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TIN DEPOSITS OF THE BLACK RANGE CATRON AND SIERRA COUNTIES NEW MEXICO

A PRELIMINARY REPORT

BY

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TIN DEPOSITS OF THE BLACK RANGE, CATRON AND SIERRA COUNTIES, NEW MEXICO

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ABSTRACT

Twelve areas in which tin deposits are known to occur and five more in which they have been reported are scattered over a region that embraces about 450 square miles on the west side of the Black Range, in Catron and Sierra Counties, southwestern New Mexico. This report is based on detailed examination of the three principal areas, which are along Taylor Creek, Hardcastle Creek, and Squaw Creek, and preliminary study of rock and ore specimens. The deposits were explored and sampled by engineers of the Federal Bureau of Mines as a part of the same investigation, and their results were made available to the author.

The rocks in the region are mid-Tertiary and younger and comprise rhyolite breccia, rhyolite tuff, rhyolite and basalt flows, and clastic sediments. Tin-bearing stringers occur mainly, if not wholly, in the altered and fractured parts of certain thick flows of porphyritic rhyolite near the bottom of the sequence. The stringers are irregular and discontinuous; they range in size from thin films that extend for 1 or 2 feet along fractures to tabular bodies about an inch thick and 20 or 30 feet long. Cassiterite, which is the tin-bearing mineral, encrusts specularite (iron oxide) and is intergrown with it. The cassiterite constitutes about 25 percent of the vein material and is disseminated in the rhyolite immediately adjacent to stringers.

The zones of altered rhyolite are adjacent and parallel to belts, from 200 to 1,000 feet wide and more than a mile long, in which the flow banding has a fanlike pattern in cross section. These belts probably overlie fissure vents. Metallization and alteration were probably localized by fractures related to these vents. The tin seems to be genetically related to the porphyritic rhyolite.

The stringers are too small to be mined separately, and the deposits would have to be mined by bulk methods. In the areas sampled no sizable deposit has been found that contains as much as 1 pound of tin per ton. Placer deposits have been found only in the vicinity of bedrock deposits. The best placer deposit sampled contains about 4,000 cubic yards of gravel that averages about 2 pounds of tin per cubic yard. The gravel in the other deposits sampled averages less than 0.05 pound, and a large part of it averages less than 0.005 pound.

INTRODUCTION

Twelve areas in which tin deposits are known to occur and five more in which they have been reported are scattered over a region that embraces about 450 square miles in the Gila National Forest, southeastern Catron County and northwestern Sierra County, New Mexico. (See figs. 48 and 49.) As the region lies on the west side of the Black Range and as the best-known deposit is at Taylor Creek, previous descriptions have referred to the deposits collectively as the Taylor Creek, Catron County, or Black Range tin deposits. The three principal tin-bearing areas in the region are on Taylor Creek, Squaw Creek, and Hardcastle Creek. Black Springs Post Office, which is in the west-central part of the region, is connected with Silver City, 92 miles to the southwest, by a narrow dirt mountain road for 65 miles of the distance and the oiled State Highway 180 and U. S. Highway 260 for the remainder of the distance. Magdalena lies 85 miles to the northeast, 64 miles of which distance is served by a narrow dirt road and the remaining 21 miles by the oiled U. S. Highway 60. Hot Springs, on the Rio Grande 89 miles to the east, is reached by a good dirt road. The roads to Hot Springs and to Silver City are closed for a part of the winter because of snow. Branch lines of the Atchison, Topeka & Santa Fe Railway reach Magdalena and Silver City. All the known tin deposits, except those in the southern part of the district, can be reached by car over narrow dirt roads or tracks that connect with the main roads.

Nuggets of cassiterite were found in the gravel of Squaw Creek in 1909, and by 1920 tin-bearing stringers had been found in all the principal areas shown in figure 49. In the fall of 1920 [1] the New Mexico Tin & Metals Co. drove a 440-foot tunnel

1/ Hill, J. M., The Taylor Creek tin deposits, New Mexico: U. S. Geol. Survey Bull. 725, p. 357, 1921.

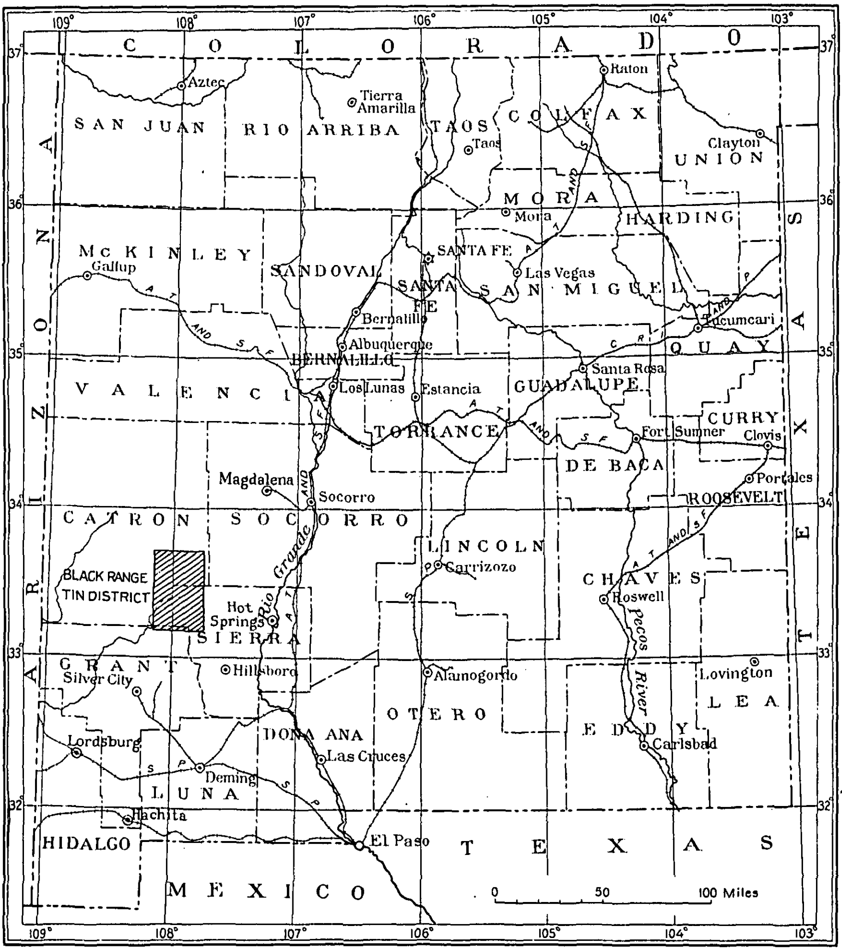

Figure 48.--Index map of New Mexico showing location of Black Range tin district.

into the altered rock on the north side of Taylor Creek half a mile east of the mouth of Cox Creek. In 1939 the Colorado & New Mexico Tin Corporation erected a 25-ton mill on Taylor Creek and ran tests on dump material. One owner was operating a placer in the Hardcastle area during 1939 and the spring of 1940.

