Mount St. Helens—site of recent volcanic activity in the southern Cascades of Washington, see page 18 for details (Photo by U.S. Forest Service).

Midnite mine—Washington's oldest producing uranium mine.

WASHINGTON GEOLOGIC NEWSLETTER

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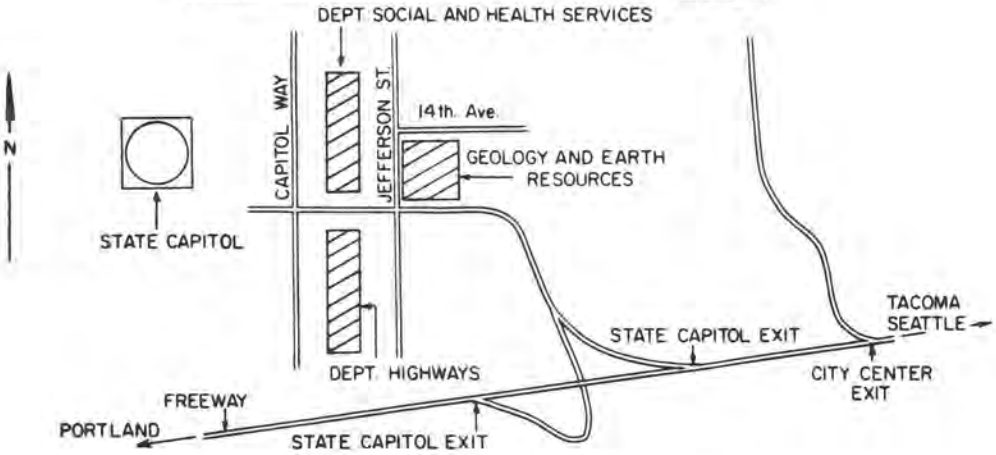
LOCATION MAP: DIVISION OF GEOLOGY AND EARTH RESOURCES



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

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

URANIUM IN WASHINGTON[1/]

Introduction

Nuclear power growth establishes the basic demand for uranium in the United States. Forecasts indicate that by 1985 around 16 percent of the nation's energy will come from nuclear power plants. To assure an adequate domestic supply after 1983, all known uranium deposits in the United States will have to be explored and developed. The free world's uranium resources of about 1.5 million tons of U_3O_8 in conventional deposits are less than half the minimum projected requirements to the year 2000.

The largest known reserves of uranium in Washington are on the Spokane Indian Reservation. Deposits held by Western Nuclear, Inc. are reported to contain 14.2 million pounds of uranium oxide, and reserves at Dawn Mining Co.'s Midnite mine probably exceed 2 million pounds. Uranium ore is also present in the Mount Spokane area of Spokane County, as well as in the Lost Creek area of Pend Oreille County; however, the total reserves for these areas are probably less than 100,000 pounds. Uranium reserves at the Midnite mine appear to be sufficient for at least 3 years of continuous operation; the reserves at Western Nuclear's Sherwood property are sufficient for at least 15 years of production. Undoubtedly, additional reserves will be developed at both properties; however, it is doubtful that production from new reserves will exceed past production. The production of uranium from areas outside the Spokane Indian Reservation depends to a large part on an increase in the price of uranium oxide. However, the combined known reserves of several past producers appear to be sufficient for only 2 or 3 years of mining. Thus, if Washington is to maintain its uranium production beyond the next 15 years, additional deposits will have to be discovered and developed.

Washington Uranium Deposits

Until 1954, despite persistent search, no uranium occurrences of significance had been found in Washington. In the summer of 1954, uranium minerals were discovered by the LeBret brothers on the Spokane Indian Reservation in Stevens County. The discovery was made while prospecting for tungsten at night, with an ultraviolet lamp. This find became the Midnite mine (fig. 1, no. 1) and touched off a uranium boom in the state. Shortly thereafter uranium was discovered on the Dahl farm on the west slope of Mount Spokane (no. 2), some 40 miles east of the

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1/ Condensed from *Energy Resources of Washington*, Washington Division of Geology and Earth Resources Information Circular 50, p. 83-87; and *Uranium in Washington State: Proven deposits and exploration targets*, by P. Clinton Milne: *In* The Canadian Mining and Metallurgical Bulletin, April 1979.

