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OREGON'S MINERAL AND METALLURGICAL INDUSTRY IN 1973

Ralph S. Mason, Deputy State Geologist
Oregon Department of Geology and Mineral Industries

The value of minerals produced in Oregon in 1973 increased a healthy 8.77 percent over the previous year. Higher production of sand and gravel, nickel, clays, and cement accounts for the increase. Production of stone declined somewhat from 1972. The dollar value of all minerals produced in the State amounted to $83,231,000, according to a preliminary estimate prepared by the U.S. Bureau of Mines. This figure reflects the pit price of the minerals only; it excludes any value added by beneficiation as well as the value of primary metals such as nickel, aluminum, steel, and the various exotic metals that are smelted and refined in Oregon.

In a year marked by rapid and large price increases for most commodities, it is interesting to observe that the sand and gravel unit cost rose only 4.9 percent, and the stone industries' yearly average showed no increases in unit costs whatsoever.

Industrial Minerals

Sand and gravel and stone accounted for 64 percent of the State's total mineral production in 1973. On a per capita basis each person living in Oregon accounted for about $26.50 worth of these two commodities during the year. Very likely this expenditure represented the "best buy" made, since mineral aggregates produced in the State still sell at bargain prices. Just how long this situation will prevail is problematical since energy plays a large part in aggregate production and delivery costs. Production costs will undoubtedly increase as operators begin complying with the Mined Land Reclamation Act, which requires the eventual reclamation of the pit site as well as some changes in operational procedures.

Deposits of sand and gravel and stone are non-renewable; we are rapidly depleting them or removing them from mining by urbanization. As the demand increases and the supply shrinks, the price will inevitably rise. Careful planning will extend the useful life of the deposits, and more effort in this direction is imperative because no substitute has been found.

The per capita annual need for mineral aggregates for the manufacture of concrete in the United States amounts to 9,000 pounds of sand and gravel and 8,500 pounds of stone, to which might be added 800 pounds of cement and 600 pounds of clays, plus smaller amounts of other minerals. All of these products are low-value items in terms of their weight. Transportation from pit to market place represents a large part of the delivered cost, and with rising fuel costs, the need for local supplies becomes increasingly more important.

SOME OF OREGON'S MINERALS AT A GLANCE

Mineral	1972	1973
Clays	$ 238,000	$ 278,000
Gem stones	793,000	793,000
Lime	2,129,000	2,577,000
Nickel	W	W
Pumice and volcanic cinder	W	1,191,000
Sand and gravel	34,981,000	35,631,000
Silver	4,000	½*
Stone	18,380,000	17,654,000
Value of items that cannot be disclosed: Cement, diatomite, gold, talc, tungsten, and values indicated by symbol W	19,991,000	25,107,000
Total	$76,516,000	$83,231,000

½* Less than ½ unit

The Metals

Gold disappeared from the U.S. Bureau of Mines listing of commodities produced in Oregon during 1973, almost certainly the first time since records have been kept. Commercial gold production, troubled by increasing environmental restraints, has been declining for many years despite a firming of prices. Non-commercial, or recreational, gold mining has increased sharply in recent months but data on production is difficult if not impossible to obtain.

Whether or not the price of gold will stabilize at a price sufficiently high to attract major mining companies in the face of environmental restrictions remains to be seen.

Mercury production declined to the vanishing point during the year, following the general world-wide downward trend triggered by adverse reports on mercury published earlier.

As with gold and mercury, silver production decreased; in Oregon it is mineralogically associated with gold and produced largely as a co-product.

Nickel ore production at Riddle increased by 7 percent over the previous year, although the nickel content of the ore declined from 1.20 percent in 1972 to 1.17 in 1973. The Riddle operation produces the only primary nickel in the United States and accounts for roughly 8 percent of the total U.S. demand.

Aluminum production, despite a temporary shutdown at Reynold's Troutdale plant due to power shortage, increased 50 percent in the state over the previous year.

Mined Land Reclamation

Although the Legislature passed a Mined Land Reclamation Act during the 1971 session, administration of the new law was hampered by lack of funding. During the year, one man was hired to inventory all mining operations in the State to develop an accurate data base for the Department's files. The 1973 legislative session revised the fee schedule, which provided extra funding to hire more personnel. Rules and regulations for administering the act were formulated and two public hearings were held during the year. Since that time, one additional geologist has been hired to assist in administering the act, and more personnel will be added to the staff when additional funds are acquired as a result of the new fee schedule. The inventory of mining operations, which is essentially complete, will place possibly 800 to 1,000 mining operations in the State under the act.

