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BORON IN ALVORD VALLEY, HARNEY COUNTY, OREGON

By
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Introduction

The advent of the Space Age brought high-energy fuels into sharp focus. Boron compounds have offered promise as an important component of these fuels and have received much publicity in this connection. Thus attention has been directed to possible new sources of boron even though no shortage of domestic supplies can be foreseen at present.

Around the turn of the present century borax was harvested commercially from crusts formed on the surface of Alvord Valley, south of Alvord Lake, in southern Harney County, southeastern Oregon, just east of the famous Steens-Pueblo Mountains.

In 1957-58 a minor boom developed in applications for prospecting permits on federal land in the general vicinity of Alvord Lake basin. The present paper describes the conditions of boron occurrence in the basin and attempts to bring developments in the area up to date.

In July, 1947, the author was in the basin locality and sampled the water of Hot Lake at one outlet; the assay returned 80 p.p.m. of B_2O_3. During the last week of August and the first week of September, 1960, the area was revisited and thermal springs sampled as described in the following text.

Location

Alvord Valley is a generally flat surface, irregular in outline, about 70 miles long, and about 8 miles wide in the widest part near Alvord Lake (see accompanying map). On some maps the main valley is subdivided into three parts - Alvord Desert on the north, Wild Horse Valley in the central part, and Pueblo Valley on the south. The northern third of the valley is narrow, averaging about two miles in width. The remainder is a broad plain extending south into Nevada. The whole was once occupied by a large body of water, an arm of ancient Lake Lahontan, which covered much of southeastern Oregon and northern Nevada during Pleistocene time. The valley is fringed on the east by White Horse or Trout Creek mountains. The general area is included in Tps. 32 - 39 S., Rs. 33 - 36 E.W.M.

Access

This part of the county has only a few inhabitants, who are engaged mainly in stock raising. A graveled road traverses the west side of the valley and connects three small settlements - Andrews, Fields, and Denio (the last on the Nevada line) - with Winnemucca, Nevada, on the south and Burns, by the way of Follyfarm, on the north. A road extends eastward by the way of White Horse ranch to U. S. 95, thence to McDermitt (on the Nevada border) and Winnemucca, Nevada. A road extends northwest from Fields through a pass in the Steens, thence north to French Glen and Burns. Distance from Fields to Burns by the way of French Glen is 107 miles; from Fields to Burns by the way of Follyfarm is about 130 miles; from Fields to Lakeview by the way of Denio and the partially built "Winnemucca to the Sea" highway is about 145 miles; from Fields to Winnemucca by the way of Denio is about 124 miles; from Fields to Winnemucca by the way of McDermitt is about 171 miles. Burns, on a branch of the Union Pacific Railroad, and Winnemucca, on the Western Pacific Railroad (as is Lakeview) are railroad shipping points.

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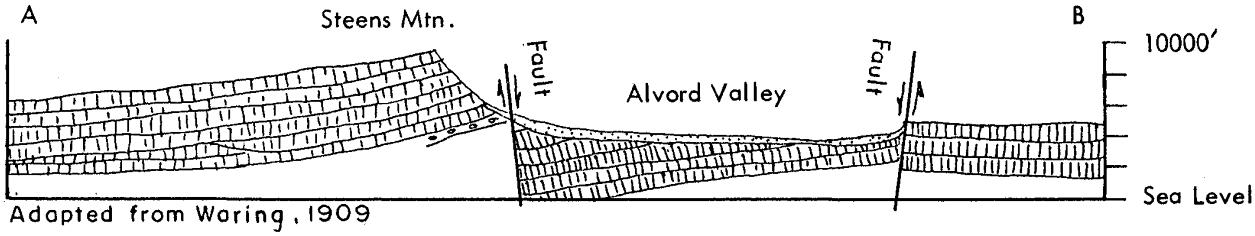
Topography

Waring (1909) states that the Steens Mountains form the western compound limb of a great uplift or arch and that the western side of Alvord Valley borders an extensive fault zone, movement along which formed the large escarpment, giving such striking views from the east and from the air. The central part of the great arch sank to form the graben of Alvord Valley (see cross section). The eastern part of the valley



CROSS SECTION SHOWING ALVORD VALLEY GRABEN

has lower escarpments and gentle dips to the east. The highest point of the Steens range is situated westerly from the Alvord ranch and has an altitude of 9670 feet. The highest point of the Pueblo range is Pueblo Mountain at 8725 feet southwest of Tum Tum Lake. The valley surface varies from about 4200 to about 4400 feet.

Climate

Alvord Valley has a semi-arid climate with rather wide extremes of temperature, which is common in the eastern Oregon basin regions. U. S. Weather Bureau records taken at Andrews show maximum temperature of about 106° F. and a minimum as low as minus 30° F. Annual precipitation has averaged about 7.75 inches with mean snowfall of about 20 inches.

Grazing is the most important industry. Some grain and hay as well as hardy fruits and vegetables are grown for local consumption and in a few favorable places restricted irrigation is practiced. Killing frosts are expected in spring and fall.