Only three shipments of ore from the region are known to have been made. M. T. Anderson in 1937 shipped 325 pounds of hand-picked vein material from the Taylor Creek area to the Nicholls Copper Co. Paul Bellamy made two shipments from the Hardcastle area, one in 1939 of 700 pounds of nuggets assaying 63 percent of tin and another in February 1940 of 838 pounds.

Detailed geologic maps of these areas, covering about 10 square miles, were made in the fall of 1939. At the same time the deposits were explored and sampled by the Federal Bureau of Mines. Topography and geology were mapped with telescopic alidade and plane table. The samples collected by the writer and his assistant, and some of those collected by engineers of the Bureau of Mines, have been studied petrographically and chemically, but the laboratory investigations are not yet complete. Field work was resumed in May of 1940.

The work was under the general supervision of S. G. Lasky. The writer is indebted to the claim owners in the region, particularly Messrs. Paul Bellamy, M. T. Anderson, and C. E. Dawson, for their courtesy. Miss J. J. Glass, of the Federal Geological Survey, has identified the minerals in the rocks. Dr. C. E. Needham, president of the New Mexico School of Mines, has kindly afforded facilities for laboratory work. Prof. N. P. Peterson, also of the New Mexico School of Mines, made qualitative spectrographic analyses of heavy-mineral concentrates. M. E. Volin, who had charge of the Federal Bureau of

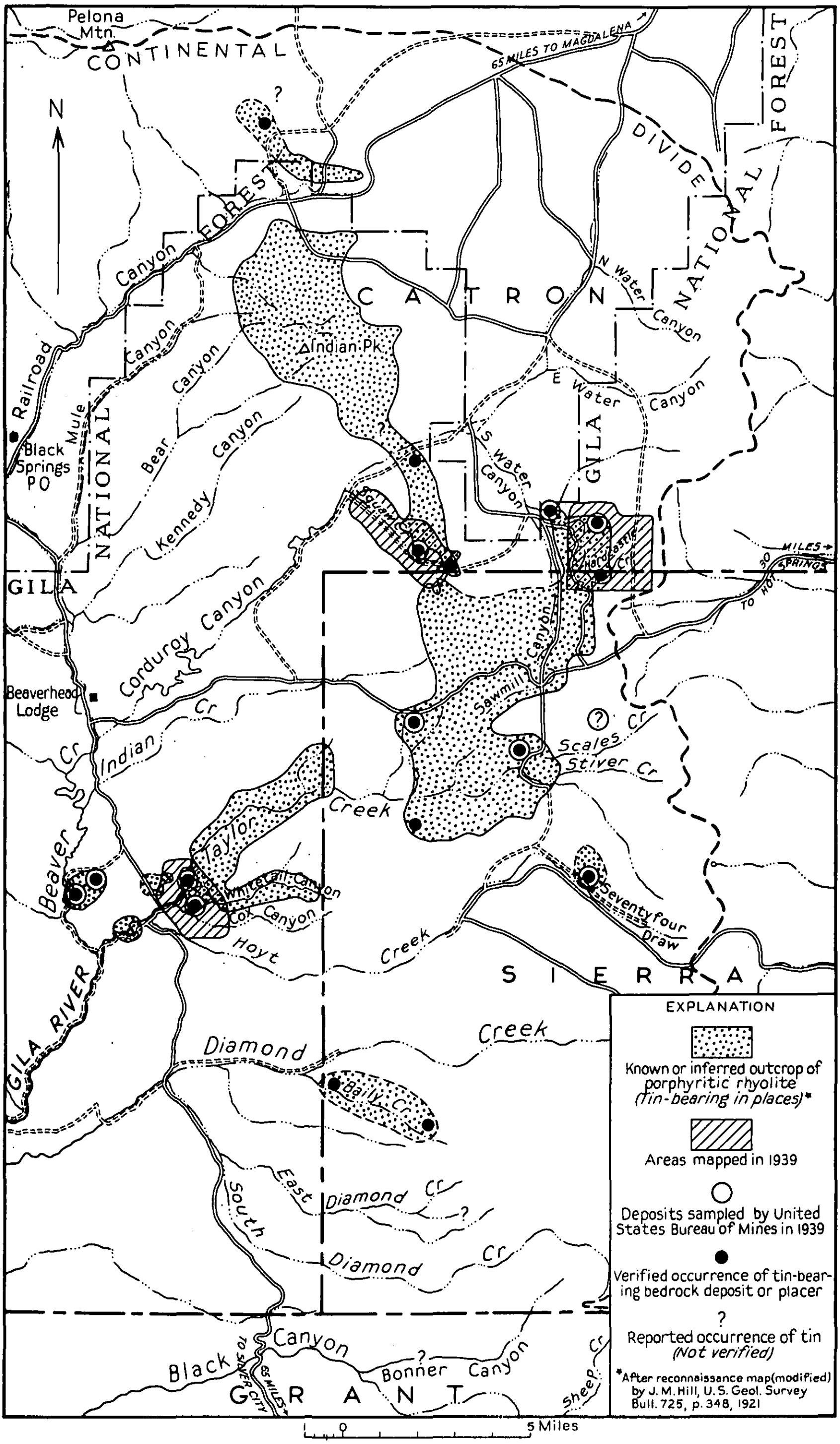

Figure 49.--Outline map of the Black Range district showing location of tin deposits and distribution of the tin-bearing formation.

Mines investigation in the region, was particularly cooperative during field work. H. E. Wenden, Jr., aided in both field and laboratory work.

