INVESTIGATION OF A LOW-GRADE GOLD DEPOSIT IN THE OROGRANDE DISTRICT, IDAHO

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
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By William L. Rice

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Rice, William L

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INVESTIGATION OF A LOW-GRADE GOLD DEPOSIT IN THE OROGRANDE DISTRICT, IDAHO

by

William L. Rice

ABSTRACT

Geochemical humus sampling techniques were used by the Bureau of Mines in investigating a potential large, low-grade gold deposit in the Orogrande district, Idaho. Conifer needle humus samples were processed by ashing and fire assay-atomic absorption analysis. An area bearing anomalous concentrations of gold and silver was outlined by the geochemical method.

INTRODUCTION

This report is a summary of information on the Orogrande district, Idaho, and describes Bureau of Mines mineral deposits investigations on low-grade gold deposits in the area.

The Orogrande district was recommended to the Bureau of Mines in early 1967 as having favorable exploration targets for large-volume, low-grade gold deposits. A reconnaissance investigation of the district and contiguous areas was made in July 1967, and the first work at the Orogrande-Frisco mine was done at that time. Results from the reconnaissance work were largely negative, except for a geochemical soil sampling program that indicated anomalous conditions near the Orogrande-Frisco mine.

During the 1969 field season, a semidetailed geochemical humus and soil sampling program was carried out to define and possibly extend the anomalous target area indicated by the 1967 work. Results from the 1969 geochemical sampling reinforced evidence from the earlier work and indicate the direction that further efforts should follow.

LOCATION AND ACCESS

The Orogrande district is in central Idaho County, Idaho, about 12 miles south of Elk City and approximately 58 miles southeast of the Camas Prairie Railroad railhead at Grangeville, Idaho (fig. 1). Road access to the district from Grangeville is by paved Idaho State Highway 14, except for the final 10 miles of graveled U.S. Forest Service secondary road. The graveled road is

closed to wheeled vehicles by snow for about 4 months during the winter, although it is generally open to snow-mobile traffic.

The Orogrande district is in a region of rolling hills, probably a dissected plateau. The primary drainage is the Crooked River, which flows northward into the South Fork of the Clearwater River. Altitudes in the district range between 4,100 and 5,500 feet.

The snow-free period extends from early June until late October; average depth is between 10 and 20 inches at lower elevations in the district. Average January temperatures are between 20° and 28° F; the average July temperature varies between 66° and 70° F.

Most of the slopes have a dense cover of conifer timber, part of which is second growth. Deciduous vegetation grows chiefly along the drainage courses.

A thick soil cover is present. Rock outcrops are rare, and occur mostly along streams and on ridgetops; other exposures can be found in roadcuts and similar manmade excavations.

The only currently available topographic map covering the district is the Army Map Service 1:250,000 scale Elk City sheet. U.S. Forest Service planimetric maps at a 2 inch = 1 mile scale, and Forest Service 1:15,840 scale, 1960-dated aerial photographs cover the region.

HISTORY AND PRODUCTION

The Orogrande district has produced the largest tonnage of gold ore of any district in Idaho County. The ore was mainly from the low-grade deposit of the Orogrande-Frisco mine; a substantial amount of placer gold was produced by dredging operations on the Crooked River north of Orogrande.
Initial work on the low-grade deposit was done by Arthur Hogan in about 1900; the mine was first brought into production in 1902 as the Butte and Orogrande. A 20-stamp mill was built in 1902, and a 100-ton-capacity cyanide plant was added a few years later. The mine was operated nearly every year from 1902 to 1909, and again from 1914 to 1920. During the entire period (1902-20), 42,491 tons of ore were mined and 2,927 ounces of gold and 309 ounces of silver were produced (4).

Orogrande-Frisco Mines, Inc., put the property into operation again in 1934 and processed 5,600 tons of ore the first year. During 1935 the mill was enlarged and open-pit mining adopted; 90,000 tons were treated by straight cyanidation in 1936, and 238,671 tons of ore were milled in 1937. In the summer of 1937, the first large quantities of fresh sulfide ore were processed; all mill feed in the past had come from the surface oxidized zone. During a 6-month period in 1937, 71,137 tons of open-pit ore having a value of $1.383 per ton were mined and milled at a cost of $0.951 per ton. Gold recovery dropped from the previously reported 80 to 83 percent to 76 percent, a value of $1.087 per ton. Milling capacity was 600 tons per day (2).

