OREGON GEOLOGY

published by the
Oregon Department of Geology and Mineral Industries

VOLUME 55, NUMBER 2 MARCH 1993

IN THIS ISSUE:

OREGON GEOLOGY

(ISSN 0164-3304)

VOLUME 55, NUMBER 2 **MARCH 1993**

Published bimonthly in January, March, May, July, September, and November by the Oregon Department of Geology and Mineral Industries. (Volumes 1 through 40 were entitled *The Ore Bin*.)

Main Office: Suite 965, 800 NE Oregon Street # 28, Portland 97232, phone (503) 731-4100, FAX (503) 731-4066.

Baker City Field Office: 1831 First Street, Baker City 97814, phone (503) 523-3133, FAX (503) 523-9088.
Mark L. Ferns, Regional Geologist.

Grants Pass Field Office: 5375 Monument Drive, Grants Pass 97526, phone (503) 476-2496, FAX (503) 474-3158.
Thomas J. Wiley, Regional Geologist.

Mined Land Reclamation Program: 1536 Queen Ave. SE, Albany 97321, phone (503) 967-2039, FAX (503) 967-2075.
Gary W. Lynch, Supervisor.

The Nature of Oregon Information Center: Suite 177, 800 NE Oregon Street # 5, Portland, OR 97232, phone (503) 731-4444, FAX (503) 731-4066, Donald J. Haines, Manager.

Second class postage paid at Portland, Oregon. Subscription rates: 1 year, $8; 3 years, $19. Single issues, $2. Available back issues of *Ore Bin/Oregon Geology* through v. 50, no. 4, $1. Address subscription orders, renewals, and changes of address to *Oregon Geology*, Suite 965, 800 NE Oregon Street # 28, Portland 97232. Permission is granted to reprint information contained herein. Credit given to the Oregon Department of Geology and Mineral Industries for compiling this information will be appreciated. POSTMASTER: Send address changes to *Oregon Geology*, Suite 965, 800 NE Oregon Street # 28, Portland 97232.

Information for contributors

Oregon Geology is designed to reach a wide spectrum of readers interested in the geology and mineral industry of Oregon. Manuscript contributions are invited on both technical and general-interest subjects relating to Oregon geology. Two copies of the manuscript should be submitted, typed double-spaced throughout (including references) and on one side of the paper only. If manuscript was prepared on common word-processing equipment (IBM compatible or Macintosh), a file copy on diskette should be submitted in place of one paper copy (from Macintosh systems, 3.5-inch high-density diskette only). Graphic illustrations should be camera-ready; photographs should be black-and-white glossies. All figures should be clearly marked, and all figure captions should be together on a separate sheet of paper.

The style to be followed is generally that of U.S. Geological Survey publications. (See the USGS manual *Suggestions to Authors*, 7th ed., 1991 or recent issues of *Oregon Geology*.) The bibliography should be limited to references cited. Authors are responsible for the accuracy of the bibliographic references. Names of reviewers should be included in the acknowledgments.

Authors will receive 20 complimentary copies of the issue containing their contribution. Manuscripts, news, notices, and meeting announcements should be sent to Beverly F. Vogt, Publications Manager, at the Portland office of the Oregon Department of Geology and Mineral Industries.

Cover photo

Port facility at Coos Bay completed during 1992 by Glenbrook Nickel Company for off-loading, crushing, and drying nickel ore, which the company imports from New Caledonia in the South Pacific. Related summary of 1992 mining and mineral exploration in Oregon begins on next page.

MINERAL EXPLORATION ACTIVITY

Since the level of new mineral exploration in Oregon has decreased significantly since this report was started in 1989, the full, tabulated listing of all activities will no longer be published in each issue. Significant changes, however, will continue to be reported on an irregular basis. In this issue, see the summary report on mining and exploration on the following pages.

Questions or comments should be directed to Gary Lynch or Allen Throop in the Mined Land Reclamation Office of the Oregon Department of Geology and Mineral Industries, 1536 Queen Avenue SE, Albany, OR 97321, telephone (503) 967-2039, FAX (503) 967-2075. □

ANNOUNCEMENT
from
The Oregon Department of Geology and Mineral Industries

Because of anticipated curtailment of funds, the Oregon Department of Geology and Mineral Industries expects to close its geologic-geochemical laboratory.

A sealed-bid sale will be held for the laboratory equipment and such infrastructure items as benches, fume hoods, and other built-in devices. Following is a partial list of items, most of which are in excellent condition.

Jaw crusher	X-ray diffractometer (XRD)
Cone crusher	Atomic absorption spectrometer
Ring and puck mill	Two centrifuges
Disk pulverizer	Two analytical balances
Hammer and screen mill	Microbalance
Sieve shakers, 8- and 8/12-in.	Toploader balance (4-kg cap.)
Drying ovens	Gold Screw autopanner
Two filter presses	Reflectance meter
Large ultrasonic cleaner	Compressor, 5 hp.

Fire-assay furnace and assay chemicals

Interested persons may call Jean Pendergrass at (503) 731-4100 for further information.

Capitol display case features geology of Oregon

The Oregon Department of Geology and Mineral Industries (DOGAMI) has provided the current exhibit for the Oregon Council of Rock and Mineral Clubs at the State Capitol in Salem. Installed on January 23, the exhibit was designed to focus attention on the geology of Oregon—one of the state's greatest natural resources.

The case features a computer-generated shaded-relief map of Oregon with mountains, valleys, lakes, and other physiographic features clearly visible. Photographs and explanations of interesting geologic features found in all parts of the state are keyed to the map. Samples of Oregon's rocks, minerals, fossils, and gemstones are included in the case, along with a new brochure, "Oregon's Heritage, Geologic Treasures," which is available at the Capitol Information Desk or from the Nature of Oregon Information Center, Suite 177, 800 NE Oregon St., #5, Portland, OR 97232, phone (503) 731-4444.

Viewers of the exhibit are urged to go out and look at the geology of Oregon, enjoy it, and learn about it by studying books, maps, and brochures; by taking classes at community colleges, colleges, and universities; and by attending or joining local geology or rock and gem clubs.

The display case is located on the main floor of the Capitol building in Salem, in a hall to the west of the Information Desk. Since it was installed in 1982, the case has held displays by many Oregon rock clubs and DOGAMI. The current display will remain in place until May 1. DOGAMI wishes to thank the Oregon Council of Rock and Mineral Clubs for this opportunity to make Oregonians and visitors to the state aware of Oregon's geologic treasures. □

Mining and exploration in Oregon during 1992

by Frank R. Hladky, Resident Geologist, Grants Pass Field Office, Oregon Department of Geology and Mineral Industries

ABSTRACT

The value of Oregon's mineral industry in 1992, including natural gas, was about $245 million, down 12 percent from preliminary 1991 estimates. Domestic nickel production declined slightly, and nickel prices fell, decreasing the value of Oregon's mineral production. The value of sand, gravel, and crushed stone also declined from the previous year. Other industrial minerals values remained essentially unchanged.

Events in the metals industry highlighted the news in 1992. Glenbrook Nickel Company announced temporary slowdowns at its facilities in southwestern Oregon, responding to depressed worldwide nickel prices. Newmont Mining Corporation acquired a 35-year lease of the Atlas Corporation Grassy Mountain project in Malheur County. USDA Forest Service and U.S. Bureau of Land Management officials reported additional requests for environmental assessments.

Regional geologic mapping combined with mineral-resource assessment continued to be of major significance in the activities of the Oregon Department of Geology and Mineral Industries (DOGAMI).

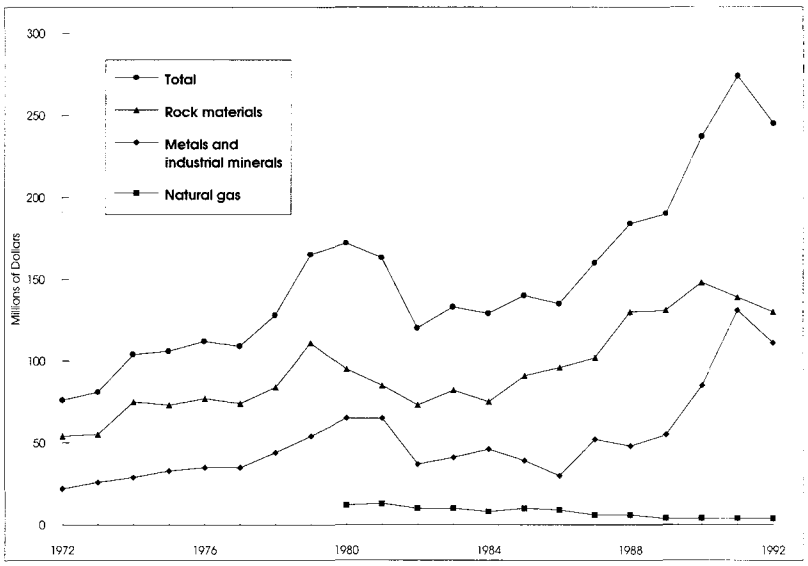


Figure 1. Mineral production value in Oregon for the last 21 years. Data from Table 1.

PRODUCTION HIGHLIGHTS

The value of Oregon's 1992 mineral production, including natural gas, is estimated to be about $245 million, down 12 percent from preliminary 1991 estimates (Table 1 and Figure 1). The U.S. Bureau of Mines (USBM) estimated the value of Oregon's mineral production to be about $199.5 million, excluding nickel and natural gas. The USBM reported advances in the value of portland cement but declines in the value of sand, gravel, and crushed stone. Other industrial minerals production values remained essentially unchanged. The value of domestic nickel production fell as world prices fell and as Glenbrook Nickel Company began shifting from Oregon ore to New Caledonian ore. Glenbrook Nickel Company valued its Oregon nickel production at $41 million. The value of natural gas produced in Oregon during 1992 is estimated to remain unchanged from 1991, about $3.9 million. The cumulative value of natural gas production in Oregon is expected to reach $100 million during 1993.

WESTERN OREGON

At Riddle, Glenbrook Nickel Company (mine site 22 [for all active mine sites, see Figure 2 and Table 2]) produced an estimated 19.3 million pounds of contained nickel from Nickel Mountain ore and 6.4 million pounds from New Caledonian ore. Domestic nickel production in pounds decreased by 17 percent from 1991, but nickel produced from imported ore pushed the combined total up by 23 percent. Glenbrook will produce upwards of 36 million pounds of nickel annually at peak capacity.

Glenbrook Nickel Company, a subsidiary of the Cominco Group, completed its $30 million off-loading, crushing, and drying facility at Coos Bay to handle over 800,000 tons of wet and dry New Caledonian nickel ore per year (Figure 3). The operation employs 25, and an additional 50 are employed trucking ore to Riddle.

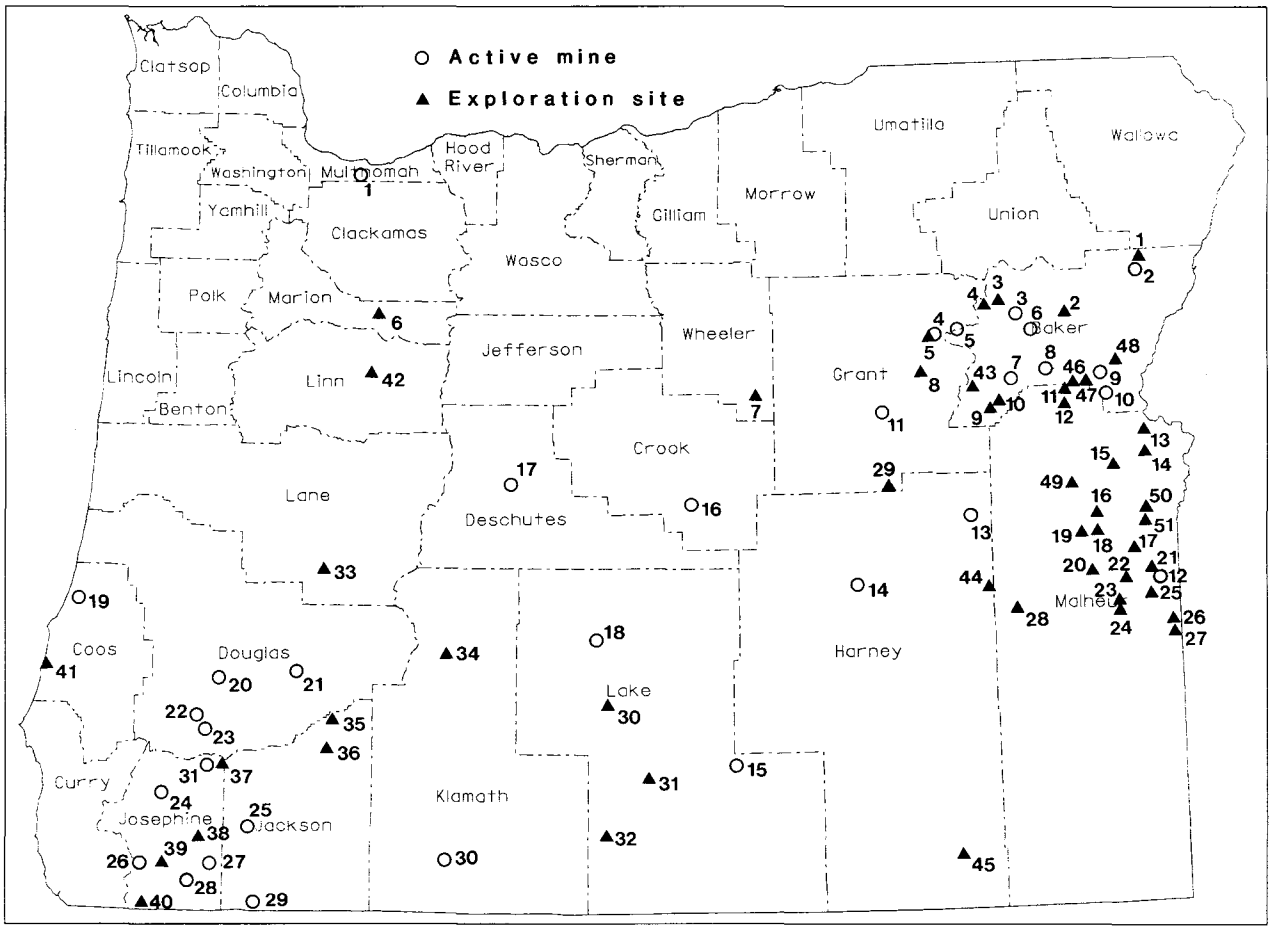
The Coos Bay facility supplements drying and crushing operations at Riddle. The facility can dry up to 119 tons of ore per day in its propane-fired rotary kiln. Conveyors and crushers are enclosed

Table 1. *Summary of mineral production value (in millions of dollars) in Oregon for the last 21 years. Data for 1992, derived from U.S. Bureau of Mines annual preliminary mineral-industry survey and Oregon Department of Geology and Mineral Industries statistics, are based on voluntary reporting and should be considered as minimums.*

	Rock materials[1]	Metals and industrial minerals[2]	Natural gas	Total
1972	54	22	0	76
1973	55	26	0	81
1974	75	29	0	104
1975	73	33	0	106
1976	77	35	0	112
1977	74	35	0	109
1978	84	44	0	128
1979	111	54	+	165
1980	95	65	12	172
1981	85	65	13	163
1982	73	37	10	120
1983	82	41	10	133
1984	75	46	8	129
1985	91	39	10	140
1986	96	30	9	135
1987	102	52	6	160
1988	130	48	6	184
1989	131	55	4	190
1990	148	85	4	237
1991	139	131	4	274
1992	130	111	4	245

[1] Includes sand, gravel, and stone.

[2] For 1992, this includes cement; clays, including bentonite; copper-zinc; diatomite; gemstones, including Oregon sunstone; gold-silver; nickel; perlite; pumice; quartz; silica sand; talc, including soapstone; and zeolites.