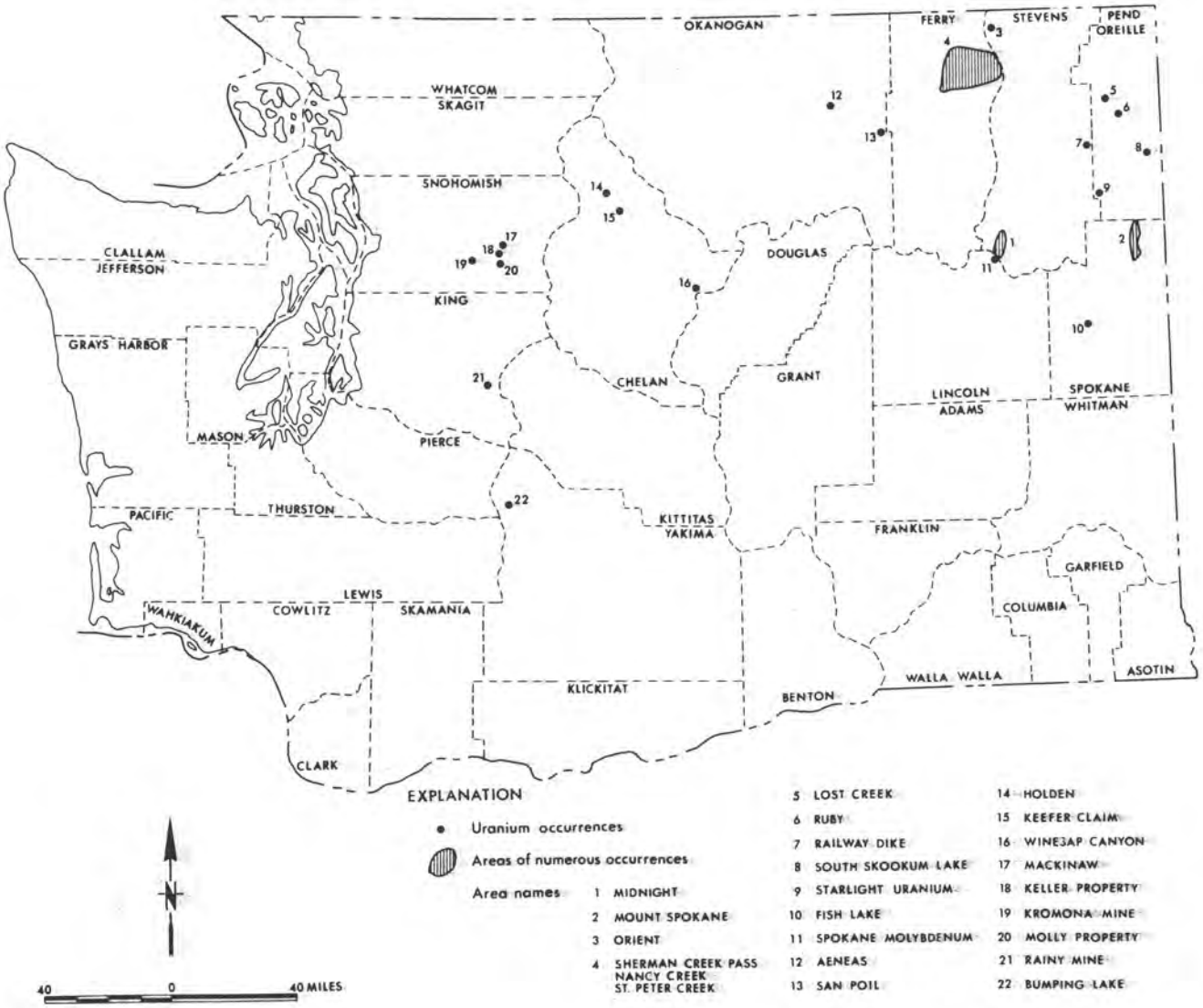
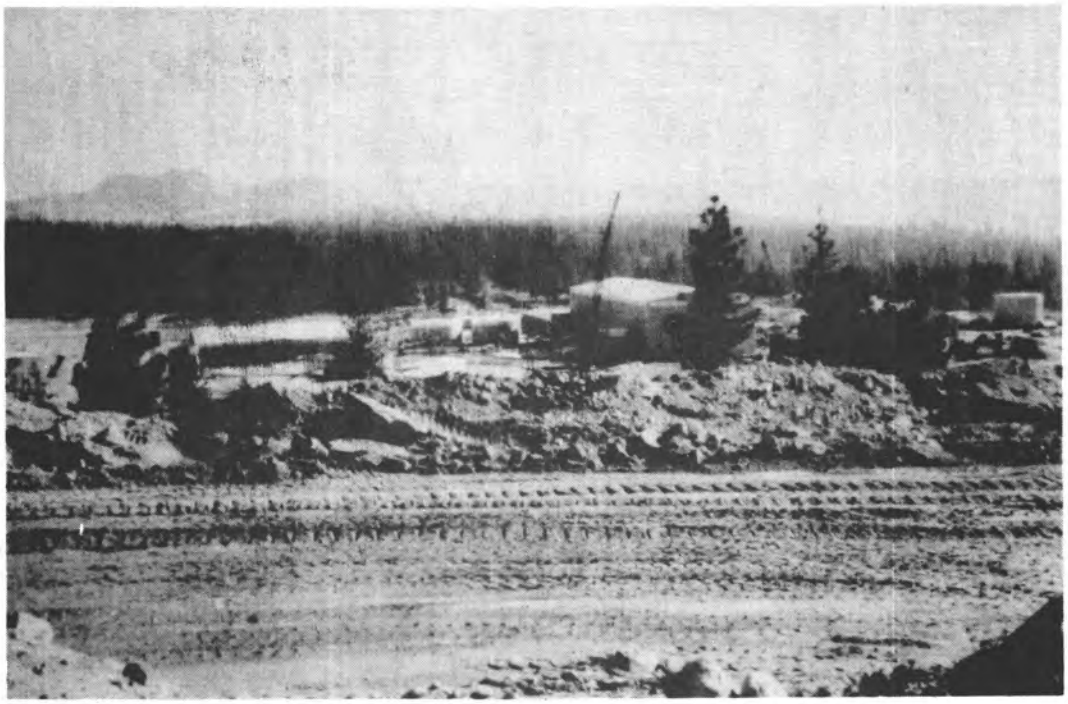


FIGURE 1.—Uranium in Washington.



Western Nuclear's mill at their Sherwood mine

Mining operations at Midnite mine

Midnite mine and about 30 miles northeast of Spokane. This became the Daybreak mine and marked the discovery of a second uranium area in the state. Other discoveries were made, but none proved to be as important as the original two. As a result of these discoveries, a mill was built in 1957 at Ford, in Stevens County, to treat the ores, and Washington became an important producer of uranium. Around 1968, the Sherwood mine south of the Midnite was acquired by Western Nuclear, Inc. and exploration drilling disclosed a large deposit of low-grade uranium ore. In 1977, a mill was built at the deposit, and in 1978, the Sherwood mine became the state's largest producer of uranium.

Exploration for uranium in Washington State has been at a relatively high level of activity for the last several years. The escalating dollar value for U_3O_8, the new Sherwood project owned by Western Nuclear, Inc., and the numerous uranium occurrences and diverse potential environments for uranium ore in northeastern Washington, where approximately 80 percent of the known uranium occurrences in the state are located (Ferry, Stevens, Pend Oreille and northern Spokane Counties), appear to account for this exploration intensity. Twenty to twenty-five companies have been active in northeastern Washington in recent years.