GEOLOGY

The rocks in the mapped areas are mid-Tertiary and younger. The oldest unit set off in mapping consists of interbedded rhyolite breccia and flows of nonporphyritic rhyolite. It is overlain by thick flows of porphyritic rhyolite, which is similar in composition to the underlying rocks. The tin deposits, so far as is now known, are almost exclusively in this rock. The porphyritic rhyolite is unconformably overlain by a series consisting of (1) rhyolitic tuff, breccia, and thin flows; (2) basalt flows; (3) sandstone and conglomerate; and (4) sand and gravel. These four units are separated by minor unconformities, and even the youngest appears to have been slightly deformed. Thin deposits of gravel, which in some places contain placer tin, lie in and near the bottoms of the present valleys.

Older rhyolitic rocks.--The only outcrop of the older rhyolitic rocks is in the walls of Taylor Creek Canyon, about half a mile east of the mouth of Cox Creek. They are exposed also in the New Mexico Tin & Metals Co.'s tunnel. They consist of breccia and lava. (See pl. 55.) The maximum exposed thickness is about 200 feet. The rocks, which are friable and easily eroded, are red brown to light gray or white on fresh surfaces and rusty brown in weathered outcrop. The breccia is rudely bedded, but the flows are distinctly layered and not conspicuously porphyritic. A little tin is present in these rocks.

Porphyritic rhyolite.--The distribution of the porphyritic rhyolite (the tin-bearing formation), so far as it is now known, is shown in figure 49. The formation appears to be represented by a single flow in each of the areas studied, but it is probably not all part of the same flow; it may have been extruded contemporaneously from several vents. At Taylor Creek the flow may be several times as thick as the 500 feet that is exposed. Flow-layering is prominent throughout this rhyolite. The freshest rock is light red brown to pink. Phenocrysts are easily seen and make up from 30 to 50 percent of the rock. They are chiefly of quartz and clear sanidine (a form of potash feldspar), which are present in nearly equal amounts. Crystals of whitish plagioclase and small red-brown books of biotite are present in minor quantity. The groundmass is microcrystalline. About 1 to 3 percent of the volume of the freshest rock consists of vesicles, which are lined with different forms of silica and small quantities of zeolites. Many vesicles contain also a few crystals of magnetite and specularite (iron oxides).

Much of the porphyritic rhyolite is altered to a porous white rock that is easily crushed but tough and hard to blast. Some of the bleached zones are as much as 1½ miles long and from 200 to 1,400 feet wide. (See pls. 54 and 62.) The mapping of their boundaries is somewhat arbitrary, for their limits are ill-defined. The porosity, which is in some places as high as 35 percent, has resulted from leaching of the groundmass. The groundmass is in part replaced by the silica minerals tridymite, chalcedony, opal, and quartz and by minor quantities of zeolites. It also contains specularite and a little secondary magnetite. The feldspar phenocrysts even in the bleached rock are unaltered, but the quartz crystals have been enlarged.

Rocks younger than porphyritic rhyolite.--A period of erosion followed the extrusion of the porphyritic rhyolite, and at many places the overlying rocks rest with steep contacts on the old erosion surface. These rocks are later than the metallization. The oldest of them are rhyolitic breccia, tuff, and

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thin flows overlain in places by tuffaceous sandstone. They have a total thickness ranging from 50 feet to more than 500 feet. The rhyolitic rocks are overlain in the Taylor Creek area by basalt flows that have a maximum thickness of 150 feet. The basalt is overlain by sandstone and conglomerate, which are more than 350 feet thick in places but pinch out at the east side of the Squaw Creek area and are not present in the Hardcastle Creek area. Unconsolidated sand and gravel, which have a maximum thickness of 150 feet in the Squaw Creek area but form only a thin cover in parts of the Taylor Creek and Hardcastle Creek areas, overlie all the other rocks.

The Recent alluvium is from a few inches to about 30 feet thick, though generally it is less than 20 feet. It consists largely of coarse gravel and boulders of volcanic materials.

STRUCTURE

The flow layers of much of the porphyritic rhyolite, especially in the tin-bearing areas, are steep and irregular. Belts more than a mile long and from 200 to 1,000 feet wide in which the flow layers are nearly vertical cross the Taylor Creek and Hardcastle Creek areas and have been noted just north of the limits of the Squaw Creek area. At one place in the Taylor Creek area vertical flow layering is exposed through a height of nearly 400 feet. The flow layers at many places are seen to gradually diverge upward toward either side, from a central vertical zone, so that they form a roughly fanlike pattern in cross section. Minor inverted fans and other irregularities are present within the major fan structure. The major belts of vertical layering have a northerly trend but have some short branches.

The persistently steep flow layers and the large fan structures described cannot have resulted from post-lava movements, for no possible type of folding could produce such features, and the rocks show neither megascopic nor microscopic evidence of the fracturing that would accompany intense folding. The fanlike flow layers must be due to original flowage, and it is presumed that the belts of vertical layering mark the sites of fissure vents through which the rhyolite was extruded.

The zones of altered rhyolite are parallel to the zones of vertical layering. They are cut by many steep discontinuous and irregular slickensided fissures, of northerly strike, traceable for a few hundred feet at most but usually for less than 50 feet. The rock adjacent to the fissures is highly fractured. This fracturing preceded the deposition of the rocks that overlie the rhyolite.

The structure of the formations that overlie the porphyritic rhyolite is relatively simple. The angular discordances between the rhyolite and the overlying rocks are largely due to high initial dips where these rocks lapped against steep hills of rhyolite. There may be slight angular discordances between successive strata of the younger rocks, but the steeper dips appear to be initial dips conforming to old erosion surfaces. The younger formations are cut by a few normal faults on which the recognizable displacement does not exceed 100 feet.

TIN DEPOSITS

Bedrock deposits

Occurrence.--The tin mineral cassiterite occurs mainly in widely scattered stringers of northerly trend, which cut the rhyolite in the altered zones. The distribution of the stringers at the surface is illustrated on plates 55 and 62. The stringers range in size from thin films 1 or 2 feet long to tabular masses, many of which are about an inch thick and 20 or 30 feet long and a few of which are larger. The small stringers shown on plate 57 illustrate their irregular and nonpersistent character. Cassiterite is disseminated in the wall rock for a few inches on either side.

Mineralogy.--The stringers consist mainly of specularite (iron oxide) and cassiterite (tin oxide), cassiterite constituting from a few percent to nearly 90 percent and averaging between 20 and 30 percent. In some places a little magnetite is intergrown with the specularite. Minor quantities of cristobalite and tridymite (forms of silica) encrust the specularite and cassiterite in some stringers. Other encrusting minerals are chalcedony, opal, and quartz. Fluorite is a rare constituent of the veins; zeolites (hydrous aluminum silicates of calcium, sodium, and potassium) are commonly present; and calcite has been noted at one place. No sulphides have been recognized.

