

# WASHINGTON STATE'S MINERAL INDUSTRY

..... the first of a series of four  
raw material resource reviews .....

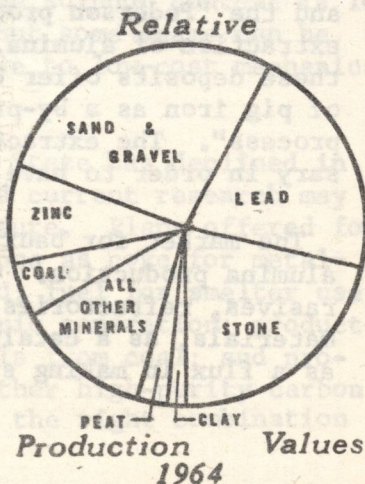
WASHINGTON STATE DEPARTMENT OF COMMERCE AND ECONOMIC DEVELOPMENT  
BUSINESS AND ECONOMIC RESEARCH DIVISION

DANIEL J. EVANS, GOVERNOR JUDSON WONDERLY, ACTING DIRECTOR  
KEITH E. YANDON, DIVISION MANAGER

An increasing demand for minerals, new technological developments and improved prospecting techniques can be expected to accelerate further development of Washington's mineral deposits. Coupled with new market demands is the growing need for high quality raw materials and less reluctance by industrial consumers to consider unfamiliar and newly developed supply sources. These factors plus population increases, new manufacturing processes, low cost hydroelectric power, an adequate water supply and improved transportation services provide additional incentive for further local production.

Washington is a richly mineralized state with a wide diversity of minerals and, as a result, offers an unusually broad range of development opportunities. These opportunities exist for the miner, the minerals processor and the consumer of minerals. Over 2,000 documented occurrences of both metallic and nonmetallic minerals exist. While many of these occurrences have been fully explored, the true extent of all of these deposits is not really known. The statement, "It is little more than tapped" is very appropriate when applied to Washington's total mineral resource.

An active growing minerals industry has flourished in Washington since the first mining of coal in the early 1850's. Since that time more than \$1.8 billion of minerals production has been recorded. A detailed record of that production follows. Segments of Washington's minerals industry hold national prominence. The State ranks sixth in lead production, eleventh in zinc, sixth in gold, sixth in silver, third in diatomite, fifth in carbon dioxide, tenth in sand and gravel,



second in magnesite, seventh in talc and soapstone, first in olivine, and sixth in uranium production.

A recent study of western markets for mineral raw materials concludes, "There is a gradual shifting of requirements from metals to nonmetals and from distant to local sources of supply". In Washington, as in the rest of the West, the real story is not only what is currently produced, but what will be produced when demand and technology make it economically feasible. There are mineral resource areas that appear to offer development opportunities exceptional in their total potential. Presently they appear to require only the application of money, knowledge, research effort or await proper market conditions. These development opportunities are reviewed below.

Bauxite - Extensive deposits of ferruginous bauxite occurring in Washington are a potential source of aluminum and iron. These deposits, as yet not completely documented, cover well over 2,000 acres with maximum thicknesses of from 15 to 20 feet. These occurrences lie in beds which could be easily mined by inexpensive strip-pit methods. They are located adjacent to the lower part of the Columbia River which provides both barge traffic and access to deep-sea shipping. Large deposits of material that is chemically and physically similar also occur in adjacent areas of Oregon.

Extraction techniques are known but have not been used commercially in this country. The "acid-leach" process and the "Pederson process" have proved successful in the extraction of alumina. Rich in iron (39%  $Al_2O_3$ , 29%  $Fe_2O_3$ ) these deposits offer the possibility of the production of pig iron as a by-product utilizing the "Pederson process". The extraction of iron might well be necessary in order to have a commercially feasible operation.

The market for bauxite is not confined to that for alumina production. Other utilizations include: abrasives, refractories, high-alumina cement, insulating materials, as a catalyst by the petroleum industry, and as a flux in making steel and ferroalloys.

