Clinton R. Stauffer

UNITED STATES DEPARTMENT OF THE INTERIOR

TIN DEPOSITS OF NORTHERN LANDER COUNTY NEVADA

GEOLOGICAL SURVEY BULLETIN 931-L

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 931-L

TIN DEPOSITS OF NORTHERN LANDER COUNTY NEVADA

BY

CARL FRIES, JR.

Strategic Minerals Investigations, 1941
(Pages 279-294)

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1942

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - - - Price 20 cents

CONTENTS

ILLUSTRATIONS

TIN DEPOSITS OF NORTHERN LANDER COUNTY, NEVADA

By Carl Fries, Jr.

ABSTRACT

Tin-bearing veinlets are exposed in a small area near Izenhood Ranch, 22 miles north of Battle Mountain, Nev. They occur in thick rhyolitic flows of Miocene (?) age, and wood tin, found in the gravels of arroyos that head in the surrounding rhyolite, presumably comes from other veinlets not yet discovered. The exposed veinlets are about 20 feet in maximum length and a quarter of an inch in average thickness. Parallel and reticulating veinlets form lodes 4 to 6 feet thick and 15 or 20 feet long. Virtually no cassiterite is disseminated in the wall rock.

The veinlets contain specularite, cassiterite, sanidine, andradite, cristobalite, tridymite, quartz, chalcedony, fluorite, and opal. All these minerals, except possibly cassiterite, together with topaz and pseudobrookite, are likewise present in cavities that are widely distributed in the rhyolite. The similarity of the mineral assemblage in the veinlets to that in the cavities indicates that the tin originated in the rhyolite magma, and spectrographic analyses indicate that the average rhyolite contains about 0.001 percent of tin. It is therefore believed that the incrustations were deposited in fumarolic vents along fissures formed by differential contraction during the cooling of the lavas.

There is no record of any production of tin from the area. Possibly a few tons of the metal might be produced from the exposed veinlets by narrow stoping and hand sorting. No large body of rock in the area, however, contains even 0.2 of a pound of tin to the ton; and the amount of tin recoverable would be only a small part of that shown by assay, for not all of the tin is in grains of cassiterite large enough to be concentrated by ordinary methods.

Placer deposits of commercial grade occur in small draws that head in the area where the veinlets are exposed, but as they are only a few inches thick and of small volume, they could yield only a few tons of cassiterite. There is a large area of alluvium in the valley bottom below the tin-bearing veinlets that has not been thoroughly sampled, but a few tests indicate that the tin content of the upper 40 feet is less than 0.1 of a pound to the cubic yard.

INTRODUCTION

Tin-bearing veinlets occur in rhyolite at the northern end of the Sheep Creek Range in northern Lander County, Nevada (fig. 26). The tin-bearing area is at the base of a low ridge about half a mile north of the Izenhood ranch and spring, which are 22 miles by narrow dirt road north of Battle Mountain, a town on the main highway from Salt Lake City to Reno and on the Southern Pacific and Western Pacific Railroads. There is no record of any production of tin from the area. The principal claims were owned in 1940 by Mrs. R. R. Gamble and associates, of Battle Mountain.

The deposits were described by Adolph Knopf [1] in 1916, only 2 years after their discovery, and W. O. Vanderburg [2] visited the area for the Bureau of Mines in 1938. Little new exploratory work has been done on the deposits since 1916: the depth of the shaft on the old Mayflower claim has been increased from 10 to 50 feet, several shallow pits have been dug as assessment work, and some exploratory shafts as deep as 40 feet have been put down into the alluvium bordering the main ridge.

The deposits are similar to the tin deposits in the Black Range in New Mexico, which were studied in detail by the Geological Survey in 1939 and 1940 and explored by the Bureau of Mines in 1939, and preliminary accounts of which have been published.[3] The area is roughly rectangular, extending about 2 miles from north to south and 3½ miles from east to west. Only the more important part was mapped in detail. The writer, assisted by A. P. Butler, Jr., spent 3 weeks in the tin-bearing area in late July and early August 1940. The topography and geology of the area were mapped with telescopic alidade and plane table. Specimens of rhyolite, six channel samples across tin-bearing lodes and a dozen pannings of stream gravel were collected. Laboratory

---

1/ Knopf, Adolph, Tin ore in northern Lander County, Nevada: U. S. Geol. Survey Bull. 640-G, pp. 125-138, 1916.