The last year of production was in 1938. Mill feed was obtained from the Orogrande-Frisco pit and from a small open pit at Knob Hill, about one-fourth mile southeast of the mill. The operation started late in the year and shut down for the last time on November 22. The 1938 production amounted to 1,076 ounces of gold.

GEOLOGY

General Statement

Most of the Crooked River valley and adjoining lower hill slopes in the vicinity of Orogrande are underlain by Cretaceous age granitic rocks of the Idaho batholith (fig. 2).

In general, schistose and gneissic rocks thought to be the metamorphic equivalents of Precambrian argillite and quartzite occur in north-trending, elongate belts. The belts occupy higher elevations east and west of the Crooked River near Orogrande. However, a narrow, north-trending band of quartzite, probably of Precambrian age, crops out along the Crooked River and in the low hills west of the river about 3 miles north of Orogrande.

The metasedimentary rocks are bordered by transition zones where gneiss grades into granitic rock, and where pegmatite dikes and small-scale, irregular-shaped pegmatitic bodies and aplite dikes have been injected into the older rocks.

*Underlined numbers in parentheses refer to items in the bibliography at the end of this report.*
FIGURE 2. - Geologic Map.
Metamorphic Rocks

The oldest rocks in the Orogrande district are a group of Precambrian schists, gneisses, and quartzites that are probably equivalents of the Belt Series rocks in northern Idaho.

Several variations of the schistose rock type are exposed in the Orogrande-Frisco pit. In general, the schist is a foliated, medium- to fine-grained, light greenish-gray rock composed largely of quartz and muscovite mica. One facies contains what appears to be crushed and altered feldspar grains and a considerable proportion of a light green talcose mineral; another has abundant quartz and is considerably coarser grained than most of the schist. Bedrock exposures are generally discontinuous and partly blanketed by overburden and slough; therefore, the contact relationships of the metamorphic rocks to one another and to the granitic body to the east are obscure. The foliation in the schist strikes from N 30° to N 50° W; the dips are 45° to 50° SW.

Gneissic rocks are exposed in several locations along the east-flowing minor tributaries to the Crooked River northwest of Orogrande. The predominant rock type is a dark gray gneiss composed largely of quartz, feldspar, biotite, and hornblende, with a well-developed segregation banding of light- and dark-colored minerals. In places, this rock grades into an injection gneiss; narrow bands of light-colored acidic rock were intruded along foliation planes.

An uncommon facies of the gneissic rock is made up mostly of granular quartz and feldspar, with subordinate biotite and muscovite. The color is lighter and the banding is not as obvious as in the hornblende-bearing variety.

Quartzite is exposed in a narrow, north-trending band along the Crooked River north of Orogrande. The quartzite is a medium-grained granular, light gray to nearly white rock composed primarily of quartz and muscovite mica, with accessory feldspar and dark minerals. The contacts between the quartzite and the other metamorphic rocks appear to grade into one another.

Igneous Rocks

Granitic intrusive rocks assigned to the Cretaceous Idaho batholith occupy most of the Crooked River valley and adjoining lower slopes near Orogrande. The granitic rocks intrude the older metamorphic series, although no sharp, well-defined contacts were observed. Some outcrops of granitic rock show a linearity of the micas that grades into a slight gneissic banding away from the contact.

The granitic rocks are generally coarse-grained and porphyritic, and contain a very small percentage of dark mineral constituents. The typical rock cropping out near the Orogrande-Frisco pit is a light gray quartz monzonite, composed of quartz, orthoclase, and plagioclase feldspars in nearly equal proportions, and muscovite mica. It is light-colored rock, with over 20 percent quartz and no visible dark-colored accessory minerals.
Many small, discontinuous dikes and irregular-shaped bodies of pegmatite related to the batholithic mass occur as injections in the older metamorphic rocks. The pegmatites, consisting largely of quartz, potassic feldspar, and muscovite, are light colored and extremely coarse grained.

A fine-grained, sugary textured, tan to buff colored aplite composed of quartz, feldspar, and muscovite occurs in small-scale dikelike intrusive bodies that cut the older rocks.

Structure

Apparently the predominant structural trend in the district is northeasterly. Foliations in the schistose rocks, a linearity of minerals in the gneissic and granitic rocks, and prominent joints cutting all rock types strike from N 5° W to N 50° W and dip from 30° to 50° westward. Shenon and Reed (3) state that throughout the region the metamorphic rocks are tightly (and probably isoclinally) folded; however, bedrock exposures in the district are so few that the type of folding could not be determined.

