

VOLUME 40, No. 1

JANUARY 1978

THE ORE BIN



STATE OF OREGON

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

The Ore Bin

Published Monthly
by

STATE OF OREGON

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

Head Office: 1069 State Office Bldg., Portland 97201

Telephone: [503] 229-5580

FIELD OFFICES

2033 First Street	521 N.E. "E" Street
Baker 97814	Grants Pass 97526

MINED LAND RECLAMATION DIVISION

1129 S.E. Santiam Road

Albany 97321

Subscription Rates

1 year, \$3.00; 3 years, \$8.00

Available back issues: \$.25 at counter, \$.35 mailed

Second class postage paid at Portland, Oregon

GOVERNING BOARD

Leeanne MacColl, Portland

Robert W. Doty, Talent

John L. Schwabe, Portland

STATE GEOLOGIST

Donald A. Hull

GEOLOGISTS IN CHARGE OF FIELD OFFICES

Howard C. Brooks, Baker Len Ramp, Grants Pass

EDITOR Beverly F. Vogt

Permission to reprint information contained herein is granted. Credit given the State of Oregon Department of Geology and Mineral Industries will be appreciated.

OREGON'S MINERAL AND METALLURGICAL INDUSTRY IN 1977

Jerry J. Gray, Economic Geologist
Oregon Department of Geology and Mineral Industries

Oregon's mining during 1977 was mainly for the production of construction materials and one metal, nickel. Sand and gravel and stone accounted for 65 percent of total production; in 1976, they had accounted for 68 percent. Preliminary figures for mineral production for 1977 show an increase of 4 percent to \$116.6 million.

Table 1 summarizes the State's production for 1976 and 1977. Commodities are arranged in descending order by value, except for the group of 11 commodities combined to protect individual companies' confidential data.

Industrial Minerals

For Oregon's two major mineral commodities, sand and gravel and stone, 1977 was the year of the sellout. Several large sand and gravel and stone producers have changed hands in Oregon during the last year or so, apparently because of the phasing down of large highway and dam construction projects and also for environmental and regulatory reasons. The phase-down may be the reason Kaiser Industries sold its Pacific Building Material's Portland plant (Figure 1, Point 1) to Willamette Hi-Grade and sold the Santosh pit and plant (Point 2) near Scappoose to Cascade Aggregates. Ross Island Sand and Gravel's conflict with the Army Corps of Engineers over dredging permits for its Portland operation (Point 1) may be the reason the firm was sold to a private individual. The equipment at both the Rivergate Rock Products quarry at Portland (Point 1) and at Columbia West Construction's quarry at Rainier (Point 3) was sold at auction. The Rainier pit is in conflict with the Mine Enforcement and Safety Administration over the height of the quarry walls.

The Oregon Department of Geology and Mineral Industries continued its program of sand and gravel and stone inventory studies, including an on-the-ground survey of each pit and quarry, mined land reclamation advice, and economic analysis and forecasting. These studies are needed to provide a data base for many of the

Table 1. Some of Oregon's minerals at a glance

Mineral commodity	1976		1977*	
	Value (thousands)	Percent	Value (thousands)	Percent
Stone	\$ 42,686	38	\$ 42,555	36
Sand and gravel	33,473	30	34,000	29
Cement, copper, diatomite, gold, industrial sands, lead, lime, nickel, silver, talc, and tungsten	33,252	29	37,031	32
Pumice	2,311	2	2,262	2
Gemstones	525	0.5	525	0.5
Clays	315	0.3	227	0.2
Gold	4	-	Combined	-
TOTAL	\$ 112,566	100	\$ 116,600	100

* Preliminary data provided by U.S. Bureau of Mines

current and future actions taken under the State's land use planning laws.

Limestone, production statistics for which are included with the figures for stone, was the source rock for the following projects: (1) The Oregon Portland Cement Company announced that a new cement plant will be built near Durkee (Point 4), Baker County, to replace the one at Lime, 13 miles to the southeast. The new \$38 million plant will have a rated capacity of 500,000 tons per year, 2.5 times that of the old plant. The cement will be shipped to the Spokane area, eastern Oregon, and western Idaho. (2) Ash Grove Cement Company (Point 1) announced the enlargement of its plant, thereby doubling its lime output. Construction, to be completed by late 1978, will raise daily output from 200 tons to 400 tons. Limestone for the plant will continue to be imported from Texada Island, B.C. (3) A farm cooperative is studying the feasibility of mining the Marble Mountain limestone deposit near Grants Pass (Point 5), Josephine County. After being mined, the limestone would be ground and shipped to the Willamette Valley for agricultural use.

The American Fossil Company continued to mine diatomaceous earth, used mainly for cat litter, in Christmas Valley (Point 6), Lake County. Production of the new crushing, screening, and bagging plant, completed in early 1977, has been reported at about 20 tons per day, with plans to increase output to 50 tons per day by the end of 1977.

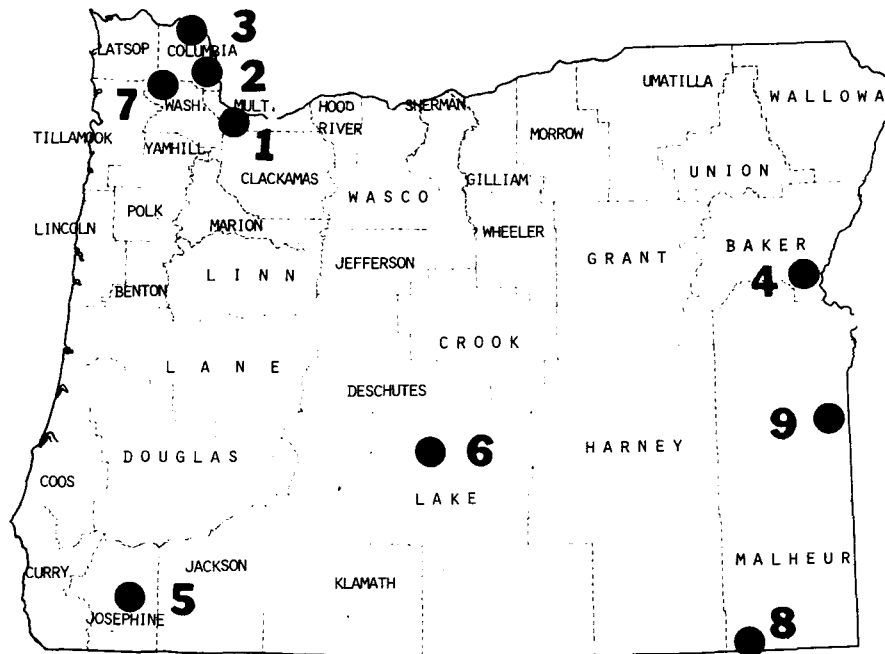


Figure 1. Oregon 1977 industrial mineral highlights. 1. Sand and gravel, stone, and lime. 2. Sand and gravel. 3. Stone. 4. Cement. 5. Agricultural lime. 6. Diatomite. 7. Shale. 8, 9. Gemstones.

The construction slowdown may have caused the closing of Oregon's only bloating shale operation (Point 7). Since 1945, Empire Building Materials had produced a lightweight concrete aggregate, using a kiln to fuse crushed shale from western Washington County into small pellets. Fines produced during processing were sold as pozzolan. During 1976, however, the plant and pit were sold to GATX Leasing; and in November 1977, the plant and mining equipment were sold at auction.

The output of picture-rock jasper from Malheur County (Point 8, McDermitt area; Point 9, Lake Owyhee area) continues to remain high. Part of the output is processed into finished gems by the mine owners. The rest is sold and shipped rough to other states. Several of the mines are large enough to require permits under the Mined Land Reclamation Law.

Metals

Oregon's dominant metal mining operation, the Hanna Mining Company nickel mine at Riddle (Figure 2, Point 1), Douglas County, operated at about the same rate as that of 1976. The Riddle operation produces the only primary nickel in the United States.

