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A PUBLICATION OF THE WASHINGTON STATE DIVISION OF MINES AND GEOLOGY

WASHINGTON GEOLOGIC NEWSLETTER

JULY 1973 VOLUME 1 - NUMBER 3

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FIRST KNOWN ACTIVE FAULT IN WASHINGTON

By Robert J. Carson [1/]

A post-glacial fault has been discovered 19 miles north of Shelton in north-central Mason County; it is believed to be the first known surface expression of an active fault in the State of Washington. The fault lies halfway between Hood Canal and Lake Cushman, and 5 miles north of Hoodsport. The fault has offset the east end of Saddle Mountain, a local name given to the ridge between Price Lake and Lilliwaup swamp. Movement of the Saddle Mountain fault has taken place since deglaciation of the southern Puget Lowland, about 13,000 years ago. The fault movement was probably accompanied by major earthquakes.

The fault was discovered by the stereoscopic study of aerial photography. Simpson Timber Company kindly allowed the Division of Mines and Geology to excavate a trench across the fault scarp. Gene Visser used his front-end loader to dig through glacial drift to the volcanic bedrock. The fault crosses an old railroad grade built when the area was logged in the 1920's. Stumps on the scarp are up to at least 137 years old, so major movement on the fault probably occurred before the 19th century. The Saddle Mountain fault strikes north to northeast, dips steeply (about 75°) to the east, and is downthrown on the west. The scarp can be traced almost 1 mile from near the east end of Price Lake to just east of two ponds in the northeast corner of section 14, township 23 north, range 4 west. The scarp varies from 6 to 20 feet high, the maximum relief occurring where the fault crosses the east end of Saddle Mountain. In the trench, the contact between Vashon Till and Crescent basalt was displaced 9 feet. In

[1/] Dr. Carson, a graduate of the University of Washington, works for the Division of Mines and Geology, under a U.S. Geological Survey grant, in the summer months and teaches at North Carolina State University, in Raleigh, during the rest of the year.

addition to being a reverse fault, there was probably strike-slip movement. The possibility exists that the fault dammed surface drainage to form Price Lake, a pond in the southern part of section 14, and the two ponds in the northeast corner of section 14.

Another possible active fault is located on the northeast end of Dow Mountain. The scarp is not as long or prominent as the scarp of the Saddle Mountain fault, so the Dow Mountain fault is considered suspected rather than known. The scarp, which is 15 to 20 feet high, can be traced for only a little more than one-quarter of a mile. The fault is best exposed in an old railroad cut, about 1 mile south of Price Lake. The Dow Mountain fault strikes northwest, and is downthrown on the southwest side.

GEOLOGIC ACTIVITIES IN WASHINGTON

U.S. Geological Survey

U.S. Geological Survey activity in Washington is being maintained at about the same level as past years. Howard Gower, Chief, Western Environmental Geology Branch, of the U.S. Geological Survey at Menlo Park, California, has given us a summary of 1973 projects of the USGS in Washington State.

MINERAL RESOURCES ACTIVITIES

Mineral resources of northeastern Washington, F.C. Armstrong. Plans this year include conducting selected mine studies, compiling a map of known mineral occurences, gathering data for resource estimation, and taking samples of ores, rocks, and stream sediments within the west half of the Sandpoint 2° sheet.

Alpine-Enchantment Lakes area, J.L. Gualtieri. Geologic mapping, field checking, and sampling of streams and bedrock as well as studying the geology of the mineral deposits in the area continues; reports are in preparation.

ENERGY RESOURCES ACTIVITIES

Geology and mineral deposits of the Mt. Spokane 15' quadrangle, A.E. Weissenborn. A geologic map and an explanatory report of the Mt. Spokane quadrangle are nearing completion. A report on uranium deposits in the area is also in preparation.

ENVIRONMENTAL GEOLOGY ACTIVITIES

Spokane-Wallace 2° quadrangles, A.B. Griggs. A short descriptive report on the rocks of the Columbia River Basalt Group in the Spokane quadrangle is nearing completion. Descriptions of the Belt units and their facies changes will be prepared.

Twin Lakes 15' quadrangle, G.E. Becraft. Geologic mapping is continuing in the project area; eventually, the results of this investigation will be incorporated into a broad study of the geology of northeastern Washington.

Glacier Peak, F.W. Cater. A report on the mixed magma contact complexes is in preparation, and final reports on intrusive and metamorphic rocks of the Glacier Peak-Lake Chelan area will soon be completed and submitted for publication.

Newport 30' quadrangle, F.K. Miller. The sampling and study of plutonic rocks in northeastern Washington continues with K/Ar dating of selected samples. A geologic map of the west half of the Sandpoint 2° sheet is in preparation and will be submitted for publication.

