OREGON GEOLOGY

published by the

Oregon Department of Geology and Mineral Industries

VOLUME 42, NUMBER 10 OCTOBER 1980

OREGON GEOLOGY
(ISSN 0164-3304)

VOLUME 42, NUMBER 10 OCTOBER 1980

Published monthly by the State of Oregon Department of Geology and Mineral Industries (Volumes 1 through 40 were entitled *The Ore Bin*).

Main Office: 1069 State Office Building, Portland 97201, phone (503) 229-5580.

Baker Field Office: 2033 First Street, Baker 97814, phone (503) 523-3133.
Howard C. Brooks, Resident Geologist

Grants Pass Field Office: 312 S.E. "H" Street, Grants Pass 97526, phone (503) 476-2496.
Len Ramp, Resident Geologist

Mined Land Reclamation Program: 1129 S.E. Santiam Road, Albany 97321, phone (503) 967-2039.
Paul F. Lawson, Supervisor

Subscription rates: 1 year, $4.00; 3 years, $10.00. Single issues, $.40 at counter, $.50 mailed.
Available back issues of *The Ore Bin*: $.25 at counter, $.50 mailed.

Address subscription orders, renewals, and changes of address to *Oregon Geology*, 1069 State Office Building, Portland, OR 97201.

Send news, notices, meeting announcements, articles for publication, and editorial correspondence to the editor, Portland office. The Department encourages author-initiated peer review for technical articles prior to submission. Any review should be noted in the acknowledgments.

Second class postage paid at Portland, Oregon.
Postmaster: Send address changes to *Oregon Geology*, 1069 State Office Building, Portland, OR 97201.

COVER PHOTO

Slide Canyon monocline, here deeply dissected by Menatchee Creek, forms southeast flank of Blue Mountains uplift in northeastern Oregon and southeastern Washington (see article beginning on next page). Grande Ronde Basalt flows of Columbia River Basalt Group are exposed in monocline.

New DOGAMI geologic map of Huntington and Oregon part of Olds Ferry quadrangles released

The Oregon Department of Geology and Mineral Industries (DOGAMI) announces the publication of *Geologic Map of the Huntington and Part of the Olds Ferry Quadrangles, Baker and Malheur Counties, Oregon*. Map GMS-13 is the newest addition to the Department's Geological Map Series and was prepared by Howard Brooks of the Department's Baker field office.

The multicolor map (scale 1:62,500) covers the Huntington quadrangle and the Oregon portion of the Olds Ferry quadrangle in eastern Oregon. It identifies sedimentary, volcanic, and intrusive rocks of Permian, Late Triassic, and Jurassic age and continental sedimentary and volcanic rocks of Miocene and Pliocene age divided into 17 different units. The Huntington and Weatherby Formations and the Jet Creek Member of the Weatherby Formation are named and briefly described as new stratigraphic units.

Price of map GMS-13 is $3.00. Address orders to the Oregon Department of Geology and Mineral Industries, either 1069 State Office Building, Portland, OR 97201, or 2033 First Street, Baker, OR 97814. Payment must accompany orders of less than $20.00. □

Stinchfield appointed to Governing Board

Allen P. Stinchfield, North Bend, has been appointed by Governor Victor Atiyeh to the Governing Board of the Oregon Department of Geology and Mineral Industries. He replaces Robert W. Doty, Talent, whose term ended June 30.