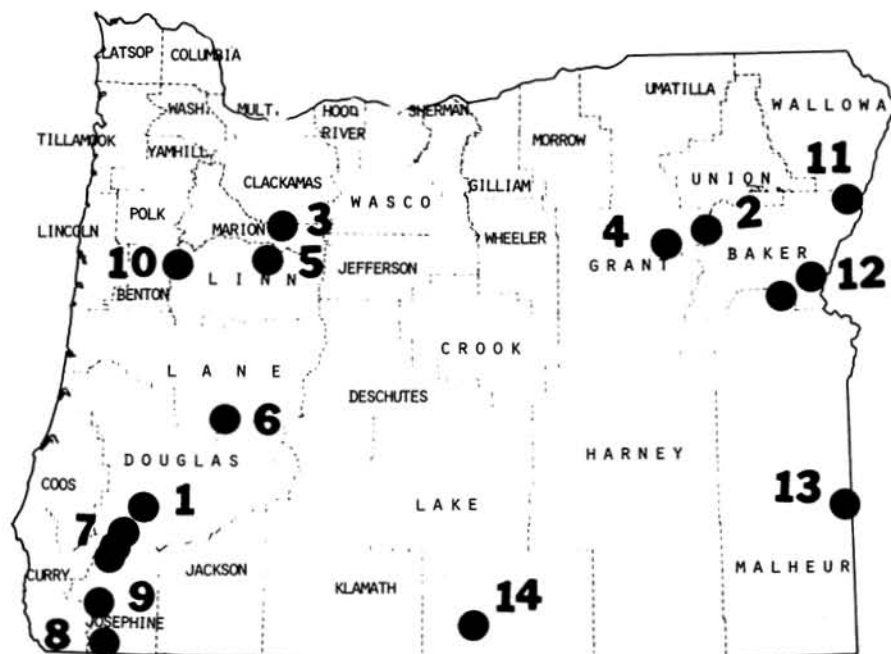


Figure 2. Oregon 1977 metallic minerals and exploration highlights.
 1, 9, 10. Nickel. 2, 4, 12, 13. Gold and silver. 3, 5, 6,
 7. Copper, lead, and zinc.

Small tonnages of gold ore from the Bald Mountain mine (Point 2), Baker County, were shipped to a smelter in Tacoma, Washington, by Tony Brandenthaler. Shiny Rock Corporation placed a 25-ton-per-day pilot lead-zinc floatation mill into operation (Point 3). Ore for the mill, located in North Santiam mining district, Marion County, comes from the nearby retimbered Ruth mine. Mill concentrates were stockpiled until an industry-wide smelter strike ended. Dixie Meadows Gold Mines, Ltd., conducted a successful gold-ore heap-leach cyanidation test at Dixie Meadows mine (Point 4), Grant County. Application was made to the Department for a surface-mining permit in preparation for full-scale mining operation. Placer-gold production was hindered because of low stream flows. Production losses cannot be determined because most placer-gold output is unreported.

Exploration Programs

In northwestern Oregon, exploration for copper, lead, and zinc massive sulfide and copper-molybdenum porphyry deposits was conducted within both the North Santiam (Point 3) and Quartzville (Point 5) mining districts, Linn County, and Bohemia (Point 6) mining district, Lane County.

The areas in southwest Oregon that have received the most attention from mining companies during the past year include the Silver Peak-Almeda mine zone (Big Yank lode) (Point 7), Douglas and Josephine Counties. Five or six mining companies have conducted geochemical sampling, geophysical surveying, claim staking, geologic mapping, and some drilling along this zone. Three of the companies entered and completed a joint venture to drill 3,000 ft of core hole. This is the third year of extensive exploration activity on this zone, which contains volcanogenic sulfide mineralization with some massive barite gangue.

The old underground workings of the Queen of Bronze copper-gold mine (Point 8), Josephine County, were reopened and mapped geologically by Canadian Superior. The mine, which was worked from 1903 to 1930, was still in fair condition when reopened.

Nickel laterite exploration activities were mainly those of the Inspiration Development Company at the Eight Dollar Mountain deposit (Point 9), Josephine County. Their work involved seismic surveying, mapping, back-hoe sampling, and trommel processing of large bulk samples to test preliminary up-grading techniques. The U.S. Bureau of Mines did some reconnaissance sampling and some bulk sampling of this and other southwestern Oregon laterites, preliminary to setting up a pilot plant at the Metallurgical Research Center, Albany (Point 10), to study methods of nickel recovery.

In northeastern Oregon, W.A. Bowes and Associates continue to explore and develop the New York and Cougar-Independence gold mines (Point 2), Grant County. Johns-Manville at Meadow Lake (Point 2), Baker County, is continuing to explore for a copper-molybdenum porphyry. Texas Gulf continued working at the old Iron Dyke copper-gold mine (Point 11), Baker County; and Ibex Minerals, Inc., explored the Bay Horse silver mine (Point 12), Baker County.

The State of Oregon Department of Geology and Mineral Industries continued to evaluate the nickel resources of Oregon, under a grant from the U.S. Bureau of Mines. Reconnaissance mapping and sampling of a few occurrences of nickel in northeastern Oregon disclosed that most prospects were zones of silica-carbonate replacement of serpentinite, with no enrichment of the serpentinite's original nickel content. All of these occurrences appear to be too low-grade to be of interest. A report on all of Oregon's nickel deposits, presently being prepared by the Department of Geology and Mineral Industries, will be published in 1978 as a bulletin.

In southeastern Oregon, the opening of a gold-silver mine in DeLamar, Idaho, affected the small town of Jordan Valley (Point 13), Malheur County, 2 mi from the Idaho line. Jordan Valley originally had a population of about 200; it now has 600. Idaho is getting the tax dollars from the mine, and Oregon is getting the

school children. The life style and values of the original 200 residents will be modified by that of the newcomers, and the original population, needless to say, is divided as to whether the mine is a good thing.

In the Lakeview area (Point 14), Lake County, several companies have been active in looking for uranium. Lucky Mc Uranium explored on claims from Utah International. Polaris Resources, a consulting firm from Golden, Colorado, is doing an evaluation for Urania, Inc. Western Nuclear continues to hold the White King and Lucky Lass and has been somewhat actively exploring with some drilling. Exxon had staked a large group of claims in 1976 but has now relinquished most of them.

* * * * *

MINED LAND RECLAMATION, 1977

Standley L. Ausmus, Administrator
Mined Land Reclamation
Oregon Department of Geology and Mineral Industries

During 1977, the reclamation of Oregon's surface mined lands continued at the rate of approximately 4.2 new projects per month. A total of 50 new reclamation projects were approved during 1976. Seven previously approved projects were completed, and the reclamation work was approved by the Department as being in conformance with the reclamation plan.

At the end of December 1977, active surface mining sites with limited exempt status (grandfather sites) totalled 322, a net increase of 16 during the past year. A total of 37 new "grandfather" sites were registered during 1977, however, and 21 were either closed or converted to operating-permit status.

The number of new "fee paying" sites averaged 7.28 sites per month, a net increase of 53 as of the end of December 1977. This slight decrease in the rate of expansion over that projected in January 1977 may reflect decreased State highway construction and maintenance activities during the past year.

During 1977, the Mined Land Reclamation Division of the Department of Geology and Mineral Industries has been cooperating with the Pacific Northwest Regional Commission in a land resource inventory project funded by the Federal government to determine the feasibility of using remote sensing data from satellites and high altitude photography for mineral-resource inventory and surveillance. Although this project has not been completed, considerable evidence indicates that, at least in certain areas of

the State, this new technology may prove to be a very valuable tool for mineral-resource survey.

The 1977 Oregon State Legislative Session effected certain changes in the Mined Land Reclamation Statute, resulting in improvements in the Department's ability to fund the Mined Land Reclamation program. In addition, the Department now has greater flexibility in determining when and where field inspections are to be conducted.