Stevens County, R.G. Yates. A report on the geology of the Deep Creek area and its regional significance, and an analytical report on the geology of northeastern Washington is in preparation.

Northern Okanogan Highlands, C.D. Rinehart. Geologic mapping continues in the Mt. Bonaparte and Tiffany Mountain 15' quadrangles. Mapping in the northern half of the Aeneas Valley 15' quadrangle will soon be underway. The composite map of the Loomis, Oroville, Tonasket, and Conconully 15' quadrangles is nearing completion and will be published by the Washington Division of Mines and Geology. Petrographic studies of plutonic and metamorphic rocks in the project area continues, and a report on the geochronology of orogenic events is in preparation.

Olympic Peninsula, W.M. Cady. Petrographic and radiometric studies continue, and a reconnaissance geologic map of the Olympic Peninsula is in preparation. A structural analysis program of the core rocks in the project area and an account of the popular geology of the Olympic National Park are nearing completion. The preparation of a final report on the geology of the Peninsula will soon be under way.

Geology of the northwestern Olympic Peninsula, P.D. Snavely, Jr. Geologic mapping and stratigraphic, structural, and petrologic studies of the Cape Flattery area continue; reports are being prepared for publication. An interpretation of a vector aeromagnetic survey of the area will soon be completed.

Volcanic hazards in the Cascade Range, D.R. Crandell. Studies of the age, stratigraphy, mineralogy, origin, and distribution of late Quaternary volcanic rocks and surficial deposits at Mt. St. Helens and Mt. Baker continue in order to document the kinds, scale, and frequency of volcanism. A report on volcanic hazards at Mt. St. Helens, as well as other reports, will be prepared.

Cenozoic floras of Pacific Northwest, J.A. Wolfe. The analysis of fossil plant assemblages of the Tertiary age from Washington continues; physiognomic analyses of leaf floras for climatic studies are under way.

Cenozoic and Mesozoic stratigraphy, Pacific Coast, W.O. Addicott. Field studies on shallow-water Oligocene and Miocene sequences in western Washington will be continued this year; reports on middle and late Tertiary biostratigraphy of the Pacific Northwest are in preparation.

GEOCHEMISTRY AND GEOPHYSICS ACTIVITIES

Genesis of basalt, T. L. Wright. Reconnaissance mapping of the Columbia River Plateau in the eastern part of the State has begun. Electron microprobe studies of residual glasses and phenocryst minerals as a basis for interpretation of petrogenesis will be conducted.

Columbia River Basalt, D. A. Swanson. Mapping continues in the eastern part of the State to determine the stratigraphy, lateral extent, thickness changes, structure, and vent areas for the upper part of the Columbia River Basalt. Field and laboratory studies of two intravalley flows that occur along the Snake River between Devils Canyon and Asotin are nearing completion. Petrographic and petrochemical studies of the basalt, emphasizing methods of correlation, paragenesis, definition of chemical types, and problems of origin, are continuing. Detailed mapping within the Ice Harbor area continues to determine the relationship between the Ice Harbor dike swarm and local lava flows.

Geodimeter studies of Cascade volcanoes, D. A. Swanson. A Model 8 geodimeter has been installed and periodic remeasurement is in progress of small strain networks on several Cascade Range volcanoes. A strain network will be established on Mt. Rainier and the network on Mt. St. Helens will be remeasured if time permits.

Thermal surveillance of volcanoes, J. D. Friedman. The ERTS-1 multispectral scanner images and airborne infrared imaging systems are being used in conjunction with ground observations and ground-based transmitting and recording thermistor arrays to identify,

map, and monitor surface thermal anomalies in the volcanic areas of the Cascade Range; thermistor arrays and DCP transmitters will be emplaced at fumaroles near the summits of Mt. Baker and Mt. St. Helens.

National aeromagnetic survey, D. R. Mabey. Approximately 4,900 square miles of aeromagnetic surveying is scheduled for the northeastern part of the State. This investigation is being done in cooperation with the Washington Division of Mines and Geology. In addition, an aeromagnetic survey is scheduled in the northern part of Puget Sound.

Engineering geophysics, H. D. Ackermann. A seismic-ground water study in Colville Indian Reservation, near Grand Coulee Dam, is under way.

Satellite volcano surveillance, P.L. Ward. Earthquake counters and standard seismometers are being installed on Mt. St. Helens, Mt. Rainier, and Mt. Baker. Data transmitted twice daily to the ERTS-1 satellite will be evaluated in near real-time in an effort to develop a system for giving early warning when apparently dormant volcanoes are becoming active.

Tilt studies, R.V. Allen. Three 3-component tiltmeters designed by the Geological Survey have been installed in shallow drill holes at the Hanford Works, but elapsed time since installation is too short to have produced any significant results.