Black Sands - Extensive black sand deposits containing iron, titanium, and minor amounts of other minerals cover several square miles near the mouth of the Columbia River, in Grays Harbor and other coastal beaches, and out into the ocean for an unknown distance. It is expected that the extent of deposits beneath the ocean will be documented by the Bureau of the Mines' newly created Marine Minerals Technology Division.

Black sands are considered a source of iron and titanium with perhaps zircon and garnet being recoverable as by-products. Considerable interest has been exhibited in black sands at various times. During World War II similar deposits in Oregon were mined and concentrated for their chromite content. More recently a major minerals firm has conducted an investigation of the sands deposits near the mouth of the Columbia River.

Commercial processing of black sands is not currently feasible because of difficulties in producing concentrates due to the mineral composition of the sands. The resource is available but the know-how for commercial production has not yet been demonstrated.

Coal - Not really an untapped resource but in Washington it is an under-utilized resource. Within the State of Washington lie the largest coal deposits in the Pacific states — 6.2 billion tons. These deposits contain bituminous, sub-bituminous, lignite and anthracite coals including metallurgical coking coals. Washington coals have a moderately high BTU content. Although the coals are high in ash they can be upgraded and the sulphur content is low. Mining costs are generally high, but some seams can be strip-mined and others are amenable to low-cost mechanical methods.

Although coal production in the State has declined in recent years, changing markets and current research may reverse this trend in the near future. Plans offered for utilization include such suggestions as coke for metallurgical uses both here and abroad; fuel for smelter use; rock wool production; steam-electric generation; production of gas, gasoline, and chemicals from coal; and production of electrode carbon and other high-purity carbon products. With proper timing and the right combination

