A BRIEF GEOLOGICAL SURVEY OF THE

EAST THUNDER MOUNTAIN MINING DISTRICT

Valley County, Idaho

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Idaho Bureau of Mines and Geology
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SUMMARY

Known gold mineralization at the Sunnyside property in the Thunder Mountain mining district, Valley County, Idaho is restricted chiefly to quartz veinlets in the upper 100 feet of the Sunnyside tuff, a crystal-rich rhyolite ash-flow tuff of Eocene age. The ash flow was extruded as a filling unit after the collapse of the Thunder Mountain caldera. At the nearby Dewey property, slightly younger volcanoclastic strata, composed chiefly of debris derived from the post-collapse rhyolite ignimbrite, contain erratic distributions of gold values. Gold mineralization of this latter type is not known on the Sunnyside property.

Commonly, the non-welded, crystal-rich top weathers to a residual soil, which has been preserved in this unglaciated area. Recognition of this unit by its high crystal content is the key to outlining concealed, potentially favorable auriferous areas.

The original continuity of this apparently simple stratigraphic target has been disrupted by numerous normal faults of small displacement (commonly 50 to 100 feet); these radiate from the relatively recent, small, Sunnyside caldera and have led to a series of small jumbled horst and graben structures. Further complicating the structural pattern are possible arcuate faults encompassing the caldera and a major normal fault on the western slope of Thunder Mountain, having a displacement of at least 300 feet. Individual tilted blocks, commonly several hundred feet long and wide, have gentle but variable dips.

The distribution of the gold deposits is governed by secondary structural controls. The average grade of ore mined from stopes and intercepted in churn-and-diamond-drill holes reportedly was 0.2 ounce of gold per ton.

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INTRODUCTION

The geology of the eastern part of the Thunder Mountain mining district was mapped in the summer of 1973 (Plate 1). The district is in unsurveyed T.19N., R.11E., Boise P.M., in Valley County, Idaho. The area is approximately 40 miles by single-track dirt road east of Yellow Pine, Idaho, and 80 miles east of McCall, Idaho, the nearest railhead.

The Sunnyside and Dewey mines have accounted for nearly all recorded production of the district. Of the $518,707 of gold produced, more than 62 percent was mined between 1885 and 1907 and another 25 percent between 1935 and 1942 (Weldin and others, 1973, p. 71). Reserves have been estimated at several million tons of ore assaying 0.17 ounces of gold per ton (McRae, 1956).

Acknowledgements

The thoughtful introduction to the regional stratigraphy and structural geology by Dr. B. F. Leonard of the U.S. Geological Survey and his continuing encouragement were invaluable in unraveling the local geology.

Generous financial support from Homestake Mining Company and permission to publish the results of our research are gratefully acknowledged. Special thanks are due to Dr. J. G. Wargo for his counsel and logistic support.

Authorization for publication of this paper by the owners of the Sunnyside property, particularly Mr. Tibor Klobusicky, is greatly appreciated.

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STRATIGRAPHY

Leonard (1973, p. 45-47 and personal communication) has proposed the following stratigraphic sequence of rocks in the Thunder Mountain cauldron:

	Thickness (feet)
Dark gray latite	100-200
Black vocaniclastic breccia	0-50
Dewey volcaniclastic beds	50-300
Sunnyside rhyolite crystal tuff	
Non-welded top	30-50
Welded tuff	100-300
Basal perlitic vitrophyre	20-30
Pre-collapse rhyolite tuff	3000
Pre-collapse latite tuff and breccia	1000-1500

Core from drill holes disclosed the presence of numerous separate cooling units in the Sunnyside rhyolite crystal tuff. No holes penetrated the base of the Sunnyside tuff.

