Borates

Handbook of Deposits, Processing, Properties, and Use

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Front cover photograph: The 20-mule team used to haul borax from Death Valley, to Mojave, 1883–1890. (For more details, see Chapter 4, Figure 7.)

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3.6.3.2 Lang (Tick Canyon; Sterling Borax Company)

In 1907 colemanite was discovered in Tick Canyon in the Coastal Range, 8 km (5 mi) north of the Southern Pacific Railroad's Lang station and 48 km (30 mi) northeast of Los Angeles. In 1908 the Sterling Borax Company (owned by Stauffer Chemical, American Borax, and two borax processing companies) started mining. The colemanite was sorted underground and shipped to Lang by narrow gauge rail. As the mine grew deeper and borax prices fell, the company was sold in 1921 to Pacific Coast Borax who operated it until 1923, and dismantled it in 1926 (Ver Planck, 1956).

The 4.9-m (16-ft) colemanite bed outcropped for 305 m (1000 ft) in Tick Canyon. The bed was near the top of the Oligocene Vasquez Formation in fine-grained and thinly bedded red and brown sandstone, mudstone, and purplish silty shale. Its ore was richer than at Calico and its age was 20 My (Smith, 1985). It had a strike of north 75° west, and a dip of 70–80° south. The ore zone was deformed into folds modified by many cross- and longitudinal faults. The colemanite bed was <9.1 m (30 ft) thick (average 1.8–3 m), with subbeds that "alternated with layers of black carbonaceous shale ... some ... quite bituminous" (Eakle, 1911, p. 180) and 305 m (1000 ft) long, enclosed by and intermixed with shale. Thinner colemanite beds and several thin howlite-bearing layers were also present but not mined. Noncommercial colemanite also occurred for 3.2 km (2 mi) northeast of the mining area. About 0.4 km east they were offset 305 m by a fault (Gay and Hoffman, 1954). Near the mine "the strata are abruptly upturned against a great basic dyke" (Keys, 1910, p. 694). Also, the colemanite was "in cleaved masses, and very often in columnar bands" (Foshag, 1921, p. 103). There was shale under the colemanite, but on top there were "heavy bedded sandstones ... with efflorescence of white alkali salts along their seams and bedding planes" (Eakle, 1911, p. 180).

The colemanite was predominantly a massive bed, with 2-mm to 2-cm crystals, a glassy luster, and generally a gray color due to included mud. Specimens with a divergent columnar structure were common, and single crystals comparatively rare. In the beds some clusters of crystals were thickly grown together and attached to a base of massive colemanite. Some colemanite occurred as nodules, and as a pure white crack and cavity filler (Pemberton, 1968). There was abundant plant life in the colemanite, indicating that the deposit had once been a freshwater marsh. The colemanite's crystallographic properties were slightly different from that of other colemanite (it was called "neocolemanite"). It tended to cleave so strongly that most of the crystals from the mine were cleaved fragments (Eakle, 1911). The ore averaged 33–35% B_2O_3, typically 36.10% B_2O_3, 23.74% CaO, 13.97% SiO_2, 5.14% CO_2, 2.36% MgO, 1.32% Fe_2O_3, 1.27% Al_2O_3, and 16.10% H_2O (Dupont, 1910).

Considerable ulexite was found near the base of the colemanite bed at the 75-m (250-ft) level. It was bedded, massive, fibrous, and compact, with the fibers lying in all directions, giving a satiny luster and a botryoidal surface. The ulexite occurred "in irregular masses more or less lens-like and surrounded by thin layers of clay," producing an analysis of 43.12% B_2O_3, 14.14% CaO, 7.05% Na_2O, and 35.68% H_2O (Foshag, 1921, p. 210). Probertite occurred in very small quantities as lenticular nodules in the shale matrix, with 0.5- to 1.5-mm crystals as slender radiating prisms or occasional rosettes. Small amounts of veatchite ($Sr_4B_{22}O_{37}\cdot 7H_2O$-I), paraveatchite ($Sr_4B_{22}O_{37}\cdot 7H_2O$-II), and howlite

($Ca_4Si_2B_{10}O_{23}\cdot 5H_2O$) were found with colemanite in limestone or marl. The veatchite occurred as pearly cross-fibered seams in the colemanite. Some "howlite nodules are imbedded in the colemanite and form 'augen' [lenticular eye-shaped masses] in the strata" (Foshag, 1921, p. 211). Small amounts of howlite were also found as <1-m nodules with a cauliflower-like surface. They were white, gray, or black, but porcelain-like and white inside. Some nodules had 2-mm howlite crystals on their surface as rosettes [in the tailing piles, along with bakerite ($Ca_8B_{10}Si_6O_{35}\cdot 5H_2O$), pyrite ($FeS_2$), realgar (AsS), arsenopyrite (FeAsS), stibnite (Sb_2S_3), tremolite ("mountain leather," $Ca_2Mg_2Si_8O_{23}\cdot H_2O$) and celestite ($SrSO_4$); Pemberton, 1968]. Calcite was rare in the deposit (Foshag, 1921).

7.2.2.2 Coastal Mountain Area: Lang

Two vertical shafts, each 107 m (350 ft) deep, were employed at Lang from 1908 to 1922. The main entries were on the 30-, 61-, and 91-m (100-, 200-, and 300-ft) levels, with mining along strikes of 244–305 m (800–1000 ft). One segment, 183 m (600 ft) long, was mined on all three levels with numerous auxiliary entries. Square set timbering [12 × 18 m (40–60 ft) wide, 21 m (70 ft) long, and 18 m (60 ft) high] was needed in some stopes, and shrinkage stopes were mined in the others. The latter were about 21 m (70 ft) long, 18 m (60 ft) high, and 6.1 m (20 ft) wide at their base above the ore chutes. Pumping was constantly required, and 80 miners were employed, producing 360 metric tons/day (400 tons/day). The mine yielded 91,000 metric tons (100,000 tons), and from 1908 to 1920 was the dominant borate operation in the United States (Gay and Hoffman, 1954).

8.2.3.4 Coastal Mountain Area: Lang

Four oil-burning colemanite calciners were employed at Lang: two wedge furnaces (each producing 36 metric tons/day), and two rotary kilns (each producing 54 metric tons/day). Fine-calcined colemanite was blown from the calciners and recovered in cyclone dust collectors. The product was shipped by rail to the Lang siding on the Southern Pacific Railroad, and from there to several eastern refineries (Gay and Hoffman, 1954).

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