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## OREGON'S MINERAL AND METALLURGICAL INDUSTRY IN 1967

\* By R. S. Mason

Oregon mineral production has surged to an all-time high and passed the \$100-million mark for the first time. This milestone serves to point up the vital impact of the industry on the state's economy. It also furnishes one of the best indicators of the growth and development of the state. The mineral industry provides the basic building materials at all levels from the multimillion-dollar dam to the do-it-yourself patio. The industry is self-supporting, tax-paying, and ever responsible to community needs for "growth minerals." Minerals are indestructible but vulnerable to indifference and poor planning. Minerals are inert, but they provide the vital ingredients for our modern way of life.

In 1966, the latest year for which final production figures are available, Oregon's mineral industry exceeded the \$100-million mark for the first time--a vigorous increase of 30 percent over 1965. Preliminary estimates by the U.S. Bureau of Mines indicate a decline in value for 1967, but characteristically the preliminary figures are much lower than the final figures released later (table 1). A comparison between the Bureau's estimates and final production figures for the period 1961-1966 is shown in table 2, along with percentage increases over the previous year.

Although the \$107 million value reported set an all-time record, it did not include such Oregon-produced metallurgical products as ferro-nickel, pig aluminum, ferrosilicon, elemental silicon, the various exotic metals, regular and alloy steels, calcium carbide, and other furnace products. The value of these metallurgical products is considerable, but no figures are published to show the dollar total. Mineral production exceeded one million dollars in 19 of the state's 36 counties in 1966 (table 3). The rapid increase in the value of the state's mineral and metallurgical production is perhaps best illustrated by the fact that the value is doubling ever more frequently. Starting in 1942, it required 10 years to double the value, followed by an 8-year period in which it doubled again. The last doubling required only 6 years. Figure 1 shows the growth of the state's mineral industry for the period 1942-1966. During this 25-year period, the

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\* Mining Engineer, State of Oregon Dept. Geology & Mineral Industries.

Table 1. Some of Oregon's Minerals at a Glance  
Preliminary Figures for 1967  
(in thousands of dollars)

	1966	1967
Clays	\$ 362	\$ 328
Gold	10	6
Lime	2,283	1,724
Mercury	309	477
Sand and gravel; stone	68,615	56,000
Pumice; volcanic cinders	1,256	1,138
Miscellaneous*	19,926	17,586
Total	\$107,484	\$77,259

\* Cement, copper, diatomite, iron ore, lead, perlite, nickel, peat.

total value of production soared 664 percent.

In discussing the value of Oregon's mineral production, it must be borne in mind that the dollar values that have been reported reflect values in the pit rather than at the point of sale. Comparisons with other segments of the state's natural-resource economy are of interest, even though the commodities differ widely and the bases for computation vary (see table 4).

Oregon's mineral and metallurgical industry is many things to many people.

It supplies the aggregate and concrete for building miles of roads and dozens of bridges. It refines exotic metals for applications in outer, inner, and under space. It provides building stone for beautifying houses and other buildings, bedding material for plants, and pigment for paints. It provides more hours of recreation for "rockhounds" of all ages than any other natural resource in the state. It adds a much-needed stability to an economy plagued by seasonal employment fluctuations. It serves and benefits every community in the state. It provides jobs directly for 12,000 wage earners. Oregon's industrial-mineral producers pay taxes, cater to the varied and ever-increasing demands of growing communities, operate without benefit of federal or state subsidies, locate their own resource materials, develop, mine, and beneficiate them with their own money, and sell a product that has advanced less in price than has the general economy.

### Growth Minerals

In 1967 each person living in Oregon used an average of 7.5 tons of sand and gravel, compared to the national average of 6.5 tons. Oregon is a relatively undeveloped state which is shifting the emphasis in its construction to the more durable building materials. The demand for "growth minerals" such as crushed stone and sand and gravel has been increasing rapidly over the years and the curve will be steeply upward in the future. The unit value of a ton of sand and gravel increased 42.5 percent between 1942 and 1966, while the tonnage produced increased 430 percent. Average value for a ton of sand and gravel produced in 1966 was only 96.2 cents. It has been calculated that the demand for sand and gravel in the period 1965

FIGURE 1. Volume & Value of Sand & Gravel and the  
Total Mineral Production in Oregon (1942-1966)

