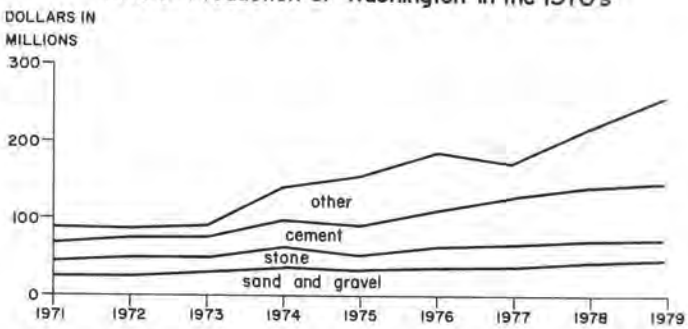
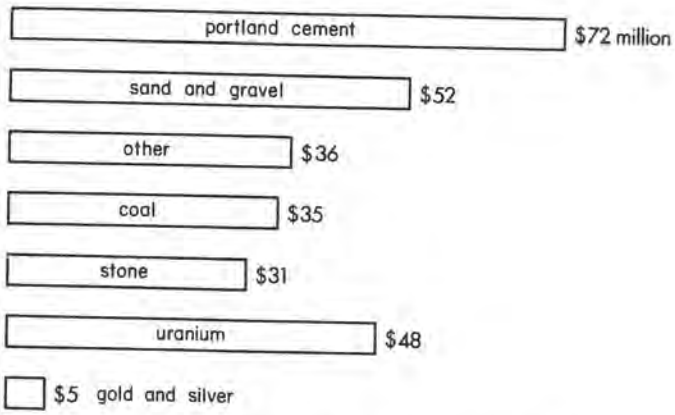
JANUARY 1980

VOLUME 8 - NUMBER 1

WASHINGTON GEOLOGIC NEWSLETTER

Mineral Production of Washington in the 1970's





Mineral Production of Washington 1979

PORTLAND CEMENT

SAND AND GRAVEL

URANIUM

COAL

STONE

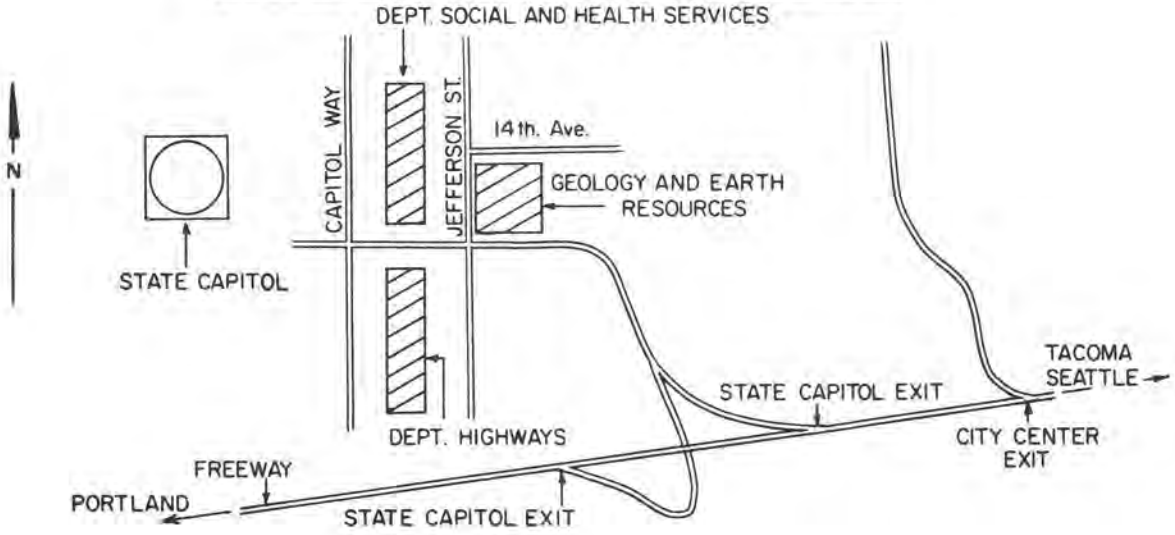
GOLD AND SILVER

BERT L. COLE
COMMISSIONER OF PUBLIC LANDS

RALPH A. BESWICK, Supervisor
DEPARTMENT OF NATURAL RESOURCES

VAUGHN E. LIVINGSTON, JR., State Geologist
DIVISION OF GEOLOGY AND EARTH RESOURCES

LOCATION MAP: DIVISION OF GEOLOGY AND EARTH RESOURCES



Mailing address: Department of Natural Resources
Division of Geology and Earth Resources
Olympia, WA 98504
(206) 753-6183

Vaughn E. (Ted) Livingston, Jr., Supervisor

J. Eric Schuster, Assistant Supervisor

Minerals and Energy Geologists

Wayne S. Moen
Weldon W. Rau
Carl McFarland
Ellis R. Vonheeder
Charles W. Walker
Mike Korosec
Glennda B. McLucas

Laboratory: Arnold Bowman

Donald M. Ford, Assistant Supervisor

Land Use Geologists

Gerald W. Thorsen
Allen J. Fiksdal
James G. Rigby
Keith Stoffel

Publications

Laura Bray
Keith Ikerd
Wanda Walker

Secretaries

Pamela Whitlock
Gina Tomasino
Anne Marie Bammert

Librarian: Connie Manson

Regulatory Functions
Donald M. Ford

Surface Mined Land Reclamation Act, Oil and Gas Conservation Act, and Geothermal Resources Act

The Washington Geologic Newsletter is a quarterly report of geologic articles published by the Division of Geology and Earth Resources, Department of Natural Resources. The newsletter is free upon request.

The division also publishes bulletins, information circulars, and geologic maps. A list of these publications will be sent upon request.

METALLIC AND NONMETALLIC MINERAL EXPLORATION WRAP-UP, 1979

by
Carl R. McFarland[1]

METALLIC MINERAL EXPLORATION

During 1979, metals explored for in Washington State in order of decreasing abundance were uranium, gold, silver, copper-molybdenum, lead-zinc, and tungsten. The Okanogan Highlands physiographic province, which occupies the northeastern part of the state (fig. 1), had the greatest amount of exploration, particularly Ferry, Stevens, and Pend Oreille Counties. The Cascade Mountains region, as in past years, experienced local property development, as well as reconnaissance exploration for base and precious metals, plus minor uranium exploration.

