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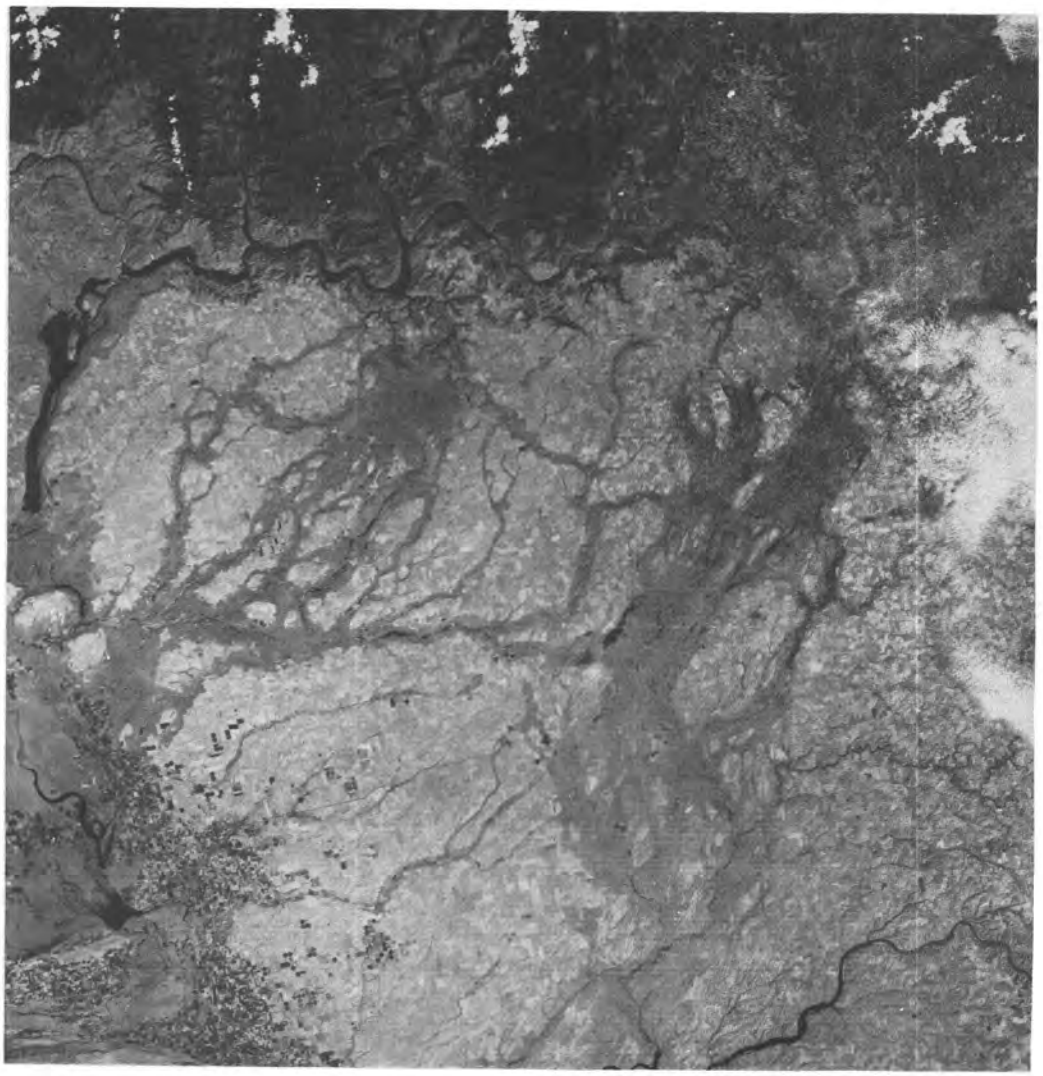

