Volume 40, No. 7
July 1978

THE ORE BIN

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DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

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Volume 40, No. 7
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LEVYNE IN THE WALLOWAS

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Introduction

The zeolite mineral levyne has been collected in a number of localities in Oregon. The purpose of this article is to report a new occurrence of this and other minerals in the vicinity of Aneroid Lake, Wallowa County, Oregon (Figure 1).

Aneroid Lake lies 6 mi by trail (#1804) from the south end of Wallowa Lake State Park (Figure 2a). Details about the trail are given in "100 Oregon Hiking Trails" (Lowe and Lowe, 1969). Good campsites around the lake are available. The store and cabins are now on private property and should not be used without permission. Current owners of the camp are the Halton Tractor Company, Portland, Oregon. The camp is made available to the Portland YMCA, and several week-long trips to the area are usually organized during the summer. For further information, contact the Metro Office of the Portland YMCA.

Geologic units exposed in the Aneroid Lake area (Figure 2b), from oldest to youngest, are (1) Martin Bridge Limestone (TRmb) - coarsely crystalline, locally metamorphosed Triassic limestone that forms many of the steep walls in the Wallowas; (2) Hurwal Formation (TRh) - Triassic siltstone and mudstone that makes up many of the crests of the Wallowa Mountains; (3) Late Jurassic-Early Cretaceous granitic intrusive rock (JKgd) - light-colored granitic rock ranging in composition from quartz diorite to granodiorite; (4) Columbia River Basalt Group (Tcr) - fine-grained, dark-colored Miocene flood basalt that once cov-

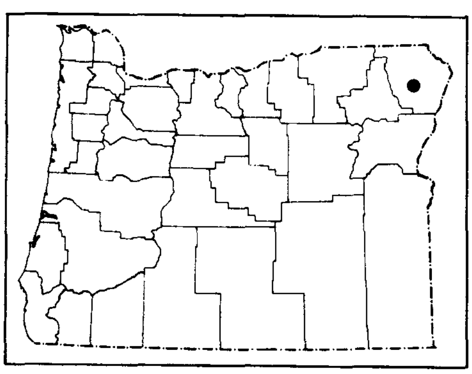

Figure 1. Index map showing location of Wallowa Mountains.

