Colemanite Deposits Near Stauffer, Ventura County, California

GEOLOGY AND MINERAL WEALTH OF THE CALIFORNIA TRANSVERSE RANGES © South Coast Geological Society 1982

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INTRODUCTION

Colemanite deposits have been known from northern Ventura County since the late 1890s. Prospecting for colemanite over an area of as much as 20 square miles in the late 1890s and early 1900s resulted in the discovery of three mines. The Frazier, Columbus and Russell mines produced hand-sorted colemanite ore between 1899 and 1913. Estimated production of crude ore for the Frazier and Columbus mines is about 34,000 short tons. There are no published estimates of production for the Russell mine. These three mines are located in Sections 14 and 23, T. 8 N., R. 21 W. SMB. (see Fig. 1). Over 4,276 acres of placer mining claims, and 25 acres of lode and millsite claims were patented between 1904 and 1949 in the township. These claims cover some ground which has not proven productive.

HISTORY AND PRODUCTION

Prior to 1898 prospectors had known of a "calcite" occurrence west of Frazier Mountain in northern Ventura County. One prospector named McLaren, who had settled in the area, recognized colemanite specimens on display in Los Angeles in 1889 as identical with "calcite" he had seen in Ventura County. At once he set out with a prary of friends to locate claims.

McLaren's discovery evolved into the Frazier mine which began production in 1899 (Gale, 1914, p. 443-444). By 1900 most Frazier Borate Mining Company stock had been purchased by the Stauffer Chemcial Co. of San Francisco and Thomas Thorkeldsen and Co. of Chicago. Teams hauled 150 tons of hand-sorted, high-grade colemanite ore a month to the railroad at Lancaster where it was shipped by rail to plants in Chicago and San Francisco (Mining and Scientific Press, Aug. 25, 1900, p. 224). Stauffer Chemical Company continued to produce up to 100 tons a month from this deposit. By 1902 the ore was hauled by traction engine to the railroad in Bakersfield, and shipped to Stauffer's plant in San Francisco (Yale, 1904, p. 1022). In 1905, 75 men were employed at this mine (Yale, 1906, p. 1094). The hand-sorted ore produced during this period was said to average from 35 to 45 percent B_2O_3. Production ceased in 1907 with the fall of Borate prices. Total production, estimated by Gale (1914, p. 444) is 25,000 short tons.

The Columbus mine (Fig. 2) was located in 1899, shortly after the discovery of the Frazier mine. Huguenin (1919, p. 756) states production began in 1902, however, Yale (1905, p. 1021) states production began in the Summer of 1904. Production ceased in 1907, but amounted to between 8,000 to 9,000 tons of crude ore (Gale, 1914, p. 449). In 1912 the National Borax Company purchased the mine and embarked on an ambitious plan to reactivate it, but the plans were abandoned by the following year (Huguenin, 1919, p. 756).

Although both of the major mines in the district were shut down in 1907, during that year the Russell borate Mining company acquired 600 acres situated between the Frazier and Columbus mines (Yale, 1908, p. 634). By 1909 no commercial production had yet taken place (Yale, 1909, p. 632). But, when Hoyt Gale visited the district in October, 1912, this mine was the only property in operation (see Fig. 3). Two grades or ore were produced. Premium grade colemanite ore averaged 42.5 percent B_2O_3, the second grade ore averaged 29 percent (Gale, 1914, p. 447-448). In 1913 a furnace for drying the ore was partially constructed, however, a decline in the price of borax silenced this operation too. There are no published production estimates from this mine.

GEOLOGY AND MINERALIZATION

Colemanite deposits occur within Member 4 of the middle Tertiary Plush Ranch Formation as defined by Carman (1964, pp. 22-23). Member 4 is composed of interbedded and interfingered limestone, water-lain tuff, basalt, gypsum, shale, feldspathic sandstone, arkose, conglomerate, and breccia that aggregate at least 1,250 feet of thickness. Member 4 is strongly deformed in the Seymour Canyon area north of Stauffer in the vicinity of the three borate mines. Beds are steeply dipping and have been warped into tight folds whose axes trend generally northeast. Rocks in Member 4 were originally deposited into, and adjacent to, an ancient lake in an arid or semiarid environment. This member and the four other members of the Plush Ranch Formation are of continental origin and at least 6,000 feet in combined thickness. The formation is exposed in an ENE trending belt about 12 miles long and 2 miles wide. It is truncated on the north by an unnamed fault and on the south by the Big Pine Fault zone. Principal colemanite deposits are in the eastern part of the exposure.