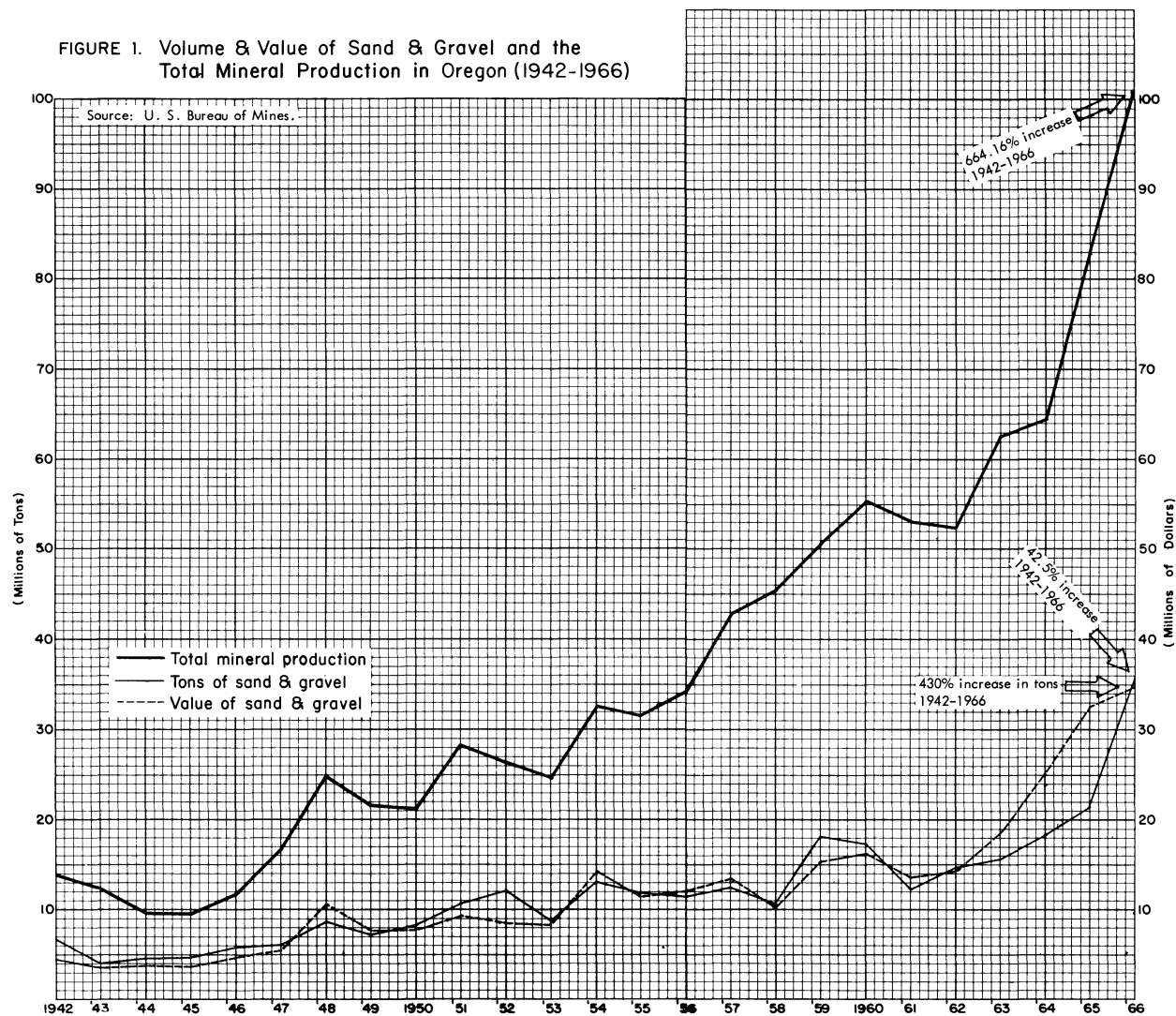


Table 2. Comparison between USBM preliminary estimates and final production figures for Oregon

<u>Year</u>	<u>Estimate</u>	<u>Final</u>	<u>% Error</u>	<u>% Increase</u>
1961	\$54,922,000	\$51,730,000	+ 6.18	--
1962	49,091,000	52,458,000	- 6.93	4.11
1963	62,693,000	62,692,000	0	19.50
1964	61,103,000	64,269,000	- 5.24	2.52
1965	68,547,000	82,967,000	-21.16	29.09
1966	80,567,000	107,454,000	-33.37	29.50
1967	77,000,000	?	?	?

to 2010 in Oregon will require the equivalent of a pit 30 feet deep, half a mile wide, and 60 miles long. In 1966 alone, a pit a mile square and 26 feet deep would have had to be excavated to equal the volume of sand and gravel produced in the state. The yield of crushed stone is roughly equal to that of sand and gravel. The state has large reserves of both of these vitally important "growth minerals" and, for the most part, they are fairly well distributed with respect to markets. In northwestern Oregon, however, rapidly increasing demand coupled with equally rapid engulfment of potential and existing sources as a result of urban expansion will create serious problems in the not too distant future.

Sand and gravel and crushed stone do not possess the same emotional appeal that other natural resources, such as fish and trees, do. The public is properly concerned over any threats to the destruction of forests, but few outcries are heard when potentially valuable quarry sites are zoned into oblivion. The problem is largely one of timing and planning. Most sand and gravel and crushed-rock operations can be conducted with a minimum of disruption of the economic and esthetic values of a community, provided that adequate provisions are made to buffer the mining activities temporarily, and to plan for restoration of the pits and their final disposition. The necessity for such planning is perhaps better understood when it is realized that a sand and gravel deposit 27 feet thick and covering only an acre of land will produce 43,560 cubic yards of material, which, if mixed with a little cement and sold as concrete, would have a sale value of about half a million dollars.

"Growth minerals" are unique among the state's natural resources. They are available in huge quantities but are nonrenewable. They are inflexible as to point of origin, are not subject to the destructible forces of the renewable resources, and for most applications are irreplaceable. They can, however, be rendered useless by lack of planning. Of all of the state's natural resources, "growth minerals" possess the unusual ability to provide, after a deposit has been exhausted, the basis for an entirely new use. Former



Table 3. The Million Dollar a Year Club\*

<u>County</u>	<u>Value</u>	<u>County</u>	<u>Value</u>
Baker	\$ 6,499,000	Lake	\$ 1,020,000
Clackamas	7,474,000	Lane	8,500,000
Coos	1,112,000	Linn	3,429,000
Deschutes	1,003,000	Malheur	1,091,000
Douglas	9,929,000	Marion	1,145,000
Gilliam	31,950,000	Multnomah	6,200,000
Hood River	1,465,000	Sherman	1,424,000
Jackson	3,402,000	Umatilla	1,820,000
Josephine	1,146,000	Washington	2,466,000
Klamath	2,124,000		

\* In addition to the values shown, there was a total of \$7,913,000 which could not be assigned to specific counties, plus the production from Lincoln and Morrow Counties, which was concealed to avoid disclosing individual company confidential data.

hillsides may become industrial areas after they have been leveled by quarrying, or a quarry on level ground may become a pit suitable for sanitary fill, a ready-made building excavation, or a lake in a public-use site. A classic example of this multiple return from a mining operation can be seen just west of the city of Bend in central Oregon. Former pumice pits are being used to bury lumber-mill wastes, and the numerous heaps of overburden have been smoothed and prepared for home construction and landscaped areas.