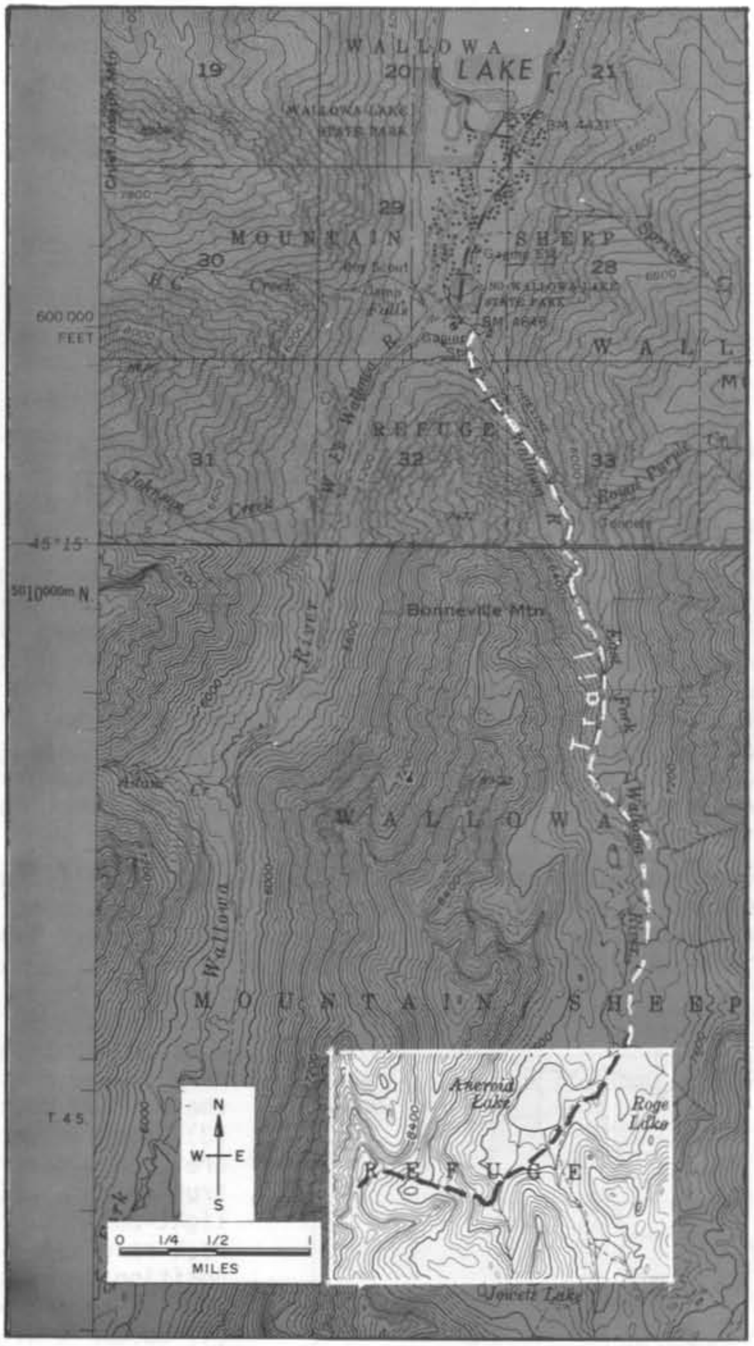

Figure 2a. Trail from Wallowa Lake to Aneroid Lake. See Figure 2b for larger scale map showing geology of Aneroid Lake area.

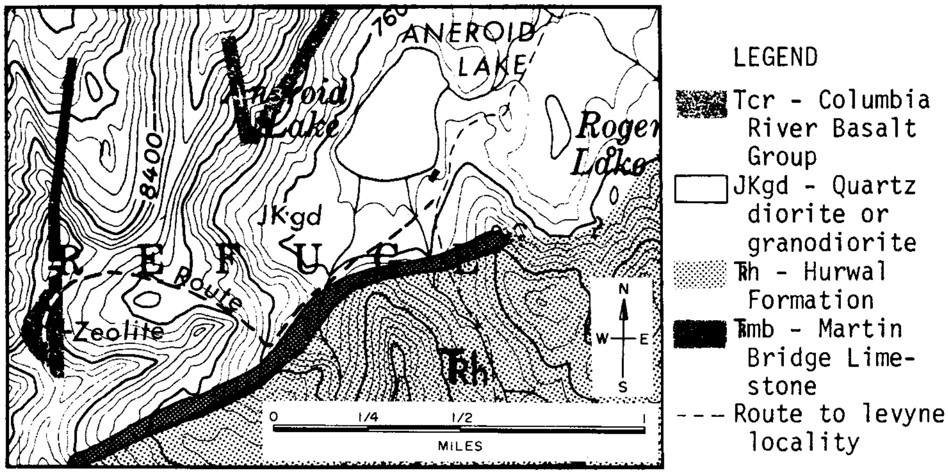

Figure 2b. Geology of Aneroid Lake area. Geology from Smith and Allen (1941). Levyne is found in Columbia River Basalt outcrop southwest of Aneroid Lake; garnets occur in Martin Bridge Limestone south of Aneroid Lake. Note that it is necessary to leave trail on southeast side of Aneroid Lake and go cross-country via recommended route to reach zeolite locality.

ered the entire region and now remains as cover for some Wallowa peaks. Columbia River Basalt feeder dikes occur in the mountain west of Aneroid Lake and elsewhere in the Wallowas.

The ridge to the west of Aneroid Lake is composed of granitic rock that has been intruded by dikes and at one time was covered by basalt of the Columbia River Group. Several of the surrounding peaks, such as Aneroid Mountain to the east, are composed of Columbia River Basalt. South of Aneroid Lake and extending up to Tenderfoot Pass are rocks of the Martin Bridge and overlying Hurwal Formations.

Locations of Minerals

Garnet and other minerals

Garnet-rich Martin Bridge Limestone is exposed on the slopes at the top of the meadow at the southern end of the lake and can be traced westward up toward the ridgetop above Jewett Lake and eastward across the ridge behind the cabins to a point near the south end of Roger Lake. The unit is several feet thick and dips steeply. The coarsely crystalline limestone is liberally sprinkled with crystals of grossularite garnet (Figure 3). Most of the garnets are opaque and irregular in form, but in some places sharp dodecahedral crystals can be found. Some of the garnets are an inch or more in diameter. In addition, diopside and blue

Figure 3. Dodecahedral grossularite garnet crystals found south of Aneroid Lake in Martin Bridge Limestone. Bar = 0.25 in.

calcite with clear, honey-brown garnet crystals have been found above Jewett Lake.

Several old mine tunnels are located near the Martin Bridge Limestone in the meadow and along the ridge to the east. The tailings show stains of malachite, which has apparently altered from disseminated grains of chalcopyrite and chalcocite. The Martin Bridge Limestone also contains considerable vesuvianite near the tunnels above the trail going south from Aneroid Lake to Tenderfoot Pass.