Hanford Microearthquake studies, A.M. Pitt. Forty-five months of microearthquake monitoring in the Hanford region has indicated about a dozen small zones of shallow intermittent swarm activity, but there still is no good evidence of a connection between these zones. Intermittent seismic activity in the 15 to 25 kilometer depth range suggests a north trending zone through the center of the network.

Geochemistry of food plants, H.T. Shacklette. Sampling of food plants and of the soils where the plants were grown continues in 11 major areas of commercial production including Yakima County. All samples will be analyzed to determine the differences in elemental composition of food plants grown in widely separated areas and to relate this to the element content of the respective soils.

MARINE GEOLOGY ACTIVITIES

Oregon-Washington Continental Margin, P.D. Snavely, Jr. Plans this year include conducting high resolution seismic reflection profiling in selected nearshore areas and coastal lakes in the Cape Flattery area of the Olympic Peninsula. Interpretation of marine geophysical data (gravity, magnetics, and CSP) obtained in the Strait of Juan de Fuca is underway.

Pacific Coast sedimentology, H.E. Clifton. A detailed analysis of the sedimentary facies found in Willapa Bay, which will include a study of the emergent terrace deposits that are composed of older estuarine sediments, will soon be underway.

Some reports of the U.S. Geological Survey that have become available since May 15, 1972, are as follows:

Cady, W.M.; Sorensen, M.L.; MacLeod, N.S., 1972, Geologic map of The Brothers quadrangle, Jefferson, Mason, and Kitsap Counties, Washington: U.S. Geol. Survey Map GQ-969.

Cady, W.M.; Tabor, R.W.; MacLeod, N.S.; Sorensen, M.L., 1972, Geologic map of the Tyler Peak quadrangle, Clallam and Jefferson Counties, Washington: U.S. Geol. Survey Map GQ-970.

Pitt, A.M., 1972, Seismic activity in the Hanford region, Washington, March 23, 1969 to June 30, 1971: U.S. Geol. Survey Open-file report.

Staatz, M.H.; Tabor, R.W.; Weis, P.L.; Robertson, J.F.; Van Noy, R.M.; Pattee, E.C., 1973, Geology and mineral resources of the northern part of the North Cascades National Park, Washington: U.S. Geol. Survey Bull. 1359.

Tabor, R.W.; Yeats, R.S.; Sorensen, M.L., 1972, Geologic map of the Mount Angeles quadrangle, Clallam and Jefferson Counties, Washington: U.S. Geol. Survey Map GQ-958.

U.S. Geol. Survey, 1973, Aeromagnetic map of parts of the Okanogan and Sandpoint 1° by 2° quadrangles, Washington-Idaho-Montana: U.S. Geol. Survey Open-file report. (See USGS open-file map*, page 11.)

In addition to these reports, summaries of significant results of many other current projects are contained in Chapter A of U.S. Geol. Survey Prof. Paper 800. Scientific notes and summaries of Survey investigations in geology, hydrology, and related fields are contained in Chapters B, C, and D of U.S. Geol. Survey Prof. Paper 800, Geologic Survey Research 1972. Reports of scientific results subsequent to January 1, 1973, may be found in the new bimonthly volumes: Journal of Research of the U.S. Geological Survey.

U.S. Bureau of Mines

The U.S. Bureau of Mines maintains an active field office in Spokane. William L. Rice, geologist, has provided us with this summary of their current activities.

The Western Field Operation Center (WFOC), U.S. Bureau of Mines, is located at West 222 Mission Avenue, Spokane, Washington. Its primary responsibility is carry out Bureau mineral-related field activities for a substantial part of the western United States. Specifically, the WFOC "baliwick" includes the states of Washington, Oregon, Idaho, Montana, Nevada, and California.

For 1973, mineral resource appraisals are underway in two National Forest areas proposed for addition to the National Wilderness Preservation System. Field work that was started two years ago in the 365,000-acre Alpine Lakes study area should be completed this season. The study area includes a large part of the high Alpine National Forest domain in the Cascade Mountains, between the Stevens Pass and Snoqualmie Pass highways. Lands involved are in King, Kittitas, and Chelan Counties, within the Snoqualmie and Wenatchee National Forests. A joint Bureau of Mines-U.S. Geological Survey open-file report on work done so far will soon be available for public review at the respective agency offices in Spokane. Final results of the investigations will be published as a U.S. Geological Survey Bulletin in the "Studies Related to Wilderness" series.

A one-year mineral resource investigation is being conducted on the approximately 200,000-acre Cougar Lakes study area in the Snoqualmie and Gifford Pinchot National Forests, in Kittitas and Yakima Counties. The study area adjoins the southeastern part of Mount Rainier National Park, and lies on the eastern flank of the central Cascade Range. An open-file report should be available for public inspection in 1974, and a formal publication may be issued at a later date.