Stinchfield is a vice president of Menasha Corporation, Land and Timber Division, North Bend. He is also Chairman of the Board, Posey Manufacturing Company, Hoquiam, Washington, and a member of the Board of Directors of the Industrial Forestry Association, Oregon Forest Industries Council, Timber Operators Council, all of Portland, and of Anadromous, Inc., North Bend. □

CONTENTS

Tectonic controls of topographic development within Columbia River basalts in a portion of the Grande Ronde River-Blue Mountains region, Oregon and Washington

by M.E. Ross, Department of Earth Sciences, Northeastern University, Boston, Massachusetts 02115

INTRODUCTION

The area discussed in this article covers 515 km² (200 sq mi) of northeastern Oregon and southeastern Washington (Figure 1). The town of Troy, Oregon, is located at the confluence of the Grande Ronde and Wenaha Rivers, near the center of the study area. The northern portion, one-third of the total area, is part of the folded and faulted Blue Mountains uplift. The faulted Grouse Flat synclinal basin (Figure 2) occupies the southern portion, the remaining two-thirds of the study area. Approximately 90 percent of the uplifted northern portion and 45 percent of the southern portion of the area consist of steep canyon walls of the Grande Ronde River and its tributaries. The maximum local relief is 915 m (3,000 ft) and occurs within the vicinity of Diamond Peak in the extreme north-central part of the area (Figure 1). The canyons in the southern two-thirds of the area are generally about 610 m (2,000 ft) deep with steep, narrow inner canyons making up about half the total depth. The inner canyons usually open upward onto fairly broad, gently sloping terraces that extend out to meet steep, outer canyon walls (Figure 3). The inner canyons are developed almost entirely in Grande Ronde Basalt of the Yakima Basalt Subgroup of the Columbia River Basalt Group, and the terraces and outer canyon walls are formed in the overlying Wanapum Basalt and Saddle Mountains Basalt, also of the Yakima Basalt Subgroup, and sedimentary interbeds (Figure 3).

STRUCTURAL GEOLOGY

The Blue Mountains uplift in this area consists of the broad, asymmetric Saddle Butte anticline, which trends east to northeast and plunges 7° NE. at its end (Figure 2). The north limb of the anticline generally dips less than 5° N.; locally, however, blocks have been tilted more steeply and in other directions. The shorter south limb of the fold dips up to 9° S. before abruptly steepening along the hinge of the Slide Canyon monocline, which is nearly parallel to the hinge line of the anticline (Ross, 1975, 1978, 1979). The monocline dips up to 49° S., with dips commonly steeper than 25°. Dips abruptly flatten to less than 5° S. along the lower hinge of the monocline to form the north limb of the Grouse Flat synclinal basin. The hinge line shown in Figure 2 is drawn approximately midway across the broad, flat hinge zone of the syncline and is parallel to the fold hinge lines to the north. A maximum structural relief of 850 m (2,790 ft) has been measured on a thick Grande Ronde Basalt flow (Troy flow, see Figure 3) traced across these folds (Ross, 1978).

The July Ridge and Crooked Creek faults (Figure 2), the two normal faults mapped within the Blue Mountains uplift, have vertical offsets of up to 408 m (1,340 ft). The Grande Ronde fault system trends northeast across the southern limb of the Grouse Flat syncline (Figure 2). Within the system, the set of N. 20° E.-striking faults is dominant, but the faults are cut in at least one spot (Squaw Canyon) by a N. 40° W.-trending fault, suggesting they are conjugate. Left-lateral offsets of up to 695 m (2,280 ft) have been measured on two dikes cut by two of the northeast-trending en echelon faults. Dip-slip offsets of up to 207 m (680 ft) occurred subsequently (Ross, 1979).

TECTONIC CONTROLS OF TOPOGRAPHIC DEVELOPMENT

The topography in the Grande Ronde River-Blue Mountains area is controlled to a great extent by tectonic features. The area can be divided conveniently into three topographic zones reflecting differences in underlying structures (see Figure 2): Zone 1, the deeply dissected, well-drained area of the Blue Mountains uplift; Zone 2, the central, poorly drained zone of broad, nearly horizontal uplands dominated by Grouse Flat and extending south from Zone 1 to the Grande Ronde River; and Zone 3, the moderately well-drained, northward-sloping zone south of the Grande Ronde River (Figure 1). Zone 3 can be subdivided into west and east halves (Subzones 3A and 3B, respectively), with the eastern subzone more extensively dissected and better drained. The streams in these zones are classified according to the following scheme: (1) Consequent streams which were either antecedent streams that developed on the initial plateau surface prior to deformation or streams that developed on the plateau surface after initiation of deformation but apparently did not follow recognized tectonically produced weak zones; and (2) subsequent streams that developed along tectonically produced or accentuated weak zones.