EXPLANATION

Active Mines and Areas

1. Columbia Brick Works
2. Bonnanza Mine (placer gold)
3. Deer Creek (placer gold)
4. Big Creek (placer gold)
5. Greenhorn area (placer gold)
6. Elk Creek (placer gold)
7. Pine Creek (placer gold)
8. Dooley Mountain (perlite)
9. Ash Grove Cement West, Inc. (cement and crushed limestone)
10. Rye Valley/Mormon Basin (placer gold)
11. Canyon City (placer gold)
12. Teague Mineral Prod. (bentonite, zeolite)
13. Eagle-Picher Industries (diatomite)
14. Ponderosa Mine (Oregon sunstone)
15. Rabbit Hills (Oregon sunstone)
16. Central Oregon Bentonite/Evergreen Bentonite (bentonite clay)
17. Cascade Pumice/Central Oregon Pumice
18. Oil-Dri Production (diatomite)
19. CooSand (silica sand)
20. Roberts Mountain (limestone)
21. Quartz Mountain (silica)
22. Nickel Mountain (nickel)
23. Silver Peak (copper, zinc, gold, silver)
24. Galice area (placer gold)
25. Bristol Silica and Limestone (silica)
26. Josephine Creek area (placer gold)
27. Jones Marble Quarry (agric. limestone)
28. Sucker Creek area (placer gold)
29. Steatite of Southern Oregon (soapstone)
30. Klamath Falls Brick and Tile
31. Coyote Creek (placer gold)

Exploration Sites and Areas

1. Cornucopia Mine (lode gold)
2. White Swan-U.P. (lode gold)
3. Bourne (gold, silver)
4. Herculean Mine (gold and base metals)
5. Mammoth (gold, silver, copper)
6. Bornite (copper, gold, silver)
7. Spanish Gulch (lode gold)
8. Copperopolis/Standard (copper, gold)
9. Record Mine (copper, silver)
10. Lower Grandview Mine (placer gold)
11. Racey property (lode gold)
12. Shasta Butte (lode gold)
13. Kerby/East Ridge (lode gold)
14. Tub Mountain area (lode gold)
15. Hope Butte (lode gold)
16. H claims (lode gold)
17. Grassy Mountain (lode gold)
18. Harper Basin (lode gold)
19. BCMX (lode gold)
20. Freeze (lode gold)
21. Camp Kettle (lode gold)
22. Dry Creek Buttes area (lode gold)
23. Jessie Page (lode gold)
24. Red Butte (lode gold)
25. South Owyhee Ridge area (lode gold)
26. Bannock (lode gold)
27. Mahogany (lode gold)
28. Stockade area (lode gold)
29. Baboon Creek (limestone)
30. Summer Lake area (lode gold)
31. Paisley area (lode gold)
32. Quartz Mountain (lode gold)
33. Bohemia District (lode gold)
34. Chemult (pumice)
35. Prospect Silica (silica)
36. Al Sarena (lode gold)
37. Martha Mine (lode gold)
38. Marble Mountain (limestone)
39. Eight Dollar Mountain (nickel laterite)
40. Turner-Albright (copper, zinc, gold)
41. Seven Devils area (black sands)
42. Quartzville (lode gold)
43. Pole Creek (lode gold)
44. Buck Mountain (lode gold)
45. Flagstaff Butte area (lode gold)
46. Cave Creek (lode gold)
47. Gold Ridge Mine (lode gold)
48. Gold Hill Mine (lode gold)
49. White Mountain (diatoms)
50. Chalk Butte/Big Red (lode gold)
51. Shell Rock Butte (lode gold)
52. Madison Butte (lode gold)
53. Rough and Ready Creek (nickel)

Figure 2. Mining and mineral exploration sites in Oregon in 1992, excluding sand, gravel, and stone. Active mines are keyed to Table 2; exploration sites are keyed to Table 3.

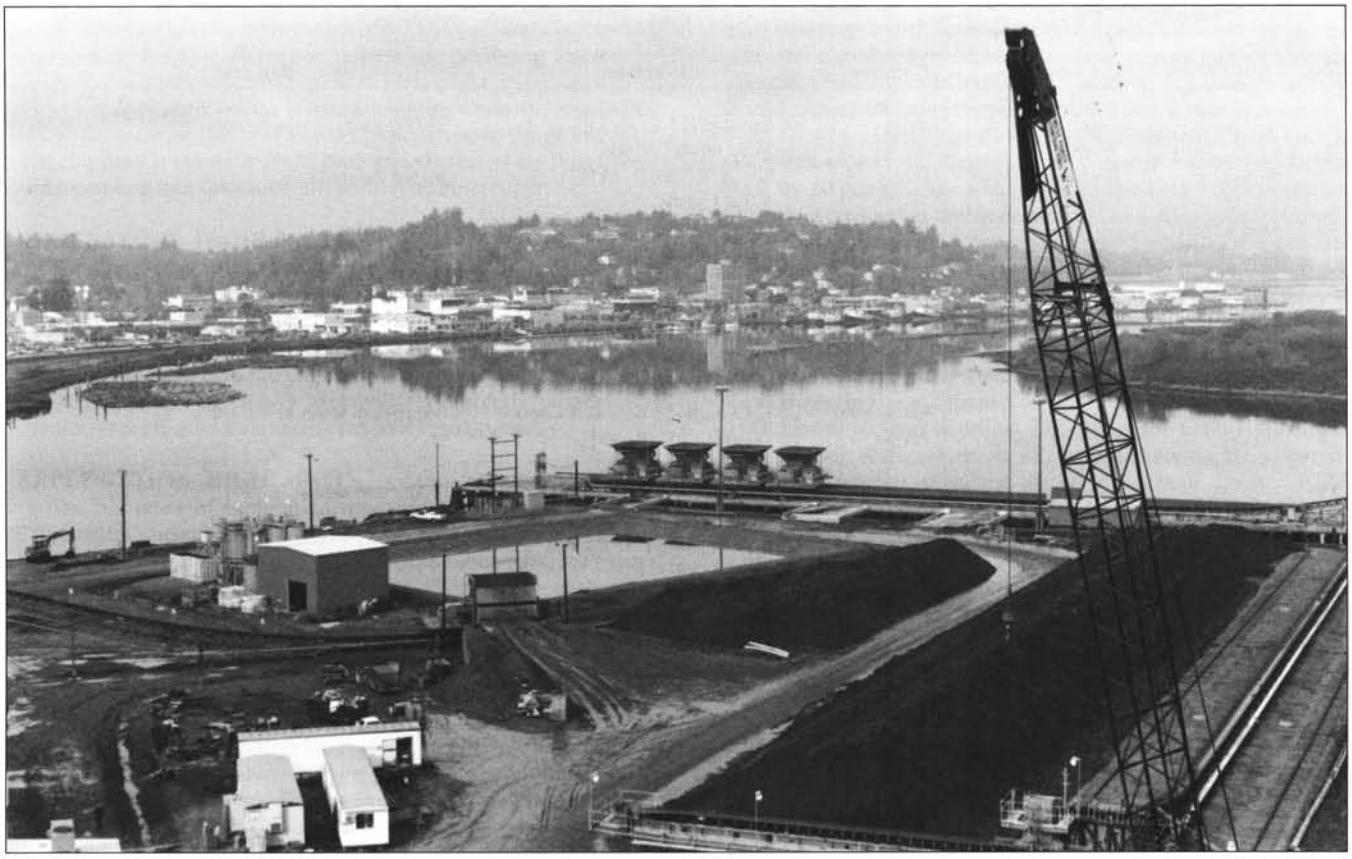


Figure 3. Glenbrook Nickel Company completed its port facility at Coos Bay to handle nickel ore from New Caledonia. Depressed worldwide nickel prices forced temporary closure of the facility at the end of the year.

to prevent dissipation of dust at the site. Dust is collected and cycled to an automated delivery silo, where it is recombined with crushed, dried ore. Wet ore is also hauled from the facility. The site is surrounded by sumps that capture rainwater runoff and direct it to a $2.5-million neutralization plant. Up to 100,000 tons of reddish-brown ore can be stored safely within a few feet of the blue-green Coos Bay estuary.

In November, company officials announced the temporary closure of the import facility. The suspension of operations began December 20. The closure affected jobs at Coos Bay and the 300 jobs at the Riddle smelter. Employees were put on extended furloughs and reduced work weeks or were transferred. The slowdowns were initiated in response to the decline in world prices of nickel, blamed largely on salvage entrepreneurs in the Commonwealth of Independent States, who were dumping nickel on world markets.

Also producing in western Oregon, Formosa Exploration, Inc., continues mining zinc and copper ore from a Kuroko-type massive-sulfide deposit at its Silver Peak Mine near Riddle (mine site 23). In the last quarter, Formosa shipped 4,245 tons of copper and zinc concentrates to Japan, up 40 percent from last year. The company received several hundred thousand dollars in funding and technical support from the Metal Mining Agency of Japan (MMAJ) as part of a program to expand company reserves. The operation currently employs more than 80 people (Figure 4).

Columbia Brick Works mined 23,000 yards of clay in Multnomah County (mine site 1). The company reported that brick production was temporarily exceeding sales.

EASTERN OREGON

Eastern Oregon producers continued to be major contributors to the state's industrial minerals production.

Ash Grove Cement West, Inc., near Baker City, remains the largest mineral producer east of the Cascades (mine site 9). Ash Grove anticipated mining about 750,000 tons of limestone, with 500,000 tons being used for cement clinker and about 250,000 tons crushed for sugar rock. The company continues to employ 105 workers, remaining a stable and sizable employer for eastern Oregon.

Eagle-Picher Industries in Harney and Malheur Counties (mine site 13) reported mining about 50,000 tons of diatomaceous earth, a decrease of about 50 percent from last year. Company officials stated that the decrease was due to inventory adjustments and did not reflect a downturn in sales. Their market includes Japan.

Teague Mineral Products in Malheur County (mine site 12) served customers in Hong Kong, Shanghai, the Philippines, and Canada. The company produces bentonite and zeolite products.

Oil-Dri Production Company in Lake County (mine site 18) mined 40,000 tons of diatomaceous earth. The company ships in bag or in bulk and worldwide. The company also implemented an aggressive reclamation effort.

Central Oregon Bentonite in Crook County (mine site 16) reported mining nearly 10,000 tons of bentonite, an increase of about 10 percent. Its neighbor, Evergreen Bentonite, has a similar-size operation and was active this year.

Klamath Falls Brick and Tile (mine site 30) fired an estimated 3 million bricks from 3,000 tons of clay. Two thirds of this years' clay was mined in Oregon, the rest in California. Some of the company's bricks were used in the construction of the new Oregon Museum of Science and Industry (OMSI) in Portland.

Cascade Pumice and Central Oregon Pumice in Deschutes County (mine site 17) continued to contribute significantly to the nation's pumice production.

Several small firms, some from the East Coast, were reported

Table 2. *Active mines in Oregon, 1992 (numbers are keyed to Figure 2)*

No.	Mine name	Company	Commodity	Location	Remarks
1	—	Columbia Brick Works	Brick	Sec. 14, T. 1 S., R. 3 E. Multnomah County	23,000 yards of clay mined.
2	Bonnanza	Bonnanza Mining Company	Placer gold	Sec. 3, T. 7 S., R. 45 E., Baker County	Mined through July.
3	Deer Creek	—	Placer gold	Sec. 30, T. 9 S., R. 38 E., Baker County	Reclaimed.
4	Big Creek	—	Placer gold	T. 10 S., R. 34 E., Grant County	—
5	Greenhorn area	—	Placer gold/lode gold	Tps. 9, 10 S., R. 35 E., Baker and Grant Counties	Testing 200 ton/day mill for Winterville/Parkerville claim group (lode).
6	Elk Creek	—	Placer gold	Tps. 9, 10 S., R. 39 E., Baker and Grant Counties	Small-scale production.
7	Pine Creek	—	Placer gold	T. 12 S., R. 38 E., Baker County	Insufficient water at this site.
8	Dooley Mountain	Supreme Perlite Company	Perlite	Tps. 11, 12 S., R. 40 E., Baker County	—
9	—	Ash Grove Cement West, Inc.	Cement, limestone	Sec. 11, T. 12 S., R. 43 E., Baker County	Production similar to 1991.
10	Rye Valley/ Mormon Basin	—	Placer gold	T. 13 S., Rs. 42, 43 E., Baker County	—
11	Canyon City placers	—	Placer gold	T. 13 S., R. 32 E., Grant County	—
12	—	Teague Mineral Products	Bentonite, zeolite	Secs. 28, 29, T. 23 S., R. 46 E., Malheur County (and nearby Idaho)	Company ships to several nations of the Pacific Rim.
13	Eagle-Picher	Eagle-Picher Industries, Inc.	Diatomite	Tps. 19, 20 S., Rs. 35, 36 E., Malheur and Harney Counties	50,000 tons mined for fiscal 1992.
14	Ponderosa Mine	—	Oregon sunstone	T. 23 S., R. 30 E., Harney County	—
15	Rabbit Hills	—	Oregon sunstone	T. 33 S., Rs. 24, 25 E., Harney County	Eight BLM notices of intent; sunstone extraction is active.
16	—	Central Oregon Bentonite Co./ Evergreen Bentonite Co.	Bentonite	Sec. 4, T. 19 S., R. 21 E., Crook County	Central Oregon Bentonite reported mining about 10,000 tons in 1992; neighboring Evergreen Bentonite was similarly active.
17	—	Cascade Pumice Co./Central Oregon Pumice Co.	Pumice	Tps. 17, 18 S., R. 11 E., Deschutes County	—
18	—	Oil-Dri Production Company	Diatomite	Secs. 14, 21, 23, T. 26 S., R. 16 E., Lake County	Mined about 40,000 tons; extensive reclamation.
19	—	CooSand Corporation	Silica sand	Sec. 34, T. 24 S., R. 13 W., Coos County	Active silica sand mining operation.
20	Roberts Mountain	Mountain Valley Resources	Limestone	Sec. 20, T. 28 S., R. 5 W., Douglas County	Annual production is less than 5,000 tons.
21	Quartz Mountain	Quartz Mountain Silica	Silica	Sec. 2, T. 28 S., R. 1 W., Douglas County	Annual production measured in hundreds of tons.
22	Nickel Mountain	Glenbrook Nickel Company	Nickel	Secs. 28, 29, T. 30 S., R. 6 W., Douglas County	Estimated smelter production of about 13.3 million pounds of contained nickel from Nickel Mountain.
23	Silver Peak Mine	Formosa Exploration, Inc.	Copper, zinc, gold	Sec. 23, T. 31 S., R. 6 W., Douglas County	Shipped 4,245 tons of concentrates to Japan in November.
24	Galice area	—	Placer gold	Tps. 34, 35 S., R. 8 W., Josephine County	Intermittent small-scale mining.
25	—	Bristol Silica and Limestone Co.	Silica	Sec. 30, T. 36 S., R. 3 W., Jackson County	Production between 5,000 and 10,000 tons annually.
26	Josephine Creek area	—	Placer gold	Tps. 38, 39 S., R. 9 W., Josephine County	Patents pending on small operations.
27	Jones Marble quarry	—	Limestone	Sec. 31, T. 38 S., R. 5 W., Josephine County	—
28	Sucker Creek area	—	Placer gold	Tps. 39, 40 S., Rs. 6, 7 W., Josephine County	Seasonal small-scale mining.
29	—	Steatite of Southern Oregon	Soapstone	Secs. 10, 11, T. 41 S., R. 3 W., Jackson County	Estimated 140 tons mined for 1992.
30	—	Klamath Falls Brick and Tile Co.	Brick	Sec. 19, T. 38 S., R. 9 E., Klamath County	3,000 tons of brick clay used; 2,000 tons mined from Oregon.
31	Coyote Creek	Jack Smith	Placer gold	T. 33 S., Rs. 5, 6 W., Josephine County	Reclamationist of the Year for small mines.

busy extracting sunstones from the Rabbit Hills of Lake County this year (mine site 15). The trade reflects an increasing interest in Oregon's state gemstone.