Exploration for uranium appears to have declined slightly in Washington in 1979 as compared with the previous year, while exploration for gold, silver, copper, and molybdenum has increased slightly.

Uranium Exploration

Uranium was the most highly prospected metal this year, as it has been for the past 3 years. The Midnite and Sherwood uranium mine area of southwestern Stevens County and north-central Lincoln County received the greatest amount of activity (fig. 2). Companies prospecting for Sherwood and Midnite-type deposits in this area are Rexcon, Western Nuclear, Denison, Minatone, U.S. Borax, Anaconda, Dawn, and Union Carbide.

In the Mount Spokane area of northeast Spokane County, Pathfinder, Conoco, and Rexcon were active.

The Tertiary sedimentary sequence (Tiger Formation) of the Pend Oreille Valley in Pend Oreille County still holds interest for the following companies: Cotter Co., Denison, Conoco, and BurWest. Several other companies, however, have abandoned this area.

Elsewhere in the Okanogan Highlands province the following companies are doing work: Pathfinder, Conoco, Western Nuclear, Rexcon, Chevron, BurWest, Inspiration Development Co., and Cotter Co.

BurWest also conducted reconnaissance exploration in the Cascade Mountain region, as did several other mining companies.

As the result of high geochemical anomalies found by the Bendix Corp. in the metasediments of the Kettle Dome, that part of the dome that falls in Stevens County received special interest this year by many companies.

Gold-Silver Exploration

Gold and silver activity, as in the past, was confined to the Cascade Mountains and the Okanogan Highlands physiographic provinces.

After producing last year, Charleston Resources confined their activities to development drilling this spring at the Melrose silver mine near Northport in Stevens County. In November, they

[1] Geologist, Division of Geology and Earth Resources, Department of Natural Resources.

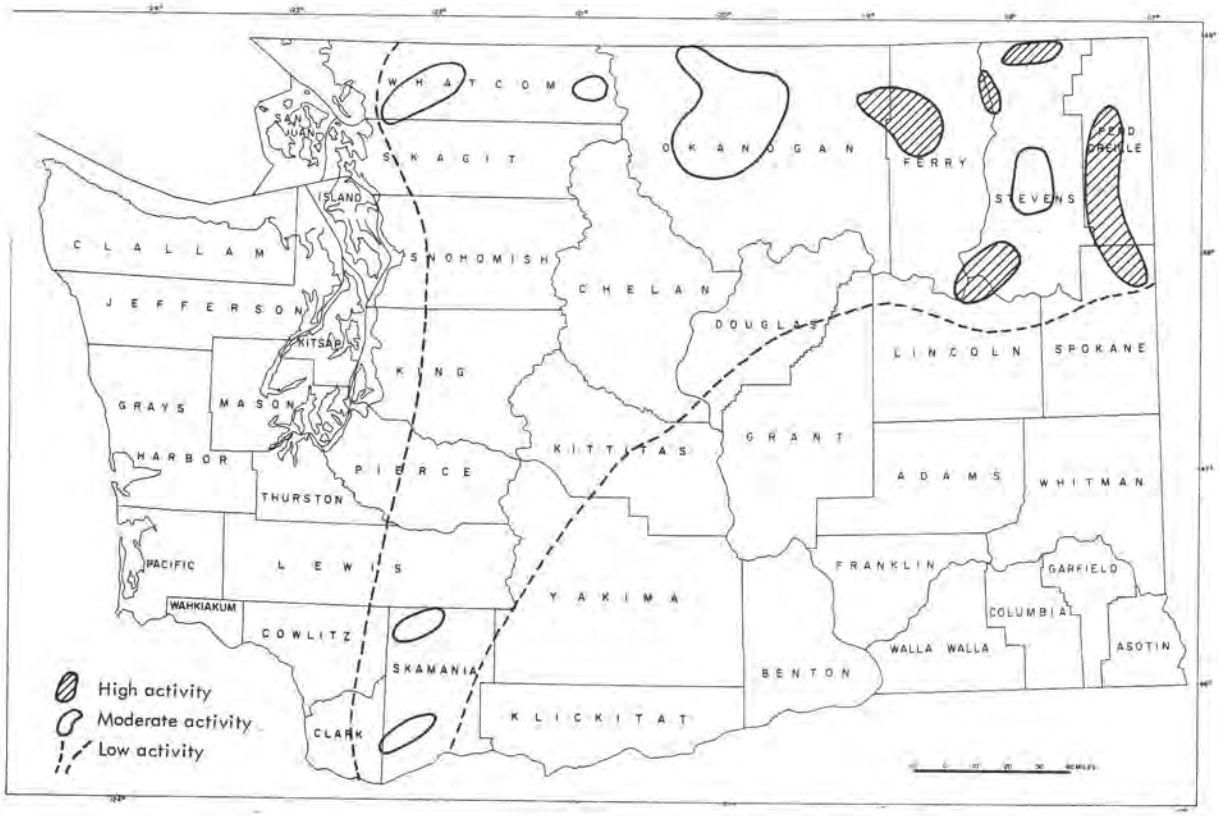


FIGURE 1.—Areas of exploration showing intensities of activity, 1979.

