MINING

Five Year Mineral Programs Forecast

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Oregon and Washington

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Five Year Mineral Programs Forecast

Prepared by

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

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Dear Friend,

The Bureau of Land Management is responsible for administration of mineral and energy resources on approximately 53 million acres of public domain and acquired lands in Oregon and Washington, including those resources on lands managed by the Forest Service and other Federal land holding agencies. In addition, BLM serves as a minerals trustee for over 3 million acres of native American tribal lands in the two States. To aid in making sound program management decisions, the BLM State Office Division of Mineral Resources has developed this "Five-Year Mineral Programs Forecast" as a basis for dealing with the wide spectrum of policies and resource issues affecting our statewide mineral program. The report summarizes our current understanding of geologic terrains favorable for future mineral exploration and development, examines trends in the mineral industry, and applies this information to predicting Bureau workload program requirements through 1990.

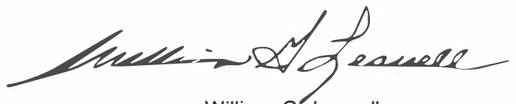
Careful development and use of these mineral resources contribute to the national economy and also directly benefit local governments. Fifty percent of all proceeds realized from BLM leasing of oil, gas, coal, and geothermal resources are paid to State and local governments. In 1984 this amounted to about $2.2 million.

Equally important as development of mineral resources is the protection of water and air during development and the protection and reclamation of the land. To accomplish these goals, BLM relies upon close coordination with other Federal and State agencies, such as the U.S. Forest Service, the Bureau of Indian Affairs, the Washington Department of Natural Resources, and the Oregon Department of Geology and Mineral Industries. Cooperation with these and other agencies, as well as the general public is essential to effective Federal mineral management and environmental protection.

This forecast is divided into two main sections. The first section contains a description of favorable geologic environments (terrains) for occurence of energy and mineral resources in Oregon and Washington. Mineral commodities covered include oil and natural gas, geothermal, coal, sand & gravel and crushed rock, metallic minerals, (gold, silver, copper, lead, zinc, and molybdenum), uranium, and other non-metallic minerals (diatomite, clays, zeolites and silica). The second section includes a recount of historical and current budget data as a basis for prediction of statewide mineral program needs in 1990.

FIVE YEAR MINERAL PROGRAMS FORECAST

Although more comprehensive studies concerning geologically unique areas of mineral commodities have been done in the past, to our knowledge this forecast is the first of its type for Oregon and Washington. Furthermore, it is hoped that this forecast will serve not only as a model for future statewide mineral development, but as a source of general information on regional mineral economics. Public comment on this forecast is welcomed in order to enhance both the description of mineral terrains and interpretation of future Bureau needs to carry out an effective mineral management program on Federal and tribal lands in Oregon and Washington. We hope you find this publication useful.



William G. Leavell
State Director

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I. Introduction

Opposite Page: The tramway utilized for carrying nickel ore to the smelter at Hanna Nickel Mine near Riddle, Oregon. This system us being phased out currently and is being updated to a water-slurry pipeline transport system.

The Bureau of Land Management administers mineral development on virtually all Federal land. The minerals programs administered by BLM in Oregon and Washington have recently experienced dramatic changes, principally as a result of the incorporation of responsibilities previously carried out by the Minerals Management Service (MMS). So that BLM effectively carries out the new charter, it is important that we examine what demands will be placed on the various components of BLM minerals management.

This five-year mineral forecast estimates the workload that we may experience in BLM minerals programs in 1990. We estimate workload for each BLM District and the State Office, based on what we foresee industry activity to be and on what geologic terrains are favorable for mineral activity.

Section II of this report is a comprehensive discussion of geologic terrains favorable for occurrence of the principal mineral commodities managed by BLM. Forecasts of industry activity and corresponding BLM workload and dollar expenditures are presented in Section III; Section IV summarizes overall results, compares work load demands to overall work force availability, and discusses sources of error.

Forecasts are presented for each of the seven mineral budgeting subactivities:

4111	:	Oil and Gas
4113	:	Geothermal
4121	:	Coal
4131	:	Mineral Materials (Sand & Gravel, Stone, etc.)
4132	:	Mining Law Administration-Locatable
4132	:	Minerals
4133	:	Non-Energy Leasable Minerals
4134	:	Uranium

While the methods for forecasting vary among the subactivity, certain procedures were used throughout the analysis. In all cases, we examined historical budget data for general trends. Statistical correlations of work-months with indicators of industry activity were tested for each subactivity. In almost all cases, lack of a good historical budget data base prohibited use of correlations as a forecasting tool.

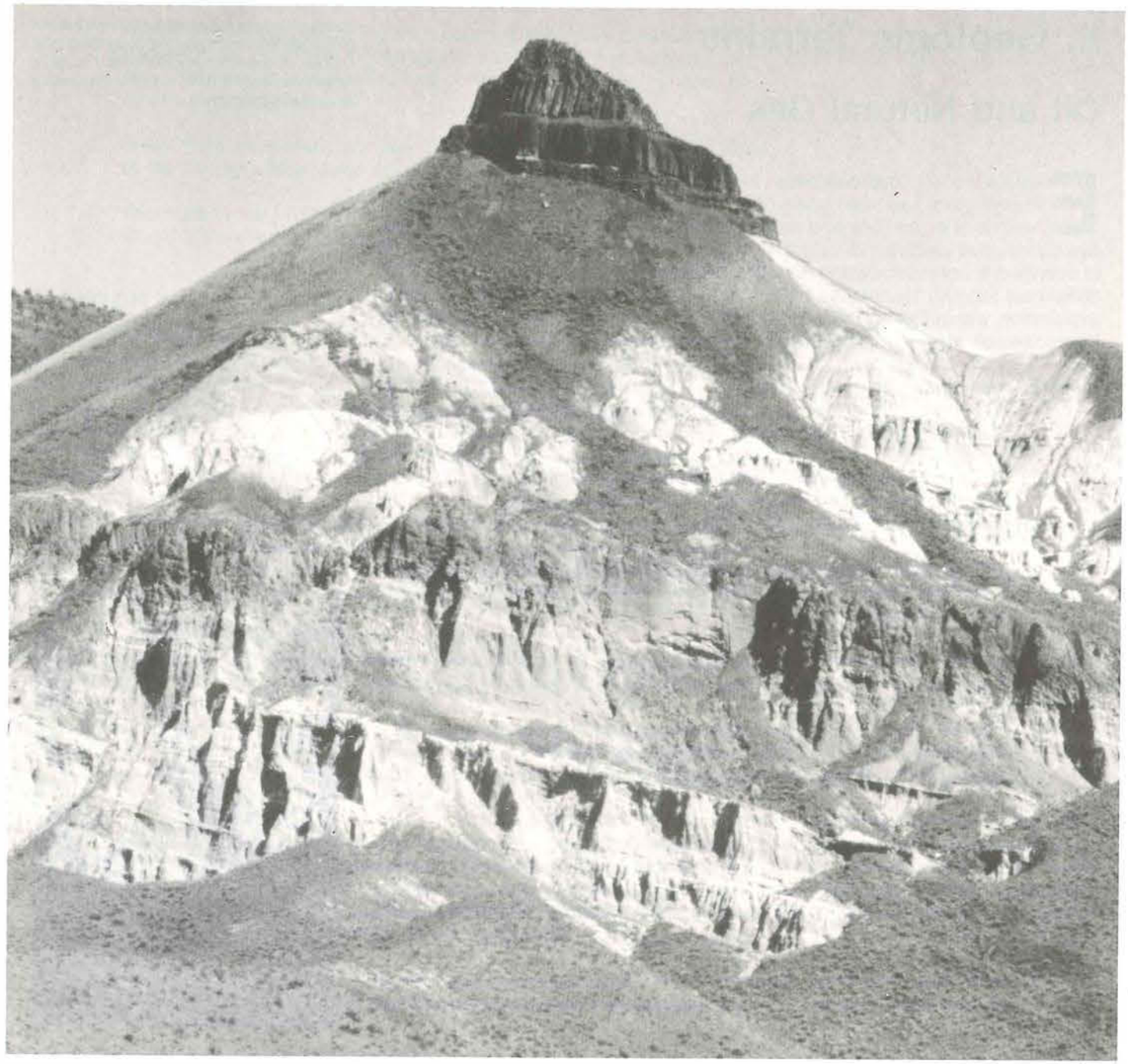
In order to project dollar expenditures, we assumed that average 1985 work-month costs would escalate two percent per year. Further, except for uranium

management, we assumed the 1985 relationship between total expenditures and work-month dollar expenditures would continue to hold true in 1990. This forecast also includes establishing BLM's other responsibilities which are not necessarily tied to year to year changes in mineral production. These responsibilities include consideration of mineral resources in preparation of land use plans, wilderness studies, and disposals (sales and exchanges) of Federal mineral estate.

Mineral and energy resources on Federal lands are managed under the authorities granted by Congress in the Mining Law of 1872, the Mineral Leasing Act of 1920, the Mineral Material Sales Act of 1947 the Mining and Materials Policy Act of 1970, the Federal Land Policy and Management Act of 1976, and the National Materials and Minerals Policy, Research and Development Act of 1980. The cornerstone of BLM mineral resource management policy is that all public land shall remain open to mineral exploration and development, unless it is clearly in the national interest to withdraw lands from entry. Further, BLM activity encourages environmentally sound mineral exploration and development by private industry on public lands in a manner that satisfies national and local needs.

Opposing Page: Typical geologic terrain found in eastern Oregon along the John Day River. Rock formations are better preserved in eastern Oregon generally because of lower annual rainfall.

FIVE YEAR MINERAL PROGRAMS FORECAST



II. Geologic Terrains

Oil and Natural Gas

Exploration for hydrocarbons in the Pacific Northwest (Oregon and Washington) has been going on for approximately 100 years. Intermittent periods of exploration and drilling activity in many areas throughout these two states have yielded mostly noncommercial oil and natural gas shows. Lack of overall drill hole distribution and until recently the lack of good geophysical down-hole logging techniques have been a major determent for hydrocarbon exploration within Oregon and Washington. To date, only three commercially producible oil and gas fields have been discovered:

1) Rattlesnake Hills gas field (1913-1941) in northern Benton County, Washington; approximately one billion cubic feet of gas produced (Hammer, 1934; Glover, 1936).

2) Ocean City oil field (1957-1961) near the community of Ocean City, in Grays Harbor County, Washington; approximately 12,500 barrels of oil produced (Rau & Wagner, 1974).

3) Mist gas field (1979-present) near the community of Mist in west-central Columbia County, Oregon. Estimated reserves (60 billion cubic feet of Natural gas).

There are three important factors exploration companies must consider when concerned with the accumulation of hydrocarbons in an area:

1) **Source rock** - content and type of organic material present
2) **Reservoir rock** - type and mineralogic composition
3) **Entrapment** - structural, stratigraphic or combination closure

New and improved geophysical techniques, better well completion tests, correlation and understanding of sub-surface stratigraphic relationships, and structural control of source and reservoir lithologic units will certainly influence exploration activity and the possibilities of discovering new reserves of hydrocarbons in Oregon and Washington. Four areas in which future discoveries may occur are:

1) Peripheral areas associated with the Mist gas field in the Coast Range of northwest Oregon.

Below: A rotary drilling rig utilized for natural gas exploration in Columbia County near Mist, Oregon. Federally administered O&C lands lie to the southeast of Mist, where active drilling is currently taking place.

2) Formations located below the thick covering of Tertiary Columbia River Basalts in south-central Washington, near Yakima. Similar rock types may extend over a large area into north-central Oregon beneath the basalt covering also.