In metals production, the Bonnanza Mining Company worked its placer mine (mine site 2) in Baker County through the end of July. The company is currently reclaiming mined areas along Pine Creek and extending its exploration efforts into nearby properties.

REGULATORY HIGHLIGHTS

The final set of rules pertaining to cyanide heap leaching were approved by the Environmental Quality Commission (EQC) September 1. Regulations of the Oregon Department of Geology and Mineral Industries and the Oregon Department of Fish and Wildlife had been finalized earlier. Newmont Mining Corporation, with its recent acquisition of Grassy Mountain, is currently proposing a cyanide-process gold mine under the new regulations.

EXPLORATION HIGHLIGHTS

The big news in exploration this year was Newmont Mining Corporation's acquisition of Atlas' Grassy Mountain project in Malheur County (exploration site 17 [for all exploration sites, see Figure 2 and Table 3]). Newmont entered into a 35-year lease with Atlas Corporation. The lease also involves the Musgrove Creek Prospect in Idaho. Grassy Mountain has probable reserves of 995,000 oz of gold and 2,467,000 oz of silver.

EASTERN OREGON

In eastern Oregon, USDA Forest Service officials reported that exploration by major mining firms in the Wallowa-Whitman, Umatilla, and Malheur National Forests had declined and the number of small-scale operators requesting environmental assessments had increased considerably. BLM officials in eastern Oregon districts reported generally little exploration activity. Exploration sites in several eastern Oregon counties remained active near year's end.

In Grant County, Formation Capital Corporation held onto its Mammoth project (exploration site 5), though it reduced its claim block by 50 percent. The Mammoth prospect is a copper-gold and gold-silver prospect hosted in Paleozoic rocks. Also in Grant County, Placer Dome leased the Copperopolis and Standard Prospects (exploration site 8). The company was conducting active surface surveys late in the year.

Cracker Creek Gold Mining Company and Cable Cove Mining Company continued small-scale exploration efforts at their Bourne (exploration site 3) and Herculean (exploration site 4) projects, respectively, in Baker County.

Golconda Resources drilled 25 holes at the Gold Hill Mine in Baker County (exploration site 48) and was keeping the property.

Several projects remained active in Malheur County. ICAN Minerals, Ltd., drilled 17 holes at Racey (exploration site 11). As of the last quarter, Western Mining was keeping its Freeze project (exploration site 20). Battle Mountain was keeping its Freezeout claims in the Dry Creek Buttes area (exploration site 22). Cyprus Metals Exploration and Development Company went through a name change but was retaining interests in the Red Butte (exploration site 24) and Mahogany (exploration site 27) projects. The Red Butte project was contingent upon an anticipated BLM recommendation to remove it from Wilderness Study Area designation. Carlin Gold drilled seven holes in the Stockade area (exploration site 28). Malheur Mining hung on to Kerby (exploration site 13). A suit has been brought against the BLM for its environmental assessment of

Figure 4. Geologists of Formosa Exploration, Inc., are exploring for additional reserves of zinc and copper ore at the Silver Peak mine near Riddle in Douglas County. From right to left: Chris Sebert and K.I. Lu (both with Formosa), H. Hamaii (Dowa Mining Company), and Y. Kogai (Marubeni Mining Company). Photo by David Hembree, Formosa Exploration, Inc.

Table 3. *Exploration sites in Oregon, 1992 (numbers are keyed to Figure 2)*

No.	Mine name	Company	Commodity	Location	Remarks
1	Cornucopia	UNC Corporation	Lode gold	Sec. 27, T. 6 S., R. 45 E., Baker County	—
2	White Swan	Kennecott	Lode gold	Tps. 9, 10 S., Rs. 41, 42 E., Baker County	Properties allowed to lapse.
3	Bourne	Cracker Creek Gold Mining Co.	Gold, silver	T. 8 S., R. 37 E., Baker County	Assessment.
4	Herculean	Cable Cove Mining Company	Gold, base metals	Sec. 22, T. 8 S., R. 36 E., Baker County	30 tons of concentrates tested.
5	Mammoth	Formation Capital Corporation	Gold, silver, copper	Secs. 8, 17, T. 10 S., R. 34 E., Grant County	Surface evaluation; reduced claim block by 50 percent.
6	Bornite	Plexus, Inc.	Copper, gold	Sec. 36, T. 8 S., R. 4 E., Marion County	Pending EIS record of decision.
7	Spanish Gulch	Placer Gold Development	Lode gold	T. 13 S., Rs. 24, 25 E., Wheeler County	—
8	Copperopolis/ Standard	Placer Dome, Inc.	Lode gold	Secs. 1, 12, T. 12 S., R. 33 E., Grant County	Active surface studies.
9	Record prospect	Manville Corporation	Gold, copper	T. 14 S., Rs. 36, 37 E., Baker County	Manville sells mineral arm to Celite; gives up leases.
10	Lower Grandview	Earth Search Sciences	Lode gold	Sec. 6, T. 14 S., R. 37 E., Baker County	Returned to Grandview Inc.; no further activity.
11	Racey property	ICAN Minerals, Ltd.	Lode gold	Tps. 12, 13 S., Rs. 40, 41 E., Malheur County	Drilled about 5,000 ft in 17 holes.
12	Shasta Butte	Earth Search Sciences	Lode gold	Sec. 29, T. 13 S., R. 14 E., Malheur County	Surface geological/geochemical evaluation.
13	Kerby/ East Ridge	Malheur Mining Company	Lode gold	Secs. 22, 27, T. 15 S., R. 45 E., Malheur County	Maintaining property.
14	Tub Mountain area	Atlas Precious Metals, Inc.	Lode gold	Tps. 16, 17 S., R. 45 E., Malheur County	Atlas turns back its Oregon properties in 1992.
15	Hope Butte	Horizon Gold Shares, Inc.	Lode gold	Sec. 21, T. 17 S., R. 43 E., Malheur County	Project terminated.
16	H claims	U.S. Gold	Lode gold	Secs. 2, 10, 11, T. 20 S., R. 42 E., Malheur County	Assessment work.
17	Grassy Mountain	Atlas Precious Metals, Inc./Newmont Mining	Lode gold	Sec. 8, T. 22 S., R. 44 E., Malheur County	North America's largest gold producer acquires 35-year lease.
18	Harper Basin	Atlas Precious Metals, Inc.	Lode gold	T. 21 S., R. 42 E., Malheur County	Returned to claimant.
19	BCMX	—	Lode gold	Secs. 10, 11, 14, 15, T. 21 S., R. 41 E., Malheur County	Surface geological/geochemical studies by claimant.
20	Freeze	Western Mining Corporation	Lode gold	T. 23 S., R. 42 E., Malheur County	Retaining this year.
21	Camp Kettle	ASARCO, Inc.	Lode gold	T. 23 S., R. 45 E., Malheur County	Project withdrawn.
22	Dry Creek Buttes area	ASARCO, Inc.; Battle Mtn. Explor.; BHP-Utah, Int'l.; Noranda Explor., Inc.	Lode gold	Tps. 23, 24 S., Rs. 43, 44 E., Malheur County	ASARCO withdraws; Noranda drops land positions; BHP-Utah withdraws from its Oregon properties; Battle Mountain retains Freezeout claims.
23	Jessie Page (Quartz Mountain)	MK Gold	Lode gold	Sec. 6, T. 25 S., R. 43 E., Malheur County	Project being reclaimed and terminated.
24	Red Butte	Cyprus Metals Exploration and Development Co.	Lode gold	Secs. 26, 27, 34, 35, T. 25 S., R. 43 E., Malheur County	Project awaiting decision on Wilderness Study Area designation.
25	South Owyhee Ridge area	Noranda Explor., Inc.; Atlas Precious Metals	Lode gold	Tps. 24, 25 S., R. 45 E., Malheur County	Noranda pulled claim posts at Goldfinger and SR claims; Atlas returns leases at Katey.
26	Bannock	Atlas Precious Metals and Manville Corp.	Lode gold	Sec. 11, T. 26 S., R. 46 E., Malheur County	Project terminated.
27	Mahogany	Cyprus Metals and Manville Corp.	Lode gold	Secs. 25, 26, T. 26 S., R. 46 E., Malheur County	Cyprus retains interest; Manville drops out.
28	Stockade area	Carlin Gold	Lode gold	Tps. 25, 26 S., R. 38 E., Malheur County	Drilled seven holes of 400 ft each.
29	Baboon Creek	Blue Mountain Mining	Limestone	T. 19 S., R. 32 E., Grant County	—
30	Summer Lake area	N.A. Tracy Gold Corp.	Lode gold	Sec. 14, T. 30 S., R. 16 E., Lake County	—
31	Paisley area	Atlas Precious Metals, Inc.	Perlite	T. 34 S., Rs. 18, 19 E., Lake County	Atlas retains perlite claims.

Table 3. *Exploration sites in Oregon, 1991 (continued)*

No.	Mine name	Company	Commodity	Location	Remarks
32	Quartz Mountain	Pegasus Gold, Inc.; Quartz Mtn. Gold Corp.; Wavecrest Resources	Lode gold	Secs. 26, 27, 34, 35, T. 37 S., R. 16 E., Lake County	Joint-venture partners maintain project.
33	Bohemia District	—	Lode gold	T. 22 S., Rs. 1, 2 E., Lane County	—
34	—	Chemult Pumice	Pumice	Sec. 21, T. 27 S., R. 8 E., Klamath County	New project utilizing Mazama ash.
35	Prospect Silica	Mountain Valley Resources	Silica	T. 30 S., R. 2 E., Jackson and Douglas Counties	Project awaits USDA Forest Service approval.
36	Al Sarena	Fischer-Watt Gold Company, Inc.	Lode gold	Sec. 29, T. 31 S., R. 2 E. Jackson County	Project was drilled in 1991; reclaimed and let go in 1992.
37	Martha Mine	Dragon's Gold	Lode gold	Sec. 28, T. 33 S., R. 5 W., Josephine County	Project maintenance.
38	Marble Mountain	Campman Calcite Company	Limestone	Sec. 19, T. 37 S., R. 6 W., Josephine County	County approves mine plan; project in marketing.
39	Eight Dollar Mountain	Doug Smith/ Lynn Wegner	Nickel laterite	T. 38 S., R. 8 W., Josephine County	BLM moved toward completed environmental assessment in early 1993.
40	Turner-Albright	Cominco American Resources, Inc.; Savannah Resources, Ltd.	Copper, zinc, gold	Secs. 15, 16, T. 41 S., R. 9 W., Josephine County	Cominco returned property to Savanna.
41	Seven Devils area	Oregon Resources Corp.	Black sands	T. 27 S., R. 14 W., Coos County	Pre-feasibility, testing, planning, and marketing stage.
42	Quartzville	Placer Dome	Lode gold	T. 11 S., R. 4 E., Linn County	Drilled 10 holes and dropped.
43	Pole Creek	Placer Dome	Lode gold	Sec. 4, T. 13 S., R. 36 E., Baker County	Let lapse.
44	Buck Mountain	Teck Resources/ Carlin Gold	Lode gold	T. 24 S., Rs. 36, 37 E., Harney and Malheur Counties	Teck withdrew its interest; Carlin Gold retained property.
45	Flagstaff Butte area	Noranda Exploration	Lode gold	Sec. 5, T. 39 S., R. 37 E., Harney County	Drilled five holes for total of 2,100 ft.
46	Cave Creek	Nerco	Lode gold	T. 12 S., R. 42 E., Baker County	Reclaimed project site.
47	Gold Ridge Mine	Golconda Resources, Ltd.	Lode gold	Sec. 16, T. 12 S., R. 43 E., Baker County	Reclaimed and let lapse.
48	Gold Hill Mine	Golconda Resources, Ltd.	Lode gold	Sec. 1, T. 12 S., R. 43 E., Baker County	Drilled 25 holes for total of about 4,500 ft; holding property.
49	White Mountain	White Mountain Mining	Diatomaceous earth	T. 18 S., R. 41 E., Malheur County	Exploration status.
50	Chalk Butte	Battle Mountain Exploration	Lode gold	T. 20 S., Rs. 44, 45 E., Malheur County	Allowed to lapse.
51	Shell Rock Butte	Western Epithermal	Lode gold	Secs. 12, 13, T. 21 S., R. 44 E.; secs. 5-8, 17, 18, T. 21 S., R. 45 E., Malheur County	Drilled three holes and retaining.
52	Madison Butte	Frank Blair	Lode gold	T. 5 S., R. 27 E., Morrow County	Geochemical analyses of 530 surface samples have identified precious metals (up to 84 ppb gold) in broad, fault-controlled epithermal system.
53	Rough and Ready Creek	Walt Freeman	Nickel laterite	T. 40 S., R. 9 W., Josephine County	Application to patent 4,360 acres.

the project. Western Epithermal drilled at Shell Rock Butte (exploration site 51) and was retaining the property. Earth Search Sciences was conducting surface studies at Shasta Butte (exploration site 12).

Noranda drilled five holes this year at its Flag prospect in the Flagstaff Butte area in Harney County (exploration site 45) and remained interested. Carlin Gold retained its interest at Buck Mountain in Harney and Malheur Counties (exploration site 44). In Lake County, Pegasus Gold once again committed itself to the Quartz Mountain Prospect (exploration site 32).

Frank Blair, an independent geologist, worked on a large, metalliferous epithermal system at Madison Butte in Morrow County (exploration site 52). Extensive surface geochemical sampling (530 samples) has indicated zones anomalous in gold, silver, arsenic, antimony, and mercury within brecciated and silicified arkosic sandstones and volcanic rocks of Eocene to Oligocene age.

WESTERN OREGON

Exploration in Western Oregon in 1992 included a handful of active projects. In southwestern Oregon, smaller operators applied for more patents and environmental assessments. Some drew increasing attention.

Walt Freeman, an independent mining engineer, applied for patent of 4,360 acres of nickel claims in the Rough and Ready Creek drainage of Josephine County (exploration site 53). In addition to nickel, the laterite ore contains high values of chrome and iron.

At Eight Dollar Mountain in Josephine County (exploration site 39), the BLM conducted an environmental assessment of an area designated as an area of critical environmental concern. In January 1993, the BLM approved a plan to allow claimants Doug Smith and Lynne Wegner to mine a 10,000-ton test batch of nickel laterite.

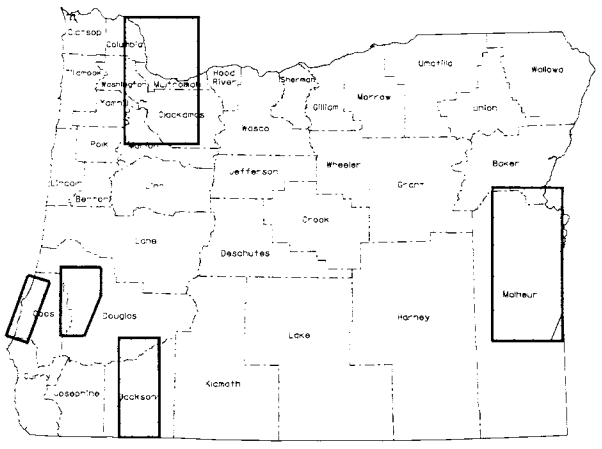


Figure 5. Areas of mapping by the Oregon Department of Geology and Mineral Industries.

Plexus, Inc., maintained an active presence at its Bornite copper porphyry project in Marion County (exploration site 6). The project is in permitting status. The USDA Forest Service is currently reviewing the anticipated environmental impact of the proposed project.

