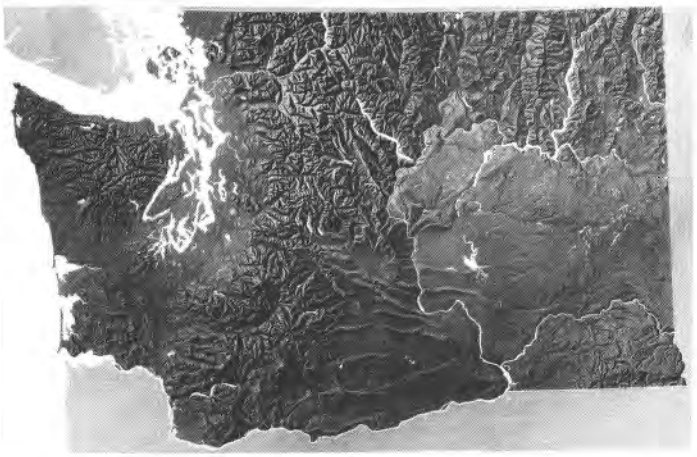

WASHINGTON GEOLOGIC NEWSLETTER

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Washington State Department of Natural Resources

Division of Geology and Earth Resources

Coal being loaded at the John Henry No. 1 mine, King County. (See article, p. 21)

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WASHINGTON GEOLOGIC NEWSLETTER

The Washington Geologic Newsletter is published quarterly 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, reports of investigations, and geologic maps. A list of these publications will be sent upon request.

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GEOLOGIC HAZARDS PROGRAM

by
Ray Lasmanis, State Geologist

Landslides, debris avalanches and torrents, coastal bluff erosion, volcanic hazards and the potential for large earthquakes demonstrate that Washington State has a dynamic geologic environment that can threaten life and property. With only one full-time environmental geologist and increments of time contributed by other staff geologists, the Division can respond only to crises; it is not in a position to provide even a minimal level of attention or hazard mitigation guidance to the citizens and local governments of the State.

During the current biennium, a series of three related developments have made it imperative that in the future the Division of Geology and Earth Resources fulfill its mission to provide the needed geologic hazard expertise. The three driving forces are:

- Debris avalanches and debris torrents in the northwest part of the state (1983 and 1985) were of disastrous proportions, causing death, extensive property damage, and loss of fish habitat.
- The U.S. Geological Survey and Federal Emergency Management Agency (on Dec. 9, 1986) announced that the Puget Lowland and Portland, Oregon, areas have been assigned highest priority in the Nation in terms of seismic research needs and have committed $7 million to this area over 3 years to document geologic processes related to earthquake risk.
- Agreement, in principle, has been reached among environmental groups, the

(Continued on page 23)

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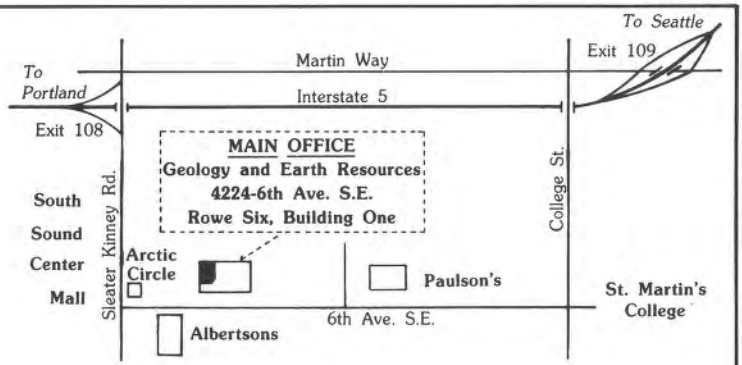


WASHINGTON'S MINERAL INDUSTRY, 1986

by
Nancy L. Joseph

According to information obtained by the Division of Geology and Earth Resources, thirty-three metal and industrial mineral operations and four Portland cement plants were active in Washington in 1986 (Table 1). Nonfuel mineral production (excluding aluminum) is preliminarily estimated by the Bureau of Mines at $254 million. Gross sales of industrial minerals remained steady, as calculated from the state occupation tax, while sand and gravel production increased slightly. Production of precious metals rose significantly in 1986 because of increased production at the Cannon mine. A record 154,000 ounces of gold was produced in Washington in 1986.

Nine companies produced processed calcium carbonate in 1986. Portland cement was produced by four companies and contributed more than a quarter of the revenues from the state's mineral industry. Columbia River Carbonates began production of fine-ground white calcium carbonate at their plant in Cowlitz County. This is the first major operation in the northwest to produce ultrafine-ground high-calcium carbonate suitable for filler and coating for white paper.

No uranium was produced in Washington in 1986. The last uranium production in the state was in 1984, when two properties were being mined.

Total revenue from prospecting, mining, and quarrying, including sand and gravel production, on state lands was $451,906 for the fiscal year ending June 30, 1986 (Fig. 1). This value is down approximately 30 percent from 1985, and it represents a drop in revenues from mineral leases and contracts and from sand and gravel production.

The information in this report is summarized from voluntary replies to a questionnaire sent to companies and individuals active in mineral exploration and development in the state, as well as from published information. The questionnaire is limited in scope, and, therefore, details of activities on individual properties are not always

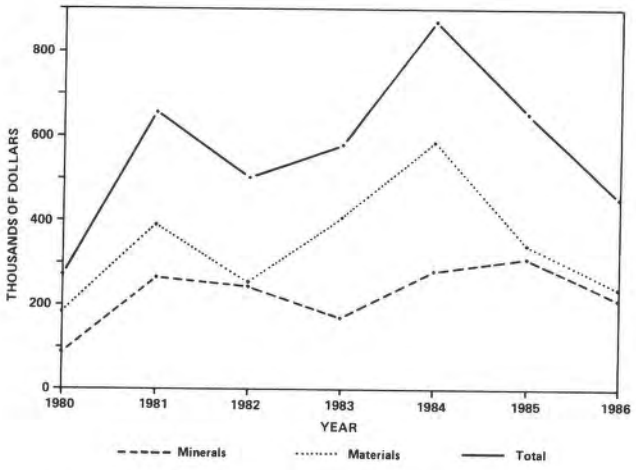


Figure 1.--Revenue from prospecting, mining, and quarrying on state lands.

available. Not all questionnaires were returned, and some information requested, particularly regarding expenditures and production, is considered confidential by many of those questioned and is not reported. Therefore, while this summary is a reliable indication of the mineral activity in the state, it is general in nature.

Fifty companies reported development and (or) exploration for metals in 1986, down from 62 companies who replied to the questionnaire in 1985. Expenditures for exploration and development for metals decreased significantly in 1986, reflecting the completion of development work at the Cannon mine in Chelan County. However, the minimum expenditure of $3.5 million for work related to metallic minerals reported on the 1986 questionnaire is nearly identical to that for 1982--before work began at the Cannon mine.

Thirty-one companies reported exploration for and(or) development of industrial mineral deposits in Washington in 1986. A minimum of $3 million, more than double the 1985 figure, was reported on the questionnaire to have been spent on these activities. Industrial minerals, excluding sand and gravel, accounted for more than $35 million of the

Table 1.--Exploration and development in Washington, 1986; see Figures 2a and 2b for property locations

Loc. No.	Owner and (or) Operator	Property	Location	Commodity	Remarks
1	Asamera Minerals (U.S.) Inc.; Breakwater Resources, Inc.	Cannon mine	Chelan County sec. 16 T.22N., R.20E.	Au, Ag	Mining and milling; exploration/drilling
2	Asamera Minerals (U.S.) Inc.	Wenatchee Silica quarry	Chelan County sec. 21 T.22N., R.20E.	Silica; sand	Producing backfill for Cannon Mine
3	J & S Mining	Grey Wolf claim	Chelan County Blewett	Au	Placer mining in Peshastin Creek
4	Sunshine Valley Minerals, Inc.	Holden	Chelan County secs. 17-18 T.31N., R.17E.	Au	Exploration
5	Teck Resources (U.S.) 1983 Inc.	Lovitt mine	Chelan County sec. 22 T.22N., R.20E.	Au	Exploration and drilling
6	Tenneco Mineral Company	B-Reef, L-D mine, Canyon No. 2	Chelan County secs, 16, 22, 18 T.22N., R.20E.	Au, Ag	Sold royalty interest in Wenatchee property to Echo Bay Mines Ltd.
7	Tillicum Gold Mines Ltd.; Montana de Oro, Inc.	Blewett property	Chelan County Numerous sections T.22N., R.17E.	Au	Geological and geochemical exploration and drilling
8	Ideal Basic Industries Inc.	Twin River quarry	Clallam County secs. 22-23 T.31N., R.10W.	Clay	Mining
9	Hidden Brick Company	Hidden Brick	Clark County Vancouver	Clay	Mining
10	Crown Resource Corp.; Gold Texas Resources Ltd.; Echo Bay Exploration	Granny	Ferry County secs. 15-16, 22 T.39N., R.33E.	Au, Ag	More than 6,600 ft drilled by Echo Bay
11	Crown Resource Corp.; Gold Texas Resources Ltd.; Echo Bay Exploration	Key	Ferry County secs. 7-8, 17-18 T.37N., R.34E.	Au, Ag	Geologic, geochemical, and geophysical exploration and drilling by Echo Bay
12	Crown Resource Corp.; Glamis Gold, Ltd.	South Penn	Ferry County secs. 27-28 T.37N., R.32E.	Au, Ag	Heap leach test by Glamis Gold
13	Crown Resource Corp.; Sutton Resources, Inc.	Seattle mine	Ferry County secs. 27-28, 33-34 T.37N., R.32E.	Au, Ag	Mine inactive pending refinancing
14	Hecla Mining Company	Republic unit	Ferry County sec. 26, 27, 35 T.37N., R.32E.	Au, Ag	Exploration, mining, milling, completion of new shaft
15	High Country Mining	Valley mine	Ferry County sec. 6 T.37N., R.33E.	Au, Ag	Mine and mill in production
16	Newmont Exploration Ltd.		Ferry County Danville district	Au	Exploration and drilling
17	Sundance Mining - Development, Inc.	Gold Hill	Ferry County Danville district	Au, Ag, Cu	Leased by Vulcan Mountain
18	Vulcan Mountain Inc.	Gold Dike	Ferry County secs. 7-8, 17-18 T.40N., R.34E.	Au, Ag, Cu	Geological exploration and drilling, mine development
19	Basic Resources Co.	Rock Top	Grant County sec. 20 T.22N., R.26E.	Clay	Began road building