3) Grays Harbor area, and peripheral areas north along the western side of the Olympic Mountains adjacent to the Pacific Ocean.

4) The continental shelf off the coast of Oregon (Coos Bay area) and Washington (Grays Harbor area).

Oregon

Most of the hydrocarbon potential in Oregon, delineated by exploration and drilling activity, is associated with early Tertiary-predominantly Eocene and other Cenozoic-sediments (mostly marine, some terrestrial). Difficulties with stratigraphic correlation and intraformational facies differentiations, delineation of three-dimensional sub-surface volcanic profiles, and complications caused by structure are just a few of the problems faced by oil and gas exploration companies in Oregon.

Dividing the state into regions of possible hydrocarbon potential is very difficult because of rock-type differentiation associated with each individual geomorphic province. Generally three areas (plus offshore potential) are associated with hydrocarbon exploration and drilling activity:

1) Coast Range and Willamette Basinal region.
2) Sediments below the Columbia Plateau and surrounding area.
3) Basin and Range region - southeastern Oregon.

This does not mean oil and gas accumulations do not occur in other areas within Oregon, but simply suggests that the three areas mentioned above probably have the greatest potential based on rock type and past exploration and drilling activity.

Exploration companies usually target basinal type environments (large accumulation of sediments) with substantial thicknesses of sediments (provided some have organic material present for hydrocarbon development), and buried deep enough (heat source) for the fractionation of hydrocarbons. Basins which might produce commercial quantities of oil and/or gas in Oregon, listed approximately by size are the:

1) Columbia Plateau basinal environment - north-central Oregon and south-central Washington.

2) Snake River Basin - southeastern Oregon.
3) Willamette Basin - between the Cascade Mountains and the Coast Range of Oregon.
4) Upper Nehalem River Basin - Mist Gas Field; northwestern Oregon.
5) Coos and Elkhorn Basins - Coos Bay area.
6) Astoria Basin - offshore northwestern Oregon.

The recent discovery and production of substantial quantities of natural gas near Mist, Oregon suggests that the Coast Range Mountains of Oregon may have the best potential for natural gas and possible oil accumulations.

The majority of natural gas production at Mist Gas Field, in west-central Columbia County, Oregon, occurs in the 'Clark and Wilson' arkosic sand horizons found within the late Eocene Cowlitz Formation. Stratigraphic formations in the Coast Range to the south which may have similar characteristics as those delineated by Armentrout (1985) in the Cowlitz Formation are:

1) Spencer Formation - north-central Coast Range; Forest Grove, Salem and Corvallis areas.
2) Nestucca Formation - north-central to central Coast Range; Sheridan and McMinnville area.
3) Coaledo Formation - southern Coast Range; Coos Bay area.

Source rock evaluation is still debated for the Mist Gas Field. Armentrout (1985), suggests migration has occurred, because of the thermal maturation of the gas. Bruer (1980) suggested that the Astoria and/or northern Willamette Basins could be possible sources of the thermal gas.

Recent drilling for hydrocarbons (active and pending permits) in Oregon's Coast Range Mountains and adjacent Willamette Basin by county, are as follows:

County	Area	County	Area
Clackamas	- east of Monitor	Coos	- Allegany
Clatsop	- Jewell - east of Olney - Lousignot Creek	Douglas	- Drain - Tyee - West of Melrose - Ivers Peak
Columbia	- Mist - Natal - Pittsburg - Clatskanie	Lane	- Creswell
		Linn	- Lebanon
		Marion	- West Stayton - St. Louis

Southeastern Oregon may be a prime exploration site for the discovery of oil and gas. The area is characterized by the geology of the Basin and Range and the Snake River Plateau geologic provinces and is blanketed by several thousand feet of Cenozoic volcanics and lacustrine sediments. According to Newton (1965), during Miocene-Pliocene time, several large non-marine sedimentary deposits accumulated in basins formed within southeastern Oregon: Western Snake River Basin, Klamath Basin, Harney Basin, and Goose Lake Basin.

Large accumulations of pre-Cenozoic marine sediments, may occur in southeastern Oregon and the area associated with the Snake River Downwarp, under the blanket of Cenozoic sediments (Warner, 1980). Cenozoic basins may offer good possibilities for hydrocarbon accumulations, but much more geophysical work and exploratory drilling will have to be done before the older underlying sediments in this area can be evaluated for oil and gas potential.

Areas of past drilling activity, delineated by Newton (1965) in southeastern and south-central Oregon are the Snake River Downwarp in northeastern Malheur County; Harney Basin in north-central Harney County; Goose Lake Basin in southwestern Lake County; and Klamath Basin in southeastern Klamath County.

The Columbia Plateau Region of Central Oregon is another area which may yield potential commercial quantities of oil and gas. The thick covering of Columbia River Basalts has deterred many oil and gas exploration companies from finding unknown hydrocarbon sources. Mesozoic marine sediments as thick as 30,000 feet may exist within the basinal environment below the Tertiary, predominantly Miocene volcanics (Newton, 1965).

Washington

As in the State of Oregon geophysical and exploratory well drilling have been in Tertiary predominantly Eocene sediments. There are five areas within the State of Washington, excluding the offshore continental shelf potential, which have favorable conditions for large accumulations of oil and/or natural gas:

1) Columbia Basin - southeastern and south-central Washington
2) Willapa Hills - southwestern Washington
3) Grays Harbor Basin - northwestern Washington
4) Puget Lowland - between Washington's Coastal Range - Olympic Mountains and the Cascade Range
5) Northern flank of the Olympic Peninsula and Strait of Juan de Fuca

Areas within the Columbia Basin, including Yakima, Benton, Kittitas and Grant Counties, have recently been the site of considerable exploration, leasing, and deep exploratory drilling by major oil companies, especially the region northeast

of Yakima, the Saddle Mountain Anticline and Frenchman Hills Anticline areas. The thick covering of Tertiary volcanics which are predominantly Miocene Columbia River Basalt and associated interbeds, in addition to the structural complications caused by past tectonic activity, prohibited exploration and drilling until the advent of newly applied geophysical techniques (Magneto Tellurics, Resistivity-Time Domain Electromagnetic, and deep seismic methods), and modern portable deep drilling rigs.

There are three large grabens in the northwestern part of the Columbia Plateau, which may extend under the Yakima Basalt Subgroup of the Columbia River Basalt Group: Chiwaukum Graben, Methow Graben, and Republic Graben.

These grabens contain thick accumulations of marine, (Methow graben), fluvial-lacustrine, and volcaniclastic sediments (mostly tuffaceous interbeds) which could conceal sufficiently large reserves of hydrocarbons underneath the Yakima Basalt. Most of the marine sediments are associated with the Methow graben. Major formational groupings associated with the Columbia Plateau, including the basalts and underlying units, are:

Age	Western Portion	East Portion
Mid-Miocene	Yakima Basalt	
	Yakima Basalt	Miocene Beds
Late Oligocene	Wenatchee Form.	Wenatchee Form.
Early Eocene	Roslyn Form.	Chumstick Form.
Late Eocene	Swauk Form.	Swauk For,

From Gresens & Stewart (1981)

Eocene arkosic sandstone units, Swauk/Chuckanut or Chumstick/Roslyn contain insignificant amounts of organic material for oil generation, but have good potential for natural gas production (Gresens & Stewart, 1981). The Oligocene Wenatchee Formation is locally rich in organic content, contains lensoidal sand deposits, and is capped by Miocene shales, making this formation favorable for hydrocarbon generation and retention (Gresens & Stewart, 1981).

The Willapa Hills region of southwestern Washington has good potential for economic accumulations of natural gas because of the similarities in lithology and structure with that of northwestern Oregon and the Mist Gas Field where commercial reserves of natural gas occur. Regional structure in this area consists of a doubly plunging anticlinorium, which extends in a northerly direction from the Nehalem Arch in Oregon, swinging to the west in the Willapa Hills Uplift area eventually heading north again toward the Willapa Basin in the region southeast of Grays Harbor (Armentrout & Suek, 1985).

The Grays Harbor Basin, along the central Washington coast, is the only area

in which commercial production of oil has occurred within the Pacific Northwest (Oregon and Washington). Although the Ocean City oil field only produced for five years and has a small production record, exploration and drilling activity has recently increased in Grays Harbor County as well as further to the north in Jefferson County.

Much of the interior region within the Olympic Mountains geographic province consists of 20,000 feet of indurated, complexly folded and faulted sediments (argillite and graywacke) which lack hydrocarbon potential; however, possible source beds for petroleum may exist in a horseshoe-shaped pattern around this topographic highland on the north, west and south sides (Rau & Wagner, 1974).

The Puget Lowland region is a northerly extension of the Willamette Basin. Glacial sediments have obscured underlying older formations in some portions of this region making exploration difficult. In the eastern portion of the lowland, Cretaceous and Eocene sediments (shales and sandstones as much as 14,000 feet thick) and overlying Oligocene strata may possess hydrocarbon source rocks and reservoir potential.

Gas was discovered in western Whatcom County near Bellingham in Pleistocene glacial sand lenses (Livingston, 1958). Possible sources of this high-nitrogen gas could have been upper Cretaceous-lower Eocene continental sandstones which unconformably underlie the Pleistocene glacial material interstratified within clays, sands and gravels (Glover, 1935).

Geothermal Resources

Exploration and development of geothermal resources in the Pacific Northwest is a relatively recent effort, i.e., within the last ten years. An overall lack of geothermal temperature gradient information because of limited drill hole distribution has been a major deterent in understanding the geothermal potential in Oregon and Washington. The majority of exploration occurs within Oregon.

Oregon

Geologic provinces associated with future geothermal activity in Oregon will most likely be the Western and High Cascade Province, Basin and Range Province, Owyhee Upland and Blue Mountains Province, and Klamath Mountain Province.

"Geothermal Exploration in Oregon, 1980" by Priest (1981) outlines possible high-temperature resource areas of the High Cascade Province, as well as low to moderate-temperature resource areas and areas in which the Oregon Department of Geology and Mineral Industries has completed geothermal

Geothermal drilling operation near Breitenbush Hot Springs in the western Cascade Range. Currently the Cascade Range may offer the best conditions favorable for high temperature geothermal gradient potential in both Oregon and Washington.

assessment work. Priest (1985) stresses the Cascade Mountain Range is one of the top priority areas for future geothermal resource potential.

These geothermal resource areas encompass all Bureau of Land Management districts except for the Coos Bay District. Most geothermal activity involving the western BLM districts is situated along the eastern portion of each district. Most of the geothermal activity is associated with the boundary between the younger High Cascade volcanics and the older Western Cascade volcanics.

Exploration for prospective geothermal resource areas in the past concentrated on high-temperature (above boiling point) areas. The Cascade Range has the best potential in the Pacific Northwest for high-temperature geothermal resources, and to date the Cascades and the Klamath Falls area has had the most geothermal drilling activity. Oregon has a high percentage of existing and potential low- to moderate- temperature resource areas. In the past, low- to moderate-temperature geothermal resources could not be utilized for commercial electrical generation, but within the last ten years, binary-cycle, portable power plant electrical generating technology has allowed utilization of these moderate-temperature resources. In years to come more emphasis may be put on utilizing these moderate-temperature resources.

Direct and indirect uses of geothermal resources in Oregon have been developed in Lakeview, Vale, and Klamath Falls. Significant utilization of geothermal district heating systems for many years have been utilized at the Oregon Institute of Technology as well as in over 400 other larger commercial buildings and residential homes. Lakeview area geothermal resource utilization includes indirect use of hot water for warming greenhouses and development of binary power plant systems. In Vale, a new multi-million dollar mushroom cultivating facility will use geothermal heat.