Strong shearing that may have been a controlling factor in the formation of the gold ore bodies is exposed in the Orogrande-Frisco and Knob Hill open pits. The shearing has a north to northerly trend and a westerly dip.

OROGRANDE-FRISCO DEPOSIT

The Orogrande-Frisco open pit is 400 feet long and 300 feet wide. Mining was conducted principally from an upper bench, with a small lower bench representing an insignificant amount of work. The pit is situated on the east slope of a north-trending ridge; the workings have the long dimension oriented north-south.

The mineralized structure or zone of altered and structurally disturbed rock is exposed in the northwestern end of the pit, where it is about 250 feet wide. Alteration diminishes in intensity to the east and south; rock exposed on the mine road just south of the pit is a normal appearing, weathered quartz monzonite.

The deposit has been variously described as a mineralized dike, a stockwork, a disseminated deposit in gneiss and aplite, and as a large shear zone. It is probably a disseminated deposit located in a large north-trending shear zone that in turn is roughly localized along a gradational contact between metamorphic rocks and a granitic intrusive body.

The best exposures of the type of material mined are in the upper bench wall at the north end of the pit. The rocks are a complex assemblage of sheared, altered quartz-mica schist, coarse-grained quartz monzonite, and pegmatite. Schist predominates in the extreme northwest pit corner, and intrusive igneous rock is predominant in the remainder of the workings.

The schist is a well-foliated, generally intensely fractured, light greenish-gray rock composed mostly of quartz and muscovite.
red-brown to black iron and manganese stain occurs along the foliations, and a small amount of disseminated grains of pyrite was observed in places. In areas bordering prominent shear planes, the mineral grains are severely crushed, and occur in a green-colored talcose matrix.

The schistose rocks are in contact with highly fractured, bleached, coarse-grained, light gray to buff colored porphyritic quartz monzonite; contact relationships are obscure because of poor exposures and intense local structural disturbance. The quartz monzonite is composed of quartz, feldspars, and muscovite mica; it is an extremely light-colored rock, containing over 20 percent quartz. The rock is profusely iron stained along numerous fractures, and has well-developed siliceous boxwork along some prominent fractures.

Pegmatite dikes and irregularly shaped small intrusive bodies intersect the older rocks. The pegmatites are light colored and similar to the quartz monzonite in composition. In common with the older rocks, the pegmatite is also well fractured and moderately to highly altered.

The predominant structural trend is northwesterly. Shearing, foliation in the schistose rocks, prominent joints, and a linearity of mineral grains in the quartz monzonite strike from N 5° W to N 50° W and dip from 40° to 50° to the southwest. The structural trend appears to swing more northerly in the extreme northeast end of the pit. All the rocks in the pit have been altered, although the granitic rocks were more severely affected. Bleaching is prevalent, and some granitic rock is soft; the feldspars are almost completely altered to a soft, plastic clay. The rocks are silicified; an area in the north-central pit wall contains several narrow, vertical ribs that are extremely hard and well silicified. Moderate to heavy iron and manganese stain occurs along joints and fractures in all the rocks, and along foliation planes in the schist. In one area of intense shearing, the schist contains a high percentage of a green-colored talcose or chloritic mineral.

Most of the gold is thought to occur in the free state as fine disseminations throughout the rocks in and adjacent to the shear zone. Character samples from quartz stringers and from pyrite-bearing rock assayed only a trace of gold. The sole metallic mineral observed was pyrite, which occurs in all the rock types (probably concentrated in the schist) as small disseminated blebs and crystals, and as thin crystalline fracture fillings.

Surface oxidation and secondary enrichment do not appear to have been important factors in forming the Orogrande-Frisco ore body. Although iron staining occurs throughout the pit, fresh pyrite is found at all elevations except in the first few feet near the surface.

During the early period of operation by the Butte and Orogrande Company (1902-20) the average grade of rock milled was 0.068 ounce gold per ton; the schist reportedly contained 0.087 ounce gold per ton, and the granitic rock 0.014 ounce gold per ton. The overall grade of material mined through 1938 was 0.052 ounce gold per ton.
Silver was apparently not considered important, or the mill recovery may have been low. For the period 1902-20, only 309 ounces of silver were produced as contrasted with 2,907 ounces gold for the same period. Silver was not reported at all from later production.

The Orogrande-Frisco pit was thoroughly sampled by the A. O. Smith Co. in 1936. A total of 380 samples were taken; 247 assayed 0.015 ounce gold per ton or more. Silver assays were made on 125 samples; the average silver assay was 0.26 ounce per ton.

