The Ore Bin

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The ORE BIN
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MOUNT ST. HELENS VOLCANO: RECENT AND FUTURE BEHAVIOR

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and Meyer Rubin
U.S. Geological Survey, Reston, Virginia

Mount St. Helens, a prominent but relatively little known volcano in southern Washington (Figure 1), has been more active and more violent during the last few thousand years than any other volcano in the conterminous United States. Although dormant since 1857, St. Helens will erupt again, perhaps before the end of this century. Future eruptions like those of the recent past would affect a broad area beyond the volcano, but the area most likely to be severely affected is not yet heavily populated.

The high probability, based on past behavior, that Mount St. Helens will erupt again indicates that potential volcanic hazards should be considered in planning for future uses of the land that could be affected by an eruption. The potential risk from future eruptions may be low in relation to the lifetime of a person or to the life expectancy of a specific building or other structure. But when dwelling places and other land uses are established, they tend to persist for centuries or even millenia. Major changes in long-established land-use patterns, which become necessary to protect lives or property, can themselves be economically disastrous and socially disruptive; therefore, potential volcanic hazards should be considered while choices can still be made with respect to future land use, even though eruptions may still be decades away.

Because of its smooth, little-eroded slopes, Mount St. Helens has long been known to be younger than the neighboring volcanoes such as Mounts Rainier, Adams, and Hood (1). However, we have learned only recently how young St. Helens is and how often it has erupted in the recent past. Although its history extends back more than 37,000 years (2,3), virtually the entire visible volcano has formed since about 500 B.C., and most of its upper part has been built within the last few hundred years (Figure 2) (4). This knowledge of its formation resulted largely from detailed studies of the

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origin and sequence of the volcano's eruptive products, coupled with nearly 30 radiocarbon dates from which the volcanic chronology is inferred. The numerous dates were made possible by abundant charcoal in the deposits of many pyroclastic flows (avalanches of hot, dry rock debris) and by charcoal and other vegetative matter interbedded with tephra (explosively erupted, airborne debris).

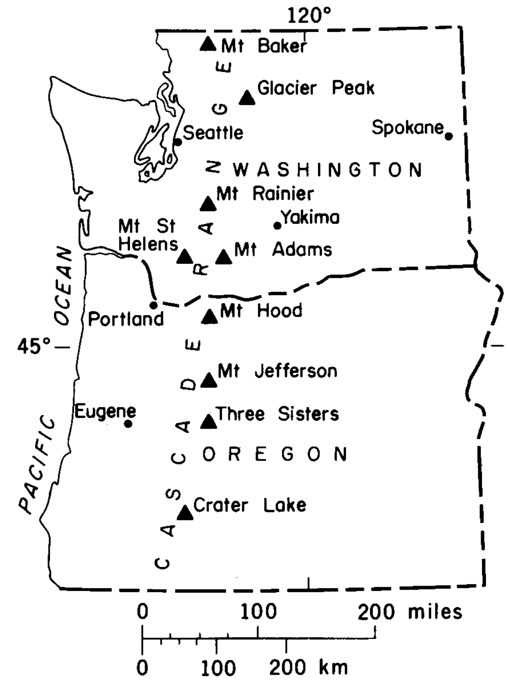

Figure 1. Index map of Washington and Oregon showing location of Mount St. Helens and other volcanoes.

Our purpose in this report is to summarize a remarkable and generally unrecognized record of recent activity at Mount St. Helens and to compare it with the history of some other well-known volcanoes. We also assess the significance of the present dormant interval, which has lasted nearly 120 years. The data now available suggest that since about 2500 B.C. the volcano has never been dormant for more than about five centuries at a time and that dormant periods of one or two centures or less have been more typical.