Table 4. Comparison of productive value of Oregon natural resources, 1965 or 1966\*

Forest products	1,470,000,000+	1966 estimate
Agriculture	513,570,000	1966
Mining and metallurgy	107,484,000	1966
Commercial fishing	9,300,000	1965 estimate

\* Forest products figures are based on an f.o.b. mill price for most items (data from Western Forestry and Conservation Assoc.). Agriculture values are the total cash farm receipts (data from Oregon State Department of Agriculture). Mining and metallurgy figures for industrial minerals are based on the value of the products in the pit (data from U.S. Bureau of Mines). Values for metals are national annual averages. Commercial fishing values are based on the price paid to fishermen (data from Oregon State Fish Commission).

Table 5. Summary of withdrawals of Public Domain from mineral entry during 1967.			
County	Acres	Agency Requesting	Use
Josephine	47	U.S. Dept. Agriculture	seed production
Morrow, Grant	50	U.S. Dept. Agriculture	recreation
Clatsop, Tillamook, Lincoln, Lane, Coos, Curry	346	U.S. Bureau Sports Fisheries & Wildlife	wildlife refuge
Curry, Josephine	5223	U.S. Forest Service	botanical area
Lane	430	U.S. Corps Engineers	reservoir
Umatilla	10	U.S. Forest Service	administrative site
Benton	132	U.S. Bur. Land Mgt.	recreation
Coos, Josephine	434	U.S. Forest Service	seed production, recreation
Douglas	1	U.S. Forest Service	roadside strip
Klamath	4	U.S. Forest Service	roadside strip
Umatilla	9	U.S. Forest Service	forest road system
Lane	.22	" " "	lookout
Jackson	155	U.S. Forest Service	administrative site
Grant	160	U.S. Forest Service	public use and recreation
Baker	110	U.S. Bur. Reclamation	reservoir

Federal agency withdrawals of public domain from mineral entry continued at a brisk pace during the year. A summary of the various withdrawals is given in table 5.

A pile of sand and gravel, sacks of cement, and a coil of wire do not look very impressive. When mixed properly, these same ingredients can become one of the most exciting building materials of the time. Prestressed concrete beams 100 feet long have become common, and the variety of thin-walled structural members seems endless. Precast concrete has come a long way from the solid 8x8x16-inch block. More than 100 patterns of concrete block in various colors and consistencies are available. The old solid concrete poured wall is still being used, but many modern buildings have walls that are poured flat and tilted up -- complete with window and door frames,



conduits, and reinforcing. Precast wall panels weighing tons and intricately sculptured also have everything except the glass installed when they are delivered on the job. The technology of concrete has come a long way in the past 25 years, but the next quarter of a century will see far greater strides for this number-one building material.

## The Metals

The mining and metallurgical industry as a tax-paying, profit-seeking industry must necessarily produce materials that are in demand. There is no government subsidy for not mining and refining ore, nor does the industry get paid for minerals and metals which it has produced but cannot sell. As a result, the industry is both viable and pliable. Over the years Oregon mines and mills have produced minerals and metals as they were required and in the quantities needed, in both peace and war. Years ago the West needed, above all else, two vital ingredients -- manpower and wealth. The mines attracted the men and the men produced gold and silver (wealth) in prodigious quantities. During two world wars Oregon was a major producer of strategic chrome and mercury. Today the federal government has decided that gold and silver are unimportant in our national economy and the emphasis has turned to the modern metals.

Oregon is one of the principal centers for the production of the various exotic metals used in atomic applications and space-age hardware. The state's exotic-metals industry was fully discussed in the October 1967 ORE-BIN. In addition to the unique aspects of this branch of metallurgy, some of the new metals are replacing old-line metals where severe corrosion or heat problems exist. Skins of aircraft have changed from canvas to aluminum to titanium, and exteriors of railroad passenger cars have evolved from wood, through steel, to titanium.

Wah Chang Corp. was purchased by Teledyne Inc. during the year and renamed Wah Chang Albany Corp. After the acquisition by Teledyne, the Albany plant increased its capacity for zirconium sponge by 80 percent. Heavy expenditures for fume- and waste-disposal controls were also made. Construction of a new technical center which will house a wet laboratory and spectrographic, X-ray, and neutron-absorption facilities got under way late in the year.

Oregon Metallurgical Corp. became a wholly owned subsidiary of Armco Steel Corp. early in the year and ground was broken in October for a \$2.4-million expansion of the titanium-melting complex. Three new vacuum arc melting furnaces will more than double the plant's present capacity. The new furnaces will have the capability of producing 36-inch-diameter ingots weighing 20,000 pounds, the largest in the country. Oremet is primarily concerned with titanium-ingot production. The plant also turns out titanium castings and high-purity vanadium metal. Early in the

year the third titanium-sponge reduction unit was completed out of a projected total of eight. Planning for an electrolytic magnesium and a titanium tetrachloride plant was instituted. The two plants would provide raw material for the titanium-sponge operation.

Northwest Industries operated a machining facility for reactive metals used in high-temperature and corrosion-resistant applications.

Construction began in December on two new plants in the Albany area. TiLINE Inc. is building a half-million-dollar facility for casting metal bodies around preformed linings of exotic, corrosion-resistant metals such as titanium. The products will be sold principally to the chemicals industry. REM Metals Corp. has a precision casting plant under construction with completion scheduled for late 1968. REM's products will be used by the aircraft industry.

