

## STATE MINERAL PRODUCTION NEAR RECORD LEVEL IN 1966

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A wide variety of mineral deposits occur in Washington. Records indicate that from the first reported discovery of gold in 1853 through 1966, Washington's total cumulative mineral production has had a value of about \$2.3 billion, of which about \$384 million is in metallic minerals and about \$1.9 billion is in nonmetallic minerals.

All but 10 of the State's 39 counties have produced gold, silver, copper, lead, or zinc. However, by far the greatest part of the production of metals has been from the northern row of counties adjacent to the Canadian border—Pend Oreille, Stevens, Ferry, Okanogan, and Whatcom Counties—and the northern Cascade Mountains counties of Chelan and Snohomish. This encompasses much of the area in the northern Cascade Mountains which has been proposed for essentially exclusive recreational use as national parks and(or) wilderness areas.

The principal metals, in decreasing order of production value, are zinc, gold, lead, copper, silver, and uranium. Lesser amounts of tungsten, mercury, iron ore, antimony, manganese, molybdenum, and chromite have been mined in the State. Nonmetallic mineral commodities that have been mined in Washington, in decreasing order of production value are coal, cement, sand and gravel, stone, magnesite, limestone, clay, diatomite, silica, lime, olivine, pumice, peat, oil and gas, talc and soapstone, gemstones, carbon dioxide, barite, epsomite, gypsum, graphite, fluorite, grinding pebbles, asbestos, bentonite, pulpsontes, strontium, and sodium sulfate.

Washington's mineral production value for 1966 was \$85.6 million, a decline of about three-quarters of 1 percent from a record-breaking \$86.2 million in 1965, according to a preliminary report of the U.S. Bureau of Mines. This compared favorably with \$79.2 million for mineral production value in Alaska, \$80.6 million in Oregon, and \$105.6 in Idaho.

The construction materials—sand, gravel, stone, and cement—accounted for 80 percent of the total value of Washington's mineral production in 1966. Other nonmetallic minerals produced during the year were carbon dioxide, clay, coal, diatomite, gem stones, lime, magnesite, olivine,

peat, pumice, talc, and soapstone. Leading metal in production value was zinc at \$7 million. Following in order of value were gold, lead, silver, uranium, and copper.

Vigorous growth characterized the aluminum industry in the State during 1966. Multimillion-dollar investment programs were announced by the aluminum manufacturers and fabricators. Aluminum Company of America, Intalco Aluminum Co., Kaiser Aluminum & Chemical Corp., and Reynolds Metals Co. announced expansions to existent aluminum reduction plants that would add over 230,000 tons to the rated capacity within the State by 1970. In addition to this, a new entrant into the area, Northwest Aluminum Co., reported its aluminum capacity was to be 130,000 tons per year at a primary reduction plant to be built on Guemes Island in Skagit County.

Major expansion was announced for the Tacoma copper smelter of American Smelting and Refining Company. Sandvik Special Metals Corp. planned to build a zirconium-alloy-tube manufacturing plant in the Richland area to make components for fuel elements used in the construction of nuclear power plants. Imperial Metals & Abrasives, Inc., began operating an electric furnace in March to produce silicon metal at a plant in Centralia.

Tacoma was the site selected for a \$4-million pilot plant to test the feasibility of producing a de-ashed coal product from low-quality coal samples gathered throughout the United States. This plant is to be built and operated by Pittsburgh and Midway Coal Mining Co. under a contract with the U.S. Office of Coal Research.

In January 1967 Pacific Power and Light Co. of Portland and Washington Water Power Co. of Spokane announced that coal deposits about 7 miles northeast of Centralia will be utilized for a steam-electric power plant, which will have a generating capacity of one million kilowatts. The initial 500,000-kilowatt generating unit is scheduled for service in 1973 and the second unit as soon thereafter as needed. Coal-field investigations, begun by the companies in 1957, showed reserves of half a billion tons of coal, which will be used to supply low-cost fuel for the huge power plant. Coal consumption at the one-million kilowatt plant will be at the rate of about 5 million tons per year, about 100 times the present total annual production of coal in Washington. Cost of the power plant is estimated at \$118 million.

Kaiser Cement & Gypsum Corp. began construction on a \$3.5-million cement storage complex at a Duwamish Waterway site acquired in 1965 from the Seattle Port Commission. The cement storage silos were the first phase of a multimillion-dollar cement manufacturing facility at Seattle to replace the company's Bellingham plant which was sold to Pittsburgh Plate Glass Co. in September 1966.