Table 1.--Exploration and development in Washington, 1986 (continued)

Loc. No.	Owner and/ or Operator	Property	Location	Commodity	Remarks
20	Witco Corporation	Grant County pits	Grant County sec. 8 T.17N., R.24E.	Diatomite	Mining, geological exploration, and drilling
21	CSS Management Corp.	Apex-Damon-Cleopatra	King County secs. 33-34 T.26N., R.10E.	Au, Ag, Cu, Pb, Zn	Mine development, mining and milling
22	L-Bar Products, Inc.	Ravensdale mine and plant	King County sec. 36 T.22N., R.6E.	Silica	Mining and processing silica sand
23	Mariposa Resources Inc.	Coney Basin	King County secs. 13-14 T.25N., R.10E.	Au, Ag	Geological and geophysical reconnaissance
24a	Mutual Materials Co.	Newcastle	King County sec. 31 T.24N., R.6E.	Clay	Mining
24b	Mutual Materials Co.	Elk pit	King County sec. 34 T.22N., R.7E.	Clay	Mining
25	G and G	G and G Placer	Kittitas County sec. 3 T.20N., R.17E.	Au	Assessment work
26	Gold Placers Inc.; M.G.M. Resource Corp.	Sunset	Kittitas County near Liberty	Au, Ag	Drilling
27	Old West Mining	Crystal City	Lincoln County sec. 21 T.28N., R.36E.	Dolomite	Removal of overburden and building of new access road
28	Agro Minerals, Inc.	Agro Minerals	Okanogan County sec. 5 T.38N., R.27E.	Gypsum	Mining
29	Columbia River Carbonates	Columbia River Carbonates quarry	Okanogan County sec. 13 T.38N., R.30E.	Limestone	Open-pit mining, crushing
30	Cordilleran Development, Inc.	Minnie mine	Okanogan County sec. 23 T.32N., R.22E.	Au, Ag, Cu	Reclamation of site
31	Richard Dart	Poland China mine	Okanogan County sec. 11 T.40N., R.29E.	Au, Ag	Geochemical and geophysical exploration, drilling
32	Kerr-McGee Corp.		Okanogan County Chesaw area	Au, Ag	Geological, geochemical and geophysical reconnaissance
33	Keystone Gold Inc.	Crystal Butte	Okanogan County secs. 25-26, 34-35 T.40N., R.30E.	Au, Ag	Drilling, geological exploration
34	Keystone Gold Inc.	Grey Eagle	Okanogan County sec. 16 T.40N., R.30E.	Au, Ag	Geochemical and geological reconnaissance
35	Nord Resource Corp.		Okanogan County Smith Canyon	Au	Drilling
36	Pacific Calcium, Inc.	Brown quarry	Okanogan County sec. 26 T.35N., R.26E.	Dolomite	Quarrying and milling
37	Pacific Calcium, Inc.	Whitestone quarry	Okanogan County sec. 14 T.38N., R.26E.	Limestone	Quarrying and milling

Table 1.--Exploration and development in Washington, 1986 (continued)

Loc. No.	Owner and/ or Operator	Property	Location	Commodity	Remarks
38	Silver Bell, Inc.; Crown Resource Corp.	Silver Bell mine	Okanogan County sec. 25 T.38N., R.31E.	Ag, Au	Exploration
39	Wayne and Betty Soderlund	Soderlund #1 and #2	Okanogan County secs. 26-27 T.35N., R.24E.	Au, Ag, Cu, Mo, Pb, Barite	Reconnaissance
40	Sundance Mining - Development, Inc.	Ida mine	Okanogan County secs. 21, 28 T.39N., R.31E.	Au	Sampling
41	Sunshine Valley Minerals, Inc.	Billy Goat mine	Okanogan County sec. 15 T.38N., R.20E.	Au, Ag	Exploration
42	Columbia Ocean Minerals, Inc.	State leases	Pacific County west of Ilwaco	Au, Fe, Ti	Offshore Vibracore drilling
43	Bockman Construction Inc.	Easy Street claims	Pend Oreille Co. secs. 23, 26 T.39N., R.44E.	Silica	Began mining
44	FRM Minerals, Inc.	Totem Talc	Pend Oreille Co. secs. 14, 23 T.39N., R.44E.	Talc	Geological reconnaissance drilling
45	LaSota-Jones Lead-Zinc Corp.	Slate Creek	Pend Oreille Co. Metaline district	Ag, Pb, Zn	Drilling
46	Lehigh Portland Cement Company	Champane Placer	Pend Oreille Co. sec. 27 T.39N., R.43E.	Limestone	Mined for production of portland cement
47	Lehigh Portland Cement Company	Troyer	Pend Oreille Co. sec. 20 T.39N., R.43E.	Silica	Mining; closed quarry
48	Lewis & Clark Mining	Lewis and Clark claim group	Pend Oreille Co. sec. 17 T.38N., R.44E.	Au, Ag, Mo, Pb, Zn	Geochemical and geological exploration
49	Meridian Minerals		Pend Oreille Co. Metaline district	Limestone	Drilling
50	Minatome Corporation	Klahowya Creek	Pend Oreille Co. sec. 26, 27 T.35N., R.45E.	U	Drilling and exploration
51	Montana Barite Co.	Bobcat	Pend Oreille Co. North of Newport	Barite	Dropped lease on property
52	Pintlar Corporation	Pend Oreille mine	Pend Oreille Co. sec. 15 T.39N., R.43E.	Pb, Zn, limestone	Mine closed and being allowed to flood
53	Mutual Materials Co.	Clay City pit	Pierce County sec. 25 T.17N., R.14E.	Clay	Mining
54	Applied Industrial Material Corp.	Twin Sisters	Skagit County secs. 3-4, 8-9 T.36N., R.7E.	Olivine	Geological exploration, milling
55	J and S Mining	China Gap	Snohomish County sec. 5 T.28N., R.8E.	Au	Placer operation on Sultan River
56	May Creek Mining	May Creek mine	Snohomish County sec. 11 T.27N., R.9E.	Granite	Exploration, mine development, mining

Table 1.--Exploration and development in Washington, 1986 (continued)

Loc. No.	Owner and/ or Operator	Property	Location	Commodity	Remarks
57	Interpace Industries, Inc.	Pottratz pit	Spokane County sec. 7 T.21N., R.45E.	Clay	Mining
58	Al Ambrose Mining	Sheep Creek	Stevens County sec. 16 T.40N., R.39E.	Au	Dredging
59	Allied Minerals, Inc.	Gehrke quarry	Stevens County sec. 2 T.29N., R.39E.	Dolomite, limestone	Mining and milling
60	Billiton Exploration U.S.A.	Aspen Hill	Stevens County Northern part of county	Ag, Pb, Zn	Geological and geochemical exploration
61	Champion Gold and Silver, Inc.	First Thought mine	Stevens County secs. 7, 18 T.39N., R.37E.	Au, Ag	Property under lease
62	Chewelah Eagle Mining Company	Chewelah Eagle	Stevens County sec. 5 T.32N., R.41E. sec. 32 T.33N., R.41E.	Marble, dolomite	Mining
63	Hemphill Brothers, Inc.	Lane Mountain Silica	Stevens County sec. 27 T.31N., R.39E.	Silica	Mining and milling, plant expansion
64	Hemphill Brothers, Inc.	Northport Limestone Division	Stevens County sec. 8 T.39N., R.40E.	Limestone	Mining, drilling, crushing, and screening
65	Peter Janni and Sons	Janni Northeast	Stevens County sec. 7 T.39N., R.40E.	Limestone	Under lease
66	Joy Mining Co. (Wash-Tex)	Flodelle Creek	Stevens County sec. 5 T.35N., R.42E.	U	No work reported
67	L-Bar Products, Inc.	Chewelah plant	Stevens County sec. 23 T.32N., R.40E.	Mg	Recycling waste products from Northwest Alloy's plant at Addy
68	Leadpoint Consolidated Mines Company	Leadpoint Consolidated properties	Stevens County sec. 12-13, 23 T.39N., R.41E. secs. 8, 17, 18, 20 T.39N., R.42E.	Ag, Pb, Zn	Assessment work
69	Mines Management, Inc.	Advance, HC	Stevens County sec. 18 T.39N., R.41E.	Au, Zn	Exploration
70	Mines Management, Inc.	Iroquois	Stevens County secs. 19-20, 29-30 T.40N., R.42E.	Au, Zn	Exploration
71	Minexco Inc.	State leases	Stevens County secs. 4, 8 T.29N., R.38E.	Au, Ag, Mo, U	Geological reconnaissance
72	Nanome Aggregates, Inc.	Several quarries	Stevens County	Dolomite	Mining and processing
73	Northwest Alloys, Inc.	Blue Creek quarry	Stevens County secs. 29-30 T.33N., R.40E.	Silica	No production in 1986

Table 1.--Exploration and development in Washington, 1986 (continued)

Loc. No.	Owner and/ or Operator	Property	Location	Commodity	Remarks
74	Northwest Alloys, Inc.	Addy Dolomite quarry	Stevens County secs. 13, 14 T.33N., R.39E.	Dolomite	Mining
75	Northwest Marble Products Company	White quarry, several properties	Stevens County sec. 10 T.38N., R.37E.	Dolomite	Mining
76	Old West Mining	H and B	Stevens County sec. 15 T.29N., R.37E.	Au, Ag, Pb, Zn	Mining and reconnaissance
77	Vanhorn-Watson Mining Co.	Weed lease	Stevens County sec. 20 T.40N., R.37E.	Au, Ag, Cu, Pb	Geologic exploration
78	Mutual Materials Co.	Bucoda pit	Thurston County secs. 10, 14 T.15N., R.2W.	Clay	Mining
79	Columbia Northwest Cement Corp.	Kendall quarry	Whatcom County secs. 14-16, 22-23 T.40N., R.5E.	Limestone	Quarrying and milling
80	Olivine Corp.	Swen Larsen quarry	Whatcom County sec. 34 T.38N., R.6E.	Olivine	Mining and milling
81	Seattle-St. Louis Mining Company	Minnesota mine	Whatcom County sec. 2 T.37N., R.16E.	Au, Ag	Surface trenching, sampling old adits
82	Western Gold Mining, Inc.	New Light mine	Whatcom County sec. 27 T.38N., R.17E.	Au	Open pit and underground sampling
83	Ardic Exploration and Development Ltd.	Morse Creek	Yakima County sec. 31 T.17N., R.11E.	Au, Ag	Geological and geochemical reconnaissance

gross receipts for minerals in calendar year 1986.