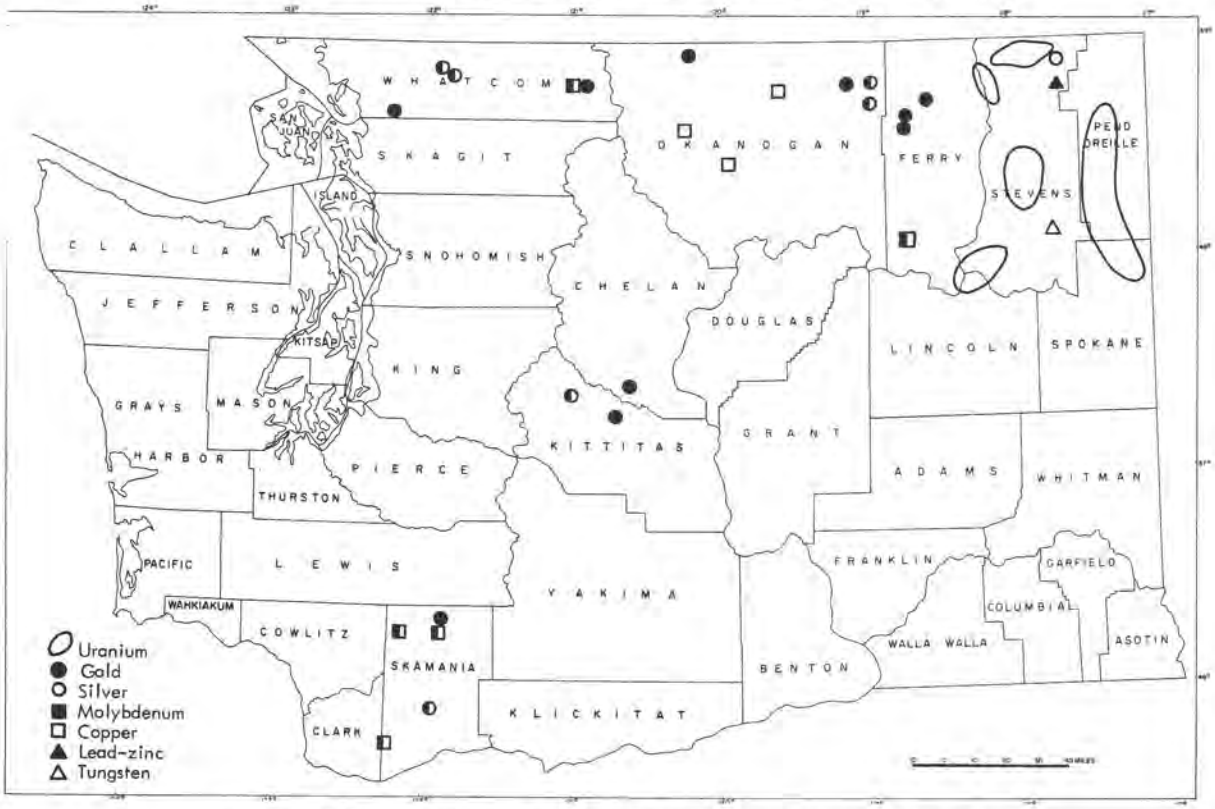


FIGURE 2.—Locations for metallic mineral exploration, 1979.

began production from a vein of silver that was discovered by diamond drilling earlier in the year. Houston Oil and Minerals Corp. is still doing diamond core drilling at the Flag Hill gold mine in the Republic area.

In Okanogan County, the Rocky Mine Co. is currently doing development work at the Silver Bell mine in the Sheridan district. The Sheridan and Bodie mines were under investigation in this same area.

U.S. Borax continues to investigate the Great Excelsior gold-silver mine in Whatcom County.

In the Wind River area of Skamania County, Foster Mining Co. is currently doing development work at the Wind River mine.

Near the center part of the state, gold and silver exploratory work was conducted in the upper reaches of the Cle Elum River of Kittitas County by an undisclosed operator.

In Kittitas County, Gold Placer, Inc. operated their washing plant on Williams Creek in the Liberty district and produced small amounts of gold.

The high price of gold has attracted an abnormally large number of individuals with gold pans and portable dredges to the rivers and creeks of the state. They were active throughout the summer in the Shaser, Negro, and Peshastin Creeks of the Blewett area of Chelan County and the Swauk Creek area of the Liberty district, Kittitas County. A 10-inch suction dredge was active during summer months on the Similkameen River in Okanogan County. On the west side of the Cascades, portable dredges were active in Slate, Ruby, and McCoy Creeks and on the South Fork of the Nooksack River. We were unable to determine the amount of gold recovered on these types of operations as the gold was either sold on the private market or is being held for an increase in price.

Ruby Mines, Inc. has put into operation a 50-ton cyanide gold mill at the Valley View mine near Curlew Lake in Ferry County.

Day Mines, Inc. is continuing production at the Knob Hill mine near Republic in Ferry County. They have reserves in the proven and probable categories of 70,000 tons, averaging .66 ounce of gold per ton.

Lion Mines, Ltd. are operating on a small scale at the New Light mine in the Harts Pass area in Whatcom County. Their mill has a 70-ton capacity with a recovery of $\frac{1}{2}$ oz. of gold per ton. This year's production will determine whether a larger all-weather mill will be built in 1980.

Base Metals and Tungsten Exploration

Base metals exploration activities continue to be more or less confined to the western Okanogan Highlands and the Cascade Mountains areas.

The Duval Corp. is continuing to explore for copper-molybdenum on Slate Creek, and Bethex has been doing copper-moly reconnaissance work south of Ross Dam, both in Whatcom County.

In southwest Skamania County, Amoco has been drilling for copper-moly in the Silver Star Mountain area. Duval Corp. continued to do copper-moly exploration in the Mount St. Helen's district, also in Skamania County.

In Okanogan County, Quintana Mineral Corp. drilled their copper prospect in the Mazama area. Bethex did some coring for molybdenum in the Thunder Mountain area west of Loomis. Gulf Mineral Resources is coring in the Buck Mountain area west of Okanogan.

Amax is still working on the large copper-moly prospect on Mount Tolman in southwest Ferry County; they have an active drilling program plus a training program for the Indian tribe members.

Exploration for copper and possibly gold was undertaken this past year by an undisclosed major mining company in the McCoy Creek region of north-central Skamania County. The McCoy Creek site contains several small stocks with a geologic environment similar to Duval's Ryan Lake copper deposit 15

miles to the west.

In northern Stevens County, Great Basin Petroleum and Washington Resources are doing exploration work on a low-grade zinc prospect in the area of Deep Creek and the Calhoun mine.

Kimmer Coal Co. did core drilling on their tungsten property in the vicinity of the Blue Grouse mine in the Deer Lake area in southeastern Stevens County. Wesley Butler had limited tungsten production in this same area.