In the Portland area the Oregon Steel Mills division of Gilmore Steel and the Midland-Ross Corp. began construction of a \$35 million steel-producing complex. Oregon Steel is building a melting and rolling-mill facility, Midland-Ross a metallized pellet plant. The plants are the newest additions to the Rivergate industrial area at the confluence of the Willamette and Columbia Rivers. Construction is scheduled for completion early in 1969. The Midland-Ross pellet plant will use iron ore imported from Peru to produce pellets containing a minimum of 95-percent iron. Oregon Steel's new plant will be able to roll plates up to 96 inches wide and from 3/16ths to 3 inches in thickness. The company's original plant on N.W. Front Avenue will continue to produce hot-rolled steel bars.

Also in the Portland area, ESCO Corp. continued to produce high-alloy castings and forgings. ESCO is a world leader in the production of nuclear-quality castings for the generation of atomic power. Precision Castparts, Milwaukie, in the Greater Portland area, is an acknowledged innovator in the manufacture of precision investment castings of alloy steels for space-research jet engines and aircraft.

### Precious metals

The production of gold and silver in the state was the lowest since the turn of the century. Rising production costs coupled with, in the case of placer-mining operations, increasing restrictions on stream use, were largely responsible for the decline. The Buffalo mine in eastern Grant County was idle during much of the year. Union Pacific leased the property to A. W. Brandenthaler, who drifted on the 500 level. Omega Mines Co. continued its underground exploration of the North Pole and the E and E mines at Bourne in the Cracker Creek District of Baker County. Gold mines in the area have a productive history extending back into the 1890's. A detailed report on the Almeda mine in Josephine County was published by the Department during the year. The Almeda mined and smelted copper ore in the period 1905 to 1917.

### Base metals

Interest in copper by two companies saw exploration programs inaugurated in the Sparta-Keating area of eastern Baker County. Bear Creek Mining Co. conducted a geological reconnaissance of the Burkemont mine area, and Cyprus Mines Co. drilled on a nearby prospect. Attention to the area followed the announcement of geochemical testing by the Department of Geology and Mineral Industries a few years ago. The Department's field work revealed the presence of a copper anomaly.

### Mercury

Despite the continuing high price for mercury, the state's production for the year was small. Active mines included the Black Butte in southern Lane County, the Glass Buttes mine in northeastern Lake County, the Elkhed mine in northern Douglas County, and the Canyon Creek mine in Grant County. Most of the state's production came from the Black Butte and Glass Buttes mines.

### Uranium

Renewed interest in uranium was shown by several companies during the year. The Nuclear Fuels Division of Gulf Oil Corp. leased 82,000 acres of state-owned land in south-central Oregon late in the year and announced plans to explore the area. Western Nuclear investigated the White King-Lucky Lass mines area in southern Lake County. The two mines have been the principal uranium producers in the state but have been idle for some time. At year's end three other companies expressed a desire to investigate uranium occurrences in the state.

### Nickel

Hanna Nickel Smelting Co. reported a record production of ferronickel for 1967 from its mine and smelter at Riddle in Douglas County. The high production reflects mechanical and metallurgical-process improvements, which are approaching design capacity of the expansion program that took place in 1964 and 1965. Hanna is the only producer of domestic nickel in the United States and furnishes the equivalent of around 10 percent of the Nation's needs.

## Industrial Minerals

### Cement, lime, and limestone

Production of cement continued from the two plants owned by Oregon

Portland Cement Co. in Baker and Clackamas Counties. Ideal Cement Co. shut down its plant at Gold Hill, Jackson County, in April and converted it into a storage and distribution center. Burnt lime was produced at the Chemical Lime plant near Baker, Baker County, and at the Ashgrove Lime and Portland Cement Co. plant at Portland. Several other lime kilns were active in the state, but their production was immediately consumed by company-owned facilities for such products as calcium carbide, sugar, and pulp.

Limestone was quarried in Baker County for the Lime plant of the Oregon Portland Cement Co. and at the Baboon Creek quarry operated by the Chemical Lime Co. Large tonnages of limestone were again imported into the Portland area from Texada Island, B.C., for use in cement, calcium carbide, and burnt lime.

#### Lightweight aggregates

Natural pumice and scoria were produced by both Central Oregon Pumice Co. and Cascade Pumice Corp., a subsidiary of Boise Cascade in Deschutes County. Both companies operate their own quarries and crushing, screening, and blending plants. Empire Building Materials Co. produced expanded shale at its quarry and kilns in northern Washington County. The plant first began operating in 1947. A pozzolan mill is operated in conjunction with the plant. The quarry and kiln, operated by Cloverleaf Mines, Inc., south of Vernonia in Washington County, was revamped during the year and was acquired by Smithwick Block Co. of Portland.

#### Miscellaneous

Production of peat continued at the Jewell's Mother Earth pit and plant near the town of Enterprise in Wallowa County. Bentonite deposits on Camp Creek in eastern Crook County were mined and sold for well-drilling mud, reservoir lining, insecticide carrier, and stock-feed binder by Central Oregon Bentonite Co. Diatomite for pet litter and floor-sweeping compound was produced by A. M. Matlock from a deposit near Silver Lake in Lake County.