At the Seven Devils area in western Coos County, Oregon Resources Corporation maintains a project (exploration site 41) to further define, test, and market onshore black sands for garnet, chromite, zircon, and titanium. The project is in the pre-feasibility stage.

Meanwhile, Cominco American Resources, Inc., has returned its interest in the Turner-Albright copper, zinc, and gold prospect (exploration site 40) in southern Josephine County to Savanna Resources, Ltd.

DOGAMI ACTIVITIES

A state-wide survey of pumice resources was completed during 1992 and is to be published in early 1993.

Regional geologic mapping and mineral resource assessment continue to be major roles of the Oregon Department of Geology and Mineral Industries (DOGAMI), in addition to its regulatory role. In Jackson and Douglas Counties, DOGAMI geologists are mapping and gathering mineral resource data within the Medford 1° x 2° sheet (Figure 5). In Malheur County, a multi-year effort by DOGAMI, the U.S. Geological Survey (USGS), and geologists from academic institutions is culminating in several geology and mineral resource maps that cover the west half of the Boise 1° x 2° sheet. Mapping in the Portland metropolitan area and in coastal areas is aiding the assessment of earthquake hazards. Mapping in the Tyee Basin of Douglas and Coos Counties is enhancing the understanding of that area's natural gas potential. DOGAMI's geologic mapping activities have the potential of being augmented by the passage of the National Geologic Mapping Act of 1992.

DOGAMI's MILOC computer database of mines and prospects aids state and local jurisdictions in planning in accordance with the state's land use laws.

Current projects are further summarized in the 1991-1997 mission statement, available through the agency's Nature of Oregon Information Center in Portland and field offices in Baker City and Grants Pass.

ACKNOWLEDGMENT

The author thanks the many geologists and corporate officers who provided information for this report. □

ANNOUNCEMENT

39th Annual
Pacific Northwest Metals and Minerals Conference:

"METALS, MINERALS, AND MATERIALS:
Quality Products With a Quality Environment"

Red Lion Inn, Lloyd Center, Portland, Oregon
May 2-4, 1993

Sponsored by
American Institute of Mining, Metallurgical, and Petroleum Engineers;
American Welding Society;
ASM International;
Association of Engineering Geologists.

Technical sessions (May 3-4)

- Keynote session
- Cyanide abatement and alternatives
- Update on laws and regulations impacting the Northwest mining industry
- Wear
- Joining of materials
- State reviews on recent rineral developments
- Reclamation practices
- Advanced materials I and II
- TQM and manufacturing quality
- New mining operations in Oregon and Washington
- Operating and permitting procedures in Oregon and Washington
- Recycling and waste disposal
- Poster sessions on materials and minerals

Field Trip, $20/person (May 5)

Tour of Oregon Steel Mills, St. John's landfill, and Columbia Steel Casting

Trade Show: 10 booths available

Registration:
U.S. $125—Includes all technical sessions and two luncheons
$99—Early Bird (if received by April 23)
$70—Single day (includes luncheon)
$10—Student (sessions only)

For more information and registration form, please contact

Al Rule
1450 Queen Ave. SW
Albany, OR 97321
Phone: (503) 967-5841
Fax (503) 967-5905

Oil and gas exploration and development in Oregon, 1992

by Dan E. Wermiel, Petroleum Geologist, Oregon Department of Geology and Mineral Industries

ABSTRACT

Oil and gas leasing activity declined during 1992. Four U.S. Bureau of Land Management (BLM) lease sales were held, with no leases purchased. There were no over-the-counter filings for BLM leases during the year. The total number of federal acres under lease at year's end was 12,145 acres. The State of Oregon conducted no lease auctions and issued one lease consisting of less than 40 acres during the year. The total number of State of Oregon acres under lease at year's end was 25,421 acres.

Five exploratory wells and two redrills were drilled at the Mist Gas Field during the year by Nahama and Weagant Energy Company, and two of them were successful gas wells, while two were suspended and the others plugged and abandoned.

Nineteen gas wells were productive at the Mist Gas Field during the year, and six were suspended wells awaiting pipeline connection at year's end. A total of 2.5 billion cubic ft (Bcf) of gas was produced during 1992 with a value of $3.4 million.

The Oregon Department of Geology and Mineral Industries (DOGAMI) is completing a study of the Tyee Basin located in Douglas and Coos Counties. Several maps and reports have been published on the oil, gas, and coal resources of the area, and others are in preparation.

DOGAMI and the Northwest Petroleum Association (NWPA) sponsored a workshop at which the U.S. Geological Survey (USGS) and Minerals Management Service (MMS) discussed the ongoing national assessment of undiscovered oil and gas reserves. Individuals who have developed information on oil and gas plays in the Pacific Northwest were invited to present them for assessment. A follow-up workshop will be held during 1993.

LEASING ACTIVITY

Leasing activity declined during 1992, which is a continuation of a trend that began during the late 1980s. Activity included four public lease sales by the BLM, and no bids were received at these sales. BLM received no over-the-counter filings for leases during the year. Federal leases that expired or were terminated during 1992 totaled 212,526 acres. Nearly all of these leases were located in eastern Oregon in Wasco, Gilliam, Wheeler, Jefferson, and Crook Counties. The total number of federal acres under lease in Oregon at the end of 1992 amounted to approximately 12,145 acres. The majority of these are located in Crook, Jefferson, and Coos Counties. Total rental income for the year was about $14,145.

During the year, no State of Oregon lease auctions were conducted. One lease consisting of less than 40 acres was issued. State of Oregon leases on approximately 13,579 acres were terminated or expired during 1992. The total number of State of Oregon acres under lease at year's end was about 25,421 acres, and rental income was about $25,421.

Columbia County held no lease sales during 1992.

DRILLING

Five exploratory oil and gas wells and two redrills were drilled in Oregon during 1992. This is about the same level of exploration drilling activity as during 1991, when six exploratory oil and gas wells and one redrill were drilled. All the wells drilled during the year were located at the Mist Gas Field, Columbia County, where most of the state's oil and gas drilling activity has occurred since the field was discovered in 1979.

At Mist Gas Field, one operator was active during the year. Nahama and Weagant Energy Company of Bakersfield, California, operated all the wells drilled during the year, which included five wells and two redrills. Of these, two were successful gas wells: CC 43-33-75 (Figure 1), located in SE¼ sec. 33, T. 7 N., R. 5 W., and drilled to a total depth of 2,548 ft; and the CC 31-15-65 redrill, located in NE¼ sec. 15, T. 6 N., R. 5 W., and drilled to a total depth of 2,546 ft. Two Nahama and Weagant wells were suspended at year's end: Adams 31-34-75, located in NE¼ sec. 31, T. 7 N., R. 5 W., and drilled to a total depth of 3,413 ft; and CC 23-31-65 (Figure 2), located in SW¼ sec. 31, T. 6 N., R. 5 W., and drilled to a total depth of 2,272 ft. The remaining wells drilled during the year were plugged and abandoned: CC 31-15-65, located in NE¼ sec. 5, T. 6 N., R. 5 W., and drilled to a total depth of 2,794 ft; and Wilson 11A-5-65 and Wilson 11A-5-65 redrill, located in NW¼ sec. 5, T. 6 N., R. 5 W., and drilled to depths of 2,765 and 2,770 ft, respectively.

Total footage drilled for the year was 18,102 ft, and average depth per well was 2,586 ft, which is about the same as the 2,523 ft per well drilled during 1992.

During 1992, DOGAMI issued seven permits to drill (Table 1), while nine permits were canceled (Table 2).

Figure 1. Preparations to flow test the Nahama and Weagant Energy well CC 43-33-75. Flow tests are done on all successful gas wells to determine the amount of gas the well is capable of producing and to measure reservoir pressures in the well.

Table 1. *Oil and gas permits and drilling activity in Oregon, 1992*[1]

Permit no.	Operator, well, API number	Location	Status, depth(ft) TD=total depth PTD=proposed TD
456	Nahama & Weagant Adams 31-34-75 36-009-00282	NE¼ sec. 34 T. 6 N., R. 5 W. Columbia County	Suspended; TD 3,413.
457	Nahama & Weagant CC 23-31-65 36-009-00283	SW¼ sec. 31 T. 6 N., R. 5 W. Columbia County	Suspended; TD 2,272.
469	Nahama & Weagant CC 31-15-65 and RD 36-009-00294/ -294-01	NE¼ sec. 15 T. 6 N., R. 5 W. Columbia County	Completed, gas; TD 2,794; RD 2,546.
470	Nahama & Weagant CC 43-33-75 36-009-00295	SE¼ sec. 33 T. 7 N., R. 5 W. Columbia County	Completed, gas; TD 2,548.
471	Nahama & Weagant Wilson 11A-5-65/ RD 36-009-00296/ -296-01	NW¼ sec. 5 T. 6 N., R. 5 W. Columbia County	Abandoned, dry hole; TD 2,765, RD 2,770.
472	Nahama & Weagant CC 41-33-75 36-009-00297	NE¼ sec. 33 T. 7 N., R. 5 W. Columbia County	Permit issued; PTD 2,850.
473	Nahama & Weagant CC 22B-25-75 36-009-00298	NW¼ sec. 35 T. 7 N., R. 5 W. Columbia County	Permit issued; PTD 2,023.
474	Nahama & Weagant LF 12A-33-75 36-009-00299	NW¼ sec. 33 T. 7 N., R. 5 W. Columbia County	Permit issued; PTD 2,148.
475	Nahama & Weagant Adams 12-31-74 36-009-00300	NW¼ sec. 31 T. 7 N., R. 4 W. Columbia County	Permit issued; PTD 1,800.

[1] Permits nos. 456 and 457 were issued in 1991.

DISCOVERIES AND GAS PRODUCTION

Mist Gas Field in Columbia County saw two new successful gas wells, a decrease from the three gas wells drilled during 1991. Nahama and Weagant Energy Company is the operator of the new producers that include the CC 31-15-65 redrill, which is located near the center of the field, and the CC 43-33-75 (Figure 3), which is one of the northernmost producers in the field. Nahama and Weagant operated 19 productive wells during 1992. At the end of the year, the field contained 16 gas producers; in addition, six wells were awaiting pipeline connection.

Gas production for the year totaled 2.5 Bcf, which is a small decline from the 2.8 Bcf produced during 1991. The cumulative field production as of the end of 1992 was 46.3 Bcf. The total value of gas produced for the year was about $3.4 million, which is a small drop from the $3.9 million during 1991. Gas prices ranged from around 13 cents to 16 cents per therm, which is about the same as during 1991. Cumulatively, the total value of gas produced since the Mist Gas Field was discovered in 1979 is about $97 million.

GAS STORAGE

The Mist Natural Gas Storage Project was fully operational during the year, after several wells were added and other modifications completed during 1991. The gas storage project has nine injection-withdrawal service wells, five in the Bruer Pool and four in the Flora Pool, and 13 observation-monitor service wells. The pools have a combined storage capacity of 10 Bcf of gas. This allows for the cycling of reservoirs between approximately 400 and 1,000 psi and will provide for an annual delivery of one million therms per day for 100 days. During 1992, about 6,144,524 mcf of gas was injected and 6,993,803 mcf was withdrawn at the gas storage project.

Figure 2. Drilling operations underway at the Nahama and Weagant Energy well CC 23-31-65, which was drilled at the Mist Gas Field and suspended during 1992.

OTHER ACTIVITIES

DOGAMI will complete a five-year study of the oil and gas potential of the Tyee Basin during 1993. The Tyee Basin is located in Douglas and Coos Counties in the southern Coast Range. The study, which is funded by landowners in the study area and by county, state, and federal agencies, is an investigation of source rock, stratigraphy, and structural framework for those characteristics that are needed to generate and trap oil and gas. During this investigation, DOGAMI has published a number of maps and reports that present a revised understanding of the geologic framework of the Tyee Basin (see reference list below). Additional publications will include a subsurface fence diagram of the basin, a geologic map of the Camas Valley quadrangle, and a summary of the gas and oil potential of the Tyee Basin. The completed publications can be obtained from the Nature of Oregon Information Center (order information on last page of this issue).

During 1992, a report and a map were completed by DOGAMI on the geologic correlation between the Coos Basin (offshore) and the Tyee Basin (onshore). This unpublished report is available for inspection in the library of the DOGAMI Portland office.

DOGAMI and the Northwest Petroleum Association sponsored a meeting and workshop at which the U.S. Geological Survey and Minerals Management Service discussed the currently ongoing na-

Figure 3. Cementing surface casing at the Nahama and Weagant Energy well CC 43-33-75, one of two successful gas producers drilled at Mist Gas Field during 1992. The surface casing consists of large-diameter pipe that is cemented in the well for the purpose of protecting fresh-water resources, anchoring blow-out prevention equipment, and maintaining the integrity of the surface hole. Truck pictured in foreground carries equipment to pump the cement down the hole.

Table 2. *Canceled permits, 1992*

Permit no.	Operator, well, API number	Location	Date issued, canceled	Reason
453	Nahama and Weagant CC 42-3-65 36-009-00279	NE¼ sec. 3 T. 6 N., R. 5 W. Columbia County	5-28-91, 5-29-92	Canceled; expired.
454	Nahama and Weagant CC 22-2-65 36-009-00280	SW¼ sec. 2 T. 6 N., R. 5 W. Columbia County	5-28-91, 5-29-92	Canceled; expired.
462	Nahama and Weagant Oregon 31-36-66 36-007-00023	NE¼ sec. 36 T. 6 N., R. 6 W. Clatsop County	8-01-91, 8-04-92	Canceled; expired.
463	Nahama and Weagant CC 34-8-64 36-009-00288	SE¼ sec. 8 T. 6 N., R. 4 W. Columbia County	8-30-91, 8-31-92	Canceled; expired.
464	Nahama and Weagant CER 12-26-64 36-009-00289	NW¼ sec. 26 T. 6 N., R. 4 W. Columbia County	8-30-91, 8-31-92	Canceled; expired.
465	Nahama and Weagant CER 31-26-64 36-009-00290	NE¼ sec. 26 T. 6 N., R. 4 W. Columbia County	8-30-91, 8-31-92	Canceled; expired.
466	Nahama and Weagant CC 23-19-65 36-009-00291	SW¼ sec. 19 T. 6 N., R. 5 W. Columbia County	9-05-91, 9-05-92	Canceled; expired.
467	Nahama and Weagant Johnston 11-30-65 36-009-00292	NW¼ sec. 30 T. 6 N., R. 5 W. Columbia County	8-31-91, 8-31-92	Canceled; expired.
468	Nahama and Weagant CER 24-22-64 36-009-00293	SW¼ sec. 22 T. 6 N., R. 4 W. Columbia County	10-07-91, 10-07-92	Canceled; expired.

tional assessment of undiscovered oil and gas reserves. This assessment is using a methodology in which oil and gas plays are evaluated for their future potential reserves. Individuals interested in oil and gas resources in the Pacific Northwest presented plays to be considered for inclusion in the assessment. A follow-up workshop will be held during 1993. Contact DOGAMI for details.

The NWPA remained active during the year. At its regular monthly meetings, speakers gave talks related to energy matters in the Pacific Northwest. For 1993, plans are to hold the annual symposium in Bend, Oregon, during September. The theme will be "Earth Resources and the Pacific Northwest." For details, contact the Northwest Petroleum Association, P.O. Box 6679, Portland, OR, 97228.

TYEE BASIN STUDY REFERENCES

Black, G.L., 1990. Geologic map of the Reston quadrangle, Douglas County, Oregon: Oregon Department of Geology and Mineral Industries Geological Map Series GMS-68, 4 p., map scale 1:24,000.