The locations of properties discussed in this article are shown in Figures 2a (counties in western Washington) and 2b (counties in eastern Washington).

BASE AND PRECIOUS METALS

Gold and silver were the focus of the five active mining operations in Washington in 1986 (Table 2). The mines produced more than 154,000 ounces of gold and 250,000 ounces of silver. The largest gold producer in the state was the Cannon mine in Chelan County, operated by Asamera Minerals (U.S.) Inc. In Ferry County, the Republic unit of the Hecla Mining Company completed construction of their new 1,300-foot-deep shaft on the Golden Promise veins, whose discovery was announced in 1985. Heap-leach operations continued at the Gold Dike mine owned by Vulcan Mountain Inc. The mine and mill at the Valley mine, operated by High Country Mining, are in production. In Stevens County, Old West Mining has a small operation at the H and B mine.

Chelan County

The Cannon mine, the largest gold mine in the state, produced nearly 111,800 ounces of gold and 117,000 ounces of silver in 1986. The trackless underground mine, which is jointly owned by Asamera Minerals (U.S.) Inc. (51%) and Breakwater Resources, Ltd. (49%), began production in July 1985.

Milling capability was temporarily reduced in mid-summer when a crack in the steel casing of the ball mill was discovered. Repairs were made to the machinery, and the mill will be replaced during routine main-

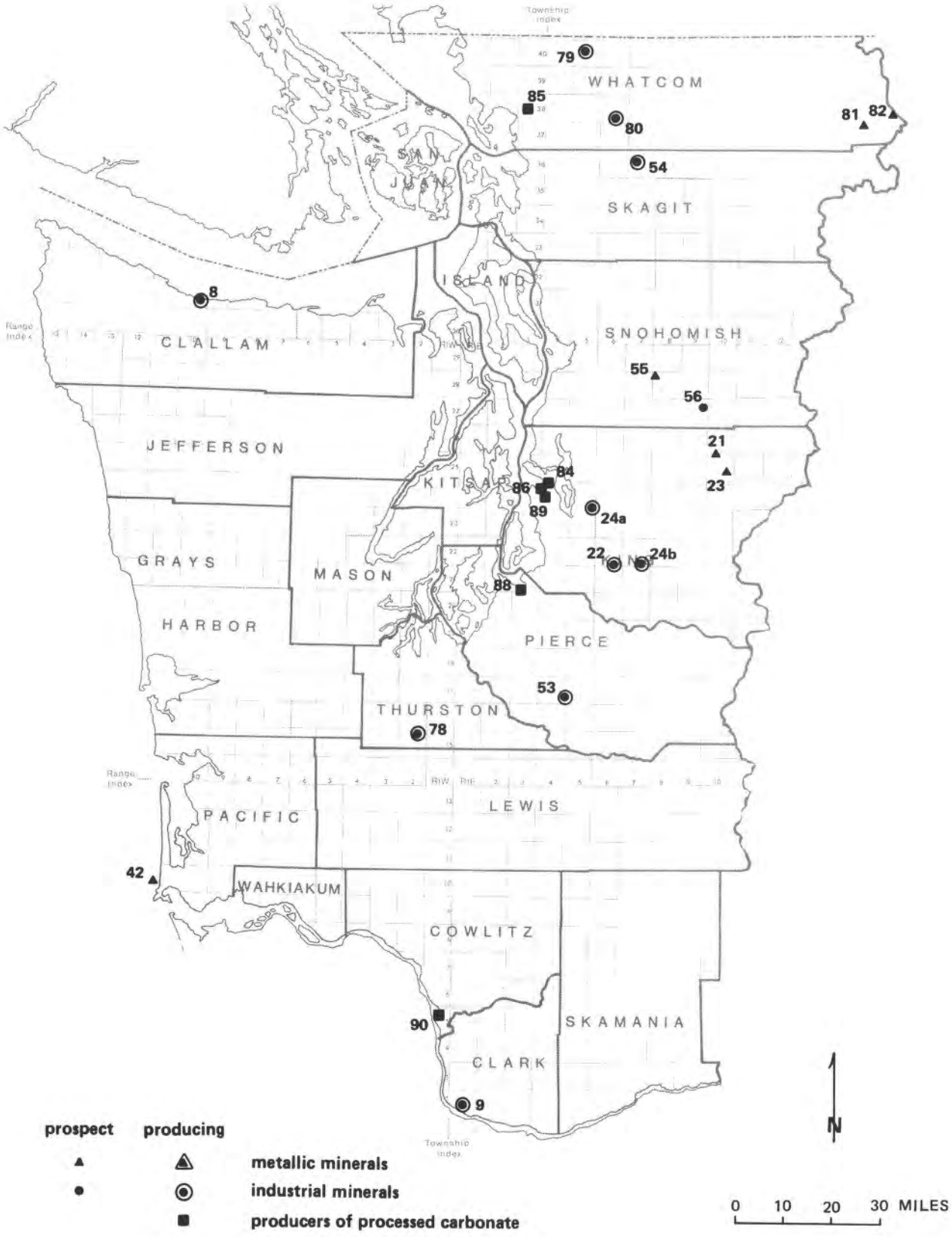


Figure 2a.--Location of selected mines (metallic and industrial minerals), producers of processed carbonates, and prospects in western Washington. Location numbers are keyed to Table 1.

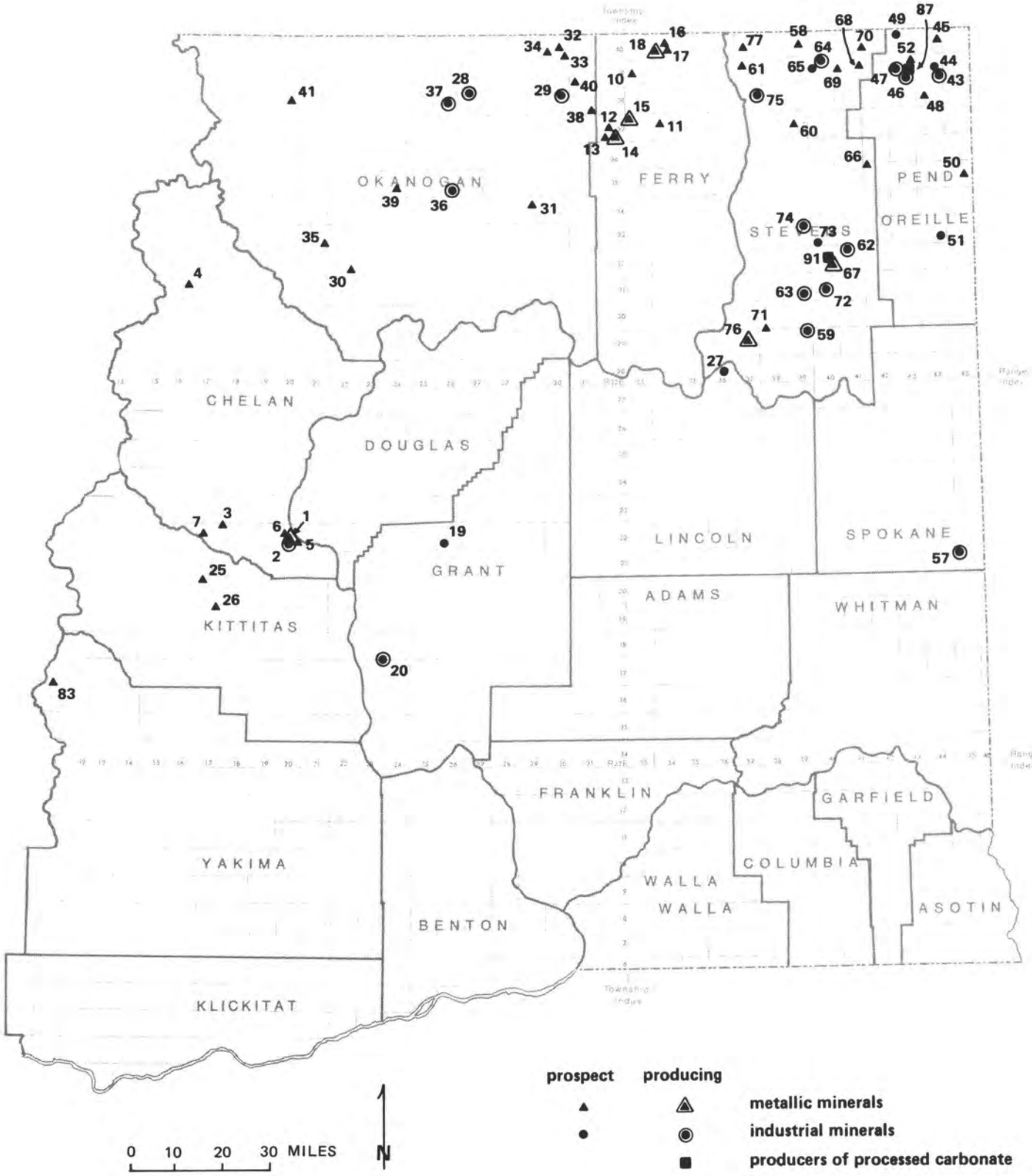


Figure 2b.--Location of selected mines (metallic and industrial minerals), producers of processed carbonates, and prospects in eastern Washington. Location numbers are keyed to Table 1.