In the future, geothermal resources could profoundly change electric power generation in the Pacific Northwest. Future geothermal activity will likely be concentrated in two areas of the state. Eastern Oregon geothermal exploration will be concentrated in four BLM districts: Lakeview, Vale, Burns, and Prineville. The High Cascades will continue to see exploration activity centered along the eastern boundaries of the western BLM districts.

Washington

The geologic provinces associated with future geothermal activity in Washington will most likely be in the Cascade Mountains, Olympic Mountains, and the Columbia Basin Provinces. The State of Washington has only one BLM district, the Spokane District. Thus, the geothermal resource areas in Washington will be described by geographic location rather than BLM district jurisdiction.

As in Oregon, the High and Western Cascades geologic provinces in Washington have good potential for finding future geothermal resource areas. The Columbia Basin Province has several geothermal resource areas of low- to moderate-temperature gradients. Most of the existing geothermal resource areas within the Olympic Mountain Province are inside the Olympic National Park, where federal law prohibits utilization of this geothermal resource.

Because of the relatively small and sc!attered amounts of BLM-administered lands in areas expected to see future geothermal exploration and development in Washington, BLM will be considerably less.involved with geothermal resources in Washington than in Oregon, although Federal resources within the boundaries of National Forests will continue to be administered jointly with the Forest Service.

Coal

Oregon

The majority of coal mined in Oregon came from Coos County between 1870 and 1915 (Newton and Mason, 1973). Currently there is no coal mining activity within the state. Coal occurs in the southwestern, northwestern, north-central, and northeastern portions of the state. Three important coal resource areas associated with previous coal mining activity or recent exploration are the Coos Bay coal field in central Coos County, the Eden Ridge coal field in southern Coos County, and the Flora-Grande Ronde lignite field in northern Wallowa County.

According to Brownfield (1981) total cumulative coal production for Oregon before 1980 was an estimated 3 million tons, calculated on the basis of a 50 percent recovery rate. The majority of production occurred from 1880 to 1920 when approximately 2.38 million tons were mined, mostly in Coos County, predominately from the Coos Bay and Eden Ridge coal field (Allen and Baldwin, 1944).

Coal distribution in Oregon is commonly associated with late Tertiary sedimentary sequences. Coal seams and occurrences are found within the Coaledo and Tyee Formations in southwestern Oregon, and some correlative formations north of this area contain coal horizons. Recent exploratory test-hole drilling and bulk analysis have been done near Flora, in northeastern Oregon. These lignite deposits of the Grande Ronde lignite field are associated with the Ellensburg Formation, which includes the Grouse Creek and Menatchee Creek interbeds (Stoffel, 1984). Both of these interbeds are stratigraphically located between flows of the Saddle Mountain basalt, including the Umatilla, Elephant Mountain, and Buford Members. The depositional environment of the interbeds may represent accumulation of organic material which was deposited in a swampy environment

Below: Two large dragline-type cranes utilized for open-pit coal mining at WIDCO near Centralia, Washington.

related to regional subsidence, such as the Troy Basinal area during quiescent interflow periods (Stoffel, 1981).

Oregon's coal resource is small. Many factors influence the mining of coal. Coal heat content, thickness, lateral continuity, and dip of coal seams, as well as parting nature of the coal are the most important considerations when evaluating potential coal mining assets. Coal seam thickness in Oregon is relatively thin, usually not more than three feet. Subbituminous and lignite coal make up the majority of the known coal reserves found in Oregon. The lignite deposits of the Grand Ronde lignite field in northeastern Oregon and southeastern Washington are an exception; some of these approach 40 feet in thickness.

Washington

Most of the substantial coal resource areas and coal-bearing rocks in Washington are found in the eastern part of the Puget Lowland and western portion of the Cascade Geomorphic Provinces. Coal also occurs in the northeastern and southeastern portions of the state.

Washington has one major coal mine, the Washington Irrigation and Development Company (WIDCO) Mine at Centralia. Washington differs from Oregon in that all ranks of coal (anthracite, bituminous, subbituminous, and lignite) occur within the state. Coal rank generally increases with geologic age: early to middle Eocene deposits, bituminous; late Eocene deposits, subbituminous; and Oligocene deposits, lignite (Lasmanis, 1983). Anthracite is associated with isolated areas where intense deformation has occurred, or possibly where igneous intrusive heat has altered lower grade coal.

According to Lasmanis and Schasse (1983) in "Washington's Coal - Future Development Potential" the coal reserve estimates as of 1981, for the State of Washington (in millions of tons) by rank were:

Anthracite	5
Bituminous	2,099
Subbituminous	4,140
Lignite	117

Many coal resource areas are associated with present day mining activity and favorable exploration areas within the state. Coal mining operations in Washington include:

WIDCO's Centralia Mine - western Lewis County (99% of the states total production)
Black Prince Mine - east of WIDCO
Palmer Coking Coal Mine - near Ravensdale

Coal exploration activity and development areas in Washington include:

Western Whatcom County - Glacier field
- Bellingham field
Western Skagit County - Hamilton field
West-central King County - Issaquah-Grand Ridge
South-central King County - Green River field
Central Kittitas County - Roslyn, Taneum-Manastash
North-central Pierce County - Wilkeson-Carbonado
South-central Pierce County - Fairfax-Ashford
Western Lewis County - Centralia-Chehalis field
Eastern Lewis County
Northwest Cowlitz' County - Kelso-Castle Rock
Asotin County - Grande Ronde field

Data from Lasmanis (1983) - revised from Beikman (1961)

"Coal Reserves of Washington" by Beikman and others; (1961), contains more information on individual coal deposits in Washington.

Sand, Gravel and Crushed Rock

The exploitability of sand, gravel and stone (cement-limestone, rock products - which includes both crushed and dimension) commodities are dependent on two important factors: (1) proximity of deposits to population centers or areas of use and (2) economic trends (construction projects). When economic conditions are subdued, construction trends tend to decline, affecting the demand for sand, gravel and crushed rock. Substantial amounts of crushed stone products are used by the Federal sector, (BLM, USFS) for road maintenance and by the State for construction of highways.

Construction commodities such as sand, gravel, crushed rock, and cement account for a substantial portion of mineral industry value in both Oregon and Washington. In the past five years, mineral industry value from sand and gravel as well as crushed rock has ranked first in dollar amounts reported in both states.

Crushed rock products are produced in nearly every county of both states. Sources and needs are highly variable and depend on geologic terrain and population density of the area concerned. In this report no attempt will be made to enumerate on any of the different types of deposits or the many quarry locations. Although sufficient crushed rock material may be present in most communities, good quality products are in high demand and short supply in some areas.

Below: Rock crushers are extensively utilized for crushing large tonnages of rock into aggregate used for road maintenance by BLM and USFS.

Oregon

Although almost every county in Oregon has sand, gravel and stone commodities, most of the activity is associated with major population centers. Price of the commodity, total employment, as well as total state and federal expenditures for highway construction, will determine sand, gravel and stone production (Friedman, and others, 1979). The four-county area around Portland which includes Clackamas, Multnomah, Washington, and Columbia Counties, utilize a majority of the sand, gravel and stone products within the state of Oregon. More information on this market and production records is in "Rock Material Resources of Clackamas, Columbia, Multnomah, and Washington Counties, Oregon"(Gray, and others, 1978). Within the last five years, Multnomah, Clackamas, and Lane Counties have led in sand and gravel production and revenue statewide (Minerals Yearbook, 1978-1982).

Limestone, which is predominantly made into cement, is found in two locations in Oregon: southwestern Oregon - Josephine, Jackson, and Douglas Counties, and in the northeastern portion of the state in Baker and Wallowa Counties, especially the area near Lime, Oregon.

Washington

The major population centers of Seattle/Tacoma, Spokane and Vancouver account for the majority of production and revenue from the sand and gravel industry within the state. King, Pierce, San Juan, and Snohomish Counties have dominated production and revenue statistics of the state's sand and gravel industry for the past five years (Minerals Yearbook, 1978-1982).

Washington has three areas associated with limestone and cement production; Okanogan Highlands, area east of Everett, and areas within the San Juan Islands.

Gold & Silver

Oregon

Gold and silver in Oregon occur in the Klamath Mountains, the Blue Mountains, and to a lesser extent the Cascade Range. Within the last several years gold and silver exploration in Oregon has changed substantially, with the larger mineral exploration companies putting less emphasis on vein- and placer-type deposits, and concentrating on Tertiary hot spring-type epithermal targets. Oregon counties with newly recognized hot spring-type gold mineralization include: Harney, Malheur and Lake Counties. Older gold districts include Baker and Grant in northeast Oregon, and Douglas, Jackson, and Josephine counties in southwest Oregon.

Below: An old abandoned adit (opening) probably utilized for mining gold and possibly mercury.

Blue Mountains

The gold belt of the Blue Mountains Province is located in Baker, eastern Grant, and Northern Malheur Counties and includes BLM's Vale and Burns Districts. This belt can be subdivided into several physiographic areas in which placer gold and/or gold-silver lode producing districts occur. Gold and silver mineralization is commonly associated with Jurassic-Cretaceous intrusive bodies. The principal gold-silver producing areas and associated districts within the Blue Mountains, ranked by past productivity, are:

1. Elkhorn Mountains Area; includes Granite, Cable Creek, Rock Creek, Baker, Cracker Creek, and Sumpter Mining Districts.

2. Wallowa Mountains Area; includes Cornucopia, Eagle Creek, Homestead, Medical Springs, and Sparta Mining Districts.

3. Greenhorn Mountains Area; includes Greenhorn and Susanville Mining Districts.

4. Lookout Mountain-Pedro Mountain Area; includes Mormon Basin, Weatherby, and Connor Creek Mining Districts.

Brooks & Ramp (1968) and Koschmann & Bergendahl (1968).

Five other isolated areas in the Blue Mountains with smaller intrusions are Virtue, Upper Burnt River, Canyon Creek, North Fork, and Quartzburg gold mining districts (Koschmann & Bergendahl, 1968). Many of these gold and silver producing districts are actively being mined or explored by mineral companies hoping to find rock type and mineralization patterns similar to known economic accumulations of gold and silver.

The Elkhorn Mountains and associated Bald Mountain Batholith complex (Cretaceous) ranks first in past production output and number of gold and silver mines in Oregon. Rock composition of the Elkhorn Mountain area varies, ranging from norite to quartz monzonite (Taubeneck, 1957). The majority of past gold and silver discoveries are concentrated along the southern contact of the Bald Mountain Batholith, occurring predominantly in argillite and some granodiorite.

Gold and silver are associated with cross-cutting veins which have the general paragenetic sequence: 1) quartz emplacement (several episodes), the first silicifying and replacing the country rock; 2) sulfides, sulfarsenides; and 3) gold; all of which are commonly brecciated between each new mineralization episode (Hewett, 1931).

The Wallowa Mountains are predominately of granitic-type rocks associated with the Wallowa Batholith (late Jurassic-early Cretaceous age). Older rocks of the Hurwal Formation (sedimentary sequence consisting of argillite, siltstone sandstone and shale), Martin Bridge Formation (massive limestone and calcareous shale sequence), and associated greenstones, sedimentary and plutonic rocks of Permian, Triassic, and early Jurassic age have been metamorphosed to the greenschist facies regionally around the batholith. A halo of more intense metamorphism adjacent to the batholith has formed schists and hornfels mineral assemblages (Brooks & Ramp, 1968).