The current Mined Land Reclamation Division staff remains the same as in 1976, with two clerical positions (one funded by CETA), one administrative position, and one full-time field representative. With this minimal staff, the ability of the Department to respond to the needs of the program in the field is limited. To accomplish the extent of field coverage the program demands, the administrator must spend up to 50 percent of his time in field activities. In spite of this limitation, the Mined Land Reclamation program is proving its effectiveness in accomplishing a State-wide reclamation ethic.

The Mined Land Reclamation Division staff would like to take this opportunity to express its appreciation for the support and cooperation of the mining industry in the development of the Mined Land Reclamation program around the State. For the most part, industry leaders and individual operators are cooperating with the Department, and as a result, the impact of the surface mining reclamation ethic is becoming obvious around the State, even to the casual observer.

In this regard, the Mined Land Reclamation Division extends to the mining industry and to all others concerned with the orderly development of the State's mineral resources, the conservation of our natural resources, and the preservation of our environmental integrity an open invitation to continue and expand this spirit of cooperation during 1978. The Department will continue its assistance to the surface mining industry, State and local natural resource agencies, and the general public in dealing with the myriad and complex environmental problems associated with surface mining activity and site reclamation. This assistance will be restricted only by the physical limits of our staff and program resources.

Questions or comments concerning the Mined Land Reclamation program should be directed to:

Department of Geology and Mineral Industries
Mined Land Reclamation Division
1129 S.E. Santiam Road
Albany, Oregon 97321

Telephone: (503) 967-2039

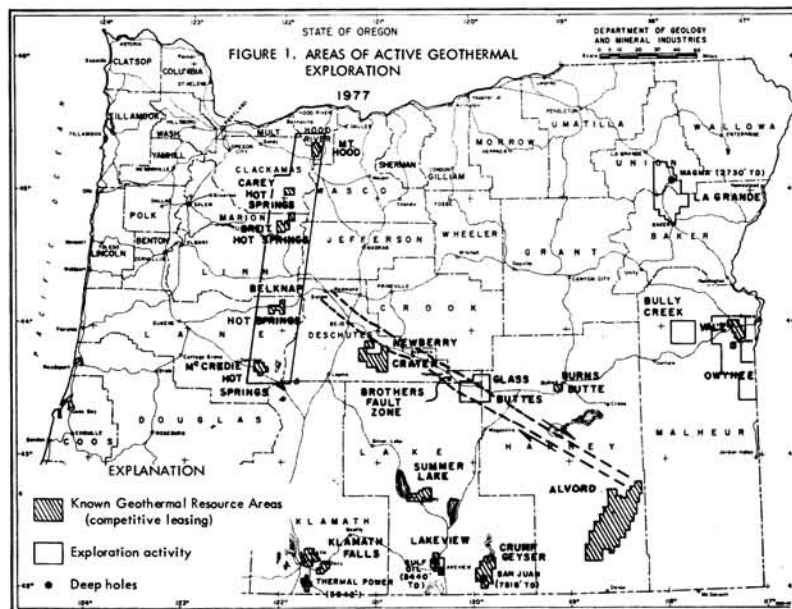
(Note change of address and telephone.)

* * * * *

GEOHERMAL ENERGY IN 1977

V.C. Newton, Jr.,* and Donald A. Hull**

In 1977, government and university researchers conducted a variety of geological, geochemical, and geophysical studies directed toward evaluation of Oregon's geothermal energy resources. Several private companies continued detailed exploration of promising geothermal prospects in Oregon (Figure 1), with most activity consisting of drilling temperature gradient holes in the Cascade Range and in southeastern Oregon.



The amount of exploration drilling increased over that of 1976. During 1977, the Oregon Department of Geology and Mineral Industries issued 20 permits for deep test holes (Table 1) and 9 blanket permits for shallow-hole programs (Table 2). Three pre-lease exploration permits were also issued by the U.S. Bureau of Land Management during the year (Table 3).

* Petroleum Engineer, Oregon Department of Geology and Mineral Industries

** State Geologist, Oregon Department of Geology and Mineral Industries

Table 1. 1977 State geothermal well permits (deep holes)

<u>Permit no.</u>	<u>Company</u>	<u>Area or lease</u>	<u>Location</u>	<u>Projected or drilled depth</u>
8	Weyerhaeuser Pacific Power and Light	Klamath Lake	NW¼ sec. 15 T37S, R7E Klamath Co.	2,006 ft T.D.*
10	Northwest Natural Gas	Old Maid Flat	SW¼ sec. 15 T2S, R8E Clackamas Co.	1,850 ft (suspended)
12	DOGAMI	Black Mountain	SE¼ sec. 21 T4S, R28E Morrow Co.	815 ft T.D.*
15	DOGAMI	Cloud Cap	SE¼ sec. 10 T2S, R9E Hood River Co.	1,500 ft (not drilled)
16	DOGAMI	Timberline	SE¼ sec. 6 T3S, R9E Clackamas Co.	1,500 ft (suspended)
17	USGS	Newberry Crater	NE¼ sec. 5 T22S, R12E Deschutes Co.	1,500 ft (not drilled)
18	USGS	Newberry Crater	SE¼ sec. 15 T21S, R13E Deschutes Co.	1,260 ft T.D.*
19	Sunoco Energy	Breitenbush	NE¼ sec. 14 T9S, R7E Marion Co.	1,500 ft T.D.*
20	Sunoco Energy	Breitenbush	SW¼ sec. 29 T9S, R7E Marion Co.	1,500 ft
21	Sunoco Energy	High Rock	SW¼ sec. 14 T6S, R7E Clackamas Co.	1,500 ft
22	Sunoco Energy	High Rock	NE¼ sec. 29 T6S, R7E Clackamas Co.	1,500 ft
23	Sunoco Energy	High Rock	SW¼ sec. 17 T6S, R7E Clackamas Co.	1,500 ft
24	Sunoco Energy	Fish Creek Mountain	Center sec. 13 T6S, R6E Clackamas Co.	1,500 ft
25	Chevron	Bully Creek	NE¼ sec. 8 T43E, R18S Malheur Co.	1,500 ft
26	Chevron	Crump Lake	SE¼ sec. 6 T41S, R24E Lake Co.	1,440 ft T.D.*

*Total depth

Table 1. 1977 State geothermal well permits (deep holes) (continued)

<u>Permit no.</u>	<u>Company</u>	<u>Area or lease</u>	<u>Location</u>	<u>Projected or drilled depth</u>
27	Phillips Petroleum	Glass Buttes	NE¼ sec. 33 T23S, R23E Lake Co.	2,000 ft
28	Phillips Petroleum	Alvord Valley	SE¼ sec. 12 T33S, R35E Harney Co.	2,000 ft
29	Amax Exploration	Vale area	SW¼ sec. 24 T17S, R42E Malheur Co.	2,000 ft
30	Amax Exploration	Vale area	SE¼ sec. 13 T17S, R42E Malheur Co.	2,000 ft
31	Amax Exploration	Vale area	Center sec. 26 T17S, R42E Malheur Co.	2,000 ft

Exploration work in the State has increased since passage of the Oregon geothermal law in 1971. The studies appear to have progressed in stages: geological and geophysical work and the drilling of gradient holes to depths of 10 m (30 ft) was done during the period 1971-1973; programs in 1974-1976 utilized gradient holes drilled to depths of 10 to 150 m (30 to 500 ft); last year, gradient holes were drilled to depths of 450 to 600 m (1,500 to 2,000 ft). Drilling in 1978 should focus on deep production tests in areas where high geothermal gradients have been found.