#### Semi-Precious Gemstones

Oregon, which has long been a prime producer of semi-precious gemstones, continued to attract increasing numbers of "rockhounds" to its widespread deposits of quartz-family minerals. "Rockhounding" emerged during the year as the state's number one recreational activity related to a natural resource. "Rockhounds" are out combing the hills the year around, there being no open or closed "seasons" for the hobby or hunting license required. Rockhounding is a family project which includes healthful outdoor activity,

combined with home craftsmanship in the preparation of specimens. The state has numerous gem clubs which meet regularly and conduct classes and competitions. In recent years the clubs have made strenuous efforts to improve public relations. The impact of rockhounding can be judged from the one million dollars that this one recreational activity alone brought into Crook County last year. Crook County has been active in promoting rockhounding for many years and sponsors a "powwow" attended by thousands each summer. Similar events were scheduled in several other counties.

### Offshore Mineral Exploration

Exploration of Oregon's "under space" was conducted by two federal agencies during 1967. The U.S. Bureau of Mines and the U.S. Geological Survey initiated sampling and bottom-study programs along the coastline. The U.S.G.S. contracted with the Department of Oceanography at Oregon State University for much of the work.

Interest by private firms in state-owned offshore lands continued, but no programs were started owing to lack of state legislation which would permit issuance of prospecting permits and mining leases for hard minerals. Minerals of possible economic importance include gold, platinum, glauconite, magnetite, chromite, and various other "heavy blacks."

The State of Oregon owns a strip bordering the coastline which extends seaward for a distance of 3 nautical miles (a nautical mile equals 6,080.20 feet) or slightly less than  $3\frac{1}{2}$  statute miles. The configuration of the seaward boundary is determined by swinging 3-mile-radius arcs from headlands and offshore stacks and islands. The state offshore lands total slightly more than 850,000 acres, of which perhaps 500,000 acres might be suitable for offshore mining.

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### USGS PUBLICATIONS CONCERN SOUTHWESTERN OREGON

Two publications recently released by the U.S. Geological Survey are:

1. "Low-temperature reaction zones and alpine ultramafic rocks of California, Oregon, and Washington," by R. G. Coleman. Concerns tectonic origin of peridotite-dunite bodies and accompanying serpentinization. Issued as Bulletin 1247; available from Superintendent of Documents, U.S. Government Printing Office, Washington D. C. 20402, for 25 cents.
2. "Marine sediment sample preparation for analysis of low concentrations of fine detrital gold," by H. E. Clifton, A. Hubert, and R. L. Phillips. Describes Survey's techniques in analysis for gold in black sands on and offshore in southern Oregon. Issued as Circular 545; free on application to U.S. Geological Survey, Washington, D.C. 20242.

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## OIL AND GAS EXPLORATION IN OREGON

By V. C. Newton, Jr.\*

Oil companies dropped 65 of the 76 Oregon and Washington offshore leases acquired in 1964 as rentals came due in December, 1967. Only eight tracts were retained off the Oregon coast and three off Washington. Pan American Petroleum Corp. and its partners withdrew from further exploration in the Northwest following the drilling of two dry holes this past summer. The six companies remaining in the Northwestern offshore venture are expected to conduct only limited operations in the coming year. An estimated \$76 million has been spent on offshore work in Oregon and Washington since operations began in 1961.

Sites which appeared to geologists as prime targets have been drilled and no commercial production was found. Reportedly, sedimentary rocks were as thick as expected but were predominantly fine grained, with very few sand layers. Thus, even though "domes" exist, no reservoir beds were located in which oil and gas could collect. Geologic factors must be reconsidered and new ideas generated before any more exploration is done on the submerged lands.

A new exploration cycle appeared to be building onshore in western Oregon; however, it will undoubtedly be on a much smaller scale than the offshore work. Mobil, Standard, and Texaco leased more than 50,000 acres of land in western Oregon during the spring and summer of 1967. The main interest is centered in Columbia County in the northwestern corner of the state. At the same time, Mobil assembled leases at three other locations in southwestern Oregon (see figure 1).

### Offshore Activity

Pan American and others (Atlantic-Richfield, Sinclair, Superior, Canadian Superior, and J. Ray McDermott) drilled a deep test 10 miles southwest of Coos Bay on OCS Tract 102 in April 1967. Oil and gas shows were reportedly encountered but testing proved them to be noncommercial (table 1). The companies moved the floating equipment ("Blue Water II," owned by Santa Fe Drilling Co.) to northern Washington, where they drilled offshore from the mouth of the Hoh River. No shows were obtained and the

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\* Petroleum Engineer, Oregon Dept. of Geology and Mineral Industries.

Table 1. 1967 offshore holes.

Company	Location Lambert Coords.		Tract No.	Area	Total Depth	Remarks
Pan Am. et al.	X	910,010	102	Coos Bay, Ore.	6,146'	Abandoned 5/14/67. Shows reported but noncommercial.
Pan. Am. et al.	X	1,024,850	5	Hoh River, Wash.	10,368'	Abandoned 7/9/67.
	Y	266,310				
Shell	X	1,022,500	28	Grays	11,162'	Abandoned 8/20/67.
	Y	578,350		Harbor, Wn.		

hole was abandoned at a depth of 10,368 feet.

Shell Oil Co. took the equipment after the second Pan American hole and moved to a location 10 miles seaward from Grays Harbor, Wash., to drill on OCS Tract 28. No hydrocarbon shows were encountered in this hole, total depth 11,162 feet. After Shell plugged the hole on Tract 28, "Blue Water II" was towed south to Long Beach, Cal., where it was docked pending the Santa Barbara sale.

Pan American Petroleum Corp. and its partners did not renew any of its Oregon and Washington offshore leases when rentals came due in December 1967. This left 6 of the 11 companies which began the Northwest-shelf studies in 1961. The remaining participants reduced holdings to just a few tracts (see table 2). Offshore acreage cuts in Oregon and Washington have continued since drilling began in 1965, as follows:

<u>Year</u>	<u>Federal Acreage</u>	<u>Rental</u>
1965	580,800 acres	\$ 1,740,000
1966	385,000	1,155,000
1967	64,000	192,000

Shell and Standard cancelled their State submerged land leases south of Reedsport in December 1967. Each firm acquired one State parcel in December 1964. Total rentals and bonuses paid by the two companies over the three-year period 1964 to 1967 amounted to \$69,800.