Even apparently dormant intervals may have been broken by eruptions that did not leave a conspicuous deposit. The eruptions noted in our chronology include only those which produced deposits large enough to be preserved and recognized today. As many or more eruptions may have occurred

Figure 2. South side of Mount St. Helens volcano (altitude, 2,950 m). The summit consists of a volcanic plug probably emplaced between A.D. 1600 and 1700. Lava flows on the lower flank of the volcano in the center of the photograph are marked by sharp, curved ridges (arrows) formed along margins of flowing lava.

for which stratigraphic evidence either does not exist or has not yet been recognized. We see clear stratigraphic evidence, for example, of only one of the dozen or so 19th-century eruptions that were reported by explorers and settlers after Lewis and Clark's pioneer expedition of 1806 (5).

Since about 400 B.C., Mount St. Helens has shown considerable diversity both in its behavior and in the chemical composition of its eruptive products. Eruptions of basaltic and andesitic lava flows and tephra have been interspersed with eruptions of dacitic domes, tephra, and pyroclastic flows (6). Mount St. Helens has had a complex recent history, and the lithologic diversity of the resulting deposits makes it possible to recognize more volcanic events than if the eruptive products had all been of a single rock type.

Eruptive Chronology

The known eruptions of about the last 4,000 years can be roughly grouped into four periods: 2500 to 1600 B.C., 1200 to 800 B.C., 400 B.C.

to A.D. 400, and A.D. 1300 through the first half of the 19th century (Figure 3).

From 2500 to 1600 B.C., following a dormant period that may have lasted as long as 4,000 years, Mount St. Helens repeatedly erupted large volumes of tephra, and successive domes were formed at the eruptive center. Shattering of the domes, perhaps by volcanic explosions, produced pyroclastic flows that moved beyond the volcano. Pumiceous tephras that were erupted at various times were carried downwind and some covered large lobate areas; at least one of these reached into northeast Oregon and another into western Alberta (2). A quiet interval of perhaps as much as 400 years may have occurred during this eruptive period.

In about 1200 B.C., after an interlude of no more than a few centuries, the volcano began to erupt domes and pyroclastic flows, but with smaller volumes of tephra. During this period, which lasted four or five centuries, many large hot pyroclastic flows of nonvesicular rock debris, pumice, or both, moved away from the volcano in nearly every direction. Some of the rock debris became mixed with water and formed lahars (volcanic mudflows) that streamed many tens of kilometers down river valleys. Radiocarbon dates from charcoal in volcanic deposits suggest that eruptions occurred sporadically throughout this period.

The eruptions of 400 B.C. to A.D. 400 produced both basaltic and andesitic lava flows, which were lacking in the earlier products of the volcano. However, the intermittent explosive eruptions of more silicic tephra, which had characterized the volcano's earlier history, continued and alternated with the eruptions of the more basic lava flows. Thus the new behavior pattern was characterized by eruptions of several different types and of different kinds of rock in quick succession, perhaps even simultaneously from different vents. Eruptions of the volcano formed andesitic or dacitic tephra at least twice, basaltic tephra six times, dacitic or andesite pyroclastic flows no less than three times, and lava flows at least twice. During this period the volcano initially produced lava flows, as well as tephra; then a series of pyroclastic flows was formed starting about 300 B.C.

Although a brief episode of explosive volcanism occurred about A.D. 840, the next major period of frequent and diverse activity evidently began between A.D. 1200 and 1300. From that time on, Mount St. Helens erupted basaltic or andesitic lava flows, dacitic domes, pyroclastic flows, and tephra. The largest tephra eruption of this period occurred about A. D. 1500 and spread pumice at least as far as northeastern Washington. The dacitic dome that forms the present summit of the volcano also was extruded during this period, probably between A.D. 1600 and 1700. The period of activity that roughly coincided with the first half of the 19th century produced tephra, a dacitic dome, and perhaps a few lava flows.