# MINERAL OCCURENCES OF WASHINGTON

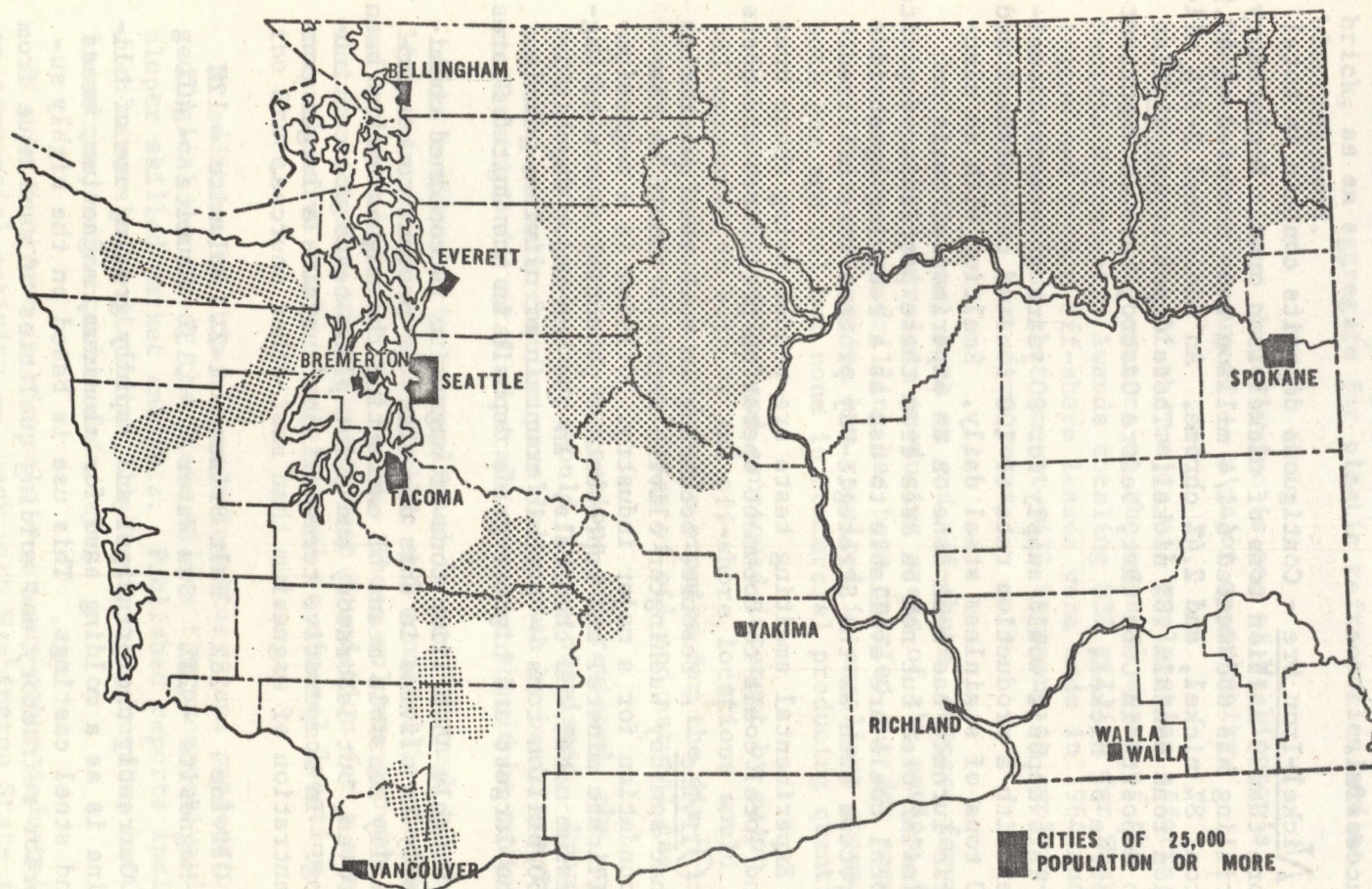
Metallic minerals	Number	Total Production <sup>■</sup>	Nonmetallic minerals	Number	Total Production <sup>■</sup>
Antimony	31	\$81,293(1907-1952)	Clay	159	\$6,816,934(1933-1963)
Chromite	83	14,365(1917-1942)	Coal (fields)	10	444,190,000(1890-1963)
Copper	605	43,412,918(1893-1963)	Diatomite	46	* (1906-1963)
Gold	411	78,302,463(1866-1956)	Dolomite	24	Amount not known
Iron	116	572,068(1919-1959)	Fluorite	5	11,000(1941-1946)
Lead	450	51,815,415(1898-1963)	Graphite	25	*
Manganese	152	* (1924-1959)	Limestone	112	* (1900-1962)
Mercury	43	711,304(1926-1958)	Magnesite	17	* (1916-1963)
Molybdenum	37	16,000(1936-1942)▲	Olivine	9	* (1946-1963)
Nickel	40	None	Oil and gas	40	730,000(1933-1941)
Silver	79	12,265,109(1866-1956)	Peat	336	1,194,420(1953-1956-1963)
Tellurium	8	None	Pumice & pumicite	187	1,993,853(1955-1963)
Titanium	6	None	Silica	79	* (1921-1962)
Tungsten	44	229,740(1933-1943)▲	Sodium sulfate	15	*
Uranium	77	12,461,164(1955-1963)▲	Stone	250	238,004,758(1918-1963)
Zinc	112	109,388,088(1911-1963)	Talc & soapstone	23	573,581(1933-1963)
Nonmetallic minerals			Sand & gravel		307,433,855(1906-1963)
Barite	35	105,252(1940-1962)▲			
Bauxite	5	None◎			
Bentonite	7	* (1956-1962)			
Carbon dioxide	-	* (1953-1963)			

\*Confidential information, value of undisclosed items: asbestos, bentonite, carbon dioxide, cement, diatomite, epsomite, gemstones, graphite, grinding pebbles, gypsum, lime, limestone, magnesite, manganese, olivine, pulpstones, silica, sodium sulfate, strontium, and gold and silver for 1957-1963. \$502,620,343

▲Estimated in part

◎Large known reserves

■ For years indicated



## METALLIC MINERALIZED AREAS

of ideas, skills and money applied to our abundant coal resources, any one of those suggestions could well prove successful.