There was little geophysical activity on the Northwest shelf in 1967. The University of Washington Department of Oceanography and Shell Oil Co., separately, ran several seismic traverses off the Washington coast this past summer. Standard Oil Co. and Mobil Oil Co. conducted seismic work off the Oregon coast for a two- or three-week period in 1967.



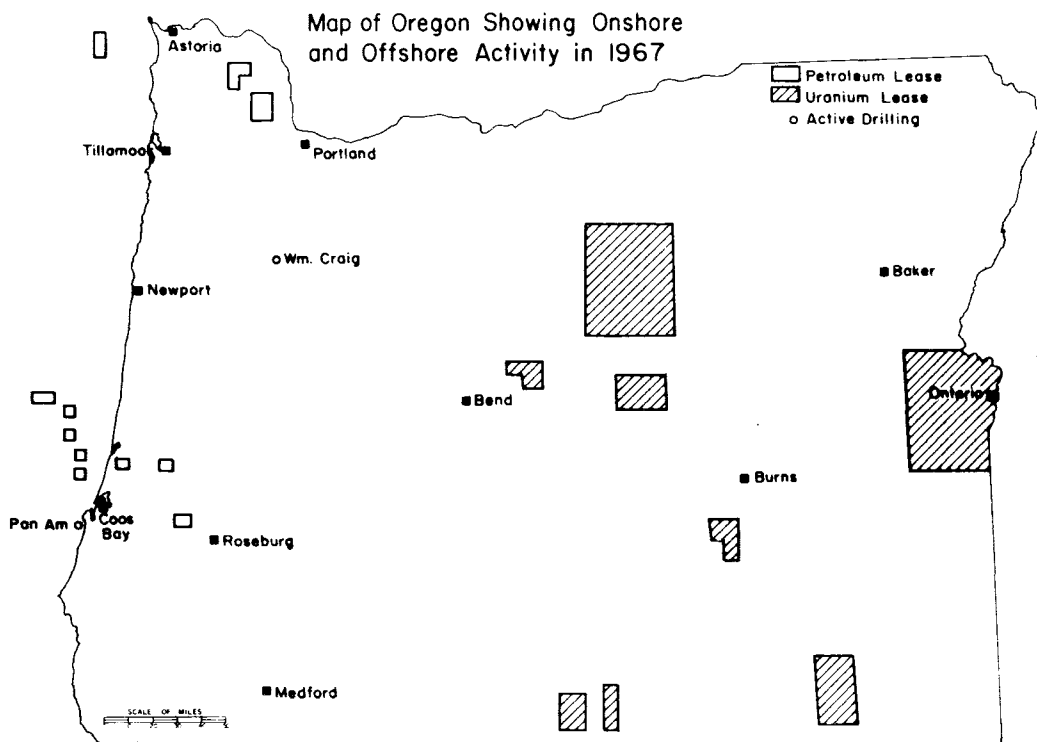


Figure 1. Map showing 1967 oil drillings and lands under lease to oil companies at the start of 1968.

Table 2. Offshore leases renewed, December 1967.

<u>Company</u>	<u>File No.</u>	<u>Tract No.</u>	<u>Area</u>
Shell	OCS-PO 73	19	Tillamook, Ore.
Shell	OCS-PO 75	22	Tillamook, Ore.
Std/Union	OCS-PO 85	39	Florence, Ore.
Std/Union	OCS-PO 86	40	Florence, Ore.
Std/Union	OCS-PO144	10	Hoh River, Wash.
Std/Union	OCS-PO145	11	Hoh River, Wash.
Std/Union	OCS-PO146	12	Hoh River, Wash.
Tex/Atl-Rich/ Mobil	OCS-PO 78	28	Florence, Ore.
Tex/Atl-Rich/ Mobil	OCS-PO113	105	Florence, Ore.
Tex/Mobil	OCS-O 116	113	Florence, Ore.
Atl-Rich	OCS-O 122	126	Florence, Ore.

## Onshore Drilling

The Department issued one new drilling permit in 1967, this to Wm. Craig of Tacoma, Wash., for a shallow hole 15 miles south of Salem (see fig. 1). The Craig test was located near a 2800-foot hole drilled by Portland Gas & Coke Co. in 1936. Gas shows in a salt-water sand were reported in the P. G. & C. hole at a depth of 2500 feet. Craig suspended operations in July at a depth of 1560 feet. Footage drilled by Craig was the only new hole made on shore last year (see table 3).

Permit No.	Company	Well name	Location	Depth	Remarks
55	Butte Oil of Oregon	Cowan 1	Sec. 8, T. 1 S., R. 3 W., Wash. County	957'	Plugged 12/18/67.
56	M. Lewis	Crossley-Jennings, 2	Sec. 31, T. 6 S., R. 4 W., Polk County	2100'	Suspended until March 1968
57D	Central Oils	Morrow 1	Sec. 18, T. 12 S., R. 15 E., Jefferson Co.	3300'	Abandoned 9/12/67
59	Wm. Craig	Gilmour 1	Sec. 24, T. 9 S., R. 4 W., Marion Co.	1560'	Suspended until March 1968

Oil leasing was initiated again in western Oregon in 1967 when Mobil Oil Co. filed for Columbia County lands. Standard of California and Texaco moved into the area shortly after Mobil's application had been filed. Approximately 50,000 acres of leases were involved in the activity. This was the first major onshore leasing program since 1962, when more than a million acres of leases were taken in the Willamette Valley.