Drainage

As shown on map, the basin contains a few shallow lakes and playas, some streams which drain the adjacent mountains, and some flowing springs several of which are thermal. Drainage is all into the basin; there is no outlet. Alvord Lake is only a few feet deep and its areal extent varies with the season and rainfall. It averages about $3\frac{1}{2}$ miles long and 2 miles wide in its widest part. During periods of heavy precipitation it may overflow into the playa to the north called Alvord Desert. In summer the lake is usually shrunken and has alkali crusts on the surface. Mann, Juniper, and Tencent lakes, all small, are in the northern part of the valley. Tum Tum Lake, sometimes dry or nearly dry, is in the southern part toward Denio.

Trout Creek is the largest stream and flows into Alvord Lake from the southeast. Average discharge is approximately 15 c.f.s. measured at a point 5 miles east of Trout Creek ranch and 14 miles northeast of Denio (U. S. Geol. Survey 1957, p. 226). The next largest is Wildhorse Creek which drains into Alvord Lake from the north and for which no discharge records are available. Lesser creeks run into the valley from the Steens slopes as the result of precipitation and discharge of springs. The flow of most of these sinks into the alluvium of the western edge of the basin.

There are several springs on the eastern slopes of the Steens range as well as on the valley floor. Some of these are thermal and discharge water near the boiling point. Several flow through vents roughly in a line trending N. 20° W. from 2 to $2\frac{1}{2}$ miles south of Alvord Lake. The largest of these on the southern end of the line has formed a large pool named Hot Lake (some maps call it Borax Lake). It has a discharge at the margin of about 900 g.p.m. at a temperature of about 97° F. (Stearns 1937). The pool is about 275 yards in diameter (Waring 1909) and is adjacent to the site of the old Rose Valley borax works described later under History. Farther north on the western side of Alvord Desert, hot springs in a group discharge approximately 135 g.p.m. at a temperature of about 168° F. (Stearns 1937).

Still farther north and about 7 miles east of the north end of Alvord Desert, as shown on map, a group of springs (called Mickey Springs locally and Hickey Springs on a 1956 Bureau of Land Management map) discharges water near the boiling point through several vents. There is no record of quantity of discharge.

Up the valley of Trout Creek a few small thermal springs, shown on map, are used for watering stock.

Several flowing wells have been sunk in the alluvial filling of the western side of Alvord Valley according to Waring (1909).

Geology

Russell (1884, 1903a, 1903b), Waring (1909), Fuller (1931), Ross (1942), and Williams and Compton (1953) have described the rocks and structures of the Steens-Pueblo mountains area. The most extensive study was made by Fuller, who first determined the sequence of the volcanic series as revealed in the magnificent Steens escarpment. A summary of the succession under three main headings of Pre-Tertiary, Tertiary, and Quaternary, for the most part according to Williams and Compton, is as follows:

Pre-Tertiary

In Oregon, pre-Tertiary rocks are exposed underlying Steens-Pueblo lavas as a broad core along the Pueblo range extending south from Horse Creek about 13 miles to the Nevada line. Prominent in the northern portion of this section are massive greenstones containing large feldspar crystals up to an inch in length. Along Arizona Creek the greenstones are associated with argillites, quartzites, and minor marble. Coarse-grained quartz diorite and monzonite are exposed on the South Fork of Willow Creek. Sericite phyllites and chlorite schists are prominent in the east face of Pueblo Mountain and farther south. It is the consensus of most geologists that the metamorphic rocks belong to the Paleozoic, while the plutonic rocks are of late Jurassic age.

Tertiary

Alvord Creek formation: As described by Williams and Compton (1953, p. 25), these beds include acid tuffs and tuffaceous sediments, clays, opaline cherts, and lenses of conglomerate. Thickness exposed in Alvord Creek Canyon is slightly more than 800 feet with the base concealed. The best exposures are at the bottom of the Steens scarp bordering Alvord and Pike creeks. Near the mouth of Pike Creek they include a rhyolite flow. Farther north the beds include andesite flows and a rhyolite laccolith. According to Baldwin (1959, p. 105), available evidence of the age of Alvord Creek beds is contradictory but appears to point to late Miocene.

Pike Creek volcanic series: As exposed along Pike Creek and in the canyons of Little Alvord, Toughey, and Indian creeks, the series overlies the Alvord Creek formation and includes rhyolite and dacite flows with tuff interbeds. Thickness exceeds 2500 feet. A flow of pinkish platy rhyolite, 250 feet thick on Pike Creek and twice as much on Toughey Creek, marks the supposed vent. Dark obsidian is in evidence near the top. Along Pike and Toughey creeks a lower platy rhyolite flow as much as 200 feet thick with high angle flow bands indicates proximity to a vent.

Four other places at the base of the Steens-Pueblo scarp have outcrops of siliceous extrusives similar to those described above and have been tentatively correlated with the Pike Creek series. These four are designated by Williams and Compton (1953, p. 25) as the Alvord Lake area, the Red Hill area, the Cottonwood Creek area, and Tum Tum point - the last projecting into the valley between Tum Tum Lake and Denio. No fossils have been found in these rocks and correlation has been indicated by stratigraphic and petrologic relationships.