The state's two active uranium mines are on the Spokane Indian Reservation, approximately 35 air miles northwest of Spokane, near the confluence of the Columbia and Spokane Rivers. This area represents the focal point for uranium exploration in Washington. The mined-out Daybreak mine in northeastern Spokane County is the only other uranium mine in Washington.

At the Midnite mine, jointly owned by Newmont Mining Co. and Midnite Mines, Inc., Dawn Mining Co. is currently mining uranium ore with an average grade of about 0.10 percent U_3O_8 for milling at 450 to 500 tons per day at its Ford mill. The mine has proven reserves of about 2.25 million pounds of U_3O_8 at a grade of 0.145 percent (Klobusicky, 1978, written communication), with a cutoff grade of a leaching site for low-grade ore (0.03 to 0.05 percent U_3O_8).

Historically, mining was initiated at the Midnite in 1955 and continued through 1962; milling of stockpiled ore continued until 1965. Mining and milling started again in 1970 and has continued to the present. To date, Dawn has produced about 10 million pounds of U_3O_8.

Western Nuclear began milling its stockpiled ore at the Sherwood mine recently at up to 2,000 tons per day. The ore grade runs from 0.02 percent cutoff to a high of 0.15 percent U_3O_8 and averages about 0.08 percent U_3O_8, with ore reserves at 8 million tons containing 14,200,000 pounds of U_3O_8. The stripping ratio varies from 2:1 for the "east orebody" to 4:1 in the "west orebody," but the ratio may at times be as high as 20:1 locally. Within the scope of mine design, the total rock material is 66.7 million tons, and on a tonnage basis the waste-to-ore ratio is 7.3:1. Potentially, the Sherwood project will produce about 1.1 million pounds of U_3O_8 per year.

Future of Uranium Mining in Washington

Discoveries made to date are more than sufficient to prove that the geological environment in eastern Washington is favorable for uranium deposits, and the chances for additional discoveries in eastern Washington must be considered good. Given the incentive to prospect, discoveries similar to the Midnite might be made along the margin of the Loon

Lake batholith. Other deposits similar to the Peters lease ore body (Sherwood) could occur in the conglomerates interbedded in the Sanpoil Volcanics.

In both of these environments, sizable ore bodies are known to occur, but poor exposures make them hard to find. Additional discoveries of ore bodies of the Mount Spokane type are almost certain to be made in the Mount Spokane area with further searching, and discoveries are possible elsewhere in Washington where rocks similar to Mount Spokane alaskite are known to occur. These ore bodies are likely to be small, but some may be large enough for a successful small operation.

Uranium occurrences found to date in the Cascade Mountains appear to have little or no potential value. This area, however, has been prospected very inadequately for uranium. Enough anomalies have been found to suggest that the areas has possibilities (fig. 1).

In order to encourage and promote the development of known uranium occurrences in the state, as well as to look for new occurrences, the Washington Division of Geology and Earth Resources has for the past 2 years been actively investigating potential uranium areas. One geologist has, during this time, carried out geological, geophysical, and geochemical surveys in areas where the geology is favorable for the discovery of new occurrences. A potential for new uranium deposits lies predominately in the northeastern part of the state. However, several parts of north-central Washington, as well as the central and east-central Cascade region, also exhibit favorable characteristics for uranium deposits based on sound geologic evidence. Fifteen areas of the state are considered favorable and will be evaluated for their uranium potential by the Division of Geology and Earth Resources, but to date only one area (Ellensburg-Yakima) has been investigated and reported on by us.

DNR GEOLOGY FIELD OFFICE OPENS IN SPOKANE

The Department of Natural Resources has opened a field office in eastern Washington for the Division of Geology and Earth Resources. The office will serve as a contact for geologic exploration, mining, and energy activities already established in that part of the state, as well as for the general public.

Keith Stoffel and Bonnie Bunning, division geologists, are now in the office. The office will be open to the public on Mondays and on Fridays from 8 o'clock until 4:30 p.m. It may also be open on other week days as field schedules permit.

The address is Department of Natural Resources, Senior Hall, Eastern Washington University, Cheney, WA 99004, telephone (509) 359-2278.

GEOLOGIC RESEARCH PROJECTS

Geologic research activities conducted by Washington colleges and universities on the geology of Washington State during 1979 are listed below:

Eastern Washington University

Faculty Research Projects

Behavior of major and trace elements in metamorphic rocks at the contacts of igneous intrusions (Mohammed Ikramuddin).

Geochemistry of granitic rocks of northeastern Washington (Mohammed Ikramuddin).

Permian bryozoans of the carbonate units of the Mission Argillite, northeastern Washington (Ernest H. Gilmour).

Fumarole and geothermal ice cave monitoring, Mounts Rainier and Baker (Eugene P. Kiver).

Quaternary geology of the northeastern Columbia Plateau and terraces along the Spokane and Columbia Rivers upstream from Grand Coulee (Eugene P. Kiver and Dale S. Stradling).

Quaternary map of northeastern Washington east of the Okanogan River (Eugene P. Kiver and Dale S. Stradling).

Compilation of computer data base of whole-rock chemical analyses of igneous rocks from Washington (Felix E. Mutschler).

Major and trace element chemistry of "porphyry" molybdenum, tin-tungsten systems (Felix E. Mutschler).

Geologic map of Inchelium quadrangle, Washington (James R. Snook).

Paleomagnetism of intrusive igneous rocks of northeastern Washington (William K. Steele).

Student Research Projects

Geology of part of the Inchelium quadrangle (Mark Abrams).

Sedimentology and depositional environments of the Touchet beds, Columbia Basin (Bruce Bjornstad).

Geochemistry of alaskite and quartz monzonite of Mount Spokane, northeastern Washington, and its relation to uranium mineralization (Roy Bongiovanni).

Geochemistry of metapelites and calc-silicate hornfelses associated with uranium mineralization at the Midnite mine, northeastern Washington (Gin Chou).