Table 2. 1977 State prospect well permits (shallow holes)

<u>Permit no.</u>	<u>Company</u>	<u>Area</u>	<u>Proposed programs</u>
27	DOGAMI	Vale Malheur County	Used existing Two States oil and gas hole
28	DOGAMI	Ontario Malheur County	500-ft gradient hole
29	Chevron	Harney County	500-ft gradient holes
30	Chevron	Lake County	500-ft gradient holes
31	DOGAMI	(changed to a deep well permit)	
32	Chevron	Malheur County	500-ft gradient holes
33	Chevron	Lake County	500-ft gradient holes
34	Sunoco	Clackamas County	500-ft gradient holes
35	Sunoco	Lane County	500-ft gradient holes

Table 3. Federal geophysical permits

Company	Area	Type survey
Geonomics	Alvord Valley	Dipole and magneto-telluric
Anadarko	Alvord Valley	Electrical resistivity
Supron Energy	Klamath Falls	Electrical resistivity and gravity

Leasing

To date, there are an estimated 600,000 acres of existing geothermal leases in the State. Lessors include 20 large companies and numerous independents. The Federal government's slowness in issuing leases is still an important factor delaying deep drilling to find commercial geothermal resources. The only lease sale held in Oregon last year was on a 640-acre Known Geothermal Resource Area (KGRA) created by an overlap of applications. No bids were received in this sale, conducted at Burns Butte, Harney County.

Court action by environmental groups has postponed drilling at Alvord Valley, southeastern Oregon, and the case is still pending. Legal action has probably delayed the drilling of two deep production tests at this high-ranked geothermal prospect.

Geothermal leasing continued in the State during 1977, but not at the same level as that of the 1974-1975 peak years. Leases in force on public and private lands last year are totalled in Table 4.

Table 4. Geothermal leases

Federal:	
30 KGRA leases issued	60,685 acres
82 noncompetitive leases issued	109,162 acres
KGRA lands not yet offered for lease	398,936 acres
State:	
Leases in force	6,080 acres
Applications	4,080 acres
Private:	
Total estimated acreage	400,000 acres

Industry Activity

Minimal surface geophysical work was done in geothermal areas during 1977, and no commercial discoveries were announced. Deep drilling consisted of temperature gradient holes varying in depth from 450 to 600 m (1,500 to 2,000 ft). In addition to the

deeper holes, shallow gradient holes were drilled to depths of 150 m (500 ft) or less in several areas (Tables 1 and 2).

Northwest Natural Gas Company, with technical assistance from the Department of Geology and Mineral Industries, drilled a 560-m (1,850-ft) temperature gradient hole at Old Maid Flat, 5 mi west of Mt. Hood (Figure 2). Sun Energy Development Company drilled a 380-m (1,260-ft) gradient hole 3 mi east of Breitenbush Hot Springs, eastern Marion County. Other exploration drilling projects were located in the Basin and Range province, southeastern Oregon.

On Bully Creek, northwest of Vale, Chevron U.S.A. completed drilling a deep gradient hole; and Amax Exploration, Inc., drilled several gradient holes to depths ranging from 65 to 100 m (220 to 320 ft). In December, Phillips Petroleum Company began drilling a gradient hole at Glass Buttes, northeastern Lake County, with a target depth of 600 m (2,000 ft).

In the Alvord Valley, Chevron U.S.A. drilled gradient holes near Borax Lake and Mickey Hot Springs and conducted several electrical surveys in other areas. Chevron also drilled gradient holes near Summer Lake and in southern Warner Valley, both in Lake County.

The city of Klamath Falls was scheduled to begin drilling a 600-m (2,000-ft) geothermal production well near the campus of the Oregon Institute of Technology in December 1977.

In 1977, Wy'East Exploration Company was issued geothermal leases adjacent to Timberline Lodge at Mt. Hood. The firm is planning to develop hot water for heating at the resort facilities. Additional exploratory drilling is planned for the spring of 1978. Financing for the project is being applied for through the Energy Resources Development Administration (ERDA) Geothermal Loan Guarantee Program.

Alexander Beamer began drilling last fall on a shallow well in the Breitenbush Hot Springs area. He plans to develop hot water for heating buildings and a swimming pool. Beamer had reached a depth of 110 m (350 ft) by December 1977. Results of the drilling thus far are very encouraging.

Research

Geological, geochemical, and geophysical studies were conducted by various individuals associated with the U.S. Geological Survey, Oregon Department of Geology and Mineral Industries, University of Oregon, Oregon State University, Portland State University, and Eastern Oregon State College (see list of publications at end of article).

In northeastern Oregon, a study of geothermal resources in Baker and Union Counties is nearing completion. This project,

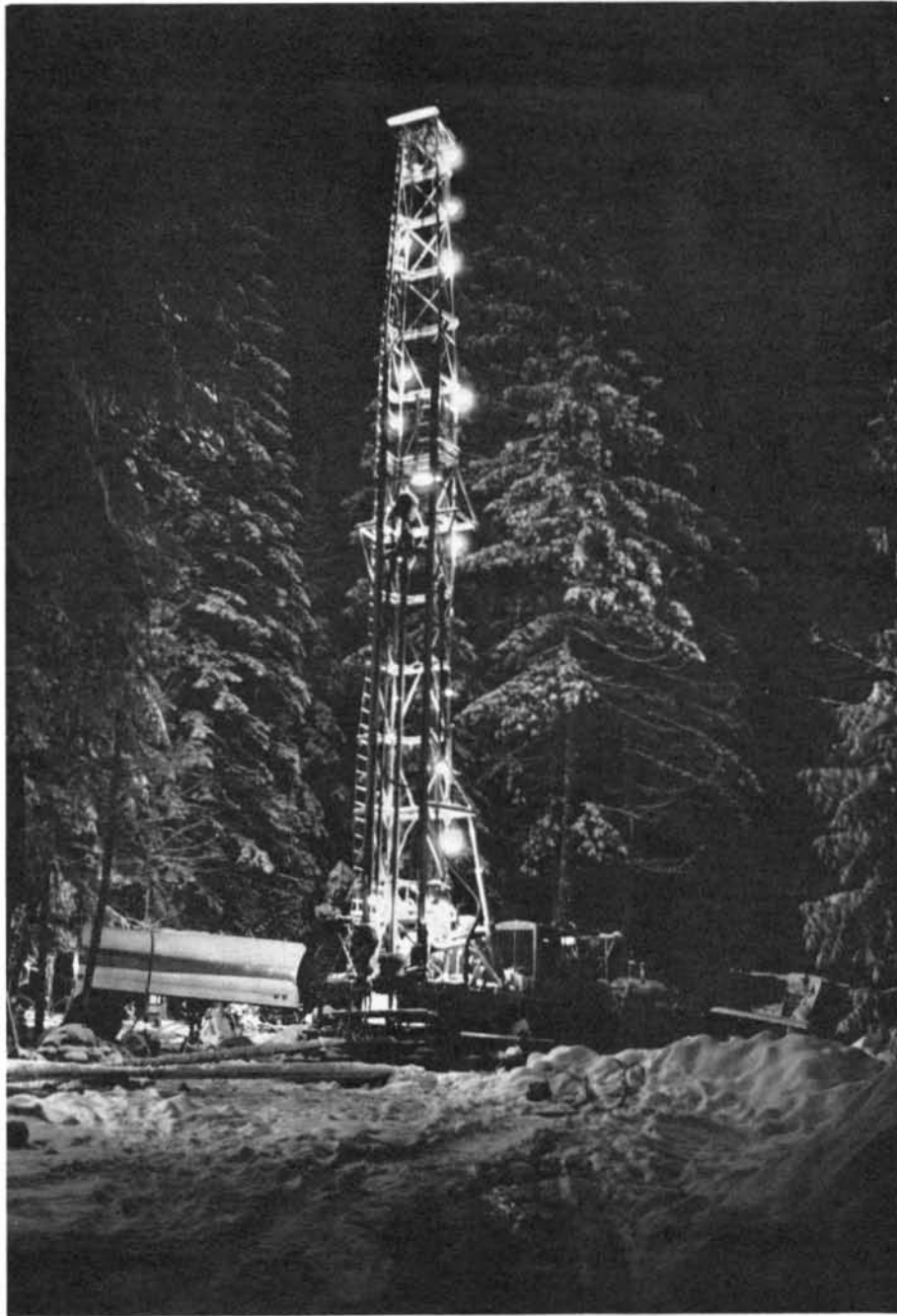


Figure 2. Night drilling at Old Maid Flat (Photo courtesy Northwest Natural Gas).

headed by Rich Huggins of the Eastern Oregon Community Development Council and faculty from Eastern Oregon State College, has included systematic sampling of hot-spring waters for chemical analysis.