A distinct unconformity is shown between the siliceous volcanic formations as described and the overlying andesitic and basaltic lavas of the Steens series.

Fifteen miles east of the last areas mentioned there is, in the general vicinity of Flagstaff Butte, a succession of tuffs and diatomite beds associated with rhyolite lavas and pyroclastics known as the Trout Creek formation. Fossil evidence places the age as late Miocene or Mascall (Baldwin 1959, p. 106) as has been indicated for both Alvord Creek and Pike Creek formations.

Steens-Pueblo series: This series is represented by massive exposures of andesite and basalt having an aggregate thickness of probably more than 2000 feet with considerable variation locally both in thickness and composition. According to Williams and Compton (1953, p. 24), interbeds of pyroclastics are relatively rare. Fuller (1931, p. 77-87) describes a massive flow of andesite in the Alvord Creek locality and gives it the name of "The Great Flow". In the valley of Cottonwood Creek, it shows a thickness of 900 feet but thins to the north. The vent from which it was extruded is exposed on the northern side of Little Alvord Creek directly above the vent of the underlying rhyolite flow. Near the close of this period of eruption a flow of pale gray and purple dacite came from a vent under Alvord Peak. An outlier of this flow as much as 400 feet thick forms Sharps Peak. To the west of Alvord Peak there is a later flow of porphyritic rhyolite as much as 150 feet thick.

An unconformity separates the Steens-Pueblo lavas from the overlying Steens basalts.

Steens basalt. Imposing eruptions of lava which formed the High Steens are shown in Wild Horse canyon and form cliffs below Smith Flat. This lava is composed of light to dark gray, coarsely crystalline and porous olivine basalt showing large phenocrysts of labradorite which often have an open network ("diktytaxitic" of Fuller). Individual lava sheets vary from a foot to 70 feet in thickness. In the aggregate their maximum thickness exceeds 4000 feet in the High Steens. They probably extend south along the crest of Pueblo Mountains as well as over a large area elsewhere in south-central Oregon. Baldwin (1959, p.106-107) correlates the Steens basalt with the Owyhee basalt which would further extend the coverage over a large part of Malheur County.

Field work done by Johnson (1960) has shown that there is a welded tuff unit lying disconformably on the Steens basalt in the Catlow Valley area. This unit can be correlated with Beattys Butte, approximately 30 miles west of the Steens, from which upper Miocene fauna has been collected (Wallace 1946). The age of the Steens basalt is therefore probably no younger than upper Miocene.

On Horse Creek the Steens basalt is cut by two volcanic necks of dense rhyolite, each of the order of three-quarters of a mile in maximum dimension. Numerous basic dikes, in general roughly paralleling the big scarp, occur along the Steens front but are rare or lacking in the Pueblo Mountains.

Quaternary

Older alluvium. The easterly mountain spurs from an east-west line about 2 miles north of Fields to an area 2 miles southwest of Tum Tum Lake are made up of alluvial materials that have been compacted and faulted. They consist of sand, gravel, and boulders of volcanics (metamorphics in the southern part) apparently deposited under torrential conditions. Thickness varies from 200 feet in the northern part to 800 feet in Cottonwood Creek valley. The general dip is westerly and in places beds are inclined as much as 35 degrees. Ross (1942, p. 236) reports the discovery of two fragments of a silicified cameloid bone, a type which is reported to range in age through most of the later Tertiary. He suggests that the relation of the beds to other rocks indicates a possible Pliocene age. Williams and Compton (1953, p. 32) think it could be early Pleistocene.

Recent alluvium. The floor of Alvord Valley proper is made up of alluvial materials laid down in Pleistocene and later lakes.

Structure

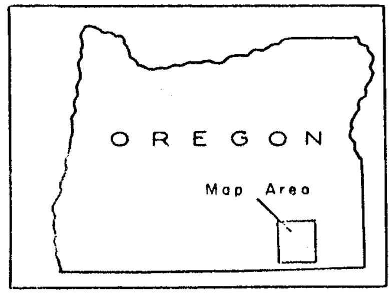
Russell (1884, p. 438-445) first suggested that the Steens-Pueblo range represents the western flank of an arch, the keystone of which dropped down to form the Alvord Valley graben. Subsequent investigators have been in general agreement. The maximum downthrow may have been as much as 10,000 feet. There is evidence of similar conditions on both sides of the valley, although on the east side the escarpments are on a much smaller scale.

Several fault systems are described by Williams and Compton (1953, p. 34) who trace major "boundary faults", together with subsidiary and transverse faults, all of which are related to the Steens-Pueblo block movements. A map of Baldwin (1959, p. 101) indicates some principal trends. Normal faulting appears to be the rule.

The hot springs, including Hot Lake, south of Alvord Lake, probably emerge on one of these faults or fault extensions. Williams and Compton (1953, p. 37) comment on recent earthquake activity in the region west of Alvord Lake, also on the evidence of faulting in the older alluvium. It is noted that some shocks were felt "about 25 years ago" and that at the same time unusual activity was observed in the hot spring at Hot Lake.

