0260 0001 Majuba Hill, Nevada

267

item 1

Arthur A. Bookstrom (Mine Finders, Inc.)

W. Bruce MacKenzie (Mine Finders, Inc.)

CASE HISTORY OF GEOCHEMICAL SURVEY

1. Objective

Majuba Hill was chosen for exploration because it consists of hydrothermally mineralized and altered rhyolite porphyry stocks, dikes, and breccias (MacKenzie and Bookstrom, 1977), because the Majuba Mine has produced copper, silver, and tin, and because Majuba Hill has been studied by geologists of the U.S. Geological Survey as a possible source of tin (Smith and Gianella, 1942), and uranium (Trites and Thurston, 1949).

2. Location

Majuba Hill is in Pershing County, Nevada, approximately 100 mi northeast of Reno and 18 mi west of Imlay, at about 40°40' N, 118°28'E, in sections 2 and 3, T 32N, R31E, and sections 34 and 35, T33N, R31E. An area of about 6 sq mi was intensively explored.

3. Local geologic setting

Talus and alluvium cover about 30 percent of the Majuba area to depths of a few inches to about 50 ft. Thin, immature soils are developed on weathered bedrocks and on alluvium.

The host rocks for most of the mineralization at Majuba Hill are subvolcanic rhyolite porphyries and breccias of mid-Tertiary age. A few veins also are present in the northeast-trending, steeply-dipping argillites that surround the intrusive complex.

The high-grade copper and tin ores produced from the Majuba Mine were from a zone of triple intersection of the Majuba Fault, a tourmaline breccia pipe, and the subsurface top of a Late Rhyolite Porphyry dike (MacKenzie and Bookstrom, 1977), all three of which contained arsenic- and silver-bearing copper ore. The tin was in cassiterite-rich pods in tourmaline breccia near the fault.

These deposits are tentatively classified as xenothermal with an overprint of supergene alteration. They share some of the characteristics of copper-bearing tourmaline breccia pipes, and some of porphyry tin-silver deposits.

Three large, very low-grade stockworks of veinlets containing copper-, molybdenum-, tin-, silver-, and/or arsenic-bearing minerals are present within the Majuba complex. These deposits are transitional in character between porphyry copper, porphyry molybdenum, and porphyry tin-silver deposits.

Relatively minor veins and breccias in the argillites peripheral to the intrusive complex contain copper-, zinc-, lead-, silver-, and/or arsenic-bearing minerals.

Hydrothermal sericite, kaolinite, montmorillonite, tourmaline, and silica are common to abundant in the rhyolitic rocks of the Majuba intrusive center. Secondary potassium feldspar is present locally at depth. Argillites near the contacts of the intrusive complex are locally silicified and tourmalinized, and epidote is common in limy boudins in the argillites farther from the contacts. Chlorite is common in dioritic to quartz-monzonitic dikes that cut the argillites peripheral to the complex.

ble
ce

4. Mineralization

Ore and gangue minerals characteristic of Majuba Hill are listed below, followed by the designations (a) for abundant, (c) for common, (s) for sparse, and (r) for rare:

1. Ore Minerals (Primary): pyrite (c), chalcopyrite (c), arsenopyrite (c), pyrrhotite (c), molybdenite (c), sphalerite (c), galena (s), cassiterite (s), enargite (r);
2. Ore Minerals (secondary): chalcocite (c), digenite (c), malachite (c), chalcanthite (s), clinoclase (s), arthurite (s), olivenite (r), metazeunerite (r), other secondary copper-and arsenic-bearing minerals (r);

3. Gangue Minerals: quartz (a), tourmaline (a), fluorite (c-s).

The approximate plan-view dimensions of the targets tested by drilling at Majuba Hill correspond roughly with the dimensions of the geochemical anomaly patterns for copper (135 ppm) and molybdenum (6 ppm) as shown in Fig. 1. They range from about 500 ft to 3,000 ft across.

The Majuba Mine has produced about 4,000 tons of 12 percent copper ore, 23,000 tons of 4 percent copper ore, and 350 tons of 2-4 percent tin ore. The copper ores carried good values in silver, but total production of silver is not recorded.

The veinlet stockwork-type deposits of Majuba Hill are of sub-economic grade. Drill holes were relatively widely spaced, and although several of them passed through hundreds of feet of rock containing 0.2 to 0.4 percent copper and 0.01 to 0.1 percent molybdenum, we lack the closely spaced drill information necessary for tonnage and grade estimates.

