Taylor Creek tin district--Stratigraphy, structure and timing of mineralization

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Taylor Creek tin district—stratigraphy, structure, and timing of mineralization

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Introduction

Primary tin deposits commonly are found in granitic plutonic environments where the tin occurs as cassiterite in greisen veins and as disseminations in altered granite (Taylor, 1979). In southwest New Mexico, however, tin occurs as cassiterite in hematite-cassiterite veins which cut Tertiary rhyolite domes and flows. This type of tin deposit has been reported at only two other localities in North America, Lander County, Nevada (Fries, 1942), and the State of Durango, Republic of Mexico (Foshag and Fries, 1942; Pan, 1974; Huspeni and others, 1982). These unique tin deposits presently are the focus of attention by various mining concerns, the U.S. Geological Survey, and numerous university research groups. Studies by Charles Maxwell of the U.S. Geological Survey, John Lufkin of the Colorado School of Mines, and these authors are aimed at defining the origin of various aspects of the tin mineralization. In addition, Dave Harvey (University of Texas at El Paso) is evaluating the economic potential of a portion of the region.

The Taylor Creek tin district is located in the north-central Black Range some 80 km west of Truth or Consequences, New Mexico (fig. 1). Cassiterite nuggets were first found in placers in the district in 1909 (Fries, 1940a). Shortly thereafter, cassiterite and wood tin were found in vein deposits in porphyritic rhyolite lavas as well as in placer deposits (Hill, 1921). Since that time, numerous authors have reported on the geology, geochemistry, and economic potential of the area, among them Fries (1940a,b), Fries and others (1942), Lufkin (1972), Coney (1976), Richter (1978), Correa (1981), and Goerold (1981). Since the discovery of the tin deposits, the reported production from the placer deposits has been 9.85 tons of concentrate averaging 50% tin (Volin and others, 1947). Lode production has been minimal.

The primary tin veins consist of hematite and cassiterite with minor amounts of quartz, cristobalite, chalcedony, calcite, potassium-feldspar, heulandite, and topaz (Lufkin, 1972; Goerold, 1981). These veins are generally less than one centimeter wide, but in some locations such as Paramount Canyon, the veins may reach three to four centimeters in width and a few meters in height and length. A disseminated cassiterite halo has been noted around the veins in Squaw Creek.

A recently discovered rhyolite porphyry has intensely altered the surrounding country rock near NM-59 where the road crosses the Continental Divide. This porphyry is locally quartz-sericite altered and contains as much as 1% pyrite. Similar intrusives have been mapped by Woodard (1982) southeast of the Taylor Creek region.