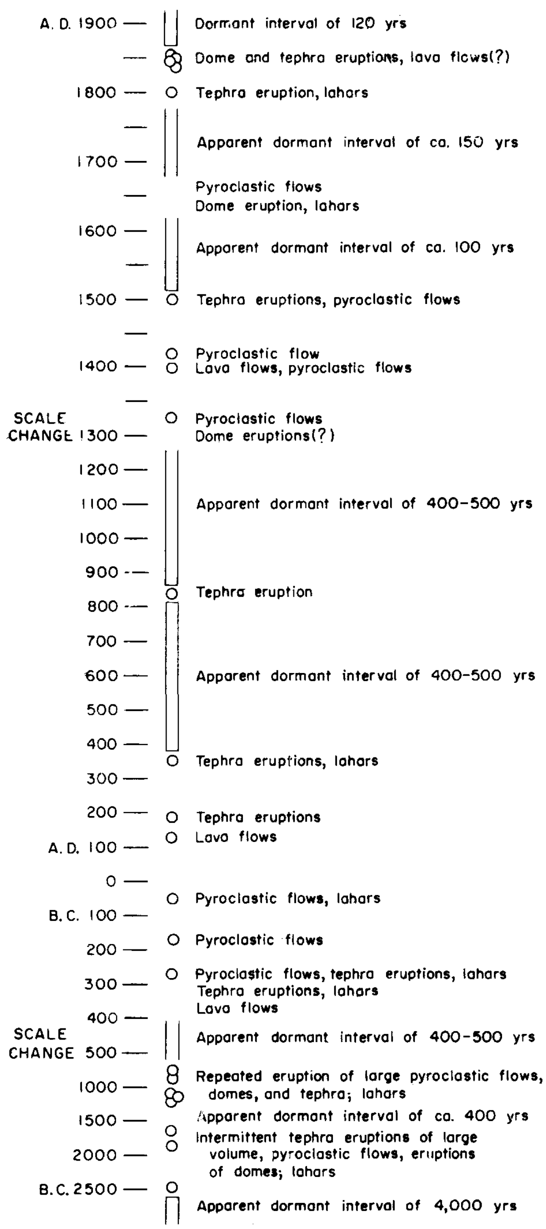

Figure 3. Eruptions and dormant intervals at Mount St. Helens since 2500 B.C. Circles represent specific eruptions either dated or closely bracketed (13); vertical boxes represent dormant intervals.

Frequency, Duration, and Volume

The frequency of eruptive activity can be inferred from the record and dates of known volcanism, but little is known about the duration of individual eruptions. Many eruptions, even relatively violent and voluminous ones, could have occurred within periods of a few days or months; other eruptions probably consisted of a series of small events spread over many decades. Volcanism at Mount St. Helens probably has included many brief but violent eruptive episodes like the catastrophic "Plinian" eruption of Vesuvius in A.D. 79, the eruption of Mount Lamington in Papua (New Guinea) in 1951 and 1952, or the violent outbursts at Santa Maria Volcano, Guatemala, that started in 1922 and still intermittently continue.

The recent stratigraphic record at Mount St. Helens, together with the early 19th century historic record, suggests that if the area had been occupied by record-keeping people, the eruptive history would resemble that of some volcanoes for which long written records are available (Figure 4). Some eruptive episodes probably were virtually single large events; others probably were smaller events repeated at intervals of a few years over a long time.

The historic record at Vesuvius includes at least 10 and possibly 14 eruptions in the 1060 years following the one in A.D. 79 which buried Pompeii (7,8); seven of these also can be identified in the stratigraphic record. Then a period of almost 500 years elapsed during which no unequivocal eruptions occurred; this period ended with the large 1631 eruption. Since 1631, however, the volcano has erupted at intervals of no more than a few decades.

At Fuji, another famous volcano with a long historic record (9), clusters of activity have been separated by dormant periods of varying length, up to 428 years; the volcano has now been inactive for more than 265 years. In contrast, Hekla Volcano in Iceland has erupted at least every hundred years or so since the island was settled (10).

With respect to the volume of material erupted into the air (in contrast to lava flows), Mount St. Helens has produced much less than did prehistoric Mount Mazama at the site of Crater Lake, Oregon, about 6,600 years ago, or Tamboro in the East Indies in 1815; the latter was one of the most voluminous (if not the most voluminous) explosive eruptions of historic time. The volume of ejecta produced by some of Mount St. Helens' largest eruptions of the last four millennia, however, has been similar to that produced at certain times by Vesuvius, Fuji, and Hekla. Tephra erupted from Mount St. Helens in 1900 B.C., for example, is estimated to have a volume of at least 3 km^3, and an eruption in about A.D. 1500 laid down roughly 1 km^3 of similar ejecta. For comparison, the tephra from the 1707 eruption of Fuji is about 0.8 km^3 in volume (9). The largest deposit from a historic Hekla tephra eruption in A.D. 1104 is about 1.5 km^3 in volume (10), and the volume of the tephra deposit resulting from the Vesuvius eruption of A.D. 79 has been calculated to be about 2.6 km^3 (11).