Niem, A.R., Niem, W.A., and Baldwin, E.M., 1990, Geology and oil, gas, and coal resources, southern Tyee Basin, southern Coast Range, Oregon: Oregon Department of Geology and Mineral Industries Open-File Report O-89-3, 95 p., 3 plates. □

Correction

Richard N. Pugh of Cleveland High School in Portland, Oregon was the author whose name we unfortunately left off when we printed his report on the Coos Bay fireball of 1992 in the last issue (January 1993, page 22). We regret the omission all the more because most of the story was immediately repeated—and credited to *Oregon Geology*—in The Wallace Miner (v. 90, no. 3, January 21, 1993), which is published in Kellogg, Idaho. Pugh has been a frequent contributor to *Oregon Geology* for a long time. —*ed.*

Summary of 1993 activities, Oregon Department of Geology and Mineral Industries

Focus	Activity/project	Contact persons	Description and partners
Geologic hazards (Delineation to serve mitigation)	Earthquake hazard inventory	George Priest Ian Madin Matthew Mabey (503) 731-4100	Provide ground-response maps and models for urban and coastal areas, seismic-velocity data from cooperative bore holes, leadership or technical assistance for earthquake scenarios, paleoseismology, active faults, workshops, and policy-centered mitigation. Partners and cooperators include USGS, METRO, PSU, ODOT, EMD, SSPAC, FEMA, and the Department of Higher Education.
	Coastal erosion	George Priest Dennis Olmstead Mark Neuhaus (503) 731-4100	Continue analysis of coastal erosion in a central-coast pilot project, using geologic analysis and historic shoreline data; evaluate results, integrate geologic considerations into a model, and cooperate in outreach efforts to develop mitigative strategies. The partners and cooperators include LCDC, OCZMA, OSU, and local government. Membership on Coastal Natural Hazard Policy Workshop Group and Technical Advisory Committee.
Regulation of extraction of geologic resources (Environmentally sound and safe exploration and production, followed by second beneficial land use)	Surface mined land reclamation	Gary Lynch Allen Throop Frank Schnitzer (503) 967-2039	Provide for safe and environmentally sound surface mining, leading to beneficial second use in cooperation with other agencies, including local government. Includes aggregate, metal mines, cyanide heap leach mines, and exploration. Cooperation with local government is provided in rules and State Agency Coordination Agreement. Partnerships with federal agencies delineated in memoranda of understanding.
	Oil, gas, and geothermal resources	Dennis Olmstead Dan Wermiel (503) 731-4100	Provide for conservation of resource, protection of environment, safety, and second beneficial use of land plus equitable distribution of revenues where necessary. Authority includes exploration, drilling, production, and reclamation. Governing Board functions as Oil and Gas Commission. Partnership with federal agencies defined in memoranda of understanding.
Geologic mapping and data collection (Multidisciplinary geologic data for a broad variety of societal needs)	Northwest Oregon	George Priest (503) 731-4100	Guide in cooperation with Advisory Committee and prepare geologic mapping in northwestern Oregon with emphasis on quadrangles in the Portland area, East Vancouver sheet, etc., and with emphasis on facilitating or attracting mapping efforts by cooperators in support of agency objectives.
	Southwest Oregon	Tom Wiley Frank Hladky (503) 476-2496	Conduct in cooperation with Advisory Committee mapping on a cooperative basis in the east-central Medford 1° x 2° sheet. Emphasis is on the Medford valley. Partners and cooperators include U of O and USGS.
	Southeast Oregon	Mark Ferns (503) 523-3133	Conduct in cooperation with Advisory Committee geologic quadrangle mapping of the Brogan Sheet and the east half of the Boise 1° x 2° sheet for the purposes of guiding wilderness discussion, enhancing the local economy, and delineating geologic hazards. Cooperators and partners include the USGS, PSU, and the Oregon Lottery Commission. Current emphasis is on completion of the 1:100,000-scale final map products.
Public service and information (Getting the information out of government and to the public)	The Nature of Oregon Information Center	Don Haines (503) 731-4444	A multidisciplinary, multi-agency outlet for natural resource agency information. Located in the new state office building. Emphasis is on distribution of information to the public in the Portland metropolitan area for the purposes of general public education, tourism enhancement, and public service. Cooperators include natural-resource agencies, the Oregon Productivity Fund, and USGS.
	Oregon Geology, publications, library	Beverly Vogt (503) 731-4100	To release a broad array of agency and cooperative geologic information to the broad public in a timely and cost-effective manner with publications, a subscription-based periodical, and a technical library coordinated with the State Library System.

Summary of 1993 activities, Oregon Department of Geology and Mineral Industries (continued)

Focus	Activity/project	Contact persons	Description and partners
Economic geology (Facilitating economic diversification, primarily in rural Oregon)	Mineral data base for GIS, planning and policy guidance (MILO)	Jerry Gray (503) 731-4100	A PC-oriented database of 8,500 mines, prospects, and occurrences based on all USGS, BLM, and MLR data and agency unpublished data bases and designed for dBase 3+ retrieval
	Industrial minerals	Ron Geitgey (503) 731-4100	Conduct statewide assessments and regional evaluations of industrial minerals for purposes of rural diversification. Current emphasis is on initial stages of studies with potential for rural economic development or environmental protection, including dimension stone, clay, diatomite, or zeolites. The possible need for targeted aggregate studies is being monitored.
	Geologic Energy	George Priest Jerry Black (503) 731-4100	Serve as source of geotechnical advice for geothermal energy and inventory resources in Cascades and south-eastern Oregon. Continue natural-gas assessment of the southern Coast Range (Tyee Basin) with emphasis on resource targeting through reconnaissance mapping and transect development. Cooperators include BPA, landholders, DSL, Oregon Lottery, OSU, USFS, and BLM.
	Rock and mineral laboratory	Gary Baxter Chuck Radasch (503) 229-6966	Provide quantitative analytical data in support of agency programs through a cooperative lab facility focused on unique tasks with emphasis on sample preparation, quality control, scientific sampling, and proper interpretation of results. Includes curation of samples and voluntary drill cores. Emphasis on minerals with rural economic development potential and data bases with broad range of applications for mining, planning, and environmental interpretations.
Selected planning (Making sure geology, minerals, and hazards are responsibly addressed by decision makers)	Water	Dan Wermiel (503) 731-4100	Link agency geologic mapping and data with state water-quality and water-quantity planning efforts through referrals, delivery of publications, and strategic technical advice, particularly to SWMG members.
	Local government	Dennis Olmstead Dan Wermiel (503) 731-4100; also, technical assistance by regional geologists at Baker City (503) 523-3133, Grants Pass (503) 476-2496, and Portland (503) 731-4100	Prioritize and oversee agency planning involvement. Link planning efforts to necessary agency data bases with emphasis on periodic review and plan amendments. Input is largely in areas of mineral potential and geologic hazards.
	Offshore coordination	Dennis Olmstead (503) 731-4100	Contribute to state offshore policy development through participation in OPAC.

Acronyms:

BLM	U.S. Bureau of Land Management	OCZMA	Oregon Coastal Zone Management Association
BPA	Bonneville Power Administration	ODOT	Oregon Department of Transportation
DSL	Division of State Lands	OPAC	Ocean Policy Advisory Council
EMD	Emergency Services Division	OSU	Oregon State University
FEMA	Federal Emergency Management Administration	PSU	Portland State University
LCDC	Land Conservation and Development Commission	SWMG	Strategic Water Management Group
METRO	Metropolitan Service District	U of O	University of Oregon
MILO	Mineral Information Layer for Oregon	USFS	USDA Forest Service
MLR	Mined Land Reclamation	USGS	U.S. Geological Survey □

Oil and gas leasing in Oregon: The duty of the independent landman

by Randy Helms, CPL, Conoco Inc., PO Box 2197, ML3024, Houston, Texas 77252; and Harriet Person, CPL/ESA, Dominick, Person, and Associates, 917 Western American Circle, Suite 306, Mobile, Alabama 36609

This is one of a series of articles on the oil and gas industry that have been written for Oregon Geology *by people who work in various occupations within the industry itself. Earlier articles in this series have discussed the formation of oil and gas (v. 48, no. 8), the logging of wells (v. 50, no. 7/8), and geophysical exploration (v. 51, no.3).* —ed.

THE LAND

Oregon is one of the largest unexplored regions in the lower 48 states. The state has approximately 62 million acres within its boundaries. The vast majority of the nation's public lands are located in the western half of the United States, and Oregon is blessed with a considerable amount of federally owned land available for oil and gas leasing and exploration. In the state of Oregon, some 33 million acres are owned by the federal government, representing a little over 54 percent of the state's total acreage. Over half of that is owned by the USDA Forest Service.

The state and counties combined own over 3 million acres of land, all of which fall under their jurisdiction for leasing. Columbia County, in particular, has experienced a high level of exploratory activity in recent years. By virtue of its vast amount of federal, state, and county lands, Oregon provides a very attractive environment in which to explore for oil and gas.

Although the majority of Oregon's land is federal, state, and county owned, the remaining 46 percent is fee or privately owned. Ironically, in the areas where exploratory interest is the greatest, the majority of the land is owned by private individuals and large timber companies. The companies owning the largest blocks of acreage are Longview Fibre, Hanson Natural Resources, and Weyerhaeuser.

The year 1979 marked the real beginning of the present phase of exploratory activity in Oregon with the discovery of the Mist Gas Field by Reichhold Energy Corporation. After drilling several wells in Columbia County, Reichhold made its initial discovery on May 1, 1979, at a depth of 2,446 ft. Since Reichhold's initial discovery, numerous independents and majors alike have migrated north to Oregon to try their hand at drilling for fame and fortune as they have done in Texas, Oklahoma, Louisiana, and other great oil-producing states.

WHAT IS A LANDMAN?

In order to better understand who or what an independent landman is, we must first look at the definition. The definition of a "landman" is divided into three parts: (1) land work, (2) land professional, and (3) landman.

"Land work" is defined as the actual performance or supervision of any one or more of the following functions:

- Negotiating for acquisition or divestiture of mineral rights.
- Negotiating business agreements that provide for the exploration for and/or development of minerals.
- Determining ownership in minerals through the research of public and private records.
- Reviewing the status of title, curing title defects, and otherwise reducing title risk associated with ownership of interests in minerals.
- Managing rights and/or obligations derived from ownership of interests in minerals.
- The unitization or pooling of interests in minerals.

"Land professional" is defined as a person who derives a significant part of his or her income as a result of performing "land work."

Finally then, "landman" is defined as a "land professional" who has been primarily engaged in negotiating for the acquisition or divestiture of mineral rights and/or negotiating business agreements that provide for the exploration and/or development of minerals.

It should be pointed out that the masculine gender in the name "landman" refers to both men and women, as there are a number of women who are "landmen."

There are two types of landmen in the oil and gas business: company landmen and independent landmen. Company landmen, you may have guessed, are actual employees of companies such as Mobil, Exxon, and Conoco. The independent landman is usually hired by the company landman to obtain leases in prospects generated by the company. A company usually utilizes an independent landman for two main reasons: (1) anonymity, so the competition won't know which company is leasing; and (2) saving time for the company landman, who can then conduct regular job functions without being out of the office for extended periods of time.

The primary duty of the independent landman is to obtain oil and gas leases from the various types of mineral owners mentioned above. The oil and gas lease gives an energy company the right to explore for and produce oil and gas. This article will concentrate primarily on who these professionals are and what their relationship is to the mineral owner from whom they lease and to the major and independent companies that hire them.

TERMINOLOGY

Numerous terms are used by a landman during negotiations with a landowner. These terms and their definitions are listed below.

Assignment—In oil and gas terminology, this usually means a transfer of lease or property interest from one party or company to another. Most of the time, a landman will take the lease in his or her own name and assign the lease at a later date to the company that hired him or her.

Delay rental—A sum of money, usually $1 per acre per year, that is payable to the lessor by the lessee for the privilege of deferring the commencement of drilling operations or the commencement of production during the primary term of the lease.

Draft—An order for the payment of money drawn by one person or bank on another. Drafts are depository items, not cash items, and are used in lieu of cash.

Lease bonus—The cash consideration paid to the landowner for the execution of the oil and gas lease.

Lessee—The individual or company entitled under an oil and gas lease to explore, drill, and produce oil and gas.

Lessor—The owner of mineral rights who has executed a lease. The lessor may or may not be the surface landowner.

Oil and gas lease—A document that conveys an estate in real property for a certain term, subject to certain conditions that grant the lessee the right to explore for and to produce oil, gas, and other minerals.

Paid-up lease—A lease effective during the primary term without further payment of delay rentals, the aggregate of rentals for the entire primary term having been paid in advance.

Patent—The original conveyance granting the recipient legal title to public lands and containing all the reservations for easements,

rights-of-way, or other interests in land provided by the applicable act or imposed on the land by applicable law.

Primary term—The period of time, typically 5 or 10 years, during which a lease may be kept alive by a lessee, even though there is no production by virtue of drilling operations on the leased lands or the payment of rentals.

Royalty—Landowner's share of production, free of expenses of production. In underexplored wildcat areas, this typically amounts to a share of 1/8, or 12.5 percent.

Wildcat acreage—An area of land with little or no exploratory activity, unproven territory. Sometimes referred to as an underground horizon from which there is no production in the general area.

Mineral reservation—Mineral rights that are held by an owner who is different from the surface owner (severed mineral rights).

Grantee—A person or company who acquires mineral rights through lease or sale.

Grantor—A person or company who gives up or loses mineral rights through lease or sale.

DOING THE HOMEWORK

After a company geologist and/or geophysicist has determined the geologic outline of a prospect, that outline is given to the company landman, who in turn hires the independent landman to commence leasing. The independent is usually, but not always, familiar with the area of interest, so the first step in learning about the area is to obtain ownership maps indicating the configuration of the land to be leased. The independent landman will probably conduct a personal cursory inspection of the surface of the land, looking for homes on the land and other evidence of people in possession of the property as well as location of roads, rivers, streams, and rights of way. During this inspection, any wells on the land that may be producing or abandoned will also be noted.

A large portion of an independent landman's time is spent in the county courthouse and with title companies in the county where the acreage to be leased is located. Prior to contacting the mineral owners, the landman will thoroughly research public records to determine surface and mineral ownership. Records from the last 10 to 20 years are checked to determine if there are valid oil and gas leases on the subject lands. If the public records have no sectional information (an index that lists documents by a geographic description), the landman must determine ownership of the minerals to be able to check for a current lease. The landman also checks with the state governmental authority for records of old wells on the lands. Should there be any physical evidence of old wells, the landman checks the records of the state authority for the status of the wells, plugging records, and all correspondence found in the files. This reflects any problems operators of old wells may have had on the subject lands.

If there appear to be no current leases of record, the landman conducts a detailed search of the records to determine who owns the minerals. The mineral estate may have been severed from the surface ownership in years past. Therefore, the landman will locate the patent for the land or at least begin the search at the turn of the century or at a time when the landman is comfortable that the minerals and surface were still owned by the same person(s).

There are several methods of checking records within a given county. If the records are indexed by sectional information, that will be the place to begin. The landman will record from the sectional index the book and page numbers in the deed records and oil and gas lease records all documents relating to the subject description. The landman will locate those books, read the recorded documents, and make written notes of all information regarding the subject lands. In particular, the landman will pay attention to the type of document (deed, right of way, will, etc.), the grantor (the person conveying the property), the grantee (the person receiving the property), the date of the document, the date the document was recorded, and any reservations (such as mineral reservation) and restrictions in the document.

From these written notes, the landman builds a "chain of title," ideally, from the beginning date to the present, without any breaks in the chain. However, very seldom does that happen. The landman will check the alphabetical index of all documents filed in the deed and oil and gas lease records. There are two of these indices: direct and reverse. The direct is indexed by the last name of the grantor of the lease. The reverse book in indexed by the grantee's last name and is used to find how title is vested in a person where there is a break in the chain of title. The landman checks all documents indexed in the name of the person who owns the land from the date the land was acquired to the date the land was conveyed to the next person. Then all the documents indexed under the next person's name are checked until the land was conveyed to someone else, and the process is continued to the present-day owner. In documents where there are mineral reservations, the name of the owner who retained some or all of the minerals is checked in the same manner described above.