History

Harney County was originally included in Grant County and did not become a separate entity until



Index Map

		General Geologic Column of Area
QUATERNARY	Recent	Recent Alluvium -- Younger alluvial deposits filling the valley floor.
	Pleistocene	Older Alluvium (800' ±) -- Lenticular beds of sand, gravel and boulders, moderately indurated, deformed, and faulted.
TERTIARY	Middle or Upper Miocene	Steens Basalt (4500' ±) -- Light to dark gray, cliff-forming olivine basalt flows. Caps the high Steens Mountain. Equivalent lavas occur throughout southeast Oregon.
		Steens Mt. Volcanic Series (3000'±) -- Augite and olivine basalts, andesites; local areas of dacite and rhyolite cap the series. Pyroclastic interbeds rare or thin. Disconformable on underlying Pike Creek series.
		Pike Creek Series (2500' ±) -- Thick sequence of rhyolites, dacites, tuffs, tuffaceous sediments and volcanic agglomerates separated from Alvord Creek beds by angular unconformity.
		Alvord Creek beds (800' ±) -- Light-colored fine-grained tuffaceous sediments with minor opaline chert and conglomerate.
PRE-TERT.		Metasedimentary and metavolcanic rocks of probable Paleozoic age which have been intruded by monzonitic and dioritic plutons.

February 25, 1889, when the bill creating Harney County was signed by Governor Pennoyer.

In the early 1860's a number of expeditions of miners crossed south-eastern Oregon on their way to the gold discoveries at Auburn and Canyon City in Oregon, and at the Idaho camps. In addition, there were the western moving emigrants. To protect these travelers from the hostile Snake River Indians, military posts were established at various points along the routes. Among them was Camp Alvord, southwest of Alvord Lake named for Brigadier General Benjamin Alvord, paymaster of the Department of Oregon 1854-62 and in command of the Department of Oregon 1861-65. The Camp Alvord post was evacuated and moved to a new location called Camp C. F. Smith, on White Horse Creek in 1866 (McArthur 1952, p.12). The latter post was abandoned in 1869.

In the late 1860's and early 1870's cattlemen came into the country with stock and started ranches both in White Horse Valley and Harney Valley west of the Steens. After the Indian wars and abandonment of Fort Harney (established in 1867 as Camp Steele at the mouth of Rattlesnake Creek about 14 miles east of present-day Burns) many small ranch holdings were taken over by the large cattle owners. The largest of these was the Pacific Livestock Company which was a power in the political history of the Harney County area (Anon. 1902).

Settlers in Alvord Valley had observed a white saline crust formed by evaporation of waters flowing from hot springs south of Alvord Lake. They called the crusts "alkali" and paid little attention to them. It is related (Anon. 1902) that "a few years ago a borax expert discovered that the crusts contained borax." It is further stated that the "expert" interested capitalists who purchased the land in question for $7,000. In due time a plant was erected and production of borate began. Probably these events were a little before the turn of the century. In 1909 Waring (1909, p. 72) described the operation as follows:

"For the last nine or ten years borax has been shipped from the works near the hot springs south of Alvord Lake. Of the deposit here Joseph Struthers (1901, p. 870-871) says:

'The marsh deposits of sodium borate in Harney County, which extend over 10,000 acres south of Lake Alvord, have been operated during the last few years, and the refineries have produced a yearly output of approximately 400 short tons of refined borax, which is carried by mules to Winnemucca, on the Central Pacific Railway, whence it goes to Chicago, St. Louis, and occasionally to San Francisco. The Rose Valley Borax Company owns 2,000 acres of the richest portion of the deposit close to the lake. The ground is level and treeless and is incrusted with a layer of sodium borate several inches in thickness, which contains also sodium carbonate, sodium sulphate, sodium chloride, and other salts. During the summer the loose surface deposit is shoveled into small heaps and is replaced by a second incrustation within a comparatively short time. As no mining is done in winter, sufficient material is collected in summer to furnish a supply to operate the refining works throughout the entire year. The crude mineral, containing from 5 to 20 percent of boric acid, is shoveled into tanks of boiling water, and chlorine or sulphuric acid is added to decompose the alkali salts, and thus free the boric acid. After twenty-four hours the clear supernatant liquor is drawn off into crystallizing tanks and cooled, yielding white pearly scales of high-grade boric acid, and a mother liquor, which is used repeatedly if it contains a sufficient quantity of sodium salts to warrant a separate treatment.'

"In the collection of the alkali crust, Chinamen have been employed chiefly. This crude deposit is first scraped into windrows with shovels and then loaded into wagons and hauled to the works. Sagebrush is used as fuel under the dissolving tanks. The refining plant consists of two of these tanks, of 6,000 and 8,000 gallons capacity respectively, and 24 crystalizing tanks, each of 1,200 gallons capacity. The crystallized product of borax is sacked and hauled to Winnemucca, Nevada, by 16-mule teams."

According to reports in "Mineral Resources of the United States", borax was not produced from the Harney County deposits in 1902 nor thereafter.

Ruins of the plant and sodhouse living quarters may still be seen on the west side of Hot Lake.