Geologic hazards in the Spokane quadrangle (Tom Davis).

Geochemistry of granitic rocks from the Newport quadrangle, northeastern Washington (Abebe Kassaye).

Geochemistry of the Loon Lake quartz monzonite and its relation to uranium mineralization at the Midnite mine, northeastern Washington (Kirk P. Kinart).

Geology of part of the Dunn Mountain quadrangle (Ed Lucas).

Geology of part of the Inchelium quadrangle (Howard Orlean).

Geology of part of the Inchelium quadrangle (Bruce Smith).

Patterned ground in the Cheney quadrangle (Lee Ann Tallyn).

Computer modeling of total geomagnetic field anomalies over basalts in northeastern Washington (Hau-Ran Wang).

Geology of part of the Inchelium quadrangle (Dick Winters).

Grays Harbor College

Faculty Research Projects

The distribution and transport of sediments near the entrance to Grays Harbor (James B. Phipps).

Bay-shore erosion at Ocean Shores (James B. Phipps).

University of Washington

Faculty Research Projects

Origin of the Lopez tectonic complex, San Juan Islands (Darrel Cowan).

Mesozoic structural evolution of the southern San Juan Islands (Darrel Cowan).

Structural and petrologic evolution of the San Juan Island and adjacent areas (John T. Whetten).

Structure, stratigraphy, and sedimentology of the Chiwaukum graben (John T. Whetten).

Origin of chaotic rocks in the San Juan Islands (Darrel S. Cowan).

Stratigraphy, metamorphism, and tectonic evolution of the San Juan Islands (Joseph A. Vance).

Tertiary stratigraphy and structure of the area between Darrington and Skykomish (Joseph A. Vance).

Fission track geochronology of the Tertiary volcanic rocks of the Washington Cascades and Oregon (Joseph A. Vance).

Chronology of neoglacial moraines at Mount Rainier (Stephen C. Porter).

Regional Cenozoic tectonic patterns and geologic hazards of the Skagit nuclear power site (Eric S. Cheney).

Stratigraphy and structure and ore deposits of the Okanogan Highlands (Eric S. Cheney).

Structure and origin of the Twin Sisters Dunite (Nikolas I. Christensen).

Physical properties of Olympic Peninsula graywackes (Nikolas I. Christensen).

Gravity studies south and southwest of Mount Baker (Nikolas I. Christensen).

Petrology of ultramafic hornfelses, Icicle Creek, central Cascades (B. R. Frost).

Stratigraphy, structural geology, and regional interpretation of the Wenatchee Formation (Randall L. Gresens).

Mounts Baker and Shuksan 15-minute quadrangles (Peter Misch).

Metamorphic facies and petrogenesis of Shuksan greenschist (Peter Misch).

Petrology of Cascade River schist and its associated metaplutonic rocks (Peter Misch).

Metasomatic progressive metamorphism of ultramafic rocks in Skagit metamorphic suite (Peter Misch).

Geology, geochemistry and origin of the Golden Horn batholith (Peter Misch, with R. T. Stull).

Outline of the petrology of the Yellow Aster complex (Peter Misch).

Stratigraphy and structure of rocks in the Hoh River, Clearwater River area, western Olympic Peninsula (Richard J. Stewart).

Enrichment carbon-14 dating of late Quaternary glacial events, Olympic Peninsula, Washington (Minze Stuiver).

Carbon-14 and carbon-13 analysis of Douglas fir trees from western Washington as an indicator of carbon reservoir changes (Minze Stuiver).

Sunspot activity as monitored by C-14 changes in Pacific Northwest trees (Minze Stuiver).

Stratigraphy and structure of Mesozoic and Tertiary rocks of the western Cascades (John T. Whetten).

Minor and trace element geochemistry of Mesozoic oceanic volcanic and plutonic rocks in northwestern Washington (Joseph A. Vance).

Geochemistry of the Easton blueschists and greenschists (Joseph A. Vance).

Quaternary evolution of the Willapa Bay estuary (Barbara L. Whitney, V. Standish Mallory, and Sandra Leo).

Correlation of stratigraphic units of Washington and western Oregon (V. Standish Mallory).

Stratigraphy and paleontology of Lower Cretaceous sediments of the northern Methow Valley (Julian D. Barksdale and V. Standish Mallory).

Petrology and metamorphic history of the Chiwaukum schist in the Stevens Pass area (Bernard W. Evans).

Sources and fate of sediment from Olympic Mountains (Thomas Dunne and Leslie Reid).

Graduate Program

Paleoecology and biostratigraphy of the Kulshan glaciomarine drift, northwestern Washington (Maria A. Balzarini).

Late Quaternary volcanic stratigraphy and concomitant volcanic hazards at Glacier Peak, Washington (James Beget).

Structural geology and petrology of pre-Tertiary rocks on southern San Juan Island, in northwestern Washington (Mark Brandon).

Volcanic and glacial stratigraphy of the Goat Rocks area, central Cascade Mountains (Geoffrey Clayton).

Mechanics of river meanders, Sinlahekin River (William Dietrich).

Hydrothermal clay and thermal activity in source areas of debris avalanches at Mount Rainier and Mount Baker (David Frank).

Late Quaternary evolution of western Washington coast (A. Dan Horn).

Petrology of pelitic and ultramafic hornfels north of Icicle Creek, Washington (B. Keith Kaneda).

Stratalogic analysis of the intra-Miocene Ochoco unconformity in Washington-Oregon (Sandra Leo).

Fossil vertebrates from the Clarendonian and Hemphillian of northern Oregon and Washington (James Martin).

Paleoecology of the upper Eocene Cowlitz Formation and its associated coalbeds, southwestern Washington (Dann Joseph May).

Factors affecting the oxygen-18 composition of Douglas Fir tree rings from western Washington (Robert L. Burk).

Tertiary volcanic rocks of the Mount Daniel [area], central Washington Cascades (Eric Simonson).