Producing Mines

Only seven metal mines had a record of production during 1979. In southwestern Stevens County, Western Nuclear had their 2000-ton-per-day mill at the Sherwood mine operating at near capacity. The ore has a grade of approximately 0.08 percent U_3O_8. A few miles to the north, at the Midnite mine, the Dawn Mining Co. is operating their mill at a rate of 500 tons per day. The ore has a grade of 0.13 percent U_3O_8.

The Knob Hill gold mine north of Republic continued production throughout the year at a rate of about 120 tons per day.

Ruby Mines, Inc. has the Valley View gold mine on limited production and Lion Mines Ltd. also has the New Light gold mine on limited production. Gold Placer, Inc. and others had minor gold production throughout the state.

Wesley Butler had limited tungsten production from the Blue Grouse mine in southeastern Stevens County.

MINERAL PRODUCTION

Due to a reorganization within the U.S. Bureau of Mines, their 1979 production figures are not available now. The figures used here were obtained by canvassing companies in the industry. The estimated value of mineral production in Washington for 1979 is $279 million; this is a 5 percent increase in value of the minerals that were included in the 1978 U.S. Bureau of Mines figures. The 1979 figures used here include values for uranium, coal, and gold which were not used in the 1978 U.S. Bureau of Mines figures. The 1979 production is broken down as follows:

Portland cement	$72 million
Sand and gravel	$52 million
Stone	$31 million
Uranium	$48 million
Coal	$35 million
Gold and silver	$ 5 million
	$243 million

The other $36 million is made up of olivine, diatomite, shale, clay, barite, kaolinite, peat, feldspar, talc, silica, jade, pumice, gypsum, and epsom salts.

MINING COMPANIES ACTIVE IN MINERAL EXPLORATION IN WASHINGTON, 1979

Amax
Amoco
Anaconda
Bendix Corp.
Bethex
Burlington Northern Inc.
BurWest
Charleston Resources
Chevron USA
Conoco
Cotter Co.
Dawn Mining Co.
Day Mines, Inc.
Denison Mines, Inc.
Duval Corp.
Foster Mining Co.
Gold Placer, Inc.
Great Basin Petroleum
Gulf Mineral Resources Co.
Houston Oil and Minerals Corp.
Inspiration Development Co.
Kimmer Coal Co.
Lion Mines Ltd.
Minatone Corp.
Pathfinder
Quintana Minerals Corp.
Rexcon
Rocky Mine Co.
Ruby Mines, Inc.
Union Carbide
U.S. Borax
Washington Resources
Wesley Butler
Western Nuclear

NONMETALLIC AND INDUSTRIAL MINERALS

Nonmetallic minerals are produced in every county of the state, with the major production concentrated near the larger urban areas. Zoning and environmental problems are gradually forcing these sites farther away from the business and residential areas, increasing the cost of sand and gravel greatly because of added hauling costs. In areas where sand and gravel is in short supply, it would be wise to defer zoning a given tract for residential or industrial usage until after a controlled sand and gravel removal. This would avoid the covering and loss of valuable materials.

Over 100 rock quarries in the state produced stone, consisting mainly of basalt, limestone, dolomite, sandstone, quartz, quartzite, and granite. Except for limestone and dolomite quarries, the locations of the remaining quarries are more or less controlled by population, with a larger number of quarries in the more heavily populated areas.

Over 330 active sand and gravel pits operated in the state and, like the rock quarries, they are concentrated more or less according to population. The general feeling is that because of a reduction in housing starts, and a decrease in road construction, the demand for rock and sand and gravel will be somewhat softer; that is, very little growth, but a decline is not foreseen. Prices are expected to continue to rise, due in part to inflation and in part to federal, state, and county regulations that increase operating costs and hinder pit development near urban areas.

Dolomite

Dolomite is mined from 12 quarries located in the northeastern part of the state. The mineral is used for building stone, decorative stone, and soil conditioner.

Dolomite is also used by Northwest Alloys as a raw material source for the production of magnesium metal at their Addy plant. The Addy plant has a capacity of 24,000 tons of magnesium and 16,500 tons of silica annually. The magnesium portion of the plant is running at 102 percent of capacity. However, they have had to close down the silica plant because of the loss of an economical source of electrical power.

Olivine

Washington has two producers of olivine: Olivine Corporation, in Whatcom County and Northwest Olivine International, in Skagit County. Olivine Corp. expects to produce 20,000 tons this year (1979) from the north side of the Twin Sisters Mountain. Northwest Olivine expects to produce around 40,000 tons from the southwest side of the Twin Sisters. Northwest also has major production in North Carolina. The North Carolina production is about equal to or slightly exceeds the Washington production, making Washington the first or second largest olivine producer in the nation.

Diatomite

Witco Chemical Corp. produced an undisclosed amount of diatomite from their two pits near George in Grant County. Although we were unable to get Witco's production, we did learn that the State of Washington is a leading producer (second or third) of diatomite in the nation. Diatomite is used extensively as a filtering agent and as an insulating medium.

Other Industrial Minerals

Shale, clay, barite, kaolinite, feldspar, talc, silica, jade, peat, pumice, gypsum, and epsom salts are also produced in the state. Most of these materials are utilized within the state, with minor amounts exported.

ENERGY

Oil and Gas

Only one shallow oil and gas exploratory well was drilled in Washington State this year. This well, which is located near the mouth of the Hoh

River in northwest Jefferson County on the Olympic Peninsula, has not been completed as yet, and the company, Pyramid Petroleum Inc., is not giving out any information.

Currently, over 400,000 acres of state land are under lease for oil and gas purposes in Kittitas, Yakima, Grant, Benton, Pacific, Wahkiakum, and Grays Harbor Counties. Shell Oil Co. holds leases on over 50 percent of the total acreage, and has about 500,000 acres tied up in the Columbia Basin of southeast Washington.

As a result of the recent gas discovery in the late Eocene Cowlitz Formation, in the Mist area of northwestern Oregon, several major companies are active in the southwest part of Washington State. At last report, Union, Texaco, Getty, Gulf, Mobil, American Quasar, Exxon, Chevron as well as several independents all have land men working in southwest Washington.

Coal

Approximately 5 million tons of coal was produced in Washington State this year, 99 percent of which was produced by Washington Irrigation and Development Corp. at their Centralia strip mine. The entire tonnage was used as boiler fuel for their thermal plant.