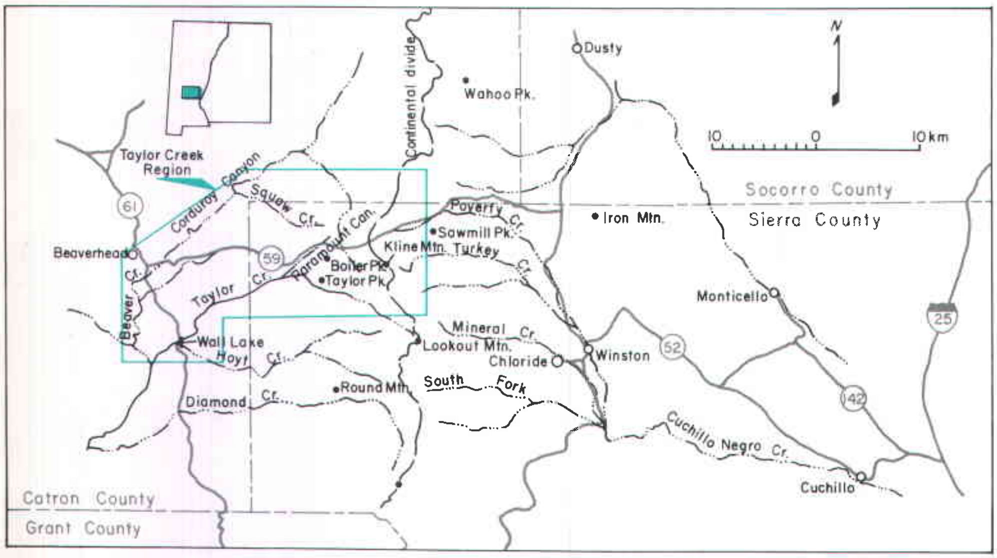

FIGURE 1—LOCATION MAP OF TAYLOR CREEK REGION (adapted from U.S. Geological Survey map of New Mexico at scale of 1:500,000).

Regional geology

The tin-bearing Taylor Creek Rhyolite is located in the Mogollon-Datil volcanic field, a mid-Tertiary volcanic field consisting of intermediate to felsic volcanic rocks and volcaniclastic sedimentary rocks that unconformably overlie older rocks of various ages. In the Taylor Creek region, the volcanics overlie Paleozoic limestones and clastic sedimentary rocks. Overlying and interbedded with the uppermost volcanic rocks is the Gila group, a thick sequence of coarse clastic sedimentary rocks. The Gila group was deposited in basins resulting from the formation of the Rio Grande rift and the Basin and Range province.

The Taylor Creek region is part of the Mogollon Plateau, a structurally simple block bounded on the west by the Glenwood graben and on the east by the Winston graben, both of which are related to the Basin and Range province and the Rio Grande rift. The region is a westerly dipping monocline with numerous small unconformities suggesting that the central part of the Mogollon Plateau underwent minor subsidence from at least 33 m.y. to 21 m.y. ago. The Mogollon Plateau has interacted with the extensional tectonism as an essentially coherent block. The entire block was downdropped, covered with Gila group sedimentary rocks, later uplifted, and is presently being exhumed. The interior of the ☞

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block, at least in the Taylor Creek region, underwent no significant faulting during the downwarping and subsequent uplift.

Volcanic stratigraphy

The following descriptions are based on field work which is part of the Ph.D. dissertation of the senior author. The regional mapping has been released as Open-file Report 177 of the New Mexico Bureau of Mines and Mineral Resources (Eggleston, 1982b).

The oldest volcanic rocks in the region are approximately 440 m of interbedded, intermediate-composition lavas, breccias, and pyroclastic material. (Fig. 2 is a schematic stratigraphic section graphically displaying the stratigraphy and geologic relationships in the Taylor Creek region.) The lavas are andesitic to latitic and generally thin with brecciated-flow tops and bottoms. Latitic ash-flow tuffs are a minor constituent as are volcaniclastic sedimentary rocks (Woodard, 1982). All of the units are laterally discontinuous. This sequence has been called the Spears Formation (Coney, 1976) and the Rubio Peak Formation (Woodard, 1982), which are laterally equivalent. Using the nomenclature of Osburn and Chapin (1983, in press), these rocks are part of the Datil Group. The age of the Datil Group spans 37–33 m.y. (Elston and others, 1973; Elston, 1976; Chapin and others, 1978).

The Hells Mesa tuff is as much as 150 m of crystal-rich, moderate to densely welded ash-flow tuff erupted from the Socorro cauldron (Woodard, 1982; Eggleston, 1982a). The top of the unit is characterized by a thinly bedded, poorly to moderately welded tuff as much as 30 m thick. This unit may represent air-fall and small-volume ash-flow material late in the eruption of the Hells Mesa. The Hells Mesa contains up to 50% phenocrysts consisting of sanidine, quartz, plagioclase, and coppery biotite in proportions of approximately 2:1:1:0.1, respectively. Though the term Hells Mesa tuff is used for this tuff, the Kneeling Nun Tuff, erupted from the Emory cauldron to the south, is of similar age and lithology so the correlation with the Hells Mesa is not entirely clear.

