May 3, 1942.

Mr. Benj. C. Charles,
Charles, Keith and Rivers,
510 West Sixth Street,
Los Angeles, California.

Dear Ben,

I, too, have been reading Ward Smith's recently received paper, 931-C on Majuba Hill with considerable interest. It does not paint an attractive picture, I must admit. Smith, of course, is entitled to his interpretation, as I am to mine.

Attached you will find my reactions to this paper. I apologize for the length I have gone to, but I believe it warranted. This rebuttal represents only my own ideas and should not be construed as representing Freeport's. Since it is all a matter of personal geologic interpretation, I am sure that I have this right to speak my mind. You will find nothing specific, such as assay data; only individual's observations are being presented.

My hope is that what little I can contribute may show that there is another side to the story. Incidentally, may I suggest that if you are in Reno you contact Prof. V. P. Gianella, the co-author of Bulletin 931-C. I feel that what he might give you verbally, would be a bit more encouraging than the conclusions reached in this bulletin. Soxy knows him well, and so it could be easily arranged. If you want me to drop him a line, I'll be glad to.

Thank you for the kind reference, contained in your letter to Mr. Gray. I appreciate it.

Give my best regards to Doug McKinnon when you write him.

Best wishes to you, Ben, and remember the invitation still stands to try the steelhead on the Rogue.

Sincerely,

David LeCount Evans

Box 190, Grants Pass,
Oregon.
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLoGICAL SURVEY

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REPORTS

Reports are sold by the Superintendent of Documents, Government Printing Office, Washington, D. C., to whom remittances should be sent by money order.


This paper describes the Iron Hill stock and associated rocks of southwestern Colorado. The country rocks associated with the stock are dolomitic sandstone and diabase. The stock is a large, lens-like body, with a diameter of about 2 miles. The stock is composed of a single chamber, which is divided into several smaller chambers by dykes and sills. The stock is believed to be a batholith.


This paper records and illustrates the species and genera of foraminifera from the Oligocene rocks near Milby, Alabama. The foraminifera are divided into three groups: the Globigerinidae, the Elphididae, and the Discorbidae. The report also includes a map of the area.


The tin and copper deposits at Majuba Hill, Pershing County, Nev., are in a partly brecciated plug of Tertiary diabase porphyry, which is located near the town of Majuba and is in some places intensely metamorphosed. The tin mineral, cassiterite, appears to be associated with the alteration, and the single concentration of it was formed by replacement of altered breccia. The deposit is enclosed in a body of altered rock, and is thus a deposit of the type described as "replacement deposit." The deposit is estimated to contain about 12,000 pounds of metallic tin. The deposit is not yet worked, and the future development of the deposit is uncertain.


Scheelite ore bodies occur in widely separated localities in the Sierra Nevada near Bishop, Calif. The deposits are in altered igneous rocks at or near the contact between granite rocks and metamorphic rocks. The scheelite ore is associated with the alteration of the granite, and the scheelite ore bodies are closely associated with the granite. The scheelite ore bodies are estimated to contain at least 200,000 tons of scheelite.

Chromite deposits occur at the southern end of Keral Peninsula, Alas., in three areas, Claims Point and the Dorado area. They are contained in masses of amphibolite rocks, which are intrusive into a complex of metavolcanics, slates, and quartzites of Paleozoic age. The intrusive bodies are large, the largest known being about 1 mile in diameter. The chromite deposits consist of black, massive, coarse-grained chromite, and are associated with pyroxene, feldspar, and quartz. The chromite is associated with pyroxene, feldspar, and quartz. The chromite is massive, coarse-grained, and black. The chromite is coarse-grained and massive, with pyroxene, feldspar, and quartz.


The Riddle nickel deposit is located near the north end of the Mount Shasta, about 6 miles northwest of Riddle, Douglas County, Oreg. The deposit is a layered deposit, containing at least three distinct nickeliferous intervals, which rest upon unaltered serpentinites. The lower interval is a thick, massive body of massive chromite and pyroxene, and is about 30 feet thick. It is followed by a series of thin, massive bodies of massive chromite and pyroxene, separated by thin layers of unaltered serpentinites. The upper interval consists of a series of thin, massive bodies of massive chromite and pyroxene, separated by thin layers of unaltered serpentinites.