After much deliberation, the Department adopted Rules and Regulations for the administration of the act, and these, together with copies of various forms, were printed and made ready for distribution. A separate office was opened at Albany to handle the various phases of the Mined Land Reclamation Act. Correspondence concerning the act should be sent to Department of Geology and Mineral Industries, P.O. Box 1028, Albany, Oregon 97321; telephone number is (503) 926-5571, ext. 277. Copies of the act, rules and regulations, and the various forms may also be obtained at the Department offices in Portland, Grants Pass, and Baker.

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OIL AND GAS EXPLORATION IN 1973

Vernon C. Newton, Jr.
Petroleum Engineer, Oregon Dept. Geology and Mineral Industries

There is still potential for finding deposits of oil and gas in Oregon in spite of many past drilling failures. No commercial production has been discovered thus far in nearly 200 attempts. However, only 32 deep holes have been put down onshore in Oregon since 1945 and only 8 holes drilled offshore since activity began there in 1965. Deep drilling has greatly increased knowledge of subsurface conditions in this geologically complex region. Results of deep drilling have been generally discouraging, but they have shown that there is a thick section of marine sedimentary rocks and that at many locations porous and permeable sands exist within the stratigraphic section.

Exploration activity

Three major oil companies continued geologic studies in Oregon in 1973. The work is believed to have consisted of surface mapping subsequent to geophysical surveys made a year or two earlier.

Standard Oil Company of California drilled an 8,414-foot test hole in southeastern Malheur County this past summer. The hole was drilled on the 100,000-acre Blue Mountain Federal Unit (see Figure 1) 25 miles north of McDermitt, Nevada. Rocks on the surface in the vicinity of the site are mapped as Miocene volcanics and some areas of younger terrestrial sediments. Standard plugged and abandoned the Blue Mountain test in August and released the drilling equipment. Statistics on the well are as follows:

STATE DRILLING PERMIT NO. 64

Standard Oil Co. of Calif.	Blue Mtn. Fed. Unit No. 1	SW¼, sec. 34 T37S, R41E Malheur County	8,414 TD	Abandoned August 8, 1973

Leasing

Acquisition of oil and gas leases in 1973 continued to be substantially slowed by the moratorium on Federal lands declared in December 1971 by Secretary of the Interior Morton because of environmental questions raised by the Oregon Environmental Council and supported by the State Department of Environmental Quality and Senator Packwood. Action on applications in the state for 447,000 acres of Federal leases was postponed

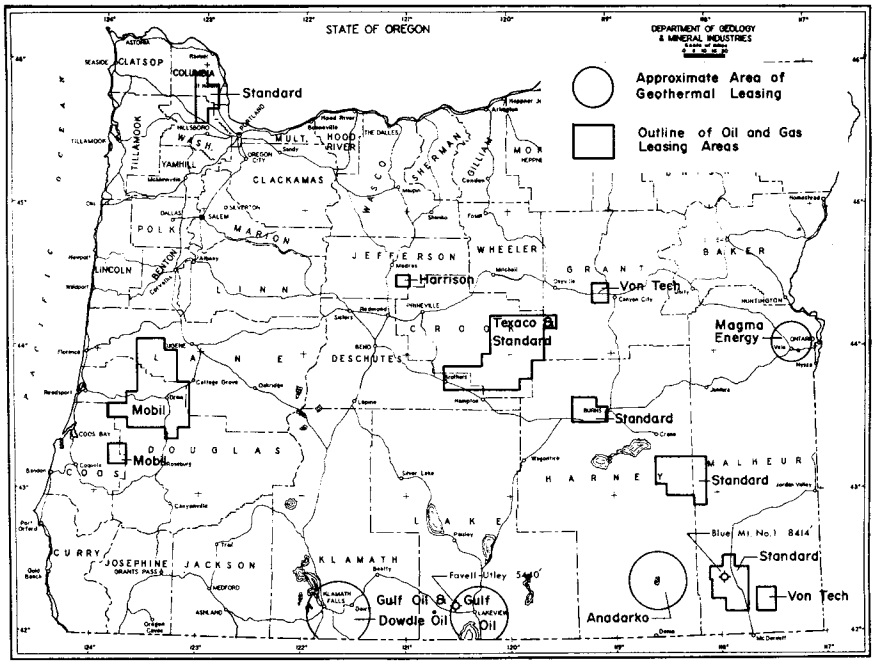

Figure 1. Map showing location of petroleum and geothermal lease areas, 1973.