The Geo-Heat Utilization Center at Oregon Institute of Technology (OIT) and the Oregon Department of Geology and Mineral Industries (DOGAMI) are completing an investigation into direct geothermal energy applications in the food-processing industry, with emphasis on two areas of prime agricultural importance: the Snake River basin near Vale, Ontario, and Nyssa, northern Malheur County; and the Klamath basin, southwestern Oregon. In the former area, the study has focused on sugar and potato processing; in the latter area, a wide range of prospective applications has been identified. The U.S. Department of Energy (formerly ERDA) has provided funds for the OIT-DOGAMI work.

Richard W. Couch, Oregon State University, and Brian Baker, University of Oregon, have supervised an aeromagnetic survey in the central Cascade Range. Couch has also recently completed an aeromagnetic survey of the Vale area, where previous gravity surveys have been useful in delineating the structural control of hot springs.

A statewide inventory of Oregon's low-temperature geothermal resources (those less than 90°C) is being conducted by DOGAMI with funds from the U.S. Department of Energy. A long-term statewide heat-flow study being conducted jointly by DOGAMI and David D. Blackwell, Southern Methodist University, is nearing completion.

A 3-year geothermal energy resource assessment of Mt. Hood volcano was begun in 1977. The project was undertaken jointly by the U.S. Department of Energy (DOE), U.S. Geological Survey (USGS), U.S. Forest Service, and DOGAMI. In 1977, a variety of geophysical surveys were made by USGS personnel, including aeromagnetics (David L. Williams), self-potential (Don B. Hoover), microseismic (H.M. Iyer and Craig S. Weaver), and infrared (Ken Watson, Jules D. Friedman, and David L. Williams).

A magnetotelluric and telluric electrical resistivity survey was supervised by Norman E. Goldstein and associates, Lawrence Berkeley Laboratory (LBL), University of California. Thermal modeling is being done by David D. Blackwell. Studies of Columbia River Group basalt in the vicinity of Mt. Hood are underway under the direction of Marvin Beeson, Portland State University.

Geological and geochemical studies of young volcanic rocks at Mt. Hood were conducted by Craig M. White, University of Oregon; and areas of hydrothermal alteration were examined by Donald A. Hull, DOGAMI. Water chemistry at Mt. Hood was studied by Harold A. Wollenberg, LBL, James H. Robison, USGS, and Richard G. Bowen.

Elsewhere in Oregon, geochemical samples of various hot



Figure 3. Thermal gradient drilling by USGS near Newberry Crater, July 1977.

springs were collected by DOGAMI personnel and Robert H. Mariner and associates, USGS.

At Newberry Crater, the USGS is engaged in a study of geothermal energy under the direction of E.A. Sammel (Figure 3). Included in the project are drilling and geochemical sampling of hot springs. The Oregon Energy Department and the Department of Geography at Oregon State University completed a study of structural lineations and geothermal phenomena in portions of Lake County and adjoining areas in California.

References

- Blackwell, D.D., Hull, D.A., and Bowen, R.G., 1977, Regional geothermal assessment of Oregon [abs.]: Geological Assoc. Canada annual meeting, Vancouver, B.C.
- Bowen, R.G., Blackwell, D.D., and Hull, D.A., 1977, Geothermal exploration studies in Oregon: Oregon Dept. Geol. and Mineral Indus. Misc. Paper 19, 50 p.
- Couch, R.W., 1977, Analysis of geophysical data pertaining to the Vale KGRA: Final report to the U.S. Geol. Survey under grant 14-08-0001-G-222, 52 p.
- Couch, R.W., and Baker, B., 1977, Geophysical investigations of the Vale-Owyhee geothermal region, Malheur County, Oregon:

- Tech. Rept. 2 to the U.S. Geol. Survey.
 _____, 1977, Geophysical investigations of the Cascade Range in central Oregon: Final report to U.S. Geol. Survey under grant 14-08-0001-G-231, 55 p.
- Friedman, J.D., and Frank, D., 1977, Structural and heat-flow implications of infrared anomalies at Mt. Hood, Oregon: U.S. Geol. Survey Open-File Rept. 77-599, 29 p.
- Hassemer, J.H., and Peterson, D.L., 1977, Principal facts for a gravity survey of Breitenbush KGRA, Oregon: U.S. Geol. Survey Open-File Rept. 77-67-A, 2 p.
- Hodler, T.W., and Rosenfeld, C.L., 1977, Lineations and hydro-geothermal locations in the northern Basin and Range province, Oregon, California: Joint publication of Oregon State University and Oregon Dept. of Energy, 3 p.
- Hull, D.A., Blackwell, D.D., Bowen, R.G., and Peterson, N.V., 1977, Heat flow study of the Brothers fault zone, Oregon: Oregon Dept. Geol. and Mineral Indus. Open-File Rept. 0-77-3, 43 p.
- Hull, D.A., Blackwell, D.D., Bowen, R.G., Peterson, N.V., and Black, G.L., 1977, Geothermal gradient data: Oregon Dept. Geol. and Mineral Indus. Open-File Rept. 0-77-2, 134 p.
- Hull, D.A., Bowen, R.G., Blackwell, D.D., and Peterson, N.V., 1977, Preliminary heat-flow map and evaluation of Oregon's geothermal energy potential: Ore Bin, v. 39, no. 7, p. 109-123.
- O'Donnell, J.E., Broughan, G.W., Martinez, R., and Christopherson, K.R., 1977, Telluric survey data for Breitenbush KGRA, Oregon (supplement to 76-701-D): U.S. Geol. Survey Open-File Rept. 77-66-B, 2 p.
- U.S. Geological Survey, 1977, Aeromagnetic map of Breitenbush Hot Springs and vicinity, Oregon: Open-File Rept. 77-820.
- _____, 1977, Aeromagnetic map of Mt. Hood and vicinity, Oregon: Open-File Rept. 77-819.

* * * * *

OIL AND GAS EXPLORATION IN 1977

V.C. Newton, Jr., Petroleum Engineer
 Oregon Department of Geology and Mineral Industries

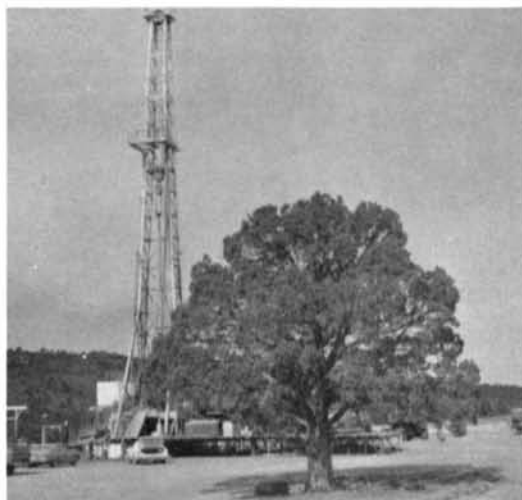
On shore

The Department issued five new oil and gas drilling permits in 1977: one to Mobil Oil Company; three to Reichold Energy Corporation, Tacoma, Washington; one to John M. Rex, Terrebonne, Oregon (Table 1). In December, Mobil applied for a permit to drill a 14,000-ft explor-