Table 2.--Properties producing base and precious metals, 1986

Metal	Property	Owner and (or) Operator	County	Production, development
Au, Ag	Cannon mine	Asamera Minerals (U.S.) Inc.; Breakwater Resources, Ltd.	Chelan	Produced nearly 111,800 oz of gold and 117,000 oz of silver
Au, Ag	Republic unit	Hecla Mining Company	Ferry	Produced more than 40,000 oz of gold and 130,000 oz of silver
Au, Ag	Valley mine	High Country Mining	Ferry	Mining and milling
Au, Ag, Pb, Zn	H and B	Old West Mining	Stevens	Mined 1,600 tons
Au, Ag, Cu	Gold Dike mine	Vulcan Mountain Inc.	Ferry	Continued heap-leach operation

tenance. Underground development continued during the mill shut-down.

The Cannon operators continued an aggressive exploration program in the mine and around the mine site to maximize reserves. Surface and underground drilling, as well as geological, geochemical, and geophysical reconnaissance, were undertaken in the Wenatchee area. The deposit is in Eocene fluvial sediments of the Swauk Formation, which has been intruded by two generations of hypabyssal rocks. The younger intrusion (4.2 ± 0.4 m.y., K-Ar), a rhyodacite, is spatially and genetically related to silicification and gold mineralization (Ott and others, 1986).

Echo Bay Mines Ltd. acquired the North American gold properties of Tenneco Mineral Company in November. This transaction included the royalty interest on the former Tenneco properties adjacent to the Cannon mine that were sold in 1985 to the Asamera joint venture.

Teck Resources (U.S.) 1983 Inc. conducted geologic, geochemical, and geophysical exploration and drilling on their property in the Wenatchee area. This property is also in the Eocene Swauk Formation.

Gold exploration has continued in the Blewett district. Tillicum Gold Mines Ltd. has increased their land position to 8,000 acres in the district by means of an agreement with Montana de Oro, Inc., to earn a 65 percent interest in their property on the Peshastin vein. Six holes were drilled by Tillicum on the vein over a 2,400-foot strike length. Additional surface and underground drilling and geologic mapping were also undertaken. Mineralization in the district occurs in quartz-calcite-talc sulfide veins in serpentinized ultrabasic rock.

J and S Mining conducted geologic exploration on their gold placer claim in Peshastin Creek.

Sunshine Valley Minerals, Inc. continued work on the gold tailings at their Holden property in the northern part of the county.

Ferry County

The northwestern quarter of Ferry County saw the most activity in the state for precious-metal exploration and development in 1986 (Fig. 3).

Major development was completed at the Republic unit owned by Hecla Mining Company. A $2.2-million, 1,300-foot-deep, circular steel-lined shaft, with a 6-foot inside diameter, was constructed to provide access to the Golden Promise veins, whose discovery was announced in 1985. The new shaft, which connects with the Knob Hill 1100 level, will be mainly used to haul personnel and equipment, while ore will continue to be conveyed by tram to the #2 shaft, almost a mile away. A new "dry" (a miners' dressing area) and an access road were also built. Underground drifting and drilling, including at least 12 diamond drill holes, were undertaken in 1986 to locate ore grade mineralization in the four discontinuous Golden Promise veins.

The Republic unit produced more than 40,000 ounces of gold and 130,000 ounces of silver in 1986 from the Bailey and Golden Promise veins. The Golden Promise veins, which can be as wide as 35 feet, are reported to contain reserves of approximately 372,000 tons of ore averaging 1.0 oz/ton gold and 4.5 oz/ton silver (Wallace Miner, Dec. 18, 1986), which should extend the life of the mine for ten years. Prior to the discovery of the new veins, closure of the mine was anticipated in mid-1986 (Wallace Miner, Feb. 20, 1986).

The banded epithermal Golden Promise veins are in pyroclastic units of the Eocene Sanpoil Volcanics. A 30-foot-thick, disseminated and stockwork deposit, averaging 0.248 oz/ton gold and 0.15 oz/ton silver, was also discovered in the Sanpoil Volcanics beneath the post-mineralization cover of the Klondike Mountain Formation.

Vulcan Mountain Inc. continued leach operations at the Gold Dike mine west of Danville. Geologic exploration, drilling, and mine development were done at the gold property. The Gold Hill prospect, which is owned by Sundance Mining-Development, Inc., and is adjacent to the Gold Dike, is leased by Vulcan Mountain. Mineralization at the Gold Dike and Gold Hill properties is fault controlled and spatially associated with a Cretaceous syenite porphyry dike.

Echo Bay Mines Ltd. entered into a joint-venture agreement for the Key and

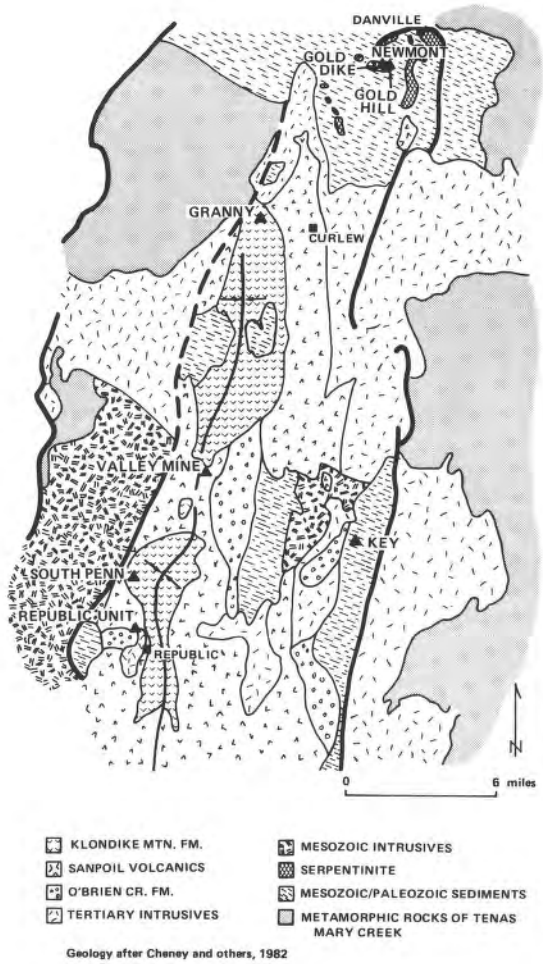


Figure 3.--Areas of active exploration and development in northwestern Ferry County.

The new Golden Promise shaft at the Republic Unit of Hecla Mining Co. The shaft is 1,300 feet deep and will be used for moving personnel and equipment. (Photo courtesy of Hecla Mining Co.)

Granny properties, which are held by Crown Resource Corp. and Gold Texas Resources Ltd. Echo Bay reportedly can earn up to a 60-percent interest in the properties through exploration and development expenditures. Geologic and geochemical reconnaissance and drilling were done by Echo Bay Exploration, as the operator, at both properties. Crown Resource announced that, as of late August, ten reverse circulation and four core holes had been drilled at the Granny, for a total of 6,649 feet (Wallace Miner, Oct. 9, 1986). The rock drilled was reported to include 70 feet averaging 0.158 oz/ton gold and 130 feet of material grading 0.07 oz/ton gold. Crown Resource reported that the deposit should contain 3.3 million tons grading 0.053 oz/ton gold which could be mineable by open-pit methods (North American Gold Mining Industry News, Aug. 15, 1986). This bulk-tonnage mineralization at the Granny occurs in the Sanpoil Volcanics near the contact with the Klondike Mountain Formation. Mineralization is believed to be genetically related to veins similar to the mineralized veins in the Republic district. Drilling at the Key "has identified geological reserves of about one million tons, with an undiluted grade of approximately 0.15 troy ounces of gold per ton" (Echo Bay Mines Ltd., third quarter report, 1986) that can be exploited by open-pit mining methods. Gold at the Key is associated with magnetite-pyrite mineralization replacing Paleozoic limestones intruded by the Eocene Scatter Creek Rhyodacite.

Echo Bay Mines Ltd. has also acquired the right of first refusal to participate in financing required for exploration at the Seattle mine, a joint venture of Crown Resource Corp. and Sutton Resources Ltd. The Seattle mine was inactive in 1986 pending refinancing and geological and geochemical work. The Seattle mine is in an epithermal vein deposit in the Sanpoil Volcanics.

Glamis Gold Ltd. continued leach testing at the South Penn property, 3 miles north of Republic. The South Penn is a joint venture between Glamis Gold Ltd. and Crown Resource Corp. Mineralization at the South Penn is similar to that at the Granny deposit.

High Country Mining has begun mining the gold- and silver-bearing quartz-calcite vein at the Valley mine. The mine and mill are in operation, and concentrates are being sent to a smelter in Colorado.

Newmont Exploration Ltd. has been exploring for gold in several geologic environments in northern Ferry County. Drilling was undertaken in the Danville district, while the company carried out geological, geochemical, and geophysical exploration elsewhere in the area.

Nicor Mineral Ventures explored for stockwork gold and silver within volcanic rocks through geological and geochemical reconnaissance. In January 1987, Nicor became part of Westmont Mining Inc. through a merger.

