SITE INSPECTION REPORT FOR THE ABANDONED AND INACTIVE MINES IN IDAHO ON U. S. BUREAU OF LAND MANAGEMENT PROPERTY IN THE LEMHI PASS AREA

LEMHI PASS AREA,
LEMHI COUNTY, IDAHO

FIELD INSPECTION BY:

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Idaho Geological Survey

FINAL REPORT PREPARED BY:
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2001

Prepared for the U.S. Bureau of Land Management
Under Agreement No. 1422-D910-A3-0206,
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GEOLOGY

PREVIOUS WORK

Lemhi Pass is located at the crest of the Beaverhead Mountains on the boundary of Idaho and Montana. It's first description was in the journals of the Lewis and Clark Expedition, whose Advance Party crossed Lemhi Pass, along a Shoshoni Indian hunting trail, on August 12, 1805. Captain Lewis recorded their entry into Idaho, "...I now descended the mountain about 3/4 of a mile which found much steeper than on the opposite side, to a handsome bold running Creek of cold Clear water. Here I first tasted the water of the great Columbia river ..."
Their guide, Sacajawea, was reunited with her Shoshoni Nation, in the Lemhi Valley.

Westward expansion had begun, and prospectors and miners soon followed into the new Idaho Territory. Not far below Lemhi Pass, the Copper Queen mine, located just off Agency Creek, produced about $ 100,000 worth of copper ore between 1893 and 1910, with sporadic production since then (Staatz, 1979). Anderson (1961) notes that the Copper Queen ores consisted of quartz-bornite veins and fissure fillings with lesser chalcopyrite and gold.

However it was not until the discovery in 1949 of thorium mineralization, that the district saw much activity. Found by radiometric surveys, the discovery started a staking rush in the Lemhi Pass area that lasted until approximately 1957. Many new claims and prospects were discovered using the newly available Geiger counters and scintillometers. Some of the exploration was conducted under joint sponsorship of the federal government, through the U.S. Atomic Energy Commission and the DMEA program, and private companies (Anderson, 1958). Much bulldozer prospecting was done. Anderson reported that while some thorite was mined and concentrated in 1959, many operations were only in the planning stage.

More comprehensive geologic investigations by the U.S. Atomic Energy Commission and the U.S. Geological Survey soon followed, including papers by Sharp and Cavender (1962); Staatz (1972); Staatz, et al. (1972); and Staatz (1979). In addition, A.L. Anderson (1958, 1961a,b) working for the Idaho Bureau of Mines and Geology investigated the geology and mineral resources of Lemhi Pass and nearby areas, documenting a number of uranium, thorium, and rare earth deposits in the greater Salmon region. In the opinion of the present authors, Anderson's descriptions of the deposits and the geologic history of the area are frequently more accurate than the later work by Staatz (1979).

All workers agree that the Lemhi Pass District covers a very large area on the west slope and summit of the Beaverhead Mountains, approximately 26 miles southeast of the town of Salmon. They also agree that the thorium deposits are hosted in folded and faulted impure quartzites and phyllitic rocks of Precambrian age, generally part of the Proterozoic-age Belt series. The correlation and stratigraphy of the numerous Proterozoic quartzites of the Salmon region is still a hotly debated issue, and one which will not be part of this report. Tertiary-age volcanic rocks overlie the quartzites in part of the district. The mapping of Staatz and more recent thesis mapping shows the volcanics with principally faulted contacts against the older metasediments. The volcanic rocks in the region are mid-Eocene (45-49 m.y.a.) in age, according to K-Ar age dating by more recent work (Janecke et al., 2000; Blankenau, 1999).

We noted a propylitically altered mafic dike exposed in one of the Copper Queen adits, but its age and relationship to mineralization was not clear. Nor is it shown on other maps. The copper veins at the Copper Queen are thought to be older than the thorium veins, but that is uncertain, and based on one underground report in the literature.

Staatz (1979) mapped approximately 250 veins in the district, which extends into Montana. The thorium veins range in length from a few feet to several thousand feet long, and in width from a few inches to 40 feet wide. Staatz (1979) reported that the indicated thorium oxide resource in the district was 176,500 tons of ThO_2, with the ten largest veins having an average grade of 0.43 percent ThO_2. Some ores contained several percent of thorium dioxide. However, since the thorium market apparently collapsed shortly after the U.S.G.S. investigations, the veins are still unmined, and many of the workings have caved, leaving only a number of bulldozer prospects and a few old adits to show to modern geologists. Many of the thorium veins also contain substantial concentrations of Rare Earth Elements (REE), with analysis in the percent range.