Mobil also leased several thousand acres in Lane and Douglas Counties of southwestern Oregon in May and June 1967. The area is not new to the company, since it conducted geologic studies in southwestern Oregon in the late 1950's and drilled a deep hole 10 miles northeast of the coastal city of Reedsport in the summer of 1957.

Many oil companies today have divisions within the firm that are concerned with resources which are either by-products of refining or related to energy supplies other than petroleum. These subsidiary interests include sulfur, ammonium nitrate, coal, natural thermal power, and radioactive minerals. One example of such auxiliary operations was seen last November when the Nuclear Fuels Division of Gulf Oil Corp. acquired more than 80,000 acres of leases in eastern Oregon for uranium prospecting (see fig. 1). The construction by Shell Oil Co. of an anhydrous ammonia plant near St.

Helens, Ore. in 1965 is another of these operations. Dry natural gas and atmospheric nitrogen are the main raw materials at the Shell plant.

### Sedimentary Basins

Oregon can be divided into two marine provinces and several lacustrine basins for the purpose of discussing petroleum prospects (see figure 2). Tertiary marine rocks underlie most of Oregon west of the Cascade Mountains, excluding the Klamath Mountains in southwestern Oregon. Complexes of Mesozoic and Paleozoic marine, volcanic, and intrusive rocks are exposed in the Klamath Mountains, and also in the Blue Mountains of eastern Oregon. Several large intermontane basins formed during late Cenozoic time in central and eastern Oregon. Four of these basins have been explored for oil and gas: western Snake River basin, Harney Lake basin, Goose Lake basin, and the Klamath Lake basin. Of the non-marine basins in Oregon, only the western Snake River and Goose Lake basins are currently regarded as having any possibilities for production of hydrocarbons (mainly gas).

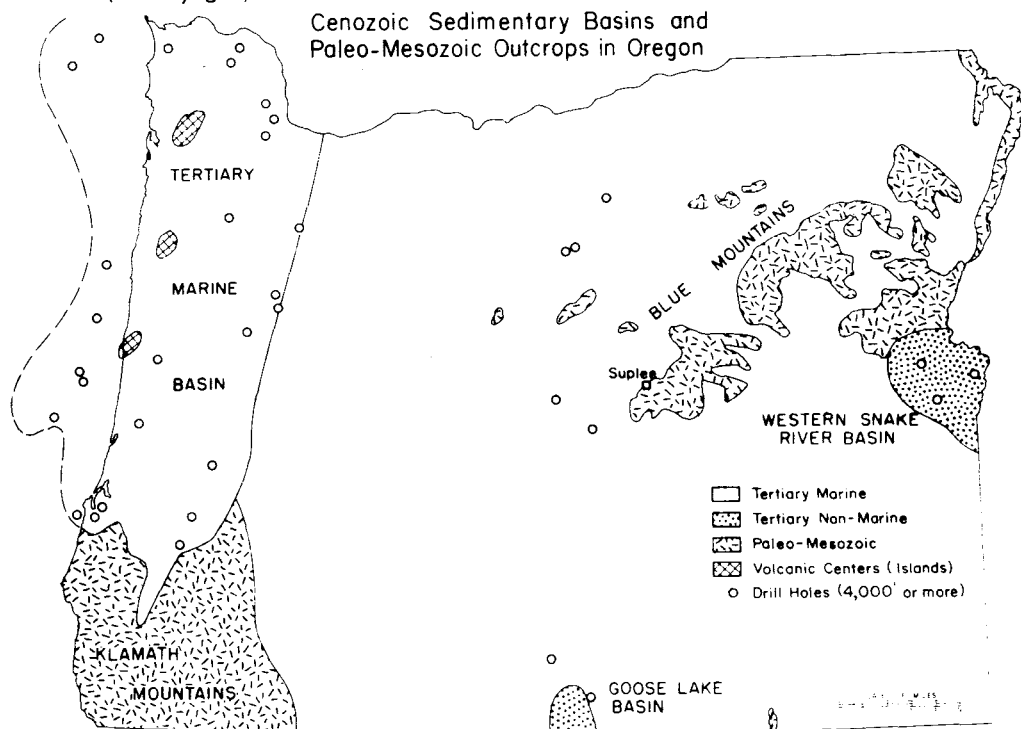


Figure 2. Map showing outlines of outcrop areas in Oregon which are related to possible petroleum source rocks.

### Paleozoic-Mesozoic province

Little is known as yet about the Paleozoic rocks in Oregon because of their complex structure and limited exposure. The oldest rocks in the state are those found in the southeastern part of the Klamath Mountains on the California border. These rocks are mainly chlorite and graphite schists believed to be Silurian or older in age (Baldwin, 1959). However, Paleozoic rocks in the Suplee area are much less altered and less distorted than elsewhere in Oregon (Merriam and Berthiaume, 1943). Devonian limestone and marine clastics have been described from the Suplee area (Kleweno and Jeffords, 1961). Generally, the Paleozoic exposures in central Oregon range in age from Carboniferous to Permian.

Mesozoic marine sediments occur in southwestern, central, and eastern Oregon (see fig. 2). More than 34,000 feet of Triassic and Jurassic rocks, predominantly marine, have been described near Suplee in central Oregon (Dickinson and Vigrass, 1965). Although these rocks have been complexly folded, they show little, if any, metamorphism. A great deal of volcanic material is intermixed with the marine sediments, indicating periods of widespread volcanism. Paleogeologic studies by Eardley (1951) suggest the presence of a volcanic landmass in western Oregon during much of Paleozoic-Mesozoic time, when an inland seaway connecting the Puget Trough with the Gulf of California occupied central Oregon.