The Greenhorn Mountains area is located in Baker and Grant Counties. The Greenhorn Batholith composition is similar to that of the larger Wallowa and Bald Mountain Batholiths (Brooks and Ramp, 1968). Meta-argillites and greenstones are intruded by the Greenhorn Batholith. Gold and silver mineralization often occurs in quartz veins injected into the argillite and, to a lesser extent, the greenstone, with a majority of the load mines having a high silver-to-gold ratio (Brooks & Ramp, 1968).

The Lookout Mountain-Pedro Mountain area is located in southern Baker and northern Malheur Counties. Gold and silver load deposits in this area, according to Brooks and Ramp (1968) "appear to be genetically related to a northeasterly aligned group of exposures of Jurassic-Cretaceous intrusive rocks, mainly granodiorite of medium grain size."

Klamath Mountains

Gold and silver related deposits associated with the Klamath Mountains Physiographic Province include: Beach Placer deposits, Salmon Mountain-Sixes area, Mule Creek-Bolivar area, Illinois-Chetco area, Galice area, Silver Peak area, Greenback-Tri-County area, Gold Hill-Applegate-Waldo area, Myrtle Creek area, and Ashland area.

Host rocks associated with lode gold and silver mineralization in the Klamath Mountains occur mostly within greenstones, but can also be associated with diorites and metasedimentary rocks, such as argillites, quartzites, etc. (Diller, 1914).

Gold and silver occurrences can be subdivided into three categories: 1) small quartz veins with sulfides and some free gold, the most common type of deposit, 2) mineralized shear zones, and 3) rock alteration and sulfide impregnated deposits (Brooks & Ramp 1968).

Renewed interest in old lode and placer districts will involve the BLM districts of Coos Bay (mostly eastern portion), Roseburg (southern portion), and Medford within the next five years.

Cascade Mountains

Gold and silver related deposits of the western Cascade Mountains Physiographic Province can be divided into three mining districts: North Santiam (Clackamas and Marion Counties), Quartzville (Linn County), and Bohemia (Lane County). Gold and silver mineralization occurs within fissure veins of low temperature and shallow depth (epithermal type deposits), which seem to be genetically related to dioritic intrusive bodies of Miocene age (Callahan and Buddington, 1938). Propylitic alteration of the host rock (predominantly andesite-rhyolite composition) usually accompanies these dioritic intrusions with gold and silver mineralization (Peck and others, 1964).

Hot-spring systems related with epithermal gold and silver deposits have not yet been fully understood. According to Silberman (1982) "deposits of disseminated low grade, large tonnage gold and silver in shallow, epithermal hot-spring environments" were thought to be only associated with Carlin-type deposits until recently when large deposits of this type are starting to be explored in other rock types, usually volcanic and/or volcaniclastic. Much of the exploration for these types of deposits is concentrated in the southeast part of Oregon and in old mining districts associated with mercury mining in the Ochoco Mountains. Epithermal gold deposits could become the greatest source of activity within the state and will take an increasing important role in exploration in the future.

Washington

Gold and silver in the State of Washington occur in the Okanogan Highlands, northeastern Washington and the Cascade Range Physiographic Provinces. Counties with prominent gold and/or silver mining activity are: Chelan, Ferry, Snohomish, Pend Oreille, Okanogan, Stevens, and Kittitas Counties.

Wenatchee, in southern Chelan County, Washington, was the center of activity for gold and silver exploration and development in 1984. Announcement by Asamera, Inc. and Breakwater Resources Ltd. of their exploratory findings near the Lovitt mine, at what is now the Cannon mine, sent a multitude of Canadian and U.S.-based mineral companies to the area to explore for gold and silver. More than half of the money spent in 1983 for gold and silver exploration in Washington was in Chelan County (Bunning, 1984). The Cannon mine is expected to produce 182,000 oz. gold annually, according to The Wallace Miner.

Okanogan Highlands

Gold and silver mineralization within the Okanogan Highlands is generally associated with Mesozoic and early Tertiary granitic rocks.

In Ferry County the Gold Dike mine went into production in 1983 near Danville;

cyanide-leach recovery will be utilized. The Knob Hill mine has been the principal producer of gold and silver in this district but reserves were thought to have been exhausted and mine closure was anticipated in late-1984. Additional ore zones have since been discovered and the mine life has been extended for an additional two years (Bunning, 1985).

In Okanogan County, activity was centered around gold ore production at the Silver Bell Mine. The mine produced nearly 800 tons of ore during 1983, of which some portions of the ore had silver concentrations of 700 oz/ton (Bunning, 1984). Active exploration for gold and silver near the old Silver Bluff mine also occurred. Exploration activity in Pend Oreville County was centered around lead, zinc, and silver prospects in the Cambrian Metaline Limestone. Mining activity in Stevens County continued at the Deer Trail mine, near Fruitland, Washington. Sub-surface mining operations began in October of 1983 (Bunning, 1984).

Cascade Mountains

Gold and silver mineralization within the Cascade Mountains Physiographic Province occurs in Tertiary granitic rocks along the western portion of the range. An exception to this general mineralization trend is the area around Wenatchee, where gold and silver occurrences are associated with Eocene Swauk Formation, which consists of a series of arkosic sandstones, shales, and conglomerates. According to Bunning (1983) the productive gold mineralization and ore controls have all been associated with the arkosic sandstone units.

Exploration for gold in Chelan County centered around the activity initiated by the discovery of high grade gold reserves at the Cannon mine near Wenatchee, Washington. A total of 19 mineral companies were actively pursuing gold within Chelan County last year (Bunning, 1984). Initial mine production at Cannon mine is expected in late 1985.

The only other county which had appreciable mining activity was King County. Ore containing gold and silver was produced from the Apex and Damon mines.

More information on active gold and silver mines (mine operator and production figures) and mineral companies involved in gold and silver exploration in 1984 is contained in the Washington Geologic Newsletter (January 1985).

The three counties most favorable for future gold and silver exploration and mining activity are Wenatchee, Stevens and Ferry. Wenatchee County will see most of the activity over the next five years. An increase in activity for the Spokane District's Hard rock Locatables subactivity will accompany this increased activity.

There are also acquired lands in the Wenatchee area where gold and silver and other normally locatable minerals are treated as leasable minerals (see subactivity 4133 Non-Energy Leasing forecast section).

Nickel

Oregon

The geologic provinces with nickel deposits are: the Klamath and Blue Mountains. Four types of nickel-related deposits found in conjunction with these geologic provinces are: nickel laterite, sulfide, silica-carbonate, and serpentinite related.

The nickel laterite-type deposits are all associated with ultramafic rocks in southwestern Oregon. Deep weathering and development of laterites are major factors in the location of potential nickel deposits within the state. Some sulfide deposits containing nickel are also located in the area.

Nickel deposits associated with the Blue Mountains are: sulfide, silica-carbonate, and serpentinite related. Deep weathering of nickel-bearing rocks has not occurred in the Blue Mountains, but has occurred in the southwestern Oregon Klamath Mountains.

Oregon continues to be the only domestic source of primary nickel. The Hanna Mining Company is currently mining nickel, after the closure for a majority of 1983, at its Nickel Mountain Mine located four miles west of Riddle, in southwestern Douglas County, Oregon.

Washington

The geologic provinces associated with nickel-related occurrences and deposits in Washington are: Okanogan Highlands and Northern portion of the Cascade Mountains. Within these two physiographic regions nickel-bearing rocks occur in two different types of deposits: ultramafic rocks and sulfide (copper, lead, and zinc) related.

Deep weathering of ultramafic rocks has formed similar lateritic deposits like

Below: A view of the nickel smelter at the Riddle Nickel Mountain Mine.

those found in southwestern Oregon. However, the size of the deposits are much smaller than that near Riddle, Oregon. Concentrations of nickel in sulfide deposits are usually small and the nickel bearing minerals are commonly found as impurities within the sulfides.

Because there is no nickel mining activity within Washington and only one active mining site in Oregon, little emphasis on work force or expenditures at the BLM state office level should be expected beyond those of the past five year history. Any further development activity of nickel resources during the next five year horizon would most likely be in southwestern Oregon where BLM's Roseburg and Medford Districts would oversee most future significant work force deviations or expenditure changes.

Nickel mining operations are not expected to be initiated in other nickel laterite deposits in southwest Oregon in the next five years. BLM workload will mainly be in conflict resolution issues related to prospecting and exploration activities and the sensitive plant communities that seem to flourish in the lateritic soils of the region .

Copper, Lead, Zinc, and Molybdenum

Copper, lead, zinc, and molybdenum are four other hard rock locatable mineral types which are found in Oregon and/or Washington. These metallic commodities are commonly found in close conjunction with gold and silver occurrences or occur in similar geologic environments.

Major (large tonnage) copper-molybdenum deposits are known to occur in Washington and more can be expected in the Oregon and Washington Cascades, Okanogan Highlands and Blue Mountains areas. However, under the present depressed market conditions and the excess production capacity worldwide, these deposits are not likely to be developed in the near future.

A review of the mineral activity publications show that for the past five years production of these metallic minerals have been essentially nil. Little or no exploration for these commodities is expected, except to the extent they are associated with gold. Detailed discussion of these commodities are therefore beyond the scope of this document. BLM's total work-force and revenue expenditures in conjunction with these metallic minerals is limited when compared to the emphasis on gold. For these reasons no forecasts for copper, lead, zinc and molybdenum will be made.

Below: A view of an exploratory shaft driven into the copper-molybdenum deposit at Mt. Tolman Washington on the Colville Indian Reservation.

Uranium

Oregon

The two geologic provinces associated with uranium production and exploration are the Basin and Range, and the Owyhee Upland Provinces. Three BLM districts, Lakeview, Burns, and Vale, encompass most of these two geologic provinces.

Only two mines, the White King and Lucky Lass, located northwest of Lakeview, have produced any significant amount of uranium within the state; neither is in operation today. According to Peterson (1968) "total Oregon production has been about 200 tons of U_3O_8 from 120,000 tons of ore, with the bulk of the production from the White King mine" as of that year. Past exploration has focused on southeast Oregon, in Harney and Malheur Counties. The McDermitt and Trout Creek Mountain areas are the most promising for exploration. A majority of the uranium occurrences are associated with Miocene-Pliocene acidic volcanism and shallow intrusive rocks (Brooks, 1979). The McDermitt Caldera and associated volcanic rocks have been the site for past extensive uranium exploration activity in southwest Malheur County and a major low-grade uranium deposit is now known in this area.

Uranium occurrences that are similar to those found near Lakeview, McDermitt, and in southeastern Harney County will be targets for future exploration. BLM districts that will see further uranium exploration will most likely be Lakeview, Burns, and Vale.

Washington

Uranium occurrences are associated with two geologic provinces in the State of Washington: The Cascade Mountains and Okanogan Highland Provinces.

Several occurrences are found in the north-central Cascade Mountains in Snohomish and Chelan Counties. The majority of uranium occurrences are located in four northeastern Washington counties: Ferry, Stevens, Pend Oreville and Spokane. Production of uranium oxide is currently limited to the Spokane Indian Reservation.

Two mines, both located on the Spokane Indian Reservation, have produced substantial amounts of uranium: the Midnite Mine, operated by the Dawn Mining Company and the Sherwood Project, operated by Western Nuclear. Open-pit mining techniques have been utilized at both mine sites. Both mines are now closed. The majority of exploration has occurred in areas adjacent to the Spokane Indian Reservation, in southwest Stevens County, and further to the

Below: A view of Sherwood uranium mine with Rosevelt Lake in the background. The mine is located on the Spokane Indian Reservtion and is currently closed.

northeast in the Pend Oreville Valley in Pend Oreville County (Babitzke, 1978).