Recent Developments

Records of the U. S. Land Office in Portland, Oregon, show that on June 20, 1960, there were 45 apparently valid sodium prospecting permits* covering approximately 96,000 acres in Alvord basin, Harney County. In addition, applications had been made for four sodium permits (covering nearly 11,000 acres) and one potassium permit (covering 800 acres) in Lake County which adjoins Harney County on the west. The records indicate that 29 of the Harney County permits covering approximately 63,176 acres expire in late 1960.

In 1958 shallow drilling was reportedly done by Mojave Mining and Milling Company, Wickenburg, Arizona. Most of this prospecting was in secs. 11 and 14 with some in secs. 2, 12, and 13, all in T. 37 S., R. 33 E. It was reported that 32 holes were drilled from 2 to 22 feet deep. No information on sampling results has been made public.

In 1959 and 1960 some further development drilling reportedly was done by Boron, Inc. which employed Boyles Bros., Salt Lake City, to put down core drill holes east of Fields. The deepest hole was stated to be 600 feet where rock was encountered. No information on the alluvial material penetrated or the saline content is available.

Samples

Information on hot water samples collected in 1960 by the author is given below. Sample locations are shown on the map.

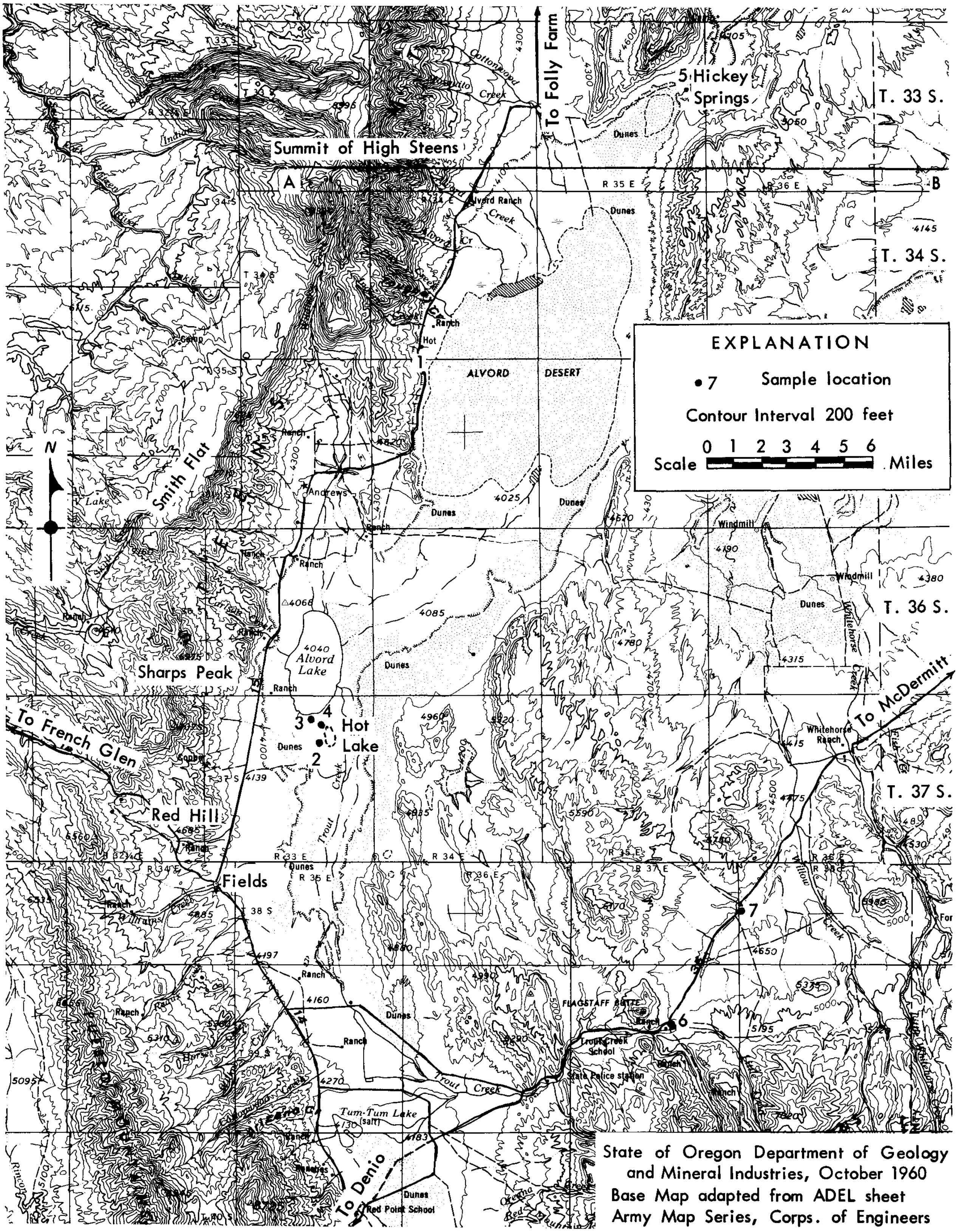
No. 1 -West side of Alvord Desert, 6 miles south of Alvord Ranch close to main road in sec. 33, T. 34 S., R. 34 E. Several vents. Sample taken at a main vent. Flow 135 g.p.m. Temperature 167° F. (Stearns 1937, p. 176-177). Flow goes to bath house. Total solids in solution, 0.298 percent. B_2O_3, 106 p.p.m.