King County

CSS Management Corp. continued development at their Apex, Damon, and Cleopatra properties. Improvements were made to their pressure-leaching mill in Skykomish. The "Cashman Process" was developed to be used on ore that has a high arsenic content while not releasing pollutants.

Geologic and geophysical reconnaissance were done by Mariposa Resources Inc. at their Coney Basin gold-silver property.

Kittitas County

M.G.M. Resource Corp. concluded negotiations with Gold Placers Inc. to earn up to a 60-percent interest in mining leases on the Sunset gold property. The company has also staked claims in the area. Six holes were drilled at the Sunset; however, low gold values were reported (Wallace Miner, Oct. 9, 1986). The Sunset property is reported to be in Eocene sandstones and carbonaceous shales of the Swauk Formation. Propylitized and silicified rock occurs adjacent to major faults and shears (North American Gold Mining Industry News, June 13, 1986).

Okanogan County

The Minnie mine, formerly worked as a gold heap-leach operation by Cordilleran Mines, Inc., is no longer active. The leach pads and solution ponds have been chemically neutralized by the U.S. Forest Service as part of the reclamation procedure.

Several companies explored for gold and silver in Okanogan County. Keystone Gold Inc. continued geochemical and geological reconnaissance on their Grey Eagle property,

and drilling was undertaken at their Crystal Butte claims. Geophysical and geochemical exploration, as well as drilling, were conducted at the Poland China mine in the Meyers Creek district by Richard Dart. Geochemical and geophysical reconnaissance was done by Wayne and Betty Soderlund on their claims near Peacock Mountain. Kerr McGee Corp. did limited geological, geochemical, and geophysical reconnaissance in the Chesaw area. Nord Resources Corp. is reported to have drilled at their gold property in Smith Canyon. Sampling was done by Sundance Mining-Development, Inc., at the Ida mine.

Pacific County

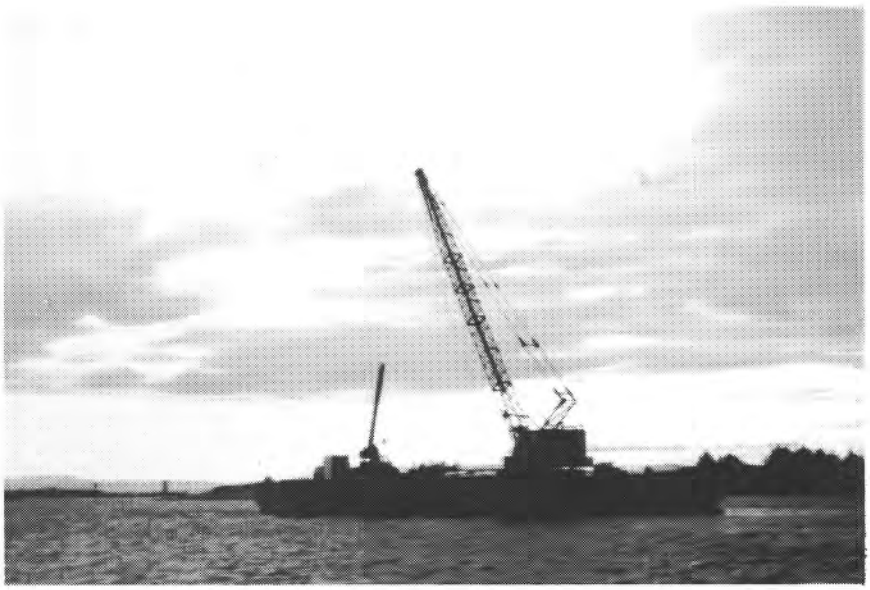
Columbia Ocean Minerals, Inc., explored for gold and accessory titanium and iron on an offshore bar near the mouth of the Columbia River, west of Ilwaco. The intent of the project was to investigate potential economic concentrations of heavy minerals that may have been transported by the Columbia from the mineralized areas in the river's upper drainage. Exploration was spurred by a 1906 U.S. Geological Survey mineral resource report that discussed beach sands in the area that averaged 0.025 oz/ton gold (Day and Richards, 1906, p. 1218-1219). At least four Vibracore holes were drilled offshore in 1986. Results of the drilling have not been released.

Pend Oreille County

The Pend Oreille mine, last worked in 1977, is being allowed to flood, and the ventilation fans have been shut off. Pintlar Corporation, a subsidiary of Gulf Resources and Chemical Corp., had continued ventilating the mine and pumping while various parties considered options on the property. Salvaging of remaining underground equipment in the former lead-zinc mine has been completed. Geological exploration and drilling were carried out elsewhere in the Metaline district by Pintlar Corporation.

Base and precious metals were the exploration targets of several companies in the county. The LaSota-Jones Lead-Zinc Corp. drilled at their property in the Metaline district. Silver King Mining and Milling Company conducted geological and geochemical exploration and drilling at their lead-zinc-gold-silver property. Lewis and Clark Mining reported geochemical and geological exploration on their claim group south of Sullivan Lake. Cominco American Incorporated undertook geological and geochemical exploration for massive sulfide deposits containing lead, zinc, and silver in the Precambrian Belt Supergroup.

Two companies reported exploring for uranium in the county. Uranium-bearing veins were being sought by geological, geochemical, and geophysical reconnaissance and drilling by Minatome Corp. at their Klahowya Creek



Offshore Vibracore drilling west of Ilwaco by Columbia Ocean Minerals Inc. (Photo courtesy of Don Hull, Oregon Department of Geology and Mineral Industries)

property. Numerous showings of secondary uranium minerals and other radiometric anomalies are present at the property, which is in the Cretaceous Hungry Mountain pluton. Rocky Mountain Energy utilized geological and geochemical techniques to explore for uranium in the county.

Snohomish County

J and S Mining mined placer gold at their China Gap property on high bench areas of the Sultan River.

Stevens County

Base and precious metals and uranium were the targets of companies exploring in Stevens County. Although several companies explored for metals in the county, only one small operation was actively mining.

Old West Mining mined 1,600 tons at their H and B property. The prospect consists of four veins which contain gold, silver, lead, and zinc minerals.

Champion Gold and Silver, Inc., had previously leased the First Thought mine to Shell Mineral Company, which has, in turn, subleased it to Rochester Mining Co. Drilling was done by Rochester at the property, which produced more than 30,000 ounces of gold between 1904 and 1910.

Billiton Exploration U.S.A. (Shell Mining Co.) conducted geological and geochemical exploration at the sedimentary exhalative lead-zinc deposit at their properties in the northern part of the county.

Lead and zinc mineralization in the Metaline Formation was the target for several companies. Mines Management, Inc., continued exploration at the Iroquois, Advance, and HC properties. Leadpoint Consolidated Mines Company did assessment work at their properties in the Northport mining district.

Polymetallic stratabound and vein mineralization within the Precambrian Togo Formation was being examined by geological exploration done by Minexco Inc. in the Huckleberry Mountains.

Vanhorn-Watson Mining Company conducted limited geological exploration on their properties in the northwestern part of the county. Base and precious metals in quartz veins in the Jurassic Rossland Volcanics were the focus of this work.

Placer mining was begun on Sheep Creek by Al Ambrose Mining; a 4-inch dredge was used.

Boise Cascade Corp. continued exploration for disseminated and massive sulfide deposits on corporate lands in the county.

Nicor Mineral Ventures explored for sedimentary exhalative silver and base metals in the Kootenay Arc through geologic mapping and geochemical sampling.

Rocky Mountain Energy continued geologic reconnaissance in the search for uranium mineralization.

A total of more than $5 million in equity in the Dawn Mining Company was written off by the owners, Newmont Mining Corp. (51%) and Midnite Mines Inc. (49%) early in 1986. Dawn produced uranium from the Midnite mine on the Spokane Indian Reservation until it ceased operation in 1982. The mine continues in standby status.

Whatcom County

Gold was the target of companies exploring for metals in the county. Exploration continued at the Minnesota mine, owned by the Seattle - St. Louis Mining Company. Surface trenching was performed on quartz veins, and old adits at the mine were reopened and sampled. The New Light mine, owned by Western Gold Mining, Inc., and leased by RB Resources (USA) Ltd. of Vancouver, B.C., was subleased by the lessee to Stray Horse Resources, Inc. Open-pit and underground sampling was conducted at the gold property in the Slate Creek mining district.

Yakima County

Ardic Exploration and Development Ltd. conducted geological and geochemical reconnaissance at their Morse Creek property. The deposit is reported to be a bulk-tonnage gold target in Tertiary igneous rocks.

Statewide

Several companies explored for precious metals statewide. Coeur Exploration, Inc. did geological reconnaissance for epithermal gold and silver deposits. Lacana Gold Inc. explored for gold in several geologic environments. Kennecott Corporation used

geochemistry and geophysics to explore for gold. Rio Algom Exploration Inc. examined several properties for gold and silver. Homestake Mining Company conducted geological and geochemical reconnaissance in the search for gold. American Copper and Nickel Company, Inc. also explored for gold.

INDUSTRIAL MINERALS

Twenty-one companies developed 28 properties for industrial minerals in 1986. Four companies mined clay from seven properties. Five companies mined calcium carbonate for cement, white filler, and agricultural use. Silica was produced by five operators, including one new producer whose silica was used for making cement in Pend Oreille County. Dolomite was produced by at least five firms. Diatomite, olivine, gypsum, and crushed rock and stone were also produced by several companies in the state. Tables 3 and 4 provide details of these operations.

Chelan County

Wenatchee Silica Products Inc., now owned by Asamera Minerals (U.S.) Inc., continues to provide backfill for the Cannon mine as well as very limited production of golf-course and playground sand. The Wenatchee quarry previously was a supplier of flux to the ASARCO Tacoma smelter which ceased operation in 1985.

Clallam County

The Twin River quarry, owned by Ideal Basic Industries Inc., is the largest producer of clay in the state. The company produced 115,000 tons of clay, which is barged to their plant in Seattle where it is used in the manufacture of Portland cement. The clay is mined from weathered mudstones of the Twin River Group of Oligocene age.