In several areas of north-central Oregon, particularly near the town of Mitchell (Wilkinson and Oles, 1968) and at Bernard Ranch near Suplee (Dickinson and Vigrass, 1965), there are deposits of Late Cretaceous shales, sandstones, and conglomerates that lie unconformably on older Mesozoic and Paleozoic strata. The Cretaceous beds are not as deformed nor as diagenetically altered as the older formations. They could, therefore, become potential reservoir rocks in places where the necessary conditions for entrapment of petroleum may exist.

Mesozoic marine rocks similar to those in the central Oregon inlier are also exposed in north-central and northwestern Washington. Buddenhagen (1967) suggests that much of the area between the Oregon and Washington exposures now covered by Tertiary lavas may be underlain by unmetamorphosed Mesozoic marine beds.

### Tertiary marine province

A eugeosynclinal trough formed in the coastal area and adjacent Willamette lowland of western Oregon in the Tertiary period. Volcanic activity was intense during the initial stages of downwarping. At times a volcanic archipelago formed (Snively and Wagner, 1963).

Many local downwarps occurred in the eugeosyncline as a result of differential warping of the crustal rocks. An estimated 15,000 feet of sediments collected in the deeper basin areas, beginning in early Eocene time

and continuing through Miocene time (Snively, Wagner, and Bromery, 1964). Later marine deposits were west of the present shoreline except for Pliocene deposition in the Coos embayment (Baldwin, 1966).

The core of the northern Coast Range consists of submarine lavas, while southward these rocks interfinger with marine sediments. Younger marine rocks occur in an arcuate belt around the north end of the volcanic core and extend into the Willamette syncline (Snively, Wagner, and Bromley, 1964).

Deep drilling in the Tertiary basins of western Oregon has not produced any significant shows of hydrocarbons. Drill-stem tests on sands have all yielded salt water with minor amounts of gas. Structural and stratigraphic conditions were favorable in most cases, but no oil was entrapped.

#### Cenozoic non-marine basins

Large intermontane basins formed at several locations in eastern Oregon in the Pliocene and Pleistocene epochs. The Klamath and Lakeview basins resulted from block faulting which occurred with the Basin and Range development. Genesis of the western Snake River and Harney basins was also related to faulting (Newton and Corcoran, 1963; Piper, Robinson, and Clark, 1939). All of the eastern basin deposits are a mixture of lacustrine, subaerial, and volcanic debris. Diatomite is common and often thin beds of sub-bituminous coal are found in the basin deposits. Many gas shows have been found in the western Snake River basin, a few of them of significant proportion (Newton and Corcoran, 1963). A total of 19 holes has been drilled in the Oregon portion of the basin; no commercial production was found.

Humble Oil & Refining Co. drilled two deep test holes in the Goose Lake basin in 1960-61, but the objective was to test pre-Tertiary marine rocks. Tertiary lavas and sediments were found to be more than 12,000 feet thick. One interesting gas show in this area was Tri-State Petroleum's "Fisher 1" (Stewart, 1954; Newton, 1965).

### What Are Oregon's Prospects?

Oil firms and wildcatters have drilled 183 holes in the state during the past 65 years. However, only 37 were adequate tests, including the 8 deep offshore holes. No significant surface seeps of oil or tar are known in Oregon; only a few very minor occurrences of hydrocarbons. No commercial discoveries have been made in any of the drillings to date and nothing more than traces of oil recovered on drill-stem tests. Widespread volcanic activity produced an environment that was inhospitable for generating petroleum, particularly around volcanic centers. Furthermore, in

past geologic time, much of the detritus supplied to the basin areas was fine grained.

These are the main discouraging facts relating to Oregon's future as an oil-producing area. There are positive factors as well. Thousands of square miles of marine sediments have not been tested in the state. Several of the holes drilled thus far have encountered porous and permeable sands. The geologic history of the Pacific margin was one of considerable volcanic activity from Alaska to the Gulf of California. Nonetheless, marine sediments, particularly the Tertiary deposits in the Pacific Trough, have been prolific producers of hydrocarbons.

Besides the geologic factors, political and economic conditions have a decided influence on exploration activity in an area. In the past it has been more profitable for large firms to exploit foreign resources. It is becoming increasingly less profitable to do so. Inequities in the "balance of payments" have forced the present Administration to bring pressure on foreign investments and expenditures. Another economic factor is competition for productive lands in the western hemisphere which drain capital away from the domestic "wildcat" areas. A good example of this is the present outlay for Alaskan development and the coming offshore lease sale in the Santa Barbara Channel of California. This sale alone is expected to net \$300 million in bonus payments (Oil and Gas Journal, Dec. 25, 1967).

Oregon shelf lands look much less attractive with eight dry holes than they did four years ago before drilling began, but a vast area of shelf remains to be explored. The attention of industry has been drawn away by competition elsewhere, and further studies and leasing must be put off until later. Therefore, little work can be expected on the Northwest shelf for at least five years. On shore, a new exploration cycle seems to be building up in the northwestern corner of the state. If geologic studies prove interesting, one or more deep test holes will be put down. A significant show in one of these could initiate a great deal of excitement. Oregon will see more exploration in the years ahead because of the growing need for petroleum and because it is one of the few remaining undrilled areas in the United States.

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#### OAS TO MEET AT OREGON STATE

The Oregon Academy of Science will hold its annual meeting February 24 at Oregon State University, Corvallis. Presentation of papers will begin at 9:30 a.m. and continue through the day. Dr. Jack Green, geologist for Douglas Aircraft Co., will give a talk before the Academy on interpretation of the lunar features based on the latest orbiter photographs. Cyrus W. Field and Robert E. Frenkel are co-chairmen of the geology-geography section.

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