The larger part of the cassiterite is dark red brown and fibrous, and forms concentrically laminated nodules, which grew from centers on the specularite crystals and coalesced to fill completely the open spaces between them. It has also partly replaced the specularite and has become intimately intergrown with it. Some stringers contain small nodules built up of shells of dark-brown, red, and pale-yellow cassiterite formed around nuclei of iron oxide. In a few places specularite crystals are covered or intergrown with clear dark-red striated crystals of cassiterite. The specularite forms glistening black plates and blades. Some small crystals that appear under the microscope to be pure specularite leave residual minute flakes of cassiterite when dissolved in hydrochloric acid, but not all of the specularite contains cassiterite.

Origin.--Inasmuch as most of the tin-bearing stringers have not been crushed since their formation, nearly all the shearing and fracturing of the rhyolite in the zones of alteration must have preceded the metallization. The close association of the belts of fractured and altered rock with the belts of fan structure in the rhyolite and the similarity of strike suggest a genetic connection. The fracturing was possibly an effect of differential contraction of the cooling rhyolite in the vents and in the flows. The fact that the tin deposits occur only in the altered zones suggests that the fluids that carried the tin and those that altered the rhyolite had the same source and that their movement was controlled by the fractures.

The absence of tin-bearing stringers from the younger formations indicates that the deposition of tin followed closely the eruption of rhyolite. The similarity of the mineral assemblage in the vesicles of the fresher rhyolite to that in the porous groundmass of the altered rhyolite and in the stringers suggest that solutions from which the minerals were deposited came from the rhyolite, perhaps in part from the flows and in part from the rhyolite in the vents.

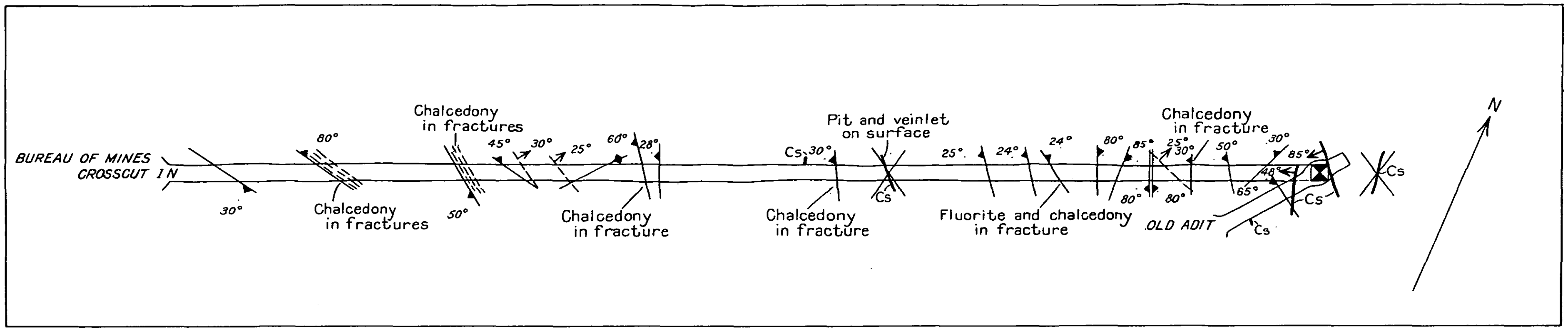
Although the depth at which the deposits now exposed were formed may have been no greater than the thickness of rhyolite that has been eroded, tin-bearing stringers now exposed in canyons in the Taylor Creek area indicate an apparent vertical range in metallization of at least 400 feet.

Grade.--Although the tin content of the minable rock along the richest of the exposed stringers may be as much as 12 pounds to the ton, the tin-bearing stringers are too small to permit mining them separately. It would be necessary to mine by bulk methods, and the average grade of the material mined would depend on the spacing of the stringers and the degree to which cassiterite is disseminated in the country rock. The richest bulk sample collected by engineers of the Bureau of Mines contained 11 pounds of tin to the ton, but it included a pocket of specularite and cassiterite. This sample was 120 cubic feet in volume. Of 407 samples taken by those engineers, only 50 contained more than 1 pound of tin to the ton, and only 5 contained more than 5 pounds.

Assays of Bureau of Mines samples and of duplicate samples collected by the writer indicate that no appreciable quantity of cassiterite is disseminated in the country rock except immediately adjacent to visible stringers. They further indicate that the spacing of the stringers is erratic and that no continuous body of rock more than about 5,000 tons in weight is known in which the stringers are spaced closely enough to yield more than 2 pounds of tin to the ton. In fact, no sizable deposit has been found that contains as much as 1 pound of tin to the ton. Much of the cassiterite, moreover, is so intimately intergrown with specularite (see p. 364) that ordinary methods of grinding will not completely separate the two minerals; and, as smelting of tin concentrates high in iron presents an unsolved metallurgical problem, the recoverable cassiterite would be considerably less than the small amount indicated by assay.

Placer deposits

Nuggets of cassiterite are scattered throughout the alluvium of the mapped areas. Stream tin may possibly be sparsely distributed in all the sedimentary strata that overlie the porphyritic rhyolite, but no concentration sufficient to encourage development has been found in any of these strata. The quantity of tin that may be recovered by ordinary placer methods from the unconsolidated sand and gravel, older than the Recent alluvium, appears to be about 0.001 pound to the yard. Although the larger part of the Recent gravel in the bottoms of the arroyos appears to contain a small quantity of tin, the tenor is highest in the vicinity of the bedrock deposit and varies roughly in inverse proportion to the distance from such deposit. It also is inversely proportional to the volume of