The Midnite Mine and nearby uranium occurrences are associated with the Precambrian Togo Formation (schist, phyllite & quartzite) intruded by the Cretaceous Loon Lake Batholith (Weissenborn, 1974). Uranium mineralization is associated with metamorphosed sedimentary rocks in which secondary uranium redistribution was caused by groundwater movement, but controlled to some extent by faulting. Uraninite, a uranium oxide, is the principal mineral mined.

The majority of future exploration for uranium in Washington will likely concentrate on extending current boundaries of known occurrences on the Spokane Indian Reservation, as well as in Colville, Stevens, Pend Oreville, and northern Spokane Counties.

Non-Metallic Minerals

Non-metallic locatable mineral commodities are important in supplementing the mineral industry economy in Oregon and Washington. Within the two states; diatomite, clays (bentonite), zeolites, and silica are the most important non-metallic commodities.

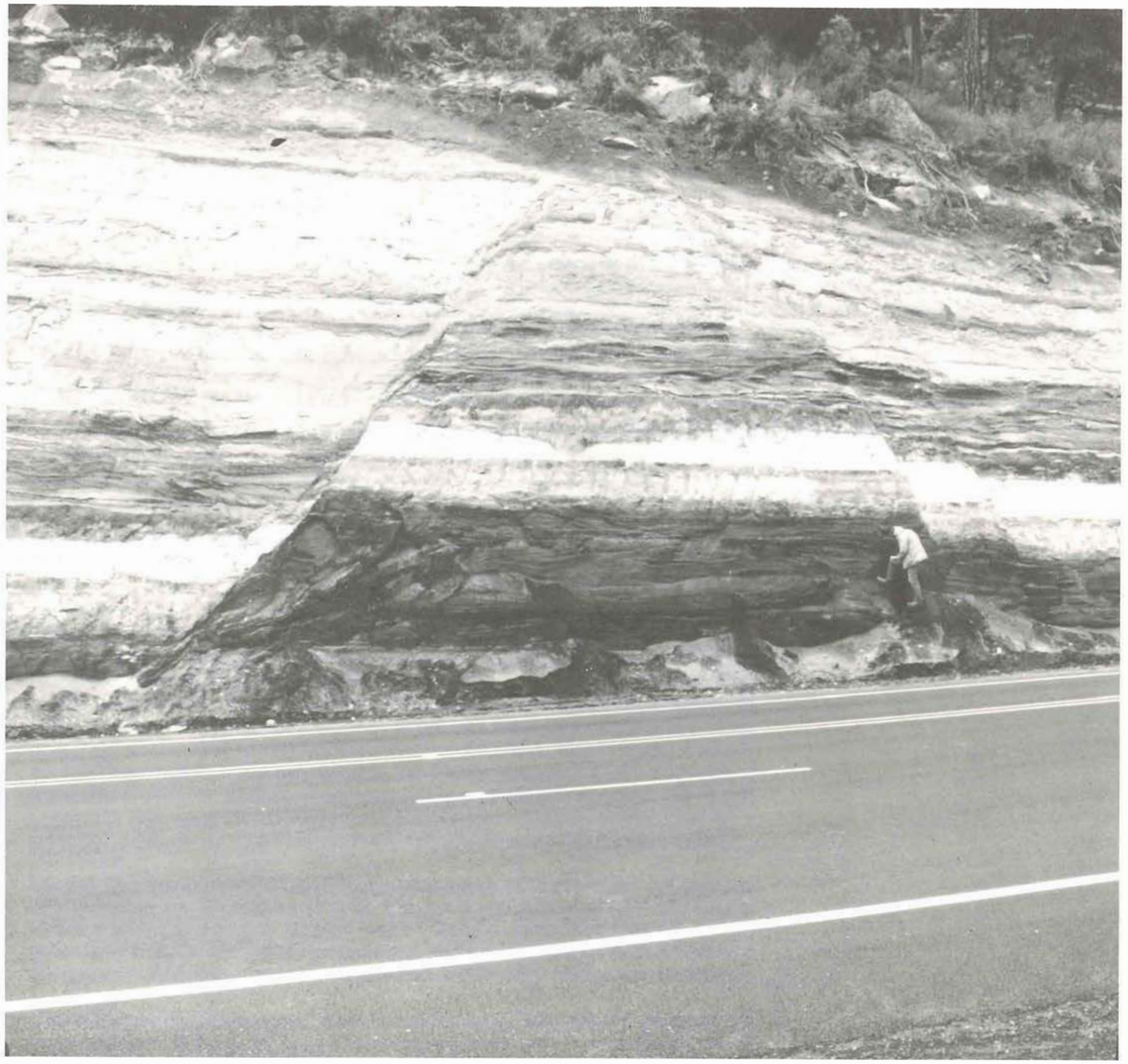
The United States is the world's largest producer and consumer of diatomite-diatomaceous earth. Diatomite has numerous uses, but is most commonly utilized as a filtration medium, and as additives and fillers. Production primarily comes from four western states; Oregon, Washington, California, and Nevada. Diatomite is found is several areas of southeastern Oregon: east-central - Christmas Valley area, the south-central portion - Klamath Falls area; and White Horse and Drewsey Basins in Harney-Malheur Counties. Currently active mining of diatomite occurs in the Christmas Valley area in Lake County, Oregon. In addition, Eagle-Picher Industries, Inc., is developing a large diatomite mining operation at Drewsey in Harney County. The Columbia Basin area of south-central Washington is the only area of the State where significant deposits of diatomite are found. Scattered occurrences are located throughout the Puget Lowlands. Currently Witco Chemicals Corporation, Quincy, Washington is a principal producer of diatomite in the Pacific Northwest (Meisinger, 1985).

Oregon contains one of the handful of producing zeolite deposits in the country, near Adrian within BLM's Vale District. Extensive deposits of zeolites are known to occur within altered tuff beds of eastern Oregon. Other deposits are known in western Oregon and on National Forest administered lands of the Cascade Range which are also commonly associated with Tertiary altered vitric tuff beds.

Clay minerals are utilized extensively in both states. Two types of deposits are most common; 1) those utilized for building materials, and 2) swelling-type clays

(bentonite). In Oregon the Willamette and Tualatin Valleys have commercial deposits utilized for building materials (bricks, etc.). The area near Adrian, Oregon along the Oregon - Idaho border has commercial bentonite deposits. In Washington, commercial deposits of clay which are utilized for building materials occur in the same types of environments as those found in Oregon; the Puget Lowland and the northeast corner of the state. The only area associated with commercial bentonite deposits in Washington are in the Columbia Basin in Benton County.

Silica is a the most abundant elemental compound found in the earth's crust, but highly pure deposits of economic value are rare. The occurrences of silica, both as quartzite and quartz sandstone, are scattered throughout both states. Washington has the majority of the producing silica localities. Economic silica deposits in Washington are concentrated in the northeastern portion of the state, and the central and west - central Cascade region. Commercial economic silica deposits in Oregon are concentrated in the southwest portion of the state. Quartz Mountain in Douglas County and Bristol Silica in Jackson County are the only two commercial producers of silica within the state.



III. Forecasts

Management of Oil and Gas Subactivity 4111

BLM is the oil and gas leasing agent for all on shore Federal lands. For these lands, BLM is responsible for oil and gas resource evaluation, conservation, and oversite of exploration and development. In Oregon and Washington the largest BLM workload for the oil and gas subactivity is associated with leasing; specific program elements include lease issuance, relinquishments, terminations, and assignments. In fiscal year 1984, a total of 178 leases covering over 400,000 acres were issued, 749 leases covering over 1,700,000 acres were terminated, and 3,040 leases covering 7,350,000 acres were in effect at the end of the fiscal year.

The balance of BLM's current oil and gas work is coordinating program policy and regulations in conjunction with the Washington D. C. Office, District Offices, industry, and other governmental agencies. Maintaining up-to-date knowledge of the potential oil and gas producing areas in Oregon and Washington and detailed basin analyses insure opportunities for exploration and development on Federal lands are foreseen.

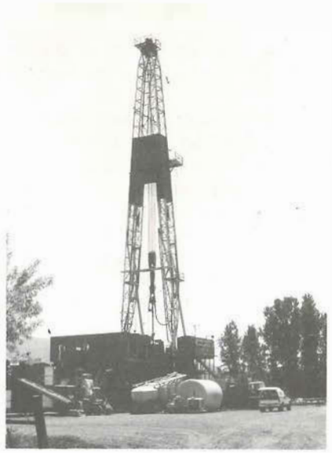
An examination of past BLM expenditures related to the historical price of oil and natural gas shows industry demand for BLM leasing services increases and decline with similar changes in the price of oil and natural gas. Tahmassebi, Chief Economist for Ashland Oil Company, predicts, "no changes in oil prices until 1987 and increases thereafter only at the rate of 5% per year." Tahmassebi foresees oil prices increasing at not less than 3% and not more than 9% over the next five years.

Rotan Mosle of Paine Webber, predicts real wellhead gas prices for the lower 48 states will see "no real price increase until 1986" (OGJ, 9/10/84). Mosle estimates "average wellhead gas price of $2.86/MCF in 1985, $3.09/MCF in 1986, $3.72/MCF in 1987, and $5.54/MCF in 1990."

Assuming these estimates hold true, and that BLM expenditures for leasing and lease administration will increase as prices and demand for oil and gas increase, BLM can expect an increased workload. A review of the attractive geologic terrains for oil and gas indicates that industry interests are likely to continue in the Columbia Basin of south-central Washington and north-central Oregon, as well as around the Mist gas field in northwestern Oregon. In fact, these areas are currently subject to reasonably intense and increasing exploration.

Opposing Page: Bedded sediments containing a dark organic horizon and faulted in the middle portion. Organic layers such as this one could be source rocks for natural gas and oil when buried at great depths.

Below: A large exploratory drilling rig utilized by MOBIL oil corporation to drill the Ira Baker well north of Eugene, Oregon. The well was abandoned at a depth just shy of two miles.



It is reasonable to assume that there will be at least one commercial discovery of oil or natural gas in the Spokane or Salem District by the year 1990. A discovery of commercial reserves of oil and/or gas could mean a significant increase in BLM workload. If the discovery was made on private land, but proximate to Federal land, workload increases could be expected for

- processing unit agreements, i.e., industry proposals to explore or develop Federal and non-Federal lands that maximizes resource extraction
- determination of Known Geologic Structures (KGS), i.e., indentifying commercially productive resource on Federal lands that would be subject to competitive auction bidding;
- drainage determinations, i.e., identifying whether production on non-Federal land is coming from Federal land; if so, compensatory royalties are due to the United States;
- offering unleased Federal land in KGS's at competitive auction;

If the discovery was made on Federally administered lands, additional workload could be expected beyond those responsibilities for private land discoveries including:

- granting permission to drill, and verifying production;
- inspection and enforcement, i.e., insuring that wells are drilled and maintained to appropriate engineering and site security standards.

Table 1 outlines our estimate of distribution of dollar and work-month related costs at the State and District level within the oil and gas subactivity (4111) by 1990. In the State office an additional 19 work-months would be required to respond to increased demand for leasing, evaluate bids received at competitive sales, process unit exploration agreements, and conduct the resource evaluation work for drainage determinations and for establishing known geologic structures. The Salem and Spokane District Office would require an additional 3 work-months each to do the environmental assessment work necessary for preparation of the anticipated competitive lease sale. In total BLM in Oregon and Washington will require a total of 181 work-months to effectively accomplish oil and gas management on Federal lands at both the state and district level in 1990.

