outcrops along a small cliff a few feet above the level of Ahtell Creek. In 1955-56 Fred Bronnicke of Slana drove an adit on the vein but encountered glacial debris at a distance of 55 feet from the portal. No work has been done since.

The vein trends N5° to 8°W and dips 67°W. A dark serpentinized olivine basalt or gabbro, containing abundant chrysotile-calcite veinlets forms the hanging wall and a dense gray tuff (?) the footwall. The wall rocks are brecciated and limonite-stained as much as 5 feet on both sides of the vein. Slickensides plunging 50°NW along the hanging wall and local development of clay gouge containing broken vein material indicate strong post-mineral movement. The vein ranges from 3 to 5 feet in width and is composed principally of massive milky quartz, locally brecciated, and irregular pods of carbonate (ankerite?). Sphalerite, with subordinate amounts of chalcopyrite, galena and pyrite, occurs sparsely scattered throughout the vein. Samples collected in 1955 assayed between 0.02 and 0.90 oz. gold and between a trace and 0.76 oz. silver (Jasper, 1956).

Locality 9. This silver prospect, one of the oldest known mineral occurrences in the area, is on Silver Creek about 1½ miles west of locality 8. Moffit (1938) was apparently the first to describe the prospect, but even at the time of his visit in 1936 the exploratory adits, shafts and open cuts were largely caved and buried. In 1945 the property was re-examined and sampled by Thorne (1946); however, from the description given no work had been done since Moffit's earlier visit. Within a year prior to our investigation in August 1963 a crude tractor road had been completed to the property from Grubstake Creek and some stripping done.

The prospect consists of a number of quartz-carbonate veins containing minor sulfides that strike NW and dip steeply NE. The veins apparently occupy cross fractures in a 100-foot, or more, wide fault zone striking N10-20°E and dipping 65°-80°W. Principal rock within the fault zone in the prospect area is a dense gray silicified and pyritized hornfels of sedimentary origin. A few hundred feet west of the fault a dark gray, medium-grained hornblende-bearing intrusive rock, which is probably a phase of the biotite diorite stock, is exposed in a few small outcrops. Immediately north of the prospect area the fault appears to mark the contact between intrusive rock and the interbedded sediments and flows.

Near the veins the rock is highly carbonatized and limonite-stained. Chalcopyrite, galena, sphalerite, and pyrite were observed in minor amounts in old dump material throughout the prospect area. Silver, which runs as high as 17.5 oz. per ton across 1-foot channel samples, is evidently contained in associated tetrahedrite (Thorne, 1946).

Locality 10. A mass of brecciated and sheared quartz and carbonate has been exposed in a small cliff face south of Ahtell Creek and 200 feet east of the Grubstake Creek trail at an elevation of 2,750 feet. Shears in the rock strike N67°W and dip 71°N. No sulfides were observed, nor is the country rock exposed. According to Mr. O. Hoaglund, a local retired prospector, the prospect area exhibited weak anomalous radioactivity.

Locality 11. Described under gold placer section.

Gold Placers

Three gold placer deposits (localities 2, 7 and 11) are known in the mapped area but none have been active within the last 3 or 4 years. Moffit (1938) has described the better known placer on Grubstake Creek (locality 2) which was intermittently worked up to about 1959 and also mentioned the existence of gold in Boulder Creek, across the ridge from Grubstake Creek in the Porcupine drainage. Subsequently in the mid-1950's placer mining was conducted on Boulder Creek (locality 11) by Mr. F. Bronnicke, but the operation was short-lived. A placer on Willow Creek (locality 7) was evidently worked and abandoned in the late 1930's.

The placer gold is associated with native silver and native copper in Grubstake Creek and with native silver, native copper, and bismuth minerals in Boulder Creek (Moffit, 1938, p. 49; Moffit, 1954, p. 195). Most of the gold and silver in the Ahtell and Porcupine drainages is wiry or dendritic, showing little or no evidence of lengthy transport. At Grubstake Creek, in fact, the bedrock source of the gold is probably within a few hundred feet of the junction of the north and south forks. However, careful prospecting since the discovery of the placer deposits has failed to reveal any lode gold occurrence in the area.

Geochemical Anomalies

One hundred and fifteen stream sediment samples were tested for heavy metals during the course of the field work. The University of Alaska cold heavy metal test (Mukherjee and Mark Anthony, 1957) was used in the field and anomalous samples analyzed by x-ray spectrographic methods in the laboratory.

Four geochemical anomalies in or near known mineralized areas and one anomaly of unknown origin were detected. The anomalies apparently related to known mineralization are: (1) east side of The Dome, down weak drainage from locality 1, (2) Upper Grubstake Creek drainage, (3) Silver Creek, downstream from locality 9, and (4) small lake below silver-lead prospect at locality 6.