Nickel-Iron Ore - Contiguous deposits contain in total more than 9 million tons of nickel-iron ores. Exploratory drilling has documented 6-1/4 million tons composed of 40.9% iron, 8% nickel, and 2.4% chrome. An additional 2-3/4 million tons contain .8% nickel. These deposits are similar to deposits in Cuba that, before Castro, were an important source of nickel.

This deposit would supply for 90 years an electric smelter with a production rate of 100 tons of carbon steel and 30 tons of stainless steel daily. Smelting with an electric furnace has been done on an experimental basis on similar ores but not on ores from these particular deposits. Local coals are available to use as a reducing agent if a process such as the Strategic-Udy process were utilized.

Experimental smelting tests are needed using these ores and local coals to document operating procedures and costs.

Olivine - A resource occurring in such vast quantities - that someday Washington olivine deposits should be the foundation for a major industry. Olivine is a magnesium-silicate mineral and represents a potential source of magnesium metal and chemicals. In the one major deposit is 160 billion tons — a whole mountain of olivine. It is the largest and highest grade deposit in the United States.

Roughly 45 billion tons of magnesium is combined chemically in olivine in this deposit. At present no commercially feasible means of extracting the magnesium has been proven, but laboratory and pilot plant tests are continuing. In comparative terms olivine contains a larger concentration of magnesium than most other sources.

Olivine	- 28%	Salt Brines	- 1-2%	Dolomite	- 12%
Magnesite	- 28%	Sea Water	- .13%	Brucite	- 40%

Currently the principal and rapidly growing use of olivine is as a molding sand for aluminum, magnesium, brass and steel castings. This use is based on the highly superior refractory and molding qualities of sand made from

olivine as compared with conventional molding sand. Smaller amounts are being used as a pressed refractory brick, as an aggregate for plastic refractories and as blasting sand.

It would appear that olivine is one of Washington's largest latent resources — a major opportunity.

Petroleum - One of the major oil exploration efforts in the world today centers on the coastal areas of the Pacific Northwest. Awards totaling \$35 million for Washington and Oregon off-shore leases were made in 1964, and two to three times that amount will be spent on exploration during the next five years.

Geologic factors, both on and off-shore, compare favorably to other petroleum producing areas of the nation. On-shore exploratory drilling has been carried out for some time. This exploration has resulted in excellent shows of both gas and oil but none in commercial producing quantities.

The intense activity and continued interest by major oil companies in both on and off-shore locations would appear to indicate considerable promise for the discovery of commercial quantities of oil and natural gas.

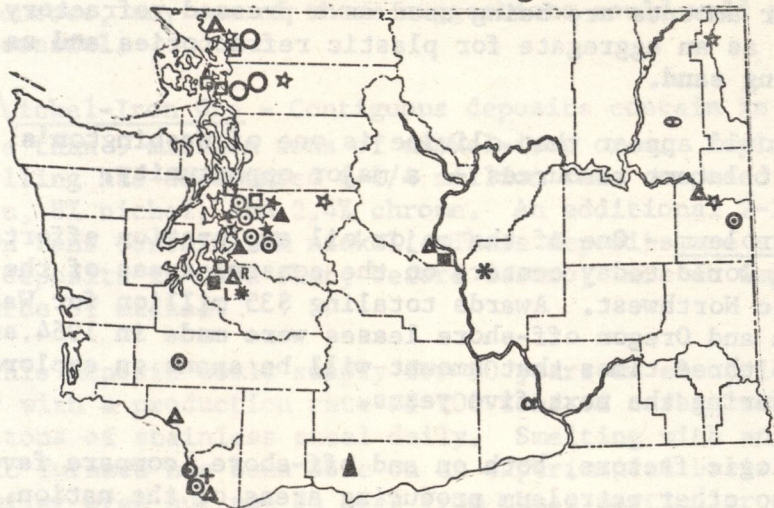
As these development suggestions are reviewed, the present minerals production should not be dismissed. Growing, maturing markets require parallel growth by basic suppliers so Washington's total minerals resource should be reviewed.