The only other coal production in the state at the present time is Palmer Coking Coal of Ravensdale, King County. Palmer produced approximately 25,000 tons of coal this year.

The following companies or organizations conducted coal exploration work in the state this past year: Amax, Harrison/Western, Gulf Resources, and Sandia.

In June, Sandia Laboratories of Albuquerque began exploration drilling for a possible underground coal gasification pilot project in the Tono Basin, northeast of Centralia. Five holes have been drilled to depths of up to 750 feet and have been completely logged. Continued site characterization and geophysical surveys will continue into early 1980.

The project, the first of its kind attempted in this state, is funded by the Department of Energy. If successful, underground coal gasification would allow a more complete resource recovery from those seams that are considered too deep or too steep to mine successfully using conventional methods.

Geothermal

The Division of Geology and Earth Resources has completed the first year of a planned five-year geothermal assessment program under the sponsorship of the U.S. Department of Energy. The initial phase of this program involved a regional examination of the southwestern Cascades, using gravity measurements, temperature gradient drilling, thermal gradient well logging, and geochemical analysis of thermal and mineral springs as reconnaissance tools. In addition, geologic mapping and geophysical surveys were carried out in the White Pass and Camas areas.

The results of the first year's effort include measurements at 743 new gravity stations in the area from Mount Rainier south to the Columbia River; 11 heat-flow holes 400 to 500 feet deep in the Cowlitz River valley, White Pass, Mount St. Helens, and Camas areas; temperature-gradient measurements in about 80 existing wells in southwestern Washington; about 60 thermal gradients calculated from older USGS water-well records; chemical analyses of 40 water samples representing 20 spring systems; a detailed geologic map of the Cougar Lakes-White Pass area; and a D.C. resistivity survey of the Camas area. A public information map is currently being compiled which will present all current information relating to geothermal resources in the state.

Next year's efforts will involve an examination of the southeastern and central Cascades with continued gravity surveys, temperature-gradient drilling, temperature-gradient well logging, and geochemical analysis, along with delineation of lineaments, detailed geologic mapping, and a combined hydrologic temperature-gradient study of the Columbia Basin in eastern Washington.

UTILIZATION OF WASHINGTON'S GEOTHERMAL ENERGY RESOURCES[1/]

By

R. Gordon Bloomquist

Geothermal energy is usually thought of as a means of generating electricity. It is possible to utilize several different forms of geothermal energy to generate electricity. Dry steam can be used such as at the Geysers area in northern California. Superheated water which partially changes (flashes) to steam when brought to the earth's surface can be used as can binary systems, where geothermal fluids vaporize certain liquids to drive turbines.

Unfortunately, geothermal resources of the quality and quantity needed to produce electricity are unavailable in most parts of the world. Temperatures of at least 150°C (302°F) are needed to generate electricity. Even in areas where geothermal resources are plentiful, the high temperature resources practical for electrical generation will only account for a small percentage of the heat energy known to exist.

On the other hand, direct utilization of geothermal resources for space heating, industrial processing, agriculture, and aquaculture is possible at temperatures as low as 20°C (68°F) (figure 1), and resources with temperatures of 10°C (50°F) or less can economically be used for space and process heating through the use of heat pumps.

Washington State appears to be situated above abundant amounts of low to moderate temperature geothermal resources suitable for direct utilization. This is evidenced by hot springs throughout the Cascades and numerous warm water wells scattered over much of the central and eastern parts of the state.

Washington's greatest near-term geothermal energy potential appears to lie in the development of these low to moderate temperature geothermal resources for space heating as seen in figures 2 and 3 Geothermal space heating is possible either on the

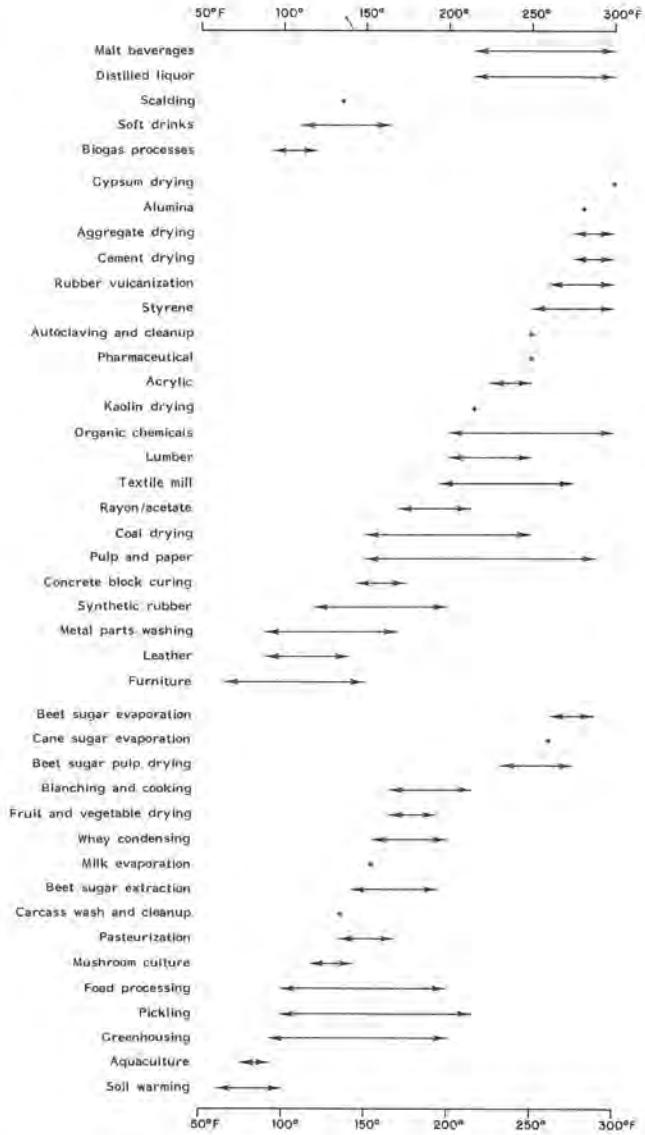


FIGURE 1.—Direct thermal application of geothermal energy.

1/ Reprinted from WSEO newsletter, Oct. 1979, v. 2, no. 4.