The Minerals Availability System (MAS) is a component of the Bureau of Mines minerals-intelligence function, designed to conduct and maintain an inventory of mineral resources vital to national needs. MAS involves the collection, coding, and automated storage-retrieval of information concerning the availability of minerals from specific deposits. Current and projected MAS studies involving Washington mineral resources include investigations of tungsten, gold, silver, and nickel deposits.

WFOC is taking part in the Western Water Study Plan. Present activities involve gathering and analyzing resource and production data to determine land and water requirements for Washington's mineral industry. When completed, the study information will be made available to the state for inclusion in the state's comprehensive water plan.

The Bureau of Mines is working cooperatively with the Bureau of Outdoor Recreation in developing a program to reclaim surface mined land sites by converting them to recreation areas. Two former gravel pits, one in King County and the other in Spokane County, are being reclaimed under this program.

The Bureau of Mines is also participating in the development of the Department of Interior Resources and Land Information Program (RALI). RALI is a digitized departmental information system designed to include data on all aspects of the use and management of the land resource. The system will aid in assuring comprehensive and timely land use planning on several governmental levels. WFOC is working on two RALI demonstration projects: (1) A sand and gravel resource study for western King County, and (2) A nonmetallic mineral resource study for a selected area south of Seattle.

The Western Field Operation Center has several public service functions in addition to its normal project work. WFOC has one of the best geological and mining libraries in the Northwest. A nearly complete collection of U.S. Geological Survey and Bureau of Mines publications is available for public reference. Most State publications covering geology and mining in the west are on file, and a comprehensive listing of current and obsolete mining periodicals is kept.

A staff mineralogist is available to identify minerals and rocks in hand specimens, and the office staff is prepared to answer public queries concerning mining and related subjects.

USGS Water Resources

Bruce Foxworthy of the U.S. Geological Survey's ground-water branch in Tacoma, Washington, reports that they will be busy in Washington this year. Below are listed ground-water branch projects for the current year.

Water Resources of the Lummi Indian Reservation, G. G. Parker and D. R. Cline

Urban Pilot Study of water-related problems in the Puget Sound area, G. G. Parker

Water Resources of the Skokomish Indian Reservation, Dee Molenaar

Lakes of Washington, data collection, G. Bortleson, J. McConnell, and R. Innes

Water Resources of the Colville Indian Reservation, ground water, D.A. Myers

Flood Hazard Information, on certain state streams, E. G. Nassar

Test Drilling and Geophysical Logging, near Walla Walla, K. L. Walters and W. V. Frederick

Evaluation of the State Observation-Well Project, K. L. Walters

Sediment Characteristics of Streams in Washington, L. M. Nelson

Ground Water in East-Central Washington, A. I. Hansen

Water Resources of the Yakima Indian Reservation, D. O. Gregg and R. J. Burt

Ground Water Models of the Columbia Basin Irrigation Project, H. Tanaka

Review of the Ground-Water Conditions in the Pullman Area, H. Tanaka and W. Lum

Evaluation of Water Resources in the Walla Walla Basin, using digital modeling, R. D. MacNish and R. Barker

Water Quality Conditions in the Duwamish Estuary, W. Haushild

Other studies being done include a stream hydraulics and anadromous fish study of several rivers and creeks, in both eastern and western Washington, and surface water studies in the Colville area.

The address of the division is:

U.S. Geological Survey
Water Resources Division
1305 Tacoma Avenue South
Tacoma, WA 98402

"In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs."

Sir William Osler

SOVIET GEOLOGISTS VISITS WASHINGTON

During late May, the Division of Mines and Geology hosted Dr. S. M. Aleksandrov, a research associate at the Institute of Geochemistry and Analytical Chemistry, Moscow, USSR. Dr. Aleksandrov is a leading authority on a group of rare borate minerals that occur in contact metamorphic zones at the margin of intrusive rock bodies. The best known member of this mineral group is ludwigite, a magnesium iron borate that sometimes contains several percent of tin.

Dr. Aleksandrov visited ludwigite deposits in Utah and California before coming to Washington, and he is now studying deposits in Alaska. The purpose of his study is to learn as much as possible about the occurrence of ludwigite and related minerals so that the knowledge gained can be applied toward finding commercial deposits of ludwigite, to be exploited for their boron and tin content, in the Soviet Union.

Two occurrences of ludwigite are known in Washington: the Read Magnetite prospect near Hunters in Stevens County, and the Jumbo Mountain near Darrington in Snohomish County. These occurrences have been studied by W.A.G. Bennett, a retired geologist, from the Division of Mines and Geology. Dr. Aleksandrov, accompanied by Eric Schuster and Dr. Bennett, visited the Read prospect and was able to study the deposit and collect rock samples to his satisfaction. However, the Jumbo Mountain occurrence proved to be inaccessible due to snow cover.