BUREAU OF MINES INVESTIGATIONS

Reconnaissance Bedrock Sampling

During the summer of 1967, the Heavy Metals Investigations project made a reconnaissance investigation of the Orogrande district and the area adjoining to the north. The purpose was twofold: (1) To investigate a reported regional mineralized zone (the so-called "Hogan Dike"), and (2) to evaluate the Orogrande-Frisco mine as a potential large, low-grade gold deposit.

The Hogan Dike is mentioned in the literature as a north-trending mineralized zone of regional magnitude that begins near Orogrande and terminates over 10 miles to the north near Elk City. Because the Orogrande-Frisco deposit was reported to be a part of the extensive zone, the Bureau's field investigation of the Hogan Dike was started in an area west of the Crooked River and north of the Orogrande-Frisco mine. Traverses were made up all drainages and ridge crests from Orogrande north to the mouth of Relief Creek—a distance of about 3-1/2 miles. The traverses reached distances averaging about one-half mile west of the river. The few bedrock exposures encountered were located along streams, roads, trails, and in prospect workings. All prospect pits and dumps from underground workings were sampled, and all bedrock outcrops were examined for evidence of a mineralized zone. The workings apparently exposed only small mineralized structures; no evidence was found for the presence of an extensive zone of regional size. Samples from all workings encountered were assayed for gold and silver. A total of 29 samples were taken; one assayed 0.04 ounce gold per ton, two contained 0.03 ounce per ton, two assayed 0.005 ounce per ton, and most of the remainder showed no gold. Three samples assayed 0.05 ounce silver per ton.

The Idaho Champion claims, located west of the mouth of Relief Creek and about 3-1/2 miles north of Orogrande, were briefly investigated and sampled. The claims contain 3,500 feet of workings that reportedly explore a large, low-grade gold-bearing zone. The overburden is relatively thick and the underground workings are inaccessible; therefore, samples were restricted to open cuts, from over portals of caved adits and from dumps. One sample, from a small dump of fine material near the millsite, contained 0.96 ounce gold and 2.35 ounces silver per ton; another contained a trace; and the remainder were negative.

A small open pit known as the Knob Hill workings is situated on Quartz Creek, about one-eighth mile southeast of Orogrande. During the last year of
operation at the Orogrande-Frisco mine (1938), part of the mill feed is reported to have come from the Knob Hill pit. The workings consist of a single 250-foot bench with a face 150 feet high developed in the side of a low hill. The rocks are an assemblage of metamorphic and igneous rock types with the same general appearance and composition as those in the Orogrande-Frisco mine. Three chip samples taken across a total width of 220 feet of the mineralized zone averaged 0.03 ounce gold per ton; a 42-foot interval ran 0.05 ounce silver per ton.

The Orogrande-Frisco open-pit workings presented a problem in sampling. Large parts of the pit walls are covered by weathered rock sloughed in from above; the northern end of the pit wall is steep and contains silicified ribs that are exceedingly hard and resistant. Because of these factors, the Bureau's sampling program consisted of two horizontal and one vertical channel sample taken in the upper northwestern pit wall, and a horizontal channel sample cut in the northern wall. The last sample stopped short of the steep, siliceous ribbed area. The two westernmost horizontal channels and the vertical channel cut mostly weathered rock that may not have been in place; the northernmost horizontal channel sample was apparently in solid bedrock. The three samples comprising the weathered, sloughed material contained only a trace of gold; a 105-foot section of the bedrock sample assayed 0.04 ounce gold per ton and 0.02 ounce silver per ton.

Reconnaissance Geochemical Sampling

During the 1967 field season, a suite of 70 geochemical soil samples was taken covering a 1,400- by 800-foot area adjoining the Orogrande-Frisco pit on the west, north, and south sides. The samples were taken at 100-foot intervals on east-west lines spaced 200 feet apart. Each sample contained about 1 pound of soil from the "B" horizon, taken from 4 to 6 inches below the surface. Analyses were made by the U.S. Geological Survey by atomic absorption methods for gold, silver, and mercury, with the results reported in parts per million.

The geochemical determinations were made to test the applicability of the method to this region, and to establish trends of mineralization or target areas for additional work.