Overlying the Hells Mesa tuff is an unnamed, poorly to moderately welded, crystal-poor, ash-flow tuff as much as 20 m thick. Little is known of this unit as it is poorly exposed and apparently discontinuous, possibly filling shallow paleovalleys on top of the Hells Mesa tuff. The tuff contains approximately 7% phenocrysts of feldspar (6%) and biotite (1%).

The basaltic andesite of Poverty Creek (28 m.y.; W. E. Elston, 1982, personal communication) consists of interbedded andesite and basaltic andesite lavas and breccias with green volcaniclastic sedimentary rocks separating many of the flows. The andesites are fine grained and contain phenocrysts of pyroxenes (?) that have altered to a brown claylike mineral. Quartz crystals are locally seen and are believed to be phenocrysts. Coney (1976) estimated that the unit is in excess of 200 m thick. Near the Kline Mountain rhyolite porphyry, the andesites have undergone mild to intense propylitic alteration. The mildest alteration produced epidote along joint surfaces, the most intense alteration produced a bleached rock with secondary epidote, calcite, and possibly chlorite. Near the contact with the intrusive, the andesites contain clay minerals that may be due to mild argillic alteration.

The tuff of Stiver Canyon overlies the basaltic andesite of Poverty Creek and is as much as 200 m thick (Woodard, 1982). This tuff is poorly to moderately welded, crystal-poor to moderately crystal-rich, and white to buff in color. The unit contains 7–15% phenocrysts of sanidine, quartz, and coppery biotite. Sanidine is the dominant phenocryst with minor quartz and a trace of biotite. Pumice is not common, and where it is present it is only slightly collapsed. In the head of Poverty Creek, the Stiver Canyon contains a thin sedimentary rock interval consisting of conglomerates, sandstones, and mudstones. This interval is a good marker horizon near the base of the unit, but it pinches out approximately 1 km south of NM–59 and 2 km east of the Continental Divide on NM–59. On the north flank of Kline Mountain, the entire section of Stiver Canyon pinches out and reappears south of Kline Mountain. The source of the Stiver Canyon is unknown at this time.

Several units overlie the tuff of Stiver Canyon at various places. These units include the rhyolite of Dolan Peak, the tuff of Kline Mountain, and an unnamed red latite lava. The red latite lava is less than 35 m thick and consists of large potassium feldspars (up to 2 cm in length) in a red, lithoidal, fine-grained groundmass. The base of the unit is a flow breccia; where the unit pinches out east of the Continental Divide, a breccia carapace containing vitric clasts of the lava in a very fine grained breccia matrix was found.

The tuff of Kline Mountain (new, informal name) pinches out against the red latite lava. This unit is as much as 160 m thick (estimated) along the Continental Divide and pinches out southwest of Kline Mountain. The geometry of the unit suggests deposition in a basin or broad paleovalley. The unit is a sequence of interbedded ash-flow and air-fall tuffs and volcaniclastic sedimentary rocks. The tuffs are crystal-poor to crystal-rich with variable proportions of sanidine and quartz with traces of biotite. The volcaniclastic sedimentary rocks are tuffaceous sandstones, siltstones, and pumice-bearing conglomerates. The upper few meters of the unit contain vitric clasts similar to the overlying rhyolite of Dolan Peak suggesting a genetic relation between the two units. Alteration related to the Kline Mountain intrusive has been mild to intense. Near the contact with the intrusive, an advanced argillic assemblage of alunite-silica-clays was produced. Away from the contact, an argillic assemblage of clay (kaolin?)-silica-alunite was produced. This is the unit that was mined for