The geochemical anomaly of unknown origin (locality 12) at the headwaters of Willow Creek may be economically significant. High concentrations of zinc (approximately 10X background) were detected in six stream and lake samples in a zone 4,000 feet long along the main Willow Creek drainage (Figure 3). One sample from just below the mouth of lake 2750, which contained a very high concentration of zinc, was also enriched in copper and lead. The anomaly is underlain by thin glaciofluvial deposits; the country rock of the drainage area consists principally of sediments (south) and volcanic flows (north). No base metal deposits are known to occur in the drainage area.

Summary

The genesis of the small, scattered sulfide deposits in the mapped area is poorly understood. The ore minerals are principally simple sulfides (chalcopyrite, sphalerite, and galena) and occur with quartz and minor carbonate in fissure-filling-type hydrothermal veins. Native gold, silver, and copper are also undoubtedly present in some of the veins as evidenced by the local placer deposits. Although it appears reasonable to assume that the hydrothermal solutions responsible for the deposition of the quartz and sulfide minerals were derived from the monzonite-diorite magmas there is only the evidence of the spatial relationship between the sulfide deposits and intrusives to support this view. Three of the deposits (localities 1, 3, and 4) occur in contact rocks along the periphery of the hornblende quartz monzonite intrusive, one (locality 5) may be in the quartz monzonite contact zone and one (locality 9) is near the diorite intrusive. These same deposits can also be related to other features such as faults (localities 1 and 9) and dikes (localities 3 and 4), hence the relationship between the deposits and large known intrusive bodies may be entirely fortuitous. Moreover, three deposits also occur well outside the intrusive contact zone (localities 6,8, and 10) and may be controlled by faults (localities 8 and 10) or a combination of faulting and dike injection (locality 6).

Other than the general lack of sulfide deposits in the intrusives, the type of country rock does not appear to exercise any control on the deposits. Wall rocks may be either volcanic or sedimentary and range from ultramafic to acidic in composition and from schistose to massive in texture.

CONCLUSIONS AND RECOMMENDATIONS

The geologic investigations undertaken to date in the Ahtell Creek area indicate that the Slana district has been favorable for the widespread deposition of sulfide minerals. This observation together with (1) the presence of a passive igneous intrusive complex (Stringham, 1960), (2) proximity of major structural breaks, (3) the local biotitization and hydrothermal alteration exhibited by some of the intrusives, and (4) the regional pyritization and carbonization of the bedded country rock, supports and economically optimistic recommendation for the district. On the basis of the limited knowledge available on the district, however, no attempt will be made to recommend specific areas for exploration. Although the quartz-sulfide veins may be genetically related to the massive intrusives, it does not necessarily follow that exploration should be confined to the intrusives or their contacts. On the contrary, as shown in the Ahtell Creek area, the larger veins may be as much as two miles from the intrusive-bedded rock contact.

The district is amenable to geochemical stream sediment sampling. In the Ahtell Creek area the favorably located known mineralized zones and the unprospected silver-lead occurrences at locality 6 are associated with geochemical anomolies. One anomaly of unknown origin was detected and roughly delineated.

Information concerning the new silver-lead prospect and the geochemical anomaly was released to the public on January 20, 1964. Both of these discoveries warrant further exploration work.

REFERENCES

Jasper, M. W.
1956. Fred Bronnicke's Gold-Quartz Prospect, Ahtell Creek, Slana District, Alaska; unpubl. Property Examination Report. Dept. Mines, Terr. of Alaska.

Mendenhall, W.C.
1905 Geology of the Central Copper River Region, Alaska; U.S. Geol. Survey Prof. Paper 41, 133 p.

Moffit, F.H.
1929 The Slana District, Upper Copper River Region; U.S. Geol. Survey Bull. 824, p.111-124.

1938 Geology of the Slana-Tok District, Alaska; U.S. Geol. Survey Bull. 904, 54 p.

1954 Geology of the Eastern Part of the Alaska Range and Adjacent Area; U.S. Geol. Survey Bull. 989-D, p. 65-218.

Mukherjee, N.R. and L. Mark Anthony
1957 Geochemical Prospecting; Univ. of Alaska, School of Mines Publication, Bull. 3, 81 p.

Payne, T.G.
1955 Mesozoic and Cenozoic Tectonic Elements of Alaska; U.S. Geol. Survey Map I-84.

Stringham, B.
1960 Differences Between Barren and Productive Intrusive Porphyry; Ec. Geol., 55, p. 1622-1630.

Thorne, R.L.
1946 Exploration of Argentiferous Lead-Copper Deposits of the Slana District, Alaska; U.S. Bur. Mines, R.I. 3940, 9 p.