Table 1
Oil and Gas Program Forecast (Dollars in Thousands)

	1984		1985		1990	
State Office:	**WM***	**$**	**WM**	**$**	**WM**	**$**
Division of Minerals (920)	97.0	76.1	28.0	103.7	37.0	110.0
Division of Operations (940)	82.0	191.5	81.0	184.2	86.0	252.8
Other	26.0	67.2	10.0	40.6	15.0	44.6
Sub Total	**135.0**	**334.8**	**119.0**	**328.5**	**137.0**	**407.5**
District Offices:						
Lakeview (010)	2.0	8.2	1.0	4.7	1.0	3.7
Burns (020)	4.0	14.2	3.0	12.3	3.0	9.8
Vale (030)	4.0	9.8	4.0	9.5	4.0	10.9
Prineville (050)	3.0	11.6	3.0	9.5	3.0	12.2
Salem (080)	4.0	10.2	3.0	9.5	7.0	25.0
Eugene (090)	5.0	13.0	5.0	12.4	5.0	16.2
Roseburg (100)	5.0	14.6	5.0	11.4	5.0	15.5
Medford (110)	1.0	1.3	1.0	2.0	1.0	2.6
Coos Bay (120)	2.0	5.3	1.0	4.7	2.0	7.9
Spokane (130)	10.0	29.0	10.0	27.5	13.0	40.6
Sub Total	**40.0**	**117.2**	**36.0**	**103.5**	**44.0**	**144.2**
Grand Total	**175.0**	**452.0**	**155.0**	**432.0**	**181.0**	**551.7**

*WM: Work-Months

Skills not currently on hand that would be required to meet this increased demand for services include economic evaluation and petroleum engineering.

This forecast is based on what appears to be likely at the moment. In order to stay ahead of events, it is extremely important that BLM in Oregon/Washington continue to closely monitor industry leasing and exploration activities. Coordination with the Oregon State Department of Geology and Mineral Industry and with the Washington State Department of Natural Resources will continue to be essential.

Management of Geothermal Subactivity 4113

BLM in Oregon and Washington manages the mineral estate on lands that many

Below: Geothermal well spudding of the Union Oil deep temperature gradient hole near Newberry Crater in the Deschutes National Forest.

consider extremely attractive for discovery for commercially valuable geothermal resources.

BLM's current major geothermal workload items are leasing, policy and program development, and oversight of exploration activities. Leasing activities include lease issuance and relinquishments. In FY 1984, 128 leases covering 226,000 acres were issued, 33 leases covering 50,000 acres were terminated, and 48 lease applications covering 100,000 acres were pending resolution of appeals before IBLA.

Geothermal policy and program development continue to be a major workload item because geothermal resource exploration and development is still relatively new to the Federal government across the nation. Each year, new policy and program development issues require resolution, and resolution requires coordinated efforts among the Federal agencies, state and local government agencies, industry, and the public. Policy and program development issues which received attention in FY 1984, included revision of the Federal geothermal regulations, revisions of the Geothermal Resources Operational Orders, clarifying the requirements of exploratory drilling operations in a draft Notice to Lessees, and approval of exploratory drilling permits on the Winema National Forest.

We expect to continue issuing new leases over the counter at a rate of about 100 per year. Also, about 400 lease applications are pending action by the U.S. Forest Service, and many of these applications will likely result in leases as the Forest Service completes its land use planning. Currently all exploration is concentrated on USFS administered lands, but BLM carries out mineral management responsibilities.

We do not expect any unusual new demand for geothermal leasing, so the effort we put into new geothermal leasing probably will begin a slow decline as existing leases expire. This does not mean industry interest is waning. Our oversight of exploration activities has recently increased substantially to respond to exploration plans for Federal leases in the Winema National Forest in Klamath County, and other proposals in Deschutes County. In Klamath County, California Energy Company, Inc., will drill one or two temperature gradient wells in 1985. If that exploration shows an attractive resource, two additional wells will be drilled in 1986. Currently, three exploration units have been approved in Oregon and we expect five years from now to be administering four exploration units, two each in the Prineville and Lakeview, Districts.

Overall, we expect the emphasis in geothermal to shift from a leasing mode to an exploration mode. Industry exploration will probably be focused on the flanks of the Cascades, principally affecting the Prineville and Lakeview Districts. **Table 2** shows the projection of 4113 activity by office.

Table 2
Geothermal Program Forecast (Dollars in Thousands)

	1984		1985		1990	
State Office:	**WM***	**$**	**WM**	**$**	**WM**	**$**
Division of Minerals (920)	35.0	115.0	36.0	183.7	35.0	157.1
Division of Operations (940)	39.0	117.3	43.0	113.0	39.0	175.0
Other	4.5	12.0	3.0	36.3	4.5	20.2
Sub Total	**78.5**	**244.3**	**82.0**	**333.0**	**78.5**	**352.3**
District Offices:						
Lakeview (010)	8.1	42.0	10.0	35.0	16.0	66.1
Burns (020)	11.0	34.0	4.0	23.5	6.0	22.4
Vale (030)	7.0	17.0	3.0	10.0	7.0	33.0
Prineville (050)	6.0	21.3	6.0	24.0	16.0	75.4
Salem (080)	1.0	2.6	1.0	2.5	1.0	3.9
Eugene (090)	1.0	2.6	1.0	2.5	1.0	4.1
Roseburg (100)	2.0	5.1	1.0	4.0	2.0	10.1
Medford (110)	1.0	2.0	1.0	2.5	1.0	4.1
Coos Bay (120)	0.0	0.0	2.0	0.0	0.0	0.0
Spokane (130)	1.0	3.1	0.0	7.0	0.0	0.0
Sub Total	**38.1**	**129.7**	**29.0**	**111.0**	**50.0**	**219.1**
Grand Total	**116.6**	**374.0**	111.0	**444.0**	**128.5**	571.4

*WM: Work-Months

Below: The largest coal seam at WIDCO's Centralia open-pit coal mine. The seam ranges in thickness from 20-40 feet and contains abundant white volcanic ash partings.

A discovery of commercial, geothermal resource would entail many of the procedures outlined for commercial discovery of oil and/or natural gas. In addition any proposal for construction of electrical generating facilities would be reviewed under BLM's plant siting regulations in close coordination with the Oregon State Energy Facility Siting Council.

Coal Resource Management Subactivity 4121

Coal on Federal lands is available for exploration and development as authorized by the Mineral Leasing Act of 1920, as amended. In Oregon, coal resources occur on Federal lands near Coos Bay, near Salem, and in the northeastern part of the State. The only currently commercial deposits of coal in the Pacific Northwest lie east of Centralia, Washington.

BLM administers five Federal coal leases in the two states. Coal is currently being produced from one of these leases at the Centralia coal mine operated by Washington Irrigation and Development Company. A second Federal lease associated with the Centralia mine will likely be in or close to production by 1990. No activity is expected on any of the remaining three leases; it is reasonable that all three will terminate for lack of production prior to 1995.

The industry is continuing to concentrate their exploration interest west of the Cascades. Two companies have recently expressed interest in *in situ* gasification in the area, and another is considering an underground development. New developments, however, are limited by markets and profitability; *in situ* gasification has yet to be shown commercially feasible anywhere in the U.S., and new traditional coal production is limited by a slow growth in the regional demand for electricity and by current lack of a Pacific Rim export market.

Nevertheless, exploration will continue west of the Cascades. Because Federal land is intermingled with private holdings in the area, we expect by 1990 that BLM will process at least one coal exploration license. This will entail the appropriate NEPA compliance, adjudication, and monitoring on-the-ground activities; the majority of the work will be carried out by the Spokane District and require three additional work months.

No other substantial changes are expected for total coal management expenditures; however, by 1990 we do expect to have transferred to the Spokane District Office all operational responsibilities for the WIDCO operation. This change is reflected in **Table 3**, as well as the three work months to process the exploration license application.

Mineral Materials Management Subactivity 4131

Under BLM's mineral material program, common varieties of sand, stone, gravel, cinders, and clay are disposed through sales or permits for specific volumes of material. In FY 84, 147 sales and free use permits were issued which accounted for 1,226,350 cubic yards of mineral material with a value of $731,519. An estimated additional one million cubic yards of road construction material was utilized for BLM's timber sale road construction and maintenance.

As a general rule demand for sand, gravel, and related mineral materials tracks with changes in economic and construction activity. Put another way, sand and gravel are essential to concrete mixtures and road surface materials. However, because BLM lands contribute such a small proportion of total supply of mineral materials in Oregon and Washington (approximately 3% in the two states in 1984) and because the great majority of BLM material is used for rural roads, we do not expect any strong linkage between demand for mineral materials from public lands and general economic activity.

Below: A sand and gravel operation located in the Cascade Range foothills.

Table 3
Coal Program Forecast (Dollars in Thousands)

	1984		1985		1990	
State Office:	**WM***	**$**	**WM**	**$**	**WM**	**$**
Division of Minerals (920)	10.0	54.2	15.0	62.9	5.0	22.2
Division of Operations (940)	1.0	3.7	1.0	3.0	2.0	8.9
Other	0.1	0.1	0.0	0.1	0.0	0.0
Sub Total	11.1	**58.0**	**16.0**	**66.0**	**7.0**	31.1
District Offices:						
Lakeview (010)	0.0	0.0	0.0	0.0	0.0	0.0
Burns (020)	0.0	0.0	0.0	0.0	0.0	0.0
Vale (030)	0.0	0.0	0.0	0.0	0.0	0.0
Prineville (050)	0.0	0.0	0.0	0.0	0.0	0.0
Salem (080)	0.0	0.0	0.0	0.0	0.0	0.0
Eugene (090)	0.0	0.0	20.0	0.0	0.0	0.0
Roseburg (100)	0.0	0.0	0.0	0.0	0.0	0.0
Medford (110)	0.0	0.0	0.0	0.0	0.0	0.0
Coos Bay (120)	0.0	0.0	0.0	0.0	0.0	0.0
Spokane (130)	0.0	0.1	1.0	3.0	10.0	37.4
Sub Total	**0.0**	0.1	**1.0**	**3.0**	**10.0**	**37.4**
Grand Total	11.1	**58.1**	**17.0**	**69.0**	**17.0**	68.5

*WM: Work-Months

Instead, we believe that it is most likely that demand for BLM mineral material and the associated workload will remain relatively static throughout the upcoming five year period. **Table 4** shows our overall expectation that BLM's workload and expenditures for the 1990 program will be about midway between our efforts in 1984 and 1985. Demand for mineral material will continue to be strongest in the Vale and Burns Districts. In total, BLM will spend $127 thousand and require about 35 work-months to administer the program. Total material produced from BLM lands will continue at a level of slightly greater than two million cubic yards, including about one million for maintenance of timber haul roads.

This forecast assumes a reasonably constant level of rural road building and maintenance. However, in the event that a large construction project, such as

Table 4
Mineral Materials Program Forecast (Dollars in Thousands)

State Office:	1984 WM*	1984 $	1985 WM	1985 $	1990 WM	1990 $
Division of Minerals (920)	7.7	25.8	3.0	13.8	4.0	20.2
Division of Operations (940)	0.0	0.1	0.0	0.0	0.0	0.0
Other	0.1	0.5	0.0	0.5	0.0	0.0
Sub Total	**7.8**	**26.4**	**3.0**	**14.3**	**4.0**	**20.2**
District Offices:						
Lakeview (010)	2.0	8.4	1.0	6.8	2.0	8.3
Burns (020)	9.5	21.9	6.0	16.4	7.0	22.0
Vale (030)	8.0	19.9	6.0	19.3	7.0	21.8
Prineville (050)	2.0	4.0	1.0	3.3	2.0	7.2
Salem (080)	1.0	2.6	1.0	3.1	1.0	3.6
Eugene (090)	4.4	10.3	4.0	10.4	4.0	13.2
Roseburg (100)	3.0	9.5	3.0	10.2	3.0	13.7
Medford (110)	0.8	2.7	1.0	3.2	1.0	3.7
Coos Bay (120)	2.0	4.8	1.0	3.6	2.0	8.0
Spokane (130)	2.0	5.1	2.0	4.4	2.0	6.1
Sub Total	**34.7**	**89.2**	**26.0**	**80.7**	**31.0**	**107.6**
Grand Total	**42.5**	**115.6**	**29.0**	**95.0**	**35.0**	**127.8**

*WM: Work-Months

a major water impoundment or highway, were to commence in southeastern Oregon, demands for material from public land would increase dramatically and would require additional program attention and corresponding expenditures.