No. 2 -West outlet of Hot Lake in sec. 15, T. 37 S., R. 33 E., near ruins of old borax works. Temperature at western overflow outlet 82° F. several hundred feet distant from vents in bottom of lake. Temperature is reported as 97° F., with approximate discharge of 900 g.p.m. and diameter of lake about 275 yards (Stearns 1937, p. 176-177). (Hot Lake is 3.8 miles east of main road to Fields measured from a point 4 miles north of Fields where a desert road branches off.) Total solids in solution, 0.170 percent. B_2O_3, 61 p.p.m.

No. 3 -0.7 mile N. 20° W. of Hot Lake on fault line of vents. Sample from pool near north end of line. Temperature 122° F. (Vents from which nos. 3 and 4 were taken are mentioned by Waring [1909, p. 37].) Total solids in solution, 0.155 percent. B_2O_3, 31 p.p.m.

No. 4 - 0.1 mile south of No. 3 on same line of vents. Deep pool 3-4 feet in diameter. Sinter cone is arched. Temperature 198° F. Total solids in solution, 0.15 percent. B_2O_3, 56 p.p.m.

* A federal sodium prospecting permit may cover up to 2,560 acres or the equivalent of four sections of public land. It is normally granted for two years and, according to federal regulations, may be succeeded by a lease.



BORON DEPOSITS IN ALVORD VALLEY, HARNEY COUNTY, OREGON

No. 5 - Mickey Springs (Hickey Springs on Bureau of Land Management map) approximately 7 miles east of Follyfarm road, on south side of road which branches from Follyfarm road at right angle jog, 3½ miles north of Alvord Ranch. Springs include several vents, pools and sinter cones extending down hill toward flat of Alvord Desert extension. Sample taken from easterly of twin pools near bottom of first slope below upper pool. Some steam; pools about 8-10 feet in diameter. Water can be heard running underground. Temperature of sample 198° F., estimate of discharge uncertain, perhaps of order of 100 g.p.m. or more. Evidence is that activity was formerly greater. Total solids in solution, 0.168 percent. B_2O_3, 33 p.p.m.

No. 6 - At base of Flagstaff Butte on Trout Creek road in sec. 16, T. 39 S., R. 37 E., half a mile below mouth of Little Trout Creek. Vent on Deffenbaugh's ranch east of house and close to road. Discharge approximately 45 g.p.m. Temperature 136° F. Used for stock after flowing to pool. (No. 72 of Stearns, 1937, p. 177) Total solids in solution, 0.083 percent. B_2O_3, 4.4 p.p.m.

No. 7 - Near Trout Creek road on east side, few small springs, 5 miles northeast of Flagstaff Butte and 7.6 miles southwest of White Horse ranch. Temperature 95° F. Flow given by Stearns (1937, p. 177) (No. 71) as 30 g.p.m. Total solids in solution, .015 percent. B_2O_3, 1 p.p.m.

Spectographic analysis of the total solids obtained by evaporating Sample No. 1 gave elements in the following percentages:

(1) Concentrations more than 10%
Silicon, sodium

(2) Concentrations 10% - 1%
Potassium (high), boron (low), calcium

(3) Concentrations 1% - 0.1%
- - - - -

(4) Concentrations 0.1% - 0.01%
Lithium, iron, magnesium, vanadium

(5) Concentrations 0.01% - 0.001%
Molybdenum, barium

(6) Concentrations below 0.001%
Titanium, copper

The other samples gave similar results except that there was some variation in percentages of the same elements. Samples 1, 4, and 6 showed lithium. The others did not. All the samples showed calcium with the largest percentages indicated in Nos. 1, 4, and 6. Possibly this might have some future significance if it can be shown that boron may occur as calcium borate.

Summary

Possibilities of boron accumulation in commercial quantity in Alvord Valley are dependent upon factors such as:

(1) The valley is a large natural closed basin, in which all surface drainage is inward; there is no surface outflow. Extent and movement of subterranean drainage is unknown.

(2) Boron is a constituent of hot springs which drain into the basin and, in the past, borate has been produced commercially from saline crusts deposited in marshes south of Alvord Lake and adjacent to Hot Lake.

(3) In the aggregate, a large quantity of boron in dilute solution is discharged continuously from vents over the marshes surrounding the springs. Some of the solution forms crusts by evaporation and some percolates into the ground. If the two larger springs are considered as an example, those from which samples No. 1 and No. 2 were taken and whose quantity of discharge has been recorded - they represent a total discharge of approximately 1035 g.p.m. The No. 1 sample spring (135 g.p.m.) contains 106 p.p.m. B_2O_3 and No. 2 sample spring contains 61 p.p.m. B_2O_3. Thus in a year these two springs discharge a total of about 150 tons of B_2O_3, plus some lithia. The springs in the basin have been flowing for an unknown period of time and presumably have been fairly uniform in mineral content over their lives. What has happened to the minerals in the subsurface travels of the solutions is a moot question. Perhaps crystals have formed in a reservoir of brine as has happened in other similar basins. Only subsurface exploration can provide an answer. No attempt has been made to estimate the amount of saline crusts on the surface.