Quarry Tile Co. built a plant in Spokane to manufacture clay products. The products were shipped to customers in the Pacific Northwest, California, and the South.

### New Mining Operations

American Zinc Co. placed their new 1,200-ton mill in operation in October. The mill, at the Calhoun mine, 25 miles northeast of Colville, is processing zinc-lead-silver ore from underground mining operations.

Lucky Joe Mining Co. of Coeur d'Alene, Idaho, put into operation a 100-ton flotation mill northeast of Newport in Pend Oreille County. Lead-copper-silver ore from underground mining operations is to be beneficiated.

Baxter Mining Co. of Portland mined and shipped gold- and silver-bearing quartz from the Wind River mine in Skamania County. Shipments were made to the Tacoma smelter.

Fern Hill Cinnabar of Morton mined and retorted cinnabar from veins near the old Roy No. 5 mine, which produced mercury in the 1930's.

### Mineral Exploration

Snohomish County.—Kennecott Copper Corp. drilled 2,000 feet of diamond drill hole at its Glacier Peak copper property. Late in the year they announced plans for a \$15 million open-pit mine at the property.

King County.—Westland Copper Ltd. conducted exploration work in a large area near the Gilbreath (Clipper) property at the head of the Middle Fork of Snoqualmie River. A large low-grade deposit of copper-molybdenum is indicated by surface trenching and diamond drilling.

Copper Range Co. of Michigan did geologic mapping, sampling, and core drilling in the area of the Rainy mine in the Taylor River area northeast of North Bend. Copper-molybdenum mineralization is in quartz diorite breccia at this property.

Cougar Development Co. of Spokane undertook exploration of the old Dutch Miller property on the eastern edge of King County. A 100-foot shaft was de-watered and surface trenching and diamond drilling done. The company reports encouraging showings of copper.

Mono Mines Inc. of Randle, Wash., drove a 700-foot production tunnel at the Mono property in the Miller River area south of Skykomish. Gold-silver-copper-zinc occurs in a breccia pipe of silicified andesite.

Skagit County.—Valumines Inc. of Puyallup did development work on a lead-zinc-copper-silver vein near Cascade Pass. A mill-level crosscut is being driven that will intersect the vein several hundred feet below the outcrop, and a 100-ton flotation mill is under construction.

Whatcom County.—Inland Copper Ltd. of Vancouver, B. C., investigated the Davis copper property west of Ross Lake near the Canadian border. Exploration work, which consisted of mapping, drilling, trenching, and sampling, revealed a low-grade copper-molybdenum deposit. Extensive development work is planned for this year.

Glacier Mining Co. of Seattle undertook magnetometer and geochemical surveys on an extensive gossan area east of Glacier. According to the company's geologist a deposit of low-grade copper occurs in brecciated andesites.

Western Gold Mining Inc. of Seattle initiated a geochemical (soil) survey at its New Light mine in the Slate Creek mining district. The company will investigate several geochemical anomalies this coming season.

Skamania County.—Northwest Mining Co. of Portland did exploration work at the old Skamania and Last Chance mines on upper Washougal River. A trial shipment of copper ore was made to the Tacoma Smelter.

Verde Mining Co. of Tacoma explored several copper-gold veins at the headwaters of the Green River in the Spirit Lake mining district. Additional work is planned this year to evaluate favorable showings.

Pacific County.—Washington Mineral Products, Inc. of Ilwaco, Wash., did exploration drilling and made tests in their magnetic concentrator to recover iron and titanium ores from Columbia River sands.

Chelan County.— L-D Mines of Wenatchee conducted exploratory diamond drilling on siliceous reefs in the vicinity of their Gold King mine. This work is part of the Government's heavy metals program.

Okanogan County.—Argonaut Exploration Co. Ltd., together with Brenda Mines Ltd. of Vancouver, B. C., conducted extensive geochemical and geophysical surveys in the Mazama area west of Winthrop. Claims have been staked on copper-molybdenum mineralization in brecciated andesite.

Coin Exploration of Osoyoos, B. C., undertook geologic mapping and sampling at the Triune mine in the Wannacut area. The copper-molybdenum potential of the property is being studied.

Ferry County.— Bear Creek Mining Co. conducted geochemical and geophysical surveys in the Keller area of the Colville Indian Reservation.