2/ Vanderburg, W. O., Reconnaissance of mining districts in Lander County, Nevada: U. S. Bur. Mines Inf. Circ. 7043, pp. 54-57, February 1939.

3/ Fries, Carl, Jr., Tin deposits of the Black Range, Catron and Sierra Counties, N. Mex., a preliminary report: U. S. Geol. Survey Bull. 922-M, pp. 355-370, 1940.

Strategic minerals investigations, progress report on exploration of tin deposits: U. S. Bur. Mines Inf. Circ. 7154, pp. 4-5, March 1941.

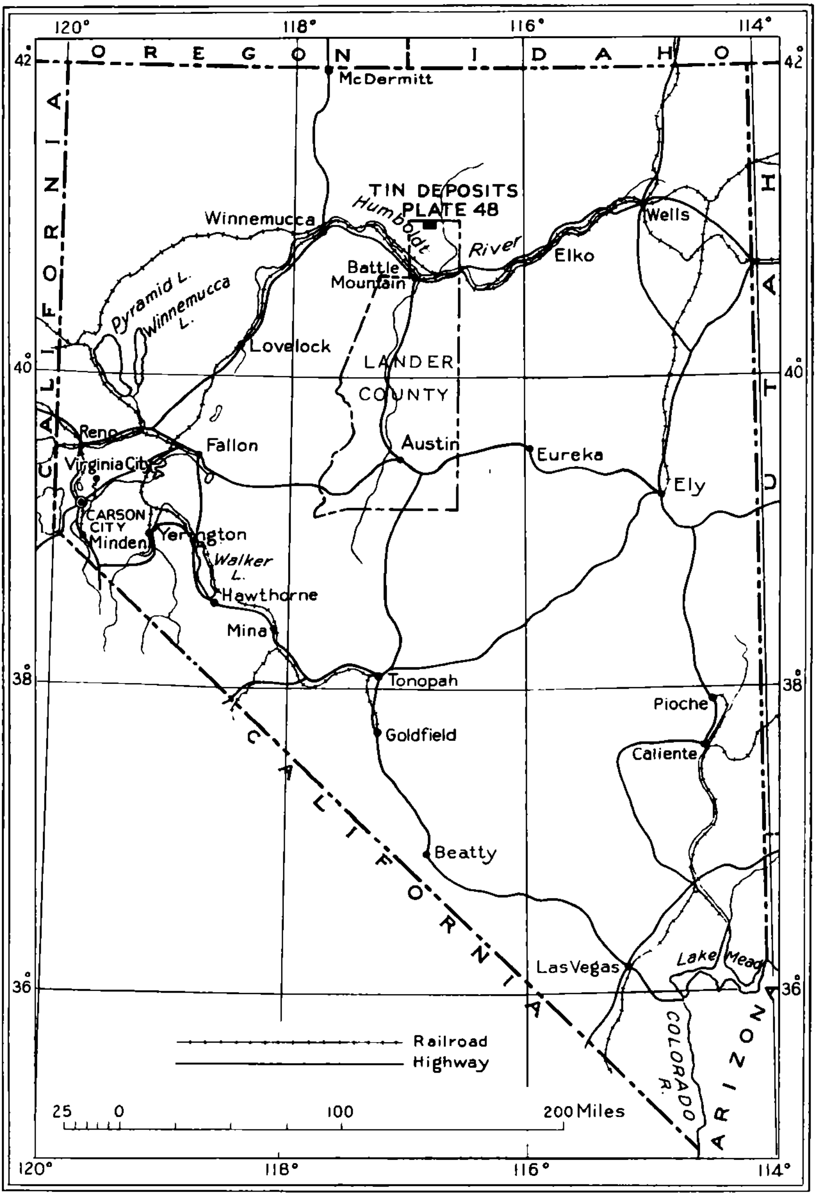


Figure 26.—Index map of Nevada showing location of tin deposits.

studies were made by the writer and Miss J. J. Glass of the Geological Survey. Owing to the scarcity of cassiterite in the samples, heavy minerals were concentrated from crushed rock with heavy liquids and examined microscopically. Quantitative spectrographic assays for tin were made of some of the concentrates.