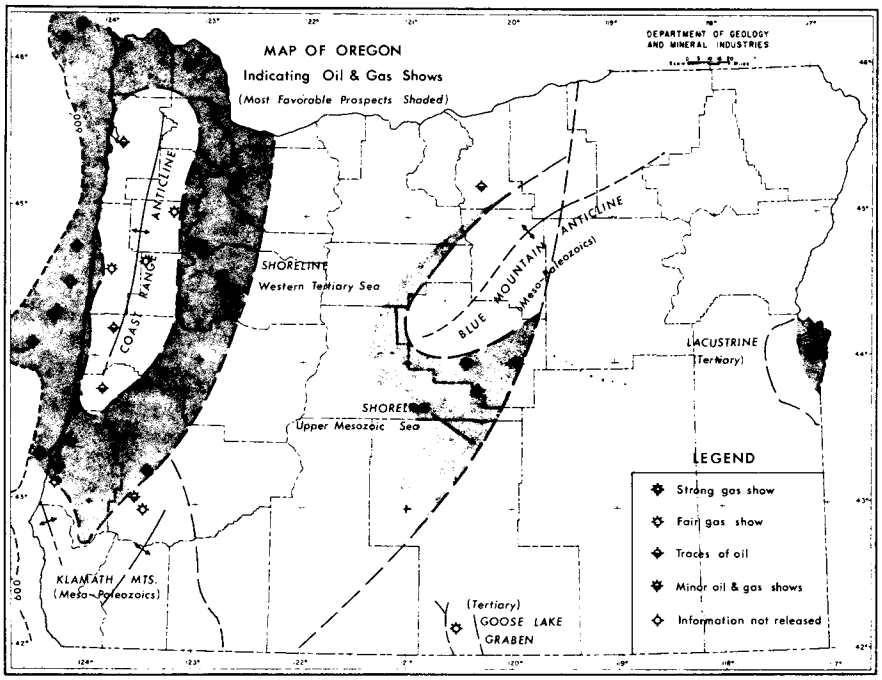

Figure 2. Map indicating favorable drilling prospects and wells with hydrocarbon shows.

until a determination of environmental effects of drilling could be made. With nearly 56 percent of the State owned by the Federal government, Federal policies have a significant influence on leasing activity. Early in January 1974, Governor McCall contacted Secretary Morton and urged that the impact study controversy in Oregon be resolved to allow reopening of Federal lands to leasing. Processing of applications for Federal oil and gas leases will probably be resumed in the near future.

Texaco renewed existing Federal leases in central Oregon following abandonment of its wildcat near the town of Paulina in November 1971. Gas shows were logged in what appeared to be Cretaceous sandstone. The Wolf Brothers, independent operators from Denver, and AMOCO Production Company withdrew applications for more than 200,000 acres of Federal leases, which were shelved by the moratorium. Leases on public lands for petroleum and geothermal resources are shown in Figure 1. Federal lands under lease as of January 1, 1974 were 232,000 acres.

Favorable areas

Past drilling has delineated regions of the State where more exploration could be done to find oil and gas deposits. Geologic features are greatly simplified in Figure 2 to portray regional conditions. A large area of the western Tertiary marine basin onshore is still open to more testing, and much of the adjacent continental shelf has never been explored by drilling. The prospective shelf areas include a deep sedimentary basin off Coos County.

Geology of the central State region is complicated by a thick cover of Tertiary volcanic rocks, and until more deep drilling is done subsurface conditions cannot be well understood. The mantle of volcanic rocks is penetrated with difficulty or not at all by present geophysical tools. Most of the surface seeps of oil and tar found in the State occur in this region, but even in central Oregon surface indications of petroleum are rare. The Mesozoic prospects shown in Figure 2 probably could be extended if deep holes were put down a distance from the Mesozoic outcrop areas.

The eastern Oregon Tertiary lake basin has had numerous interesting gas shows. This sedimentary basin is several thousand feet deep and has a potential for gas production, providing permeable sands can be found in the stratigraphic section. Tests on gas samples from a well in the Idaho portion of the basin showed that it contained petroleum condensate. Gas shows have been encountered in Goose Lake graben also, but producing possibilities in that area appear to be quite limited.

Deep wells which encountered shows of oil or gas have been plotted in Figure 2. For the most part, the oil shows were in trace amounts. Gas shows plotted rate a "fair show" classification; either they were obtained in a water-saturated zone or they were found in beds with low permeability. An exception is the Reserve Oil and Gas Company gas show, which is classed

as strong since a formation test on the zone between 7,055 and 7,106 feet in volcanic rock yielded 2,000 B/D of very gassy saltwater with a bottom-hole flow pressure of 4,482 psi . Oil shows in the Uranium Oil and Gas Co. and Oil Developers wells on the southeastern border of the Tertiary basin were better than trace amounts; the first was probably found in Cretaceous sandstone and the latter obtained in lower Eocene sandstone. Gas shows were recorded from 1,700 to 3,600 feet in Cretaceous sandstone in the Texaco well drilled in central Oregon in 1971 (Figure 3).