The lower strata of green and purple latite and buff rhyolite units probably originated as ignimbrites in the Thunder Mountain cauldron prior to its explosive collapse (Leonard, 1973). The rhyolite comprises many ash flow units having welded centers and non-welded tops. Unlike the post-collapse Sunnyside rhyolite tuff, the earlier rhyolite tuff contains few if any (commonly 2 to 3 percent) phenocrysts both in its welded and non-welded parts. No gold mineralization is associated with the pre-collapse latite and/or rhyolite tuffs, which crop out around the periphery of the Thunder Mountain mining district.

Overall the Sunnyside rhyolite tuff characteristically contains 10 to 20 percent phenocrysts in both its welded and non-welded facies. Leonard believes that it was emitted from the Sunnyside vent after the collapse of the main Thunder Mountain caldera. As the gold deposits are associated only with the Sunnyside rhyolite tuff and with no other volcanic units, it seems logical to attribute the source of the gold to the eruption of the late Sunnyside vent.

The basal vitrophyre of the Sunnyside tuff is a black to dark-green perlitic obsidian. Outcrops of it are rare and restricted to fault slivers.

The welded part of the Sunnyside rhyolite crystal tuff is composed of 10 to 30 percent phenocrysts of high-albite, high-quartz and sanidine in an ashy groundmass. It contains as much as 3 percent pyrite. Leonard concedes that his estimate of its thickness is a guess because its contacts with the underlying and overlying units are rarely exposed. Recent drill-core data support the inference that the Sunnyside welded tuff is thicker than 300 feet. The Sunnyside rhyolite tuff characteristically contains pumice shards which are angular to subrounded where the tuff is not welded, but are flattened where it is welded. The size of the pumice shards diminished outward from the Sunnyside caldera. Within the caldera, the welded tuff is comprised of chlorite, epidote, quartz, calcite, and hematite. This assemblage, characteristic of the greenschist temperature and pressure facies, suggests that the rhyolite tuff in the caldera may have been altered by heat derived from the tuff and (or) a subjacent plutonic water derived from ground or surface sources.

The light to medium gray, non-welded top of the Sunnyside rhyolite tuff has the same mineralogical composition and commonly the same proportion of phenocrysts as the welded part of the tuff beneath it. In most places the non-welded tuff has been weathered to a residual soil; therefore, outcrops of non-welded tuff are rare. The weathered, Sunnyside, non-welded crystal tuff can be distinguished from the weathered, pre-collapsed, non-welded tuff by the great difference in the crystal content of the residual soils. The non-welded Sunnyside top commonly is oxidized intensively. The pyrite has been altered to goethite and locally to jarosite. At the base of the non-welded unit, intensive argillization has altered the non-welded tuff to a light greenish-gray clay that has a blue cast when wet. This "blue clay" reportedly overlies the ore zone in the Sunnyside mine, and hence may be an empirical ore guide in gold exploration. Evidence is equivocal as to whether the alteration resulted from downward moving meteoric waters, heat transferred upward from the welded part of the unit, dammed, upward moving hydrothermal fluids, or some combination thereof. The concentration of ore values in the top 100 feet above the first clay zone favors a meteoric control; so do the recent ideas advanced by Taylor (1973, p.747-764).

The Dewey volcaniclastics contain some fragments of reworked pre-collapse latite and rhyolite, but they are comprised chiefly of reworked welded and non-welded Sunnyside rhyolite tuff. Sorting of detritus in the Dewey beds is exceptionally poor, both horizontally and laterally, ranging across intervals of a few inches to a few feet from thinly laminated lignitic siltstone to grit to coarse, subrounded conglomerates containing carbon trash. Leonard states that the thickness of the Dewey unit where measured at the Dewey mine may be exaggerated because of repetition of beds by faulting (Leonard, 1973, p. 46). Output of gold from the Dewey beds has been nominal. One piece of high-grade gold ore in the Smithsonian Museum reportedly contains coarse visible gold in Dewey conglomerate.

The "black" (dark gray) breccia channel deposits above the Dewey volcaniclastics may be an indurated mudflow. Its present distribution may be fault-controlled. It is composed of fragments of volcanic rocks and silicified and carbonized plant fragments in a muddy matrix of quartz and feldspar. Most gold production from the Dewey mine has been from the black breccia. Perhaps the abundant carbon within the unit has reduced gold from solution and precipitated it.