Table 1 classifies the major streams and tributaries in the area according to this scheme. A stream may fall into more than one of the categories if the underlying structures change along its length or if its relationship to them changes. This table illustrates the strong tectonic control on stream development in the area.

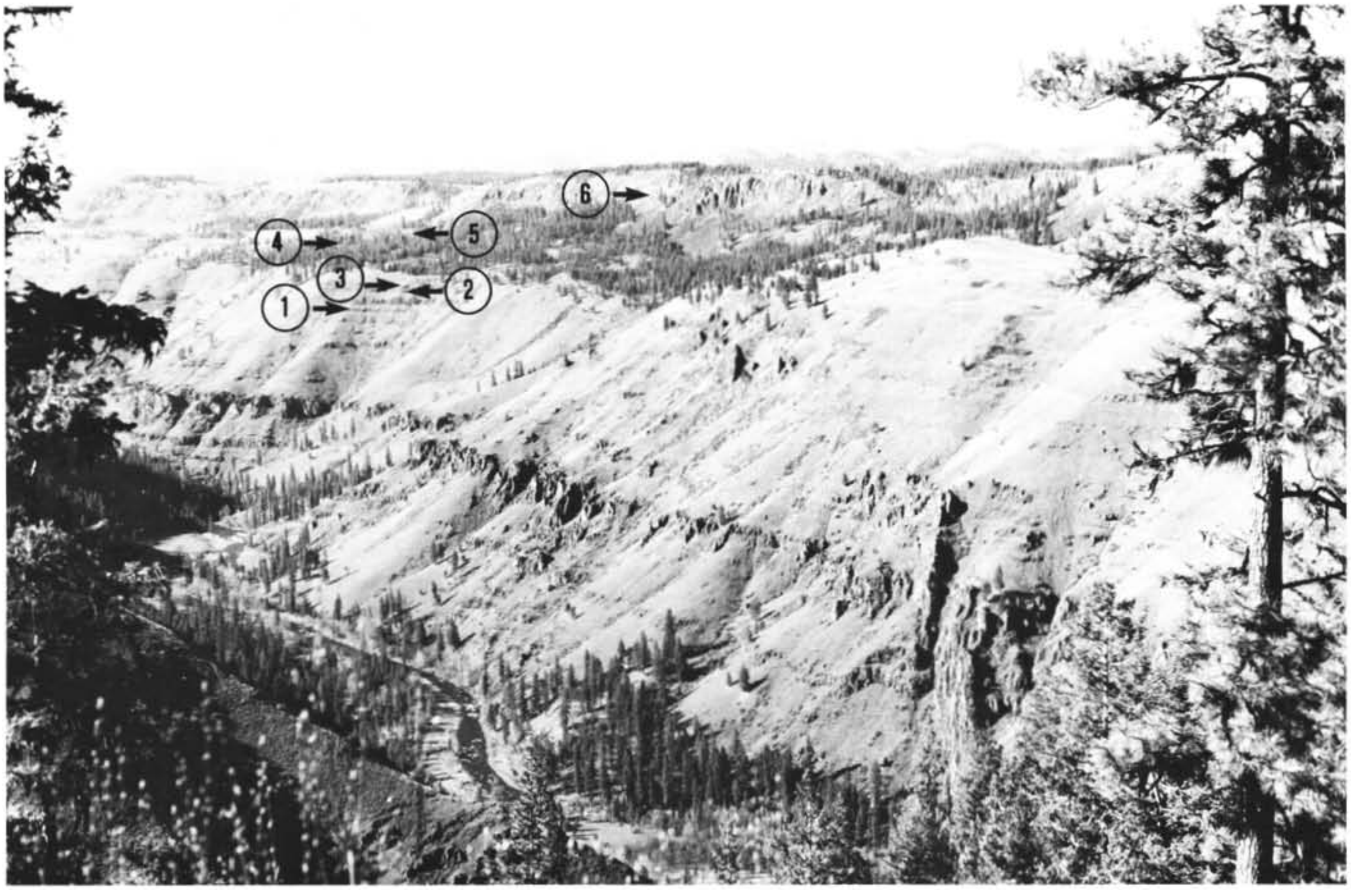

Figure 3. View looking northwest across Wenaha River approximately 4 km (2.5 mi) west of Troy, Oregon. Inner canyon is 366 m (1,200 ft) deep at this point. The Troy flow, which is 87 m (287 ft) thick, forms the prominent cliff midway up inner canyon wall. Numbered stratigraphic reference points are as follows: 1. Contact between R_2 (below) and N_2 magnetostratigraphic units within Grande Ronde Basalt. 2. Base of Wanapum Basalt sequence marked here by two Dodge flows. 3. Powatka flow of Wanapum Basalt, N_2 magnetic polarity. 4. Umatilla flow, normal magnetic polarity, at base of Saddle Mountains Basalt. 5. Grouse Creek sedimentary interbed (covered). 6. Wenaha flow, normal magnetic polarity, of Saddle Mountains Basalt. All magnetic polarities were determined with a portable fluxgate field magnetometer. A source dike for the Wenaha flow is exposed in the right foreground. The snow-covered Blue Mountains form the horizon in the background.

Zone 2

Zone 2 is dominated by the Grouse Flat syncline and consists of a broad, horizontal to nearly horizontal, poorly drained plateau surface. The Wenaha River is the principal stream in this zone and, at the town of Troy, joins the Grande Ronde River, which forms the southern limit of the zone. This section of the Wenaha River seems to be mainly subsequent, with its southeastward-flowing stretch possibly following northwest-trending conjugate