Clark County

Hidden Brick Company continued to produce clay at their mine in Vancouver. Approximately 112 tons were mined.

Cowlitz County

Columbia River Carbonates began production of ground white calcium carbonate at their plant in Woodland. The marble, which is mined in Okanogan County, has a high brightness. The fine and ultrafine ground products are suitable as a filler for paper products, paints, and plastics, as well as for coating white paper.

Grant County

Witco Corp. is the sole producer of diatomite in the state. A net production of 90,000 tons came from lakebeds interbedded with the Miocene Columbia River basalts. The diatomite is utilized for filler in paints and as filters.

Basic Resources Company has begun road building and development of a small open pit at their clay property.

King County

Silica sand for colored bottles and the cement industry is produced at the Ravensdale mine and plant. The plant, which produces 100,000 tons of silica per year, is now owned by L-Bar Products, Inc., of Albuquerque, New Mexico. The operation was formerly owned by Industrial Mineral Products, Inc. Clay-cemented sandstones of the Eocene Puget Group make up the mined deposit.

Mutual Materials continues to mine clay from their Elk and Newcastle pits, southeast of Seattle. Mutual Materials is the second largest producer of clay in the state and operates four western Washington pits.

Lincoln County

Old West Mining reported that removal of overburden and building of a new access road have begun at the Crystal City dolomite property. The dolomite is reported to contain 31.5 percent CaO and 21 percent MgO; the balance is given off on ignition. Dolomite of this composition is utilized in the glass industry (Mills, 1983, p. 341).

Okanogan County

Columbia River Carbonates, a limited partnership of Bleeck Management, Inc., and Genstar Carbonates Inc. (a subsidiary of Genstar Stone Products Co.), continues to mine high-grade calcium carbonate from their quarry near Wauconda. In 1986, the operation, which began in 1985, produced 25,000

Table 3.--Properties producing industrial minerals, 1986

Commodity	Property	Owner/ Operator	County	Production and development data
Clay	Hidden Brick	Hidden Brick Co.	Clark	Mined 112 tons
	Twin River quarry	Ideal Basic Industries, Inc.	Clallam	Mined 115,000 tons
	Pottratz pit	Interpace Industries, Inc.	Spokane	Mined 56,000 tons
	Elk pit	Mutual Materials	King	
	Bucoda pit	Mutual Materials	Thurston	Mined 100,000 yd^3 in 4 pits
	Clay City pits	Mutual Materials	Pierce	
	Newcastle	Mutual Materials	King	
Dolomite/ Magnesium	Gehrke quarry	Allied Minerals, Inc.	Stevens	Mining and milling
	Chewelah Eagle Mining Co.	Chewelah Eagle Mining Co.	Stevens	Mined 300 tons
	several quarries	Nanome Aggregates, Inc.		Produced ground dolomite, architectural aggregate
	Addy quarry	Northwest Alloys, Inc.	Stevens	Mined more than 500,000 tons
	White quarry, other quarries	Northwest Marble Products Co.	Stevens	Mining white dolomite
	Brown quarry	Pacific Calcium, Inc.	Okanogan	Mining and milling
	Chewelah plant	L-Bar Products, Inc.	Stevens	Recovering magnesium from sludge produced by Northwest Alloys plant
Diatomite	Grant County pits	Witco Corp.	Grant	Produced 90,000 tons
Gypsum	Agro Minerals	Agro Minerals, Inc.	Okanogan	Mined, dried, and sized gypsum
Limestone	Kendall quarry	Columbia Cement Corp.	Whatcom	Mined 500,000 tons
	Columbia River Carbonates quarry	Columbia River Carbonates	Okanogan	Mined and crushed 25,000 tons
	Champane Placer	Lehigh Portland Cement Co.	Pend Oreille	Mined 237,791 tons
	Northport Limestone Division	Hemphill Brothers, Inc.	Stevens	Mined 80,000 tons
	Whitestone quarry	Pacific Calcium, Inc.	Okanogan	Mining and milling
Olivine	Twin Sisters	Applied Industrial Material Corp.	Skagit	Milling
	Swen Larsen quarry	Olivine Corp.	Whatcom	Mined and milled 100,000 tons
Silica	Lane Mtn. Silica	Hemphill Brothers, Inc.	Stevens	Mined and milled 180,000 tons
	Ravensdale mine and plant	L-Bar Products, Inc.	King	Produced 100,000 tons
	Wenatchee Silica quarry	Wenatchee Silica Products Inc. (Asamera Minerals (U.S.) Inc.)	Chelan	Supplying backfill for Cannon Mine; minor production of playground, and golf-course sand
	Easy Street claims	Bockman Construction Inc.	Pend Oreille	Began production; 6,000 tons mined in 1986
	Troyer	Lehigh Portland Cement Co.	Pend Oreille	Mined 13,056 tons; production from quarry ceased

Table 4.--Selected producers of processed carbonate products, 1986; see Figures 2a and 2b for locations

Location No.	Commodity	Owner/ Operator	County
84	Portland cement	Ash Grove Cement West, Inc.	King
85	Portland cement	Columbia Northwest Cement Corp.	Whatcom
86	Portland cement	Ideal Basic Industries, Inc.	King
87	Portland cement	Lehigh Portland Cement Co.	Pend Oreille
88	Lime	Tacoma Lime, a division of Continental Lime, Inc.	Pierce
74	Lime	Northwest Alloys, Inc.	Stevens
89	Ground limestone	J.A. Jack and Sons, Inc. (Hemphill Brothers, Inc.)	King
90	Ground limestone	Columbia River Carbonates	Cowlitz
72	Ground, crushed dolomite	Nanome Aggregates, Inc.	Stevens
37	Ground dolomite and limestone	Pacific Calcium, Inc.	Okanogan
91	Crushed dolomite	Northwest Marble Products Co.	Stevens

tons of marble grading 98 percent $CaCO_3$ from the Spectacle Formation of the Anarchist Group. The rock is crushed at the quarry, then sent by rail to the Columbia River Carbonates plant at Woodland, near Vancouver, where it is ground to a fine and ultrafine powder and slurry.

Pacific Calcium, Inc., produced limestone from their Whitestone quarry near Tonasket and dolomite from their Brown quarry west of Riverside. The carbonate is crushed in Tonasket and sold for poultry feed and soil amendment and as a lawn-care product.

Agro Minerals, Inc., continued to mine gypsum from the bottoms of small saline lakes north of Tonasket. The gypsum is dried, sized, and then sold for agricultural use.

Columbia River Carbonates calcium-carbonate fine-grind plant at Woodland. (Photo courtesy of Joerg Bleeck, Columbia River Carbonates).

Pend Oreille County

Lehigh Portland Cement Co. mined more than 200,000 tons of limestone from the Metaline Formation for use in the production of Portland cement. Silica from the Three Sisters Formation of Precambrian Z age (Burmester and Miller, 1983) was produced from the Troyer pit for use in manufacturing Portland cement during the first part of the year. However production there ceased, and Bockman Construction Inc. of Ione has begun to provide silica to Lehigh from their Easy Street claims north of Sullivan Lake. Approximately 6,000 tons were mined in 1986 from the property, which is reported to be a low-alkaline alluvial deposit. The company expects to mine about 30,000 tons per year from this deposit for the cement plant.

Exploration for talc was active in Pend Oreille County during 1986. FRM Minerals, Inc., a subsidiary of First Mississippi Corporation of Jackson, Miss., conducted geologic reconnaissance at their talc property. Drilling was done there by their partners, United Catalyst Corp. Nicor Mineral Ventures also explored for talc in this county.

Montana Barite Co. dropped their lease on the Bobcat property north of Newport because of the depressed barite market caused by the slump in domestic oil and gas exploration. The barite is in veins in Proterozoic rocks.

Meridian Minerals Company is reported to have drilled a limestone property near Gardner Caves State Park. Limestones of the Metaline Formation near the park are reported to average 97.2 percent $CaCO_3$ and approximately 1.3 percent MgO, with 0.6 percent silica. The limestones have been suggested for possible use as chemical and metallurgical lime and mineral filler (Mills, 1962, p. 53).

Skagit County

Applied Industrial Material Corp. of Illinois purchased International Minerals and Chemical Corp. in November. Milling continued at the olivine producer (Applied Industrial Material Corp.) in the Mount Baker mining district; most of the plant's production is for foundry application (Griffiths, 1984).

Snohomish County

May Creek Mining Company mined granite for landscape applications from the Snoqualmie batholith at the May Creek mine.

Spokane County

Interpace Industries mined 56,000 tons of clay from their Pottratz pit. This represents a substantial increase from the reported 1985 production.

Stevens County

Hemphill Brothers, Inc., continues to operate two properties in Stevens County. Lane Mountain Silica Co., the 25th largest silica producer in the United States in 1985, produced 180,000 tons of silica in 1986 from a structure-related friable zone in the Addy Quartzite. The quartzite is crushed, floated, ground, and sized at their plant at Valley. The plant was updated in 1986 by the addition of a new dryer and magnetic separators to accommodate increased production and purity requirements associated with their contract to supply the new PPG Industries Inc. plate glass plant in Chehalis. Uses for the silica include glass, foundry and blasting sand, and roofing granules.

The Northport Limestone Division of Hemphill Brothers produced 75,000 tons of 98 percent $CaCO_3$ in 1986.

Northwest Alloys Inc., a subsidiary of Aluminum Company of America, continues to mine dolomite for the manufacture of magnesium metal. More than 500,000 tons of the rock was mined from their Addy dolomite quarry for use at their Addy plant. However, no silica was produced from their Blue Creek quarry in 1986. Production from the Blue Creek quarry had supplied the raw material for the manufacture of ferrosilicon, which is used in the silicothermic process (whereby magnesia in calcined dolomite is reduced by silicon) to produce magnesium metal from dolomite. The ferrosilicon furnaces have been shut down, and Northwest Alloys now obtains ferrosilicon from other sources.