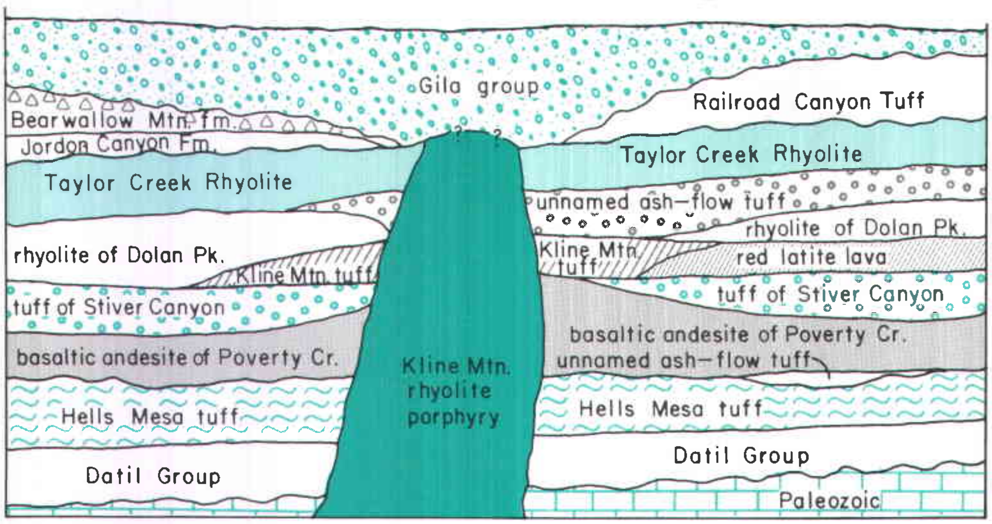

FIGURE 2—SCHEMATIC STRATIGRAPHIC SECTION SHOWING STRATIGRAPHY AND GEOLOGIC RELATIONSHIPS IN TAYLOR CREEK REGION.

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its kaolin content where NM-59 crosses the Continental Divide.

The rhyolite of Dolan Peak overlies the red latite lava, the tuff of Kline Mountain, and the tuff of Stiver Canyon. It is a white-to-buff, flow-banded, moderately crystal rich rhyolite lava. The rhyolite consists of phenocrysts of iridescent sanidine, quartz, and a trace of plagioclase in a fine-grained, devitrified, and locally spherulitic groundmass. This unit pinches out east of where NM-59 crosses the Continental Divide and reappears south of Kline Mountain, but attains a total thickness of approximately 130 m (Coney, 1976).

An unnamed ash-flow tuff overlies the rhyolite of Dolan Peak and the tuff of Kline Mountain along the Continental Divide. This tuff is densely welded, crystal-poor, and white to gray in color. Phenocrysts of sanidine predominate with minor quartz. The unit pinches out west of Kline Mountain. Vapor-phase alteration has locally been intense. Pseudobrookite and bixbyite are frequently found in pumice fragments. Correlations with this tuff are unknown, but Elston and Northrop (1976, editors' note, p. 35) suggest that the unit may correlate with the rhyolite of Diamond Creek of Ericksen and others (1970).

The tin-bearing Taylor Creek Rhyolite is the next younger unit in the stratigraphy. Work to date suggests that it was erupted as domes and flows about 25 m.y. ago (Elston and others, 1973; R. H. Weber, personal communication, 1982). The Taylor Creek Rhyolite is a series of white, very crystal-rich, flow-banded, rhyolite lavas covering an area of approximately 450 mi^2. The phenocrysts are quartz and sanidine in varying proportions with minor biotite. An exception to the above generality is the Taylor Creek Rhyolite exposed on the north rim of Paramount Canyon. This lava contains only 15–20% phenocrysts but is mineralogically and texturally similar to other Taylor Creek exposures. Volcaniclastic sedimentary rocks and tuffs are frequently found between the rhyolite lava flows and in basins between domes. The pyroclastic material is believed to be cogenetic with the rhyolite lavas and indicates periods of explosive volcanism associated with the emplacement of the rhyolite domes.