PLAN

EXPLANATION

Flow layers in rhyolite, showing dip

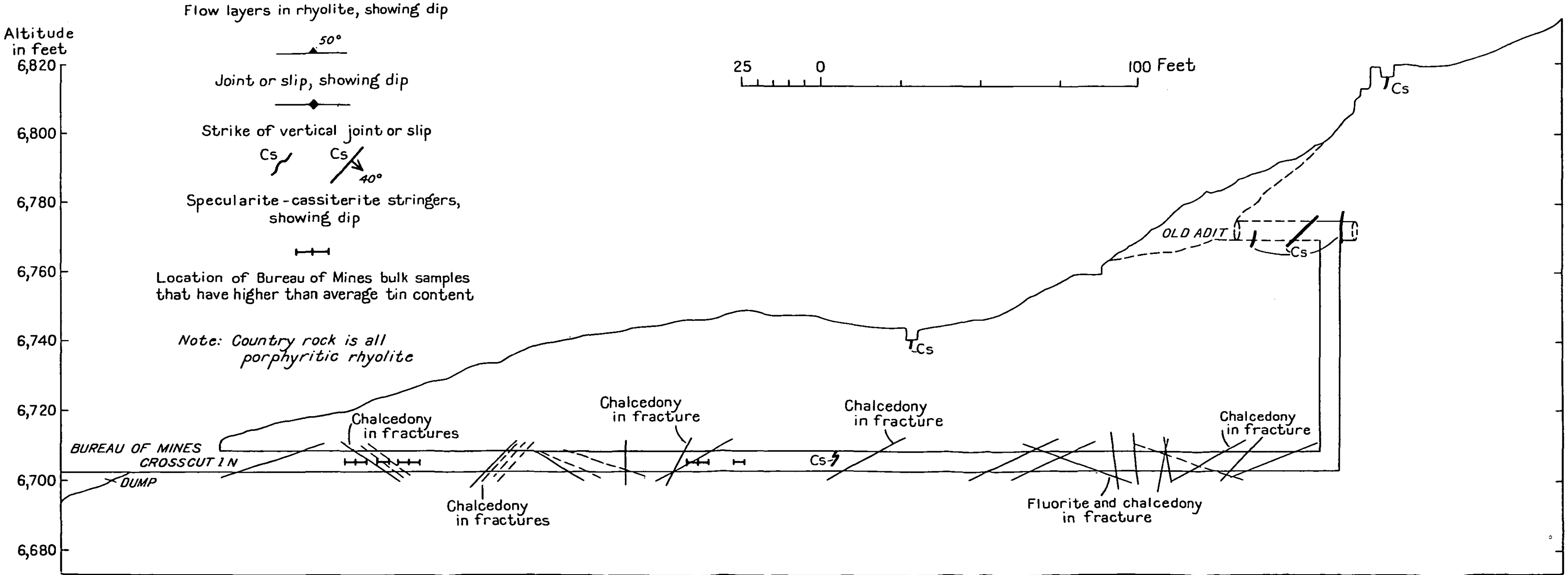
Joint or slip, showing dip

Strike of vertical joint or slip

Specularite-cassiterite stringers, showing dip

Location of Bureau of Mines bulk samples that have higher than average tin content

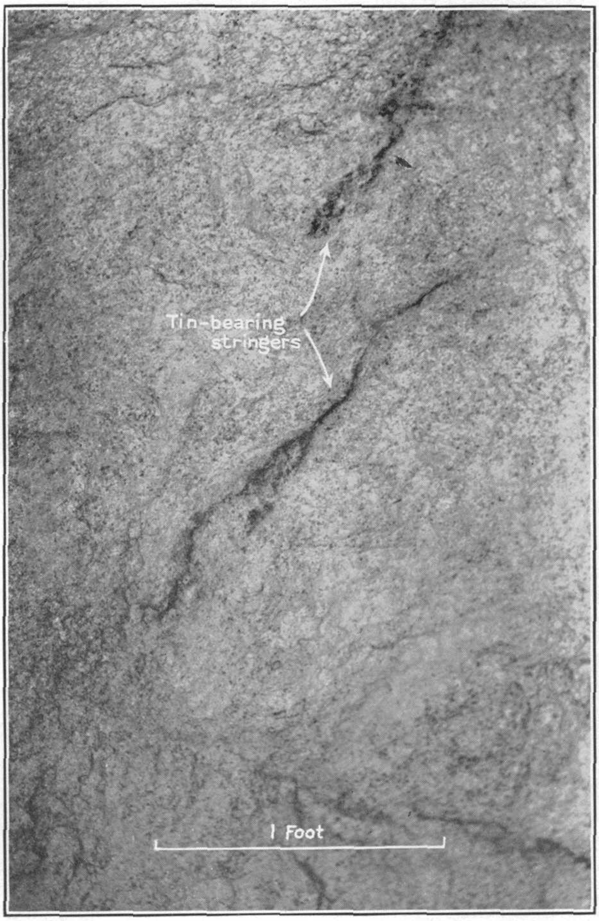
Note: Country rock is all porphyritic rhyolite



SECTION

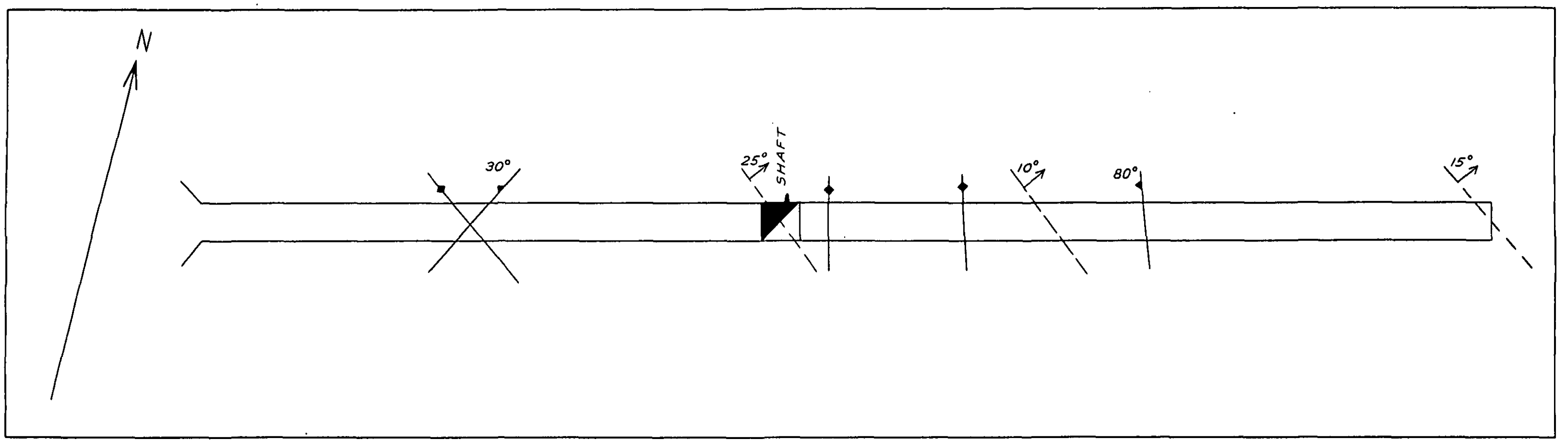
U. S. GOVERNMENT PRINTING OFFICE : 1940—O-261949

GEOLOGIC PLAN AND PROJECTION OF BUREAU OF MINES CROSSCUT 1N IN TAYLOR CREEK AREA



TIN-BEARING STRINGERS IN WALL OF BUREAU OF MINES CROSSCUT 1 N IN TAYLOR CREEK AREA.