Table 1. Drilling permits

	<u>Company</u>	<u>Permit number</u>	<u>Well name</u>	<u>Location</u>	<u>Total depth</u>	<u>Status</u>
	Reichhold (API No. 009-20007)	69	Columbia County No. 1	NW $\frac{1}{4}$ sec. 11 T6N, R5W Columbia County	3,111 ft	Suspended 9/29/77
	M.T. Halbouty (API No. 025-20023)	70	Federal No. 1-10	NE $\frac{1}{4}$ sec. 10 T23S, R29E Harney County	7,684 ft	Abandoned 9/11/77
	Reichhold (API No. 009-20008)	71	Dia-Shamrock Columbia County No. 2	NE $\frac{1}{4}$ sec. 14 T6N, R5W Columbia County	3,088 ft	Suspended 10/15/77
17	Reichhold	72	Dia-Shamrock Columbia County No. 3	SE $\frac{1}{4}$ sec. 10 T6N, R5W Columbia County	-	Permit issued 10/3/77
	Reichhold	73	Dia-Shamrock Longview Fibre No. 1	SW $\frac{1}{4}$ sec. 11 T6N, R5W Columbia County	-	Permit issued 10/3/77
	John M. Rex (API No. 031-20001)	74	Grizzly No. 1	SE $\frac{1}{4}$ sec. 33 T12S, R15E Jefferson County	-	Spud 12/2/77 Drilling 500± ft
	Mobil Oil	75	Sutherland No. 1	SW $\frac{1}{4}$ sec. 36 T24S, R5W Douglas County	-	Application for permit 12/9/77

Figure 1. Michel Halbouty's deep oil and gas test hole drilled near Burns, Harney County, 1977.



atory hole north of Roseburg in southwestern Oregon. Reichhold engaged in follow-up test drilling with its new partner, Diamond Shamrock Corporation, Houston, Texas. John Rex began drilling a 4,500-ft wildcat on the Morrow Brothers ranch near Madras in central Oregon. Interest in Oregon's oil and gas prospects last year was greater than in prior years, as shown by the increase in requests to the Department for regulatory and geological information.

The moratorium on Federal oil and gas leases in Oregon was lifted in December 1974 by the U.S. Department of the Interior. Lease applications pending since 1971 were processed, allowing three major exploration programs to proceed: one by Texaco in eastern Oregon; one by Michel Halbouty near Burns (Figure 1); and a third by Mobil Oil Company in southwestern Oregon.

Mobil Oil Company continued extensive geophysical studies in 1977 on its 900,000-acre lease block in southwestern Oregon. This end of the Tertiary marine basin has never been explored below a depth of 5,000 ft (Union Oil drilled a 7,000-ft hole in the area in 1951, but steeply dipping beds shortened stratigraphic penetration).

Last spring, a large oil seep in Clatsop County was called to the attention of the Department by an Oregon State University geological field party. The seepage was found on the Alfred Watson property near the town of Olney, approximately 10 mi southeast of Astoria (Figure 2). Three oil companies have confirmed the fact that the seepage is crude oil.

Offshore

Gulf Energy and Minerals Company conducted limited geophysical surveys off the Pacific Northwest coast in 1977. Less ac-



Figure 2. Oregon Department of Geology and Mineral Industries test drilling at Watson oil seep in Clatsop County.

tivity took place along the Oregon shelf in 1977 than in the previous 7 years, when five oil companies made geophysical surveys along the Oregon coast. The decrease in activity may be a result of Secretary of the Interior Cecil Andrus' postponement indefinitely of OCS (outer continental shelf) leasing off the Oregon and Washington coasts.

The reason cited for the cancellation was that the northwest Pacific shelf region was rated low in oil potential, compared to other offshore prospects in the United States. Three major oil firms, however, stated publicly this past summer that they were definitely interested in Oregon-Washington shelf prospects. In private conversation with representatives of this Department, geologists from three or four other international oil companies have indicated they would very likely participate in future OCS lease sales involving Oregon and Washington shelf lands.

The U.S. Bureau of Land Management has stated that the Pacific Northwest ranks low as a prospect, as indicated by replies from the oil industry. This rating is of questionable value, since oil companies place different priorities on future prospects. Oregon and Washington OCS development should not be comparable with the Atlantic, because there has already been leasing and drilling here. Knowledge of geologic conditions has been obtained from the 12 deep holes drilled on the Oregon-Washington shelf. Results were discouraging in that no reservoir rocks were encountered; but shows of petroleum were found in three of the holes drilled, and 60 MCF/D (1,000 cu ft/day) of natural gas were obtained on a formation test in the Pan American well drilled off the southwest coast of Oregon. Recent interpretations of seis-

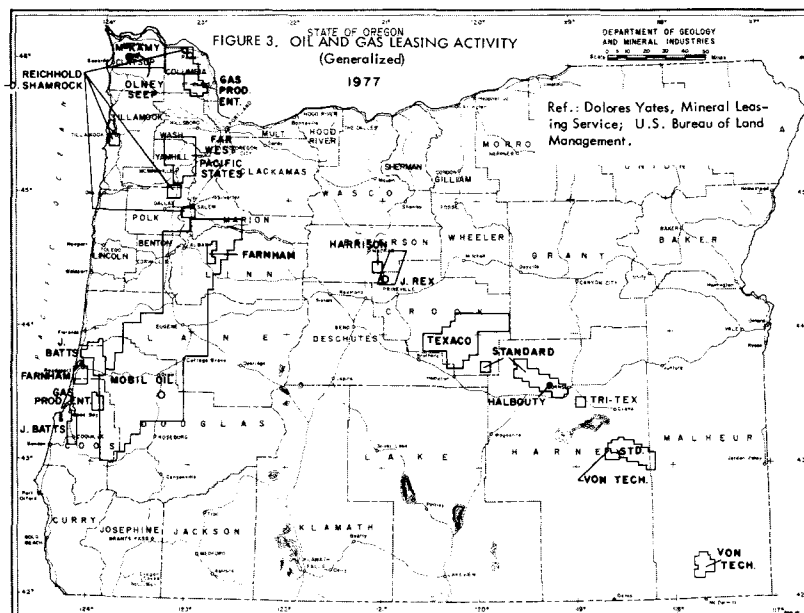
mic data suggest that two of the holes were drilled on shale piercement structures and thus did not penetrate a typical section of rocks.

In the recent past, exploration, though greatly diminished, had been continuing off the Oregon coast until 1969, when Secretary of the Interior Hickel declared a moratorium on all OCS drilling. Furthermore, only portions of the coast were open for leasing in 1964, when the only OSC sale in this area was held; and recent studies indicate that portions of the coast not opened to leasing during that sale may contain coarse-grained sediments (reservoir rocks).

There are still prime targets on the Oregon-Washington OCS lands for future drilling. If the current OCS leasing schedule remains intact, Oregon-Washington shelf land will not be offered for lease until some time after 1981; and if production is eventually found, it cannot be utilized until 1986 or 1988 because of the delay in making environmental studies and completing exploration drilling.

Leasing

The past year was the most active on record for oil and gas leasing in Oregon. Oil and gas leases, either in force or under application, were estimated to amount to 1.3 million acres at the close of 1977. At least eight exploration firms and a dozen or more individuals hold leases at the present time (Figure 3). Some leasing can be credited to speculators who have been attracted to



the State by announcements of increased oil and gas activity.
The figures for oil and gas leases are as follows:

Ownership	Total acres
Federal lands (237 leases)	439,802
State lands (leases)	38,182
County lands (estimated)	80,000
Private lands (estimated)	800,000

The following major lessors have assembled the oil and gas leases in the State:

Mobil Oil Corporation	Denver, Colorado
Texaco, Inc.	Los Angeles, California
Standard Oil	San Francisco, California
Reichhold Energy	Tacoma, Washington
John Rex and Associates	Terrebonne, Oregon
John Batts	Billings, Montana
Inter American Petroleum	Denver, Colorado
Erick Von Tech	North Bend, Oregon
Farnham Chemical	Portland, Oregon
R.F. Harrison	Seattle, Washington
Tenneco Oil Company	Bakersfield, California
Northwest Exploration	Denver, Colorado
Far West Oil	Portland, Oregon

In 1975, Shell Oil Company began a large leasing program in the Columbia basin of eastern Washington, and Texaco and Gulf Oil have since joined the leasing effort. An estimated 300,000 acres are believed to be under lease in this region at the present time, but leasing has not yet extended into the Oregon portion of the basin.