Mining Law Administration (Locatable Minerals) Subactivity 4132

BLM's administration of the Mining Law of 1872 has five principal components: recording of mining claims and assessment notices, surface management of mining claims, processing claimant's operating plans, conducting validity examinations of claims, and processing mineral reports. While many minerals are locatable under the Mining Law of 1872, the majority of our workload is

Below: Open-pit nickel workings at the Nickel Mountain mine, Riddle, Oregon

related to claims for gold. Consequently, changes in BLM mining claim workload are generally correlated with changes in the economic attractiveness of the gold mining business, as affected by changes in the price of gold. For example, in 1980 the average price of gold reached $612.65 per troy ounce, almost double the previous year's price. The demand for BLM mining claim services increased accordingly; almost 15,000 new claims were recorded, more than double the average of the preceding three years. Presently about 60,000 mining claims are maintained on BLM records. About 240 mining notices and plans of operation are processed each year on BLM managed lands.

Sarnoff (NWMA, 1983) predicts that gold will climb to $600 per ounce by 1990. Sarnoff's estimate is based on increased use of precious metals in fabricating electronic components within the Pacific Rim countries. Pretorius (Economic Geology, 1982) predicts the gold price to average $500 to $600 per troy ounce over the next fifteen years.

Over the past few decades, approximately one half of the world's gold production came from the Republic of South Africa. However, in the near future production there is likely to decline as presently mined ore bodies are depleted. This reduction from the world's leading supplier, combined with recent political unrest in South Africa, are probably the most significant upcoming supply-side events that lead to additional upward price pressure.

Overall, it is reasonable to expect that sometime within the five year horizon of this study the gold price will approach $500 per ounce and the claim filings and associated on-the-ground operations will increase.

While it is likely that BLM's mining claim workload will continue to be most strongly related to the level of gold prices, it is important to keep in mind that BLM's administration of the Mining Law of 1872 covers many other "hard rock" mineral commodities, e.g., silver, copper, lead, zinc, molybdenum, and nickel. Substantial workload demands on BLM are not expected in any of these commodity areas, although known reserves of nickel, chromium, cobalt, and molybdenum occur on BLM-administered lands. Substantial zeolite resources occur on BLM lands in southeastern Oregon, but limited market opportunities will likely continue to inhibit their development over the next five years.

Table 5 shows the expected level of work effort for administration of the Mining Law of 1872 in Oregon and Washington. We expect that the projected increase in the gold price will increase claim filings substantially. More environmental and surface management oversight work by our Prineville, Burns, Vale, Medford, and Spokane District personnel will be required in response to increased levels of gold mining activity. Overall, we expect in 1990 to utilize 164 work-months and expend $477 thousand for administration of the Mining

Table 5
Mining Law - Locatable Minerals Program Forecast (Dollars in Thousands)

State Office:	1984 WM*	1984 $	1985 WM	1985 $	1990 WM	1990 $
Division of Minerals (920)	10.0	11.0	42.3	10.0	26.5	
Division of Operations (940)	65.0	142.9	64.0	130.8	76.0	201.3
Other	2.9	16.5	1.0	5.8	3.0	7.9
Sub Total	**77.9**	**192.6**	**76.0**	**178.9**	**89.0**	**235.7**
District Offices:						
Lakeview (010)	1.8	7.0	2.0	7.2	2.0	6.8
Burns (020)	6.9	21.2	9.0	26.0	9.0	26.9
Vale (030)	14.0	40.7	16.0	44.0	20.0	61.9
Prineville (050)	3.0	7.5	2.0	6.1	4.0	14.3
Salem (080)	3.0	7.4	3.0	8.6	3.0	9.7
Eugene (090)	2.0	5.2	2.0	4.5	2.0	5.8
Roseburg (100)	3.4	10.8	4.0	13.3	3.0	11.9
Medford (110)	17.0	43.9	17.0	49.6	20.0	62.9
Coos Bay (120)	2.0	5.1	2.0	6.0	2.0	7.3
Spokane (130)	4.1	14.3	7.0	24.8	10.0	33.4
Sub Total	**57.2**	**163.1**	**64.0**	**190.1**	**75.0**	**241.0**
Grand Total	135.1	355.7	140.0	**369.0**	**164.0**	**476.7**

*WM: Work-Months

Below:Typical surface mining equipment utilized for excavating overburden and bedrock.

Law, compared to 140 work-months and $369 thousand in 1985.

Management of Non-Energy Leasable Minerals Subactivity 4133

This subactivity includes the management of a diverse group of minerals on various types of mineral estates: potassium, sodium and phosphates on public domain land, and any minerals except coal, oil, or gas on lands purchased by the United States or administered in trust for native American Indians.

There are few favorable geologic provinces in Oregon and Washington for the major non-energy leasable minerals (sodium, potassium and phosphate); so

Table 6
Non-Energy Leasables Program Forecast (Dollars in Thousands)

State Office:	1984 WM*	1984 $	1985 WM	1985 $	1990 WM	1990 $
Division of Minerals (920)	18.0	76.4	15.0	68.9	18.0	82.3
Division of Operations (940)	3.0	7.0	5.0	13.0	3.0	13.7
Other	0.0	0.3	1.0	3.6	0.0	0.0
Sub Total	**21.0**	**83.7**	**21.0**	**85.5**	**21.0**	**96.0**
District Offices:						
Lakeview (010)	0.0	0.0	0.0	0.0	0.0	0.0
Burns (020)	0.0	0.0	0.0	0.0	0.0	0.0
Vale (030)	0.0	16.3	1.0	4.6	0.0	0.0
Prineville (050)	0.0	0.0	1.0	7.4	0.0	0.0
Salem (080)	0.0	0.0	0.0	0.0	0.0	0.0
Eugene (090)	0.0	0.0	0.0	0.0	0.0	0.0
Roseburg (100)	0.0	0.0	0.0	0.0	0.0	0.0
Medford (110)	0.0	0.0	0.0	0.0	0.0	0.0
Coos Bay (120)	0.0	0.0	0.0	0.0	0.0	0.0
Spokane (130)	3.0	17.0	7.0	24.5	3.0	13.1
Sub Total	**3.0**	**33.3**	**9.0**	**36.5**	**3.0**	**13.1**
Grand Total	**24.0**	**117.0**	**30.0**	**122.0**	**24.0**	**109.1**

*WM: Work-Months

no new activity is anticipated for leasing these minerals.

Similarly, few changes are expected in the level of activity on lands purchased by the Federal government. Acquired lands near Wenatchee, Washington and Prineville, Oregon, have recently been the subject of preliminary exploration activity for gold and associated minerals, but little or no substantial increase in activity is likely.

Subactivity 4133 also covers leasing Indian lands for all mineral resources except coal, oil and gas, geothermal and uranium. The principal commodities of interest on Indian lands are sand and gravel on most large reservations and molybdenum on the Colville Reservation. Again we do not foresee, within the 5-year horizon, dramatic change in workload for these commodities.

Therefore, we expect the 4133 activity will remain about constant, with dollar increases attributable only to increases in average work-month costs. **Table 6** shows the projection.

Mt. Tolman on the Colville Indian Reservation, Washington, encompasses a large, well defined molybdenum deposit. Success of the Tribe's ongoing marketing venture of these resources or a substained price increase would lead to increased BLM service to the Tribe. While current market conditions for molybdenum are not favorable for development of the Mt. Tolman deposit, the known resources are extremely large. The Colville Tribe is actively promoting their mineral resource potential. Significant interest by major mineral companies is not unlikely.

Uranium Management Subactivity 4134

BLM uranium activity will continue to be concentrated in the Spokane District at the Spokane Indian Reservation. Five years from now, we expect that BLM responsibilities for the Sherwood and Midnite mines on the Spokane Reservation currently being handled by State Office staff in the Division of Mineral Resources will be carried out by Spokane District personnel. The only functions remaining at the State Office will be overall program coordination and technical support. **Table 7** shows this redistribution of work-months and an overall reduction in statewide total work-months due to program efficiencies.

Non-work-month dollar expenditures are expected to be reduced from the current level of about $90 thousand (principally for the hydrologic study of the Midnite mine) to $50 thousand for monitoring facilities and services. Again, this amount will be the responsibility of the Spokane District.

The market for uranium is extremely depressed and likely to stay so for some time. No new nuclear power plants have been constructed since the Three Mile Island incident; inventories are large; and foreign uranium is stiff price competition for domestic mines. Both mines on the Spokane reservation are essentially closed; only minimum maintenance crews and security personnel are regularly on site.

Assuming satisfactory resolution of reclamation bonding issues at the Midnite Mine, mining at the site could recommence. However, because the market outlook is dim we expect that our activity in 1990 at the Midnite Mine will be only the review of a yet-to-be submitted mine plan.

Below: Benches cut into uranium ore at Dawn Mine on the Spokane Indian Reservation. Suppressed uranium prices have forced the closure of both Dawn and Sherwood uranium mines.

Table 7
Uranium Management Program Forecast (Dollars in Thousands)

	1984		1985		1990	
State Office:	**WM***	**$**	**WM**	**$**	**WM**	**$**
Division of Minerals (920)	15.0	132.2	16.0	103.6	4.0	23.3
Division of Operations (940)	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.1	0.0	0.3	0.0	0.0
Sub Total	**15.0**	**132.3**	**16.0**	**103.9**	**4.0**	**23.3**
District Offices:						
Lakeview (010)	0.0	0.1	0.0	0.0	0.0	0.0
Burns (020)	0.0	0.2	0.0	0.0	0.0	0.0
Vale (030)	0.1	0.4	0.0	0.0	0.0	0.0
Prineville (050)	0.0	0.0	0.0	0.0	0.0	0.0
Salem (080)	0.0	0.0	0.0	0.0	0.0	0.0
Eugene (090)	0.0	0.0	0.0	0.0	0.0	0.0
Roseburg (100)	0.0	0.0	0.0	0.0	0.0	0.0
Medford (110)	0.0	0.0	0.0	0.0	0.0	0.0
Coos Bay (120)	0.0	0.0	0.0	0.0	0.0	0.0
Spokane (130)	3.0	11.7	10.0	33.1	18.0	105.1
Sub Total	**3.1**	**12.4**	**10.0**	**33.1**	**18.0**	**105.1**
Grand Total	**18.1**	**144.7**	**26.0**	**137.0**	**22.0**	**128.4**

*WM: Work-Months

Mineral Support Functions

BLM mineral specialists are responsible for several functions that either do not lend themselves to association with a specific commodity, or that are carried out to benefit programs to manage non-mineral resources on public lands.

A broad category of responsibility is preparation of reports on the occurrence of minerals under Federal lands that are being considered for sale, exchange, or for some special use management classification. These reports require an expert evaluation and opinion on the extent or likelihood of occurrence of minerals, and on whether the mineral estate should be conveyed in the contemplated land transaction. From ten to thirty percent of a field mineral specialist's time may be spent on the preparation of mineral reports.