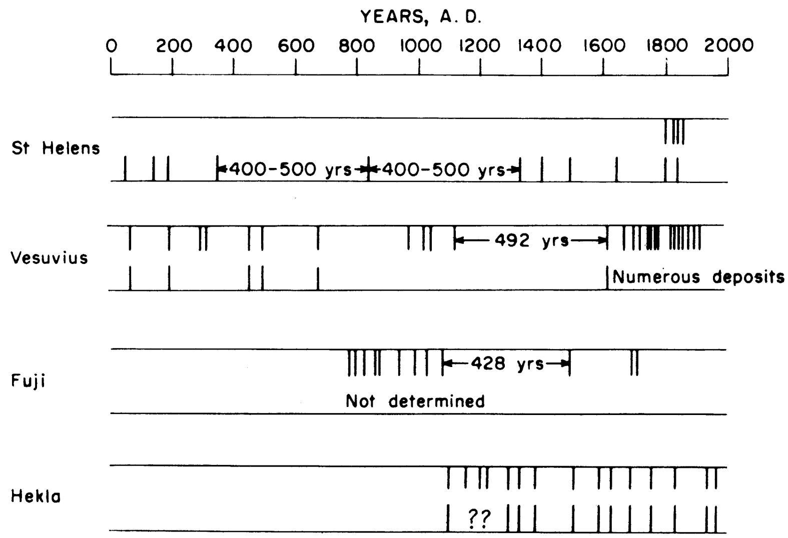

Figure 4. Volcanic activity at Mount St. Helens compared with the activity at Vesuvius (7,13), Fuji (8), and Hekla (9), as shown by the historical records (upper scales) and the stratigraphic record (lower scales).

Dormant intervals of thousands of years during the older history of Mount St. Helens can be recognized from buried weathering profiles in volcanic deposits. The profiles indicate that the weathered deposits were exposed at the surface for a long time before being covered by products of the next eruption. Radiocarbon dating of the youngest weathered deposit in such a profile, as well as of the oldest deposit above it, discloses the approximate length of a dormant interval. The imprecision of the radiocarbon dating method, which amounts to only a few hundred years, is minor relative to the total length of the dormant interval.

Dormant intervals of a few centuries are hard to recognize because weathering profiles developed in such short intervals are weak. The lengths of short intervals are also determined by radiocarbon dates, but the imprecision of the method is then large relative to the length of an interval. However, the radiocarbon method seems adequate to approximate intervals of several hundred years (Figure 3) where there are many dates and good stratigraphic control.

During the last four millennia there has not been a dormant interval of as much as a thousand years at Mount St. Helens. Within this time, however, there were five or six intervals of more than two to about five centuries before A.D. 1800 during which the volcano seems to have been dormant. In addition, 12 dormant periods of one or two centuries in length have been tentatively identified, and many intervals of a few years or a few decades surely occurred during extended periods of eruptive activity.

A Forecast

The repetitive nature of the eruptive activity at Mount St. Helens during the last 4,000 years, with dormant intervals typically of a few centuries or less, suggests that the current quiet period will not last a thousand years. Instead, an eruption is likely within the next hundred years, possibly before the end of this century. Because of the variable recent behavior of the volcano, we cannot predict whether the next eruption will be of basalt, andesite, or dacite, and whether it will produce lava flows, pyroclastic flows, tephra, or volcanic domes. But if the eruptive period lasts years or decades, a variety of eruptive events and lithologic types can be anticipated (12).