Objectives in the Columbia Plateau leasing appear to be Tertiary nonmarine and pre-Tertiary marine beds underlying Miocene lavas. Discovery of oil in Tertiary nonmarine rocks at Trapp Springs, southeastern Nevada, has focused attention on a whole new area, including similar deposits in the Northwest.

Table 2. Oil and gas records released

<u>Operator</u>	<u>Well name</u>	<u>Location</u>	<u>Total depth (ft)</u>	<u>Released</u>
Reichhold Energy Corp.	Crown Zellerbach No.1 Northwest Natural Gas	Sec. 22 T2S, R10W	5,557	8/21/77
Reichhold Energy Corp.	Finn No. 1 Northwest Natural Gas	Sec. 17 T6S, R4W	7,252	9/23/77
Reichhold Energy Corp.	Merrill No. 1 Northwest Natural Gas	Sec. 24 T8S, R4W	5,282	10/14/77
Reichhold Energy Corp.	Crown Zellerbach No.1 Northwest Natural Gas	Sec. 8 T4N, R3W	5,805	11/ 1/77

Selected References

- Allen, J.E., and Beaulieu, J.D., 1976, Plate tectonic structures in Oregon: Ore Bin, v. 38, no. 6, p. 87-99.
- Braislin, D.B., Hastings, D.D., and Snavelly, P.D., Jr., 1971, Petroleum potential of western Oregon and Washington and adjacent continental margin: Am. Assoc. Petroleum Geologists Mem. 15, p. 229-238.
- Cushman, J.A., Stewart, R.E., and Stewart, K.C., 1947, Five papers on Foraminifera from the Tertiary of western Oregon: Oregon Dept. Geol. and Mineral Indus. Bull. 36, parts I-VII.
- Deacon, R.J., and Benson, G.T., 1971, Oil and gas potential of eastern Oregon and Washington and Snake River basin of western Idaho: Am. Assoc. Petroleum Geologists Mem. 15, p. 354-359.
- Newton, V.C., Jr., 1969, Subsurface geology of the lower Columbia and Willamette basins: Oregon Dept. Geol. and Mineral Indus. Oil and Gas Inv. 2, 121 p., cross sections.
- , 1976, Prospects for natural gas production and underground storage of pipeline gas in the upper Nehalem River basin: Oregon Dept. Geol. and Mineral Indus. Oil and Gas Inv. 5, 56 p., geologic map.
- Newton, V.C., Jr., and Corcoran, R.E., 1963, Petroleum geology of the western Snake River basin, Oregon-Idaho: Oregon Dept. Geol. and Mineral Indus. Oil and Gas Inv. 1, 67 p., geologic map.
- Rau, W.W., 1973, Preliminary identification of Foraminifera from General Petroleum Corporation "Long Bell No. 1": Oregon Dept. Geol. and Mineral Indus. Oil and Gas Inv. 3, species chart.
- , 1973, Preliminary identification of Foraminifera from Warren "Coos County Well": Oregon Dept. Geol. and Mineral Indus. Oil and Gas Inv. 4, species chart.
- Snavelly, P.D., Jr., and Wagner, H.C., 1963, Tertiary geologic history of western Oregon and Washington: Washington Div. Mines and Geol. Rept. Inv. 22, 25 p.
- Snavelly, P.D., Jr., Pearl, J.E., Lander, D.L., and Scott, E.W., 3rd., Interim report on petroleum resources potential and geologic hazards in the outer continental shelf - Oregon and Washington Tertiary province: U.S. Geol. Survey Open-File Report 77-282, 64 p.
- Stewart, R.E., and Newton, V.C., Jr., Oil and gas exploration in Oregon: Oregon Dept. Geol. and Mineral Indus. Misc. Paper 6, revised 1965.
- Stewart, R.E., and Stewart, K.C., 1949, Mollusca, Foraminifera, and Ostracoda of the Wildcat Coast section, Humboldt County, California: Oregon Dept. Geol. and Mineral Indus. Bull. 36, part VIII.

* * * * *

NEW STATE GEOLOGIST



Donald A. Hull
(Photo courtesy Oregon Journal)

December 16, 1977 marked the beginning of Donald A. Hull's tenure as State Geologist for the Oregon Department of Geology and Mineral Industries, a post he assumed after having served as the Department's geothermal specialist since October 1974.

Prior experience includes four years with Homestake Mineral Development Company as district exploration manager, in charge of exploration in the northwestern United States and Canada; a year as geologist-in-charge for Homestake Mining Company, Carlin, Nevada, where he directed a conceptual exploration program for Carlin-type gold deposits; and a year with Port Costa Clay Products Company, Port Costa, California, as geologist and assistant manager, directing the search for, acquisition of, and mining of clay and shale deposits.

Hull earned his Ph.D. degree at the University of Nevada, Reno, in 1970. His dissertation was entitled "Geology of the Puzzle Vein, Creede Mining District, Colorado." His master of science degree came from McGill University, Montreal, Canada, in 1962, after undergraduate studies at the University of Idaho.

Hull is a member of the Canadian Institute of Mining and Metallurgical Engineers, the Northwest Mining Association, the Geothermal Resources Council, and the Engineers Club of San Francisco. He is author or coauthor of several publications, primarily geothermal studies.

* * * * *

THE OREGON AGATE AND MINERAL SOCIETY will present its annual Gem and Mineral Show from January 28 through February 5 at the Oregon Museum of Science and Industry.

Admission is free beyond the OMSI gate. A prize drawing will be held. Hours: 9 - 5 weekdays; 9 - 9 Friday; 9 - 6 Saturdays and Sundays.

RALPH MASON RETIRES

Ralph S. Mason, who retired from his position as State Geologist September 30, 1977 remained with the Department as Acting State Geologist until December 15. He left behind him a record of service and achievement of which he can be proud and for which we of the State Department of Geology and Mineral Industries are deeply grateful.

A native Oregonian, Ralph was born in Hood River and lived in Hood River County until 1930. He received a B.S. in geology from Oregon State University in 1937 and was a Registered Mining Engineer for the State Department of Geology and Mineral Industries from 1943 to 1971. He served as Deputy State Geologist from 1971 through 1976. In 1977 he became State Geologist, a position for which he was extremely well qualified.

Ralph's 34 years of service to the people of Oregon have produced approximately 75 articles and publications on the mineral industry of Oregon; hundreds, if not thousands, of talks to interested groups and organizations; numerous radio and television appearances; assistance to Department staff members; and countless answers to questions from the public, industry, press, and fellow geologists about Oregon's geology and the State's role in the development and protection of Oregon's mineral resources.

Mason has been associated with many societies including the American Institute of Mining, Metallurgical and Petroleum Engineers; Geological Society of the Oregon Country; Oregon Museum of Science and Industry; Oregon Association of Engineering Employees; Oregon Inventors Council; and Columbia Inter-Agency Task Force on Lands and Minerals. He was an instructor in geology in the Portland State College Evening Program from 1950 to 1972 and a guest lecturer at the Oregon State Junior Engineers Science Summer Institute from 1958 to 1972. His interests extend beyond geology and mining to specialty woodworking and design, practical around-the-home inventions, and civic service.



Ralph S. Mason

At the core of Ralph's contribution is a quality available only through long-term experience and commitment. The Department has been very privileged to have had Ralph on its staff. We will miss his knowledge, high standards of excellence, unfailing courtesy, and unexpected witticisms. To Ralph Mason, resource in rough times and leader in good times, wit cracker and occasional whip cracker, and friend, we extend our deepest appreciation and wishes for a healthy and happy retirement.

A V A I L A B L E P U B L I C A T I O N S

(Please include remittance with order; postage free. All sales are final - no returns.
A complete list of Department publications, including out-of-print, mailed on request.)