The Steens and Pueblo Mountains range, in the eastern part of Harney County, Oreg., contains more than 20 known deposits of quicksilver. These deposits were discovered by the Bureau of Mines in 1935 and 1936. The deposits are in the upper part of the Steens and Pueblo Mountains range, in the eastern part of Harney County, Oreg. The quicksilver is associated with pyrite, chalcopyrite, and bornite. The quicksilver is in the upper part of the Steens and Pueblo Mountains range, in the eastern part of Harney County, Oreg. The quicksilver is associated with pyrite, chalcopyrite, and bornite. The quicksilver is in the upper part of the Steens and Pueblo Mountains range, in the eastern part of Harney County, Oreg. The quicksilver is associated with pyrite, chalcopyrite, and bornite.


The tin deposits are located in the western part of the Lander County, Nev., and are associated with feldspar, quartz, and muscovite. The tin deposits are in the western part of the Lander County, Nev., and are associated with feldspar, quartz, and muscovite. The tin deposits are in the western part of the Lander County, Nev., and are associated with feldspar, quartz, and muscovite.


The nickel deposit is located near Pine Creek, Lassen County, Calif., and consists of disseminated nickeliferous pyroxene and amphibolite. The nickel is associated with pyroxene, serpentine, and pyroxene. The nickel is associated with pyroxene, serpentine, and pyroxene. The nickel is associated with pyroxene, serpentine, and pyroxene. The nickel is associated with pyroxene, serpentine, and pyroxene.


Contains abstracts of articles on geophysical research, including methods and results related to geophysical studies, with an emphasis on the study of geophysical phenomena in the crust of the earth. The abstracts cover a wide range of topics, including studies of seismic waves, gravity, and magnetic fields.


The water-level data in the United States in 1942 are presented in tabular form, showing the water levels in various streams and lakes for the year 1942. The data are compiled from a variety of sources, including federal and state agencies, and private water authorities.


This report contains a summary of the yearly discharge at gauging stations in the United States, compiled from data collected by the United States Geological Survey. The summary includes data for streams and rivers throughout the country, as well as data for lakes and reservoirs.

OLDER REPORTS

Bulletin 809. Formulas and tables for the determination of the composition of ore. 1903.

The primary purpose of this publication is to provide formulas and tables for the determination of the composition of ore. The formulas and tables are based on a large body of experimental data, and are intended to be a useful tool for geologists and mining engineers in the laboratory.
Practically no cassiterite is disseminated in the wall rocks. It is believed that the cassiterite was deposited in residual veins along fracture formed by differential contraction during the cooling of the batholith. There is no record of any production of tin from the area. Possibly a few tons of the metal might be produced from the residual veins by pressure grouting and hand mining. No large body of cassiterite in the area, however, contains even 0.1 part of tin to the ton, and the amount of tin recoverable would be only a small part of that shown by assay for all of the tin in grams of cassiterite large enough to be concentrated by ordinary methods. Higher deposits of commercial grade occur in a few areas that are only a few miles from the area, but as they are only a few inches thick and of small volume, they could yield only a few tons of cassiterite. The report reviews a topostructural and geologic map of the principal part of the tin-bearing area. This is one of the chapters of "Strategic Minerals Investigations," 1941.


The nickel deposit of the Copper Mountain mine, near Gold Hill, 32 miles northwest of Denver, Colo., is in the pre-Cambrian rocks of the Colorado Front Range. The deposit is in a brecciated layer of amphibolite in the lenticular schist of the Idaho Springs formation, a mile west of the border of a small body of the pre-Cambrian Boulder Creek gneiss. A disseminated body of hornblende-quartz gneiss, related to the gneiss, is exposed in the lower workings, and many irregular segregations, distinct from the schist, amphibolite, and gneiss. Disseminated intergrowths of pyrite, pyrrhotite, chalcopyrite, and several nickel minerals are distributed along the margins of the ore body, and in the ore body itself. On the basis of development and diamond drilling, it appears to be about 2,000 tons of ore, broken out that contains between 4 and 5 percent of nickel, and an additional 2,000 tons of ore that contains 2.5 percent of nickel. The nickel seems to be exceptionally small, but the ore-deposit as a whole is large enough to be economically produced and shipped to the pre-Cambrian gneiss dike. The report contains a geological and geological map of the vicinity of Gold Hill, thus, and a detailed map and description of the Copper Mountain mine. It is one of the chapters of "Strategic Minerals Investigations," 1941.