Drawn from a photograph.



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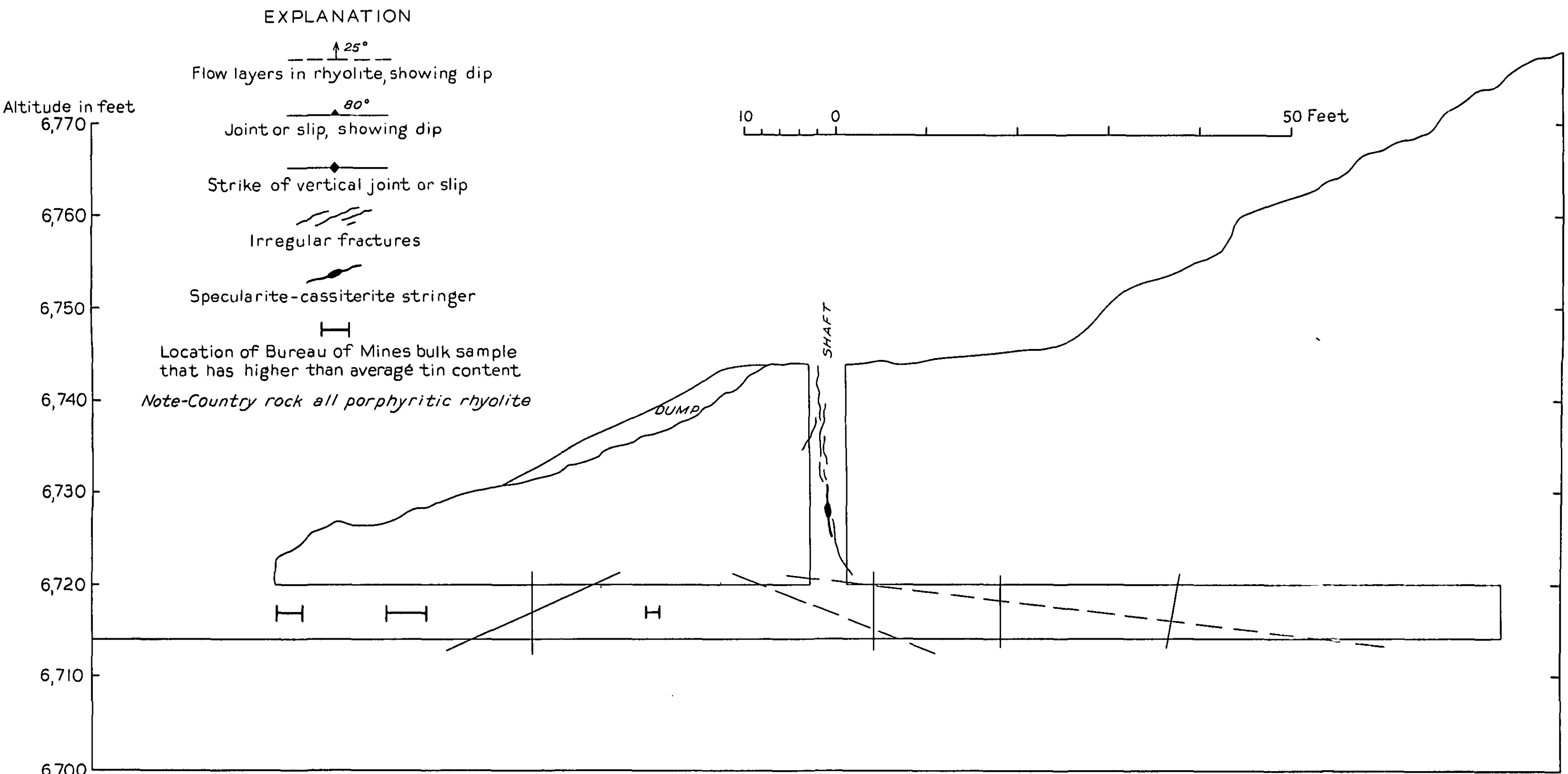