Levyne

Levyne is found in vesicles in Columbia River Basalt occurring on the very crest of the ridge to the west of the small, unnamed lake southwest of Aneroid Lake. This area lies about 1,200 ft above the camp area, at an elevation of almost 9,000 ft above sea level (see Figures 2a and 2b). From this ridge, the view of the Aneroid and Roger Lakes basin, the West Fork lake basin, and all the surrounding peaks is truly spectacular. There is no trail to the ridgetop, so the easiest route to it is to leave the main trail, go through the private cabin area and across the meadow at the south end of Aneroid Lake, following the central stream south and taking the canyon to the west. From there, go up along the face of the portion of the ridge to the left of the waterfall, across the unnamed lake basin, and up a short scree slope to the top. The zeolite area is some distance south from the saddle along the top of the ridge, in rock at the base of a 12-ft-high "tower" (Figure 4).

Various zeolites, including thompsonite, chabazite, apophyllite, cowlesite, stilbite, and levyne, are found in vesicles in the basalt. Some occur as amygdules; most of the cavities are filled or lined with fibrous thompsonite, on top of which may be crystals of chabazite. There is no thompsonite lining, however, in the cavities in which levyne occurs. Chabazite crystals associated with stilbite and calcite crystals covered with thompsonite line cracks and cavities in the nearby rocks.

Levyne

Levyne (or levynite) is a calcium aluminum silicate of the chabazite group with the formula $Ca[Al_2Si_4O_{12}]\cdot 6H_2O$ (Deer and others, 1963). Members of the chabazite group all have a similar atomic structure in the form of a framework of silicon aluminum oxide arranged in two types of structures: (1) 6-fold rings that form hexagonal prisms and (2) larger, cagelike 8- or 12-fold rings. The various types of zeolites differ in the order of stacking of these units. The chabazite group, including chabazite, gmelinite, and levyne, all crystallize in the rhombohedral system, but because of the subtle differences in internal structure, their crystal habits are quite different. Chabazite typically forms rather simple rhombohedrons; these "pseudo-cubes" make identification rather easy (Figure 5). Gmelinite also forms equant crystals, but with considerably more faces present. Levyne crystals are almost always tabular, with well-developed basal faces, which often give the crystals a bladelike appearance.

Levyne was first collected from the Faroe Islands in 1825. It has also been found in northern Ireland; Table Mountain, Colorado; Kamloops, British Columbia; and several places in Oregon, especially Ritter Hot Springs and a site along Beech Creek, north of Mt. Vernon (Figure 6). Crystals from these last two locations typically form thin blades occurring in basalt vesicles. They are white because of a surface coating of a thin, fibrous layer of another zeolite, offretite (White, 1975).

When levyne from the Aneroid Lake area occurs within a cavity, it is the only mineral present within that cavity, with no evidence of the thompsonite coating that fills neighboring vesicles and forms a base layer in those vesicles containing chabazite. The levyne crystals are clear and uncoated; their habit, while tabular, is not bladelike, but considerably more equant (Figure 7). The crystals are up to 1 mm thick and are clustered so that only a few faces of each crystal show. The habit resembles that of the crystals from the Faroe Islands, reported by Goldschmidt (1918), rather than those of the Ritter and Beech Creek locations.

Figure 4. View looking west across meadow south of Aneroid Lake to zeolite locality. Best way to ridge is marked by dashed line. Levyne and other zeolites occur in basalt "tower" in center, directly above waterfall.