Consolidated Mining & Smelting Co. of Wilbur, Wash., uncovered silver-lead-copper mineralization at their property near Keller on the Colville Indian Reservation. A mill test run of the ore is planned.

Cascade Natural Gas Co. investigated mineral possibilities in the Park City area of the reservation. Silver-bearing galena is considered the most important mineral of the area.

Stevens County.—Dawn Mining Co. did diamond drilling to develop new ore reserves at its Midnite mine on the Spokane Indian Reservation. The company's mine and 400-ton mill have been shut down for the past year; however, growing interest in uranium for nuclear power reactors prompted the new exploration. Ore reserves of more than half a million tons were reported at the time the mine was closed.

Western Nuclear, Inc. of Denver began a diamond drilling program to evaluate uranium leases that they have near the Midnite mine.

Midnite Mines, Inc. of Wellpinit, Wash., diamond drilled copper showings at the Copper King property west of Springdale and a lead-silver vein at the Honest John property southwest of Springdale.

Cleveland Silver Mines of Hunter, Wash., uncovered an interesting deposit of lead-antimony-copper-silver about  $\frac{1}{4}$  mile south of the old Cleveland mine, which produced \$3 million in the 1920's. The ore body was found by geochemical prospecting.

Engineered Mines, Inc. of Hayden Lake, Idaho, undertook exploration and development work at the old Tenderfoot, Big Chief, and Chloride Queen mines on Clugston Creek north of Colville. The company plans open-pit mining operations on deposits of lead, zinc, and silver.

Calix American Corp., a subsidiary of Calix Gold Mines, Ltd. of Vancouver, B. C., crosscut a new body of high-grade zinc ore during a development program at the Schumaker mine north of Colville. The company hopes to develop enough ore to erect a 400-ton flotation mill at the property.

Northwest Mining Ventures of Seattle began development work on the Bluebird group north of Kettle Falls. Open-pit mining operations are planned and a 40-ton mill is under construction.

Big Nine Mine and Minerals, Inc. of Orient diamond drilled lead-zinc-copper showings on the Mammoth claim north of Orient. Possible open-pit mining operations are being considered by the company.

Murphy Bros. Construction Co. of Spokane drilled and shot several thousand tons of low-grade lead-zinc-silver ore at the Silver Crown mine east of Northport.

Spokane County.—W. R. Grace & Co. of New York undertook an exploratory diamond drilling program for tin and tungsten at the Silver Hill mine south of Spokane.

## State Assistance

The Washington State Division of Mines and Geology of the Department of Conservation does geologic mapping and other research that is used as the framework for more detailed mineral-resource explorations by private companies. In addition to geological work the Division is doing some geochemical prospecting, and in the recent past has done some geophysical exploration.

The Division's work may be roughly broken down into two types of investigations: (1) geologic mapping of selected areas and (2) mineral-commodity surveys. Some jobs are a combination of the two. Some of the geologic mapping is done with the Division's staff, some by use of temporary summer help, usually university professors, and some through cooperative agreement with the U.S. Geological Survey. Currently Division staff members are doing geologic mapping along the south flank of the Olympic Mountains in western Washington and in an area including Colville in Stevens County. The western Washington work, by Weldon Rau of the Division's staff, is in an area of interest for oil and gas exploration. The first report on this work was published in December 1966. This is Bulletin No. 53, "Stratigraphy and Foraminifera of the Satsop River Area, Southern Olympic Peninsula, Washington." This geologic mapping is being extended westward into the Wynoochee River area and a second report on this area is now in preparation.

In eastern Washington a geologic map and report on the south half of the Colville 30-minute quadrangle is in preparation. This work is being done by W.A.G. Bennett of the Division staff, and it is expected that this will be completed and published soon.

In the east half of the Kettle Falls quadrangle, which is just west of Colville in Stevens County, the Division has Dr. Joseph W. Mills, Chairman of the Department of Geology at Washington State University, mapping the geology and preparing a report that should be completed soon. Immediately to the west of Dr. Mills' area is the west half of the Kettle Falls quadrangle and the Sherman Peak quadrangle in Ferry County. Here the Division has Dr. C. D. Campbell, of the staff of the Department of Geology at Washington State University, completing some mapping that he started years ago. He is being helped in this job by G. W. Thorsen of the Division staff. This report should be completed in 1967.

The State Division of Mines and Geology has cooperative geologic mapping projects with the U.S. Geological Survey in three areas in the State: (1) the Grays River area near the mouth of the Columbia River, (2) the Oroville area in Okanogan County, and (3) the Chewelah area in

in Stevens County. The Grays River report by Ed Wolfe is essentially completed and should be ready to publish early in 1967.

