STATE OF IDAHO
H. C. Baldridge, Governor

BUREAU OF MINES AND GEOLOGY
Francis A. Thomson, Secretary.

THE VIENNA DISTRICT
BLAINE COUNTY
IDAHO

By
Clyde P. Ross
U. S. Geological Survey

University of Idaho
Moscow, Idaho.
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Summary of the report.

The lodes of the Wigma district are in shear zones in hydrothermally altered granite of probable Cretaceous age. Paleozoic (?) sedimentary strata and Miocene (?) volcanic rocks are also present in the district. The gangue is altered granite and vein quartz, with a little siderite. The metallic minerals include proustite, stibnite, arsenopyrite, tetrahedrite, pyrite, some galena and sphalerite, and a little chalcopyrite. Such ore deposits, characterised by ruby silver and other antimonial and arsenical minerals in a quartzose gangue, are rather rare in Idaho.

The district was active in the early eighties and may have produced as much as 42,000,000 at that time, but it has had little production since. A little work has recently been done in the Jabfoot mine. The Jabfoot and Solace mines and some tunnels below the Solace are the only workings now accessible. None of these attain a depth of more than a few hundred feet. The ore bodies are mostly not more than a few feet wide, and those now exposed are not very long. It appears that bodies of antimonial and arsenical silver ore of moderate size and grade can still be found in the lodes of the district, and with careful development they might well prove profitable to mine under favorable market conditions. Some lead and zinc ore exists, but present exposures and the record of past production do not hold out much hope of the discovery of sufficiently large amounts of such ore to repay the cost of development. Operating conditions are fairly favorable, but it would be necessary to study the metallurgical treatment carefully.
The Vienna district, Blaine County, Idaho.

Foreword.

The Vienna district, in northern Blaine County, Idaho, is one of the old districts in which renewed interest has been shown in recent years. Unlike many other mining districts in Idaho, the Vienna district yielded ore in which almost the only valuable metal was silver. With minor exceptions the gold content was small. In comparatively recent years a little lead and zinc ore has been mined. It has been hoped by some that such ore, now more attractive than in the early days, might be found in quantity, but the amount at present in sight is small. In accordance with a suggestion of the Idaho Bureau of Mines and Geology the district was visited by the writer in August, 1926, and several days were devoted to its examination.

Location and means of access.

The Vienna district as defined by Unplieby comprises the valleys of Smiley and Vienna creeks, in the Sawtooth National Forest, in the northwestern part of Blaine County. Vienna Creek was not visited in the present investigation, as it is reported that there has been no recent activity on the creek. The more extensive workings are on the upper reaches of Smiley Creek, near the northern boundary of unsurveyed T. 5 N., R. 14 E.

The distance from the boarding house now occupied down Smiley Creek to the highway on the west side of the valley of Salmon River is 7.7 miles. From this point good dirt roads extend northward to Stanley and beyond and southeastward over Galena Summit to Ketchum and Hailey. The distance to Stanley is about 30 miles from the point where the road down Smiley Creek joins the highway. Ketchum, the nearest railroad station, is about 31 miles from the same point, and Hailey is 12 miles farther south. The nearest post office is Obsidian, about 5 miles north of the road fork on Smiley Creek.

Acknowledgments.

Mr. C. H. Sahre, Jr., rendered efficient aid in the examination of the district. Mr. C. H. Holte, watchman at the mines, was most hospitable and gave valuable assistance and information.

The published reports of Unplieby on the ore deposits of the Sawtooth quadrangle as a whole, and of Ballard on the area immediately north of the Vienna district furnished a valuable setting for the present study and have been freely drawn upon. Mr. E. N. Short, of the Geological Survey, was of much assistance in the identification of some of the metallic minerals.

History.

Ore deposits in this part of Blaine County were discovered in the late seventies and early eighties. The first discovery in the Vienna district was made in 1879. During the next six years there was much activity in the district, which was then part of the Sawtooth district. The town of Vienna, on Smiley Creek, had at this time a population of about 1,000 and contained 200 or more buildings and a 50-ton stamp and chlorination mill. Now the mill and almost all the other buildings are razed, and the town has been entirely uninhabited for many years.

It is probable that nearly all the veins now known were discovered prior to 1886. Umblyby estimates that the total output up to the time of his visit in 1914 amounted to about $1,000,000. Most of this was produced in the eighties. There has been little production since Umblyby's visit. Apparently most of the early production was in silver bullion containing some gold. In general such base metals as were mined do not appear to have been saved, but a few shipments of lead ore were made in the early nineties.

Many companies operated in the district in the early days, but the properties were gradually consolidated until nearly all were included in the Solace group of 16 patented claims and the Vienna group of 33 patented claims. The claims in the district were sold for taxes about 1906, and in 1912 three of them were worked under bond and lease from the person who bid them in. Some ore was mined in 1915. In 1917 the Vienna Consolidated Mines & Smelting Co. acquired control of the Solace and Vienna groups. A mill and other buildings were erected, and roads were repaired and built so that vehicles could be brought nearly to the head of Smiley Creek. It is still possible to take an automobile as far as the boarding house erected by this company on the Vienna group, but roads leading to the Solace workings further up Smiley Creek are in disrepair. The ore-dressing mill built in 1917 has never been operated, and it appears that only a small amount of mining was done at that time, although some ore was shipped. A. P. Perry held the property under bond and lease at the time of visit in 1926. He had mined some ore in the summer of 1925 but had done little in 1926. The results of his work in 1926 were sufficiently encouraging to arouse interest in the old district among local mining men, and they hope for further development.