5. Local geographic factors

Majuba Hill is a prominent and rugged mountain with about 1700 ft of relief. It is surrounded by a circular drainage pattern and by the rounded hills of the Antelope range. Outcrop abundance in the Majuba area is approximately 30 percent. The climate is arid to semi-arid, and the soils are immature pedocals. Soil depths generally range from 0 to 2 ft of predominantly c-horizon material. Caliche is locally developed in alluvium. Sage brush is ubiquitous, and creosote bushes and sparse grasses also are present. Mine dumps, an abandoned tailings pond, and a collapsed tram line are the known sources of contamination.

6. Sampling procedures

Soil samples were taken by George Eliopulos and others from small pits dug with pick and shovel to depths of six to ten inches. Samples were taken on 300 ft spacings over the entire area, and on 100 ft spacings in anomalous zones (Fig. 1-A).

Figure 1. Soil sample locations and geochemical anomaly patterns, Majuba Hill intrusive center.

A. Outline of the Majuba Hill intrusive center, (line drawing), and geochemical soil sample locations (dots). The area sampled extends well beyond the margins of the area shown in this diagram (about 3,000 ft to the north, 3,600 ft to the east and west, and 900 ft to the south).

B. Contour map showing soil geochemical anomaly patterns for copper in parts per million (ppm).

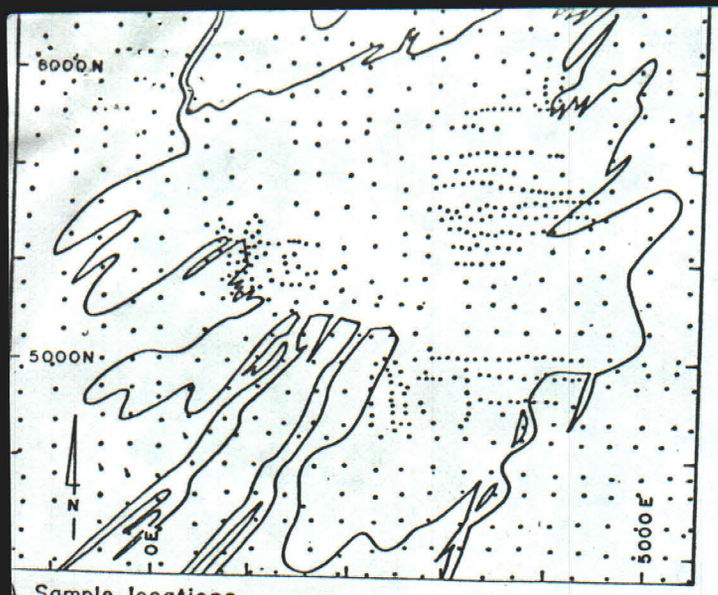
C. Contour map showing soil geochemical anomaly patterns for molybdenum in parts per million (ppm).

D. Contour map showing soil geochemical anomaly patterns for tin in parts per million (ppm).

E. Contour map showing soil geochemical anomaly patterns for silver in parts per million (ppm).

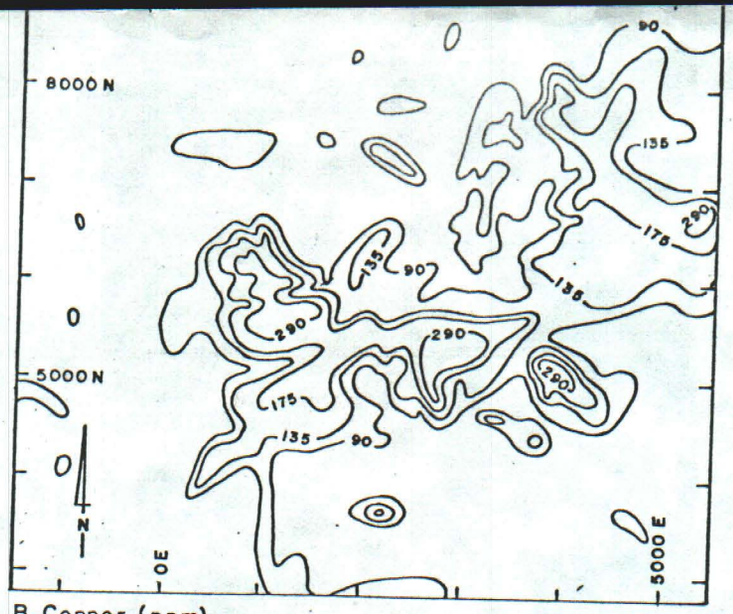
F. Outline of the Majuba Hill intrusive center, showing three zones of altered and mineralized rocks, as follows:

1. Sericitized rocks with anomalous concentrations of Cu, Sn, and Ag—spacially, temporally, and genetically associated with a subjacent stock of Felsite.
2. Silicified, sericitized, and locally K-feldspathized rocks with anomalous concentrations of Mo, Cu, and Ag—spacially, temporally, and genetically associated with a subjacent stock of Majuba rhyolite porphyry.
3. Tourmalinized rocks with anomalous concentrations of Cu, Ag, Sn, and Mo—spacially, temporally, and genetically associated with the triple intersection of the Majuba Fault with a tourmaline breccia pipe, and the subsurface top of a Late rhyolite porphyry dike.



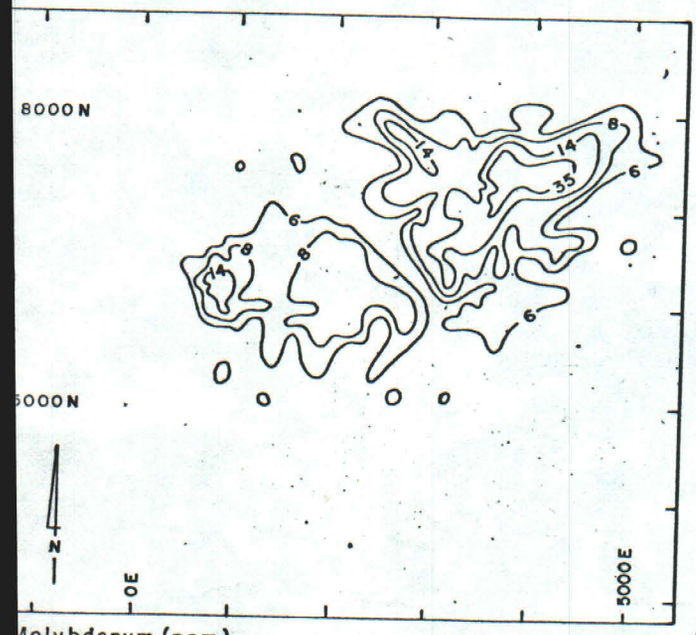
A. Sample locations

0 1000FT.



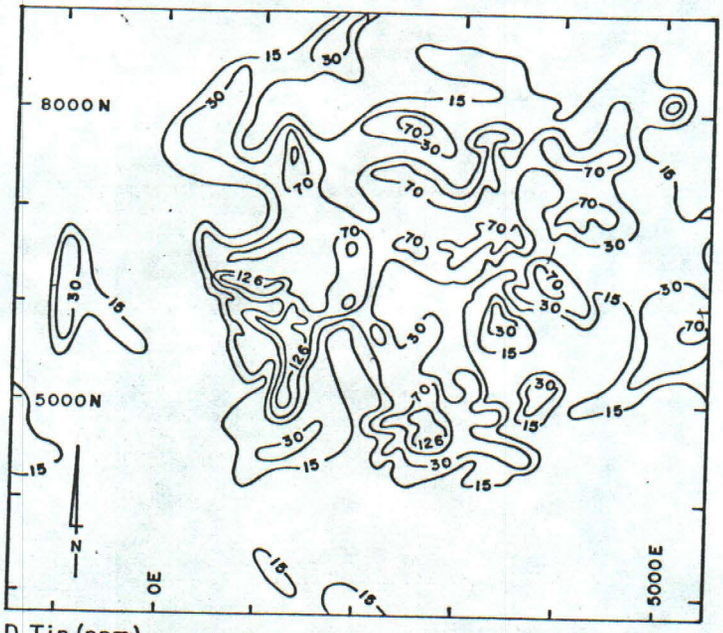
B. Copper (ppm)

0 1000FT.