The uppermost, dark gray latite or Land Monument Mesa latite, formerly misidentified as basalt, is a dark gray aphanitic rock which has no gold mineralization associated with it.

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STRUCTURAL GEOLOGY

Regionally, the Thunder Mountain caldera is a graben. However, subsequent movement has lifted the central part of the area to form a triangular horst bounded by linear grabens on the northwest along Monumental Creek, on the northeast along Marble Creek, and on the south along Coon Creek (Leonard, 1973, p. 47).

Locally, the Sunnyside caldera is bounded by a series of arcuate normal faults dipping inward. A series of normal faults radiate from the vent as spokes from a hub cap to form small linear horsts and grabens aligned normal to the vent. They jumble the surrounding terrain into many tilted blocks commonly ranging from 200 to 500 feet on an edge, but in places being as long as 2,000 feet. Vertical displacement along these faults is on the order of 20 to 200 feet. Dips within individual blocks commonly do not exceed 25°; however, opposite dips may occur in adjoining blocks. Slopes on the non-welded tuff commonly match those of the dipping blocks. Hence, such blocks capped by non-welded tuff are logical exploration targets.

The radial pattern is interrupted on the western side of Thunder Mountain by the western boundary normal fault which strikes N. 15° E., dips 75° northwest and has a vertical displacement of at least 300 feet. Sunnyside welded tuff on the southeast is juxtaposed against Dewey conglomerates on the northwest. The fault, in reality several slivers within a fault zone, is silicified and brecciated and has slickensides along the fault scarp. In several places, blocks on the downslope side show backward rotation. Linear sags occur along the fault trace.

GEOMORPHOLOGY

The Thunder Mountain area is an unglaciated area surrounded by glacial terrain. Therefore, residual soils which form over less indurated,rocks such as non-welded tops of rhyolite tuffs, persist.

Because Thunder Mountain has had considerable recent faulting activity, the topography mimics the structural geology. Furthermore, nearby major mudflows probably were activated one or more times in response to movement along faults. Slickensided fault scarps with talus slopes at their bases attest to the recency of major movements along the western boundary normal fault and perhaps to the arcuate faults (?) that surround the Sunnyside caldera. Differential weathering in the Sunnyside tuff, between hillocks in the more resistant welded rock and saddles, in the less resistant non-welded rock, emphasize minor horsts and grabens (such as the one between Thunder Mountain and Lightning Peak) resulting from smaller displacements along normal faults radiating from the Sunnyside vent.

A veneer of non-welded tuff masks many dip slopes of welded Sunnyside tuff. The circular outline of the Sunnyside caldera is emphasized by 500 feet of topographic relief between its rim and its center. The caldera wall is breached on the northeast.

Linear creeks radiating outward from Thunder Mountain may be structurally controlled or may be consequent on the slope.

MINERALIZATION

Gold mineralization at Thunder Mountain is low-grade and sporadic in distribution. Previously mined stopes in the Sunnyside rhyolite crystal tuff probably were fault controlled. Reported tenor of the ore averaged 0.2 ounce of gold per ton.

Gold mineralization is confined chiefly to the uppermost 100 feet of the non-welded top of the upper (?) cooling unit of the Sunnyside rhyolite crystal tuff. Most economic gold values lie above the first clay alteration zone in the non-welded top. Gold mineralization tends to be concentrated in tiny, quartz veinlets along fracture zones.

GENESIS

The non-welded top of the upper (?) cooling unit of the Sunnyside rhyolite crystal tuff contained a minor amount of syngenetic gold. The gold values were redistributed by heated meteoric waters (Taylor, 1973, p. 747-764) and concentrated along fracture zones in secondary quartz veins. Supergene circulation of the warm ground water was limited to the part of the non-welded tuff above the highest clay zone. Gold was transported by ground water that moved into the overlying Dewey strata and possibly was precipitated in the presence of carbonaceous debris.