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13. The radiocarbon dates used in this report were based on the best known half-life determination and were corrected for possible initial variations in ^{14}C concentrations by using H. E. Suess' tree-ring calibration curves [Nobel Symp. No. 12 (1970), pp. 303-311].

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GEOLOGIC MAP OF WESTERN OREGON REPRINTED

The Geologic Map of Oregon West of the 121st Meridian, which has been out of print for several months is again available. The map, prepared by the U.S. Geological Survey in cooperation with the Oregon Department of Geology and Mineral Industries, was printed in 1961. The reprinted map is for sale by the Department at its Portland, Baker, and Grants Pass offices at $2.00 over the counter and $2.25 by mail.

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FIELD STUDIES SUMMARY ON OPEN FILE

"Field-Oriented Geology Studies in Oregon, 1974," compiled by John D. Beaulieu, Department stratigrapher, has been placed on open file and is available for inspection at the Department's offices in Portland, Baker, and Grants Pass. Copies are available at cost of reproduction at the Portland office.

The report is issued strictly for reference purposes to show what projects were underway and the areas studied during the past year; it is not to be quoted or printed elsewhere.

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WELL RECORDS ON FEDERAL OFFSHORE LANDS AVAILABLE

The U.S. Geological Survey issued OCS (outer continental shelf) order No. 12, in December 1974, releasing all records on wells drilled on Federal shelf lands in the United States. The release involved data on more than 1,100 offshore holes. Eight wells off the Oregon Coast and four off the Washington Coast are included in the release.

West Coast OCS records can be inspected at the U.S. Geological Survey's Regional Oil and Gas Division office in Los Angeles (7744 Federal Building, 300 North Los Angeles Street, Los Angeles, Calif. 90012) and at the Oregon Department of Geology and Mineral Industries office in Portland (1069 State Office Building, Portland, Oregon 97201).

Reproductions of the records are handled by two Los Angeles firms:

Continental Graphics
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1712 Newbury Road, Newbury Park, Calif. 91320

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GEOTHERMAL GRADIENT REPORT ON OPEN FILE

Geothermal gradient data gathered by the Oregon Department of Geology and Mineral Industries between 1971 and 1973 are now on open file in the Department's Portland office. The information consists of temperature gradients for 75 deep, pre-drilled bore holes (mainly water wells and mineral exploration test holes) located throughout the State. The work was performed by R. G. Bowen and other Department personnel as part of the Department's contract with the U.S. Bureau of Mines to study the geothermal potential of Oregon.

In progress is a detailed study of heat flow utilizing data from many shallow bore holes as well as the information from the deep holes. Results of the study will be contained in a comprehensive report by the Department in cooperation with Dr. David Blackwell, Southern Methodist University, Dallas, Texas, who has worked closely with the Department staff during the study. Dr. Blackwell directed the building and calibrating of the equipment used in measuring the temperature gradients and made conductivity determinations for a number of wells, including those reported in the January 1973 ORE BIN.

The open-file information is presented mainly on computer read-out sheets and consists of tabulated temperature data and graphic plots. The information is released in this preliminary form to assist those doing more detailed geothermal gradient and heat-flow studies for geothermal exploration. Copies of the open-file report are available from the Department for $10.00, postpaid.

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INFORMATION ON NICKEL DEPOSITS ON OPEN FILE

Last summer the Department began a survey of the nickel deposits in Oregon, particularly those associated with laterized peridotites in the southwestern part of the State. This project has been financially supported through a contract with the U.S. Bureau of Mines as part of its Minerals Availability System program and will be completed next summer.

Several private geologists have indicated an interest in the information developed thus far, and therefore, in order to encourage further exploration in the State, the Department is placing the data on open file for public use. Anyone wishing to inspect the field maps and analyses of drill samples may do so by contacting Len Ramp, District Geologist, Dept. of Geology and Mineral Industries, P. O. Box 417, Grants Pass 97526; telephone (503) 476-2496.