The Sawtooth district as defined by Umblyby adjoins the Vienna district on the north. In the early Mint reports the areas here called the Vienna and Sawtooth districts are grouped together under the name "Sawtooth. These two adjoining areas have had essentially similar histories. The Sawtooth district is described briefly by Umblyby and more fully by Ballard in the publications referred to above. At the time of the writer's visit to the Vienna district the shaft of the Silver King mine, which is the principal mine in the Sawtooth district, was being watered, but as it was reported that work had not progressed far enough to expose the vein the district was not visited. It is said that when the water was removed from the 600-foot shaft a good exposure of ore was found in the lower workings. Little appears to have been done in the other mines in the district since the area was visited by Ballard.

1/ Umblyby, J. E., op. cit., p. 247; also the Mint reports for 1881 to 1894.
The Vienna district is near the southeast end of the Sawtooth Mountains, as that range is delimited on the topographic map of the Sawtooth quadrangle prepared by the Geological Survey, which should be consulted by those interested in the district. Plate 1 is based on this map, but the topographic contours have been omitted to avoid obscuring the geology. The position of a road built since the publication of the quadrangle map is sketched on Plate 1. The old town of Vienna is shown about a mile farther south on Plate 1 than on the quadrangle map. There are ruins of houses at intervals along much of the intervening creek bottom, but the mill and principal settlement are at the place indicated on Plate 1.

The Sawtooth Mountains constitute one of the most rugged and picturesque ranges in Idaho. Southeast of Stanley they rise in towering, jagged pinnacles of rock flecked here and there with perennial snow banks to altitudes well over 10,000 feet. The higher parts of the range are almost devoid of soil. They contain innumerable lakes, some of which are famous for their game fish and would be more so were it not for their isolation. Several of the larger lakes in the eastern foothills are becoming known as summer resorts and have hotels and cottages along their shores. The part of the range in which the Vienna district lies is less ornately carved but is almost as high as that farther north. The mine buildings and workings on Smiley Creek range in altitude from 8,000 to 8,700 feet, and the mountains on each side rise 1,000 feet or more above the highest of the workings.

The Sawtooth Range is bordered on the east by the remarkable open valley in which Salmon River flows above Stanley. This valley flat is nearly 3 miles wide in Stanley Basin, narrows to less than a mile near the mouth of Red Fish Creek, and widens to about 4 miles at Beaver Creek. Smiley Creek, which joins the Salmon just above Beaver Creek, flows for several miles across this flat at an altitude of a little over 7,000 feet. Southeast of Smiley Creek the mountains close in, and the flat disappears.

General Geology

In his reconnaissance of the Sawtooth quadrangle Umpleby distinguished Paleozoic sedimentary rocks, granitic rocks, dikes of several kinds, Tertiary eruptive rocks, and Quaternary detrital deposits. Representatives of all these rocks are present in the Vienna district. As Umpleby spent only 12 days in a quadrangle containing 864 square miles, his geologic mapping was necessarily much generalized. For the part of the quadrangle seen during the present investigation his mapping is revised on Plate 1. The area of about 25 square miles along Smiley Creek the geologic boundaries were traced with some care by the writer and C. H. Behe. Outside of this small area the geology was sketched on the basis of long-range observations and on the character of the gravel brought by the streams into the valley of

Salmon River. In Plate 1 the area accurately mapped is distinguished from that roughly sketched by differences in the patterns representing the rock units. The map is extended beyond the area mapped in detail in order to give an adequate setting to the geologic description of the district.

Paleozoic (?) rocks.

Old sedimentary rocks form the northeast end of the ridge separating Smiley and Beaver creeks. Umpleby\(^1\) recognized the presence of such rocks, although he did not map them. These rocks include in apparently ascending order (1) blue-black limestone, (2) white quartzite with bands of black quartzite and of limestone, (3) buff quartzite and blue-gray calcareous sandstone, and (4) white and gray quartzite. As the rocks are faulted it is possible that detailed work would modify this apparent order of succession. No mineral deposits are known in these rocks in or near the Vienna district, although there is no evident reason why such deposits should not occur.

On the north side of Smiley Creek near the road about 2 miles below Vienna there are small exposures of bluish-black banded limestone. The exposures are too poor for satisfactory determinations of the attitude of the beds.

The slopes immediately above this are composed of nearly white quartzite with bands of black impure quartzite and of limestone in places. Some bands are composed essentially of tremolite, which has presumably replaced limestone. The strike is north, and the average dip is 40° W.

Farther north on the same slope the rocks are buff sandy quartzite and blue-gray wall-cemented calcareous sandstone with cross-bedding in places. The strike is in general north, and the dip is 10° or less to the west. The beds are broken by numerous faults with displacements of 1 or 2 feet.