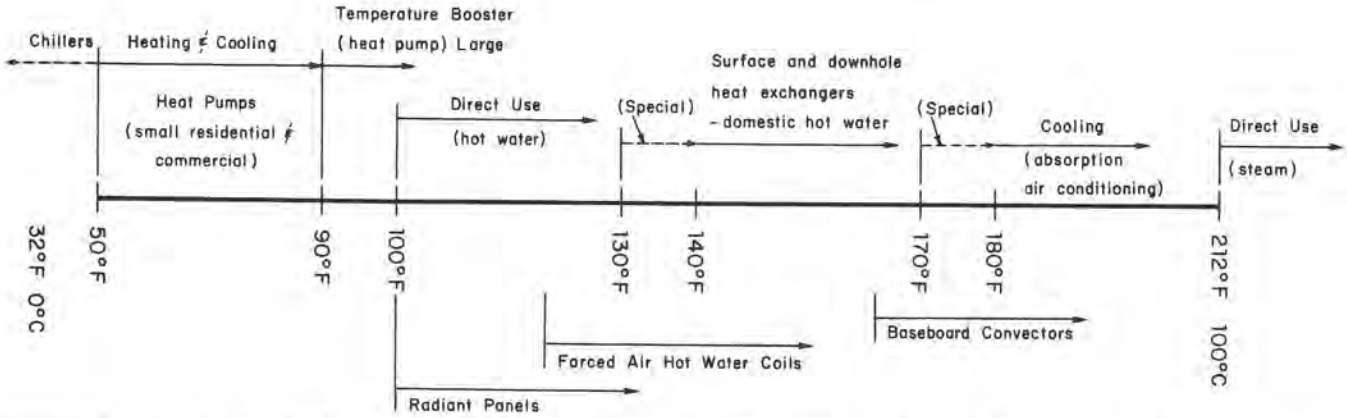


FIGURE 2.—The four major types of heating systems most commonly used are forced air, convectors, radiant panels, and heat pumps (figure 3) all of which are adaptable to geothermal energy. These systems can also be readily and economically converted (retrofit) to geothermal.

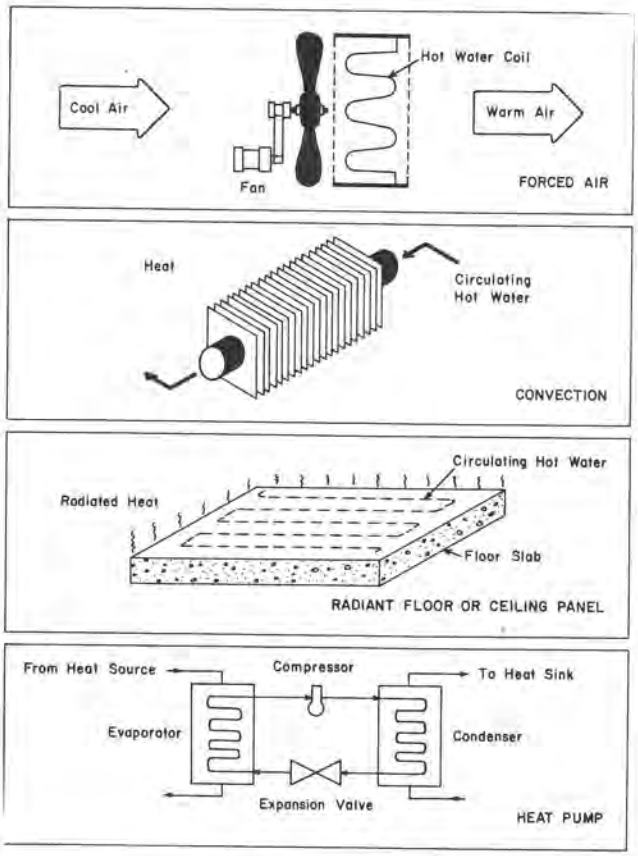


FIGURE 3.—Space heating systems suitable for geothermal applications.

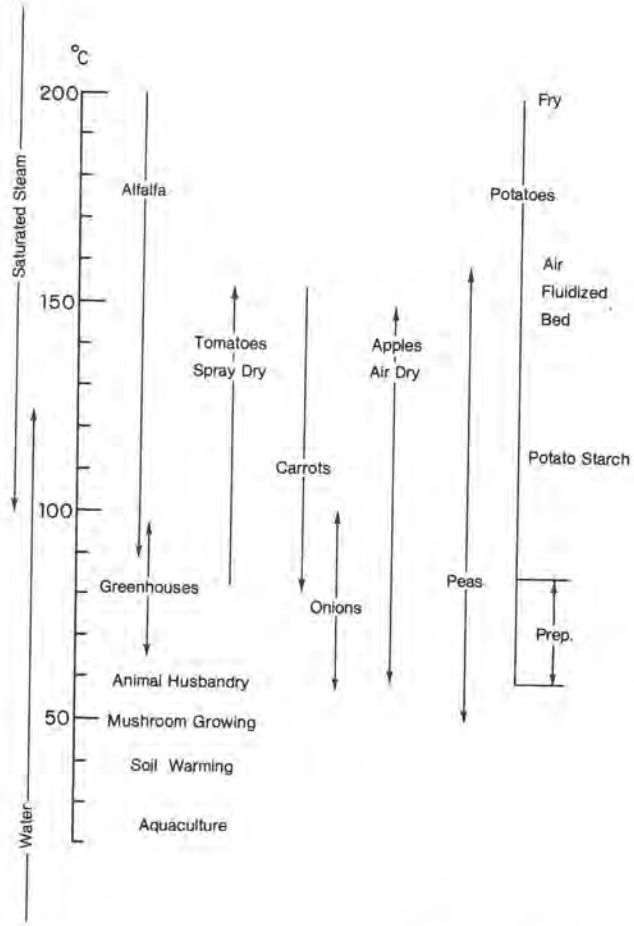


FIGURE 4.—Agricultural uses of geothermal energy.

basis of individual wells supplying an individual user or group of users, or through the formation of geothermal heating districts where warm water will be made available to users much as natural gas is now available. In areas where the low temperature of the resource requires the use of heat pumps, both heating and air conditioning will be possible. Another great potential for the utilization of the state's low to moderate temperature geothermal resource exists in agriculture as seen in figure 4.