Acknowledgments

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GSA TO SELL CHROMITE ORE

General Services Administration has announced plans for the disposal of approximately 89,750 long tons of domestic chromite ore and 151,000 lb of ferroalloys from the national stockpile.

In another move, GSA declared 169,000 lb of cobaltiferous materials in excess to defense needs and available for sale. Included in the excess inventory are partially processed ores, sludges, carbonates, metallics and oxides from which cobalt can be derived. (From E &MJ Metal and Mineral Markets, October 6, 1960.)

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GOLD AND MONEY SESSION BOOKLET PUBLISHED

The 1960 Pacific Northwest Metals and Minerals Conference has just published Gold and Money Session, a 60-page booklet consisting of the papers and statements by the eight mining and monetary experts who participated in the day-long Gold and Money Session at the AIME 1960 Pacific Northwest Metals and Minerals Conference held in Portland April 28-30.

Permission for the conference to publish the booklet was granted by AIME. General Chairman for the conference was Hollis M. Dole, Director, State of Oregon Department of Geology and Mineral Industries, who announces that the booklet, Gold and Money Session, is being distributed by the department, 1069 State Office Building, in Portland. The price is $1.50, and checks should be made payable to: 1960 Pacific Northwest Metals and Minerals Conference.

Gold and Money Session, as outlined below, includes introductory notes, the three papers presented at the morning session, the luncheon address, and a full transcript of the statements, discussion, and summary by members of the afternoon panel.

"Foreword," by Evan Just, Head, Mineral Engineering Department, Stanford University, and Co-Chairman of Gold and Money Session.

"Notes for the Gold and Money Session," by Pierre R. Hines, Mining Engineer, Portland, Oregon, and Chairman of the Gold and Money Session. (A report written to serve as an introduction to the session. Originally published in the February 1960 Ore.-Bin.)

"Gold in the International Monetary System Today," by Miroslav A. Kriz, Associate Economist, First National City Bank of New York. (Paper presented at the morning session).

"The Problem of Gold Convertibility," by O. K. Burrell, Professor of Finance, University of Oregon. (Paper presented at the morning session).

"Review of Gold Production," by Donald H. McLaughlin, President, Homestake Mining Company. (Paper presented at the morning session).

"How to Obtain a Sound International Monetary System," by Philip Cortney, President, Coty, Inc. (Luncheon address).

Transcript of the afternoon panel discussion on gold and money - Evan Just as moderator.

a) Opening statement by V. C. Wansbrough, Managing Director, Canadian Metal Mining Association.

b) Opening statement by Oscar L. Altman, Advisor, Research and Statistics Department, International Monetary Fund.

c) Question and discussion period conducted by Evan Just, with Mr. Wansbrough, Dr. Altman, Dr. Kriz, and Dr. McLaughlin participating.

d) Summary of entire panel discussion by Oscar L. Altman.

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NEW MINING ADVISORY COUNCIL OFFICERS

F. I. Bristol, Chairman of the Oregon delegation to the Western Governors Mining Advisory Council, reports that A. J. Teske, Secretary, Idaho Mining Association, was elected Chairman of the Western Governors Mining Advisory Council at the group's annual meeting October 10 at Las Vegas, Nevada. He succeeds Clark L. Wilson, Chairman, Emergency Lead-Zinc Committee, Washington, D.C. Russell W. Beamer, Executive Secretary, Wyoming Mining Association, was elected Vice Chairman, and Frank P. Knight, Director, Arizona Department of Natural Resources, was re-elected Secretary. After a report on the past year's activities of the Council, the meeting was adjourned subject to the call of the chairman.

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RUSSIA GAINING IN MINERAL STRENGTH

Russia's stepped up trade in minerals is revealed in the U.S. Bureau of Mines new statistical report, "The Foreign Mineral Trade of the U.S.S.R. in 1959 - Mineral Trade Notes Supplement No. 60." The publication, announced in the Bureau's September 26 press release, may be obtained free of charge from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Avenue, Pittsburgh 13, Pennsylvania.

Evidence of growing mineral strength, the Bureau states, is shown by the fact that Russia's mineral exports in 1959 gained 14 percent in value over 1958 and were twice the 1955 value. The Soviets cut down on shipment of zinc, tin, and aluminum to Free-World countries in 1959, while delivering substantially more of many bulk products, including solid and liquid fuels, iron ore, pig iron, rolled steel, manganese ore, chromite, asbestos, apatite concentrate, and potash salts.

Summaries of U.S.S.R. foreign mineral trade for the years 1956 and 1957, taken from earlier U.S. Bureau of Mines Mineral Trade Notes, appeared in the October 1958 and March 1959 issues of the Ore.-Bin.

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UNPUBLISHED GEOLOGIC REPORTS ON INCREASE

The Department is rapidly building up a library of graduate student theses, Government open-file reports, and other unpublished data on Oregon geology not ordinarily available to the public. During the year 1960 the following such reports have been acquired, and anyone wishing to consult them is welcome to do so at the Department's Portland office, 1069 State Office Building.