The rest of the strata in this area are largely white and gray quartzite, in part banded. They occupy the upper slopes between Beaver and Smiley creeks and extend downward on the north and northwest until they disappear beneath the detrital material in the valleys. A small amount of dense white quartzite similar to that in the upper part of this mass crops out below the lava on the east side of Smiley Creek near its mouth. There are probably many faults throughout the white and gray quartzite, as in some places the dip is vertical and in others it is nearly horizontal. Observed strikes range from north to N. 30° W. No measurement of thickness was attempted, but it is thought that at least 1,000 feet of beds are present.

The Paleozoic (?) beds have been briefly described above in their apparent stratigraphic order, the lowest being mentioned first. However, it is certain that faults are present, and it may be that detailed studies would show that the true stratigraphic order differs markedly from that followed in the descriptions. Similar rocks elsewhere in the general region are known to be broken into complicated mosaics of fault blocks.

\(^1\) Umpleby, J. B., op. cit., p. 248.
On the east side of Salmon River and north of Pole Creek there are similar sedimentary beds, presumably a continuation of the same series. It appears from the gravel brought into the valley of Salmon River by streams from this area that much of the rock is dark, impure, and in part calcareous quartzite.

No fossils have been found in the sedimentary beds, and it is impossible to fix their age closely. They are undoubtedly to be correlated in a general way with the strata elsewhere in the Sawtooth quadrangle classed by Upleby as of probable Paleozoic age, and his assignment has been adopted in the present report, although it is recognized that the strata in the Vienna district may be pre-Cambrian. The only detailed stratigraphic work yet done in this part of Idaho is that of Westgate in the Hailey quadrangle, which adjoining the Sawtooth quadrangle on the east. The strata near Vienna, especially the quartzite, with bands of tremolite rock and the white quartzite on the upper slopes, more nearly resemble strata tentatively assigned by Westgate to the pre-Cambrian than any other he describes. The bluish-black banded limestone, on the other hand, is similar to part of the rocks he assigns to the Pennsylvanian on fossil evidence. In view of the marked variations in the stratigraphy of this part of Idaho such lithologic resemblances have little value as a means of correlation.

Granite

The granitic rock that occupies the greater part of the Sawtooth quadrangle is in the southern part of the great mass commonly referred to as the Idaho batholith. This batholith has generally been considered to be of Cretaceous or Eocene age, but recent studies by the present writer indicate that it is not younger than Cretaceous, and possibly is even older.

Upleby says that within this quadrangle the batholith includes granite, quartz monzonite, and quartz diorite, and that each of the varieties resembles the others closely in mesasocline appearance.

The portion of the batholith exposed in the Vienna district is a granite containing quartz, microcline, biotite, some andesine and myrmekite, and a little titanite. Most of this granite is a gray, moderately fresh rock such as is typical of the rocks of the Idaho batholith. In the immediate vicinity of the lodes it has been altered by the mineralizing solutions, but elsewhere there is little evidence of hydrothermal activity. At the contact with the Tertiary lava the granite is weathered. In places for several inches below the contact it is fractured, is stained dark red, and has its feldspars clouded with alteration products.

Dikes in the granite.

One lamprophyre dike is mapped on Plate 1. Others were noted near the head of Smiley Creek, outside of the area mapped in detail. A small one is exposed in the Tebooot mine. Silicic dikes such as Ballard found in the Sawtooth quadrangle were not noted along Smiley Creek. The

2/ Ross, C.P., Geology and ore deposits of part of the Wallowa Mountains, Ore. (Manuscript report to be published by U.S. Geol. Survey).
lamprophyre dikes and probably also those of silicic composition are of the kinds commonly regarded as late products of granite intrusions. The lamprophyre in the Webfoot mine cuts the lode and thus suggests a close relation in time between the mineralization and the granite intrusion.

In the Webfoot mine one small dike of altered feldspar porphyry having approximately the composition of diorite was noted. Its relation to the mineralization is not known, but the extent to which it is altered suggests that it is older. The disturbance of the rocks and the timbering made necessary by the mining operations obscure the relations of the dike to the neighboring rocks.

Tertiary eruptive rocks.

A large part of the Sawtooth quadrangle is mapped by Empley as underlain by Tertiary eruptive rocks. As is shown in Plate 1, they are not quite as extensive in the Vienna district and in the area north of it as his reconnaissance map indicates. They form the slopes bordering Smiley Creek on both sides from the old town of Vienna downstream except where the Paleozoic (?) beds are exposed.

Similar beds extend eastward over Galena Summit and down Wood River. On the east side of Salmon River they stretch northward as far as Pole Creek. On the west side they were not noted north of the area mapped on Smiley Creek, but detailed work in the mountains north of the old town of Sawtooth may discover small areas of them where only granite is indicated on Plate 1.

Most of the rocks are flows of latitic and amesitic composition. Some of the flows may have the composition of rhyolite, but no rock as calcic as basalt was noted. Black obsidian is present but not abundant. Small amounts of a pink zeolite were noted in places in the lava.

