DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP MR-14

BORATE IN THE UNITED STATES

(Exclusive of Alaska and Hawaii)

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Introduction

This map shows the location of borate deposits in the United States (exclusive of Alaska and Hawaii). Because all the known borate deposits of the United States of any historic or present economic importance occur in California, western Nevada, and southern Oregon, this map covers only the western part of the country.

In compiling this map both past production and estimated reserves have been combined to assign the deposits or groups of closely spaced deposits to one of four general size categories based on orders of magnitude. These are: more than 10,000,000 short tons of B_2O_3 (see map Explanation), 1,000,000 to 10,000,000 short tons of B_2O_3, 100,000 to 1,000,000 short tons of B_2O_3, and less than 100,000 short tons of B_2O_3.

The most prominent deposits and districts are identified by name on the map, and all are numbered to correspond to the Locality Index.

Both published and unpublished data have been used in this compilation; the principal sources are cited in the Locality Index and identified in the section References Cited. Special attention is directed to the following papers that provide numerous additional citations to the literature on borates: Hanks, 1833; Bailey, 1902; Yale and Gale, 1914; Foshag, 1912; Ver Planck, 1956; Smith, 1960.

The deposits shown on the map, with two minor exceptions, occur as Quaternary surficial deposits in arid basins or as layers and lenses of borates in sections of sedimentary rocks accumulated in such basins in Tertiary time.

The most important borate minerals in the deposits shown are borax, $Na_2B_4O_7.10H_2O$; kernite, $Na_2B_4O_7.4H_2O$, which is present only at Kramer, but in large quantity; ulexite, $NaCaB_5O_9.8H_2O$; and colemanite, $Ca_2B_6O_{11}.5H_2O$. These hydrated borates of sodium and calcium commonly occur with minor amounts of other borates, and with various assemblages of other minerals, mostly sodium, calcium, and magnesium carbonates, sulfates, and chlorides.

The largest and most productive deposit is at Kramer, California. The ore consists of thick layers of coarsely crystalline borax interlayered with limy shales and siltstones, enclosed in more or less deformed sedimentary rocks of Tertiary age. Kernite replaces some of the borax. Other Tertiary deposits, also in deformed lake sediments, consist mostly of layers or lenses of colemanite and ulexite. Of these, the best known are in the Furnace Creek district, Death Valley, California.

At the Searles Lake deposit, second in size and productivity, borax and other products are extracted from brines that are pumped from two very porous layers of coarsely crystalline saline minerals. The layers underlie a salt pan or playa; they are the residue from desiccation of large quantities of water that entered the desert basin of Searles Lake during Pleistocene time. Kramer and Searles Lake together supply nearly all the borates now produced in the United States.

The so-called marsh deposits formerly provided a substantial part of the borate output, but they have not been an important factor in the industry since about 1900. Marsh deposits are thin crusts of borate minerals mixed with other evaporates at or near the surface of desert basins. They are Quaternary in age.

Certain small deposits are of geologic interest. These include Borax Lake, California, where coarse crystals of borax occur in the bottom mud of an intermittent lake; Chetco, Oregon, a vein-like occurrence of priceite ($Ca_4B_{10}O_{19}.7H_2O$); and Cave Spring, Nevada, an occurrence of searlesite ($NaBSi_2O_6.H_2O$) in veinlets.

Locality Index

	Lat. N.	Long. W.
CALIFORNIA		
Lake County		
1. Borax Lake. Quaternary lake deposit, borax crystals in mud. Anderson, 1936; Gale and others, 1939; Hanks, 1883; Vonsen and Hanna, 1936	38°59'	122°40'
Inyo County		
2. Saline Valley. Quaternary marsh deposits, ulexite crusts. Gale, 1914a; McAllister, 1956; Ver Planck, 1956	36°42'	117°49'
3. Owens Lake. Quaternary lake deposits, borax brine in salt pan. Dub, 1947; Gale, 1915; Smith and Pratt, 1957	36°20'	116°52'
4. Harmony. Quaternary marsh deposits, ulexite crusts. Bailey, 1902; Mumford, 1954; Smith 1960	36°29'	116°52'
5. Furnace Creek. Tertiary layered colemanite. Erd and others, 1959; McAllister, 1958; Noble and Wright, 1954; Smith, 1960	36°18' to 36°28'	116°39' to 116°51'