Contains abstracts of world literature on geophysics, covering studies made by provisional, magnetic, gravimetric, acoustical, radiometric, geophysical, and geochronological methods, and of unclassified methods and topics related to geophysics. Includes a list of new publications on geophysics and a list of patents granted.


The water levels in wells near the stage of these natural reservoirs, showing to what extent they are replenished in seasons of abundant rainfall or during snow. The water levels in wells within the vicinity of the reservoirs in the state of South Carolina are also given in the report. The report gives records of ground-water levels at several points in observation wells in the southeastern States. The report includes a detailed study of the artesian reservoirs in the state of South Carolina. The report is one of the chapters of "Strategic Minerals Investigations," 1941.


The tables summarizing in convenient form for general reference the figures of maximum and minimum daily discharges and yearly mean discharges for all stream gaging stations in the Great Basin, both active and discontinued, for which records of 10 or more complete years have been collected and published. Figures are given both by water years ending September 30 and by calendar years. The tables are intended to be statistical purposes and forms for preliminary studies, but they give data for every gaging station represented. The report includes a detailed study of the artesian reservoirs in the state of South Carolina. The report is one of the chapters of "Strategic Minerals Investigations," 1941.

Older Report Still Available


The primary purpose of this publication is to provide tables for the construction of the polyconic projection of topographic maps of standard quadrangles without any interpolation. The tables have been prepared with segments for each meridian and parallel represented on maps of standard quadrangles, and the data are given in inches for each of the standard maps employed by the Geological Survey. The bulletin also represents the theory of the polyconic projection, with the formulas developed in detail and the use of polyconic projection with only in average knowledge of mathematics and cartography. Finally, the theory of the polyconic projection of the map of the world is explained, and tables for its construction are given with the data in meters on the natural scale and in inches on the scale of 1:1,000,000.

"The copper deposit is in the Majuba Fault and, therefore, formed later than the tin."

The Majuba fault cuts through one end of the brecciated area which fosters the copper deposit, but except for the aid this fault rendered in localizing secondary copper mineralization, had no other influence on the ore body. There is certainly no evidence to support the contention that primary mineralization followed this structure. There is more evidence to support the thought that primary mineralization, followed a greater area of weakness, the breccia pipe, which antedated the Majuba Fault.

Smith attempts to make the tin and copper separate periods of mineralization. However, in the high grade tin area cassiterite is associated intimately with copper arsenates and carbonates, and in the copper stope area cassiterite is intimately mixed with the dialcopyrrole, arsenopyrite, pyrite mineralization.

Since there is much evidence to support faulting of the tin structure, and since it is difficult to interpret the copper area, on any basis of offsetting, it was imperative that Smith establish two such periods.

Under 'Breccia' he writes: "some small masses of breccia, exposed on the south side of Majuba Hill probably mark faults."

These small masses of breccia are Smith's only reference to that which the writer has mapped as breccia pipes. Smith apparently considers them of no significance; they are not shown on his surface map.

The largest has a long axis of 400 feet, and a short axis of 200 feet. Drilling followed this one structure down to about 600 feet below its outcrop, which indicates an interesting persistency. Cuts at the surface, in this largest pipe showed angular fragments of rhyolite and tourmalinized rhyolite, cemented by heavy iron oxide, some copper carbonates and arsenates. These can easily be considered mineralization channels and not fault outcrops.
Under 'Tin and Copper Deposits' he writes: "This shoot is in the hanging wall of the Majuba fault and the displaced footwall portion has not been found --.--.--.--."