There is a considerable amount of pyroclastic material, both flow breccia and tuffaceous conglomerate. Some beds of the conglomerate contain pebbles and boulders of granite with a maximum diameter of about 2 feet.

The volcanic rocks on the east side of Smiley Creek strike a little east of north, dip east at an average angle of about 12°, and are over 1,000 feet thick. On the west side they appear to form a syncline whose axis trends east and whose limbs dip as high as 50°. The western boundary of this volcanic area is, at least in part, a fault. Another fault may be buried under the alluvium of Smiley Creek. The trend of the stream is about N. 20° E., approximately parallel to the fault on the west side of the lava. There are doubtless other faults and flexures, and the structure if worked out in detail would be found to be more complicated than is here indicated.

The contact of the lava with the granite and Paleozoic (?) beds is clearly erosional. The surface on which the lava was poured out was irregular in detail, did not have a thick soil cover, and probably had

[Empley, J.B., op. cit. pl. 4.]

-7-
moderate relief. There is sufficient coarse clastic material in the eruptive series to indicate fairly active erosion during the period of volcanism, and this suggests that the initial surface possessed considerable relief, an inference which is in accordance with the character of the contact of the volcanic strata and the underlying rocks where that contact has been observed. The shape and attitude of the contact surface have been modified by subsequent orogenic movements, so that its original relief can not be directly determined.

The volcanic rocks are clearly later than the granite and older than the Pleistocene glaciation. They are presumably of Tertiary age. There is no local evidence for determining their age more closely, but they are tentatively correlated with similar rocks of supposed Miocene age elsewhere in the region.

Quaternary deposits.

Unconsolidated detrital material floors the lower parts of the stream valleys of the region. In the larger valleys it extends well up toward their heads. A considerable part of this detritus is of glacial origin and hence of Pleistocene age. Smiley Creek, for example, has moraines near its mouth, and much of the gravel in its valley is of glacial origin, particularly the coarse gravel in banks between old Vienna and the cirques at an above the Soloe mine. In the lower valley of Salmon River and on the lower courses of its tributaries much of the unconsolidated material is Recent stream alluvium. Much of the detritus is gravel similar in appearance to that which has been placer-mined elsewhere in Idaho, but little attempt to work it appears to have been made here, presumably because the lodes in the vicinity, although fairly rich in silver, contain little gold.

Ore Deposits

General Description

The ore deposits of the Vienna district and of the adjoining Sawtooth district are moderate-sized lodes in granite which, unlike most lodes in such rock in central Idaho, are valuable principally for their silver content. In places, however, they contain some lead and zinc. They consist chiefly of ruby silver, tetrahedrite, and stibnite with minor amounts of other sulfides in a matrix of quartz with some siderite and hydrothermally altered granite. Lindgren¹ in his classification of Idaho deposits groups the veins of these two districts and of the Banner district, in northern Lemore County, as belonging to what he calls the Banner type. This type differs from his Atlanta type, which includes the deposits of the Atlanta and Rocky Bar districts, Lemore County, mainly in containing a smaller proportion of gold. The deposits listed as belonging to the Banner and Atlanta types are the only pre-Miocene lodes in which ruby silver is abundant recognized by Lindgren after his extensive study of the deposits of southern and south central Idaho.

They all lie within a circle having a radius of about 16 miles with Atlanta at the center. There are a few small mines in essentially similar deposits south of Hailey, and deposits resembling them occur in the Flint district, Owyhee County. Shannon lists a number of deposits in Idaho in which ruby silver occurs. Many of these are in other respects distinctly different from those of the Banner type, and from the brief data given it appears that apart from those in the districts mentioned above few of the deposits of any consequence listed by Shannon belong to the type here discussed. In general, therefore, it appears that in central Idaho deposits of this type are localized in a comparatively small area. Most of these lodes have yielded rich returns from bonanza ore mined on a small scale, but heretofore difficulty has been experienced in treating the lower-grade ore.

Structure

In each of the two mines visited the premineral fissures appear to be due in part to contraction during cooling of the granite and in part to later shearing and fracturing. Mineralization has taken place wherever the rock was sufficiently broken to give ready passage to the solutions commonly along the zones of shearing, but in some places on the joint planes and in others along minor fractures cutting the major shear zones. Consequently the mineralized zones are irregular and somewhat discontinuous. The irregularities are indicated to some extent in Plates 2 and 3 and Figure 2. Most of the zones closely lagged as to conceal many details, but enough could be seen to make it clear that better exposures would have disclosed even more variation in the attitude of the mineralized fractures composing the lodes than is indicated on the maps here presented. In general the major shear zones and major joints in any one locality are nearly parallel in strike, but the dip of the joints is steeper than that of the shear zones, and the average dip of the ore bodics is more nearly parallel to that of the shear zones.

It appears from Ballard's description in the Sawtooth district the eastward-striking system of joints is even more prominently developed than it is in the Vienna district, but he considers that the lodes are later than the joints and uninfluenced by them. He states that the veins belong to two systems, one of which strikes east and the other northwest. The Solace lode in the Vienna district would thus belong to the first system, and the Whitfoot to the second.