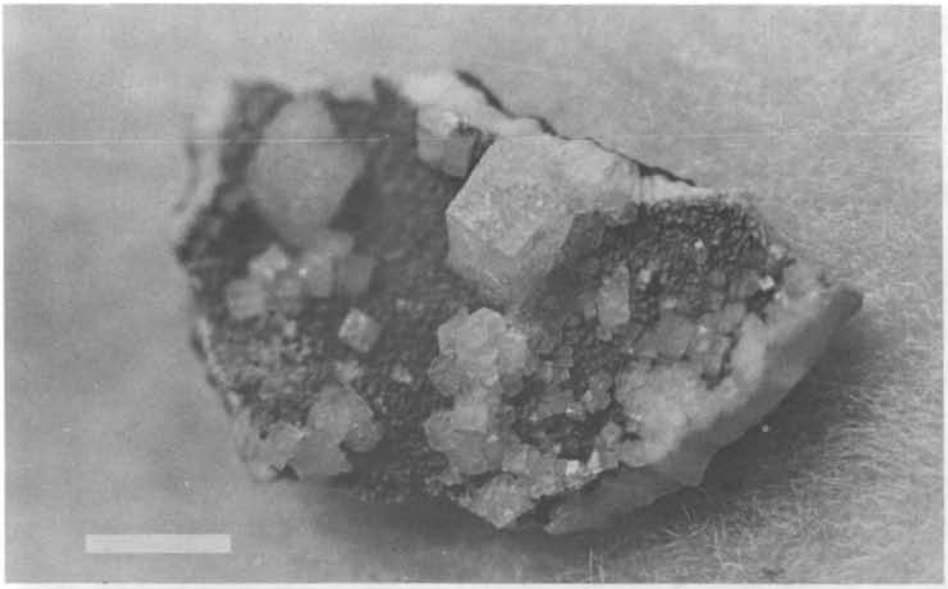

Figure 5. Rhombohedral chabazite from Aneroid Lake area, Wallowa Mountains, Oregon. Bar = 0.25 in.

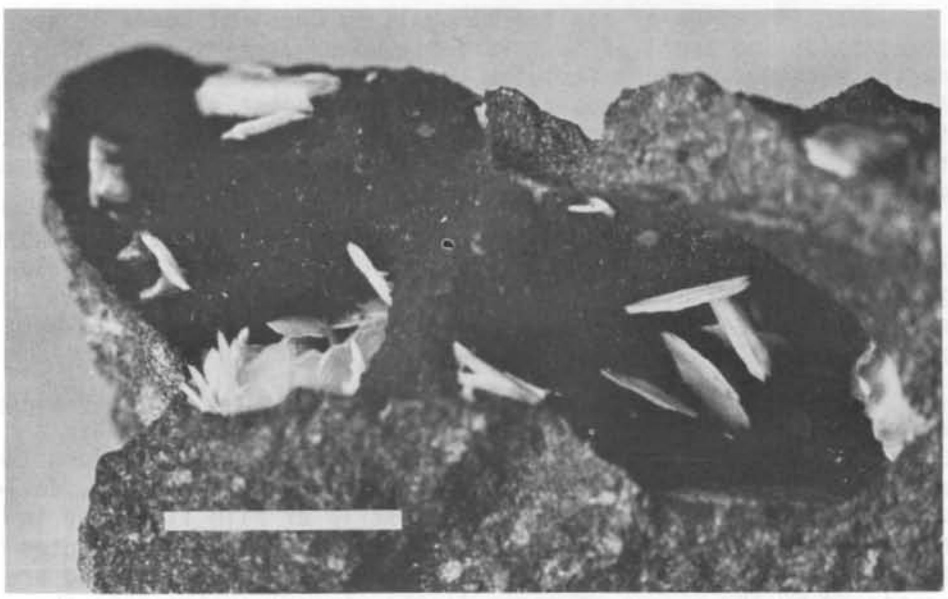

Figure 6. Levyne with covering of offretite. These crystals were found at Beech Creek, Oregon. Bar = 0.25 in.

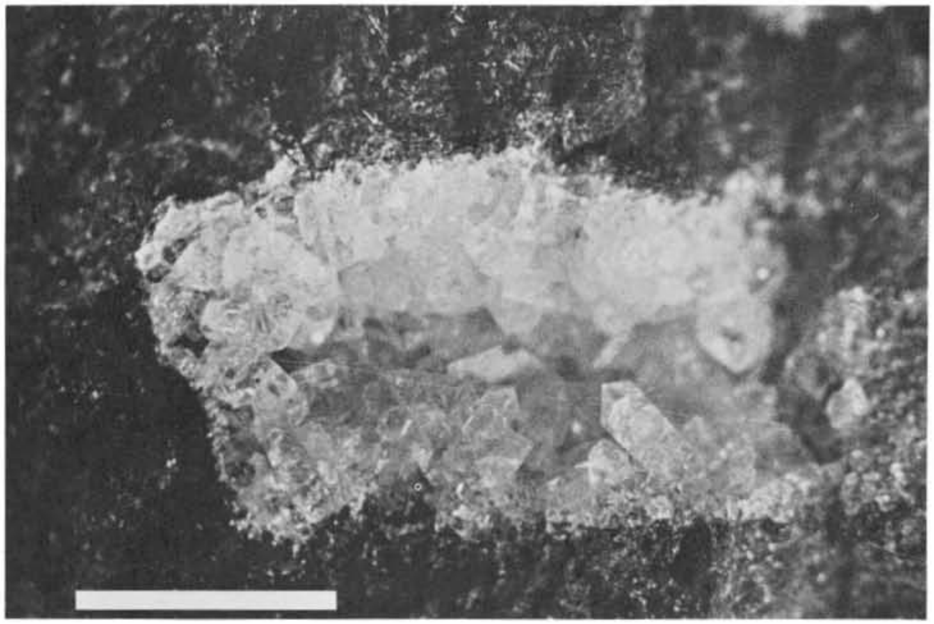

Figure 7. Levyne crystals from Aneroid Lake area, Wallowa Mountains, Oregon. Bar = 0.25 in.