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STATE ENERGY COUNCIL REPORT AVAILABLE

The recently completed energy study of the State of Oregon, requested by the 1973 Legislature, is now available. The report, entitled "Transition," was prepared by the Office of Energy, Research and Planning. It can be obtained from the Office of the Governor, State Capitol, Salem, Oregon 97310 for $5.00. The report recommends a halt to nuclear fission electric power and advocates a systematic transition to a solar-based economy, utilizing other sources of energy during the transition period.

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VALUE OF U.S. MINERAL OUTPUT SOARS IN 1974

Value of U.S. raw mineral output in 1974 soared to a new high of $54.9 billion, despite drops in production of many commodities, Secretary of the Interior Rogers Morton reported.

Based on data provided by the U.S. Bureau of Mines, the 1974 record-breaking figure surpasses the 1973 value of $36.8 billion by almost 50%. Reflected in the totals are value increases for all sectors of the mineral industry, including metallics, nonmetallics, and mineral fuels.

"Most of the raises resulted from higher prices, not increased output," Morton said. "Of the 80 mineral commodities included in the totals, 38 showed production gains, and 63 registered value increases." Noting that the value of processed materials and energy, derived from imported and domestic minerals, was now in excess of $200 billion, Morton said, "This emphasizes the need for increased productivity, both in raw materials and in their conversion to useful forms, as a major part of our efforts to reduce the serious erosion caused by inflation."

(Amer. Mining Cong. News Bull., no. 75-1, 1975)

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ELTON A. YOUNGBERG RETIRES FROM AEC

Elton A. Youngberg, Manager of the Grand Junction Office of the Atomic Energy Commission, retired December 1974 after 26 years with AEC. Youngberg was on the staff of the Oregon Department of Geology and Mineral Industries between September 1944 and May 1946, during which time he was Field Engineer at the Department's Grants Pass office. Youngberg is the author of Department Bulletin 34, "Mines and prospects of the Mount Reuben mining district, Josephine County, Oregon."

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NAS REPORT VIEWS MINERALS, ENVIRONMENT

The National Academy of Sciences (NAS) has published a 348-page report entitled "Mineral Resources and the Environment" based on a comprehensive two-year study by its Committee on Mineral Resources and the Environment.

The NAS committee identified two schools of thought concerning future adequacy of the world's mineral resources and associated environmental costs. One view is that exhaustion of resources is inevitable unless drastic measures are taken to reduce economic growth. The other is that mineral resources virtually are economically and physically infinite. The committee determined that the U.S. will face serious difficulties in attempting to increase some supplies of minerals from domestic sources and expressed doubt whether even current levels of supply could be maintained for all materials. The report concluded generally that resources must be conserved and that adequate information on mineral resources must be generated. These actions, according to the report, should be designed to conserve resources and increase efficiency in their use.

The study also noted that there are currently no standardized techniques for making either long-term demand forecasts or resource estimates, nor are means available to assess adequately the accuracy of the existing methods. Another conclusion was that reliable data on mineral resources are difficult to obtain because of their proprietary or international nature.

The committee preparing the report was composed of four separate groups that studied technology, supply, environment, and demand. The report of the technology panel concluded that technology will not always be capable of closing gaps between rising demand and limited supply of mineral resources. According to this panel, the Federal government should proclaim and pursue a national policy of conservation of materials, energy, and environmental resources.

The supply panel addressed current methods of estimating mineral reserves and resources and the quality of current resource estimates. It reached the conclusion that a major problem in proving estimates is the difficulty of obtaining proprietary information and the inadequate recognition of economics and rates of mineral production in current resource estimates.

According to this group, world resources of coal are large relative to current energy requirements. As regards reserves and resources of copper, it was concluded that an ore grade of about 0.1% copper represents a point beyond which mining and recovery of copper are unlikely to proceed. If the U.S. production rate is to be maintained until the end of the century, the report states, additional discovery at a significant rate will be necessary. It recommended aiding and stimulating domestic exploration and production. It also recommended that recovery of ocean bed copper resources be encouraged.

The environmental panel concentrated on environmental problems associated with coal production and use, namely pneumoconiosis and emissions of sulfur oxides. A conclusion was reached that the problem of sulfur emissions is not being attacked correctly in that there is too much concentration on larger particles. The report also concluded that current monitoring methods are inadequate and that funds for the study of environmental impacts of fossil fuels should be increased.