5/ Idem, p. 18.
Ore and gangue minerals and their deposition.

Nonmetallic minerals.

The nonmetallic minerals produced during mineralization include quartz, sericite and related mica, chlorite, epidote, microcline, siderite, and hisingerite. All except the hisingerite, part of the quartz, chlorite, and mica, and most of the siderite were formed during the alteration of the granite, which preceded the deposition of most of the metallic minerals. The rest of the quartz, chlorite, mica, and siderite are in bands and lenses in the altered granite. They were formed essentially by filling of open fractures, whereas those previously mentioned were formed by replacement of the rock. However, the two processes graded into each other. It is impossible, for example, to draw sharp distinctions between quartz formed in the veinlets and that formed during stilification of the granite. The hisingerite was formed by a later and perhaps entirely distinct process.

Alteration of the granite was most intense where the shearing was most pronounced but extended for some distance on both sides of the lodes. All the granite in the Webfoot mine is altered, although much of it shows no other evidence of mineralization. The alteration was somewhat less intense in the Solace. In both mines it consisted mainly in sericitization of the feldspars, chloritization of the biotite, and later replacement by quartz.

Most of the purer quartz is in bands and lenses elongated parallel to the major shear zones and doubtless occupying fractures produced by the shearing. It is possible that this clear quartz, much of which is in aggregates of rather coarse irregular grains, was formed in part at the expense of the adjoining wall rock, but it seems at least equally possible that it was formed in open spaces either existing at the time of its advent or produced as a result of injection of the siliceous solution into the already sheared granite. Some deposition in open cavities took place, for drusy cavities lined with quartz crystals were formed, but these are rare. This quartz contains in places, especially in the Webfoot mine, subordinate amounts of siderite, chlorite, and white mica. The micaceous minerals are nowhere abundant in the veinlets and generally line cracks in the quartz or occur in isolated bunches.

In some places in the Webfoot mine aggregates of light silvery-green chlorite are prominent. Much of the altered granite in both mines contains epidote. These minerals are products of the hydrothermal alteration but are less universally abundant than the sericite. It appears that in general the sericitization preceded the formation of quartz, but there is abundant evidence that the two processes were interrelated. Sericitization extended to a greater distance from the zones of maximum shearing than most of the quartz, but in general where the lodes show marked sericitization there is considerable quartz and where little quartz has been deposited sericite is not abundant. Also some of the quartz Veinlets contain both mica and chlorite in well-developed plates. In some places, particularly on the lowest level of the Webfoot mine, silicification has gone so far as almost to obliterate the granitic texture. The silicified granite near the winze on the third level of the Solace mine contains stringers of quartz and
microcline which appear to merge into the quartz that replaced the granite, as if the two were formed by essentially the same process.

In places alteration has gone so far as to reduce the granite to a soft gneisslike mass that requires heavy timbering in order to maintain mine workings in it. This softening may be in part the result of natural weathering, but it is believed to have been caused mainly by the breaking down of the feldspars into sericite and associated minerals under the attack of hydrothermal agencies. Yielding of the rock is accelerated by mining operations, both because of the shattering effect of the blasting and disturbance of mechanical equilibrium resulting from the removal of material from the workings and because of the chemical action resulting from the admission of air and the acceleration of the circulation of water.

The lodes are characterized by banding, which results both from the deposition of quartz and sulphide along parallel shear planes in the granite and from the fact that the sulphides were in part deposited along subparallel planes in the quartz that apparently resulted from renewed movements essentially parallel to the original shearing.

After the deposition of the minerals mentioned above, perhaps as late as Miocene time, different solutions entered the rocks and deposited hisingerite, a hydrous ferric silicate. This mineral lines fractures in the ore in the Webfoot mine but does not appear to be abundant. It was not noted elsewhere in the district. The hisingerite from the Webfoot has an index of refraction of 1.61 ± 0.01. Schaller has called attention to the fact that the index varies considerably in specimens from different localities.

Hisingerite has frequently been interpreted as a product of weathering, but the lack of oxidation in the hypogene sulphides adjoining the hisingerite in the Webfoot mine makes such an interpretation for this occurrence doubtful. Hewett believes that the hisingerite in the Wood River district was produced through the replacement of siderite by the agency of hot spring waters, which also deposited zeolites in the country rocks free from siderite, and not through weathering processes. Zeolites are sparingly developed in the near-by Tertiary volcanic rocks but were not noted in or near the mines.

**Metallic Minerals**

The hypogene metallic minerals include proustite, stibnite, arsénopyrite, tetrabédrite, pyrite, galena, sphalerite, and chalcopyrite. Microchemical tests by M. N. Short show that the proustite contains some antimony and the tetraédrite contains some arsenic. The proustite has so dark a red streak that it resembles pyrargyrite. Much of the ruby silver reported in the literature from other districts in this part of Idaho (op. 8, 9) is called pyrargyrite. In some reports both pyrargyrite and proustite are stated to be present. All gradations between the two ruby silver minerals may exist, and in the absence of detailed mineralogic examinations distinctions between them are of doubtful accuracy, especially where, as in this locality, specimens in which arsenic is more abundant than antimony have macroscopic characteristics resembling those listed in the textbooks for the antimonial ruby silver. Stephanite has been reported from the Sawtooth district and...

although not noted, may also be present in the Vianna district.