Shaded areas in Figure 2 show prospective regions of sedimentary basins where it is believed the thickness of rocks is great enough and the geologic structure suitable for accumulation of hydrocarbons. Several good drilling plays should be found in these areas, depending upon the results of supporting geological and geophysical data.

Private industry should be encouraged to explore in Oregon, as a discovery of oil or gas at this time would be very beneficial to the state. Dangers of oil and gas development have been greatly exaggerated since

Figure 3. Texaco "Federal No. 1," drilled in Crook County during 1971, logged gas shows in Cretaceous sandstone between 1700 and 3600 feet.

the Santa Barbara incident. Even though this blow-out is commonly referred to as a catastrophe, no one was killed in the accident and the birds and aquatic life re-established their prior natural balance within a year of the accident (Steinhart and Steinhart, 1972). Beaches along the bordering coastline and the boat harbor were restored essentially to normal conditions 45 days after the well blew wild in spite of severe storm conditions which prevailed at the time.

The physical property of oil preventing it from mixing with water should make it less hazardous to aquatic life than soluble pollutants. Crude oil is only moderately toxic as compared to some refined products transported in coastal waters (Holt, 1969). The increasing pollution of coastal water by waste effluents is a much greater threat to aquatic life than infrequent oil spills (Steinhart and Steinhart, 1972). Ocean spills are dissipated by dispersion, evaporation and bacterial degradation.

Oil development has been successfully conducted in metropolitan centers, exclusive residential areas, and wild life reserves. Screens, buried facilities, and subsea installations can be used to preserve aesthetic values while essential resources are recovered.

There are some risks involved in obtaining underground fluids. These include the possibility of subsidence in certain geologic circumstances, induced slippage along active faults, accidental spills, and contamination of water resources. Under existing regulations in most states, including Oregon, occurrence of any of these detrimental side effects will be rare.

At the present time, there are no substitutes for fossil fuels. They supply 95 percent of our present energy needs and very likely will continue to be the main supply for at least the next few decades.

All energy sources produce some measure of undesirable environmental side effects, but with planning and wise control, energy resources can be used without destroying or seriously impairing the environment.

References

1. U.S. Geological Survey, 1969, Pictures of the oil spill in Santa Barbara channel, 1969: U.S. Geol. Survey Pacific Region Branch of Oil and Gas Operations, January to May 1969.
2. Holt, D. P., 1969, Oil on the Sea; Proceedings of Symposium on Technology; Massachusetts Institute of Technology and Woods Hole Oceanographic Institute, May 16, 1969: New York, Plenum Press.
3. Steinhart, C. E., and Steinhart, J. S., 1972, Blowout, a case study of the Santa Barbara oil spill: North Scitaute, Mass., Duxbury Press.

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GEOTHERMAL ACTIVITY IN 1973

Richard G. Bowen
Economic Geologist, Oregon Dept. of Geology and Mineral Industries

The beginning of a new level of activity in geothermal exploration was seen in 1973. Awareness of the potential of geothermal resources has finally begun to penetrate the ranks of governmental and industrial decision makers, helped a great deal by the "energy crisis."

The Final Environmental Statement for the Geothermal Leasing Program was released during 1973 and a summary on page III-85, Vol. I, capsulized the results of the 3-year effort:

"While geothermal development will impose some unavoidable adverse environmental impacts, it appears to have the potential of being less environmentally damaging than other power generation systems using coal, oil, or nuclear energy sources. To the extent that there are net reductions in air, water, or land adverse impacts, such differences represent a positive benefit from use of geothermal resources."

As a result of the environmental study, Secretary of Interior Rogers C. B. Morton announced the decision of the Department to open all areas outside of the Known Geothermal Resource Areas (KGRA's) for filing and to take application on lands within three KGRA's in California at the Clear Lake-Geysers KGRA, Mono-Long Valley KGRA, and the East Mesa KGRA.

On the national level, the Atomic Energy Commission has started moving agressively to enlarge its sphere of interest in its drive to become the Energy Agency. Consequently it has been able to preempt nearly all the Federal research and development funds allocated to geothermal studies.

U.S. Geological Survey studies have expanded modestly and are including geothermal-related research in Oregon, Idaho, and Nevada, in addition to the more extensive studies in California.

Several significant test wells were drilled in 1973. The most extensive program was that of Gulf Oil Company, which drilled five slim-hole geophysical evaluation tests to depths greater than 5000 feet. Four of these wells were drilled in northern California, two near Susanville and two near Cedarville, and one well in Oregon near Lakeview. Gulf announced these wells were all drilled to evaluate geophysical exploration methods and consequently no information other than drilling depth has been released on any of the wells. Subsequent to the drilling in Lakeview, a representative of Gulf told a meeting of the local Lions and Rotary Clubs that they were "not discouraged" from the test and would be continuing work in the area next summer.