Metamorphism of the Chiwaukum Schist at Stevens Pass, Cascade Range, Washington (John Berti).

Tertiary evolution of northwestern Washington and southwestern British Columbia (Lee Fairchild).

Washington State University

Faculty Research Projects

Geohydrologic investigations of eastern Washington basalts (James W. Crosby, III).

Geophysical investigations of Ringold Formation in Hanford environs (James W. Crosby, III).

Computer simulation of thermal energy storage in aquifers (James W. Crosby, III).

Stratigraphy and petrogenesis of Columbia River basalt in southeast Washington (Peter R. Hooper).

Detailed geologic mapping of the Pullman and Moscow west quadrangles (Peter R. Hooper and Gary D. Webster).

Late glacial plant macrofossils and pollen, Manis mastodon site, Sequim, Washington (Peter J. Mehringer).

Age, sediments, microfossils, and tephra of cores from the Scabland Lakes of the Cheney-Palouse Tract (Peter J. Mehringer).

Geology and mineral deposits of the black shale belt, northeast Washington (Joseph W. Mills).

Sulfur isotope study of ore deposits of northeast Washington (Joseph W. Mills).

Sulfide-bearing black shales of northern Washington State (Joseph W. Mills).

Cretaceous stratigraphy, San Juan Islands, San Juan County, Washington (W. Frank Scott).

Beach erosion, San Juan Islands, San Juan County, Washington (W. Frank Scott).

Bonneville flood gravels in the Snake River Canyon (Gary D. Webster).

Devonian conodonts in the black shale belt of northeast Washington (Gary D. Webster with Francis Beka) [abstract in Cordillera GSA Meeting 1980, Corvallis].

Student Research Projects

Petrology of the Cretaceous strata, Waldron Island, San Juan County, Washington (James Baichtal).

Ore deposits of the Yellowhead horizon, Pend Oreille mine, Metaline mining district, Washington (Michael Bemski).

The Togo Formation in Hunters and Turtle Lake quadrangles (Ali Calagari).

Sedimentology and stratigraphy of an interbasalt bed along the eastern part of the Columbia Plateau (Gerry Drobny).

Petrology of the Cretaceous strata, Patos Island, San Juan County, Washington (Norman Dainty).

Petrology of the Cretaceous strata, Matia, Clark, and Barnes Islands, San Juan County, Washington (Robert Egemeier).

Strain analysis in the Kootenay Arc (Michael Ellis).

Analysis of fold interference patterns, Cedar Lake, Stevens County, Washington (Paul Ginther).

Geology of Paleozoic black shale sequences of Clugston Creek, Stevens County, Washington (Curt Hogge).

Mineralogy of the sediments of Wildcat Lake, Whitman County, Washington (Clarence Johnson).

Ore deposits of the Ruby Hill area, Okanogan County, Washington (Donald Lance).

Structural analysis and detailed mapping of the China Bend region (Donald Minkel).

Geology and petrochemistry of part of the Colville batholith (Don Orazulike).

Sheet gravels near the mouth of the Snake River (Lance Richman).

Petrogenesis of Mount Baker volcano (Victor Swan).

Gravel deposits in the Clarkston area, southeast Washington (Gail Waggoner).

Older gravel deposits in the Snake River canyon below Clarkston, Washington (Mark Wheeler).

Structural mapping in the Kettle dome, Washington (Joseph Wilson).

Geology of the northeast Cascades, Glacier Peak area, Washington (Wade Holder).

Western Washington University

Faculty Research Projects

Geochemistry of magmatic rocks in the north Cascades (R. S. Babcock).

Paleomagnetism and tectonics of the Washington coast range (M. E. Beck, Jr.).

Tectonics of the Washington Cascades (M. E. Beck, Jr.).

Shape analysis of paleomagnetic secular variation data (M. E. Beck, Jr.).

Structure and petrology of metamorphic/tectonic units in the north Cascades (E. H. Brown).

Cascades project; a study of significant geologic sites in the Washington, Oregon, and California Cascades (D. J. Easterbrook).

Glacial history of Puget Lowland and Columbia Plateau (D. J. Easterbrook).

Volcanic and glacial geology of Mount Baker (D. J. Easterbrook).

Paleomagnetism of glacial sediments in Washington (D. J. Easterbrook).

Clay mineral distribution in rocks of the Olympic Peninsula (D. R. Pevear).

Mixed layer illite/smectites in Tertiary bentonites of western Washington and British Columbia (D. R. Pevear).

Mineralogy (especially clays) of Chuckanut and Huntingdon Formations, northwestern Washington and British Columbia (D. R. Pevear).

Mineral transformation in Pleistocene paleosols, northern Puget Sound (D. R. Pevear).

Geochemical criteria for determining paleosalinity applied to tills and glaciomarine drift (D. R. Pevear).

Formation of calcareous cements in Pleistocene and Recent sediments with ultramafic clasts (D. R. Pevear).

Marine biogeographic realms during late Paleozoic time (C. A. Ross).

The fit of South and North America during the late Paleozoic (C. A. Ross).

Recent foraminiferal populations, Samish Bay, Washington (C. A. Ross).

Cobb Seamount; sea level changes during the Cenozoic (M. L. Schwartz).

Coast sea level changes, sediment drift studies, coastal archaeology, coastal morphology, and beach preservation in Puget Sound and on the Pacific coast (M. L. Schwartz).

Stratigraphic relationships of the Chuckanut Formation, northwest Washington (C. A. Suczek).

Plate tectonics and sandstone compositions (C. A. Suczek).

Graduate Program

Tectonic rotations in the Cascade Mountains of Skamania County, southern Washington (Roger Bates).

Petrology, petrography, and geochemistry of the Black Jack breccia pipe of the Silver Star plutonic complex, Skamania County, Washington (Robert Birk).

Hydrology of Whatcom Creek, Bellingham, Washington (Stan Carrick).