Although the schedule for Dr. Aleksandrov's visit did not allow time for extensive sightseeing, he was able to see Grand Coulee Dam, the Grand Coulee, Dry Falls, and the scenery around the North Cascade's highway. Dr. Aleksandrov was greatly impressed by

the variety of climate and scenery that we sometimes take for granted in Washington.

J. Eric Schuster

SOIL SURVEY REPORTS

The Division of Mines and Geology has discovered that it has in its possession several soil survey reports. These will be made available to the public, or anyone else interested, on a first come first served basis. The reports are on the following counties and areas: Benton County, Franklin County, Spokane County, Stevens County, Southwestern Washington, West Puget Sound, Wenatchee Area, and the Quincy Area.

There will be no charge made for their distribution.

MINES AND GEOLOGY PUBLICATIONS NOW AVAILABLE IN SPOKANE

The Division of Mines and Geology is happy to announce that we have an outlet for our publications in eastern Washington. Selected publications that are distributed free of charge by the Division will be available from the U.S. Geological Survey office, Room 678, in the U.S. Courthouse in Spokane. Selected reports, including free ones and those requiring payment, will be available from the Northwest Mining Association office, West 522 First Avenue, Spokane. Distribution at these two locations will be over the counter only. Mail requests will not be handled at either location in Spokane but will continue to be handled through the Division of Mines and Geology, Olympia, Washington 98504.

We feel this is a significant step forward in serving our information users in eastern Washington. We have long felt the need to be in closer contact with the mining people who are east of the Cascades, and perhaps this will be the first step, though small, toward establishing a permanent contact in the Spokane area.

We want to thank the U.S. Geological Survey and the Northwest Mining Association for their cooperation.

THE ROLE OF GEOLOGY IN PLANNING AND DEVELOPMENT

A major phase of planning is the evaluation of the advantages and disadvantages of one use of land as compared to another use, so as to make planning and zoning possible for the conservation and maximum beneficial use of land, our most fundamental natural resource. To a significant degree it is the characteristics of the earth materials underlying its surface that determine how land can be most effectively and safely used. Correlation of the requirements for potential use with pertinent geologic considerations will help assure that land use will not conflict with the limitations imposed by natural conditions. This is especially true when easily developed sites are depleted and suburban expansion is forced into marginal or hilly areas, where new and more imposing difficulties are encountered. Factors other than geology commonly dictate a given use for land, but this may then make knowledge and consideration of the geology even more important.

Problems of land use that are related to geology ultimately involve every aspect of civil engineering through their effect upon the design, construction, and maintenance of specific engineering works. Certain of these problems, such as earthquakes and some landslides, occur as natural geologic hazards inherent in the environment. Other problems, such as instability of cut banks and ground-water pollution, pose actual or potential threats because of unwise or poorly planned activities of man. Still others may have more to do with the economics of land use or development than with its safety, such as problems of difficult excavation or lack of nearby sources of earth material suitable for fill.

The importance of geology to planning and to civil engineering obviously is very

great; however, it is essential to point out that not all applied urban geology is engineering geology. Sand and gravel and other raw materials for construction are a concern of engineering geologists, but the economic geology of any mineral resource occurring within an area may have a critical bearing on local land-use planning and development.

The metropolitan areas of Washington desperately need new, detailed geologic maps and this can only be achieved through a greatly magnified engineering geology effort involving municipal, county, and state agencies and private firms, as well as our universities and colleges. The master key to real progress belongs to the local governments. They can provide the greatest stimulus for geologic investigations, and they are in the best position to insure that the results are applied for the maximum benefit of their citizens. Cities and counties can use geologic information not only in the formulation of long-range policies and plans, but in the day-to-day applications of local operation.

Ernest R. Artim

YOUR STATE GEOLOGIST REPORTS

Energy certainly is in the headlines these days. Whether we are in a serious energy crisis seems to be subject to some interpretation. Whether we are or not, the Washington Division of Mines and Geology is pulling together all available information in our files that deals with energy and will publish it under one cover. Geology plays an important part in all forms of energy, and the division is getting prepared, as best we can, to meet the challenge of exploration for new energy sources and reserves.

New information is being developed on the state's coal reserves. Work is being done in the area of geothermal energy exploration. Areas where oil or gas might occur and the state's uranium reserves are being reviewed. The hydroelectric picture is being examined and evaluated.

We are always on the lookout for new techniques and technological procedures that might make our state's energy resources more usable, or that will enhance exploration methods for as yet undiscovered energy resources.