Wire silver is reported to occur in the outcrop of an undeveloped deposit near the head of Smiley Creek and was probably present in the rich silver ore mined in the early days in the Vianna and Sawtooth districts. Other supergene minerals, such as cerargyrite, were presumably also present in the Sawtooth district but were not identified in any of the ore seen during the present investigation. Cerargyrite is reported to have been found in the Sawtooth district. All the metallic minerals except cerargyrite and native silver are believed to be hypogene.

The hypogene metallic minerals are irregularly distributed in the lodes, and their proportions vary from place to place. Except in certain isolated masses, metallic minerals are not very abundant in the parts of the lodes now visible underground. Pyrite, probably the first metallic mineral to be formed, is widespread but nowhere occurs in large masses. Stibnite and arsenopyrite are the most abundant minerals in the Webfoot mine. Gold is reported to be associated with the arsenopyrite. Promontite is present in both the Webfoot and Solace mines and is the characteristic mineral in the Solace. Tetrahedrite is widely distributed but not abundant in the ore seen. Galena is more abundant in the Webfoot ore than in that of the Solace mine but was nowhere seen in place in sufficiently large amount to constitute lead ore of much apparent value. However, the table below, compiled from the records of E. Daft, of Hailey, Idaho, shows that lead ore has been shipped from the Mountain King (Webfoot) mine. Umpleby states that three carloads of ore containing galena, sphalerite, and pyrite in a quartz gangue were shipped from this mine in 1912 and lists four assays taken at this time, the highest of which showed a lead content of 28 per cent. Probably there were, in the early days, other shipments of lead ore of which no record is available.

Shipments from the Mountain King.

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<th>Silver (oz.)</th>
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</table>

Sphalerite is even less abundant than galena in most of the ore now exposed. It is a prominent constituent of the ore in places on the third level of the Solace mine, but even here the quantity exposed seems insufficient to constitute a zinc ore. The assay of Mountain King ore referred to above showed 14.9 per cent of zinc. Bleds or chalcopyrite were observed in ore from the Webfoot mine, but this mineral is nowhere exposed in sufficient quantity to be of any economic significance.

The metallic minerals, with the exception of some of the pyrite, are all later than the vein quartz. They fill cracks and cavities in the quartz and in the silicified granite and to a minor extent have made more space for themselves by replacement. This is well illustrated in a specimen from the Solace mine in which a drusy cavity has been filled with galena, tetrahedrite, and pyrite. Some of the quartz crystals that formerly projected into the cavity have been broken and are inclosed in the sulphides. Nearly all the quartz has been corroded where it came into contact with the sulphides. The corrosion has roughened the faces but has by no means obliterated the forms of the quartz crystals.

Oxidation and enrichment

The minerals of the lodes as now exposed underground are almost without exception of hypogene origin. Such oxidation as has occurred is superficial, and most of it took place after the opening of the mine workings. There is no reason to suppose that either the pyrrhotite or any of the other sulphide minerals are products of downward enrichment. Sphalerite, a comparatively soluble sulphide, is more abundant on the third level than higher up in the Solace mine, but there is so little evidence of leaching in the ore on the first and second levels that the comparative abundance of sphalerite below is evidently a simple result of original deposition.

The reported presence of native silver in outcrops on upper Smiley Creek and of this mineral and cerargyrite in the adjoining Sawtooth district indicates that supergene enrichment has taken place near the surface in this region. The high-grade ore referred to in the early Mint reports, containing several hundred ounces of silver to the ton, was doubtless, as Ballard\(^1\) suggests, the product of careful hand sorting, but some of its silver may have been in rich supergene minerals that were absent in the ore from deeper levels.

Origin of the lodes

Both from the evidence within the district and from analogy with similar deposits elsewhere it seems clear that the lodes of the Vienna district are of magmatic origin and probably related to the Idaho batholith. As already pointed out, the lodes resemble those of the Banner, Atlanta, and a few other districts but differ from most of the others in Idaho. The lodes to which they correspond in type are generally regarded as genetically related to the Idaho batholith or its cutters. In spite of their relatively high silver content, the lodes of the Vienna district have more textural and mineralogic resemblances to the common type of lead-silver lodes associated with the Idaho batholith than to the comparatively rare type formed in association with Tertiary eruptive rocks. The ribbon-banded cryotactite quartz characteristic of the Tertiary lodes bears no resemblance to the roughly banded moderately coarse grained quartz of the deposits near Vienna. Ruby silver has not been reported from any deposits in Tertiary volcanic rocks in Idaho, except those of Owyhee County\(^2\). Selenide minerals,

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characteristic of the Tertiary deposits, are not known to occur in the Vienna district. Siderite, the characteristic gangue mineral of the lead-silver lodes related to the Idaho batholith, is present in the ore of the Vienna district but has not been reported in any ore considered to be genetically related to Tertiary volcanism.