Geology of the Chilliwack Group near Sauk Mountain, Washington (Bruce Christenson).

Geology, mineralogy, and diagenetic history of bentonites and associated rocks of the Chuckanut Formation, Mount Higgins, north Cascades, Washington (Sue Cruver).

Neoglaciation of the Middle Fork, Nooksack Valley, and Avalanche Gorge, Mount Baker, Washington (Steve Fuller).

Coal petrology of the Big Seam, Centralia, Washington (David Hadley).

The net shore drift of Whatcom County, Washington (Edmund Jacobsen).

The Chilliwack Group of Black Mountain, Washington (Jerry Lizak).

The geology and tectonic framework of the Eocene-Oligocene sedimentary rocks in the Lake McMurray area of Washington (Kim Marcus).

Structure and petrology of the Goat Mountain area, north Cascades, Washington (Paul Rady).

The depositional framework and regional extent of the West Beach silt and its significance in pre-late Wisconsin stratigraphy of the Puget Lowland, Washington (Jeffrey Sprague).

Petrology of the pre-Tertiary rocks in the Cultus Mountain area, Washington (Jack Cruver).

Geochemistry of the Shuksan metamorphic unit, north Cascades, Washington (Lea Street).

Mineralogy and origin of bentonite clays in Centralia coal mine (Linda Reinik-Smith).

Igneous activity in the Cascades (David Blackwell).

Stratigraphy and depositional environment of the Deming formation, Washington (Bob Crandall).

The mechanics of creep and its relationship to slope stability (north slope of Manastash Ridge (Ellensburg Formation) near Ellensburg, Washington) (Chuck Eccleston).

Paleomagnetism, geochemistry, and petrology of the Black Hills basalt, Thurston, Mason, and Grays Harbor Counties, Washington (Brian Globerman).

Whitman College

Department of Geology

Quaternary geology of the Skokomish area, Mason County, Washington (R. J. Carson; William Long, U.S. Forest Service).

Quaternary and environmental geology of the eastern Olympic Peninsula (R. J. Carson).

Geohydrology of eastern Jefferson County, Washington (Peder Grimstad, Washington Department of Ecology; R. J. Carson).

Yakima Valley College

Department of Geology

Stratigraphic relationship between the Thorp Gravel and Ellensburg Formation (Newell Campbell).

Evaluation of late Cenozoic structures in the southwest Columbia Basin (Newell Campbell).

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

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

Paleoecological evaluation of late Eocene biostratigraphic zonations on the west coast, by Kristin McDougall. USGS Open-File Report 79-934, 206 p.

Bibliography of selected reports related to studies on earthquake tectonics and risk, 1975-1978, by Jane P. Ohl. USGS Open-File Report 79-1184, 35 p.

Graphic display of box cores collected from tidal flats in Willapa Bay, Washington, by Gary W. Hill and John L. Chin. USGS Open-File Report 79-1501, 1 plate, scale 1:24,000.

Guidelines for logging, describing, and sampling cores and cuttings of coal and associated rocks at the drill site, by Robert G. Hobbs. USGS Open-File Report 79-1522, 23 p.

Ground-water hydrology of the sagebrush flat area and possible relations to the discharge of Rattlesnake Springs, Grant and Douglas Counties, by K. L. Walters [prepared in cooperation with the Washington Department of Ecology]. USGS Open-File Report 79-1530, 27 p.

Preliminary geologic map of the Clear Lake NW quadrangle, Skagit County, Washington, by John T. Whetten, David P. Dethier, and Paul R. Carroll. USGS Open-File Report 80-247, 2 plates, scale 1:24,000, 13 p.

Submarine features and bottom configuration in the Port Townsend quadrangle, Puget Sound region, Washington, by M. J. Chrzastowski. U.S. Geological Survey Water-Resources Investigation Open-File Report 80-14, text and map on 1 sheet, scale 1:100,000.

RECENT USGS REPORT ADDED TO OUR LIBRARY

The following report is now available for inspection in our division library:

Banks, N. D.; and others, 1979, Preliminary geologic map and geophysical studies of the NE¼ of the Spirit Lake quadrangle, Washington: U.S. Geological Survey Miscellaneous Field Studies Map MF-1046, 2 sheets, scale 1:48,000. Prepared in cooperation with the Washington Division of Geology and Earth Resources.

DIVISION LIBRARY ACTIVITIES

"Theses on Washington—A comprehensive Bibliography, 1906-1979" is the title of a forthcoming report that has been compiled by Connie Manson, division librarian. It is now in the editing and typing stage and should be ready for the printers later this spring. A report on geologic mapping in Washington is also in progress.

The theses listed below were recently added to our library and are available for reference work:

Ash, Simon Harry, 1924, Systems of coal mining in western Washington: University of Washington B.S. thesis, 74 p.

Ashleman, James C., 1979, The geology of the western part of the Kachess Lake quadrangle, Washington: University of Washington M.S. thesis, 88 p.

Barnosky, Cathy Lynn, 1979, Late Quaternary vegetational history of the southern Puget Lowland—A long record from Davis Lake, Washington: University of Washington M.S. thesis, 47 p.

Bassett, Randy Lynn, 1976, The geochemistry of boron in thermal waters: Stanford University Ph. D. thesis, 290 p.

Broch, Michael John, 1979, Igneous and metamorphic petrology, structure, and mineral deposits of the Mineral Ridge area (Moses mining district), Colville Indian Reservation,

Washington: Washington State University M.S. thesis, 204 p.

Burbank, Douglas West, 1979, Late Holocene glacier fluctuations on Mount Rainier and their relationship to the historical climate record: University of Washington M.S. thesis, 84 p.

Carpenter, John Tyer, 1932, A tentative correlation of northwestern Tertiary strata: University of Idaho M.S. thesis, 27 p.

Corson, Donald L., 1974, The western Washington coal industry, 1875-1935—A study of an ephemeral industry: California State University M.A. thesis, 63 p.