At this point in time, increased interest and effort are being directed toward geothermal energy and the different techniques that might be useful in identifying hot spots in the earth's surface. So far, division geologists have located several areas that look interesting, but much more work will be needed to develop definitive information, either positive or negative. It is our intent that the division continue to develop accurate, usable information on energy resources in the state, which will be made available to the public as it is developed.

Ted Livingston

GEOLOGIC ACTIVITIES OF COLLEGES IN WASHINGTON

Central Washington State College

Don Ringe, Chairman of the Department of Geology at CWSC, reports that the following projects are being conducted there:

Structural and stratigraphy of the Columbia River Basalt, south of Ellensburg, Robert D. Bentley and Steven E. Farkas

Geology of the upper White River area, and low-grade metamorphism in the central Cascades, Donald A. Hartman (dissertation in progress at University of Washington)

Ice contact depositional features in the northern Waterville Plateau, Don Ringe

Eastern Washington State College

The following research project is being conducted by EWSC:

X-ray fluorescence analysis for sulfur in Roza basalt, Dennis Simmelink and W. K. Steele.

NEW PUBLICATIONS OF MINES AND GEOLOGY

Two new Information Circulars are off the press and available to the public. They are as follows:

Information Circular 48, 1971-72 Directory of Washington mining operations, by J. Eric Schuster. 1973. 97 p. 3 maps. Free

Information Circular 49, Conconully mining district of Okanogan County, Washington, by Wayne S. Moen. 1973. 42 p. 16 figs. Free.

Reprinted From PACIFIC SEARCH

J. Eric Schuster, DMG geologist, prepared a geothermal report for the magazine PACIFIC SEARCH, which was printed in their May 1973 issue as "The Search for Hot Rocks, Geothermal Exploration, Northwest." This article is now available from us, at no charge, as Division of Mines and Geology Reprint 11.

The reprint lists the requirements that are necessary for a geothermal reservoir to exist and discusses the two general types of fields, dry steam and hot water. Diagrams include a pictorial view of a geothermal reservoir, showing the heat source, permeable rocks, fluid, and a cap rock; and an illustration of a dry steam and a hot water plant.

Open-file Report

Dr. Paul E. Hammond, of Portland State University, has prepared, for the Washington Division of Mines and Geology, an open-file report titled "Preliminary Geologic Map of the Southern Cascade Range, Washington." Dr. Hammond is well acquainted with the geology of the area, having worked in the central and southern Cascades since 1957. The mapping and compilation were conducted with special emphasis on young volcanic rocks, volcanic centers, and geologic structures, and should be of value in conducting the research for geothermal energy fields.

Copies will be available for inspection (but not reproduction) at the office of the Division of Mines and Geology, 1404 Jefferson St., in Olympia; the California Division of Oil and Gas, 1416 Ninth St., in Sacramento; and at the Oregon Department of Geology and Mineral Industries, 1069 State Office Bldg., in Portland.

Interested persons may have copies made at their own expense by writing to Ivor McCray's Copy Center, 121 W. Legion Way, Olympia, WA 98501.

Cispus Report

In our continuing program of responding to educational needs, we have prepared, in cooperation with the Superintendent of Public Instruction, a report titled "A Learning Guide on the Geology of the Cispus Environmental Center Area, Lewis County, Washington," by J. Eric Schuster. This geologic report will be used by the teachers of the public schools who conduct educational sessions at the Cispus Center.

STAFF PROFILES

DON FORD

Don is the Assistant Supervisor of the Division of Mines and Geology and the administrator of the Surface Mined Land Reclamation Act. He received his B.S. in geology from the University of Wisconsin and also did 2 years of graduate work there. He and his wife Jeannette have 3 children: Charlotte is married and lives in Detroit, Michigan; Carolyn is married and in the process of moving to Brazoria County, Texas; and Russell attends Washington State University.

Don's work specialities are economic geology, petroleum geology, and surface

mining. His professional career started with the U.S. Geological Survey in 1948, in Alaska; and, from there, he went to California and was employed as a petroleum geologist. In 1957, Don joined the Department of Natural Resources, Lands Division, where he was concerned with the leasing of minerals and oil and gas properties on state lands and the sale of mineral materials. In April 1970, he transferred to the Division of Mines and Geology.

Don was a pilot in the Army Air Force in World War II, was recalled in 1968 for a tour of duty, and is now in the retired reserve category with the rank of Lt. Colonel. He is very active with the Tumwater Area Council Boy Scouts and has served as District Chairman and on the Executive Board. His hobbies are hunting, fishing, and target shooting with muzzle loaders.

J. ERIC SCHUSTER

Eric joined the Division of Mines and Geology in 1970. He was raised on a wheat farm near St. John, in eastern Washington. He and his wife Kathleen have one little daughter, Dana. In 1966, he graduated with distinction in geology from Washington State University. Eric obtained his M.S. in geology from the University of Wyoming, and served as a teaching assistant at both schools in their geology departments. He spent one summer working as an exploration geologist in the Yukon Territory, Canada.