Thanks are due Mrs. R. R. Gamble of Battle Mountain and Mr. P. S. Crocker of Dayton, Nevada, for information on sampling in the placer area. Many helpful suggestions and criticisms were contributed by H. G. Ferguson, F. C. Calkins, and Ward C. Smith, of the Geological Survey, during the preparation of this report.

GEOLOGY

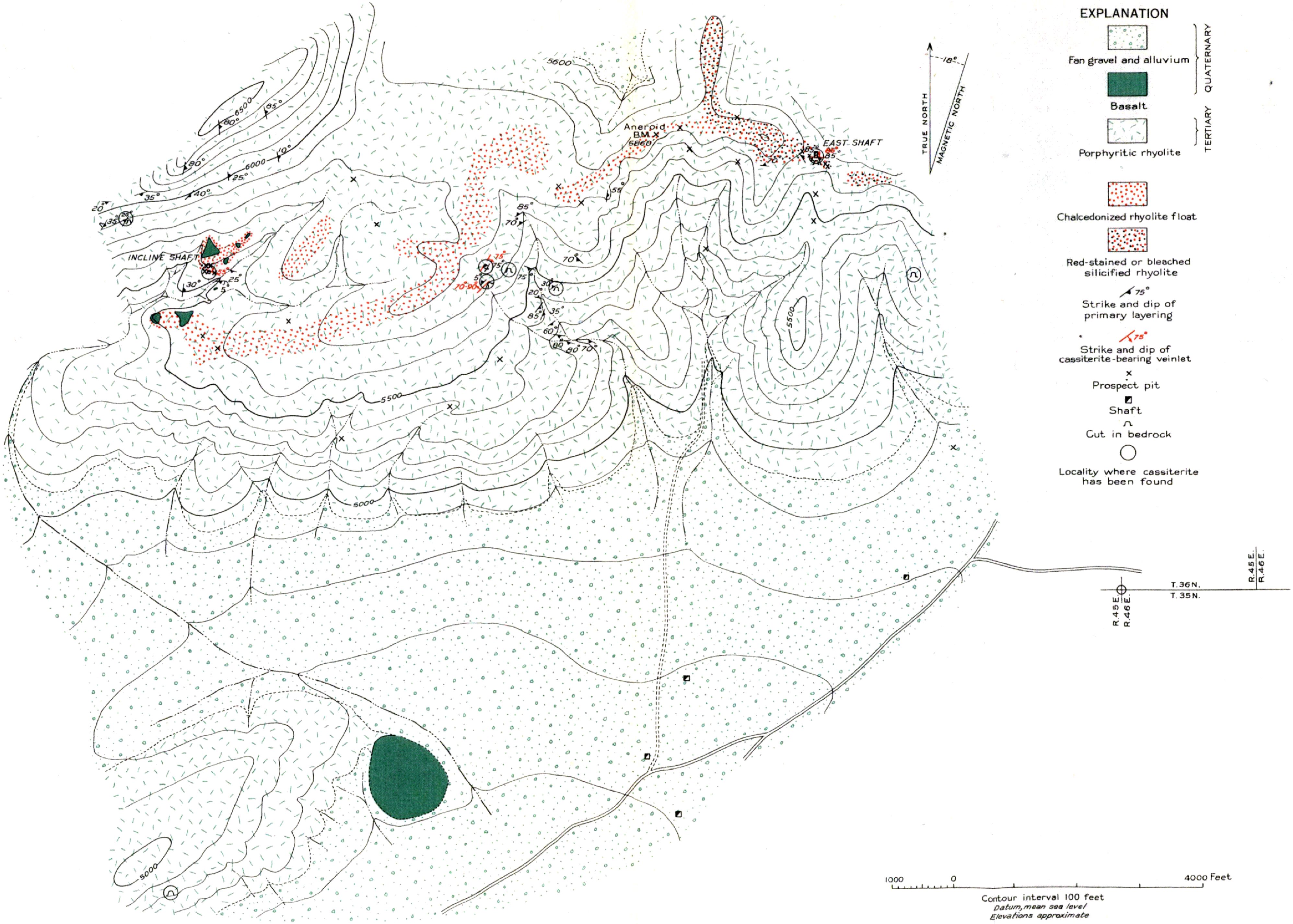
Porphyritic rhyolite

The oldest formation, in which all the tin-bearing veinlets occur, is a coarsely porphyritic rhyolite, light gray to pink in fresh exposures and dark gray to brown where weathered. The thickness of rhyolite exposed is about 200 feet, but the base is not exposed. The formation probably includes several flows, for in many places it contains masses of flow breccia, lithophysal structures, and zones in which the matrix is black glass. Continuous primary layering in the high ridge above the incline shaft (see pl. 48) indicates that one flow of rhyolite is more than 500 feet thick. No interbedded tuffs are present in the area examined. The age of the rhyolite is probably Miocene.[4]