Vapor-phase alteration of the Taylor Creek Rhyolite has locally been intense. The effects of this alteration are similar to argillic alteration in that clays have been produced in the groundmass of the rhyolite, but, in general, the feldspar phenocrysts have been unaffected. Lithophysae are generally lined with drusy coatings of quartz, hematite, pseudobrookite, bixbyite, and rare topaz, red beryl, and chalcedony (Ericksen and others, 1970; Lufkin, 1972, 1976; Kimbler and Haynes, 1980; and Narsavage, 1981). Cassiterite has been reported from the lithophysae (Lufkin, 1972), but subsequent studies have failed to locate that occurrence (C. Maxwell, 1982, personal communication; F. Kimbler, 1982, personal communication). Later, hydrothermal argillic alteration has overprinted the vapor-phase alteration near the tin occurrences. Distinguishing the events is difficult, but the hydrothermal alteration has locally destroyed the feldspar phenocrysts and produced adularia near the tin-bearing veins (Goerold, 1981).

The Taylor Creek Rhyolite formed domes in excess of 300 m high and short, thick flows away from the domes. This dome and flow pattern suggests that the lavas were very viscous, probably the result of a low-volatile content. Deep dissection by Taylor Creek and its tributaries has exposed two domes which show a fanlike internal structure. One of these domes (shown in fig. 3) is immediately downstream from Wall Lake, whereas the other is near the mouth of Whitewater Canyon on Taylor Creek. The dome near the mouth of Whitewater Canyon also shows flow folding related to a lava flow flowing north or northeast from the dome (Lufkin, 1972).

The Railroad Canyon Tuff is about 23.5 m.y. old and overlies the Taylor Creek Rhyolite (Elston and others, 1973). This tuff is generally white, poorly welded, and crystal-rich in the Taylor Creek area, but crystal-poor phases have been reported in other areas (Woodard, 1982; W. E. Elston, 1982, personal communication). This leads to the possible correlation of a series of tuffs that overlie the Taylor Creek Rhyolite near the mouth of Whitewater Canyon with the Railroad Canyon Tuff (W. E. Elston, 1982, personal communication). The phenocrysts in the Railroad Canyon consist of quartz, irridescent sanidine, and minor biotite. The total thickness is 20–40 m near the Continental Divide. The source of the Railroad Canyon is unknown.

The Jordan Canyon formation, represented by a thin volcaniclastic sedimentary rock interval near Wall Lake locally overlies the Taylor Creek Rhyolite and the Railroad Canyon Tuff (Elston, 1976). West of the Taylor Creek region, the Jordan Canyon intertongues with the Bearwallow Mountain Formation which consists of a thick pile of andesite, basaltic andesite, basalt, and latite with minor interbedded volcaniclastic sedimentary rocks. Near Wall Lake, the Bearwallow Mountain is divided into two units, the upper Wall Lake andesite and the lower Double Springs Andesite. Both of these units consist of multiple andesite flows locally separated by sedimentary rocks. The Wall Lake andesite is distinguished by the presence of green pyroxene (W. E. Elston, 1982, personal communication).

Tertiary intrusive rocks

The only intrusive found to date in the Taylor Creek area is a large rhyolite porphyry immediately south of Kline Mountain. This intrusive is informally referred to as the Kline Mountain rhyolite porphyry in this study. The rock consists of 10–15% phenocrysts of sanidine and quartz in a fine-grained groundmass. Sanidine occurs as euhedral crystals up to 1 cm in length and predominates over the small, euhedral quartz by about 2 to 1. Near the margin of the intrusive, vertical flowbanding is common. Woodard (1982) mapped several similar intrusives south of the area of interest of this study. Intrusion of this rhyolite has caused gentle doming of the overlying volcanic rocks.

The entire intrusive is altered to some degree. The most intense alteration is located near the northern margin of the intrusive where quartz-sericite-pyrite alteration was found. This alteration is characterized by silicification, alteration of feldspar to coarse white mica, and by the addition of approximately 0.5% fine-grained, euhedral pyrite to the rock. Locally small breccia bodies were found that were cemented by quartz veinlets that contain rare pyrite. This pyrite is the only metallic mineral found associated with the alteration to date. As the pyrite diminishes, the alteration changes to an advanced argillic assemblage of silica-alunite-clay near the north ☞

FIGURE 3—TAYLOR CREEK RHYOLITE WEST OF WALL LAKE; note fanlike nature of flow banding. This structure is common in domes of Taylor Creek Rhyolite.

margin of the intrusive. The southern part of the intrusive and the surrounding felsic volcanic rocks show moderate to intense argillic alteration characterized by the assemblage clay-minor silica-minor alunite. These alteration assemblages are more or less "normally" zoned around the northern end of the intrusive.