Crowley, Karl C., 1960, Geology of the Seneca-Silvies area, Grant County, Oregon: Univ. of Oregon master's thesis, 44 p. illus., geol. map.

Dodds, R. Kenneth, 1960, Geology of the western half of the Svensen quadrangle, Oregon: Univ. of Oregon master's thesis (in preparation), 98 p., illus., geol. map.(Temporarily filed with Department while author is on foreign assignment.)

Hoover, Linn, 1959, Geology of the Anlauf and Drain quadrangles, Douglas and Lane counties, Oregon: U.S. Geol. Survey open-file report, 95 p., illus., geol. map.

Koch, John G., 1960, Geology of the Humbug Mountain area, southwest Oregon: Univ. of Wisconsin master's thesis, 49 p., illus., geol. map.

Maloney, Neil J., 1961, Geology of the eastern part of Beaty Butte four quadrangle, Oregon: Oreg. State Coll. master's thesis, 88 p., illus., geol. map.

Mundorff, M. J., 1959, Geology and ground-water resources of Clark County, Washington, with a description of a major alluvial aquifer along the Columbia River: U.S. Geol. Survey open-file report, 660 p., incl. illus., well records, geol. map.

Newcomb, R. C., 1960, Storage of ground water behind subsurface dams in the Columbia River basalt, Washington, Oregon, and Idaho: U.S. Geol. Survey open-file report, 31 p., illus., geol. maps.

Peck, Dallas L., 1960, Geologic reconnaissance of the Western Cascades in Oregon north of latitude 43 degrees: U.S. Geol. Survey open-file report, 232 p., illus., geol. map.

Smedes, Harry W., 1959, Geology of part of the northern Wallowa Mountains, Oregon: Univ. of Washington doctorate thesis, 217 p. plus 32 plates, geol. map.

Taylor, Edward M., 1960, Geology of the Clarno basin, Mitchell quadrangle, Oregon: Oregon State Coll. master's thesis, 173 p., illus., geol. map.

Vhay, J. S., 1960, A preliminary report on the copper-cobalt deposits of the Quartzburg district, Grant County, Oregon: U.S. Geol. Survey open-file report, 20 p., geol. and mine maps.

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WHITE KING LEASED TO THORNBURG

The White King uranium group of claims has been leased to Vance Thornburg, of Grand Junction, Colo., it was announced by the partners who own the property. Owners are Mr. and Mrs. Don Tracy, John Roush, Wayland Roush, Walter Leehmann Sr. and Walter Leehmann Jr.

Thornburg does not plan any mining activity this fall, as the season is late, but plans to begin work next spring in producing ore at the mine. The White King has not produced since last fall and the Lakeview Mining Company's lease was dropped a few weeks ago.

Thornburg and his brother, the late Dr. Garth W. Thornburg, with their associates, Perry Bass, the Murchison interests and the late Sid Richardson, were the original lessors of the mining property which was mined from 1956 by the Lakeview Mining Company and produced ore for the company's reduction plant here. (From Lake County Examiner, October 20, 1960.)

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OREGON BOARD MEMBERS NAMED

The following Oregon members were elected to the Board of Governors, Western Division, of the American Mining Congress at the annual business meeting in Las Vegas, Nevada, October 12:

Fayette I. Bristol, President, Bristol Silica Company, Rogue River, Oregon.
Earl S. Mollard, General Manager - Oregon, The Hanna Mining Company, Riddle, Oregon.
Hollis M. Dole, Director, State of Oregon Department of Geology and Mineral Industries, Portland, Oregon.

Messrs. Bristol and Mollard were re-elected, and Hollis M. Dole was newly elected, replacing S. H. Williston of the Cordero Mining Company.

In response to an invitation to hold the American Mining Congress meeting in Portland, the Board of Governors voiced strong hope that a September meeting in 1964 could be arranged. The 1961 meeting of the American Mining Congress was set for Seattle, and the next Mining Show for San Francisco in 1962.

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ADDITIONAL OREGON PLACE NAMES

Ball Bay: bay about 2 square miles in size, indenting the western shore of Upper Klamath Lake about 8 miles west-southwest of the village of Modoc Point; Klamath County; secs. 28, 29, 30, 32, and 33, T. 36 S., R. 7 E., Willamette meridian; 42°24'30" N., 122°01'00" W. Not: Howard Bay. (q.v.)

Howard Bay: bay, about 3 miles long and 2.5 miles wide, indenting the western shore of Upper Klamath Lake about 6.8 miles northwest of Wocus; Klamath County; T. 37 S., R. 7 E. and T. 37 S., R. 8 E., Willamette meridian; 42°20'00" N., 121°55'00" W. Not: Wocus Bay (q.v.).

Wocus Bay: bay about 2 miles long and 0.4 mile wide forming the southeastern part of Klamath Marsh, about 43 miles north-northeast of the city of Klamath Falls; Klamath County; secs. 32 and 33, T. 31 S., R. 9 E., and sec. 4, T. 32 S., R. 9 E., Willamette meridian; 42° 50'00" N., 121°39'30" W.

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