Primary flow layering is well-developed in many parts of the rhyolite. The layers are highly irregular in strike and dip; at many places the dip changes within a short distance from nearly horizontal to vertical. Owing to the small extent of the area studied and the lack of continuous exposures, it was not possible to work out the structure of the flows in detail. The ap-

---

4/ Emmons, W. H., A reconnaissance of some mining camps in Elko, Lander, and Eureka Counties, Nev.: U. S. Geol. Survey Bull. 408, p. 35, 1910.



TOPOGRAPHIC AND GEOLOGIC MAP OF THE PRINCIPAL PART OF THE TIN-BEARING AREA IN NORTHERN LANDER COUNTY, NEVADA

parently confused structure is largely due to the high viscosity of the lavas at the time of extrusion.

The rhyolite is fairly uniform in composition throughout the area mapped. Phenocrysts of quartz, oligoclase, and potash feldspar, dominantly sanidine, make up from 25 to 35 percent of the rock. The rock contains a few microscopic aggregates of hematite dust, quartz, and feldspar; probably some of these represent biotite and others hornblende. The ground mass is a microcrystalline aggregate of feldspar, quartz, and chalcedony. The accessory minerals include magnetite, hematite, zircon, apatite, and sphene. Vesicles or lithophysae are present everywhere, although the rock is in general fairly dense. The minerals most abundant in the cavities are quartz and chalcedony, and specularite, topaz, pseudobrookite, and fluorite are somewhat less abundant. Sanidine, garnet, tridymite, cristobalite, opal, and possibly cassiterite occur in cavities in a few places.

A partial chemical analysis of the normal rhyolite given by Knopf [5/] shows:

SiO_2.............	76.25
K_2O.............	5.18
Na_2O.............	4.05
CaO..............	0.44

Spectrograms of lithophysal rhyolite and of average rhyolite show, in addition to the ordinary rock-forming elements and iron, between 0.2 and 0.001 percent each of titanium, manganese, zirconium, barium, copper, zinc, tin, and vanadium. Fluorine, which is not recorded on the spectrograms, probably is present in similar quantity. Strontium, molybdenum, lead, boron, gallium, chromium, nickel, and cobalt are present in quantities between 0.001 and 0.0001 percent. There is a trace of silver. Arsenic is absent, and sulphur appears to be absent.

The greater part of the rhyolite is unaltered. In some places both quartz and sanidine crystals show minor enlargement.

5/ **Knopf, Adolph, op. cit., p. 128.**

The feldspars show internal change only at the present erosion surface, where fractures in the crystals are filled with caliche. Red and brown iron stain is present in rock adjacent to fractures in the northeastern part of the area. Chalcedony and opal partly fill the cavities in the ground mass of the rhyolite on the upland bench below the high ridge, as indicated on plate 48. It seems probable that the deposition of the silica was related to an old erosion or contact surface, as the quantity of silica is greatest around small remnants of the overlying basalt, and as the rhyolite in the small draws that head in this area does not contain such secondary silica.

Some parts of the veinlets in the incline shaft at the west end of the area mapped (see pl. 48) are almost completely filled with chalcedony and opal, which have also partly replaced the ground mass of the rhyolite of the walls for half an inch. The silicification of the wall rock extends only about 10 feet below the surface. The veinlets appear to be composed of angular fragments of vein material and wall rock cemented by silica. Microscopic examination of a veinlet further shows that deposition of the silica began as an incrustation on the walls of an open fissure and on its loosely held angular filling. The present surface at the shaft is possibly no more than 10 feet below an erosion surface that was overlain by basalt, of which a few patches remain. In view of the marked increase in the quantity of chalcedony in the rhyolite near the contact surface, it is probable that the silica in the veinlets is similar in origin to that in the body of the rock.

There are no areas of porous leached rock, such as those in the Black Range tin deposits in New Mexico.[6]

6/ Fries, Carl, Jr., op. cit., p. 361.