CALIFORNIA (Cont'd)

6. Lila C. Mine. Tertiary layered colemanite. Gale, 1912 — 36°14' 116°29'
7. Eagle Borax. Quaternary marsh deposits, ulexite crusts. Bailey, 1902; Smith, 1960 — 36°12' 116°52'
8. Gerstley-Shoshone. Tertiary layered colemanite. Noble, 1926; Noble and Wright, 1954 — 36°01' 116°14'
9. Amargosa. Quaternary marsh deposits, ulexite crusts. Bailey, 1902; Noble, 1922b, 1926; Ver Planck, 1956 — 35°53' 116°15'

San Bernardino County

10. Searles Lake. Quaternary lake deposits, borax brine in salt pan and unworked solid borax. Dyer, 1950; Gale, 1915; Haines, 1959; Ryan, 1951; Smith and Pratt, 1957 — 35°45' 117°20'
11. Four Corners (East Kramer) Tertiary layered colemanite. Benda and others, 1960; Dibblee, 1958; Dickey, 1957; Griswold, 1959 — 35°01' 117°33'
12. Calico. Tertiary layered colemanite. Foshag, 1921: Wright and others, 1953 — 34°57' 116°48'

Kern County

13. Koehn Lake. Quaternary marsh deposits, ulexite crusts. Dibblee and Gay, 1952; Hanks, 1883 — 35°20' 117°55'
14. Kramer. Tertiary layered borax and kernite. Benda and others, 1960; Dibblee, 1958; Gale, 1946; Schaller, 1930, 1936 — 35°03' 117°40'

Ventura County

15. Frazier Mountain. Tertiary layered colemanite. Gale, 1914b — 34°47' 119°04'

Los Angeles County

16. Lang. Tertiary layered colemanite. Gay and Hoffman, 1954; Jahns, 1940; Switzer, 1938 — 34°28' 118°22'

NEVADA

Washoe County

1. Gerlach. Quaternary marsh deposits, ulexite crusts. Yale and Gale, 1914 — 40°40' 119°25'

Churchill County

2. Sand Springs. Quaternary marsh deposits, ulexite crusts. Hance, 1914; Hanks, 1883 — 39°17' 118°25'

Mineral County

3. Teels Marsh. Quaternary marsh deposits, borax crusts. Ferguson and others, 1954; Hanks, 1883 — 38°14' 118°20'

NEVADA

4. Rhodes Marsh. Quaternary marsh deposits, ulexite and borax crusts. Ferguson and others, 1954; Hanks, 1883; Vanderburg, 1937 — 38°16' 118°05'

Esmeralda County

5. Columbus Marsh. Quaternary marsh deposits, ulexite crusts. Ferguson and others, 1954; Hicks, Hicks, 1916 — 38°02' 117°57'
6. Fish Lake. Quaternary marsh deposits, ulexite crusts. Hanks, 1883; Spurr, 1906 — 37°52' 117°58'
7. Cave Spring. Veinlets of searlesite. Foshag, 1934 — 37°49' 117°51'

Clark County

8. White Basin. Tertiary layered colemanite. Bowyer and others, 1958; Callaghan and Rubey, 1936; Gale, 1921b; Noble, 1922a — 36°20' 114°34'
9. Callville Wash. Tertiary layered colemanite. Bowyer and others, 1958; Callaghan and Rubey, 1936; Gale, 1921b — 36°13' 114°42'

OREGON

Curry County

1. Chetco. Vein of priceite. Age unknown. Gale, 1921a; Staples, 1948 — 42°06' 124°20'

Harney County

2. Lake Alvord. Quaternary marsh deposits, borax crusts. Dennis, 1902 — 42°20' 118°40'

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