In the Oroville area Dean Reinhart and Kenneth Fox of the U.S. Geological Survey have completed mapping the Loomis quadrangle, and the Division will be publishing their map and brief report next year. Work is continuing on three other quadrangle maps in the same general area, and these jobs will also result in preliminary maps which the State will publish during the next three years. These are the Conconully, Oroville, and Tonasket quadrangles. Geochemical work is being done in all four quadrangles, and this will also result in a State publication.

Lorin Clark and Fred Miller have completed the mapping of the northeastern quarter of the old Chewelah 30-minute quadrangle, and the Division will publish their map and brief text early next year. During this past year Miller has been continuing his mapping to the south in the southeastern quarter of the Chewelah 30-minute quadrangle. In all of these co-op jobs the U.S. Geological Survey is doing the work and the State sharing the cost with them. The State Division of Mines and Geology will publish preliminary maps and reports immediately after the field work is completed; in some cases the U.S.G.S. will publish more detailed or revised maps and an accompanying detailed bulletin report at a later date.

The State Division of Mines and Geology has several mineral-commodity surveys under way at present or just recently completed. These are (1) an investigation of the stone resources of Washington by Wayne Moen of the Division staff (a report on this will be published early in 1967), (2) mineral resources of Whatcom County, by Wayne Moen, (3) mineral resources of King County, by V. E. Livingston, Jr., of the Division staff, (4) andalusite in Stevens and Pend Oreille Counties, by G. W. Thorsen of the Division staff, and (5) limestone resources of western Washington, by W. R. Danner of the staff of the Department of Geology at the University of British Columbia. This limestone report was completed as a companion to an eastern Washington limestone report by Dr. Mills that the Division published in 1962. The western Washington limestone report was published in December 1966. During the past year the Division published Reprint No. 9, "Mineral and Water Resources of Washington." This is a comprehensive resource report prepared under the supervision of A. E. Weissenborn of the U.S. Geological Survey at the request of the U.S. Senate Interior and Insular Affairs Committee. Also during 1966 the Division published a report, "Washington Mineral Deposits," by Marshall T. Huntting, Supervisor of the Division, giving geologic and historic data on mineral production here.

The Division has just completed another report that is a combination of geologic mapping and commodity survey. This is Bulletin No. 54, "Geology and Mineral Resources of the Kelso-Cathlamet Area, Cowlitz and Wahkiakum Counties, Washington," by V. E. Livingston, Jr. This report ~~is was~~ *published in January 1967.* ~~being printed now and should be ready for distribution in a few weeks.~~

A report on "Controls for Copper and Molybdenum Mineralization in the Cascade Mountains" is being prepared for the Division by A. R. Grant, who was hired as a consultant for this project. This should be completed and published some time during 1967. An important study of the geology of the northern Cascade Mountains being conducted by Professor Peter Misch of the Geology Department at the University of Washington will be published by the Division when it is completed.

Geochemical prospecting was started in a very small way by the State Division of Mines and Geology in 1964; it was expanded in 1965, but had to be cut back again in 1966 for lack of funds. This work, under the supervision of Wayne Moen, has been a program of stream-sediment and soil sampling. More than 700 samples have been taken in nine counties in northeastern Washington and in the Cascade Mountains. The samples analysed for total heavy metals by cold extraction dithizone tests have also been assayed for lead, zinc, copper, and molybdenum by a commercial laboratory. The results are tabulated and shown on county maps which have been released to open file. Copies of the maps may be obtained by anyone who is interested.

Although airborne geophysical surveys of vast areas have been conducted by the governments of many countries of the world, only relatively little has been done by the Federal or State governments in this country. Canada, for example, has already completed an aeromagnetic survey of a large part of that country. In 1960 the Washington Division of Mines and Geology published aeromagnetic maps of five quadrangles in Ferry and eastern Okanogan Counties. This survey was made and the maps prepared under a contract to a private company. Similar surveys should be completed for all of northeastern Washington, the Cascades, and the western part of the State.

In addition to their research on the geology and mineral resources of the State, the Division of Mines and Geology serves the mineral industry in another important way—as a clearing house of information. Prospectors and mineral-property owners may request help from the Division in evaluating their prospects, and users of mineral resources may request help in locating sources of needed mineral raw materials.