The Majuba structure is not a simple one-gouge fault. Branch structures with dips into the main Majuba structure can be mapped; these parallel the main structure. Three shoots have been mapped; two existed at the time of Smith's study, but he failed to find the second because of his failure to find and map an intermediate level, 25 feet above the tin shoot he describes, and leading from the 20 foot raise, which he mentions. A third shoot was developed by work done last November. Each of these is cut off line with its neighbor and separated by a structure; this suggests something approaching block faulting. It is true that the footwall portion has not been found. The proper crosscutting might extend this tin structure on both the footwall and hanging wall sides.

also--"The copper ore was deposited later as lenses in the fault, about 300 feet from the tin deposit--etc, etc, etc, --.--.--.--. and their situation on the same fault is a coincidence."

Comments regarding page 42 cover this to some extent. It is impossible in my mind to:

(1) accept the cassiterite as a separate period. This may be prejudice but, nevertheless, in both areas tin and copper have been intimately associated.

(2) believe that the copper of the copper stope area is limited to "lenses in the fault". There were sufficient workings open to permit sampling for a distance of 80 feet normal to the trend of the fault structure. All of this 80 feet was in brecciation and mineralization. Only 15 feet showed cassiterite, but it was far stronger than the few grains Smith mentions with reservations, i.e., he shows ' ? Cassiterite' for the copper stope on his maps.

"a 20 foot winze raise, a winze --.--.--.--."

Had Smith climbed a ladder at the time of his investigation he would have found an intermediate level, 25 feet above Tunnel 2, in the high grade tin area; this level had about 60 feet of workings, developing two shoots of cassiterite mineralization, separated by structure, which could be considered two separate segments of a faulted vein.

Mineralogy: rather than consider this, sentence by sentence, this paragraph could be written as follows:

TIN AREA: The ore mineral of the tin deposit is cassiterite and the gangue minerals are quartz, sericite, tourmaline, fluorite, olivenite, chalcopyllite, and to a minor extent malachite and azurite. Some material from
the crosscut is thickly coated with iron oxide, but cassiterite-rich material can be visually distinguished from barren rock by reflection of light from clean crystal faces or by a peculiar yellow coating, unidentified but a common companion of cassiterite throughout the mine. Identification in the hand specimen is, of course, quite simple because of the high specific gravity of cassiterite.

Assuming that the tunnel actually crosscuts a vein structure, and is not drifting on a pocket (which has been held by others), actual breadth of all mineralization amounts to 40 feet. Of this 40 feet, 26 feet in the footwall consists of pocketory tourmaline, fluorite and some quartz without tin values. The next fourteen feet contains the same gangue mineralization, but is also accompanied by strong cassiterite, which accounts for the 2\% tin average mentioned in Smith's paper. Limits of this 14 feet are sharp and not gradational to altered rhyolite as reported by others. Whereas, cassiterite in this 14 feet is in a sense pocketed, which causes some startling variations in adjoining samples, the 14 feet with sharp margins or limits is a definite unit, and can be considered the width of a tin vein. Copper values are not limited to the 14 feet, but are found in the 26 foot footwall zone to some extent, and even invade the crackled tourmalinized porphyry, adjacent to the structure in the hanging wall. Since copper is chiefly represented by olivenite, a copper arsenate and secondary, it is conceivable that this secondary distribution of copper could follow any open ground in the general area.

**COPPER STOPE AREA**

Values to support initial mining were derived from the accumulation of secondary copper minerals next to the Majuba fault. These were cuprite and chalococite with some malachite and azurite, and an assortment of copper arsenates.

Pockets of primary sulphide can also be found. Whether these represent remnants of the original mineralization, or another period of mineralization is still an open question. Outstanding is the pocket referred to on page 50 ("a 6' mass exposed in the manway to the copper stope"). This pocket consists of chalcopyrite, pyrite and arsenopyrite to some extent replaced by chalococite; of particular interest is the cassiterite which accompanies this sulphide and which can be recognized in all hand specimens taken from this zone. Since Smith employs a question mark, in referring to this cassiterite, and then quotes values (D.L.Evans, personal communication #6) "according to reliable assays," I believe it perfectly proper to enlarge upon the data he quoted to this extent----that channel cut thru this zone gave 15' of 0.9% Sn. All assay data given Smith for his paper were from our initial sampling.