In states such as Oregon, where there is no sectional information, the records search will begin with building a tax chain, that is, securing the names and dates of landowners whose property has been assessed for taxes, usually from the turn of the century to the current date. The landman uses these names to check the alphabetical index as described above, locating the patent and building a chain of title.

The landman utilizes other county records. The mortgage books provide information in the event a note was not paid, or the subject lands were used as collateral and a foreclosure ensued. The landman should be familiar with the state's foreclosure and right of redemption law and limitations on the term of encumbrances. Any unpaid mortgages and unsatisfied judgments and liens are noted, because they will need to be subordinated to the new oil and gas leases before a company will drill a well on the property.

When an owner seems to disappear from the chain of title and later different individuals join in a conveyance or a lease of the property, probate records are checked for any probated will and guardianship or conservatorship. The landman must be knowledgeable of the state's laws of descent and distribution and guardianships.

While searching the records, the landman is watchful for unusual information in the documents, because seemingly insignificant statements there, along with what can be learned in conversations with family and friends, can lead to information about illegitimate children, mentally incapacitated family members, and such. This information is vital when it is time to have the correct owners execute an oil and gas lease.

The landman prepares a complete ownership report of the mineral and surface estates with the information obtained from the public records, noting problems in the chain of title, questions that need to be asked of landowners when they are contacted, and any incapacities of the mineral or surface owner (minors or incompetents). Any restrictions on use of the surface will be included. The landman expresses any environmental concerns discovered in the personal inspection or in the state authority's records that the company should consider before proceeding with acquiring the rights to explore for oil and gas. This report is then submitted to the company landman.

GETTING THE LEASE

After the company landman reviews the report and elects to purchase the oil and gas leases, the independent landman is given an outline of a "buy area" and a monetary authority under which the leases are purchased. The company has "run economics" on the prospect that determine the royalty amount, bonus per acre to be paid, and the primary term under which their economics are realistic for the prospect. The landman then begins contacting the landowners to lease oil and gas rights.

This portion of the independent landman's job is just as important, if not more important than the research in the public records. For many Oregon landowners, this may be their first experience with

a landman. It is up to each individual landman to make a favorable first impression, as this may be the start of a 20- to 30-year relationship between the company and landowner. Each landman has the responsibility of maintaining good public relations with every landowner he or she meets. The landman knows that the landowners' feelings and attitudes about the oil and gas industry are formed as a direct result of their initial meeting, and therefore the landman should always act accordingly.

The landman should be cordial, honest, and straightforward when dealing with the potential lessor and should take the time to answer any questions a landowner may have about the lease, future operations on the land, or any other phase of the oil and gas business. If there are any questions that cannot be easily answered, the landman should be willing to find the answers. Once the lease is signed, it should be "filed of record" in the courthouse and a copy transmitted to the company, so that the latter will have a record of how many leases it owns on the subject prospect.

The independent landman performs numerous other duties between the time the executed lease is "filed of record" and the time the well may be spudded. Some of these include the collection of abstracts, title curative work, permitting, and settling damages—functions that are beyond the scope of this paper.

THE PROFESSION

Most landmen are active members of the American Association of Professional Landmen (AAPL), an international organization boasting a membership of over 8,000 Land Professionals. These members are bound by an accepted "Code of Ethics" to inspire and maintain a high standard of professional conduct. The AAPL mission is to promote the highest standards of performance for all land professionals, to advance their stature, and to encourage sound stewardship of energy and mineral resources. Many landmen have obtained the Certified Professional Landman (CPL) designation only after many years of experience, continuing education, and the successful completion of an intensive certification examination. It is generally accepted in the land profession that the CPL designation stands for unquestionable ethics, quality work, and true professionalism.

Questions about this article, AAPL, or landmen in general may be directed to AAPL, 4100 Fossil Creek Boulevard, Fort Worth, TX 76138, Attention Mr. Jack Deeter, Executive Vice President and Chief Executive Officer. The first author, Randy Helms, may be called at (713) 293-3003. □

Statewide study of pumice released

The Oregon Department of Geology and Mineral Industries (DOGAMI) has released ***Pumice in Oregon***, a statewide study by staff economic geologist Ron P. Geitgey, that reviews currently producing operations in Oregon and surveys other pumice occurrences to identify possible additional sources for various markets.

The report is DOGAMI Special Paper 25 and consists of a 26-page illustrated text and two plates: one map-sized sheet with tabular and graphic presentations of analytical data and one state map (scale 1:1,000,000) showing deposits, producers, sample locations, and thickness contours of pumice in the Newberry and Crater Lake volcanic areas. The price is $9.

Pumice is a volcanic rock composed of bubbles or vesicles in glass matrix formed by the effervescence of gases and rapid cooling of molten material during an eruption. Pumice is characteristically frothy and lightweight, often with a density low enough to permit it to float on water. The vesicle walls form thin sharp cutting edges when broken, which makes pumice an effective abrasive in both lump and powder forms. These characteristics are responsible for the commercial value of pumice as absorbents, insulators, abrasives, and lightweight aggregates and fillers.

Pumice is produced by two companies in Oregon, primarily for lightweight concrete aggregate and for horticultural uses. Lesser amounts are sold for absorbents, landscaping, and stone-washing garments. The Bend pumice is the primary source of current production, but producers in Bend operate in an increasingly urbanized environment. Pumice deposits from both the Mount Mazama (Crater Lake) and Newberry volcano eruptions have economic potential, but both require additional exploration and testing.

The new report, DOGAMI Special Paper 25, is now available at the Nature of Oregon Information Center, Suite 177, State Office Building, 800 NE Oregon Street #5, Portland, Oregon 97232-2109, phone (503) 731-4444. Orders may be charged to credit cards by mail, FAX, or phone. FAX number is (503) 731-4066. Orders under $50 require prepayment except for credit-card orders. Purchase by mail and over the counter is also possible at the DOGAMI field offices: 1831 First Street, Baker City, OR 97814, phone (503) 523-3133; and 5375 Monument Drive, Grants Pass, OR 97526, phone (503) 476-2496. □

Preliminary geologic maps for southeastern Oregon on file

As part of its mandate to make geologic information available to the public in a timely manner, the Oregon Department of Geology and Mineral Industries (DOGAMI) has put several 7½-minute quadrangles of southeastern Oregon on open file for examination. These maps are preliminary, hand-colored maps (scale 1:24,000) and are on file in the libraries of the Portland and Baker City offices (addresses on page 26 of this issue).

The maps were produced by the joint efforts of DOGAMI, the U.S. Geological Survey, and the Geology Department of Portland State University as part of a cooperative program to map the west half of the Boise 1° by 2° sheet, an area covering more than 3,000 mi^2 east of longitude 118° and between latitudes 43° and 44° in Malheur County. Two full-color compilation maps of the study area are scheduled for release at a scale of 1:100,000 later this year.

This study was funded jointly by DOGAMI, the Oregon State Lottery, and the U.S. Geological Survey COGEOMAP program.

Listed below are open-file number, quadrangle covered, and author(s) of each of the maps:

O-90-03	Kane Springs Gulch quadrangle	Ferns and Urbanczyk
O-91-03	Keeney Ridge quadrangle	Ferns and O'Brien
O-92-02	Bogus Bench quadrangle	Ferns
O-92-05	Cedar Mountain quadrangle	Ferns
O-92-06	Cow Lakes quadrangle	Ferns and MacLeod
O-92-07	Downey Canyon quadrangle	Ferns and MacLeod
O-92-08	Hooker Creek quadrangle	Ferns and MacLeod
O-92-09	Jordan Craters South quadrangle	Ferns and MacLeod
O-92-10	McCain Creek quadrangle	Ferns
O-92-11	Mustang Butte quadrangle	Ferns
O-92-12	Rockville quadrangle	Ferns and Gilbert
O-92-13	Sacramento Butte quadrangle	Ferns
O-92-14	Saddle Butte quadrangle	Ferns
O-92-15	Wrangle Butte quadrangle	Ferns
O-92-16	Avery Creek quadrangle	Brooks
O-92-17	Rufino Butte quadrangle	Brooks
O-93-02	Burnt Flat quadrangle	Ferns and Williams
O-93-03	Copeland Reservoirs quadrangle	Brooks
O-93-04	Crowley quadrangle	Ferns and Williams
O-93-05	Rinehart Canyon quadrangle	Ferns and Evans □

Port Orford hoax confirmed

Recent studies have verified a deliberate ruse as to the origin of the"Port Orford meteorite," supposedly discovered by John Evans in 1856 in the Siskiyou National Forest.

National Museum of Natural History scientist Roy S. Clarke, Jr., University of Western Ontario historian Howard Plotkin, and Technical University of Denmark metallurgist Vagn F. Buchwald collaborated on a new publication, number 31 in the Smithsonian Institution scientific series "Smithsonian Contributions to the Earth Sciences": *The Port Orford, Oregon, Meteorite Mystery*. Edited by Clarke, the book reveals that the meteorite specimen is really a piece of the Imilac meteorite shower discovered in Chile around 1820 and that Evans used it as "a prop in a deliberate and elaborate hoax" (Clarke).

The 43-page monograph combines two papers, a historical study by Plotkin, "John Evans and the Port Orford meteorite hoax," (pages 1-24) and a technical study by Buchwald and Clarke, "A mystery solved: The Port Orford meteorite is an Imilac specimen" (pages 25-43).

Plotkin's paper details the history of the mysterious, lost "Port Orford meteorite." The author presents previously unreported evidence indicating that Evans was not the well-trained and well-respected scientist of historical portrayals but rather poorly qualified for the scientific disciplines he served, particularly his geologic field work. Plotkin concludes that Evans' career as a scientist showed "superficial field work, unprofessional conduct, and financial problems" and that these difficulties finally consumed him. According to Plotkin's quite plausible scenario, Evans tried to use the "discovery" of the meteorite to induce Congress into voting for another appropriations bill for his survey of the Oregon Territory and at the same time to extricate himself from a rather desperate personal financial situation.

Plotkin's historical arguments stimulated the thorough metallographic examination of the Port Orford specimen, with particular emphasis on a comparison with the Imilac meteorite shower, that is presented in the second paper by Buchwald and Clarke. Buchwald used his long familiarity with the Imilac meteorite material to subject the Port Orford specimen to an unusually thorough meteorite pairing study, a common method used in meteoritics. The authors conclude from the results that Evans definitely lied when he claimed to have removed the piece from a much larger mass and that the Port Orford specimen is so indistinguishable from specimens of the Imilac meteorite shower that assuming a different origin would strain credulity.

The publication will, it is hoped, bring to an end the myth that had developed since the 1930s and was fanned by fanciful journalistic accounts. Many people searched for the phantom meteorite that was to have a mass of ten tons and was to earn the finder million-dollar profits. The Smithsonian received so many queries that it developed form letters to respond to the most frequently asked questions. In 1964, Smithsonian Assistant Curator Edward P. Henderson collaborated with then Oregon State Geologist Hollis M. Dole on an article published in this magazine, then published under the name *The Ore Bin* (v. 26, no. 7, p. 120-130), in an effort to stop the misguided activities with a critical presentation of the facts. However, the effect was the opposite of what they had hoped for. Even as historian Plotkin began his study in 1986, he was taking up the challenge of then Smithsonian Curator-in-Charge Clarke, who complained about "more than a lifetime's worth of correspondence" and wished "that historians get in there and clean up the mess." That, it seems, has been accomplished now.

Since the Smithsonian book is already out of print, The Nature of Oregon Information Center of the Oregon Department of Geology and Mineral Industries will make photocopies available for the price of $3. See last page of this issue for ordering information.

—partly from Smithsonian Institution News

Northwest Museum of Natural History finds home

The Northwest Museum of Natural History Association has advanced its museum plans to having found a location for the museum in Portland. According to Museum Association Director Dave Taylor, Portland State University has agreed to allow the Association to occupy the ground floor of the Ondine Building on the Portland State Campus. Located at SW Sixth Avenue and Hall Street, the building is easily accessible by public transportation or automobile. Now the Museum Association enters the next major step in its life, that of remodeling its space and establishing a development office to expand its support base.

The museum is to be opened in 1994, and several exhibit themes are presently being developed, including one centering on the skeleton of the museum's own *Triceratops* dinosaur, one on human origins in East Africa, and one on the plight of the Pacific Northwest salmon. The Geology Department at Portland State University is closing its earth science museum and will loan its collection of fossils, rocks, and minerals to the Museum Association.

Among recent activities of the Museum Association has been the participation in the Young Scholars program funded by the National

Members of the Northwest Museum of Natural History Association pose with a Triceratops *leg bone, which is flanked by other bones still encased in plaster. The bones will be displayed at the museum. Pictured are, in front, Dave Taylor, the Association Executive Director; on the right, Professor Emeritus John E. Allen of Portland State University and an Association honorary trustee; and on the left, Scott Frank, president of the Museum Association's board of trustees. Photo by Greg Paul.*

Science Foundation and cosponsored by the Oregon Museum of Science and Industry (OMSI) and Portland State University. In two disciplines, paleontology and aquatics ecology, high school students conducted field studies and produced research papers.

The Museum Association and Portland State University Continuing Education also offers classes jointly on topics of natural history. These classes are offered for credit to educators and professionals as well as to the general public. Current offerings include "Dinosaurs—field notes from a paleontologist," "Teaching earth science in the Northwest—geology," and "Vertebrate paleontology in the John Day country."

The Northwest Museum of Natural History is a nonprofit educational and cultural institution and welcomes involvement of any kind, such as association membership, volunteer help, or in-kind services and contributions. The address for more information is Northwest Museum of Natural History Association, P.O. Box 1493, Portland, Oregon 97207, phone (503) 725-5900.

—From Museum Association newsletter

Gem and mineral show announced

The Willamette Agate and Mineral Society of Salem, Oregon, announces its 38th annual gem and mineral show, "River of Gems," to be held Friday through Sunday, April 16-18, 1993, at the Polk County Fairgrounds in Rickreall, 10 mi west of Salem. The show will be open on Friday from 9 a.m. to 6 p.m., on Saturday from 10 a.m. to 6 p.m., and on Sunday from 10 a.m. to 5 p.m. Admission is free.

The program will include competitive and noncompetitive displays, creative craft demonstrations, dealer tables, a silent auction, and door prizes. On Friday, tours for schoolchildren will be conducted.

—Society news release

Faceting challenge comes from Australia

All Gem faceters are called to participate in the "1994 Australia vs. the United States Faceting Challenge and Individual International Faceting Championship." The Australia vs. United States competition has been held every two years since 1984 between members of the Australian Facetors' Guild Limited and members of faceting guilds in the United States. The winner becomes the holder of the Challenge Cup until the next competition and is also charged with organizing that competition. The United States last won the 1986 round, and Australia has been holder of the Challenge Cup since winning it back in 1988. However, competition rules include the provision that, since results are based on the scores of the best five entrants, other national teams could be formed, and the competition could be expanded at any time by more groups of at least five entrants from the same country who could compete as a national team.

The individual championship includes not only the entrants in the Challenge but also any individuals from any other country. At the last championship in 1992, this included entries from Canada, Great Britain, Holland, and New Zealand. A special trophy will be awarded to the highest scoring entrant from a country other than Australia or the United States.

Competitors must cut four stones according to given guidelines: an Eagle-Eye cut in cubic zirconia, a Cushion Rectangle Half Barion cut in beryl, a Checkerboard Barion Square cut in synthetic corundum, and a Square Cushion 012 cut in topaz.

The ten top scoring entrants in the overall competition will be invited to compete in the "Biron Competition 1995," which will involve cutting manmade emerald and morganite donated by Biron International of Perth, WA.