Other specific developments have been the increasing of leasing on private lands in many western states; the drilling of two exploration tests

near Chandler, Arizona by Geothermal Kinetics Systems, which are still being evaluated; the continuation of drilling by Union Oil and Dunigan Enterprises in the Valles Caldara, New Mexico area; and the continued drilling activity in the Imperial Valley and at The Geysers in California.

At The Geysers several successful wells were drilled during the year, and by late fall five drilling rigs were enlarging the field. Another power plant containing units 9 and 10 came on line, increasing output to 396,000 kw, thus making it the largest geothermal facility in the world. Construction on unit 11 is underway, with operation scheduled in 1974.

The current shortages and increasing costs in the energy field are causing a reevaluation of geothermal potential, and many firms are now giving serious consideration to its use for space and process heating. This use broadens the application and greatly increases the usefulness of the resource.

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GEOTHERMAL LEASING PROCEDURE FOR STATE LANDS

The Oregon Division of State Lands introduced a draft of leasing procedures for geothermal resources at the December 21, 1973 meeting of the State Land Board. Copies of the draft have been sent to industry and to environmental organizations for review. Hearings on the new regulations are scheduled for February 1974, and final approval is expected by March. Present applications for geothermal leases on State lands total approximately 25,000 acres. The Oregon leasing procedures differ from the Federal regulations in that they set no maximum on acreage and competitive bidding is not initiated until a discovery is made.

Leasing summary

Stage 1. A. Exploration Lease - Two years of any exploration method except deep drilling. Developer determines the possibility of a discovery; if good, he submits:

B. Land use environmental impact analysis - With facts to be used by the Lands Division before devoting land to geothermal use. Then the Division requests additional information from the public at a:

C. Public hearing - If the Division then decides to go ahead:

Stage 2. D. Deep Drilling Lease - Five years of additional exploration including at least one 4,000 foot well; if the well is a:

E. Discovery - When proven, it vests a right to a Production Lease subject to:

Stage 3. F. Development environmental impact analysis and plan;

G. Geothermal Production Lease - For a ten (10) year primary term renewable to fifty (50) years.

GEOTHERMAL LEASE REQUIREMENTS

	Exploration Lease		Deep Drill Lease					Production Lease	
	1st	2nd	1st	2nd	3rd	4th	5th	1st-10th	Later
Rent/Acre/Year	$1.00	$1.00	$1.00	$2.00	$3.00	$4.00	$5.00	$5.00 Appl. to royalty	Reappraise
Exploration expense/Acre/Year	$1.00	$1.00	$1.00	$2.00	$3.00	$3.00	$3.00	-0-	
Drilling requirement	---	---			to 4,000 feet	Carry	Carry	Per development plan	
Royalty	---	---	---	---	---	---	---	10%	
Bond	$10,000	Same	$10,000	Same	Same	Same	Same	$100,000	Same
Insurance	$20/40/20,000 to $50/100/50,000	Same	$100/200/ 100,000	Same	Same	Same	Same	$100/200/ 100,000	Same
Environmental analysis		Land use - data costs and pub.					Develop-ment -- data costs		
Environmental protection	Restoration costs	Restoration costs	Negotiated agreement	---	----	---	---	Negotiated agreement on plan	As required by law

FIELD WORK IN OREGON DURING 1973

John D. Beaulieu
Stratigrapher, Oregon Dept. Geology and Mineral Industries

During the 1972 field season, approximately 90 geologic field studies were conducted in Oregon. The list below includes those of which the Oregon Department of Geology and Mineral Industries is aware. For convenience the state is roughly divided into six sections.

The list is probably not complete and the Department would appreciate receiving information about other studies in progress in this State. The resumés received thus far have been invaluable in completing this list, and the Department is grateful for these contributions. Unless stated elsewhere, no reports on the following studies are available through this Department.

Northwestern Oregon

1. Geologic hazards of Bull Run Watershed: John D. Beaulieu
2. Environmental geology of western Linn County: John D. Beaulieu and Paul W. Hughes, Dept. of Geol. and Mineral Industries
3. Erosion processes of the Willamette Valley: W. M. Brown and S. A. Vickers, U.S.G.S., Portland
4. Biostratigraphy of the type Nestucca Formation: A. D. Callender, graduate student, P.S.U.
5. Ground water of Harrisburg-Halsey area: F. J. Frank, U.S.G.S., Portland, in coop. with State Engineer
6. Ground water of coastal Lincoln County: F. J. Frank and A. Laenen, U.S.G.S., Portland, in coop. with State Engineer
7. Micropaleontology of type Yamhill Formation: Larry Gaston, graduate student, P.S.U.
8. Oregon coastal landforms: David Greene, U of O graduate student, geography
9. Portland earthquake potential: Paul Hammond, professor, P.S.U.
10. Volcanic hazards of Mount Hood: Paul Hammond, professor, P.S.U.
11. Bauxite trace elements: R. L. Jackson, graduate student, P.S.U.
12. Ground water in north Clackamas County: A. R. Leonard, U.S.G.S., Portland, in coop. with State Engineer
13. Amphibole-bearing volcanic rocks of the Cascades: G. L. Millhollen, professor, U of South Carolina
14. Micropaleontology of the Nestucca: Daniel McKeel, Mobil Oil Corp.
15. Volcanic chronology: A. McBirney, professor, U of O, and J. Sutter, professor, Ohio State U
16. Keasey Formation: Kris McDougall, graduate student, U.S.C.