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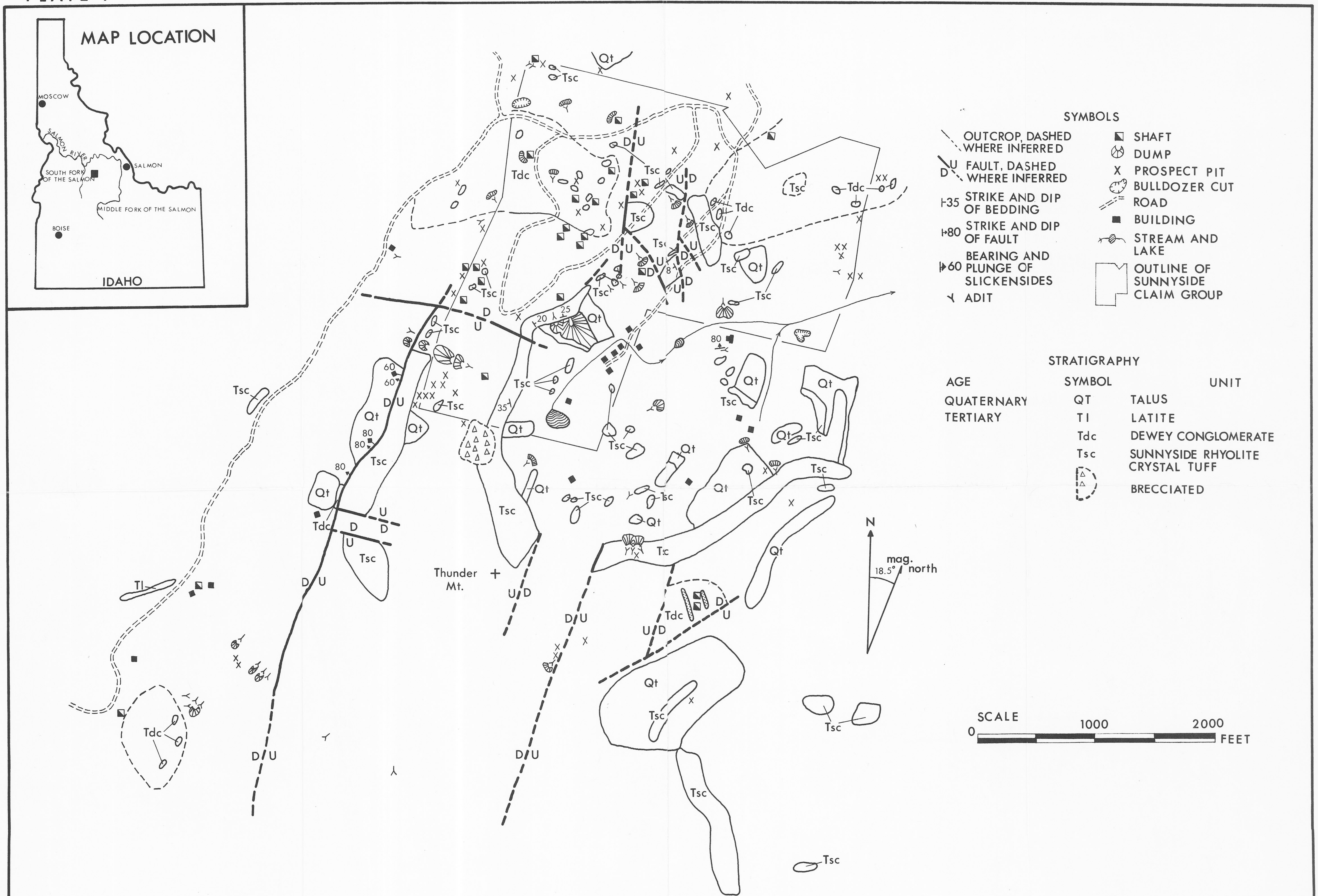
PLATE I



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