The potential for the occurrence of high temperature (150°C or greater) geothermal resources appears to be restricted in this state to the Cascades where they offer the potential for direct use not only for space heating but for industrial process heating as well, most notably in the lumber, pulp, and paper industries (figure 1). These high temperature resources may also possess the potential for electrical generation.

OPEN-FILE REPORTS RELEASED BY DIVISION DURING 1979

The following Open-File Reports were released by the Division of Geology and Earth Resources during 1979:

Mining history of Pierce County, Washington, coal fields, 1860-1962, by Joseph Daniels. Open-File Report 79-1, 161 p.

An assessment of the uranium potential in the Ellensburg Formation, south-central Washington, by P. Clinton Milne. Open-File Report 79-2, 31 p. Four maps, scale 1:250,000.

Preliminary geologic map and report of the late Cenozoic geology of the Columbia Basin, Washington, by James G. Rigby. Open-File Report 79-3, 92 p.

Strippable and underground coal resources on Washington Department of Natural Resources administered land, Pierce County, Washington, by Ellis R. Vonheeder. Open-File Report 79-4. Five sheets (reproducible).

Bibliography of the geology of the Columbia Basin and surrounding areas of Washington, by Glennda B. Tucker and James G. Rigby, revised by Glennda [Tucker] McLucas. Open-File Report 79-5, 469 p. Twenty-four index maps (reproducible).

Bouguer gravity map of the Camas area, Washington and Oregon, by Z. F. Danes. Open-File Report 79-6. Scale 1:62,500 (reproducible).

Surficial geologic map of the Okanogan quadrangle, Washington, by Larry G. Hanson. Open-File Report 79-7. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Pendleton quadrangle, Washington by Newell P. Campbell. Open-File Report 79-8. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Pullman quadrangle, Washington by Gary D. Webster. Open-File Report 79-9. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Ritzville quadrangle, Washington by Larry G. Hanson, Eugene P. Kiver, James G. Rigby, and Dale F. Stradling. Open-File Report 79-10. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Spokane quadrangle, Washington, by Eugene P. Kiver, James G. Rigby, and Dale F. Stradling. Open-File Report 79-11. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Dalles quadrangle, Washington, by Newell P. Campbell. Open-File Report 79-12. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Walla Walla quadrangle, Washington, by Newell P. Campbell, John T. Lillie, and Gary D. Webster. Open-File Report 79-13. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Wenatchee quadrangle Washington, by Randall L. Gresens. Open-File Report 79-14. Scale 1 inch=4 miles (reproducible).

Surficial geologic map of the Yakima quadrangle, Washington, by Newell P. Campbell. Open-File Report 79-15. Scale 1 inch=4 miles (reproducible).

Slope stability project for the Department of Ecology upper Deschutes River Basin, 1978, by Gerald W. Thorsen and Kurt L. Othberg. Open-File Report 79-16, 12 p. Four plates, scale 1:62,500 (reproducible).

DIVISION PUBLISHES GEOLOGIC MAP ON COASTAL AREA

The following new publication has been released by the Division of Geology and Earth Resources:

Geologic map in the vicinity of the lower Bogachiel and Hoh River valleys and the Washington coast, by Weldon W. Rau: GM-24, text, map, and 2 cross-sections on 1 sheet. Scale: 1 inch=1 mile. Price, $4.50.

GM-24, a detailed four-colored geologic map with two cross-sections, shows the distribution and complex structural configuration of the rock formations exposed in some 200 square miles of Washington coastal area. An accompanying text presents descriptions of rock units and interpretations of paleontologic and structural information as well as a summary of geologic events inferred from these data.

The author, Weldon W. Rau, a research geologist with the Division of Geology and Earth Resources, began his investigation in the coastal area in 1967. Several publications have already resulted from these studies including GM-13, a geologic map of the area to the south of the Hoh River. The present map of an area north of the Hoh River complements this previous mapping.

Large intricately folded plate segments separated by wide north-trending thrust fault zones and northeast-trending strike-slip faults constitute the tectonic setting for this and adjacent onshore areas. This complex structural style may well extend to the adjacent offshore continental shelf.

Petroleum seeps have encouraged the drilling of 19 test wells within the mapped area as well as many other wells in surrounding areas. Heretofore, detailed published geologic mapping of this area has not been available.

RECENT U.S. GEOLOGICAL SURVEY OPEN-FILE REPORTS ADDED TO OUR LIBRARY

The following reports are now available for inspection in our division library:

Selected hydrologic data for Spokane Valley, Spokane, Washington, 1977-1978, by E. L. Bolke and J. V. Vaccaro. Prepared in cooperation with the Spokane County Engineer's Office. USGS Open-File Report 79-333, 1 plate, 98 p.

Map showing landslides and relative slope stability of Quaternary deposits of the lower Skagit and Baker Valleys, north Cascades, Washington, by Paul L. Heller. USGS Open-File Report 79-963, 2 plates, scale 1:62,500.

Map showing surficial geology of parts of

the lower Skagit and Baker Valleys, north Cascades, Washington, by Paul L. Heller. USGS Open-File Report 79-964, scale 1:62,500.

Coal exploratory drilling—A cost percentage comparison of three methods, by Robert G. Hobbs. USGS Open-File Report 79-1100, 6 p.

Questions on coastal processes—Contest or co-existence with nature, by H. Edward Clifton. USGS Open-File Report 1130, 32 p.

Sulfate geothermometry of thermal waters in the western United States, by Nancy L. Hehring and others. USGS Open-File Report 79-1135, 11 p.

Petrology and stratigraphy of Paleogene nonmarine sandstones, Cascade Range, Washington, by Virgil A. Frizzell, Jr. USGS Open-File Report 79-1149, 3 plates, 151 p.

Water resources of the Swinomish Indian Reservation, Washington, by B. W. Drost. Prepared in cooperation with the Swinomish Tribal Community. USGS Open-File Report 79-12, 5 plates, 83 p.

Reconnaissance geologic map of the Columbia River Basalt Group in eastern Washington and northern Idaho, by D. A. Swanson and others. USGS Open-File Report 79-1363, 12 sheets, scale 1:250,000.