Registration forms are due in Australia by the end of October 1993. For more information about the Cup Challenge and for schedule and registration materials, any interested persons in the United States should contact Walter Carss, Route 3, Box 700, Brenham, Texas 77833, telephone (409) 836-6910. From other countries, the contact address is Rupert Pickrell, 1A Spurgin Street, Wahroonga, NSW, Australia, 2076, telephone (02) 489 7731 or, from overseas, 612-489-7731. A copy of the schedule, conditions, and rules is held for inspection in the Portland library of the Oregon Department of Geology and Mineral Industries. □

GeoMedia computer system by USGS teaches children about earth science

A multimedia interactive computer system called GeoMedia, designed to help teach middle-school children (grades four to six) about complex earth-science processes, has been developed by the U.S. Geological Survey (USGS), Department of the Interior.

"The USGS is distributing GeoMedia digital compact disks to teachers who are willing to experiment with this new technology in the classroom," said Denise Wiltshire, chief of the project and a technical-information specialist at the USGS National Center in Reston, Virginia.

"GeoMedia CD-ROMs contain a mix of information on earthquakes, the hydrologic cycle, topographic maps, and other earth-science subjects," Wiltshire said. "Unlike traditional text books on these subjects, GeoMedia is in an interactive computerized format that allows children to plot their own personal path through the scientific information."

GeoMedia is one of several educational products available from the USGS as part of its program to help teachers inform precollege students about how geology, hydrology, and other earth sciences affect them, their communities, the nation, and the world. Other recent products include a series of posters on water resources and a booklet on helping children learn geography.

As the nation's largest earth-science research and information agency, the USGS each year produces about 5,000 new reports, maps, and many forms of computer-readable information on geology, hydrology, cartography, and other earth-science subjects that are available to schools and the general public.

"The GeoMedia digital compact disk contains a wealth of facts on earth-science topics, which are linked together to promote learning at the individual pace of each reader," Wiltshire said.

"For example, students may choose to learn about the forces that create earthquakes by viewing an animated sequence of images. In addition to animation, GeoMedia includes an audible narration to explain scientific concepts. The written descriptions also provide students with the opportunity to review glossary terms for unfamiliar vocabulary.

"GeoMedia opens the doors to communicating earth science to some children who may not respond to traditional teaching methods," Wiltshire added.

Payson Steven, president of InterNetwork, Inc., a design consulting firm in Del Mar, California, that collaborated with the USGS on producing GeoMedia, said that "Children are more apt to comprehend a concept by interacting with the information that sparks their curiosity. Browsing through the information is dynamic and also allows many levels of focus."

To obtain a copy of GeoMedia, write to Project Chief, GeoMedia, U.S. Geological Survey, 801 National Center, Reston, VA 22092. The GeoMedia CD-ROM is available at no cost to teachers and libraries while the supply lasts. **Available for use with Macintosh computers only.** *—USGS news release*

April is Earthquake Preparedness Month

The month of April has been declared Earthquake Preparedness Month, and it is a good opportunity to remember that Oregon, too, especially western Oregon, is not excluded from the dangers of earthquakes that periodically shake the rim around the Pacific Ocean, including the Big Ones, so-called "great" earthquakes with magnitudes of 8 and more.

In recent years, geologic research has produced an increasing amount of evidence of past earthquakes in Oregon west of the Cascades and has helped to heighten awareness of this natural hazard and stimulate efforts to be prepared for the eventuality. And such efforts are being made—by many individuals, organizations, and government agencies, from the State Legislature down to county and city offices and schools. Some of the recent results are discussed here briefly.

USEFUL MATERIALS

The American Red Cross, Oregon Trail Chapter, in its Earthquake Survival Program, distributes a "calender" of single information sheets, one for each month, that focus on essential things to consider or have, in order to "Beat the Quake." The list includes: January, work gloves and sturdy shoes; February, portable radio and batteries; March, home hazard hunt; April, "duck, cover, and hold" (how to protect oneself); May, emergency water supply; June, first aid; July, emergency food; August, flashlight and batteries; September, adjustable wrench; October, smoke detector; November, fire extinguisher; December, how to strap the water heater.

Since 1991, Oregon schools have been required to perform periodic earthquake drills, and the American Red Cross provides an information and guidance package to school principals to help conduct the drill (scheduled this year for April 30), stimulate participation, and assist in publicizing it. The package also includes materials that can help a school to develop its own earthquake preparedness planning, including information on instructional, emergency-management, and community resources and some teaching aids, from a recipe for a "tasty quake" made with gelatin to the scenario describing a magnitude 8.2 earthquake event in a small city ten miles east of Portland.

The address of the Oregon Chapter of the American Red Cross is 3131 N. Vancouver Avenue, P.O. Box 3200, Portland, OR 97208, phone (503) 284-1234.

At the Tillamook County Office of Emergency Management, Jim Gang, Lori Monday, and Liz Kingslien have produced *Rattling the Northwest: Earthquake and tsunami danger in the Pacific Northwest*, a colorful 12-page booklet that explains earthquakes and tsunamis and how to survive them—and does so with few, well-written words and some lively illustrations. The address of the Tillamook County office is 201 Laurel Avenue, Tillamook, OR 97141, phone (503) 842-3412. Similar efforts have been reported to us from Clatsop County and Curry County, taking the forms of both publications and extensive publicity campaigns.

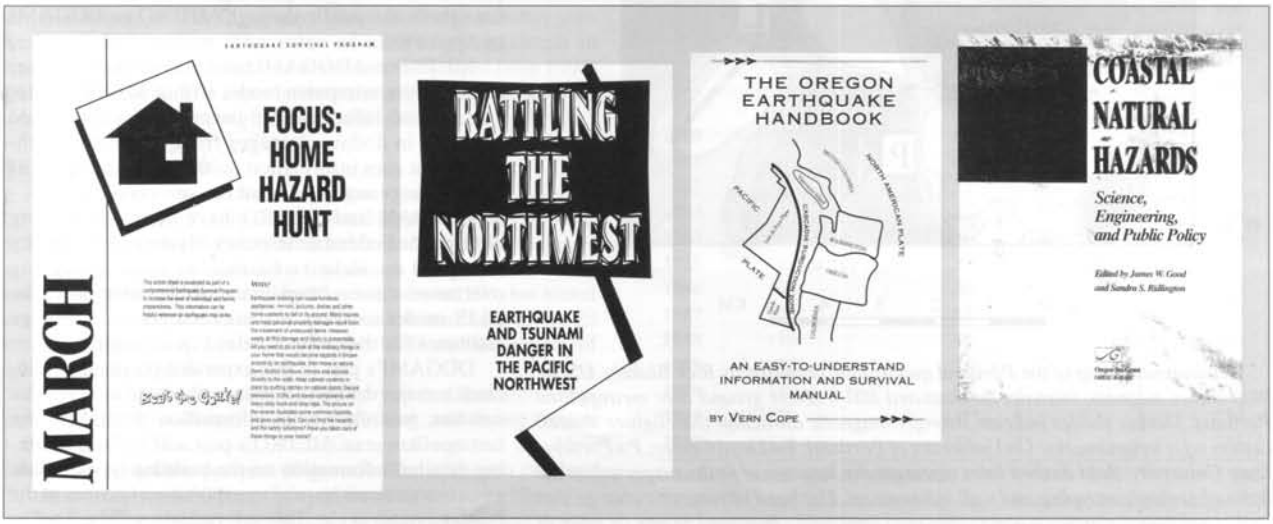
The Oregon earthquake book, by Vern Cope, addresses individuals and families. According to the author, it is "Oregon's first comprehensive earthquake manual." Of its 120 pages, about one third serves to help you understand earthquakes and tsunamis, two thirds deal with being prepared, and some 20 appendix pages, specially marked and bound so that they can be found easily and will stay flat when you open the book to them, contain instructions about what to do during and after an actual earthquake event. The book can be bought from the author, P.O. Box 19843, Portland, OR 97280, for $11.95.

Another book publication, *Coastal natural hazards: science, engineering, and public policy*, focuses on the Oregon coast. It presents the principal papers delivered at a conference held, under the same title, in Newport, Oregon, in October 1991. While it deals with natural hazards more comprehensively, some scientific contributions expressly address seismic hazards. The book was published by the Oregon Sea Grant Program of Oregon State University (number ORESU-B-92-001), Corvallis, OR 97331.

In addition to the sources mentioned above, the book publications are also available at The Nature of Oregon Information Center of the Oregon Department of Geology and Mineral Industries (DOGAMI). Ordering instructions are on the last page of this issue. Information material is also available from the State of Oregon Emergency Management Division, 603 Chemeketa Street NE, Salem, OR 97310, phone (503) 378-4124.

PORTLAND METROPOLITAN AREA

For the Portland metropolitan area, recent research results reported by scientists of the U.S. Geological Survey (USGS) confirm the possibility that major faults run through the down-



Recent publications and information materials show growing recognition that earthquake hazards must be taken seriously even by Oregonians.

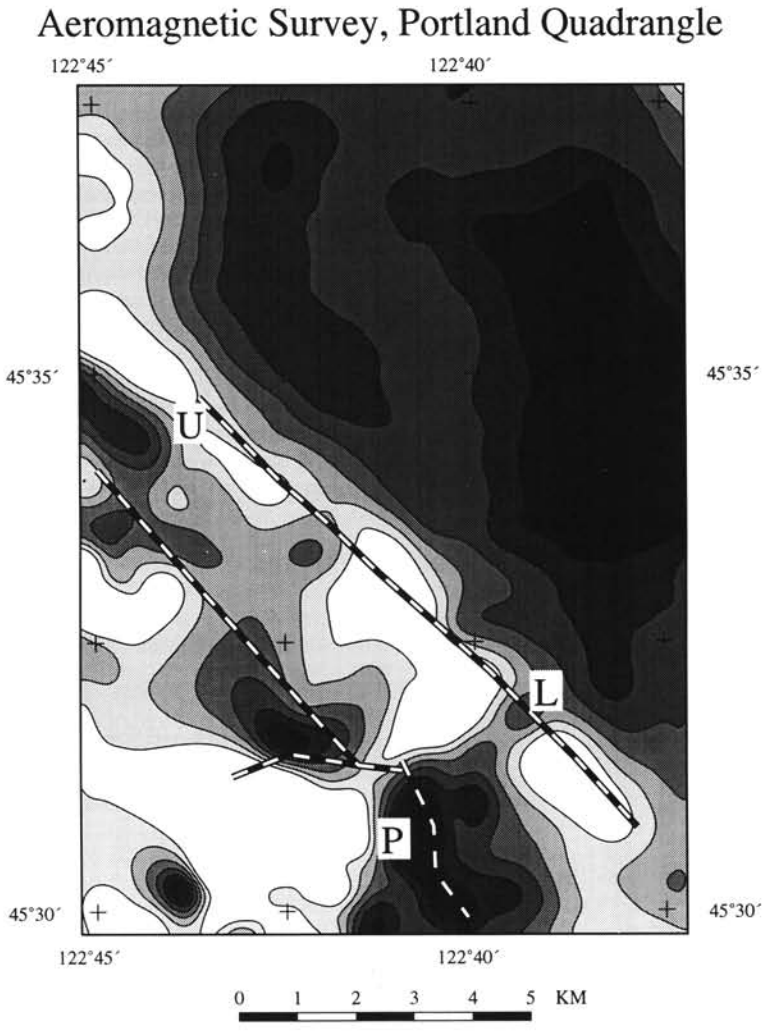
town area of Portland and could locate future earthquakes beneath this area. The following is excerpted from material prepared by Ian Madin of the Oregon Department of Geology and Mineral Industries (DOGAMI) and Tom Yelin and Rick Blakely of the U.S. Geological Survey and presented to the public at a recent press conference given by the USGS, DOGAMI, and the Portland Metropolitan Service District (METRO):

The Portland area has experienced over 100 recorded earthquakes since 1841. The largest of these have been a little over magnitude 5, just large enough to cause minor damage.

Geologists have long suspected that a major fault runs along the northeast side of the Portland Hills. Such a fault was shown on a geologic map of Portland published in 1990 [DOGAMI map GMS-75; see list on page 47 of this issue.—ed.] but was drawn with question marks because its presence was suspected but not confirmed.

Locating faults in the Portland area by geologic mapping is made difficult by heavy vegetation, thick soil, and urban development. However, some geophysical techniques can assist the geologist to "see" below the surface. Certain rock units that underlie the Portland area are more strongly magnetic than other rock units. Locations where faults have placed strongly magnetic rocks next to weakly magnetic rocks hundreds of feet below the surface can be detected by magnetic measurements made above the ground.

To accomplish this, geophysicists from the USGS conducted a detailed aerial magnetic survey of the Portland area in 1992. The survey consisted of nearly 6,000 km (3,700 mi) of flying (back and forth) over an area about 50x50 km (30x30 mi), taking frequent magnetic measurements. A map constructed from these measurements shows many complex geologic features that have yet to be explained. One major feature that is clear, however, is a strong line of magnetic change that is located on top of one of the suspected faults mapped beneath Portland. Other faults are also suspected on the basis of the new magnetic measurements, notably a fault lying beneath Sylvan and Council Crest. The magnetic map will be available soon from the USGS.



Aeromagnetic map of the Portland quadrangle prepared by Rick Blakely, USGS. Map shows magnetic intensity as measured 800 ft above ground over metropolitan Portland. Darker shades indicate stronger magnetic attraction than lighter shades. Letters refer to landmarks: U=University of Portland; L=Lloyd Center; P=Portland State University. Bold dashed lines represent the location of faults suspected on the basis of geologic mapping and well information. The band of magnetic change that strikes northwest-southeast across this map apparently is related to one or more of these faults, The agreement between the magnetic pattern and geologic mapping increases the belief that significant faults lie beneath downtown Portland.

It is not known whether any of Portland's past earthquakes have occurred on the faults identified by the magnetic study, and geologists do not know if these faults are capable of producing future damaging earthquakes. Nevertheless, the presence of such pronounced features raises the possibility that future earthquakes might be centered directly beneath downtown Portland.

Further research is planned by the USGS, DOGAMI, and Portland State University to try to determine where, how large, and how frequent future earthquakes in the Portland area might be.

Planning for future earthquakes requires an understanding of what kind of damage might occur and where the damage will be concentrated. In earthquakes around the world, most of the spectacular damage was due to local soil conditions or poor design and construction. In 1992, DOGAMI started a program to produce a map of the Portland core area that depicts the relative degree of any future earthquake damage that is likely to occur because of the given soil conditions. This map, the *Relative Earthquake Hazard Map of the Portland Quadrangle*, is produced for the nonspecialist and will be available for sale to the public through METRO or DOGAMI in April 1993.

METRO and DOGAMI have also worked together to produce a computer model within METRO's Regional Land Information System (RLIS) that would estimate, in dollars, damages from a scenario earthquake that uses information on the structural types of the buildings in the area and the soil conditions.

DOGAMI and METRO have received funding through the Federal Emergency Management Agency to expand the Relative Earthquake Hazard mapping over more of the metropolitan area and to improve the RLIS model to allow realistic and accurate damage estimates for the entire Portland quadrangle.