L-Bar Products, Inc., at its Chewelah plant, is recovering magnesium from the waste sludge produced by the Northwest Alloys plant at Addy.

Stockpiled quartzite at Lane Mountain Silica Co. This material is fed to the crusher and then to the plant to produce 30-to 125-mesh silica.

Crushed dolomite was produced by several companies in Stevens County. Nanome Aggregates mined dolomite from their numerous quarries. The varicolored stone is used as architectural aggregate, and white ground dolomite for use as fillers is also produced. Allied Minerals, Inc., mined and milled dolomitic limestone from their Gehrke quarry near Springdale. Chewelah Eagle Mining Co. mined approximately 300 tons of marble from their property northeast of Chewelah. Northwest Marble Products Company produced white dolomite from their White quarry near Kettle Falls and from other quarries in the county.

The Janni Northeast limestone quarry of Peter Janni and Sons was leased to Pluess Stauffer Industries, Inc., who in turn leased it to Vermont Marble Company.

George Maddox and Associates, Inc., did property examinations in the Addy Quartzite and Latah Formation for silica and clay resources.

Boise Cascade Corp. explored for limestone, marble, and silica on corporate lands within the county.

Thurston County

Clay was mined by Mutual Materials Company at the Bucoda pit. The company mined 100,000 yd^3 of clay from their four western Washington operations.

Whatcom County

Columbia Northwest Cement Corp. produced 500,000 tons of limestone grading 75 percent $CaCO_3$ from their Kendall quarry for Portland cement. The company is the largest producer of Portland cement to both mine and manufacture this product in the State of Washington. The fossiliferous Pennsylvanian limestone has been quarried since 1928 for the manufacture of cement.

Olivine Corporation mined and milled 100,000 tons of unaltered olivine from their Swen Larsen quarry. Foundry sand and refractory aggregates, as well as two grades of olivine flour are produced. The company has pioneered the development of a waste incinerator utilizing modular olivine refractory slabs (Griffiths, 1984).

Statewide

Meridian Minerals Company continued exploration and development for diatomite, limestone, pumice, rock, sand, and gravel. The work was conducted in King, Grant, Pend Oreille, Pierce, Snohomish, and Kittitas Counties.

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COAL ACTIVITY IN WASHINGTON - 1986

by
Henry W. Schasse

Although the level of coal exploration activity was low in Washington, a highlight of the coal industry in the state in 1986 was the opening of a new surface mine in the Green River coal district (Fig. 1) of southern King County.

Pacific Coast Coal Co. (PCCC) began production at its John Henry No. 1 open-pit mine, located 2 miles northeast of Black Diamond (Fig. 1). The opening followed 3 years of working through the permitting process, which was slowed largely by the resistance of a local citizens' group. PCCC began producing coal in October and finished the year with a production of 6,574 clean tons.

Most of the principal coal deposits in Washington are in a discontinuous belt (Fig. 1) extending along the western edge of the Cascade Range. The coal deposits are in nonmarine rocks of the Eocene Puget Group, deposited along the eastern shoreline of a north-trending sedimentary basin. PCCC will be producing from the Franklin Coal Series,

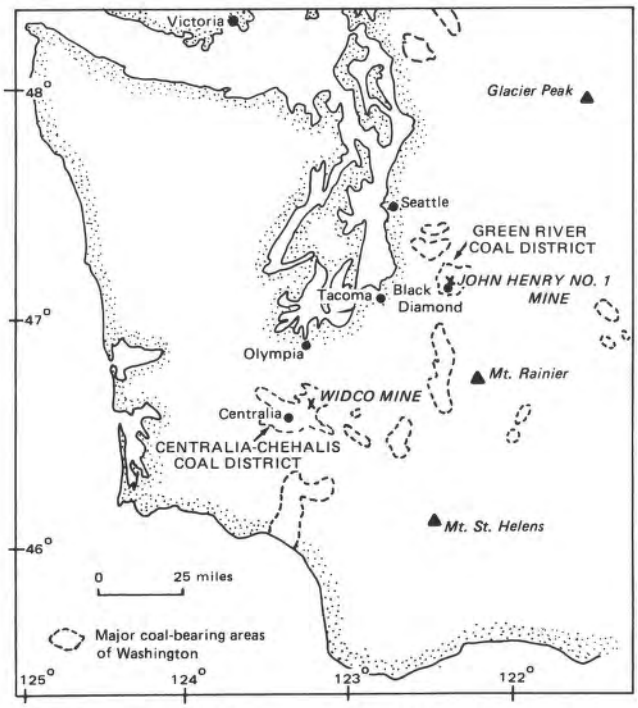


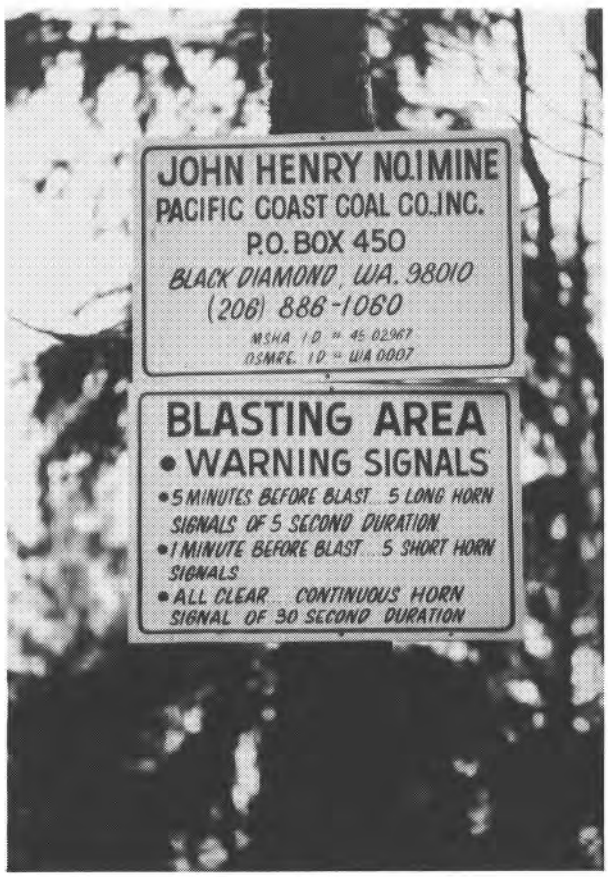
Figure 1.--Active coal-producing areas and coal districts in western Washington, 1986.

which lies stratigraphically near the base of the Puget Group.

The company is presently producing coal from the Franklin No. 9 seam. It plans to mine two seams beneath the Franklin No. 9, the Franklin Nos. 8 and 7 seams. A fourth seam, the Franklin No. 10, which lies above the No. 9 seam, may also be exploited as the mine is developed. The Franklin No. 9 seam is 18 to 20 feet thick in the mine; its coal is high-volatile B bituminous in rank. A representative proximate analysis (on an as-received basis) of the Franklin No. 9 is given below:

Percent moisture	8.4
Percent ash	12.6
Percent volatile matter	26.8
Percent fixed carbon	52.2
Percent sulfur	0.7
Btu per pound	11,984

PCCC supplies coal to several public institutions, including the University of Washington, to fuel their heating plants. The mine has the potential to supply a large part of the industrial market in the state for the next 16 years. That market has largely been supplied with coal shipped from Canada and Utah. Officials at the John Henry Mine say they hope to produce 70,000 to 80,000 tons of coal during 1987 and twice that amount in 1988 as they acquire new customers. The mine has a maximum designed production capacity of 250,000 tons per year. Mineable reserves at the mine are approximately 5.5 million tons. Current recovery from the Franklin No. 9 is reported to be about 60 percent. At the present time the coal from the mine is trucked 2 miles to the Palmer Coking Coal Company's coal wash plant at Black Diamond.



Washington Irrigation and Development Co. (WIDCO) continues as the state's largest coal producer. It produced 4,581,913 clean tons of coal in 1986 (approximately 157,000 tons more than in 1985) from its surface mine at Centralia (Fig. 1). The mine's production has averaged slightly more than 4 million tons of coal per year since it began to produce in 1971. WIDCO's sole customer is the Centralia thermo-electric power plant. WIDCO also continued confirmation drilling of its reserves at the mine. Coal mined by WIDCO at Centralia comes from the middle part of the Skookumchuck Formation, an upper member of the Puget Group.

The last remaining part of a 5-year research effort to develop Underground Coal Gasification (UCG) technology was completed during 1986 at the Centralia mine. Excavation of the burn cavity formed by the UCG CRIP test, performed during the fall of 1983 (Washington Geologic Newsletter, July 1984, v. 12, no. 3), was completed in two phases, in late May and in July 1986. Fourteen transverse, nearly vertical, serial faces, spaced approximately 10 feet apart, were excavated, surveyed, sampled, and photographed to document the nature of the test burn cavity. The work was performed for Lawrence Livermore National Laboratory by Western Research Institute of Laramie, Wyoming. The results of the excavation activities will be presented at the next UCG symposium, to be held this coming summer. UCG research similar to that which was terminated at the Centralia mine will be continued in Wyoming by Western Research Institute.

Palmer Coking Coal Co. terminated its mining activities at its McKay Section 12

mine in January 1986. The company produced 105 tons of coal and sold 11,100 tons from its stockpile. Palmer's customers will now be supplied by coal mined at the John Henry No. 1 Mine. Palmer owns the surface rights and substantial mineral holdings over the John Henry mine.

Meridian Minerals Co. rounded out the state's coal activity as it continued its low-key exploration effort on its holdings in the Green River coal district. Meridian plans to continue exploratory drilling for coal on a similarly modest scale during 1987.

GEOLOGIC HAZARDS PROGRAM

(Continued from page 2)

timber industry, state agencies, and Indian tribes. The agreement, which sets a national precedent, is titled "Timber, Fish, and Wildlife" (TFW) and will call for full consideration of geologic hazards during the planning stages of basin-wide timber harvesting activities.