Where adjacent to basalt flows, rocks in Member 4 show replacement, veining, and fracture filling with calcite by aciton of calcium carbonate solutions. This alteration was most intense where borate mineralization took place (Carman, 1964, p. 60). The principal borate mineral is colemanite ($Ca_2B_6O_{11}{\cdot}5H_2O$—$B_2O_3$ content 50.8%), with some howlite ($Ca_2SiB_5O_9(OH)_5$—B_2O_3 content 44.5%). Gale (1913, 1914) describes the nature of the colemanite bodies. He reports that bodies are solid crystalline masses of "large" size and irregular in shape, and appear to generally follow bedding of the enclosing limestone and shale. The larger bodies are adjacent to the basaltic flows. Colemanite also occurs as irregular replacement bodies in limestone, along fracture planes and in fault zones as at the Russell mine. Some of the coarser grained colemanite is milky white, or glassy, resembling calcite in overall appearance. When colemanite is fine grained and massive it is gray to black in color, probably due to included impurities. This material was called "black" ore by the miners. (Gale 1914, p. 446) reports that the "ore is so intermingled with limestone that it varies from nearly pure colemanite to limestone masses containing blotches of colemanite." Beds that contain the colemanite are generally steeply dipping and form the flanks of folds. At the Frazier mine some beds containing colemanite are flattish, but are at, or near the crest of an anticline.

Figure 1. Simplified geologic map showing the location of the Frazier, Russell and the Columbus colemanite mines, northeastern Ventura County. Bedrock units are part of the middle Tertiary Plush Ranch Formation (geology adapted from Carman, 1964).

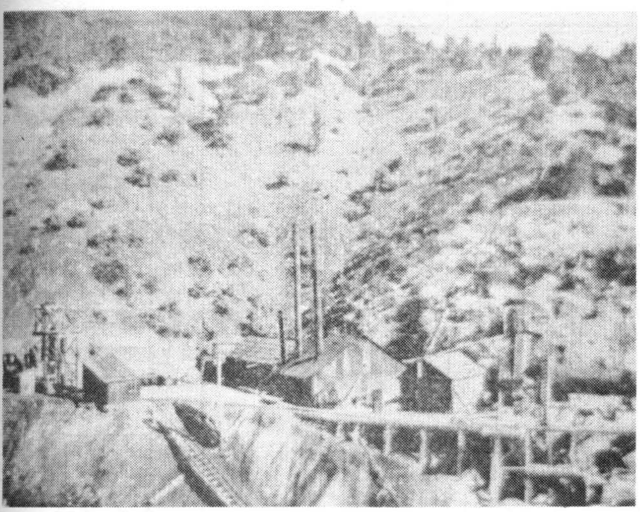

Figure 2. The Columbus mine about 1914. (from Huguenin, 1919).

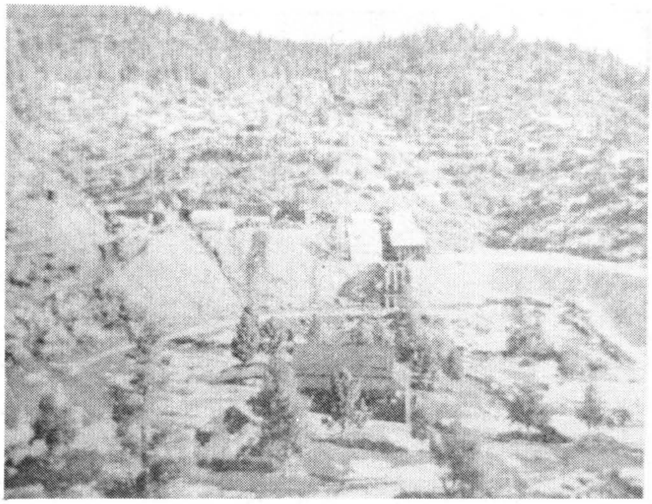

Figure 3. The Russell mine about 1914. (from Huguenin, 1919).