Deeter, Jerald D., 1979, Quaternary geology and stratigraphy of Kitsap County, Washington: Western Washington University M.S. thesis, 175 p.

Donnelly, Brian James, 1978, Structural geology of the Nancy Creek area, east flank of the Kettle Dome, Ferry County, Washington: Washington State University M.S. thesis, 251 p.

Du, Ming-Ho, 1979, Geology of the Germania tungsten deposits, Stevens County, Washington: Eastern Washington University M.S. thesis, 58 p.

Felts, Wayne Moore, 1936, A contribution to the Pleistocene paleontology of the Willamette Valley: University of Cincinnati M.S. thesis, 22 p.

Felts, Wayne Moore, 1938, A granodiorite stock in the Cascade Mountains of southwestern Washington: University of Cincinnati Ph. D. thesis, 40 p.

Fiksdal, Allen James, 1979, Geology for land use planning in part of Pierce County, Washington: Portland State University M.S. thesis, 90 p.

Finn, Dennis D., 1979, Prospecting for magmatic and hydrothermal deposits of uranium and associated elements by computer evaluation of the chemistry and petrogenesis of igneous source rocks: Eastern Washington University M.S. thesis, 336 p.

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Name	New edition	Photo revised	Latitude (indicates southeast corner)	Longitude	County
Angeles Point	1950	1978	48°07'30"	123°30'00"	Clallam
Bonneville Dam, Washington-Oregon	1979	--	45°37'30"	121°52'30"	Skamania; Hood River, Oregon
Dungeness	1956	1979	48°07'30"	123°03'00"	Clallam
Glade	1979	--	46°15'00"	119°00'00"	Franklin
Othello	1954	1979	46°45'00"	119°07'30"	Adams
Port Angeles	1961	1979	48°00'00"	123°22'30"	Clallam

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GEOLOGICAL SURVEY

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TOPOGRAPHIC DIVISION
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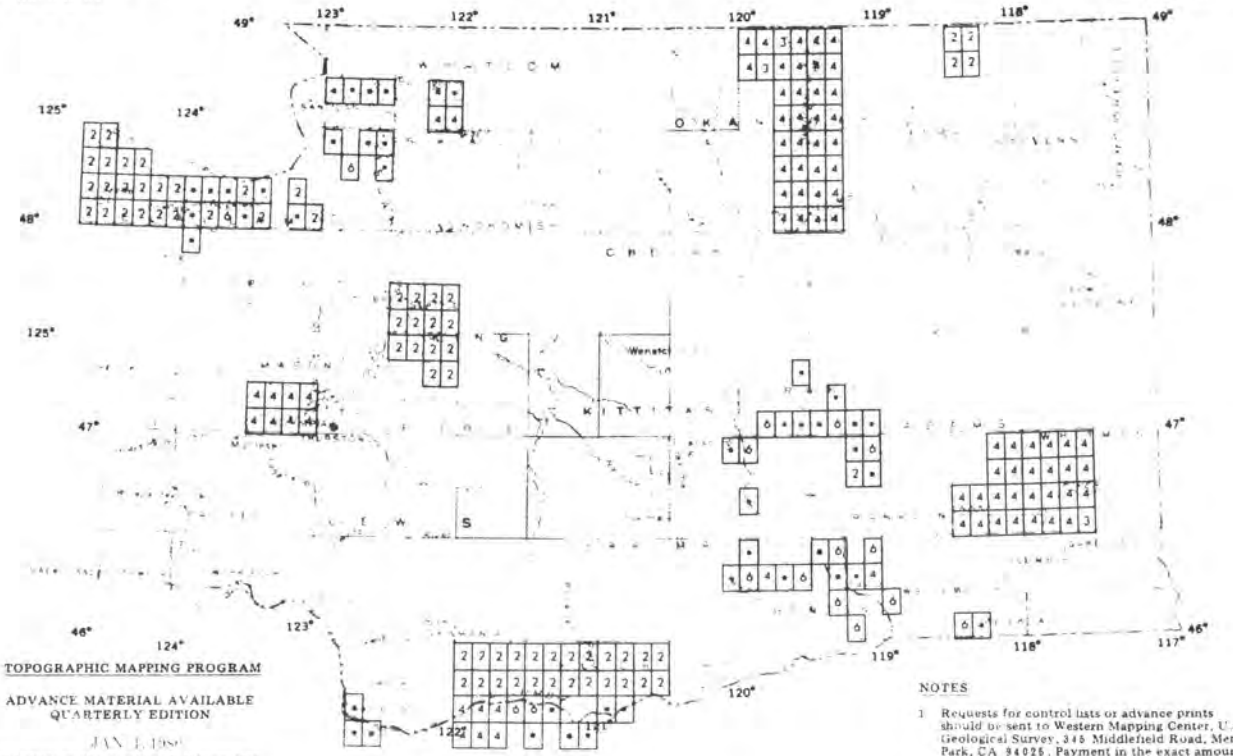

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[2] Aerial photography completed. Information available from Western Mapping Center, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025 or National Cartographic Information Center, U.S. Geological Survey, 507 National Center, Reston, Virginia 22092.

[3] Basic horizontal and vertical control completed. Descriptions and unadjusted coordinates and or elevations are available. Price is 50 cents for each 15-minute quadrangle horizontal or vertical control list. See notes 1 and 2.

[4] Prints of manuscripts compiled from aerial photographs are available at $1.25 each. Contours are shown in areas suitable for stereo-plotting. See notes 1 and 2.

[6] Final drafting completed. Partially-edited one color advance print (with names) are available for $1.25 each. See notes 1 and 2.

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Maps published at 1:62,500 scale in 15-minute units ONLY. However, 1:24,000 scale prints in 7.5-minute units, with appropriate accuracy and contour interval are available at $1.25 each. See notes 1 and 2.