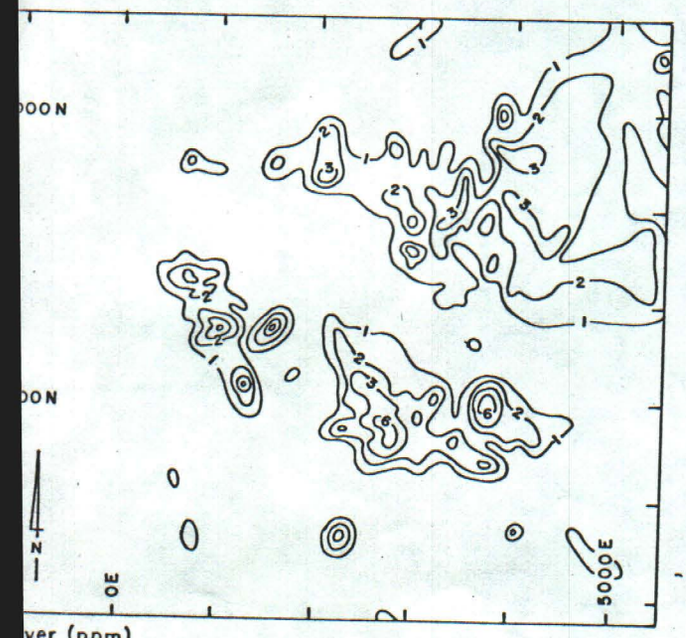
Molybdenum (ppm)

0 1000FT.



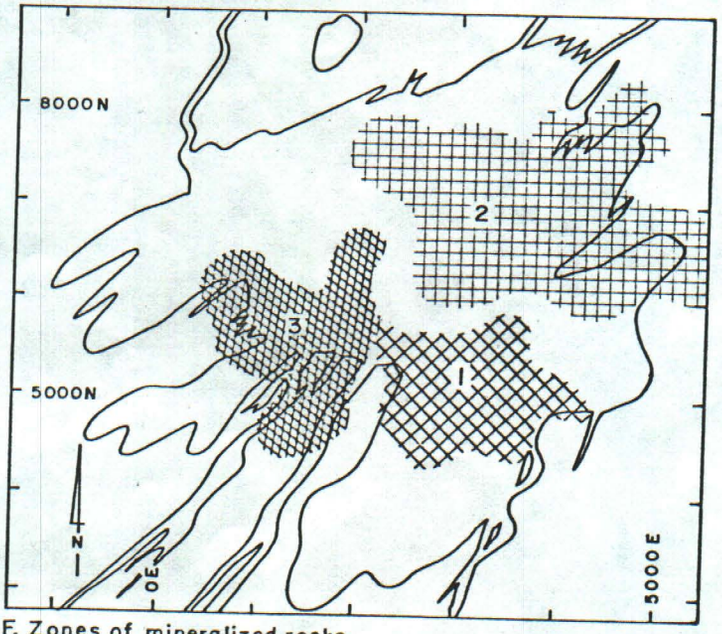
D. Tin (ppm)

0 1000FT.



ver (ppm)

0 1000FT.



F. Zones of mineralized rocks

0 1000FT.

7. Sample preparation and analysis

Prior to analysis the samples were hand cleaned of organic materials, dried, seived to minus 35-mesh, and pulverized. The 35-mesh seive was used because pilot studies indicated that tin was depleted at sieve sizes smaller than 35 mesh. Pulverization was required before digestion because of the rather coarse seive size used.

Each soil sample was analyzed for copper and silver by atomic absorption, for molybdenum by colorimetry, and for tin by emission spectrography.

8. Summary of results

Soil geochemical anomaly patterns for copper, molybdenum, tin, and silver are shown in Fig. 1. The major soil geochemical anomalies, as well as most of the mineralized and altered rocks tested by drilling at Majuba Hill are spacially related to ~~the~~ three intrusives (MacKenzie and Bookstrom, 1977), ~~shown in Fig. 1 and listed~~ as follows: (1) the Felsite stock (Cu, Sn, Ag), (2) the Majuba Porphyry stock (Mo, Cu, Sn, and Ag), (3) the Late Rhyolite Porphyry (Cu, Ag, Sn, and Mo).

Drilling in the vicinity of the Felsite stock (Zone 1, Fig. 1 F) substantiated the presence of copper mineralization indicated by the surface geochemical anomalies. The sizes of the subsurface mineralized zones are similar to those of the surface anomalies, but the copper grades encountered in the drill cores are as much as 10 times higher than those in the soils. Most of the copper in the drill core is in veinlets of chalcopyrite with pyrite, or in veinlets of very fine-grained chalcopyrite with arsenopyrite and pyrrhotite. No tin or silver minerals were recognized, but geochemical distribution patterns and drill-core assays show these elements to be directly associated with copper in the Felsite-related zone of mineralization. No molybdenum anomalies were present in the soils or in the drill cores from Zone 1, the Felsite-related zone of mineralization.