In order to meet these challenges, a phased approach is envisioned. The initial phase will consist of assembling and fielding an environmental geology team, supported by the State general fund. It would consist of a senior geologist and two junior geologists. Their prime responsibility during the next biennium would be to compile geologic data that can be used to mitigate impacts to property and life in Whatcom and Skagit Counties. Landslides (both ancient and recent), debris avalanches and torrents, and Quaternary and bedrock geology would all be mapped in detail.

To implement this phase, the Department of Natural Resources has authorized the hiring of an environmental geologist on a project basis. Also, during the current biennium, the Department has included a request for two additional staff geologists in the 1987-1989 operating budget so that the Division can address geologic hazards in the northwest part of the state. And, as late as December, the Governor's budget request included funds for mitigation of geologic hazards. However, DNR's request has been reduced by 50 percent. (See Table 1.)

With current biennium projected expenditures of $85,351 for environmental geology, even with the reduced request, our capability in the area of geologic hazards will double.

Table 1.--Geologic hazards staff funding

	DNR request	Governor's budget
FY 88 FTE	2.50	1.25
Salary	$64,182	$32,090
Benefits	16,183	8,090
Travel	4,730	2,310
FY 89 FTE	3.00	1.50
Salary	$80,448	$40,224
Benefits	19,952	9,976
Travel	4,731	2,310

The second phase of the program would be to use state matching expenditures from the environmental geology section to acquire grants from the U.S. Geological Survey. Preliminary steps are now being taken to lay the groundwork to implement a federally funded program. On November 21, the report "Washington State Seismic Safety Council Policy Recommendations" was released. This comprehensive report deals with all aspects of earthquake risk. Specifically, it mentions the Division as playing a key role in conducting geologic research, in organizing a seismic information center, and in publishing information.

With federal grants, two additional project geologists could eventually be added to the environmental geology section to address earthquake risk. A technical steering committee, with the State Geologist and the State Seismologist, Linda Noson of the University of Washington, as co-chairpersons, could guide and coordinate the work among state, federal, and university workers. Since the Division would act as an "information center", federal funding will also be sought for our data center, namely the library and services that it provides.

The environmental geology activities in the northwest part of the state and, to some extent, earthquake mitigation studies will also be utilized by the TFW.

In phase 3 of the environmental geology program, funds from TFW would be used to

accelerate the production of land stability vs. hazards maps for all of western Washington. The development of this part of the program is in a very early conceptual stage.

Landslides can be triggered by earthquakes, and surficial or Quaternary geologic materials have a direct bearing on the amount of ground movement or failure that would take place during such an event. Thus, mapping in the northwest part of the state will provide valuable information not only for land use planning but also to assist in predicting the magnitude of risks from earthquakes.

In summary, there is a need for an environmental geology program that would mitigate problems and prepare plans that can produce information to reduce damage from geologic hazards. We plan to place initial emphasis on the northwest corner of the state, followed shortly by implementation of a concurrent federally funded earthquake hazards assessment program for Puget Sound and the Vancouver, Washington, area.

GUARNERA ELECTED TO HEAD NWMA

The Northwest Mining Association recently elected **Bernard J. Guarnera** to serve as its 1987 president.

Currently the manager of the Mineral and Hydro Resources division of Boise Cascade Corporation, Guarnera's background as a geologist and engineer spans more than two decades and covers most western states as well as Canada.

Prior to joining Boise Cascade in 1981, Guarnera was the principal-in-charge and associate in the Mining and Economic Geology Group of Dames and Moore in Chicago. He also served as senior geologist for Texaco, Inc. in Oklahoma and Colorado; as a geologist for Amax Exploration in Montana,; as a geologist for Anaconda American Brass LTD in Ontario; and assistant geologist for Quebec Cartier Mining Co., LTD in Quebec.

Other 1987 officers elected by the Northwest Mining Association are: **William B. Booth**, Assistant Manager, Investor and Public Affairs, Hecla Mining Company, who will serve as first vice president; **Jon C. Sprague**, General Manager, Valdez Creek Mining Co., Inc., who will serve as second vice president; **Karl W. Mote**, Executive Director, Northwest Mining Association, who will serve as vice president; **John L. Neff**, attorney, Neff, Pillabaum and Harlow, who will serve as secretary; and **David M. Menard**, vice president, Seafirst Bank, who will serve as treasurer.

The Northwest Mining Association serves more than 2,000 members in 50 states, several Canadian provinces, and other countries. Its activities include public education, student education, land use planning, health and safety research and education, and response to regulatory and legislative proposals. The organization was founded 92 years ago in Spokane and sponsors the city's largest annual convention in December.

Bernard J. Guarnera, 1987 President, Northwest Mining Association

(Text and photo courtesy Northwest Mining Association)

COMPUTERIZED WASHINGTON BIBLIOGRAPHY SYSTEM OF THE DIVISION OF GEOLOGY AND EARTH RESOURCES LIBRARY

by
Connie J. Manson

The bibliography of Washington geology 1981-1986, continually updated) and other bibliography files are now on computer at the Division of Geology and Earth Resources library. We use an IBM XT, dBASE II software, and our own supplemental dBASE II Bibliographic Information System (BIS) programming, and we have additional hard disc memory.

We have used this system to prepare some large bibliographies: the preliminary bibliography, 1981-1984 (Manson, 1984), the preliminary bibliography, 1981-1986 (Manson, 1987), and the thesis bibliography (Manson, 1986).

We are currently working on a comprehensive bibliography of Mount St. Helens and a bibliography of the Exclusive Economic Zone, offshore Washington. Both should be available in 1987.

We have also entered most of the 1963-1980 bibliography (Manson and Burnetti, 1983) into the system, and we hope eventually to enter the rest of the Washington bibliography series (Bennett, 1939; Reichert, 1960, 1969).

These files can be searched on any combination of: subject, geographic area, author, title, date, or publisher, with results written to screen, to disc, or to paper.

The BIS supplemental programs can also be used to organize other kinds of bibliographies. Since this system was first announced in 1985, more than 90 copies of the BIS programs have been sent to various libraries and researchers.

Contact the Division if you would like more information on the data base files or the BIS programs.

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Reichert, W. H., 1960, Bibliography and index of the geology and mineral resources of Washington, 1937-1956: Washington Division of Mines and Geology Bulletin 46, 721 p.

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OPEN-FILE REPORT AVAILABLE

The Division of Geology and Earth Resources has released an open-file report titled "Offshore geology of the Strait of Juan de Fuca, State of Washington and British Columbia, Canada", by Holly C. Wagner and Janice H. Tomson. The report consists of a 16-page text and 7 map plates. The report, Open-File Report 87-1, costs $5.75 plus $1 for handling and is available from the Division at the address given on page 2.

SELECTED REPORTS ADDED TO THE LIBRARY, WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES

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Baker, Glenn Eli, 1985, Source parameters of the magnitude 7.1, 1949, South Puget Sound, Washington, earthquake determined from long-period body waves: University of Washington Master of Science thesis, 68 p.

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Zitek, William O'Neill, 1982, A study of inverse Q as a function of depth in western Washington: University of Washington Master of Science thesis, 87 p.

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Driedger, C. L.; Kennard, P. M., 1986, Ice volumes on Cascade volcanoes--Mount Rainier, Mount Hood, Three Sisters, and Mount Shasta: U.S. Geological Survey Professional Paper 1365, 28 p., 6 plates.

Flanigan, V. J.; Sherrard, Mark, 1986, Preliminary geologic interpretation of the aeromagnetic map of the Colville Indian Reservation, Washington: U.S. Geological Survey Open-File Report 86-516, 17 p., 2 plates.

Paillet, F. L., 1985, Acoustic-televiewer and acoustic-waveform logs to characterize deeply buried basalt flows, Hanford site, Benton County, Washington: U.S. Geological Survey Open-File Report 85-419, 90 p.

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Perry, R. W.; Lindell, M. K., 1986, Twentieth century volcanicity at Mt. St. Helens--The routinization of life near an active volcano; final report: Arizona State University School of Public Affairs, 171 p.

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Hartz, K. E.; Bhagat, S. K.; Starlin, L. A.; Mott, H. V.; Krivanek, K. R., 1984, Attenuation of leachate generated from co-disposal of volcanic ash and solid waste: Washington Water Research Center Report 60, 239 p.

STAFF NOTES

Staff members of the Division of Geology and Earth Resources are involved with numerous geologic issues. Activities described below are some of our current ways of studying problems and needs and of providing information and services to Washington's residents.

Bill Lingley gave a talk titled "Current Reclamation Laws in Washington" to the Washington Aggregates and Concrete Association on January 22.

Timothy Walsh is teaching an introductory geology course at the local community college, South Puget Sound Community College.

Nancy Joseph, of the Spokane office, presented a paper highlighting mineral development in the state during 1986 to the Northwest Mining Association's convention in December. Members of that association have collected and donated rocks that Nancy has been using to help Spokane-area students describe and identify rocks. She also participated in a science fair at a local elementary school.

DIVISION REPORT WINS FIRST PRIZE

A recent Division of Geology and Earth Resources publication, "Geology of the Humptulips Quadrangle and Adjacent Area," received the distinguished award (first place) for technical reports in the 1986 Regional Technical Art and Publication Competition sponsored by the Puget Sound Chapter of the Society for Technical Communication. Other entries in that category were submitted by graphic designers and technical writers representing major industries, research laboratories, and other government agencies in the Pacific Northwest. The award was shared among the author, **Weldon W. Rau**, and two of the Division's cartographers, **Donald W. Hiller** and **Keith G. Ikerd.** The report consists of a colored geologic map and sections and accompanying descriptive text. Having won the regional competition, the report is automatically entered in the international competition to be held in May of this year in Denver, Colorado.

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