NOTES

1. Requests for control lists or advance prints should be sent to Western Mapping Center, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025. Payment in the exact amount should accompany order and may be made by check or money order payable to U.S. Geological Survey. Please do not send stamps. NO DISCOUNT ALLOWED.

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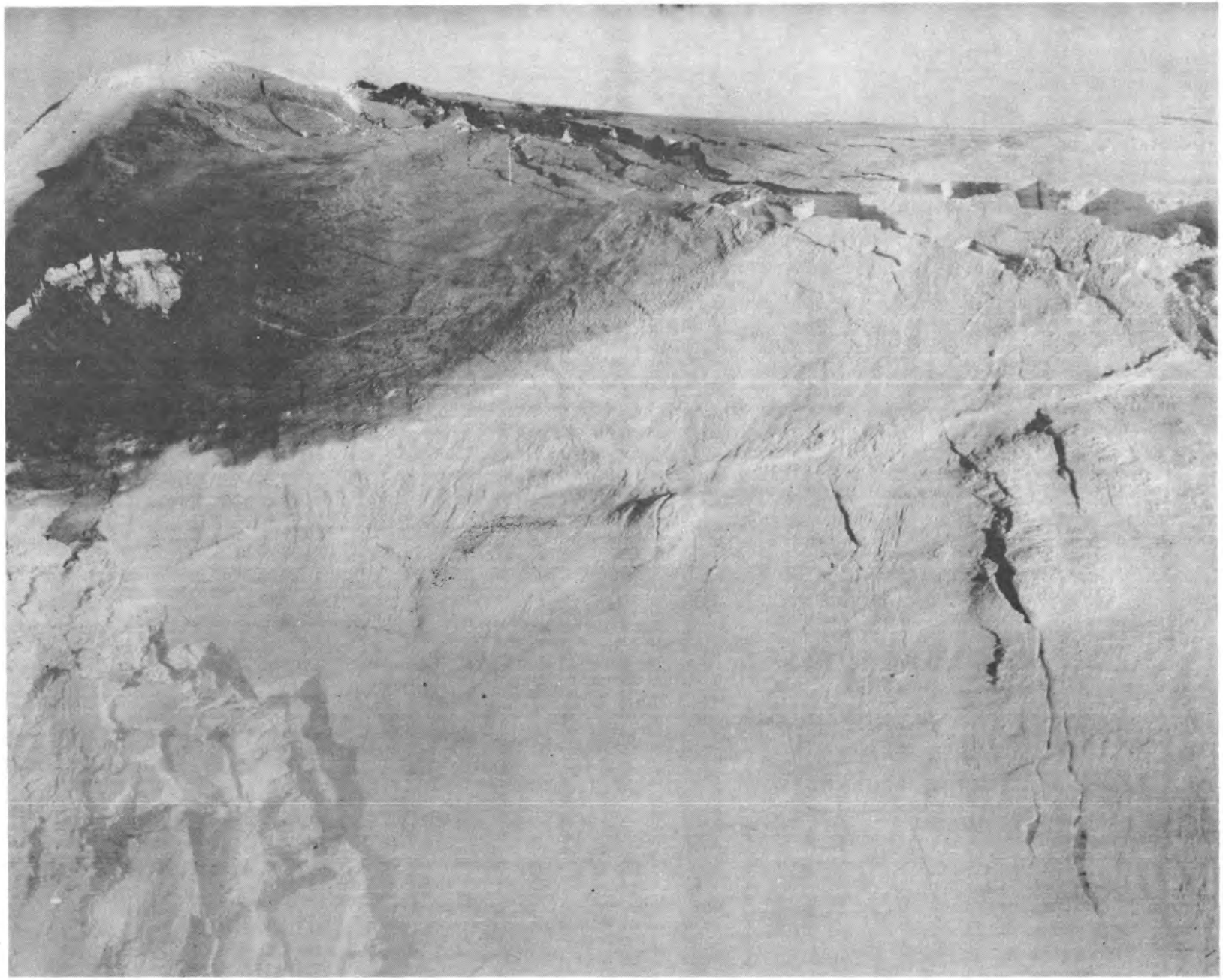
Status of topographic mapping in Washington, April 1, 1980



Summit of Mount St. Helens after gas explosion of March 27th. Explosion pit in upper left-hand corner. Dark area surrounding pit consists of steam-ejected pumice fragments. Note newly created crevasses extending across upper right of picture. (Photo by G. W. Thorsen)

MOUNT ST. HELENS ACTIVE AGAIN[1/]

Mount St. Helens, which has been called the most active and violent volcano in the United States is once again active. Around 1 p.m. on March 27, steam and ash issued from a vent near the summit on the north slope of the mountain. Since March 20, earthquakes of up to 4 magnitude (Richter scale) were recorded in the vicinity of the mountain. Over the past 4,000 years the mountain has erupted at least 24 times. The mountain has been dormant since 1857, at which time tephra eruptions and possibly some lava flows occurred. By Friday morning, March 28th, a crater roughly 300 feet in diameter and about 150 feet deep had appeared on the summit; several jagged fissures extended from the crater. Infrared photography of the summit showed heat emissions from fissures. A plume of steam and ash rose to elevations of 16,000 feet, or 10,000 feet above the summit of the mountain. Technically, the mountain has not erupted but continues to emit clouds of ash and steam.

Situated 45 miles north of the Columbia River, which marks the border between Washington and Oregon, the peak rises to an elevation of 9,677 feet in the southern Cascades of Washington. Mount St. Helens is a Quaternary stratovolcano consisting of lava flows of olivine basalt, pyroxene andesite, and pyroclastic flow deposits. Eruptive material from past eruptions filled the valley of the North Fork of the Toutle River and created a natural dam, behind which rests Spirit Lake. Mount St. Helens was named by Captain George Vancouver in October 1792.

[1/] This issue of the Washington Geologic Newsletter was ready to go to press when Mount St. Helens began issuing minor steam and ash. A full account of this recent eruptive action of the mountain will appear in the next issue of the newsletter.

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