Basalt

The rhyolite is unconformably overlain by nearly horizontal flows of basalt (pl. 48). There are six small remnants of basalt in the vicinity of the incline shaft near the northwest corner of the area mapped, and a larger patch near the valley bottom in the southern part of the area. It covers the upland bench west of the incline shaft and is the dominant rock in the Sheep Creek Range, south of the area mapped. The basalt must have flowed over an erosion surface of strong relief. It is possibly Pleistocene in age.[7]

Alluvium

The alluvium in the valley bottom at the south edge of the area mapped is composed of poorly sorted rhyolitic and basaltic material with boulders varying in size up to as much as 4 feet in diameter. Pits have been sunk as deep as 40 feet without reaching bedrock.

TIN DEPOSITS

Veinlets in bedrock

Distribution.--Cassiterite (SnO_2) occurs at eight places in an east-trending belt about 2 miles long and half a mile wide. Distinct veinlets were found at only four of these places. (See plate 48.) A small prospect cut shown at the southwest edge of the map also contains cassiterite. A pit, located on a hillside about a mile east of the east shaft but not included in the area mapped, exposes a veinlet. The veinlets probably have a wider distribution than is shown by these prospects, for cassiterite is found by panning in arroyos that head on the north side of the high ridge shown in plate 48. As cassiterite is also found

---

7/ **Personal communication from H. G. Ferguson of the Geological Survey.**

in arroyos heading on a ridge southeast of the area mapped, veinlets probably occur in the watershed of these arroyos.

General character.--The veinlets have a characteristic open texture and might be described as incrustations on the walls of fissures. The thickness of the incrustations is variable, averaging about a quarter of an inch. It is reported that pieces of vein material as thick as 6 inches have been found, but such bodies are apparently pod-shaped and at most only a few feet long. The incrustations are not limited at all places to a single fissure, but follow some of the cross and parallel fractures as well. At one place, where the rhyolite is broken into small blocks, some of the blocks are almost completely incrusted. Lodes from 4 to 6 feet thick that contain several nearly parallel or reticulated veinlets occur, but none were seen to extend for more than 20 feet either vertically or horizontally. It is possible that the vein material might appear again beyond a barren section, as some of the fissures continue beyond the incrusted sections. Although cassiterite has penetrated the wall rock as much as half an inch in a few places, in general it was not deposited in the walls, none of it being found in heavy-mineral concentrates of samples from which the incrusting material was cobbed off.

The fissures that contain the veinlets are generally erratic in strike and have steep dips. Measurements of the average strike of four tin-bearing fissures gave: N. 80° W., N. 35° E., N. 50° E., and N. 85° W. Irregularity in strike and dip along the individual fissures is so great that no appreciable movement could have taken place without strong brecciation of the walls. There is no such brecciation along any of the exposed fissures that carry vein material. Closely spaced, nearly parallel fractures and broken rock near the bottom of the incline shaft suggest faulting, but the movement was not along the tin-bearing fissures. Slickensides have not been found in the area mapped.

Mineral and chemical composition.--The incrustations are largely specularite and cassiterite. In some places cassiterite is nearly or entirely absent, but specularite is present everywhere. The greater part of the cassiterite was deposited on and around specularite, but the minerals are intergrown so intimately that they appear to have been deposited at essentially the same time. The cassiterite forms tiny red, pale-yellow, or dark yellow-brown crystals, and botryoidal masses known as wood tin. The brown crystals appear almost black and are easily mistaken for specularite. The wood tin ranges in color from nearly white through all shades of yellow and red brown to dark brownish black. A spectrogram of a few small pieces of wood tin that were picked out of a veinlet in one of the prospect pits near the center of the area mapped shows, in addition to tin and iron, small quantities of manganese, lead, antimony, tungsten, and zinc. The specularite is all in well-formed, splendent, black, platy or bladed crystals, some of which are corroded and partly replaced by cassiterite. Analyses indicate that the specularite contains small quantities of tin either as a part of the mineral or as submicroscopic grains of cassiterite which cannot be identified under the microscope.