The panel addressed the problem of demand for mineral resources and the significance of demand forecasts. Its report pointed out that national obsession with expanding supplies arises from the dramatic gap between projected demand and projected supply. It challenged the credibility of the projections and the assumption that they are not susceptible to change, and emphasized the potential for influencing demand through the market mechanism, policy, and technology.

The report also recommended that substitutes be found for the following: helium, mercury, asbestos, chromium, gold, palladium, and tin. The need for substitutes should be assessed for antimony, tungsten, vanadium, silver, and zinc.

While the report recommends that the private sector retain the main responsiblity for developing technology, it said Federal participation is often not only inevitable but necessary, perhaps even desirable.

It was noted that increased Federal intervention can be anticipated in the materials field and to be successful should aim at creating opportunities within a broad framework for individual and corporate enterprise, not stifling such enterprise. The report states that industries must be allowed adequate profits in order to invest in R&D and to attract venture capital. "Price regulation...may be consumer good will in the short term but at the expense of long-term ability to provide the goods and services that consumers will continue to expect."

(Amer. Mining Congress News Bull., no. 75-4, Feb. 14, 1975)

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OLDEST ROCKS ARE OLDER THAN EVER

The oldest rocks known in North America are some Precambrian granitic gneisses in the Minnesota River valley of southwestern Minnesota. In 1970, they were dated at 3,500 million years, but more recent Rb-Sr analyses have been carried out by the same workers, who report (Nature, Dec. 6, 1974, p. 467) a new age of 3,800 million years. These ancient rocks range in composition from tonalite to granodiorite and quartz monzonite. They have undergone a complex history of metamorphism and have been intruded by granite, pegmatite, and basalt of various magmatic episodes.

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USBM TO IMPROVE MINERAL INTELLIGENCE FUNCTIONS

A realignment to strengthen the mineral information systems and supply/demand evaluation work of the Bureau of Mines has created two associate director positions by dividing the expanded management functions of the abolished deputy director for mineral resources and environmental development.

Dr. John D. Morgan has been designated to act as the associate director, Mineral and Materials Supply/Demand Analysis, pending his appointment to the post. Under the new organization, he will oversee four new mineral information and evaluation units: metals, minerals, and materials; fuels; international data and analysis; and interindustry and economic analyses. Also, the associate director has responsibility for the state liaison program, which promotes Federal-state cooperation on mineral-related matters, and special programs involving resource conservation and development. These programs will include mineral evaluation studies of potential wilderness areas and effects of mineral operations on the environment.

Dr. Thomas A. Henrie has been named to act as the new associate director, Mineral and Materials Research and Development, pending his appointment to the new position. Metallurgy research, mining research, and the Bureau's helium program come under the new associate director. He will manage all of the Bureau's existing research and development programs involving the extraction, processing, use, disposal, and recycling of minerals and mineral-based materials, including the Bureau's research on mine health and safety programs and on land reclamation.

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GEOTHERMAL LEASE SALE POSTPONED

Leasing of 13,000 acres of potentially valuable geothermal land in the Vale Hot Springs Known Geothermal Resource Area (KGRA) has been postponed until August. The auction of geothermal rights had been scheduled for April 23, 1975. The tract is near Vale, Oregon, adjacent to 1,300 acres leased by BLM last year.

According to Max Lieurance, acting state director for BLM, the lease is being delayed because adverse weather in the area has hampered the completion of an inventory of archeological sites. BLM will not lease the area until these sites have been identified and stipulations to protect them written into the lease.

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MOVING? Please send your new address - now!

MINING LAW BULLETIN ISSUED BY STATE OF WASHINGTON

A comprehensive, 109-page, loose-leaf bulletin, "Mining Laws of the State of Washington," has just been issued by the Washington Division of Geology and Earth Resources. The publication contains information on all phases of mining law as it pertains to Federal, state and private lands. Line drawings illustrate some of the more confusing situations often encountered by the claim locator. The publication, issued as Bulletin 67, is available from the Department of Natural Resources, Olympia, Washington 98504, for $1.50.