Timing of mineralizing events

Two periods of alteration and mineralization have been defined in the Taylor Creek region. The oldest period is associated with the Taylor Creek Rhyolite and consists of argillic alteration and hematite-cassiterite veining. The other event is associated with the Kline Mountain rhyolite porphyry and consists of argillic, advanced argillic, and quartz-sericite-pyrite alteration. The hydrothermal alteration of the Taylor Creek Rhyolite crosscuts the vapor phase alteration and does not affect the overlying Jordan Canyon formation or the Railroad Canyon Tuff dated at 22.2 m.y. and 23.5 m.y. This restricts the time of alteration and mineralization of the Taylor Creek Rhyolite to 1.5 m.y. immediately following the eruption of the lavas.

Since the Kline Mountain rhyolite porphyry is not dated, it is difficult to assign a time of mineralization, but the intrusive cuts across the rhyolite of Dolan peak and has altered the unnamed ash-flow tuff above it. The intrusive has also warped the Taylor Creek Rhyolite and possibly the Railroad Canyon Tuff. This indirect evidence places the alteration at post 23.5 m.y., and it may be much younger.

Conclusions

Two periods of mineralization have been defined in the Taylor Creek region. The older is 25–23.5 m.y. old and consists of hematite-cassiterite veins deposited in the Taylor Creek Rhyolite. The other period of mineralization is associated with a rhyolite-porphyry intrusive that has altered and domed older rocks. The age of these intrusives is post 23.5 m.y., and they may be much younger. No economic mineralization has yet been found associated with the rhyolite porphyry intrusive.

The Taylor Creek tin district is located on the western margin of the Mogollon Plateau, a mid-Tertiary volcanic plateau consisting of four major volcanic assemblages. These assemblages are 1) a lower, intermediate composition assemblage of volcanic and volcaniclastic rocks (Datil Group), 2) an assemblage of ash-flow tuffs and lavas related to cauldron activity (Hells Mesa, Stiver Canyon, Railroad Canyon, and the two unnamed ash-flow tuffs), 3) a bimodal assemblage that is interbedded with the second assemblage (the basaltic andesite of Poverty Creek, red latite lava, rhyolite of Dolan Peak, tuff of Kline Mountain, Taylor Creek Rhyolite, Jordan Canyon formation, and Bearwallow Mountain Formation), and 4) a younger bimodal assemblage (unnamed basalts interbedded in the Gila group in the Winston graben). The Kline Mountain rhyolite porphyry may be a subvolcanic equivalent of the fourth assemblage, but its age and chemistry are unknown.

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Description of Cibola County

Following is the geographic description of Cibola County as it was created by House Bill 373 during the first session of the 35th New Mexico legislature in 1981.

Section 1. Cibola County created.—The county of Cibola is hereby created out of portions of Valencia County lying and situate within the following boundaries, to wit:

Beginning at the southeast corner common to Sections 10,11,14, and 15 T4N, R4W NMPM and running northerly along a line being parallel to and lying two sections west of the fourth range line west of NMPM and extending through Townships 5,6,7 and 8 north to the southerly township line of Township 9 north, thence easterly along an extension of said southerly township line to the present Bernalillo County line, thence northwesterly along such Bernalillo County line to the present Sandoval County line, thence northwesterly along the Sandoval County line, thence westerly along the Sandoval County line to the present McKinley County line, thence following said McKinley County line south and then west to the present state line thence south along the state line to the present Catron County line, thence easterly along the Catron County line and the present Socorro County line and finally to the beginning at the southeast corner common to Sections 10, 11,14 and 15 T4N, R4W NMPM.