17. Field relations of Tyee and Yamhill Formations: Robert McWilliams, professor, Miami U.
18. Astoria Formation: Al Niem, professor, O.S.U.
19. Oil and gas investigations in Columbia and Clatsop Counties: V. C. Newton, Dept. of Geol. and Mineral Indus.
20. Environmental geology of Marquam Hill, Portland: R. A. Redfern, graduate student, P.S.U.
21. Micropaleontology of Alsea Formation: W. W. Rau, geologist, State of Washington
22. Central Oregon Coast field check: P. D. Snavely and others, U.S.G.S. Menlo Park
23. Alsea Formation: P. D. Snavely and others, U.S.G.S., Menlo Park
24. Continental Margin: P. D. Snavely and others, U.S.G.S. Menlo Park
25. East Portland water quality: F. M. Tawfik, graduate student, P.S.U.
26. Zeolites in Goble volcanics: R. Tschernich, and W. S. Wise, U.Calif.
27. Pioneer Summit foraminifers: R. Thoms, professor, P.S.U.
28. Columbia River Gorge: A. C. Waters, professor, U. Calif., Santa Cruz
29. Cenozoic floras: J. A. Wolfe, U.S.G.S., Menlo Park

Southwestern Oregon

1. Miocene stratigraphy: W. O. Addicott, U.S.G.S., Menlo Park
2. Sedimentation: H. E. Clifton, U.S.G.S., Menlo Park
3. Eocene synthesis: E. W. Baldwin, professor, U of O
4. Alpine ultramafic petrology: R. Coleman, U.S.G.S., Menlo Park
5. Rogue Formation and related rocks: Mike Garcia, graduate student, U.C.L.A.
6. Graywackes, C. E. Hedge, U.S.G.S., Menlo Park
7. Geology of NW$\frac{1}{4}$ Roseburg sheet: Z. Huq, graduate student, U of O
8. Cretaceous of Canyonville and Days Creek quadrangles: D. Jones, U.S.G.S., Menlo Park
9. Quaternary sedimentation: R. J. Janda, U.S.G.S., Menlo Park
10. Geology along South Fork of Umpqua: A. Kays, professor, U of O
11. Alpine type ultramafics: R. A. Loney, U.S.G.S., Menlo Park
12. Soils of Siuslaw National Forest: H. A. Legard, U.S. Forest Service, Eugene
13. Aeromagnetic survey: D. R. Mabey, U.S.G.S., Menlo Park
14. Cenozoic marine vertebrates: C. Repenning, U.S.G.S., Menlo Park
15. Ground water of the Sutherlin area: J. H. Robison, U.S.G.S., Portland, in coop. with Douglas County
16. Geologic hazards of coastal Lane County: H. G. Schlicker, Dept. of Geol. and Mineral Indus.
17. Geology of SE$\frac{1}{4}$ Dixonville quadrangle: W. Seeley, U of O
18. Lower Tertiary orbitoids: R. Thoms, professor, P.S.U.
19. Josephine Peridotite: Scott Vail, graduate student, O.S.U.

North-central Oregon

1. Mineralogy of John Day tuffs: D. W. Baggs, graduate student, P.S.U.
2. Stratigraphy of Columbia River Basalt: R. D. Bentley, professor, Central Washington State College
3. Volcanic thermal studies: J. D. Friedman, U.S.G.S., Menlo Park
4. Picture Gorge Basalt: J. S. Fruchter, graduate student, U of O, and G. Goles, professor, U of O
5. Flat-topped volcanic landforms: B. Gannon, graduate student, P.S.U.
6. Quartzville mining district; F. R. Johnson, graduate student, O.S.U.
7. ERTS imagery: R. Lawrence, professor, O.S.U.
8. Clarno Formation: P. C. Owen, graduate student, O.S.U.
9. Deschutes County mineral resources: N. Peterson, Dept. of Geol. and Mineral Indus.
10. Water resources of Warm Springs Indian Reservation: J. H. Robison, U.S.G.S., Portland, in coop. with U.S. Federated Tribes
11. Clarno Formation: A. Rollins, graduate student, O.S.U.
12. Paleobotany: R. A. Scott, U.S.G.S., Menlo Park
13. Glacial geology: W. E. Scott, graduate student, U of O
14. Strain of volcanoes: D. A. Swanson, U.S.G.S., Menlo Park
15. Regional volcanology: R. L. Smith and H. R. Shaw, U.S.G.S., Portland
16. Broken Top: E. Taylor, professor, O.S.U.