SECTION

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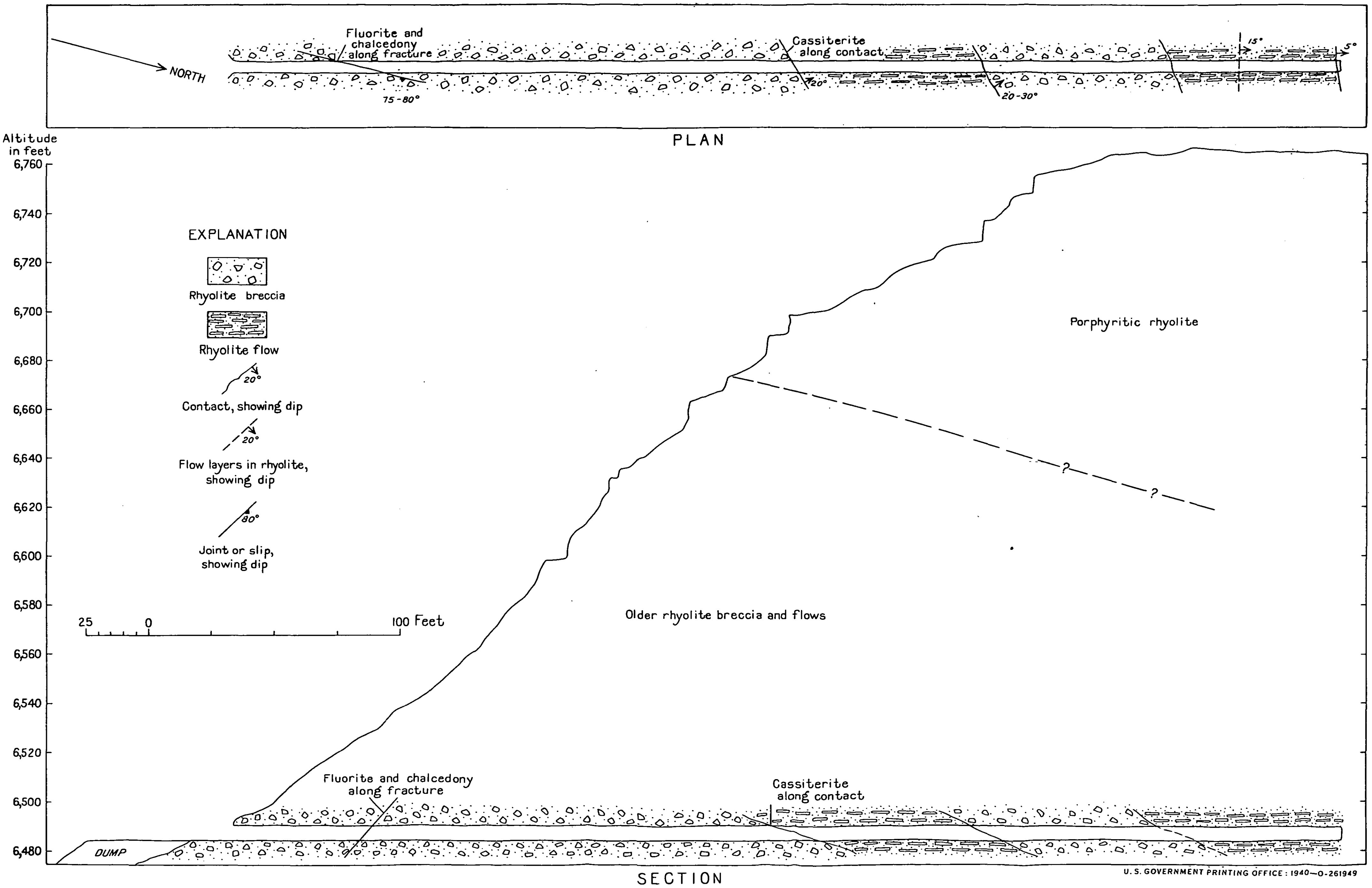
GEOLOGIC PLAN AND SECTION OF BUREAU OF MINES SHAFT 2N AND CROSSCUT 3N IN TAYLOR CREEK AREA



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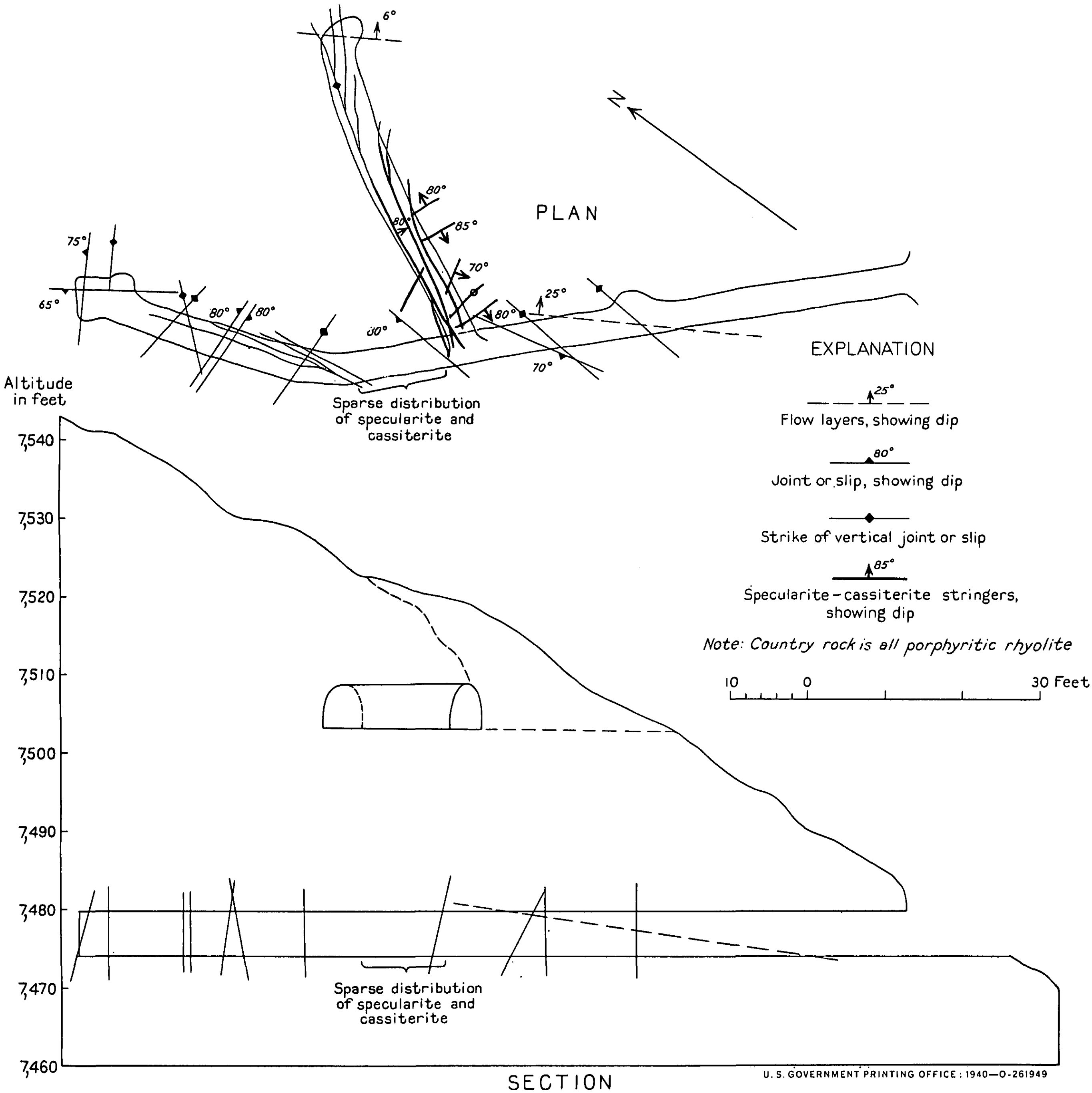
GEOLOGIC PLAN AND SECTION OF NEW MEXICO TIN & METALS CO. TUNNEL IN TAYLOR CREEK AREA



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GEOLOGIC PLAN AND SECTION OF ADITS IN SQUAW CREEK AREA gravel in the valley bottoms, for dilution of valley-bottom gravel with material brought in by tributaries that drain barren areas markedly reduces the tin content. The richest ground is composed largely of coarse gravel and boulders mixed with a little sand.