Method of Identification

Identification of zeolite minerals by chemical means is not practical. The zeolites have variable water content and can easily exchange cations (calcium replaced by sodium, for example). Moreover, the ideal composition of most zeolites is very nearly the same, in both quantity and quality. Since differences between these minerals are basically structural, it is by crystallographic means that they can be distinguished.

The zeolite minerals from this location were identified using X-ray techniques. The method, often referred to as powder analysis (Hurlbut, 1971), has the double advantage that only a few milligrams of sample are required and the sample need not be a single crystal.

The sample is ground very fine and made into a tiny rod using a non-crystalline binder such as model cement. A glass fiber coated with grease can also be used. The rod is mounted along the axis of a cylindrical metal housing, 36 cm in circumference, called a Debye-Sherrer camera (Figure 8). A strip of film lines the interior of the cylinder. X-rays of a particular wavelength enter from one side (in Figure 8, the left), strike the sample, and are scattered by the planes of atoms in the mineral grains onto the film. The sample is slowly rotated so that the reflecting planes of atoms will all be brought into position to scatter X-rays.

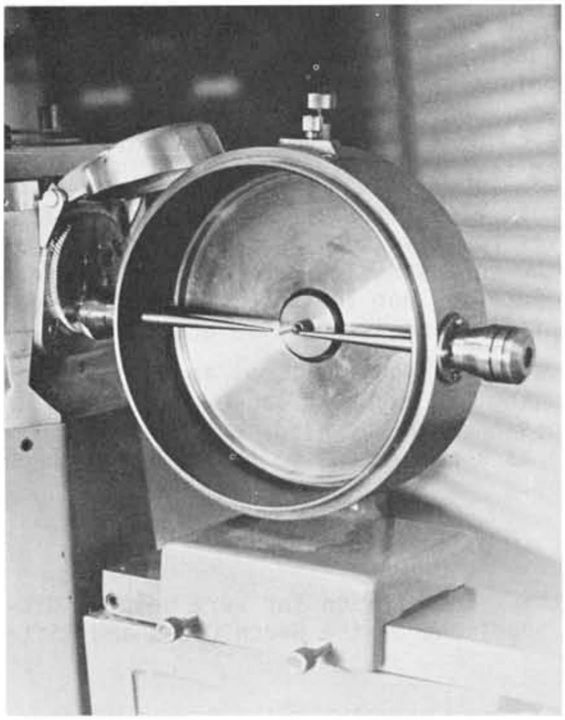

Figure 8. Debye-Scherrer camera in position on X-ray machine. Sample is mounted on rod in center of camera; strip of film lines interior of cylinder; X-rays enter camera from left via collimator, strike sample, and are scattered by planes of atoms in sample to various portions of film. See Figure 9 for pattern produced on film by levyne sample.

The film, when developed, shows a set of circular bands (Figure 9). From the known dimensions of the camera, the scattering angle corresponding to each band can be calculated; and these, together with X-ray wavelength, are used to calculate the separation between planes of atoms in the sample.

The set of interatomic plane separations, together with their relative ability to scatter X-rays, as estimated from the degree of darkening on the film, serves as a kind of "fingerprint" for any particular mineral. A card file of these patterns has been published by the American Society for Testing Materials (ASTM).

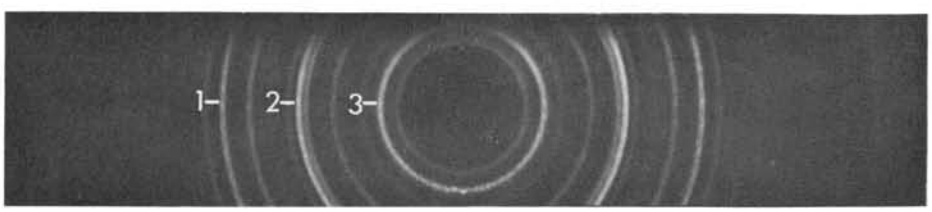

Figure 9. X-ray scatter pattern from levyne. This positive print was made from negative of film placed inside camera housing. Mineral identification is normally made directly from negative. Rings labeled "1," "2," and "3" were used in primary identification.