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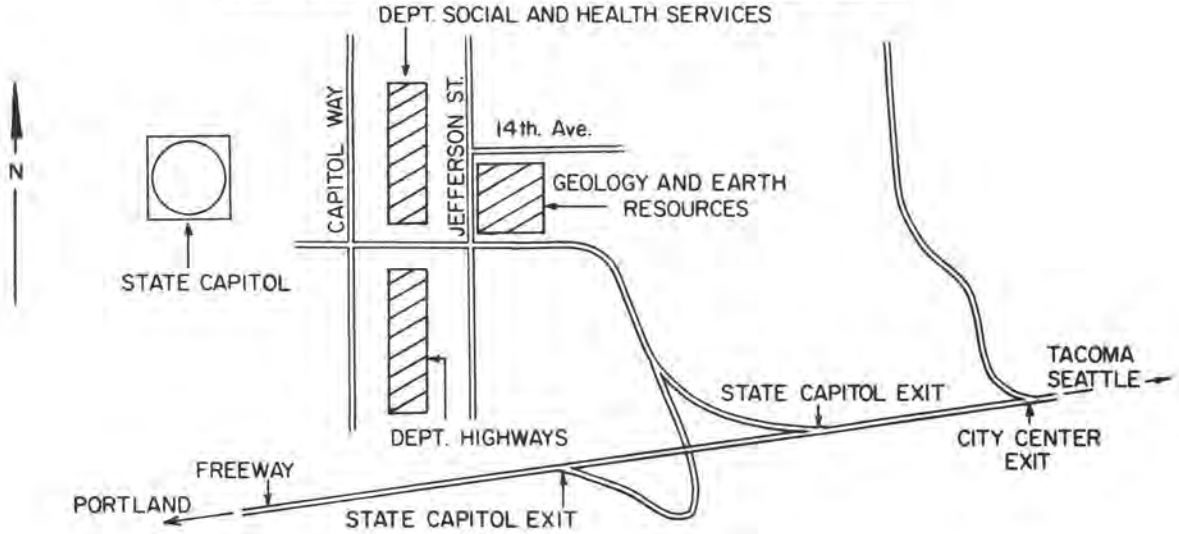
DIVISION OF GEOLOGY AND EARTH RESOURCES

DEPARTMENT OF NATURAL RESOURCES,
DIVISION OF GEOLOGY AND EARTH RESOURCES, OLYMPIA, WASHINGTON, 98504

LOCATION MAP: DIVISION OF GEOLOGY AND EARTH RESOURCES



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Mailing address: Department of Natural Resources
Division of Geology and Earth Resources
Olympia, WA 98504
(206) 753-6183

BASALT [NUCLEAR] WASTE ISOLATION PROGRAM

By Jim Rigby and Glennda Tucker

The forerunner of the U.S. Department of Energy's Basalt Nuclear Waste Isolation Program was implemented by the federal government in the late 60's. For various reasons, the program was shelved, after only a year or two of serious evaluation of potential sites in various parts of the country. The project lay dormant until mid-1977 when the present program was initiated.

The program, involving several contractors, is directed at evaluating nuclear waste repository sites in various parts of the country. One of the prime potential localities is the Columbia Basin of eastern Washington (see cover photo). Under the direction of Rockwell-Hanford International, Richland, Washington, several agencies are investigating the feasibility of interring radioactive waste material at depths of approximately 3,000 feet beneath the surface within the Columbia River basalt. The U.S. Geological Survey is responsible for establishing the basalt stratigraphy; Washington Department of Ecology will carry out hydrologic investigations; Washington Division of Geology and Earth Resources will study and map Quaternary deposits of the Columbia Basin, exclusive of the Pasco Basin which will be studied by Rockwell-Hanford geologists. The division's contract spans the period of September 1977 to July 1979, and will be carried out by five part-time geologists working under the direction of Glennda Tucker and James Rigby, staff geologists for Division of Geology and Earth Resources. During this interval, the division will (1) prepare base maps of the basin; (2) compile a bibliography of previous geologic investigations of the basin; (3) complete a series of index maps of geologic mapping in the basin; (4) and produce a reconnaissance geologic map of Quaternary deposits of the basin.

Two sets of base maps, at scales of 1:100,000 and 1:250,000 have been prepared from Army Map Service $1^{\circ}X2^{\circ}$ quadrangle sheets. The 1:250,000 sheets are being used in the preparation of the geologic index maps and will be used as base maps for the Quaternary geologic map. Maps at both scales have been supplied to other mapping contractors for use as base maps on their projects.