South-central Oregon

1. Pliocene basalts: J. C. Avent, professor, Fresno State College
2. Volcanic geology near Klamath Falls: G. Davis, and G. MacPherson, graduate students, U. Calif., Santa Cruz
3. Pleistocene shorelines: Charles Forbes, graduate student, U of O, geography
4. Mineralogy and geology, Paisley Mountains: J. W. Hammitt, graduate student, O.S.U.
5. Inventory hot water uses in Klamath Falls: N. Peterson, Dept. of Geol. and Mineral Indus.
6. Warner Valley lakebeds: D. L. Weide, U. Nevada, Las Vegas

Northeastern Oregon

1. Mineral deposits of Big Lookout Mountain area: G. M. Cox, graduate student, O.S.U.
2. Platinum group metals: G. A. Desborough, U.S.G.S., Menlo Park
3. Banded rhyolites - trace elements: G. B. Hallock, graduate student, P.S.U.
4. Jurassic of North America: R. Imlay, U.S.G.S., Menlo Park
5. Columbia River Basalt of Imnaha Canyon area: W. Kleck, graduate student, P.S.U.

6. Grande Ronde dike swarm: S. A. Price, Atlantic Richfield Hanford Co.
7. Columbia River Basalts, Imnaha to Grande Ronde River area: S. Reidel, graduate student, W.S.U.
8. Columbia River Basalt, Grande Ronde River: M. Ross, graduate student, W.S.U.
9. Columbia River Basalt: D. A. Swanson, U.S.G.S., Menlo Park
10. Geology of chromium: T. Thayer, U.S.G.S., Menlo Park
11. Pre-Tertiary of John Day area: T. Thayer, U.S.G.S., Menlo Park
12. Geology Snake River Canyon: T. Vallier, professor, Indiana State U.
13. Eagle Cap Wilderness: P. Weis, U.S.G.S., Spokane
14. N½ Bates quadrangle: G. Wheeler, graduate student, U of W

Southeastern Oregon

1. Geothermal studies: R. Bowen, Dept. of Geol. and Mineral Indus.
2. Volcanic stratigraphy of the Cordera quicksilver area: R. C. Greene, U.S.G.S., Menlo Park
3. Hydrologic reconnaissance of geothermal areas: E. A. Sammel, U.S.G.S. Menlo Park
4. Geothermal resources: J. H. Sass and A. H. Lachenbruch, U.S.G.S., Menlo Park
5. Zeolitic tuffs near Durkee: R. Sheppard, U.S.G.S., Menlo Park
6. Geothermal reconnaissance: G. Walker, N. MacLeod, E. McKee, U.S.G.S., Menlo Park
7. Oregon State map: G. Walker, U.S.G.S., Menlo Park

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NORMAN S. WAGNER RETIRES

N. S. Wagner, district geologist in charge of the Department's Field Office in Baker, retired on December 31 after 31 years of service. "Wag" came to the Department during World War II after working as a geologist and assayer for the Idaho-Maryland mine in the Grass Valley area of California and at the West Coast mine near Winnemucca, Nevada. During his time with the Department, he has authored or co-authored at least 40 reports on the geology and mineral resources of eastern Oregon, including stratigraphic and ground-water studies, geologic mapping, articles on mining history, and surveys of innumerable mineral commodities. He has rendered particularly valuable service to the mining industry by contributing his broad knowledge on the mineral potential of this large region.

Wag's recent acquisition of some top-notch photographic equipment, his keen interest in mining lore, and his knack for writing it down, lead us to anticipate seeing some interesting results in the publications field.

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GEOLOGIC HIGHWAY MAP OF OREGON AND WASHINGTON

The Department has received for sale "Geologic Highway Map of the Pacific Northwest Region -- Washington and Oregon" published in 1973 by the American Association of Petroleum Geologists. The sheet, measuring 28 by 36 inches, is printed in multicolor on both sides and folds to a standard highway map size. A small-scale map of Oregon and Washington shows the geology and the main towns and highways. The sheet includes considerable other information such as cross sections, time scales, index maps of special subjects, and texts describing the stratigraphy, geomorphology, and historical geology. The map can be obtain from the Department's offices in Portland, Baker, and Grants Pass for $2.50.