Another major task of BLM mineral specialist in Oregon and Washington is providing expert assistance to the preparation of wilderness studies of BLM lands. Wilderness study procedures call for extensive evaluation of mineral resources, because wilderness designation will prohibit any subsequent mining claims or mineral leasing. While the better part of the BLM mineral evaluation work is already complete, continued coordination with the US Geological Survey and the US Bureau of Mines will be required, because these two agencies are responsible for very detailed and comprehensive evaluations of the mineral resource potential of wilderness study areas on public lands.

Finally, as a matter of good government business, and in order to insure the most efficient delivery of public services, mineral specialists, senior staff, and line managers must pursue close communications with Federal, State, and local agencies and with interested members of the public. All of these groups share an interest in the manner in which public lands are managed for mineral exploration and development. Only through close and continued communication can BLM, as the trustee of the public interest, insure that the trust is discharged to bring the most benefit to all.

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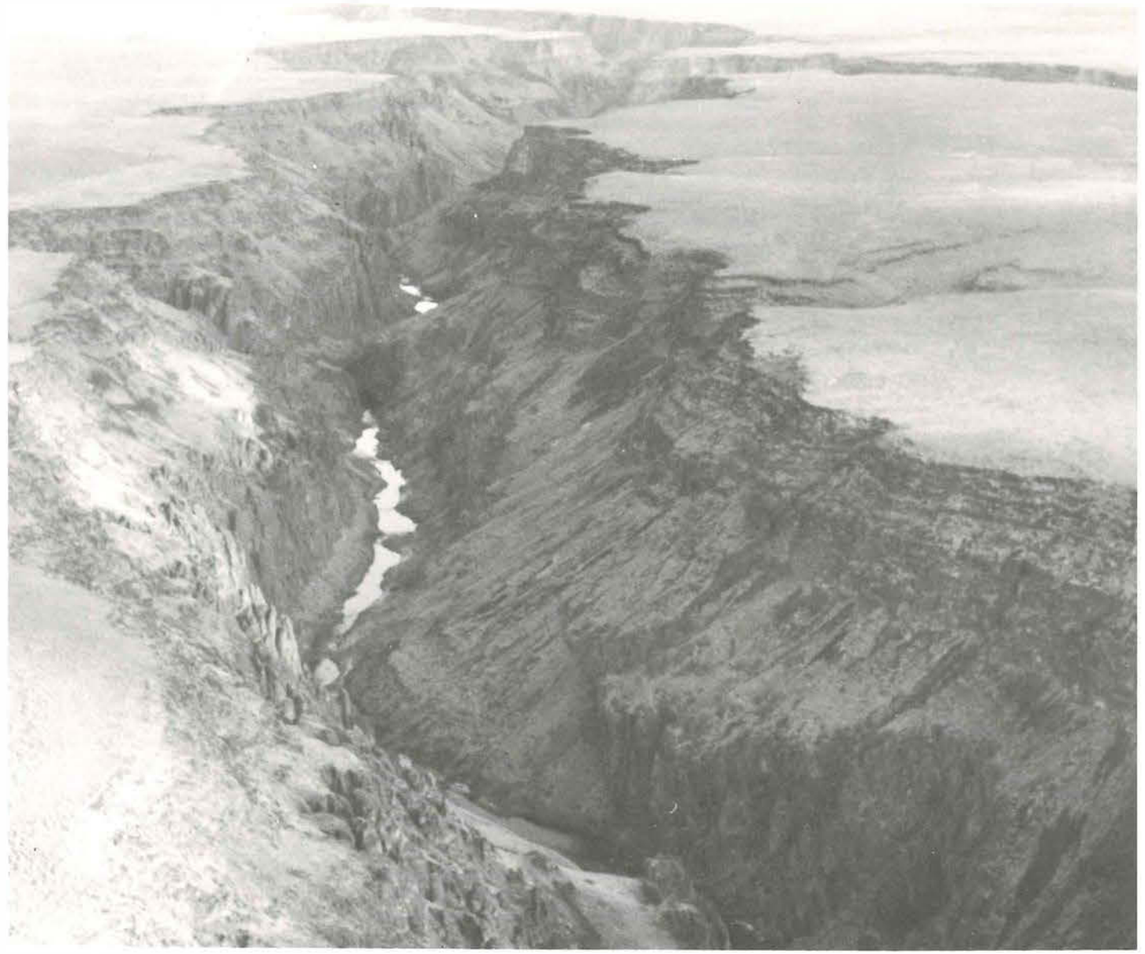

IV Summary:

Opposing Page: Picturesque deeply incised river canyon cutting through Columbia River Basalts in northeastern Oregon.

Table 8 shows an overview of our forecast of changes in BLM's seven minerals management programs. Overall we expect that completion of predicted program requirements will require 572.5 work-months and $2.0 million. This compares to 508 work-months and $1.7 million planned for 1985. Of the net increase of 74 work-months, 73 are directed to changes in the oil and gas, geothermal, and hard rock mining programs, reflecting the likelihood that industry will move to more operations and BLM will respond accordingly. Our requirements for uranium and non-energy leasables will be declining; together 4133 and 4134 are reduced by 10 work-months. Overall, these are modest changes in program emphasis.

These predictions must be viewed as estimates subject to error, and it is important to examine the possible sources of error. First, there is a lack of reliable historical budget data for most mineral programs, because no pre-MMS-merger information is available; 1984 and 1985 are the only complete data sets. While we believe that 1985 was for the most part a normal year, it is possible that basing predictions of the distribution of work-months among offices on two years of data will distort the estimates.

Second, we have relied on forecasts of industry activity that may not be realized. For example, we predict being in an active inspection and enforcement mode in the oil and gas program in 1990 in the Columbia Basin. If current strong signals of a gas discovery prove erroneous, then the forecast for 4111 is probably too high.

Error may also be introduced in the timing of events. The forecasts are made for 1990, but it is quite possible that events will transpire somewhat earlier or later.

In order to calculate total dollar expenditures, we assumed that there is a fixed relationship between payroll dollars and total expenditures. This is sound, but does not allow for unique procurements. While we do not foresee any unique requirements at this time, it is difficult to predict that the current pattern will stay constant over a long period of time.

The accumulation of these and other sources of error indicate that there is a known, though unmeasurable variance around the estimates. Our objective, as we proceed through additional iterations of this analysis, will be to reduce the variance. We have thrown the dart at the board for the first time. With practice our aim will get better.

Table 8
Summary of Subactivities by District in 1990 (Dollars in Thousands)

	4111		4113		4121		4131		4132		4133		4134		TOTAL	
State Office:	WM*	$	WM	$	WM	$	WM	$	WM	$	WM	$	WM	$	WM	$
Minerals (920)	37.0	110.0	35.0	157.1	5.0	22.2	4.0	20.2	10.0	26.5	18.0	82.3	4.0	23.3	113.0	441.6
Oper. (940)	91.0	270.6	39.0	175.0	2.0	8.9	0.0	0.0	80.0	211.9	3.0	13.7	0.0	0.0	215.0	680.1
Other	15.0	44.6	4.5	20.2	0.0	0.0	0.0	0.0	3.0	7.9	0.0	0.0	0.0	0.0	22.5	72.7
District Offices:																
Lakeview (010)	1.0	3.7	16.0	66.1	0.0	0.0	2.0	8.3	2.0	6.8	0.0	0.0	0.0	0.0	21.0	84.9
Burns (020)	3.0	9.8	6.0	22.4	0.0	0.0	7.0	22.0	9.0	26.9	0.0	0.0	0.0	0.0	25.0	81.1
Vale (030)	4.0	10.9	7.0	33.0	0.0	0.0	7.0	21.8	20.0	61.9	0.0	0.0	0.0	0.0	38.0	127.6
Prineville (050)	3.0	12.2	16.0	75.4	0.0	0.0	2.0	7.2	4.0	14.3	0.0	0.0	0.0	0.0	25.0	109.1
Salem (080)	7.0	25.0	1.0	3.9	0.0	0.0	1.0	3.6	3.0	9.7	0.0	0.0	0.0	0.0	12.0	42.2
Eugene (090)	5.0	16.2	1.0	4.1	0.0	0.0	4.0	13.2	2.0	5.8	0.0	0.0	0.0	0.0	12.0	39.3
Roseburg (100)	5.0	15.5	2.0	10.1	0.0	0.0	3.0	13.7	3.0	11.9	0.0	0.0	0.0	0.0	13.0	51.2
Medford (110)	1.0	2.6	1.0	4.1	0.0	0.0	1.0	3.7	20.0	62.9	0.0	0.0	0.0	0.0	23.0	73.3
Coos Bay (120)	2.0	7.9	0.0	0.0	0.0	0.0	2.0	8.0	2.0	7.3	0.0	0.0	0.0	0.0	6.0	23.2
Spokane (130)	13.0	40.6	0.0	0.0	10.0	37.4	2.0	6.1	10.0	33.4	3.0	13.1	18.0	105.1	56.0	235.7
Grand Total	187.0	569.6	128.5	571.4	17.0	68.5	35.0	127.8	168.0	487.2	24.0	109.1	22.0	128.4	581.5	2,112.0

Oil and Gas = 4111
Geothermal = 4113
Coal = 4121
Mineral Materials = 4131
Mining Law Adm. = 4132
Non-Energy Leasables = 4133
Uranium Management = 4134

*WM: Work-Months

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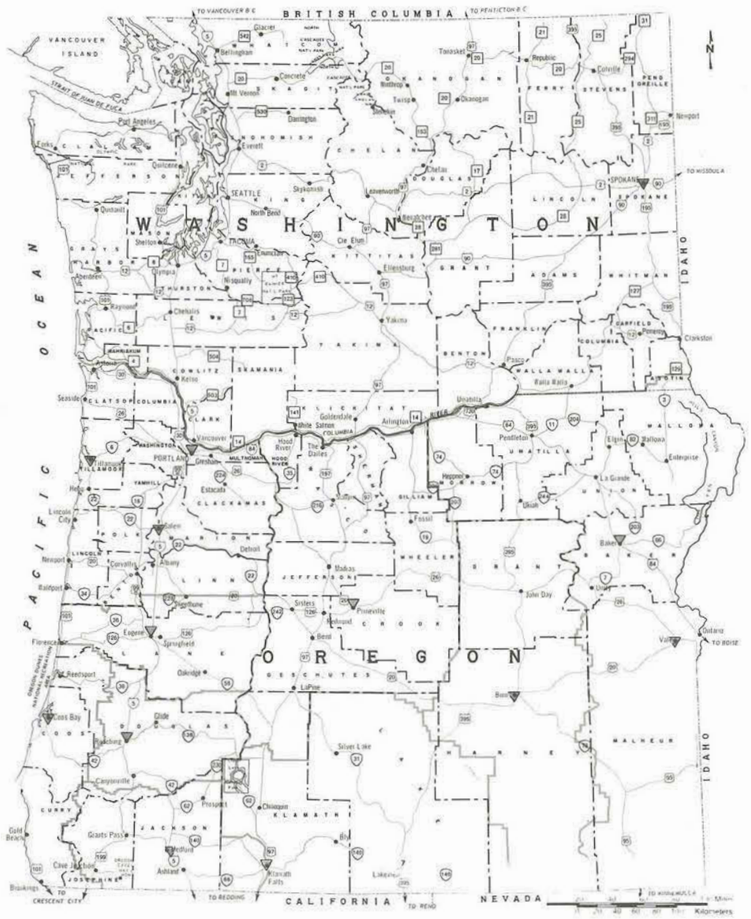

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