MINING AND MINE WORKS

Mining and prospecting has taken place from the North Fork area to 3 miles or so northeast of the Columbus mine, a total distance of about 10 miles in a northeast direction. All of the significant production, however, has come from the Frazier, Russell and Columbus mines. The main workings of the Frazier mine are entered through an adit which is at least a quarter of a mile long in a northerly direction (Fig. 4). Gale (1914, p. 444) reports the ore bodies were irregular in thickness but that ore to a height of 5 or 6 feet is still exposed in some of the workings near the extreme north end of this adit. There may have been lateral workings off the main adit. At the time of Gale's brief examination the mine was idle and heavily timbered, testifying to the weak nature of the wall rocks. Gale also reports two upper adits, no doubt on the same steeply dipping zone. In all, workings should total roughly 2,500 feet. Possibly stopes extended between adits.

The Russell mine was in operation in October, 1912 and was entered by Gale (1914), p. 445). He reports a main shaft 200 feet deep from which a crosscut was driven 350 feet on a line N 16° W to reach the ore body. From this point a drift was driven an unknown distance N 75° E on the ore body which has a southerly dip of roughly 60°. A winze was sunk to the 250-foot level near the intersection with the ore body. A "considerable amount of ore" was developed from this winze. A crosscut was run south from the 200 foot level of the main shaft. It was in basalt for 190 feet and then shale for 10 feet. Along the crosscut near the main shaft a "massive" vug of chalk white material reported to be pandermite (ulexite) was completely enclosed in basalt.

Underground workings of the Columbus mine were apparently extensive but were "wholly inaccessible" at the time of Gale's visit. He does report, however that the main adit was at least 200 feet in length on a line N 6° E. The works crosscut basalt to intersect colemanite-bearing limestone. A winze was sunk somewhere along the tunnel to an unknown depth and apparently had a large number of lateral workings off it from which most of the ore was mined. Gale reported the lower level works were filled with water.

ORIGIN

Gale (1913, 1914) suggested that the colemanite deposits were vein-like and could be the result of limestone replacement by borate solutions associated with formation of the basaltic flows. Foshag (1921) indicated that this was not a correct conclusion because the flows could not provide enough borate solution over a long enough time to replace as much limestone as apparently had been absorbed and removed. Foshag wrote of the leaching of ulexite in a sodium chloride solution at temperatures somewhat above normal. In this solution borax, colemanite and water are formed. However, the continued formation of colemanite is dependent on borax being removed as fast as it forms. Because of this Foshag suggested that ulexite and borax were the primary borate minerals and that they formed in a playa lake. Later, during folding, percolation of sodium chloride solutions converted the ulexite to colemanite with removal of borax.

Each of these hypothesis has problems, and the precise nature of the origin of the deposits is still not known. It is clear, however, that colemanite formed late, because the mineral occupies veinlets, solution cavities, fracture fillings and fault zones. Part of the difficulty is that the workings are caved and mineral specimens for study are not available. A detailed study of the mineralogy and the possible effects of migrating calcium-rich ground water should greatly aid in determining the origin of these deposits.

OUTLOOK

Colemanite-bearing zones in Member 4 of the Plush Ranch Formation were extensively prospected during the early 1900s. We do not know of any recent prospecting, although it may well be warranted. The colemanite deposits are irregular and in steeply dipping, weak, folded rocks. For these reasons it may be that extraction would have to be from strongly supported underground works, a relatively high-cost venture. This decision, however should await detailed surface sampling and extensive drilling for