Eric's work specialities are economic geology, petrology, and mineralogy. He has become our expert in the geothermal energy field. Some of his reports that are available to the public are "Geothermal Exploration in Washington" and "Geothermal Energy—Questions and Answers." He is presently conducting a program of thermal gradient and heat flow measurements. This summer, Eric will continue field work and geologic mapping on the geology of the Colville area in Stevens County.

Eric's general air of decorum and his shy smile belie the fact that one might occasionally catch him tucking a pinch of snuff in his lower lip. He does this with great aplomb and a twinkle in his eyes. As we pass a little niche in the hall, we are apt to find a special treat there from the Schusters—last week, it was cherries from Yakima. His hobbies are hunting, fishing, and the building and shooting of muzzle loaders.

OLE ORR

Love of adventure and travel took Ole to Alaska when she was just out of school. There, she stayed to work for an airline, got married, raised her family, and acquired the nickname of Ole. Now, she is known as Opal on formal documents only. We enjoy

hearing about her days of camping and fishing in the "land of the midnight sun." However, because of her husband's health, the family moved "outside," and lived in Oregon and Montana for a time. After she was widowed, Ole settled her family in her former hometown of Shelton, where she now lives.

Ole works in the nucleus of our division. She is secretary to Ted Livingston, our State Geologist, and also functions as office manager. Therefore, she is aware of all the activities and serves as a source of office information to the rest of the staff.

Prior to joining the staff of DNR, Ole worked 8 years for the City of Olympia Public Works Division and the Olympia Planning Commission as a secretary. She spent two years with the Timber Sales Division and transferred to the Division of Mines and Geology in 1969.

Ole has one daughter and one son in Shelton, Mrs. John (Sara) Watkins and Collin; one son (Foster) in California; and 2 grandchildren. When she has time, she likes to garden, fish, and travel.

"UNITED STATES MINERAL RESOURCES"

U.S. Geological Survey Professional Paper 820, "United States Mineral Resources," by D. A. Brobst and W. P. Pratt, editors, is a 1973 resource-appraisal report. The foreward, by Rogers C. B. Morton, Secretary of the Interior, is listed below:

Minerals and mineral fuels are literally the corner stones of modern life. They constitute the source materials for most of the things we use, and they supply the energy that powers our machines and heats and cools the air where we live and work. In short, they are the physical source of most of the necessities, conveniences, and comforts of life in the United States today.

Most mineral resources are nonrenewable, for the deposits from which they are extracted are not being naturally reformed at anywhere near the rate we are using them. They are extendable, however, in the sense that new deposits are discovered by exploration, and deposits once too poor in quality to recover economically are made available by advancing technology. And, of course, many mineral products can be recycled.

Because of our dependence on minerals and mineral fuels, the question of the magnitude of usable resources is of mounting concern. Generally the problem has been assessed in terms of proved reserves—workable deposits that have already been discovered and inventoried. To plan our future, however, we need some idea of the magnitude of resources that are geologically available if we are able to find and use them economically.

As a part of our response to the Mining and Mineral Policy Act of 1970, the Geological Survey provides in this volume the first overall assessment of mineral resources since that of the President's Materials Policy Commission in 1952. It goes beyond traditional resource appraisals, which have considered mainly inventoried reserves, to examine the geologic availability of resources that will be needed in future generations. For many minerals, these appraisals are preliminary at best, for not enough is known about their origin, distribution, or the geologic environments favorable for their occurrence to assess their potential now. But at the least they represent a beginning, a take-off from which we can expect to enlarge our knowledge of our mineral-resource endowment with advancing science and exploration.

Professional Paper 820 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 for $9.15, postpaid.

U.S. GEOLOGICAL SURVEY 7½-MINUTE TOPOGRAPHIC QUADRANGLES
(New maps received in the Division of Mines and Geology Library since April 1, 1973)