ORE MINERALOGY AND TEXTURE

Several vein types are found in the district. In general, they are:

Quartz-hematite	(common)
Copper veins	(Copper Queen mine)
Thorium veins	(Buffalo mine, Lucky Horseshoe mine, others)

A few thorium veins also contain copper, as at Wonder Lode. The country rock is a fine-grained micaceous quartzite. The Lucky Horseshoe mine is unusual in having a siltite/phyllite host rock.

Ore mineralogy is unique and very complex:

Common Minerals	Also Found
Specular hematite	Xenotime
Quartz	Euxenite
Feldspar	Pyrite
Barite	Magnetite
Thorite ($ThSiO_4$)	Calcite
Monazite	Siderite
Apatite	Many Others
Allanite	
Biotite	
Sericite	
Hydrous Iron Oxides (secondary)	

Microcline feldspar, quartz, and specular hematite constitute the principal gangue minerals. Thorite is the most common ore mineral, but at the Lucky Horseshoe mine, allanite and probably monazite predominate. This would account for the high REE contents of that ore. Texturally, the ore minerals "may occur irregularly through the broad zones of sheared or otherwise fractured rock, usually in greater concentration in areas of more extensive fracturing than in other areas." (Anderson, 1961) Staatz generally describes the thorium veins as "veins", but notes that at the Lucky Horseshoe mine, the "workings expose highly sheared rocks" and the country rock is unusual in being a siltite. "The vein is brecciated, black to gray, and commonly contains augen of light-colored unfractured feldspar and quartz surrounded by a granulated dark-gray matrix. Shearing of vein material gives it a marked foliation, and the vein commonly resembles a banded gneiss." (Staatz, 1979, p. 54) Gangue minerals noted by Staatz at the Lucky Horseshoe mine are microcline, quartz, specularite, and biotite with allanite being the most abundant ore mineral with lesser dark red thorite and dark-brown monazite. Samples assayed up to 1 % ThO_2 with up to 10% REE. Most of the "veins" are highly oxidized; exposures are limited to small open pits and bulldozer scraps. The Lucky Horseshoe mine is unique in exposing fresh mineralization showing only minimal supergene weathering.

AGE OF MINERALIZATION

Anderson (1958) recognized that the Tertiary volcanics were deposited on an uneven erosional surface on the much older Precambrian quartzites, implying that the thorium veins were older than the volcanics. He also noted that similar thorite veins are found in the Diamond Creek area, near the town of Salmon. The Diamond Creek veins cut Precambrian quartzite but also a granitic rock which Anderson correlated with the Cretaceous-age Idaho Batholith. Thus, he suggests that the thorium-REE mineralization took place after the Cretaceous magmatic activity. This interpretation hinges on correlating the Lemhi Pass veins with those at Diamond Creek (not examined in this investigation), and on the age of the granite at Diamond Creek. Many Proterozoic granitic rocks, including a 1370 million year old rapakivi granite, outcrop in the Salmon region.

Staatz (1979) concluded "The veins in this district are middle Tertiary or younger in age and were formed after both the Challis volcanics and the diorite were emplaced. The copper veins are somewhat older than the thorium ones. The latter are believed to have formed from fluids derived from magma that formed buried alkalic rocks." He noted that most strike northwest with a steep dip and "thorium veins are generally found along small fractures and shears that are related to faulting of Tertiary age."

However, field observations made during the course of this examination of AML sites suggests an alternate hypothesis. Field relations suggest that it is equally likely that the thorium mineralization predated the Tertiary structures cited by Staatz. Indeed, we found evidence that thorium mineralization at Site 00006 might actually be cut off by a Tertiary fault and/or covered by Tertiary rocks. At Lemhi Pass a Tertiary conglomerate with large rounded cobbles and volcanic matrix infills the Lemhi Pass Fault-bounded graben of Staatz, suggesting that the fault valley was present prior to Eocene volcanism. A 4-inch diameter, rounded cobble of non-radioactive, specularite "ironstone" was found as float near the Copper Queen road. This implies that at least some of the iron mineralization predates the Eocene. Janecke et al. (2000) also concluded, from independent, sedimentological evidence, that there were two large Eocene-age paleovalleys extending across the Cretaceous thrust belt in the Beaverhead Mountains. Since none of the thorium or copper mineralization is found in the Tertiary rocks, it seems most likely