To aid in comparison, the ASTM file is indexed according to the spacings of the three strongest lines, and these have been collected especially for the naturally occurring chemical compounds. Once a possible fit to these three lines has been located, the full set of spacings can be compared for a complete identification or to distinguish among several candidates.

The powder method is most effective for noncubic materials. However, while it often gives positive identification from a small amount of material, it can be confusing if more than one mineral is present in the sample. Such was not the case with the levyne from Aneroid Lake; the identification is positive and unique.

Though X-ray analysis can be a powerful tool in identification, it is also time-consuming (an exposure of several hours, followed by reading and cross-checking by hand) and therefore expensive. It often serves as a complement to physical and chemical means of identification.

Acknowledgment

The author wishes to thank Paul Lawson for very helpful discussions and for providing specimens of the Beech Creek and Ritter levyne.

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Hurlbut, C.S., Jr., 1971, Dana's manual of mineralogy, 18th ed.: New York, John Wiley and Sons, p. 117-122.

Lowe, D., and Lowe, R., 1969, 100 Oregon hiking trails: Portland, Oreg., Touchstone Press, p. 234.

Selected powder diffraction data for minerals, 1974: Joint Committee on Powder Diffraction Standards, 1601 Park Lane, Swarthmore, Pa.

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White, J.S., Jr., 1975, Levyne-offretite from Beech Creek, Oregon: Mineralogical Record 6, p. 171-173.

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POSTAL COSTS FORCE INCREASE IN PUBLICATIONS PRICES

Effective July 1, 1978, the price for single mailed copies of the ORE BIN increased from 35 to 50 cents. Over-the-counter sales continue at the old price of 25 cents per copy. In addition, we have raised the minimum mail order amount to 50 cents.

QUARTZ IS SYMPOSIUM TOPIC

The Pacific Northwest Chapter of the Friends of Mineralogy has scheduled its 4th Annual Northwest Mineral Symposium for Saturday, September 30 and Sunday, October 1 at the Ramada Inn South, Portland.

Among the speakers will be Paul Seel, Si Frazier, and Lanny Ream. The conference theme will be quartz and associated minerals.

Those attending will enjoy excellent displays of minerals and will have the opportunity to meet and enjoy conversation with such recognized dealers as Si Frazier, Dwight Weber, and John Metteer.

For details and registration forms, write to:

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Seattle, WA 98122

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NUCLEAR PLANT SITES SUBJECTS OF OPEN-FILE REPORTS

In January 1978 the State of Oregon Department of Energy requested the Department's assistance in evaluating geologic information relating to the Trojan nuclear power plant site to determine whether any recently recognized facts relate to the safety of temporary spent fuel storage or plant operations.

The Department prepared the 42-page Open-file Report 0-78-1, "Geologic Hazards Review, Trojan Nuclear Power Site, Columbia County, Oregon."

The procedure embraced data collection, identification of plausible hazards, interpretation of data and geologic analysis, and summarization of findings with development of conclusions and recommendations. The final report includes a lengthy reference list.

To receive a copy of 0-78-1, write to the Department's Portland Office. The price is $4.00.

The U.S. Geological Survey and Portland General Electric Company have conducted further studies since the 1974 Pebble Springs nuclear plant site was reviewed. 0-78-2, "Supplement to the February 11, 1974, Pebble Springs Review," discusses items raised since the 1974 report was made.

The 1872 earthquake; additional information regarding the effect of explosive volcanic activity in the Cascade Mountains; the April 12, 1976, Deschutes Valley earthquake; and recent studies by Shannon and Wilson, consultants for Portland General Electric Company, are subjects considered in this open-file report.

Department geologists conclude that design standards for the Pebble Springs plant are adequate; but the Department reserves the right to reassess geologic hazards as new data become available.

V.C. Newton, Jr., and N.V. Peterson wrote the "Supplement to the February 11, 1974, Pebble Springs Review"; J.D. Beaulieu was the editor.

O-78-2 is priced at $3.00 and is available at the Department's Portland Office.

* * * * *

MATSON NEW GENERAL MANAGER OF HANNA NICKEL MINE AND SMELTER

Early this year, Robert P. Matson, General Manager of the Hanna Domestic Iron Ore Division at Hibbing, Minnesota, since 1971, became General Manager of the Nickel Division Headquarters in Riddle, Oregon. E.J. Maney, Nickel Division General Manager since 1967, was transferred to Hibbing as Domestic Iron Ore Division General Manager.

The Hanna Domestic Iron Division is responsible for the operation of four U.S. iron ore pellet projects and a pellet project at Capreol, Ontario, Canada.