The bibliography entitled "Bibliography of the geology of the Columbia Basin and surrounding

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Cover Photo

Eastern Washington's Cheney-Palouse scabland tract is seen in remarkable clarity in the center of this Landsat satellite image of part of the great Columbia Basin. An ice plug, part of the Purcell ice lobe that formed during the last continental glaciation in the Northwest, dammed the Clark Fork River in northern Idaho and created an estimated 500 cubic miles of water in western Montana's glacial Lake Missoula. Developed on the surface of loess-veneered basalt, the anastomosing scabland tracts were formed by the catastrophic floodwaters that raced across the basin when the ice dam failed, approximately 13,500 years ago.

Also visible in the photo are the Spokane, Columbia, and Okanogan Rivers (along top) and the Snake River (lower right corner). Grand Coulee dam is located near the upper left corner on the Columbia River. The "patchwork" pattern between the scabland channels represents an area of intensive wheat farming. NASA photograph courtesy of EROS Data Center, Sioux Falls, SD; photo no. E-2611-17540-5, 24 Sept. 76.

areas of Washington, with selected references to Columbia Basin geology of Idaho and Oregon" has been completed and contains all published, unpublished, and open-file material dealing with the geology of the Columbia Basin. References are arranged in a topical format, including categories such as Columbia River basalt stratigraphy and Quaternary stratigraphy. Because the division's phase of the study is primarily concerned with Quaternary stratigraphy, this section is annotated to increase its usefulness.

The bibliography is now available for inspection at the division library in Olympia as: Washington Division of Geology and Earth Resources Open-File Report 78-3, "Bibliography of the geology of the Columbia Basin and surrounding areas of Washington, with selected references to Columbia Basin geology of Idaho and Oregon" (395 pages). Copies may be obtained from a private copying firm at the customer's expense.

The index maps are a compilation of all pertinent geologic mapping undertaken to date in the Columbia Basin and marginal areas. These maps (in preparation) include indices of basalt and Quaternary geologic mapping, mineral locations, locations of exploratory oil and gas wells, and tunnels and trenches in the basalt.

Preparation of a reconnaissance geologic map of the basin's Quaternary deposits will involve two seasons of field mapping by five geologists from several of the state's universities. Geologists include Newell Campbell, Yakima Community College; Larry Hanson, University of Washington; Eugene Kiver and Dale Stradling, Eastern Washington University; and Gary Webster, Washington State University.

GEOLOGIC RESEARCH PROJECTS

Geologic research projects in Washington State now in progress at our colleges and universities are listed below:

Grays Harbor Community College

- Faculty Research Projects -

Erosion and deposition of the beaches of southwestern Washington. James B. Phipps.

Green River Community College

- Faculty Research Projects -

Western extent of the Shuksan and Church Mountain thrusts in Whatcom, Skagit, and Snohomish Counties. G. M. Miller.

North Seattle Community College

Quaternary geology of the northwestern Olympic Peninsula. A. D. Horn.

Petroleum potential of Washington State. A. D. Horn and R. W. Windecker.

University of Washington

- Faculty Research Projects -

Structural and petrologic evolution of the San Juan Island and adjacent areas. Darrel S. Cowan and 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.

Geologic hazards of the Skagit nuclear power site. Eric S. Cheney.

Stratigraphy and structure 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.

The origin of Washington State ophiolites. Nikolas I. Christensen.

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

Review of geologic conditions at proposed nuclear plant sites in Washington. Howard A. Coombs.

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

Stratigraphy and structural geology of the Wenatchee Formation. Randall L. Gresens.

Marblemount 15' quad. Geology by Peter Misch 1949-1967. Peter Misch. In press.

Mount Baker 15' quad., being compiled by Peter Misch from 1949-1975 field data.

Mount Shuksan 15' quad., compilation under preparation. Peter Misch.

Metamorphic facies and petrogenesis of Shuksan Greenschist. Peter Misch.

Petrology of Cascade River Schist and its associated metaplutonic rocks. Location: largely in Marblemount 15' quad., but includes part of Eldorado Peak, Cascade Pass and Sonnyboy Lakes $7\frac{1}{2}$' quads. Peter Misch.

Metasomatic progressive metamorphism of ultramafic rocks in Skagit Metamorphic Suite (Skagit Gneiss and Cascade River Schist). Peter Misch.