Preliminary structure contour maps on the top of the Grande Ronde and Wanapum Basalts, eastern Washington, by D. A. Swanson and others. USGS Open-File Report 79-1364, 3 sheets, scale 1 inch= 5 miles: sheet 1, Grande Ronde Basalt (south part); sheet 2, Grande Ronde Basalt (north part); and sheet 3, Wanapum Basalt.

Excerpt from Mining Engineering (February 1979)

. . . figures show the small prospector is much more nimble at finding deposits than is the large institutionalized exploration firm. Of the $508 million spent on exploration in Ontario between 1951 and 1974, small mining enterprises spent only 28 percent of it—yet discovered 84 percent of the deposits classified as possibly economic.

—John D. Wiebmer

DIVISION PROJECTS DURING 1979

Geochemistry of thermal and mineral springs. Mike Korosec (division geologist). In progress.

Temperature-gradient and heat-flow drilling in the southwestern Cascades, J. Eric Schuster and Mike Korosec (division geologists). In progress.

Compilation of Washington geothermal resource map, Mike Korosec, J. Eric Schuster, Glennda McLucas, and Keith Kayler (division geologists), with assistance from Gordon Bloomquist and Stuart Simpson of Oregon Institute of Technology (OIT). In progress.

Temperature-gradient measurements in existing wells, Marshall Huntting (under contract) and Michael Jackson (Southern Methodist). In progress.

Interpretation of existing temperature-gradient data, Stuart Simpson (OIT); Mike Korosec, Keith Kayler, and J. Eric Schuster (division geologists). In progress.

Electrical resistivity survey at Camas, Clark County, Robert McEuen and Fred Rigby (under contract to the Department of Natural Resources and Crown Zellerbach). In progress.

Regional gravity survey of the south Cascades, Z. F. Danes and Al Eggers (University of Puget Sound, under contract). In progress.

Geology of the Tumac Mountain-White Pass area, Geoffrey Clayton (University of Washington, under contract). In progress.

Geothermal resources bibliography, Mike Korosec (division geologist) and Gordon Bloomquist (OIT). In preparation.

Reconnaissance surficial geologic mapping in the Forest Center and Springdale $7\frac{1}{2}$-minute quadrangles, Stevens County, Glennda McLucas (division geologist). In progress.

Bibliography of the geology of the Columbia Basin and surrounding areas of Washington, Glennda Tucker [McLucas] and James Rigby (division geologists); revised by Glennda McLucas. Division Open-File Report 79-5.

Directory of Washington mining operations, Carl McFarland, Glennda McLucas, James Rigby, and Keith Stoffel (division geologists). Report in press.

Stratigraphic correlations of Washington coastal and offshore wells, Weldon Rau and Carl McFarland (division geologists). In progress.

Geology and structure of the Humptulips 15-minute quadrangle, and vicinity, Weldon Rau and Carl McFarland (division geologists). In progress.

Geologic map in the vicinity of the lower Bogachiel and Hoh River valleys, and the Washington coast, Weldon Rau (division geologist). Published as GM-24.

Myers Creek and Wauconda mining districts, Okanogan County, Wayne S. Moen (division geologist). Field work completed; report in preparation.

An assessment of the uranium potential in the Ellensburg Formation, south-central Washington, Clint Milne. Division Open-File Report 79-2.

Preliminary geologic map and report of the late Cenozoic geology of the Columbia Basin, James Rigby (division geologist). Division Open-File Report 79-3.

Strippable and underground coal resources on Washington Department of Natural Resources administered land, Pierce County, Ellis Vonheeder (division geologist). Division Open-File Report 79-4).

Whatcom County coal test drilling, Ellis Vonheeder (division geologist). Report in preparation.

Columbia Basin geologic maps. Division Open-File reports 79-7 through 79-15 (see division open-file reports, p. 9, 10).

Geology and coal resources of the Roslyn-Cle Elum area, Charles Walker (division geologist). Report in preparation.

Oil and gas exploration in Washington, 1900-1978, Carl McFarland (division geologist). Published as Information Circular 67.

Geologic map of the Marblemount quadrangle, Washington, Peter Misch (University of Washington). Published as GM-23.

Geology of the Wenatchee area, Randall L. Gresens (University of Washington). Wenatchee quadrangle is Division Open-File Report 79-14; other quadrangles are being mapped and report is in preparation.

Coastal geology between the Hoh and Quillayute Rivers, Weldon Rau (division geologist). Report in preparation.

Fault compilation map of Washington for geothermal and mineral occurrences studies, Glennda McLucas (division geologist). In progress.

Mineral evaluation of state lands, Wayne Moen (division geologist). Continuing project.

Twisp and Methow mining districts, Okanogan County, Wayne Moen (division geologist). Preliminary work started.

Stratigraphy of pre-Vashon Quaternary sediments, southern Whidbey Island, Keith Stoffel (division geologist). Study relates to possible Quaternary tectonism supported by U.S. Geological Survey grant. Current work will be completed in February 1980.

Geology of Island County and its implications to land use, Gerald Thorsen (division geologist). Geologic mapping and interpretation of Quaternary deposits. In progress.

Geologic circuit rider project, Gerald Thorsen (division geologist). Geologic information on land use made available to general public and government in Island, Jefferson, and Clallam Counties. A cooperative effort with the U.S. Geological Survey.

Landslides of Washington, Gerald Thorsen and land use staff (division geologists). Continuing project to delineate slide areas and analyze slide problems in the state.

Forest slope stability study, Allen Fiksdal (division geologist). Departments of Ecology and Natural Resources cooperative study to evaluate slope stability on all nonfederal forest lands in western Washington.

Clallam County mapping, Kurt Othberg and Pamela Palmer. Quaternary geologic mapping. Open-file reports covering four quadrangles—Dungeness, Sequim, Gardiner, and Carlsborg—will be available in early 1980.

Regulatory functions. The division issued 93 surface mining permits and one oil and gas drilling permit during 1979.

Department of Natural Resources
Division of Geology and Earth Resources
Olympia, WA 98504

BULK RATE
U. S. POSTAGE PAID
Olympia, Washington
Permit 263