Although much of the cassiterite and specularite is not coated with later minerals, both have been incrusted in some places with cristobalite, tridymite, sanidine, quartz, chalcedony (including the variety known as lussatite), opal, and fluorite. Sanidine, cristobalite, and tridymite appear to be relatively more abundant in the tin-bearing fissures than in the cavities in the rhyolite, but the other minerals named, and specularite, are rather evenly and widely distributed throughout the rhyolite. Small grains of a zeolite attached to vein material in the east shaft appear to have been formed by pseudomorphic replacement of the incrusting sanidine. Vertical planes of parting parallel to the primary flow layering in the prospect pit near the southwest corner of the map (see pl. 48) are sparingly studded with brown crystals of andradite garnet. Heavy-mineral concentrates of small pieces of rock from here with attached garnet also contain a little cassiterite. Andradite garnet incrusting cassiterite occurs in a veinlet in the Black Range of New Mexico.

Heavy-mineral concentrates of two channel samples taken across veinlets in the incline shaft (see fig. 27) contain hematite, zircon, topaz, fluorite, pseudobrookite, apatite, cassiterite, and sphene. Spectrograms show that the only essential chemical difference between these samples and those of the average rhyolite is in the relative quantity of tin, which is about 10 times as great in these channel samples as in the rhyolite.

The wall rock adjacent to most of the veinlets is wholly unaltered.

Origin.--There is little doubt that the cassiterite was deposited before the extrusion of the basalt, since the veinlets in the incline shaft appear to have been eroded before the basalt was extruded. No veinlets, moreover, have been found in the basalt, and no placer tin has been found that could be derived from bodies of basalt in the area mapped or from larger bodies in the vicinity. The source of the vein material appears to have been the rhyolite, for spectrograms show that the chemical elements in and near the veinlets are the same as those in the average rhyolite, which contains about 0.001 percent of tin. The mineralogy of the veinlets is similar to that of the vesicle fillings in the average rhyolite. These similarities and the absence of sulfide minerals indicate that the fissures had no deep connections.

It is believed that the cassiterite-bearing incrustations were deposited along the walls of fumarolic vents which probably were not major breaks. Such an origin is suggested by the discontinuity and the extreme irregularity in strike and dip of the individual fissures, and by the absence of brecciation and detectable faulting along them. It is probable that most of the fissures were formed by differential contraction during the cooling of the solidified lavas, though some of them may have resulted from minor adjustments in the basement rocks after extrusion of the lavas.

Prospect pits.--The incline shaft near the northwest corner of the map (see pl. 48 and fig. 27) is 45 feet deep [8] but is