Name	Latitude	Longitude	County
Almira SE	47°30'00"	118°45'00"	Lincoln
Almira SW	47°30'00"	118°52'30"	Lincoln, Grant
Arlington	45°37'30"	120°07'30"	Klickitat
Ashnola Mountain	48°52'30"	120°22'30"	Okanogan
Ashnola Pass	48°52'30"	120°15'00"	Okanogan
Bauerman Ridge	48°52'30"	120°00'00"	Okanogan
Billy Goat Mountain	48°45'00"	120°15'00"	Okanogan
Brief	47°52'30"	120°22'30"	Chelan
Burr Canyon	46°30'00"	118°37'30'	Franklin
Castle Peak	48°52'30"	120°45'00"	Whatcom, Okanogan
Chikamin Creek	47°52'30"	120°37'30"	Chelan
Connell	46°37'30"	118°45'00"	Franklin, Adams
Connell SE	46°30'00"	118°45'00"	Franklin
Cormana Lake	47°22'30"	118°22'30"	Lincoln
Davenport	47°37'30"	118°07'30"	Lincoln
Frosty Creek	48°52'30"	120°37'30"	Okanogan
Harrington	47°22'30"	118°15'00"	Lincoln
Harrington SE	47°15'00"	118°15'00"	Lincoln, Adams
Hoodoo Peak	48°15'00"	120°15'00"	Okanogan
Kahlotus	46°37'30"	118°30'00"	Franklin, Adams
Lind SW	46°45'00"	118°37'30"	Adams
Lower Monumental Dam	46°30'00"	118°30'00"	Franklin, Walla Walla
McAlester Mountain	48°22'30"	120°37'30"	Chelan, Okanogan
Mesa East	46°30'00"	118°52'30"	Franklin
Mount Lago	48°45'00"	120°30'00"	Okanogan
Mount Prophet	48°45'00"	121°07'30"	Whatcom
Oval Peak	48°15'00"	120°22'30"	Okanogan, Chelan
Pasayten Peak	48°45'00"	120°37'30"	Okanogan, Whatcom
Quinton	45°37'30"	120°30'00"	Klickitat
Remmel Mountain	48°52'30"	120°07'30"	Okanogan
Shano	46°45'00"	118°52'30"	Adams
Shull Mountain	48°45'00"	120°45'00"	Whatcom, Okanogan
Sprague Lake	47°15'00"	118°00'00"	Lincoln, Adams
Sprague Lake NE	47°22'30"	118°00'00"	Lincoln
Sprague Lake SW	47°15'00"	118°07'30"	Lincoln, Adams
Stehekin	48°15'00"	120°37'30"	Chelan
Sulphur Lake	46°37'30"	118°37'30"	Franklin, Adams
Sun Mountain	48°15'00"	120°30'00"	Chelan, Okanogan
Tatoosh Buttes	48°52'30"	120°30'00"	Okanogan
Waterville	47°37'30"	120°00'00"	Douglas

U.S. GEOLOGICAL SURVEY 15-MINUTE TOPOGRAPHIC QUADRANGLES
(New maps received in the Division of Mines and Geology Library since April 1, 1973)

Buttermilk Butte	48°15'00"	120°15'00"	Okanogan, Chelan
Twisp	48°15'00"	120°00'00"	Okanogan

USGS OPEN-FILE MAP*

An open-file aeromagnetic map of parts of the Okanogan and Sandpoint 1° by 2° quadrangles, Washington-Idaho-Montana (1 sheet, scale 1:250,000) by the U.S. Geological Survey, is available for inspection at the Washington State Division of Mines and Geology office in Olympia.

SEISMIC RISK

A term that is beginning to be used frequently in discussions of earthquake hazards is seismic risk. Seismic risk carries with it the everyday meaning of seismic hazard; however, risk has the connotation of probability or chance of loss. Quantitative studies of seismic risk are few and, like the two measures of earthquake size (magnitude and intensity), the word "risk" is often used loosely in this context.

Seismic risk may be defined as the likelihood of damage or injury from an earthquake within a given time interval (design period). Seismic risk is normally given as a statement of probability; such as, in any 10-year period, the probability that the design acceleration of 10 percent of gravity will be reached or exceeded is about 50 percent.

Some terminology used in ascertaining seismic risk and their definitions are:

Maximum credible earthquake.—This is the maximum earthquake that appears capable of occurring. It is the maximum rational and believable event consistent with the known facts. While it is highly unlikely, it is still a believable event that could occur within the present geologic framework and present geologic epoch. No statement can be made with regard to its probability of occurrence, other than that it is finite.

Maximum probable earthquake.—This is the maximum earthquake that might occur with a fairly high probability. The tectonic forces which cause it are reasonably well understood. Statistical data allow the prediction of a recurrence interval for this earthquake. For all but the most critical considerations, it is the maximum "design" earthquake; that is, the one used in the design criteria of large structures.

Active fault.—An active fault is one that has moved in historic time, or along which offset of Holocene materials can be demonstrated. If Holocene materials are not offset or are absent, but numerous epicenters have been recorded on or in close proximity to the fault, a classification of active may be used.

Potentially active fault.—A potentially active fault is one that offsets Pleistocene materials, but for which offset of Holocene materials is lacking, and for which seismic activity is nominal or absent.

Inactive fault.—An inactive fault is one for which there is evidence that offset of Holocene or Pleistocene deposits has not occurred, and along which strain release has been nominal, or for which there is other geologic evidence that movement has not occurred within the present geologic framework.

Ernest R. Artim