The sequence of events connected with the formation of the lodes was probably essentially as follows. A great mass of granitic magma was intruded into the Paleozoic sedimentary rocks. In the course of cooling joints were formed in the granite. A little later shearing forces were developed, perhaps resulting from readjustments occasioned by the intrusion. Fluid material, rising presumably from the still heated rock below and probably changing in composition as mineralization proceeded, took advantage of the comparatively easy paths provided by the shear zones and spread out along them. The fluids first produced sericite, chlorite, and epidote by alteration of the granite in and near the shear zones and then deposited quartz, siderite, and minor amounts of other minerals, in part by replacement of the altered granite, in part along open fractures of various kinds. Fracturing continued intermittently during the time when the fluids were in circulation. Deposition of sulphides, particularly pyrite, started early in the course of the mineralization, but most of the metallic minerals were formed in fractures and cavities in previously deposited quartz. Deposition of the metallic minerals was less uniform than that of the gangue. It was aided by the presence of cross fractures and probably was influenced by other factors which are not known. One of the late manifestations of activity in the cooling batholith was the injection of lamprophyre dikes, some of which cut the lodes. Hisingerite was the last of the hypogene minerals to form. It is so distinctly later than the rest as to suggest that it may even be related to the Miocene (?) rather than the Cretaceous (?) igneous activity. This suggestion is supported by the fact that the zeolites which in the Wood River region clearly have genetic relations with the hisingerite are both there and near Vienna related rather to the Miocene (?) than to the Cretaceous (?) activity.

After the Idaho batholith was intruded erosion, possibly accelerated by uplift related to the intrusion, progressed until much of the cover was stripped from the batholith and the upper part of the granite itself was removed. Then came the eruption of a great thickness of volcanic material, which in its turn was completely removed in the vicinity of the present mines and over much of the surrounding region. The total erosion since the formation of the ore deposits may well have been of the order of several thousand feet. When erosion reached the upper parts of the lodes, oxidation commenced, but scouring by the glaciers and the rapid erosion in post-glacial times so effectively removed the upper portions of the lodes that the amount of oxidized ore remaining when mining commenced was not great. The fact that rapid removal of oxidized ore by erosion prevents the formation of much enriched ore by water percolating downward accounts for the lack of supergene enrichment in the ore now exposed, although some of it is less than 100 feet below the surface.
Operating conditions.

Operating conditions in the Vienna district are, on the whole, favorable. Most mines in central Idaho are handicapped by their long distances from railroads, and the distance of somewhat over 30 miles from Vienna to Ketchum is by comparison, moderate. The road is good and is being improved. Except for the branch road up Smiley Creek the entire route to Ketchum and beyond is over a State highway. The necessity of crossing Galena Summit, which has an altitude of 8796 feet, introduces some difficulty in the operation of heavily loaded trucks. At present neither the road over this summit nor that up Smiley Creek is kept open during the winter, but if the expense were justified this could be done.

There is sufficient water in Smiley Creek for the operation of a small mill, and some water power could be developed. The best timber was cut over during the early operations, but considerable still remains. There is rather more than the usual amount of sufficiently level ground for building sites in the vicinity of the mines, and along the lower course of Smiley Creek there are flats of ample size for the construction of a town.

According to report some difficulty was experienced in milling the ore during the operations of 40 years ago. The ore differs from most of that mined in Idaho, as already pointed out, and correspondingly different milling practice will have to be used in its treatment, but an experienced millman should have little trouble in getting satisfactory results. If it should be desired to separate the different metallic minerals, the intimate mixture of pyrrhotite, tetrahedrite, and galena present in some of the ore may cause difficulty, but such a separation probably need not be made at the mine.

The mines.

Summary

The early Mint reports mention about 16 mines on Smiley Creek, and there were doubtless others in operation at different times, but most of them never attained any considerable production, and nearly all have long since been abandoned and forgotten. The only two mines open at the time of visit in 1926 were the Webfoot and the Solace, both owned by L. A. Hiptack. In recent years these mines have been unmetered and drained out, so that large parts of them are now accessible. Below the Solace there are a number of tunnels. It appears that some of these were driven primarily to assist in the drainage of the Solace mine, but some may have been driven in order to prospect the ground. For purposes of description they are here grouped as the lower Solace tunnels. In addition the slopes on both sides of Smiley Creek are dotted with camps indicating the former location of prospect tunnels, now covered. When Umpleby visited the district in 1912 only one mine, known as the Mountain King, was accessible. It appears from his description of the workings and their location that this mine is identical with the one now known as the Webfoot. The workings on Vienna Creek were not visited by either Umpleby or the writer, as most of them are now caved and, according to report, none of them were extensive.
The present mine buildings are on Smiley Creek at an altitude of about 8,100 feet, 1.4 miles by road above the deserted town of Vienna. They comprise a large boarding house, an ore-dressing mill, an assay office, and a few other buildings. The mill building is finished, and much of the machinery is in place, but it appears never to have been put in operation. On the east side of Smiley Creek a few hundred feet east of the boarding house are the four tunnels of the Webfoot mine. The lowest is about 40 feet vertically above the boarding house, and the others are spaced at intervals of about 100 feet. West and southwest of the boarding house are the four lower Solace tunnels. Three of these are grouped within a few hundred yards of the boarding house and 260 to 320 feet vertically above it, and the other is about a quarter of a mile upstream, at an altitude of 8,575 feet. The main Solace mine is another quarter of a mile upstream, in a cirque basin near the head of Smiley Creek at an altitude of 8,700 feet. All these altitudes were determined by aneroid barometer and hence are approximate only.