This review can be accomplished in part through a published inventory of all metallic and nonmetallic mineral occurrences known in the State. These volumes provide the investigator with a convenient foundation for a more comprehensive study of any mineral or mineral location in the State.

In addition to this minerals inventory, and professional geological services, the State offers the prospective developer skilled market analysis. Published reports include such minerals as diatomite, lightweight aggregate, barite, limestone, refractories and clays.

If your interest is minerals — or any other industrial or commercial activity — check with Washington State first.

# Mineral Processing Plants in Washington



## ▲ ALUMINUM PLANTS

ALCOA - VANCOUVER & WENATCHEE  
KATISER ALUMINUM CORP. SPOKANE &  
TACOMA  
REYNOLDS METALS CO. - LONGVIEW  
INTALCO - FERDALE (UNDER CONSTR.)

## \* COPPER SMELTING & REFINING

AMERICAN SMELTING & REFINING - TACOMA

## ★ CEMENT PLANTS

LEHIGH PORTLAND CEMENT CO. - METALINE  
FALLS  
LONE STAR CEMENT CORP. - SEATTLE &  
CONCRETE  
IDEAL CEMENT CO. - GROTTO & SPOKANE  
OLYMPIC PORTLAND CEMENT CO. -  
BELLINGHAM  
PERMANENTE CEMENT CO. - SEATTLE

## ■ OIL REFINERIES

Mobil Oil Co. - BELLINGHAM  
TEXACO INC. - ANACORTES  
SHELL OIL CO. - ANACORTES  
U.S. OIL & REFINING CO. - TACOMA  
UNION OIL CO. OF CAL. - EDMONDS  
AMERICAN BITUMULS & ASPHALT CO.  
RICHMOND BEACH

## ▲ GLASS PLANTS

NORTHWESTERN GLASS CO. - SEATTLE  
PEMBERTHY INSTRUMENT CO. - SEATTLE

## R ROCK WOOL PLANT

UNITED STATES GYPSUM CO. - TACOMA

## L LIME PLANT

PACIFIC LIME, INC. - TACOMA

## + CARBORUNDUM PLANT

THE CARBORUNDUM CO. - VANCOUVER

## ⊗ ATOMIC REACTORS

U.S. ATOMIC ENERGY COM. - RICHLAND

## ⊙ MAGNESITE PLANT

NORTHWEST MAGNESITE CO. - CHEWELAH

## ⊙ CLAY PRODUCTS

BUILDERS BRICK CO. - SEATTLE &  
NEWCASTLE  
CHEHALIS BRICK & TILE CO. - CHEHALIS  
HIDDEN BRICK CO. - VANCOUVER  
INT'L PIPE & CERAMICS - RENTON & MICA  
LOWELL BRICK & TILE CO. - LOWELL  
PETERSON DEV. CO., INC. - SEATTLE  
RIDGEFIELD BRICK & TILE - RIDGEFIELD

## ▲ CARBON DIOXIDE PLANT

GAS-ICE CORP. - KLICKITAT

## ★ IRON & STEEL PLANTS

BETHLEHEM STEEL CO. - SEATTLE  
ISAACSON IRON WORKS - SEATTLE  
NORTHWEST ROLLING MILLS - SEATTLE

## \* DIATOMITE PLANT

KENTITE CORP. - QUINCY

## ○ OLIVINE PLANTS

NORTHWEST OLIVINE CO. HAMILTON  
OLIVINE CORP. - BELLINGHAM  
PACIFIC OLIVINE CO. - CLEAR LAKE

## ■ FERROALLOY PLANTS

OHIO FERROALLOYS CORP. - TACOMA  
KEOKUK ELECTRO METALS CO. - WENATCHEE

THE  
Surprising  
STATE

WASHINGTON