Residual soil and slope-wash in areas where tin-bearing stringers crop out may contain as much as 0.02 pound of tin to the yard, but the thickness of such material commonly ranges from a few inches to 2 or 3 feet. Bedrock is at the surface over much of the region.

Placer concentrates are largely black sand which, in the absence of easily visible nuggets of cassiterite, rarely contains more than 1 percent of tin and commonly contains only about 0.1 percent. As this black sand contains much specularite, the proportion of tin in the concentrate obtained from a yard of gravel is highly variable.

The richest placer that has been found contains about 2 pounds of tin to the yard, but the volume of gravel of this grade is probably no more than 4,000 yards. All the other gravel deposits sampled by Bureau of Mines engineers average less than 0.05 pound of tin to the yard, although the volume of gravel of this grade is large.

DESCRIPTION OF AREAS

Taylor Creek area

The tin-bearing stringers at Taylor Creek are in a large zone of altered rhyolite that lies about 1,000 feet west of the axis of the fan structure. (See pls. 54 and 55 and p. 362.) Bureau of Mines engineers drove two crosscuts and a shaft into the altered rock. The longest crosscut extends under the outcrop of two stringers, and a raise from the breast connects with an older adit that cuts three stringers. (See pl. 56.) There is no indication that the stringers on the surface continue downward, and the three stringers in the upper adit do not reach the crosscut. Only one small stringer appears in the wall of the crosscut (see pl. 57), but assays suggest that small pockets may have been included in some of the material excavated. The richest sample contained only 0.2 percent of tin.

A shaft was sunk on a fracture zone about 10 feet south of the outcrop of a stringer. (See pl. 58.) In the interval between 12 and 18½ feet a small pocket of specularite and cassiterite in the fracture zone raised the bulk assay value for that interval to 0.55 percent of tin. Below this the fractures seem to feather out. Assays of 0.1 percent of tin in three rounds in the crosscut that extends from the bottom of the shaft suggest that small stringers may have been included in the excavated material, as no stringers are visible in the walls. The altered rhyolite in the crosscut is irregularly fractured, but not all the fractures are continuous enough to map.

The tunnel of the New Mexico Tin & Metals Co. on Taylor Creek cuts interbedded rhyolite breccia and flows. (See pl. 59.) A heavy-mineral concentrate of a small specimen taken from a tight gray seam along the contact between flow and breccia 225 feet from the portal contained a few grains of cassiterite. With this exception, no stringers have been recognized in the walls of the tunnel.

Pits sunk to bedrock in the bed of Taylor Creek between Cox Creek and Nugget Gulch show the maximum thickness of the gravel to be about 15 feet. Rocker concentrates from these pits were largely black sand, and the assays indicate that the gravel averages about 0.05 pound of tin to the yard.

The supply of water in Taylor Creek is ample for placer concentration. Gravel on the bench on the north side of Cox Creek (see pl. 54) averages less than 0.005 pound of tin to the yard.

Squaw Creek area

Tin-bearing stringers crop out at only two places in the Squaw Creek area (see pl. 60). At the east edge of the area an old prospect pit reveals only thin coatings of crystals of specularite and cassiterite on the walls of irregular fractures. Two old adits that explore the outcrop near the center of section 34 reveal a group of closely spaced stringers, one of which is about an inch thick--the thickest found in the district thus far. (See pl. 61.) All but one of the stringers pinch out within 25 feet of the portal in the upper adit. The lower adit was driven to cut 28 feet below the veinlets exposed in the upper adit, but only traces of specularite and cassiterite appear in some tight fractures almost under the upper adit. Cassiterite is disseminated in the partly altered rhyolite immediately adjacent to the stringers but not elsewhere.

The gravel in the middle half of the mapped part of Squaw Creek Valley is from 4 to 8 feet thick and increases in thickness toward the valley mouth to about 30 feet. In the upper half mile of the mapped part of the valley, which is cut in older sand and gravel, the Recent alluvium may be from 4 to 12 feet thick. Small nuggets of cassiterite are sparsely distributed in the bottoms of the side draws, but these draws contain at most only a few inches of gravel. The average tin content of the Recent gravel is less than 0.05 pound to the yard, and that of the older sand and gravel is still lower. The pits on a large flat in and east of the northeast quarter of section 34 are in what appears to be residual soil on the rhyolite. The soil is from 1 to 3 feet thick and contains a few scattered nuggets, which appear to have been derived from the underlying bedrock. The tin content of this material seems to be lower than that of the gravel in Squaw Creek. Although there is no appreciable supply of water in Squaw Creek Valley, water for sluicing can be obtained from shallow wells in Corduroy Canyon at the mouth of Squaw Creek.

Hardcastle Creek area

Tin-bearing stringers crop out in the vicinity of Nugget Gulch and near the southern edge of the mapped area. (See pl. 62.) The stringers on the south side of Nugget Gulch are shorter than those at Taylor Creek or at Squaw Creek, from which they differ further in that they consist largely of small grains of cassiterite with very little specularite. The wall rock adjacent to most of the stringers is stained dark red by iron oxide and is partly silicified. The stringers that crop out at the southern end of the mapped area have been explored only by shallow pits and are similar in character to those in the Squaw Creek area (see p. 369). They appear to have no greater extent than any of the other stringers that have been sampled in the district.

The gravel in Nugget Gulch is the richest thus far found. It is from a few inches to 4 feet thick, and there appears to be about 4,000 yards that averages about 2 pounds of tin to the yard. The gravel in the large flat along Hardcastle Creek west of the mouth of Nugget Gulch is from 2 to 8 feet thick and averages about 0.03 pound of tin to the yard. The pits in the large open basin extending south of the head of Nugget Gulch are in what appears to be residual soil and slope wash from 2 to 4 feet thick. This material contains scattered nuggets and averages about 0.02 pound of tin to the yard. Nuggets have been found in the draws draining the rhyolite in the area mapped, but the thickness of the gravel is generally no more than a few inches. Water enough for small sluicing operations can be obtained from wells in Hardcastle Creek gravel.

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