Geology, geochemistry and origin of the Golden Horn batholith. With R. T. Stull. Includes parts of Crater Mtn., Azurite Peak, Slate Peak, Mount Arriva, Washington Pass, Silver Star Mountain, $7\frac{1}{2}$' quads., etc. Peter Misch.

Outline of the petrology of the Yellow Aster Complex (the pre-Devonian basement of the northwestern Cascades). Peter Misch.

Paleontology of the Ringold Formation. John M. Rensberger and Eric Gustafson.

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

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

Enrichment carbon-14 dating of late Quaternary glacial events, Olympic Peninsula, Washington. 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.

Ecological distribution of dinoflagellates in Recent sediments of Puget Sound. Barbara L. Whitney.

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

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

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

Petrology and metamorphic history of the Chiwaukum Schist in the Stevens Pass area. Bernard W. Evans.

- Graduate Program -

Contact metamorphism of marbles, Cave Ridge, Snoqualmie batholith. David Mogk.

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.

A structural and petrologic study of the Chiwaukum schist north and east of Stevens Pass, Washington. Jennifer Getsinger.

Paleoecology of the sagebrush region of eastern Washington. Dennis Hibbert.

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

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.

Structure and petrology of the Ingalls Complex and associated pre-Tertiary rocks near Mount Stuart, central Cascades. Robert Miller.

Detailed structure of a segment of the Ross Lake Fault west of Ross Lake. Wesley Wallace.

Paleontology of the Skookumchuck Formation in the Centralia-Chehalis area, Washington. Bruce Wiley.

Palynology of the Ringold Formation, eastern Washington. Kathy Barnosky.

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

Paleontology, paleoecology and biostratigraphy of the type Cowlitz Formation, southwestern Washington. Jan (Jay) R. Yett.

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

Structural geology of southern San Juan Island, Washington. Mark T. Brandon.

The structure and petrology of the Quartz Mountain area, Kittitas County, Washington. Sherree A. Goetsch.

Stratigraphy and economic geology of Buckhorn Mountain, Okanogan County, Washington. David D. McMillen.

Petrology and economic geology of the Fawn Peak dioritic stock, Methow Valley, Washington. K. Brock Riedell.

Washington State University

- Faculty Research Projects -

Structural analysis and finite strain in the Kootenay Arc, Washington. A. J. Watkinson.

Mineralogy of the "opaques" in the Columbia River basalt. J. W. Mills.

Sulfide-bearing black shales of northern Washington State. J. W. Mills.

Mineralogy of alkaline lake sediments in Washington. F. F. Foit, Jr. and P. E. Rosenberg.

Geology of the Scablands, Washington. G. D. Webster.

Stratigraphy and petrogenesis of Columbia River basalt in southeast Washington. P. R. Hooper.

The Achimin Basin lineament. J. W. Mills.

Beach erosion in the San Juan Island, San Juan County, Washington. W. F. Scott.

Borehole television scanning in eastern Washington. Principal Investigator: J. W. Crosby.

Geophysical investigations of Washington ground-water resources in central Columbia Basin. Principal Investigator: J. W. Crosby. Graduate Student: I. Wang.

National Uranium Resources evaluation (ground-water base) in northeastern Washington. Principal Investigator: J. W. Crosby.

- Student Research Projects -

Mineralogy of the sediments of Wildcat Lake, Whitman County, Washington. C. Johnson.

Structural and metamorphic history of the Nancy Creek area (east flank Kettle Dome). B. Donnelly.

Structural analysis and detailed mapping of the China Bend area. J. Bressler, W. Phillips, and K. Moser.

Detailed analysis of folding in the basalts, Columbia River Plateau. W. Saur.

Structural modelling of the faults and folds Columbia River Plateau. D. Minkel.

Geology of the Schminsky molybdenum prospect. Colville Reservation, Washington. R. O. White.

Geology of part of the Covada mining district, Colville Indian Reservation, Washington. J. W. Beck, D. Lane, and D. Lance.

Geology and mineral deposits of upper Paleozoic metasedimentary rocks, northern Stevens County, Washington. F. T. Beka.