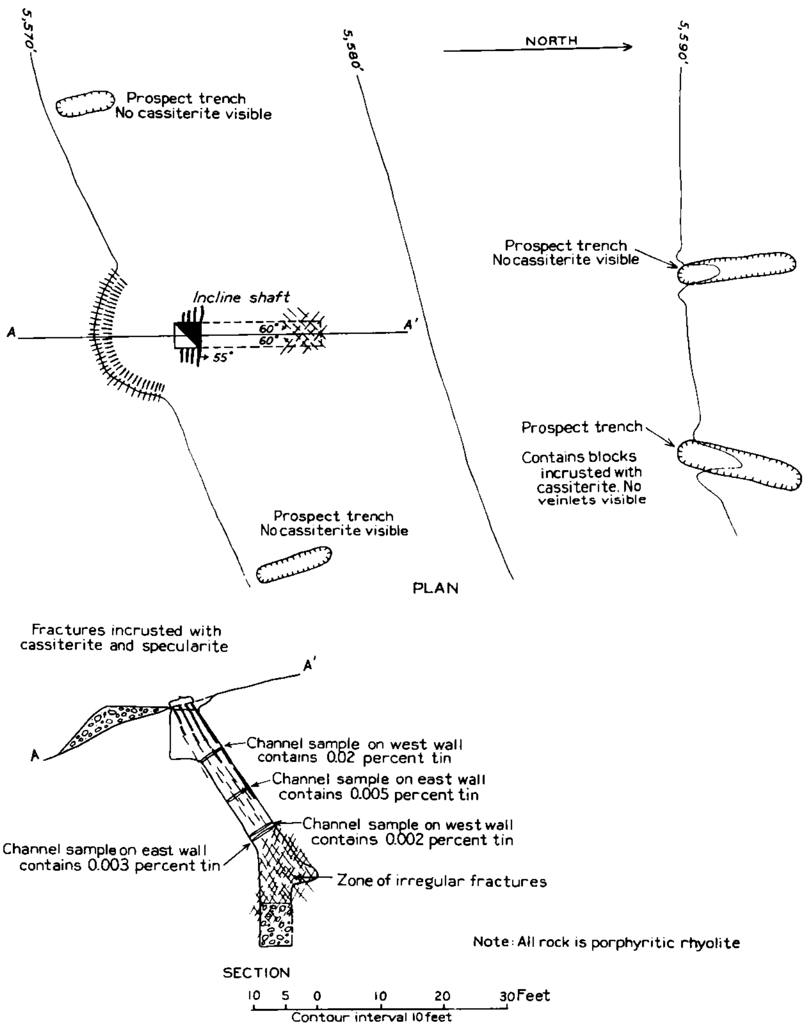


Figure 27.--Plan and section of the incline shaft.

8/ Knopf, Adolph, op. cit., p. 130.

filled for 10 feet with rubble. The shaft follows the dip of four nearly parallel veinlets. Three of the veinlets pinch out in the first 10 feet, and the remaining one ends at about 15 feet. At 25 feet there is a zone of broken rhyolite which Knopf [9/] regarded as marking a normal fault; the absence of slickensides and breccia, however, indicates that the movement was slight. As the veinlets die out before they reach the broken zone, their disappearance cannot be attributed to faulting. The veinlets cannot be traced on the surface for more than a few feet from the shaft. Two prospect pits on either side of the shaft show no vein material. The dump of one of the pits north of the shaft contains a few blocks that are incrusted with vein material, but the veinlets could not be found in place.

Grab channel samples weighing about 3 pounds each were taken at four places across the walls of the shaft. Quantitative spectrographic analyses of heavy-mineral concentrates from the crushed samples indicate that the tin content ranges between 0.02 and 0.002 percent. The decrease in tin content from the top of the shaft downward is shown in figure 27. From the analyses and the length of the veinlets visible, it is estimated that about 5 tons of ore containing 10 percent of tin could be obtained by narrow stoping and hand sorting.

The east shaft, shown near the northeast corner of plate 48 and in figure 28, is said to be 50 feet deep [10/] but is filled for 20 feet with rubble. It was not possible to examine the upper part closely, but some small irregular veinlets, which appear to strike nearly west, are visible in the southwest corner; they disappear at a depth of 15 feet. The veinlets cannot be traced on the surface away from the shaft. Vertical primary flow layering having a strike of N. 15° W. is conspicuous at

---

9/ Knopf, Adolph, op. cit., p. 130.
10/ Vanderburg, W. O., op. cit., p. 55.

the shaft. No veinlets or vein material were found in the small cut south of the shaft or in the rock excavated from it.

Small grab channel samples were taken across the north and east walls of the shaft 25 feet below the surface. Quantitative spectrographic analyses show 0.01 percent of tin across the north wall and 0.005 percent across the east wall. A few thousand pounds of ore containing 10 percent of tin might be mined from the shaft by narrow stoping and hand sorting.

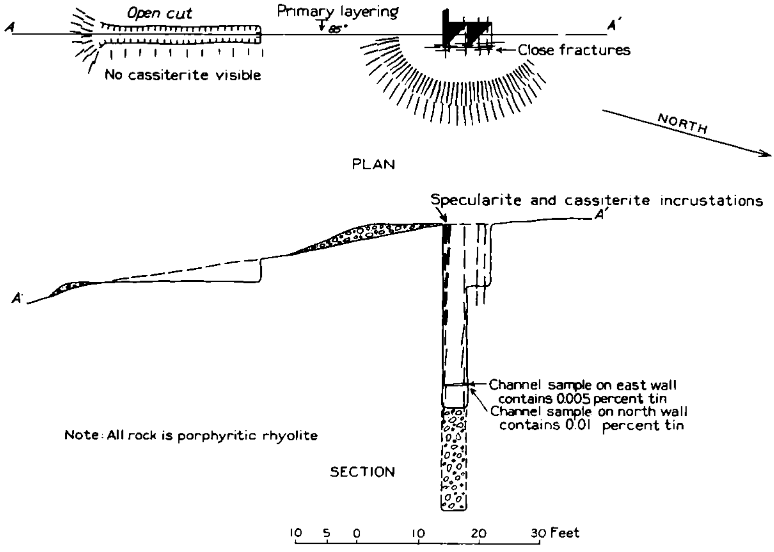


Figure 28.--Plan and section of the east shaft.