The analytical results yielded values between 0.02 part per million (ppm) and 5.0 ppm gold, from 0.6 ppm to 1.4 ppm silver, and from 0.06 ppm to 0.55 ppm in mercury. No regional background was established, but an average of the 17 lowest value samples ran 0.05 ppm gold. Taking this figure as background and using the rule of thumb of five times background for an anomalous condition, the low anomalous value for gold was set at 0.25 ppm. The analytical results for silver and mercury had such a small overall sample value range that they were not considered further.

The reconnaissance geochemical sampling program was successful in showing that anomalous gold values exist in part of the district.
Semidetailed Geochemical Sampling

During the 1969 field season, a semidetailed geochemical sampling program was carried out in the Orogrande district as a followup to the 1967 reconnaissance soil sampling. Both soil and humus samples were taken because of the Bureau's success with humus sampling in the Stibnite, Idaho, district.

The area to be sampled was broken into three one-quarter square mile blocks (fig. 3). The central block (Block A), including the Orogrande-Frisco pit and the area covered by the 1967 sampling, was scheduled first, with the results to be evaluated before proceeding.

A base line bearing N 15° W was surveyed in with Brunton and tape from a starting point near the Knob Hill pit on Quartz Creek. The line was extended northwesterly for a distance of three-fourths mile to a point north of the first drainage north of the Orogrande-Frisco workings.

A network of crosslines one-half mile long was established normal to the base line with the base line as a center. Soil and humus samples were taken at 200-foot intervals along the crosslines wherever possible. Certain areas, such as the Orogrande-Frisco pit, parts of the river valley covered by dredge tailings, and plots occupied by buildings, were not sampled.

The humus samples consisted of coniferous tree needles gathered from the 1- to 3-inch-thick pad of accumulated material beneath the trees. About 1 pound of the gray-colored layer of needles located below the brown-colored, fresher, uppermost layer was taken. Coniferous timber types in the sample block are Douglas fir (Pseudotsuga menziesii), Englemann spruce (Picea englemanii), alpine fir (Abies lasiocarpa), and whitebark pine (Pinus albicaulis). Soil samples were taken from 6 to 8 inches below the surface, in the upper part of the humus free subsoil or "B" horizon.
The humus samples were ashed and screened, and the minus 10-mesh fraction analyzed for gold and silver by a fire assay-atomic absorption process. The results were reported in parts per million.

A suite of 10 background samples was taken at random from locations adjoining a 4-mile length of the Crooked River road. A background value was calculated by averaging analytical results from the background sampling with 83 low-value samples for humus-gold and 21 low-value samples for humus-silver. Background was established at 0.03 ppm gold and 0.10 ppm silver; assuming values over five times background to be anomalous, low anomalous values were set at 0.15 ppm for gold and 0.50 ppm for silver.

The soil samples were analyzed by atomic absorption methods, but the results were so erratic in comparison with the corresponding humus samples that it was decided to rely solely on the humus sampling.

Figures 4 and 5 show target areas developed by anomalous sample values. Although the value patterns differ for gold and silver, both depict anomalous areas west and southwest of the Orogrande-Frisco workings, and both show an open-ended anomalous area to the southwest.

CONCLUSIONS AND RECOMMENDATIONS

Assay results from Bureau of Mines sampling in the Orogrande-Frisco pit were generally disappointing; however, some of the low values were probably a result of contamination from sloughed surficial material. The one sample trench that cut rock in place yielded assay results approaching the grade of ore being mined when the operation closed. The northern end of the pit containing the silicified ribs was not sampled. The Bureau sampling, therefore, was inconclusive, and the pit area might contain higher values than the sampling indicates.

Geochemical humus sampling for gold and silver defined an anomalous target area west and southwest of the Orogrande-Frisco pit; delineation of the anomalous area was not completed to the south.

It is recommended that another block of geochemical humus samples be taken to define the southern end of the anomalous area. It is also recommended that a foot reconnaissance be made of the region northwest and southeast of the Orogrande-Frisco mine to investigate possible extensions of the mineralized zone.
Note: Low anomalous value = 0.15 ppm

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<th>Dredge tailings</th>
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FIGURE 4. - Gold Geochemical Humus Sampling Map.
Note: low anomalous value = 0.60 ppm

LEGEND

- Anomalous sample values
  - 0.60 ppm Ag to 1.0 ppm Ag
  - 1.0 ppm Ag to 2.6 ppm Ag

- Prospect
- Qls: Landslide area
- Dredge tailings
- Humus sample site

Scale, feet

FIGURE 5. - Silver Geochemical Humus Sampling Map.
BIBLIOGRAPHY