DOGAMI's part in this expanded program will include a major drilling program, scheduled to begin this summer, to collect soils information throughout the metropolitan area. METRO's part will include gathering detailed information on the building types, water, gas, communications, and transportation lifelines in the Portland quadrangle. This information will be used to produce detailed damage estimates and to guide earthquake hazard reduction policies. □

AVAILABLE PUBLICATIONS
OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

GEOLOGICAL MAP SERIES

	Price	√
GMS-4 Oregon gravity maps, onshore and offshore. 1967	4.00	
GMS-5 Powers 15′ quadrangle, Coos and Curry Counties. 1971	4.00	
GMS-6 Part of Snake River canyon. 1974	8.00	
GMS-8 Complete Bouguer gravity anomaly map, central Cascade Mountain Range. 1978	4.00	
GMS-9 Total-field aeromagnetic anomaly map, central Cascade Mountain Range. 1978	4.00	
GMS-10 Low- to intermediate-temperature thermal springs and wells in Oregon. 1978	4.00	
GMS-12 Oregon part of the Mineral 15′ quadrangle, Baker County. 1978	4.00	
GMS-13 Huntington and parts of Olds Ferry 15′ quadrangles, Baker and Malheur Counties. 1979	4.00	
GMS-14 Index to published geologic mapping in Oregon, 1898-1979. 1981	8.00	
GMS-15 Free-air gravity anomaly map and complete Bouguer gravity anomaly map, north Cascades, Oregon. 1981	4.00	
GMS-16 Free-air gravity and complete Bouguer gravity anomaly maps, southern Cascades, Oregon. 1981	4.00	
GMS-17 Total-field aeromagnetic anomaly map, southern Cascades, Oregon. 1981	4.00	
GMS-18 Rickreall, Salem West, Monmouth, and Sidney 7½′ quadrangles, Marion and Polk Counties. 1981	6.00	
GMS-19 Bourne 7½′ quadrangle, Baker County. 1982	6.00	
GMS-20 S½ Burns 15′ quadrangle, Harney County. 1982	6.00	
GMS-21 Vale East 7½′ quadrangle, Malheur County. 1982	6.00	
GMS-22 Mount Ireland 7½′ quadrangle, Baker and Grant Counties. 1982	6.00	
GMS-23 Sheridan 7½′ quadrangle, Polk and Yamhill Counties. 1982	6.00	
GMS-24 Grand Ronde 7½′ quadrangle, Polk and Yamhill Counties. 1982	6.00	
GMS-25 Granite 7½′ quadrangle, Grant County. 1982	6.00	
GMS-26 Residual gravity, northern, central, and southern Oregon Cascades. 1982	6.00	
GMS-27 Geologic and neotectonic evaluation of north-central Oregon. The Dalles 1° x 2° quadrangle. 1982	7.00	
GMS-28 Greenhorn 7½′ quadrangle, Baker and Grant Counties. 1983	6.00	
GMS-29 NE¼ Bates 15′ quadrangle, Baker and Grant Counties. 1983	6.00	
GMS-30 SE¼ Pearsoll Peak 15′ quadrangle, Curry and Josephine Counties. 1984	7.00	
GMS-31 NW¼ Bates 15′ quadrangle, Grant County. 1984	6.00	
GMS-32 Wilhoit 7½′ quadrangle, Clackamas and Marion Counties. 1984	5.00	
GMS-33 Scotts Mills 7½′ quadrangle, Clackamas and Marion Counties. 1984	5.00	
GMS-34 Stayton NE 7½′ quadrangle, Marion County. 1984	5.00	
GMS-35 SW¼ Bates 15′ quadrangle, Grant County. 1984	6.00	
GMS-36 Mineral resources of Oregon. 1984	9.00	
GMS-37 Mineral resources, offshore Oregon. 1985	7.00	
GMS-38 NW¼ Cave Junction 15′ quadrangle, Josephine County. 1986	7.00	
GMS-39 Bibliography and index, ocean floor and continental margin off Oregon. 1986	6.00	
GMS-40 Total-field aeromagnetic anomaly maps, Cascade Mountain Range, northern Oregon. 1985	5.00	
GMS-41 Elkhorn Peak 7½′ quadrangle, Baker County. 1987	7.00	
GMS-42 Ocean floor off Oregon and adjacent continental margin. 1986	9.00	
GMS-43 Eagle Butte and Gateway 7½′ quadrangles, Jefferson and Wasco Counties. 1987	5.00	
as set with GMS-44 and GMS-45	11.00	
GMS-44 Seekseequa Junction and Metolius Bench 7½′ quadrangles, Jefferson County. 1987	5.00	
as set with GMS-43 and GMS-45	11.00	
GMS-45 Madras West and Madras East 7½′ quadrangles, Jefferson County. 1987	5.00	
as set with GMS-43 and GMS-44	11.00	
GMS-46 Breitenbush River area, Linn and Marion Counties. 1987	7.00	
GMS-47 Crescent Mountain area, Linn County. 1987	7.00	
GMS-48 McKenzie Bridge 15′ quadrangle, Lane County. 1988	9.00	
GMS-49 Map of Oregon seismicity, 1841-1986. 1987	4.00	
GMS-50 Drake Crossing 7½′ quadrangle, Marion County. 1986	5.00	
GMS-51 Elk Prairie 7½′ quadrangle, Marion and Clackamas Counties. 1986	5.00	
GMS-53 Owyhee Ridge 7½′ quadrangle, Malheur County. 1988	5.00	
GMS-54 Graveyard Point 7½′ quadrangle, Malheur and Owyhee Counties. 1988	5.00	
GMS-55 Owyhee Dam 7½′ quadrangle, Malheur County. 1989	5.00	
GMS-56 Adrian 7½′ quadrangle, Malheur County. 1989	5.00	
GMS-57 Grassy Mountain 7½′ quadrangle, Malheur County. 1989	5.00	
GMS-58 Double Mountain 7½′ quadrangle, Malheur County. 1989	5.00	
GMS-59 Lake Oswego 7½′ quadrangle, Clackamas, Multnomah, and Washington Counties. 1989	7.00	
GMS-61 Mitchell Butte 7½′ quadrangle, Malheur County. 1990	5.00	
GMS-63 Vines Hill 7½′ quadrangle, Malheur County. 1991	5.00	
GMS-64 Sheaville 7½′ quadrangle, Malheur County. 1990	5.00	
GMS-65 Mahogany Gap 7½′ quadrangle, Malheur County. 1990	5.00	
GMS-66 Jonesboro 7½′ quadrangle, Malheur County. 1992	6.00	
GMS-67 South Mountain 7½′ quadrangle, Malheur County. 1990	6.00	
GMS-68 Reston 7½′ quadrangle, Douglas County. 1990	6.00	
GMS-70 Boswell Mountain 7½′ quadrangle, Jackson County. 1992	7.00	
GMS-71 Westfall 7½′ quadrangle, Malheur County. 1992	5.00	
GMS-74 Namorf 7½′ quadrangle, Malheur County. 1992	5.00	
GMS-75 Portland 7½′ quadrangle, Multnomah, Washington, and Clark Counties. 1991	7.00	

BULLETINS

	Price	√
33 Bibliography of geology and mineral resources of Oregon (1st supplement, 1936-45). 1947	4.00	
35 Geology of the Dallas and Valsetz 15′ quadrangles, Polk County (map only). Revised 1964	4.00	
36 Papers on Foraminifera from the Tertiary (v. 2 [parts VII-VIII] only). 1949	4.00	
44 Bibliography of geology and mineral resources of Oregon (2nd supplement, 1946-50). 1953	4.00	
46 Ferruginous bauxite, Salem Hills, Marion County. 1956	4.00	
53 Bibliography of geology and mineral resources of Oregon (3rd supplement, 1951-55). 1962	4.00	
61 Gold and silver in Oregon. 1968 (reprint)	20.00	
65 Proceedings of the Andesite Conference. 1969	11.00	
67 Bibliography of geology and mineral resources of Oregon (4th supplement, 1956-60). 1970	4.00	
71 Geology of lava tubes, Bend area, Deschutes County. 1971	6.00	
78 Bibliography of geology and mineral resources of Oregon (5th supplement, 1961-70). 1973	4.00	
81 Environmental geology of Lincoln County. 1973	10.00	
82 Geologic hazards of Bull Run Watershed, Multnomah and Clackamas Counties. 1974	8.00	
87 Environmental geology, western Coos/Douglas Counties. 1975	10.00	
88 Geology and mineral resources, upper Chetco River drainage, Curry and Josephine Counties. 1975	5.00	
89 Geology and mineral resources of Deschutes County. 1976	8.00	
90 Land use geology of western Curry County. 1976	10.00	
91 Geologic hazards of parts of northern Hood River, Wasco, and Sherman Counties. 1977	9.00	
92 Fossils in Oregon. Collection of reprints from the *Ore Bin*. 1977	5.00	
93 Geology, mineral resources, and rock material, Curry County. 1977	8.00	
94 Land use geology, central Jackson County. 1977	10.00	
95 North American ophiolites (IGCP project). 1977	8.00	
96 Magma genesis. AGU Chapman Conf. on Partial Melting. 1977	15.00	
97 Bibliography of geology and mineral resoures of Oregon (6th supplement, 1971-75). 1978	4.00	
98 Geologic hazards, eastern Benton County. 1979	10.00	
99 Geologic hazards of northwestern Clackamas County. 1979	11.00	
100 Geology and mineral resources of Josephine County. 1979	10.00	
101 Geologic field trips in western Oregon and southwestern Washington. 1980	10.00	
102 Bibliography of geology and mineral resources of Oregon (7th supplement, 1976-79). 1981	5.00	
103 Bibliography of geology and mineral resources of Oregon (8th supplement, 1980-84). 1987	8.00	

MISCELLANEOUS PAPERS

	Price	√
5 Oregon's gold placers. 1954	2.00	
11 Articles on meteorites (reprints from the *Ore Bin*). 1968	4.00	
15 Quicksilver deposits in Oregon. 1971	4.00	
19 Geothermal exploration studies in Oregon, 1976. 1977	4.00	
20 Investigations of nickel in Oregon. 1978	6.00	

SHORT PAPERS

	Price	√
25 Petrography of Rattlesnake Formation at type area. 1976	4.00	
27 Rock material resources of Benton County. 1978	5.00	

OREGON GEOLOGY
Suite 965, 800 NE Oregon Street # 28, Portland, OR 97232

Second Class Matter
POSTMASTER: Form 3579 requested

AVAILABLE DEPARTMENT PUBLICATIONS (continued)

SPECIAL PAPERS

	Price	√
2 Field geology, SW Broken Top quadrangle. 1978	5.00	
3 Rock material resources, Clackamas, Columbia, Multnomah, and Washington Counties. 1978	8.00	
4 Heat flow of Oregon. 1978	4.00	
5 Analysis and forecasts of demand for rock materials. 1979	4.00	
6 Geology of the La Grande area. 1980	6.00	
7 Pluvial Fort Rock Lake, Lake County. 1979	5.00	
8 Geology and geochemistry of the Mount Hood volcano. 1980	4.00	
9 Geology of the Breitenbush Hot Springs quadrangle. 1980	5.00	
10 Tectonic rotation of the Oregon Western Cascades. 1980	4.00	
11 Theses and dissertations on geology of Oregon. Bibliography and index, 1899-1982. 1982	7.00	
12 Geologic linears, N part of Cascade Range, Oregon. 1980	4.00	
13 Faults and lineaments of southern Cascades, Oregon. 1981	5.00	
14 Geology and geothermal resources, Mount Hood area. 1982	8.00	
15 Geology and geothermal resources, central Cascades. 1983	13.00	
16 Index to the *Ore Bin* (1939-1978) and *Oregon Geology* (1979-1982). 1983	5.00	
17 Bibliography of Oregon paleontology, 1792-1983. 1984	7.00	
18 Investigations of talc in Oregon. 1988	8.00	
19 Limestone deposits in Oregon. 1989	9.00	
20 Bentonite in Oregon: Occurrences, analyses, and economic potential. 1989	7.00	
21 Field geology of the NW¼ Broken Top 15-minute quadrangle, Deschutes County. 1987	6.00	
22 Silica in Oregon. 1990	8.00	
23 Forum on the Geology of Industrial Minerals, 25th, 1989, Proceedings. 1990	10.00	
24 Index to the first 25 Forums on the Geology of Industrial Minerals, 1965-1989. 1990	7.00	
NEW **25** Pumice in Oregon. 1992	9.00	
26 Onshore-offshore geologic cross section, northern Coast Range to continental slope. 1992	11.00	

OIL AND GAS INVESTIGATIONS

	Price	√
3 Preliminary identifications of Foraminifera, General Petroleum Long Bell #1 well. 1973	4.00	
4 Preliminary identifications of Foraminifera, E.M. Warren Coos County 1-7 well. 1973	4.00	
5 Prospects for natural gas, upper Nehalem River Basin. 1976	6.00	
6 Prospects for oil and gas, Coos Basin. 1980	10.00	
7 Correlation of Cenozoic stratigraphic units of western Oregon and Washington. 1983	9.00	
8 Subsurface stratigraphy of the Ochoco Basin, Oregon. 1984	8.00	
9 Subsurface biostratigraphy of the east Nehalem Basin. 1983	7.00	
10 Mist Gas Field: Exploration/development, 1979-1984. 1985	5.00	
11 Biostratigraphy of exploratory wells, western Coos, Douglas, and Lane Counties. 1984	7.00	
12 Biostratigraphy, exploratory wells, N Willamette Basin. 1984	7.00	
13 Biostratigraphy, exploratory wells, S Willamette Basin. 1985	7.00	
14 Oil and gas investigation of the Astoria Basin, Clatsop and northernmost Tillamook Counties, 1985	8.00	
15 Hydrocarbon exploration and occurrences in Oregon. 1989	8.00	
16 Available well records and samples, onshore/offshore. 1987	6.00	
17 Onshore-offshore cross section, from Mist Gas Field to continental shelf and slope. 1990	10.00	

MISCELLANEOUS PUBLICATIONS

	Price	√
Geology of Oregon, 4th ed., E.L. and W.N. Orr and E.M. Baldwin, 1991, published by Kendall/Hunt (add $3.00 for mailing)	25.00	
Geologic map of Oregon, G.W. Walker and N.S. MacLeod, 1991, published by USGS (add $3.00 for mailing)	11.50	
Geological highway map, Pacific Northwest region, Oregon, Washington, and part of Idaho (published by AAPG). 1973	6.00	
Oregon Landsat mosaic map (published by ERSAL, OSU). 1983	11.00	
Geothermal resources of Oregon (published by NOAA). 1982	4.00	
Mist Gas Field Map, showing well locations, revised 1992 (Open-File Report O-92-1, ozalid print, incl. production data)	8.00	
Northwest Oregon, Correlation Section 24. Bruer and others, 1984 (published by AAPG)	6.00	
Oregon rocks and minerals, a description. 1988 (DOGAMI Open- File Report O-88-6; rev. ed. of Miscellaneous Paper 1)	6.00	
Oregon Minerals Tax Force, Mineral taxation feasibility study, 1992	5.00	
Oregon Seismic Safety Policy Advisory Commission, Report to the Governor and the Legislative Assembly for 1991-1993, 1992	5.00	
Mining claims (State laws governing quartz and placer claims)	Free	
Back issues of Oregon Geology	2.00	
Color postcard: Oregon State Rock and State Gemstone	1.00	

Separate price lists for open-file reports, tour guides, recreational gold mining information, and non-Departmental maps and reports will be mailed upon request. The Department also sells Oregon topographic maps published by the U.S. Geological Survey.

ORDER AND RENEWAL FORM

Check desired publications in list above or indicate how many copies and enter total amount below. Send order to **The Nature of Oregon Information Center, Suite 177, 800 NE Oregon Street, Portland, OR 97232**, or to **FAX (503) 731-4066**; if you wish to order by phone, have your credit card ready and call **(503) 731-4444**. Payment must accompany orders of less than $50. Payment in U.S. dollars only. Publications are sent postpaid. All sales are final. Subscription price for *Oregon Geology*: $8 for 1 year, $19 for 3 years.

Renewal ___ / new subscription___ to *Oregon Geology*: 1 year ($8) or 3 years ($19) $_____

Total amount for publications marked above: $_____

Total payment enclosed or to be charged to credit card as indicated below: $_____

Name _____

Address _____

City/State/Zip _____

Please charge to Visa__ / Mastercard__, account number: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Expiration date: ☐☐ ☐☐

Cardholder's signature _____