Webfoot Mine

The Webfoot mine appears to be the only one from which ore has been taken in recent years. This is probably the same property as that described by Unpleby as the Mountain King mine.1 There is a boarding house, used as a residence by the watchman, an assay office, other small buildings, and a nearly completed mill, which has never been operated. The main workings comprises four tunnels at vertical intervals of about 100 feet. The two upper tunnels, known as Nos. 1 and 2, are not safely accessible. It is understood that there are large stopes from No. 2 tunnel up to the surface, and it is probable that most of the ore in that portion of the mine has been removed. There has also been considerable storing between tunnels No. 2 and No. 3, but comparatively little below No. 3. The workings now accessible in the two lower tunnels are shown in Plate 2. The stopes shown on this map have probably all been opened in the last 10 years or so. This map is compiled from the company's map modified and extended by means of pace and compass methods. The topographic notes are by C. K. Behr and the writer.

The lode has an average trend of about N. 65° W., and dips steeply northeast, but as Plate 2 indicates, there is considerable variation in its attitude in different places, and there are numerous minor veins which lie at considerable angles to the average trend, and some of which dip southwest. On the lowest level the lode is not very well defined and ore occurs sporadically. In places it appears that the small ore bodies that have been mined on this level were formed at the intersection of subsidiary veins with the main lode. Although the average dip of the main lode appears to be northeast, part of No. 4 tunnel lies south of the corresponding part of No. 3 tunnel, which is approximately 100 feet vertically above it, and it may be that the main lode has not been exposed in No. 4 tunnel. This suggests the possibility that ore may exist north of No. 4 tunnel, although the accessible crosscuts on this level do not show evidence of it.

Lower Solace Tunnels

The four fairly long tunnels between the Webfoot and Solace mines and on the Solace group of claims are here termed the lower Solace tunnels. The portals of the two most westerly tunnels are within 75 feet of each other, at an altitude of about 8,420 feet. They are saved at their mouths

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1. Unpleby, J. L., Geol. Citi., Ch. 1, 265-269.
and completely inaccessible, but the dumps indicate that both are fairly long. An aerial tramway once led down into the valley from the portal of the more easterly one. A small amount of vein quartz containing pyrite, arsenopyrite, and a little proustite remains on the dumps, but it appears unlikely that much ore was obtained in either tunnel. The granite here shows little evidence of alteration such as would be expected in the vicinity of a large vein.

About 400 feet southeast of these tunnels and 60 feet below them is a third, which is still open, although evidently driven a long time ago. This tunnel is shown in Plate III, which is based on pace and compass work by the writer. The tunnel is in granite throughout. In places there is a pronounced shearing which strikes west or a little north of west and dips 25° - 55° N., but none of the later and more irregular shearing. The granite here is somewhat altered, and a little vein quartz is present. No sulphides were noted. Two of the three raises in this tunnel evidently tap workings above, and it may be that the chief purpose of the tunnel was the drainage of these upper workings.

The fourth tunnel is at an altitude of about 8,675 feet, nearly a quarter of a mile farther up Smiley Creek. The timbering at the portal has collapsed and water is issuing from the tunnel, so that it is inaccessible. It is understood to have been driven in order to drain the main Solace mine and so far as known did not reveal any ore.

Solace Mine

The Solace mine is about half a mile above the boarding house, and its portal has an altitude of about 8,700 feet. As is shown in Plate 3, which is based on pace and compass mapping by C. H. Behr and the writer, the workings consist of an upper level reached by a tunnel and a winze from this level to four lower levels. The lowest level is still flooded, and most of the stopes are filled with gob, but the rest of the workings are accessible.

The lode strikes essentially east, parallel to the major joint system, and the average inclination of the ore, as indicated by the workings, was 35° N. The joints also dip north but at much steeper angles. They are more prominently developed than those in the Webfoot mine, and many of them are slickensided. There is a complementary set which strikes a little west of north. The irregularity of the workings on the lowest accessible level results in part from a stratified arrangement of ore deposition along such subsidiary joint planes, a fact which suggests that crosscuts might disclose more ore on this level.

Most of the joint fractures are unmineralized, although probably all are earlier in origin than the shear zones along which most of the mineralization took place. Vein quartz and proustite are more-abundant than they are in the accessible parts of the Webfoot mine. Most of the ground east of the main winze between the first and third levels has been mined out, and there has been some stoping above and probably below this winze. West of the winze, however, very little work has been done, although nothing seen in the present investigation indicates that the portion of the lode on that side is any less-likely to contain valuable ore than the portion mined.