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PROJECT INDEPENDENCE REPORT SUBMITTED TO PRESIDENT

The Federal Energy Administration has submitted its Project Independence to the President. The final report indicates what can be expected from several approaches under varying conditions, including differing price levels. It does not attempt to outline actions, leaving final determinations to the Executive and Legislative Branches.

The report draws several conclusions on U.S. energy supply by 1985:

Coal production will increase to between 1.0 and 1.1 billion tons per year, depending on world oil prices, but may be limited by lack of markets. Production could be expanded further, but lower electric growth, increasing nuclear capacity, and environmental restrictions will limit.

Nuclear power is expected to grow from 4.5% to 30% of total electric power generation.

Shale oil production could reach 250,000 B/D but only if price rises to $11.

Geothermal, solar, and other advanced technologies have large potential but will not contribute materially until after 1985. Research is needed to develop these sources because of their lower environmental impact.

Copies of the complete report are available from Superintendent of Documents, Govt. Printing Office, Washington, D. C. 20402; stock no. 4118-00029; price is $8.35.

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NORTHWEST MINING ASSOCIATION MOVES

The Northwest Mining Association office in Spokane, Washington has moved to the Chamber of Commerce Building, W. 1020 Riverside Ave., zip 99201. Telephone: (509) 624-1158.

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THANK YOU FOR COMMENTS AND SUGGESTIONS

In the September 1974 ORE BIN, we included a pull-out order sheet with space for comments on The ORE BIN and its usefulness. So far, 25 readers have responded: 3 in mineral industries, 4 professional geologists, 2 teachers, 1 physician, 1 forester, and 14 "interested amateurs." Much to our surprise (and very much to our pleasure) everyone likes The ORE BIN. Some comments went like this:

--Think it's great! --All good! --Very enjoyable and informative.
--Extremely fine, informative, and accurate as well.
--Keeps me informed on what's going on in Oregon. --Good buy.
--Has just the right scope.
--Nothing to "dislike" from standpoint of an interested amateur; there is considerable I don't understand but realize it is a journal mainly for professionals; I have learned much.
--Sort of a neat collection of miscellaneous geology to keep me awake. Never know what's coming. Not tied down reading too long.
--A balanced offering of scientific papers, review articles, news items.
--Concise, interesting, and to the point. It is timely, up-to-date and compiled by very efficient and informed people. Reasonable price.
--Like the fact that reprints of many old ones are available.
--There isn't a better little book written for the geologist or miner.
--I like the surprise subject every month.

Preferred subjects mentioned were: geology of various areas of Oregon ("not too technical," someone added); Oregon's resources including geothermal, recycling resources, gravel mining, gem stones, minerals, fossils; new regulations on mining in National Forests.

We were particularly pleased to receive suggestions for future articles. Our commenters want more information on specific minerals and localities; old mines that may be profitable to open up in current mineral shortage; gem stones and minerals; and eastern Oregon. Some asked that more articles be written in language for the amateur.

To satisfy you, the reader, is our principal objective. Your comments and suggestions will always be most welcome.

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Apologies for late arrival of the February ORE BIN. Our printer for the past 2 years suddenly closed his doors, which meant the State Printer had to call for bids on a new contract for us.

AVAILABLE PUBLICATIONS

(Please include remittance with order; postage free. All sales are final - no returns. Upon request, a complete list of Department publications, including out-of-print, will be mailed)

BULLETINS

8.	Feasibility of steel plant in lower Columbia River area, rev. 1940: Miller . . .	$0.40
26.	Soil: Its origin, destruction, preservation, 1944: Twenhofel	0.45
33.	Bibliography (1st suppl.) geology and mineral resources of Oregon, 1947: Allen. .	1.00
35.	Geology of Dallas and Valsetz quadrangles, Oregon, rev. 1963: Baldwin. . . .	3.00
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86.	Nineteenth Biennial Report of the Department, 1972-1974	1.00

GEOLOGIC MAPS

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