These areas of sulphide may be significant t; they can either:
(1) represent remnants of the original sulphide mineralization and indicate what might be expected at depth

or

(2) represent a second period of mineralization, a copper-tin period, which also might indicate what to expect with depth.

Page 50 Distribution of Cassiterite

"all the cassiterite seen in place was in the tin shoot in the middle adit, in the hanging wall of the Majuba fault-----".

Reference is made to the above discussion on the copper stope area. Cassiterite was mapped by the writer at two places on the surface, 400 feet vertically above the tin area developed in Tunnel 2. Work in November carried cassiterite to a point 60 feet vertically above tunnel 2.

Page 51 "six specimens---------were crushed and the heavy minerals separated with bromoform and methylene iodide".

Of the six, four were taken from barren rock unrelated to any structure, and should be of no significance. Two came from Tunnel 1 (the uppermost tunnel) in the zone of oxide breccia. Since cassiterite in this structure appeared limited to sulphide areas, it is not surprising that cassiterite was not found in these two specimens.

Page 51 "But they do show that cassiterite is not a constant companion of tourmaline------".

This is not surprising. It would seem that structural control is far more important than wishful thinking on a widely distributed mass of tourmaline mineralization.

Page 52 Size and grade of ore body:

No comment is necessary. The possibilities would appear a lot rosier than depicted. Some basis for speculation exists in preceding paragraphs.

Page 55 Origin

Here again, rather than a sentence by sentence appraisal this paragraph could be re-written as follows:

The Majuba fault did not localize the deposition of the ore, and was subsequent to primary mineralization. The fault did serve the purpose perhaps of concentrating into a mineable unit, secondary copper minerals.
After the injection of rhyolite into Jurassic slates, and after a period of widespread spread and general tourmalization, it is conceivable that 'tail end' mineralization products were confined to certain channels, these being breccia pipes and vein structures. Characteristic of the first type is the 400 by 200 mass of brecciated and crackled rock. Characteristic of type #2 is the 14 foot vein structure in the so called tin area.

One might lean towards two periods of mineralization, the first sulfidiferous pyrite, and the second a copper-tin period (consisting of pyrite, chalcopyrite, arsenopyrite and cassiterite.

Note: The argument against the sulphide areas being remnants of original primary mineralization is the insolubility of cassiterite. Should the oxide represent a leached product which in primary form had been chalcopyrite, pyrite, arsenopyrite and cassiterite, it is believed that the tin oxide would have been left behind.

Post mineral structure (the Majuba Fault with its numerous branches) subsequently cut through both types of structure, definitely block faulting the tin vein into a combination of segments, only three of which have been determined. It is believed that there has also been definite displacement of the breccia structure.

Secondary enrichment of the primary mineralization completes the story.

Page 55-- Reserves

There is no justification for the dogmatic statement 'there are no copper reserves in sight'. Mining did not exhaust mineralization with ore possibilities.

In conclusion, it might be added, that anyone actually interested in Majuba, could consider the hill from the angle of this concluding paragraph---

Significance of Majuba

In many ways Majuba is similar to the tin occurrence at the Cerro Rico de Potosi, Potosi, Bolivia. Both areas are characterized by an intrusion of rhyolite into Jurassic slates; in both cases the cassiterite is associated with complex copper sulphides, with arsenopyrite predominant. Some suggestion of the rich silver that characterized Potosi ores is present at Majuba with an ounce of silver for every percent copper. However, this last is a poor comparison, for Potosi silver is in a class by itself.

From a domestic standpoint, Majuba appears to be the only non-pegmatitic tin possibility associated with
an acid intrusive. All others in this country are either in pegmatitic form (Spokane, Black Hills, North and South Carolinas, Irish Creek-Virginia, etc.) or associated with volcanic flows (Catron County-New Mexico and Izenhood Ranch-Nevada). The one exception is the Cajalco deposit Riverside which can be interpreted in a number of ways.