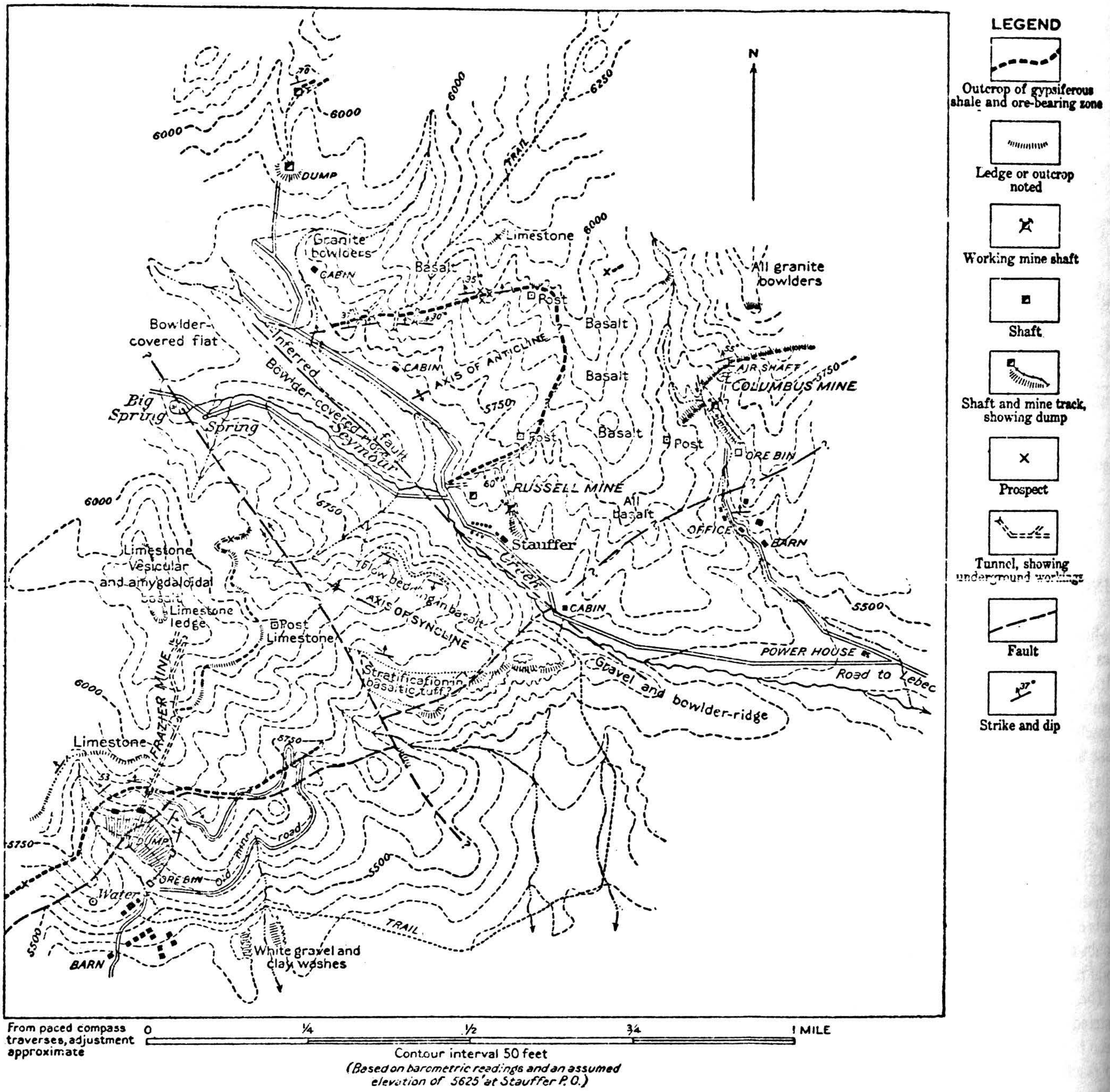

Figure 4. Sketch map showing the Columbus, Russell, and Frazier colemanite mine area, northeastern Ventura County, California (from Gale, 1914).

tonnage, grade, shape, and extent of colemanite bodies. It is possible that, locally, sufficient quality material could be extracted from an open pit and upgraded to appropriate B_2O_3 content. As much of the land is privately owned, negotiations and options would probably be a necessary prerequisite for prospecting. In summation, much colemanite may be available, particularly at depths within several hundred feet of the surface, but the cost of extraction and processing may be high. A detailed exploration program, and extraction and processing cost studies appear critical in order to make the appropriate decision.

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