The Nickel Division operates the Hanna Nickel Mine and Smelter near Riddle and the Silicon Division at Rock Island, Washington. The Nickel Mountain Mine and Smelter, in Douglas County about 5 mi west of Riddle, employs about 600 people. The only nickel mine in the United States, Nickel Mountain Mine produces about 9 percent of the national nickel consumption and is the most important metal mine in Oregon. The smelter produces ferronickel alloy averaging about 50 percent nickel.

* * * * *

1977 MINERAL OPERATIONS INCOME SET RECORD

U.S. Geological Survey estimates indicate that royalties collected in 1977 from production of oil, gas, coal, potash, phosphate, and other minerals on Federal and Indian lands exceeded $1,250 million, topping the previous record set in 1976 by $227 million.

Of the total royalties collected during 1977, more than 69 percent, or $859 million, accrued from oil and gas production on the Outer Continental Shelf; $848.9 million came from production in the Gulf of Mexico; and $10.1 million was from offshore California production. The increase in royalties is due primarily to the increase in oil and gas prices.

At the year's end, 128,000 oil and gas leases covered more than 104.5 million acres of public, acquired, Indian, military, and Outer Continental Shelf lands.

From more than 14,800 producible leases, 1977 production is estimated to have been 551 million barrels of crude oil and gas liquids plus 4.8 trillion cubic feet of marketed gas, together valued at more than $7.7 billion. This represents about 24 percent of the marketed gas and 18 percent of the total crude oil and gas liquids produced in the United States during the calendar year. Compared to 1976 production, this is a decrease of 18.0 million barrels of crude oil and gas liquids and an increase of 17.8 billion cubic feet of gas.

The Outer Continental Shelf portions of these totals are 2,089 leases, covering more than 9.8 million acres. OCS production from about 860 producible leases is estimated to be 351 million barrels of crude oil and gas liquids and 3.6 trillion cubic feet of marketed gas, valued at more than $5.4 billion. This represents about 18 percent of the marketed gas and 12 percent of the total crude oil and gas liquids produced in the United States during the calendar year.

Estimate of the total value of coal, potash, sodium, phosphate, and other minerals mined from leased Federal and Indian lands during the year is $1,140 million. More than $56 million royalty was collected on this production.

Royalties accruing from mineral leases supervised by the U.S. Geological Survey are ultimately credited to the States, Indians, the Reclamation Fund, the Land and Water Conservation Fund, and the U.S. Treasury.

* * * * *

REGISTRATION REMINDER

Qualified practicing geologists may be licensed without examination by applying to the Department of Commerce, Board of Geologist Examiners, 403 Labor and Industries Building, Salem, Oregon 97310. Applications must be received before September 30, 1978.

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CORRECTION

In the article, "A Geological Field Trip Guide from Cottage Grove, Oregon, to the Bohemia Mining District" (ORE BIN, June 1978), the following corrections should be made:

1. Page 94, checkpoint 6, line 2. "Government Road" should be changed to "Row River Road."
2. Page 94, checkpoint 8, line 1. "Row River Road" should be changed to "Government Road."
3. Page 103, checkpoint 36, line 9. "California" should be changed to "Defiance."

CLASTIC DIKES IN SOUTHEASTERN OREGON

Norman V. Peterson, District Geologist
Grants Pass Field Office
Oregon Department of Geology and Mineral Industries

A group of clastic dikes are present in a cinder-scoria deposit about 2 mi south of U.S. Highway 20 southwest of Hines, Oregon (NW 1/4 sec. 2, T. 24 S., R. 30 E.). The clastic dikes exposed in the quarry vary from a few inches to 18 in. in width and have crude vertical as well as horizontal layering. The material is pumiceous, tan to almost white, and ranges in size from fine ash to pumice lumps as large as 1 in. in diameter.

At least five dikes trend in a northwest-southeast direction and can be traced for several hundred yards. Clastic dikes of similar material cut through layered pumice on the north side of Highway 20 at the same general northwest-southeast trend.