The northeastern soil geochemical anomalies for molybdenum, copper, tin, and silver are very low-grade and irregular in shape (Zone 2, Fig. 1F). They are underlain by a stock of Majuba Porphyry, which is closely associated with an extensive zone of silicification and low-grade (less than 0.1 percent) molybdenite mineralization. The northeastern copper, tin, and silver geochemical anomalies probably represent very low-grade mineralization aureoles peripheral to the molybdenite zone.

In the southwestern part of the Majuba intrusive center, the north-northwest-trending geochemical anomaly patterns for copper, tin, and silver are closely associated with the trace of the Majuba fault. (Fig. 1 B, D, and E). Copper concentrations in the soils above the copper stope (290 ppm) are much lower than those mined from that stope (2 to 12 percent).

Broader copper and molybdenum geochemical anomalies in the southwestern part of the Majuba intrusive center (Fig. 1 B, C) are associated with stockworks of tourmaline veinlets peripheral to a tourmaline breccia pipe (Zone 3, Fig 1 F). Chalcopyrite is commonly associated with the tourmaline in such veinlets, but very little molybdenite was observed, even though assays indicate anomalous concentrations of molybdenum.

The highest-grade tin anomaly lies parallel to, and downslope from the surface exposure of the Majuba fault. Although the geochemical tin anomaly suggests that the Majuba fault is the most favorable area for tin prospecting, individual cassiterite-rich pods are not defined.

9. Remarks

The fact that copper concentrations are lower in soils than in drill cores suggests that copper has been partially leached from the soils. However, inasmuch as coherent copper anomalies remain, and the positions of these anomalies correspond to the positions of subjacent zones of copper mineralization, it would appear that copper leaching was incomplete. The incomplete copper leaching and the lack of widespread zones

of supergene enrichment can probably be attributed to the generally low sulfide content of the Majuba rocks. Evidently the amounts of sulfuric acid required for complete copper leaching and development of a strongly enriched zone were not generated during the weathering of the Majuba rocks.

Molybdenum concentrations in the soils (6 to 35 ppm) are generally lower than those of the molybdenum zones encountered in drill holes (100 to 1000 ppm), perhaps because the best zones of molybdenum mineralization do not reach the surface.

Tin is more concentrated in the soils than in the rocks. The fact that tin is depleted in soil samples seived to sizes smaller than 35-mesh suggests that tin is particulate, and that tin-bearing particles (probably cassiterite grains) range in size to 35-mesh. Cassiterite grains probably were residually concentrated during formation of the Majuba soils.

Silver content is very low in both soils and drill cores. Anomalous silver values are generally associated with anomalous copper values, but the anomaly patterns for silver are more tightly defined than those for copper.

False anomalies for copper and silver were encountered at coordinates 3500 N, 1100 E, at the probable site of a tram-line terminal.

The most significant result of the geochemical survey was that three large anomalous areas were defined within the Majuba intrusive center. These were tested by several deep but widely-spaced drill holes. The surficial anomalies were found to correlate well with zones of mineralized rock, which were found to be spacially, temporally, and genetically related to three specific intrusives within the complex. Unfortunately, however, the mineralized rocks were sub-economic in grade.

10. References

MacKenzie, W.B., and Bookstrom, A.A., 1977, Geology of the Majuba Hill area, Pershing County, Nevada: Nev. Bur. Mines Bull., in press. a call to John Schilling, Nev. Bur. Mines would give Bull. #

Smith, W.C., and Gianella, V.P., 1942, Tin deposit at Majuba Hill, Pershing County, Nevada: U.S. Geol. Survey Bull. 931-C.

Stevens, D.L., 1971, The geology and ore deposits of the Antelope (Majuba Hill) mining district, Pershing County, Nevada: Unpub. M.S. thesis, Univ. of Nev., Reno, Nev.

Trites, A.F., and Thurston, R.H., 1949, Geology of Majuba Hill, Pershing County, Nevada: U.S. Geol. Survey Bull. 1046-I.