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LINCOLN COUNTY BULLETIN PUBLISHED

"Environmental Geology of Lincoln County, Oregon" is the latest in the Department's bulletin series. The bulletin (No. 81) describes the characteristics of the bedrock units and surficial materials, the topography, and the geologic and climatic processes at work in the area. Geologic hazards that result from the complex interplay of these factors, influenced by man's activities, are the chief concerns of the bulletin.

Most of Lincoln County's population is concentrated along its coastal terraces, where seaward-tilted bedrock overlain by sands and silts are subject to severe wave erosion and landsliding. Housing is increasing along the major valleys which, unfortunately, are fequently threatened by flooding and landslides. Very recently, development has moved into the low coastal dune areas, which are highly vulnerable to the ravages of high tides and storm waves. Demand for more land on which to build recreational facilities has resulted in many poor site selections and financial losses to individuals who have invested in the property.

Bulletin 81 is the work of four geologists, all authorities in their special fields. It is illustrated with many photographs and diagrams, and is accompanied by a set of six multicolored maps showing distribution of geologic units and areas of current or potential geologic hazard. The publication should be of great service to county planners and the concerned public.

Bulletin 81 is for sale by the Department's office in Portland, Baker, and Grants Pass. The price is $7.50.

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AVAILABLE PUBLICATIONS

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

BULLETINS

8. Feasibility of steel plant in lower Columbia River area, rev. 1940: Miller . . . $0.40
26. Soil: Its origin, destruction, preservation, 1944: Twenhofel 0.45
33. Bibliography (1st suppl.) geology and mineral resources of Oregon, 1947: Allen. . 1.00
35. Geology of Dallas and Valsetz quadrangles, Oregon, rev. 1963: Baldwin. . . . 3.00
36. Papers on Tertiary foraminifera: Cushman, Stewart & Stewart. vol. 1 $1.00; vol. 2 1.25
39. Geology and mineralization of Morning mine region, 1948: Allen and Thayer . . 1.00
46. Ferruginous bauxite deposits, Salem Hills, 1956: Corcoran and Libbey 1.25
49. Lode mines, Granite mining district, Grant County, Oregon, 1959: Koch . . . 1.00
52. Chromite in southwestern Oregon, 1961: Ramp 3.50
57. Lunar Geological Field Conf. guidebook, 1965: Peterson and Groh, editors . . . 3.50
58. Geology of the Suplee-Izee area, Oregon, 1965: Dickinson and Vigrass 5.00
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67. Bibliography (4th suppl.) geology and mineral industries, 1970: Roberts 2.00
68. The Seventeenth Biennial Report of the State Geologist, 1968-1970 . . . . . 1.00
69. Geology of the Southwestern Oregon Coast, 1971: Dott 3.75
70. Geologic formations of Western Oregon, 1971: Beaulieu 2.00
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76. Eighteenth Biennial Report of the Department, 1970-1972 . . . . . 1.00
77. Geologic field trips in northern Oregon and southern Washington, 1973 . . . . 5.00
78. Bibliography (5th suppl.) geology and mineral industries, 1973: Roberts and others 3.00
79. Environmental geology inland Tillamook Clatsop Counties, 1973: Beaulieu . . . 6.00
80. Geology and mineral resources of Coos County, 1973: Baldwin and others . . . 5.00
81. Environmental geology of Lincoln County, 1973: Schlicker and others 7.50
82. Geol. hazards of Bull Run Watershed, Mult. Clackamas Cos., 1974: Beaulieu . . .in press

GEOLOGIC MAPS

Geologic map of Oregon west of 121st meridian, 1961: Wells and Peck 2.15
Geologic map of Oregon (12" x 9"), 1969: Walker and King 0.25
Geologic map of Albany quadrangle, Oregon, 1953: Allison (also in Bulletin 37) . . 0.50
Geologic map of Galice quadrangle, Oregon, 1953: Wells and Walker 1.00
Geologic map of Lebanon quadrangle, Oregon, 1956: Allison and Felts 0.75
Geologic map of Bend quadrangle, and portion of High Cascade Mtns., 1957: Williams 1.00
GMS-1: Geologic map of the Sparta quadrangle, Oregon, 1962: Prostka 1.50
GMS-2: Geologic map, Mitchell Butte quad., Oregon: 1962, Corcoran and others . . 1.50
GMS-3: Preliminary geologic map, Durkee quadrangle, Oregon, 1967: Prostka . . . 1.50
GMS-4: Gravity maps of Oregon, onshore & offshore, 1967: Berg and others
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[Continued on back cover]

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5. Oregon's gold placers (reprints), 1954 . . . . . 0.25
6. Oil and gas exploration in Oregon, rev. 1965: Stewart and Newton 1.50
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