Geology and mineral deposits of Nespelem Mining District, Colville Indian Reservation, Washington. M. J. Broch.

Friability of Addy Quartzite, Stevens County, Washington. G. C. Knutsen.

Hydrothermal alteration associated with porphyry copper mineralization in Fawn stock, Okanogan County, Washington. D. M. Orazulike.

Fluid inclusion thermometry of the ores of the Metaline mining district, Pend Oreille County, Washington. N. J. Wotruba.

Stratigraphy and petrochemistry of the Grande Ronde basalt in the Snake and Salmon River canyon (includes a small segment in southeastern Washington). S. Reidel.

Investigations of the Ringold Formation with geophysical techniques on the Hanford Reservation, Washington. I. Potter.

Whitman College

- Department of Geology -

Quaternary faults of southeastern Olympic Peninsula. Joe Wilson, Gardner-Webb College: M. J. Bartholomew, Longwood College; and R. J. Carson.

Another look at the Touchet beds, Walla Walla County. R. J. Carson, Charles McKharr, and Mark Pizey.

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

Retreat of the Puget Lobe from the Olympic Peninsula. R. J. Carson.

Geology and slope stability of the northwestern Squaxin Island quadrangle, Mason County. R. J. Carson.

DIVISION LIBRARIAN RETIRES

William H. Reichert retired as division librarian on February 28th. Many friends and associates gathered here to have cake and say goodbye to Bill earlier in the month. The last several weeks in February he had been walking around with a blissful smile, eagerly contemplating sleeping in each morning and catching up on all the projects he had been saving for retirement.

Bill obtained his B.S. in geology and his master's degree in librarianship from the University of Washington. When he joined our staff in October 1958, he assumed the task of establishing a technical reference library. The library now, in 1978, serves as a repository for more than 15,000 publications and is used extensively. He did his job well. Bill was known for his exceptional memory and his ability to immediately find the particular publication that someone was always searching for.

Several reports by Bill were published during his tenure here. Bulletin 46, a bibliography and index of the geology and mineral resources of Washington covering the years from 1937 through 1956, was released in 1960; bulletin 59, a succeeding bibliography for the years 1957-1956, was published in 1969. Shortly before Bill's retirement, his last report was published—Information Circular 61, Annotated guide to sources of information on the geology, minerals, and ground-water resources of the Puget Sound region, Washington, King County section.

Bill at retirement party in February.

New Librarian Hired

Connie Manson is the new librarian for the Division of Geology and Earth Resources. She received her masters in librarianship from the University of Washington in 1974.

Connie came here from the Wyoming Department of Economic Planning and Development, where she had organized the library, cataloging all monographs, technical reports, and government documents. While there, she authored the following reports for the department: Planning law bibliography (1977, 20 p.); Planning for housing in Wyoming—An annotated bibliography (1976, 50 p.); Outdoor recreation and open space planning—An annotated bibliography (1976, 11 p.).

From 1974 to 1975, Connie was reference librarian at the Montana State Library and served as a consultant on the Montana Energy Advisory Council.

Cataloging the reference works in our division library, obtaining copies of recent theses in geology, organizing new materials, and changing the physical arrangement of the library has kept Connie more than moderately busy. As the many users of the library come in, they are always greeted with a smile and a cheerful manner. We are pleased to have you, Connie.

U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT NOW IN LIBRARY

The following report is now in our division library and may be used for reference:

Ground-water resources of the north beach peninsula, Pacific County, Washington, by J. V. Tracy. U.S. Geological Survey Open-File Report 77-647, 7 figs., 45 p.

DIVISION PUBLISHES NEW BULLETIN

Bulletin 71, published by the Division of Geology and Earth Resources, in cooperation with the U.S. Department of Energy and the Washington Department of Ecology, is now available for purchase from our division in Olympia. The authors, M. J. Grolier and J. W. Bingham, are with the U.S. Geological Survey. The report was written to complement U.S. Geological Survey Investigations Map I-589, published in 1971.

Bulletin 71, "Geology of parts of Grant, Adams, and Franklin Counties, east-central Washington," sells for $1.50 (33 figs., 91 p.).