Two small prospect pits just north of the center of the mapped area have veinlets exposed in their walls. The wall of a nearly vertical northeast-trending fissure in the south pit is thinly incrusted; the vein material could not be traced on the surface. An incrusted, nearly vertical fissure wall is exposed in the north pit; the vein material appears to continue for at least 10 feet southwest on the surface. Possibly a few thousand pounds of ore containing 10 percent of tin might be mined from these pits.

Outlook.--Selective mining of the tin-bearing veinlets would not pay, owing to their narrowness and discontinuity. None of the veinlets exposed are more than 20 feet long. Although vein material may again appear along a fissure beyond a barren section, it is improbable that any individual deposit would extend even intermittently for more than a few hundred feet either vertically or horizontally. The maximum vertical extent of a deposit would be limited by the thickness of the rhyolitic lava and by other physical factors affecting deposition. Veins of this type have been mined in Mexico by hand stoping, but there one kilogram of concentrates containing from 25 to 50 percent of tin (worth from 30 to 50 cents United States currency in 1940), washed from ore containing from 3 to 10 percent of tin, is considered a satisfactory recovery for one man in a day. No vein in deposits of this type in Mexico or New Mexico has yet been proved large enough to be mined profitably by machine methods. In view of the exploratory work that has been done by the Bureau of Mines on the deposits in New Mexico [11] and the brief examination by the writer of many of the Mexican deposits, it seems certain that only a few tons of ore containing 10 percent of tin could be produced from any one veinlet by selective mining, disregarding cost of production.

It seems equally certain that the deposits could not be mined by bulk methods. Any large body of ore in this area would consist of rhyolite in which veinlets were closely spaced or in which cassiterite was more abundantly disseminated than it has anywhere been observed. The largest bodies of even potential ore exposed are lodes 4 to 6 feet thick, made up of veinlets that are no more than 20 feet long. It is doubtful whether these lodes would average 0.1 percent of tin, judging from six 3-pound channel samples ranging from 0.02 to 0.002 percent of tin, each taken across 4 or 5 feet of two of the lodes. Heavy-mineral concentrates of samples taken from what appear to be the

---

11/ Strategic minerals investigations, op. cit.

most favorable places indicate that no appreciable quantity of cassiterite is disseminated in the rhyolite, except very close to some of the veinlets. The amount of tin recoverable from the rhyolite, moreover, would be only a part of the small quantity present, for not all of the tin is in cassiterite that could be concentrated by ordinary methods. Some of the tin appears to be in the specularite either as a part of the mineral or as submicroscopic grains of cassiterite, and loss of tin is high in smelting concentrates that contain much iron.

Placers

All the small draws that drain the rhyolite in the area mapped carry a little cassiterite, particularly the three large draws on the east side and the large draw on the west side. (See plate 48.) Possibly a few tons of cassiterite could be economically recovered from these thin deposits of gravel, which are largely in pockets in bedrock and of very small volume.

The alluvium at the base of the ridge appears to be the most favorable large area of placer ground, for it was derived mainly from the rhyolite that contains the cassiterite-bearing veinlets. No extensive detailed sampling of the alluvium has been done, but panning by the writer of material excavated from the prospect pits shown on the map indicates that the percentage of cassiterite is very small. The people who dug some of the pits report that the quantity of cassiterite is negligible. The tin content of the gravels to the depth of sampling appears to be less than 0.1 of a pound to the cubic yard.

The alluvium apparently accumulated under conditions that were not favorable to concentration of the cassiterite. Material excavated from two shafts, each 40 feet deep [12] and entirely in alluvium, consists of sand and medium-sized gravel much finer

---

12/ Vanderburg, W. O., op. cit., p. 56.

than that in the alluvium dissected and exposed in small draws closer to the ridge north of the shafts. The alluvium probably was transported during short, heavy rain storms and deposited with little sorting, so that there was no thorough separation of materials into layers. Cassiterite may, however, have been slightly concentrated at several horizons in the deposit, and the deeper unexplored gravels in the valley bottom may have accumulated under different climatic conditions more favorable to placer concentration.

Inasmuch as the deep shafts in the alluvium struck the water table, it appears that there would be a plentiful supply of water for placer operation.

O