The dike material appears to be of the same composition as the overlying layered pumice described as Tsv by R.C. Greene and others (1972). ". . . pumice and pumiceous sedimentary rocks, light brown to white, slightly to moderately well consolidated;

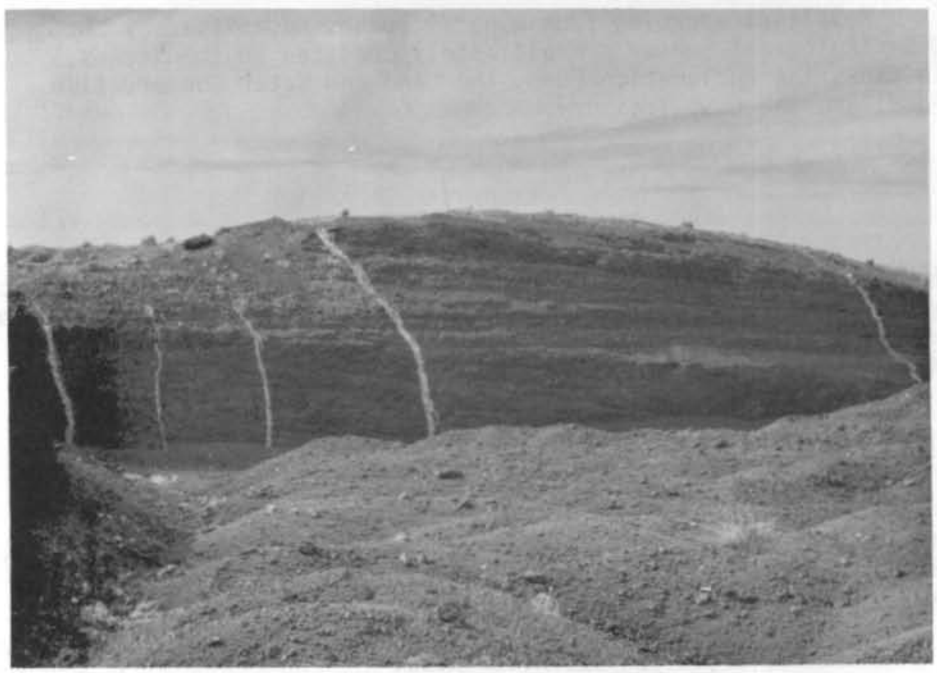

Figure 1. Clastic dikes found in cinder-scoria quarry southwest of Hines, Oregon. Dikes trend northwest-southeast and can be traced for several hundred yards.

Figure 2. Clastic dikes range in thickness from a few inches to 18 in. and contain pumiceous material.

ash flow tuff with abundant lump pumice, in part densely welded. Present on south side of Burns Butte, T. 23 S., R. 30 E."

The dikes must have been emplaced very soon after the layered pumice was deposited, as the pumice lumps and the glass shard ash are angular and fresh looking.

The length, width, and continuity of the fractures which these dikes filled certainly suggest tectonic origin. Tensional forces from doming may have opened the fractures. Mechanism for dike emplacement is not apparent, although it appears that the clastic material came in from above.

The elevation of about 4,160 ft is about 200 ft lower than Pleistocene sedimentary deposits of the Harney Basin, so it is possible that the dikes could have developed in a hydrous environment. The dikes are younger than the Pliocene sediments they cut, but no more about their age is known.

Reference:

Greene, R.C., Walker, G.W., and Corcoran, R.E., 1972, Geologic map of the Burns Quadrangle, Oregon: U.S. Geological Survey Misc. Geol. Inv. Map I-680.

GEOTHERMAL SPECIALIST JOINS STAFF

Joseph F. Riccio

Joseph F. Riccio assumed the position of Geothermal Specialist on the Department's Portland staff in May 1978.

Riccio is a graduate of the University of Southern California, where he earned his Ph.D. degree in 1965.

From 1955 to 1970 Riccio was President and Chief Engineering Geologist of Pacific Soils Engineering, Inc., Harbor City, California. He has had prior geological experience with Rothchild Oil Company, Santa Fe Springs, California, and International Petroleum, Bogata, Colombia. Between 1970 and 1976 he was a consulting geologist in Alabama and California.

In 1976 Riccio became Geothermal Development Manager of the Public Service Department for Burbank, California, with responsibility for the city's geothermal program. "Site-Specific Analysis of Hybrid Geothermal/Fossil Power Plants," a study dealing with evaluation of hybrid power plants which combine geothermal and coal energy, is an Energy Research and Development Administration (ERDA) publication to which Riccio contributed research.

Currently, he is involved in the geothermal resource assessment of Mt. Hood volcano and the statewide low temperature geothermal resource evaluation for the Department.

* * * * *

OIL AND GAS SURETY BONDS FOR DRILLING INCREASED

July 1, 1978, the Department issued a temporary rule to amend Chapter 632, Oregon Administrative Rule 10-010. The amendment raises the surety bond for drilling oil and gas wells from $4,000 to $10,000.

This increase is necessary to make coverage commensurate with current drilling costs. The bond requirement for geothermal wells was set by statute at $10,000 in 1973.

Anyone desiring a copy of the amended rule may write to the Department's Portland Office.

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