YOUR STATE GEOLOGIST REPORTS

We embarked upon a project last fall that brings a new dimension to the Division of Geology and Earth Resources. We are involved, along with many other geologic contractors, with the U.S. Department of Energy and Rockwell International in evaluating the basalt flows of eastern Washington as a potential rock repository for spent nuclear fuel. The division's job is to prepare a map of the surficial deposits that overlie the plateau basalts in eastern Washington. We have brought together a team of first-rate field geologists consisting of Dale Stradling (Eastern Washington State University), Gene Kiver (Eastern Washington State University), Larry Hanson (University of Washington), Gary Webster (Washington State University), and Newell Campbell (Yakima Valley College) to do the actual mapping. Jim Rigby and Glennda Tucker will do the coordinating for the division between the field mappers, the division, and Rockwell International (who has the overall responsibility for the total project). I am personally grateful to Rockwell for giving us an opportunity to participate in this study, not only because it provides an opportunity for local (state) input into the decisions that will be made down the track, but also because the project will supply badly needed information for our geologic data framework of eastern Washington. I expect the benefits to the people of the State of Washington to be considerable no matter what the final outcome of the total study.

Ted Livingston

GM-22, MINERAL RESOURCE MAPS OF WASHINGTON, BY WAYNE S. MOEN, NOW AVAILABLE

Because of continual public demand for basic mineral resource maps of Washington, Washington Division of Geology and Earth Resources has published a set of four maps at 1:1,000,000 scale which show the general distribution of mineral deposits, coal fields, sand and gravel pits, stone quarries, and areas of potential oil and gas and geothermal resources. Prior to the publication of these maps, no single map at a reasonable scale was available that showed the overall distribution of the state's mineral resources. Over 500 metallic and nonmetallic deposits and around 470 pits and quarries are shown. For convenience of use, the mineral and energy resource data appear on four sheets as follows:

Sheet 1 - Metallic mineral resources

Sheet 2 - Nonmetallic mineral resources

Sheet 3 - Sand and gravel pits and stone quarries

Sheet 4 - Energy resources

Inasmuch as it would be impossible to show all of the state's mineral occurrences on maps of this scale, only the most significant mineral deposits, as well as recent and present producing mines, pits, and quarries are shown. Although the maps are intended primarily for individuals unfamiliar with Washington mineral resources, individuals with an understanding of the state's mineral resources might find the maps of interest.

GM-22, Mineral resource maps of Washington, by Wayne S. Moen, is available from the Department of Natural Resources, Division of Geology and Earth Resources, at a cost of $1.50.

U.S. GEOLOGICAL SURVEY 7½-MINUTE TOPOGRAPHIC QUADRANGLES
(Maps received in the division library since October 1, 1977)

Name	New edition	Photo revised	Latitude (indicates southeast corner)	Longitude	County
Aberdeen	1957	1973	46°52'30"	123°45'00"	Grays Harbor
Anacortes North	1973		48°30'00"	122°30'00"	Skagit
Chinook	1949	1973	46°15'00"	123°52'30"	Pacific
Copalis Crossing	1956	1973	47°00'00"	124°00'00"	Grays Harbor
Corral Canyon	1977		46°15'00"	119°00'00"	Benton
Eliza Island	1977		48°37'30"	122°30'00"	Whatcom; Skagit
Freeman	1973		47°30'00"	117°07'30"	Spokane
Hoquiam	1957	1973	46°52'30"	123°52'30"	Grays Harbor
Mathews Corner	1975		46°22'30"	119°07'30"	Franklin
Mount Spokane	1973		47°52'30"	117°00'00"	Spokane
Newman Lake	1973		47°45'00"	117°00'00"	Spokane
North Cove	1956	1973	46°37'30"	124°00'00"	Pacific
Oak Harbor	1973		48°15'00"	122°37'30"	Island
Point Brown	1955	1973	46°52'30"	124°07'30"	Grays Harbor
Rosburg	1949	1973	46°15'00"	123°37'30"	Wahkiakum
Snively Basin	1974		46°22'30"	119°37'30"	Benton
Stacker Butte	1974		45°37'30"	121°00'00"	Klickitat
Sucia Island	1973		48°45'00"	122°52'30"	San Juan
Wishram	1977		45°37'30"	120°52'30"	Klickitat

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