BULLETINS	Price
26. Soil: Its origin, destruction, and preservation, 1944: Twenhofel	\$.45
33. Bibliography (1st suppl.) geology and mineral resources of Oregon, 1947: Allen	1.00
35. Geology of Dallas and Valsetz quadrangles, Oregon, rev. 1964: Baldwin	3.00
36. Papers on Tertiary foraminifera: Cushman, Stewart and Stewart, 1949: v.2	1.25
39. Geol. and mineralization of Morning mine region, 1948: Allen and Thayer	1.00
44. Bibliog. (2nd suppl.) geology and mineral resources of Oregon, 1953: Steere	2.00
46. Ferruginous bauxite deposits, Salem Hills, 1956: Corcoran and Libbey	1.25
49. Lode mines, Granite mining district, Grant County, Oregon, 1959: Koch	1.00
53. Bibliog. (3rd suppl.) geology and mineral sources of Oregon, 1962: Steere, Owen	3.00
57. Lunar Geological Field Conf. guidebook, 1965: Peterson and Groh, editors	3.50
61. Gold and silver in Oregon, 1968: Brooks and Ramp	8.00
62. Andesite Conference guidebook, 1968: Dole	3.50
63. Sixteenth biennial report of the Department, 1966-1968	1.00
64. Mineral and water resources of Oregon, 1969: USGS with Department	3.00
65. Proceedings of Andesite Conference, 1969: [copies]	10.00
67. Bibliog. (4th suppl.) geology and mineral resources of Oregon, 1970: Roberts	3.00
68. Seventeenth biennial report of the Department, 1968-1970	1.00
71. Geology of selected lava tubes in Bend area, Oregon, 1971: Greeley	2.50
72. Geology of Mitchell quadrangle, Wheeler County, 1971: Oles and Enlows	3.00
75. Geology and mineral resources of Douglas County, 1972: Ramp	3.00
76. Eighteenth biennial report of the Department, 1970-1972	1.00
77. Geologic field trips in northern Oregon and southern Washington, 1973	5.00
78. Bibliog. (5th suppl.) geology and mineral resources of Oregon, 1973: Roberts	3.00
79. Environmental geology inland Tillamook and Clatsop Counties, 1973: Beaulieu	7.00
80. Geology and mineral resources of Coos County, 1973: Baldwin and others	6.00
81. Environmental geology of Lincoln County, 1973: Schlicker and others	9.00
82. Geol. hazards of Bull Run Watershed, Mult., Clackamas Counties, 1974: Beaulieu	6.50
83. Eocene stratigraphy of southwestern Oregon, 1974: Baldwin	4.00
84. Environmental geology of western Linn County, 1974: Beaulieu and others	9.00
85. Environmental geology of coastal Lane County, 1974: Schlicker and others	9.00
86. Nineteenth biennial report of the Department, 1972-1974	1.00
87. Environmental geology of western Coos and Douglas Counties, 1975	9.00
88. Geology and mineral resources of upper Chetco River drainage, 1975: Ramp	4.00
89. Geology and mineral resources of Deschutes County, 1976	6.50
90. Land use geology of western Curry County, 1976: Beaulieu	9.00
91. Geologic hazards of parts of northern Hood River, Wasco, and Sherman Counties, Oregon, 1977: Beaulieu	8.00
92. Fossils in Oregon (reprinted from the ORE BIN), 1977	4.00
93. Geology, mineral resources, and rock material of Curry County, Oregon	in press
94. Land use geology of central Jackson County, Oregon, 1977	9.00

GEOLOGIC MAPS

Geologic map of Galice quadrangle, Oregon, 1953	1.50
Geologic map of Albany quadrangle, Oregon, 1953	1.00
Reconnaissance geologic map of Lebanon quadrangle, 1956	1.50
Geologic map of Bend quadrangle and portion of High Cascade Mtns., 1957	1.50
Geologic map of Oregon west of 121st meridian, 1961	2.25
Geologic map of Oregon east of 121st meridian, 1977	3.75
Geologic map of Oregon (9 x 12 inches), 1969 . . . . .	.25
GMS-3: Preliminary geologic map of Durkee quadrangle, Oregon, 1967	2.00
GMS-4: Oregon gravity maps, onshore and offshore, 1967 [folded]	3.00
GMS-5: Geologic map of Powers quadrangle, Oregon, 1971	2.00
GMS-6: Prelim. report on geology of part of Snake River Canyon, 1974	6.50
GMS-7: Geology of the Oregon part of the Baker quadrangle, Oregon, 1976	3.00

The ORE BIN
1069 State Office Bldg., Portland, Oregon 97201

The Ore Bin

Second Class Matter
POSTMASTER: Form 3579 requested

Available Publications (continued)

THE ORE BIN		Price
Issued monthly - Subscription	[Annual]	\$ 3.00
	[3-year]	8.00
Single copies of current or back issues	[Over the counter]	.25
	[Mailed]	.35

OIL AND GAS INVESTIGATIONS

1. Petroleum geology, western Snake River basin, 1963: Newton and Corcoran	3.50
2. Subsurface geology, lower Columbia and Willamette basins, 1969: Newton	3.50
3. Prelim. identifications of foraminifera, General Petroleum Long Bell #1 well	2.00
4. Prelim. identifications of foraminifera, E.M. Warren Coos Co. 1-7 well, 1973	2.00
5. Prospects for natural gas prod. or underground storage of pipeline gas	5.00

SHORT PAPERS

18. Radioactive minerals prospectors should know, 1976: White, Schafer, Peterson . . . . .	.75
19. Brick and tile industry in Oregon, 1949: Allen and Mason . . . . .	.20
21. Lightweight aggregate industry in Oregon, 1951: Mason . . . . .	.25
24. The Alameda mine, Josephine County, Oregon, 1967: Libbey	3.00
25. Petrography, type Rattlesnake Fm., central Oregon, 1976: Enlows	2.00

MISCELLANEOUS PAPERS

1. A description of some Oregon rocks and minerals, 1950: Dole	1.00
2. Oregon mineral deposits map (22 x 34 inches) and key (reprinted 1973):	1.00
4. Laws relating to oil, gas, & geothermal exploration & development in Oregon	
Part 1. Oil and natural gas rules and regulations, 1977	1.00
Part 2. Geothermal resources rules and regulations, 1977	1.00
5. Oregon's gold placers (reprints), 1954 . . . . .	.50
6. Oil and gas exploration in Oregon, rev. 1965: Stewart and Newton	3.00
7. Bibliography of theses on Oregon geology, 1959: Schlicker . . . . .	.50
Supplement, 1959-1965: Roberts . . . . .	.50
8. Available well records of oil and gas exploration in Oregon, rev. 1973: Newton	1.00
11. Collection of articles on meteorites, 1968 (reprints from The ORE BIN)	1.50
12. Index to published geologic mapping in Oregon, 1968: Corcoran . . . . .	.50
13. Index to The ORE BIN, 1950-1974	1.50
14. Thermal springs and wells, 1970: Bowen and Peterson (with 1975 suppl.)	1.50
15. Quicksilver deposits in Oregon, 1971: Brooks	1.50
16. Mosaic of Oregon from ERTS-1 imagery, 1973	2.50
18. Proceedings of Citizens' Forum on potential future sources of energy, 1975	2.00
19. Geothermal exploration studies in Oregon - 1976, 1977	3.00

MISCELLANEOUS PUBLICATIONS

Oregon base map (22 x 30 inches) . . . . .	.50
Landforms of Oregon (17 x 12 inches) . . . . .	.25
Mining claims (State laws governing quartz and placer claims) . . . . .	.50
Geological highway map, Pacific NW region, Oregon-Washington (pub. by AAPG)	3.00
Fifth Gold and Money Session and Gold Technical Session Proceedings, 1975 (including papers on gold deposits, exploration, history, and production)	5.00

Colored postcard, GEOLOGY OF OREGON 10¢ each; 3 for 25¢; 7 for 50¢; 15 for 1.00