joints, or even shears, related to the fault system to the southeast (Figure 2). Bear Creek, Grouse Creek, and perhaps Menatchee Creek follow this same northwest trend and may also be related to joint or shear sets. As a result, all of these streams are classified as subsequent in Table 1. Crooked Creek flows nearly due south in Zone 2 and seems to be consequent upon the northern limb of the Grouse Flat syncline (Figure 2).

Zone 3

Topographic Zone 3 lies south of the Grande Ronde River and is subdivided into west and east halves (Subzones 3A and 3B in Figure 2). Subzone 3A is transitional in character between Zone 2 and Subzone 3B, the latter of which is faulted and better drained than Subzone 3A. Subzone 3A, however, is slightly better drained than Zone 2 and consists of moderately eroded, relatively broad uplands from which much of the uppermost flow of Saddle Mountains Basalt has been stripped. This flow, the Wenaha flow (Walker, 1973), forms rounded, large remnant hills on an otherwise gently northward-sloping surface. Drainage in this portion of Zone 3 apparently is consequent upon the northward-dipping slopes.

The northeast-trending Grande Ronde fault system cuts diagonally across Subzone 3B (Figure 2). The predominant drainage direction is to the northwest,

Table 1. *Geomorphic classification of the major streams in the Grande Ronde River-Blue Mountains area*

Category	Streams
Consequent	
1A-type	Grande Ronde River and its southward-draining tributaries in Zone 1 (Blue Mountains)
1B-type	North-south stretches of Wallupa, Wildcat, Mud, and Courtney Creeks; Crooked Creek on Grouse Flat; Sickfoot Creek
Subsequent	Northwest-southeast-flowing portions of Mud and Courtney Creeks; Bear, Grouse, Buck, and Tope Creeks; perhaps Menatchee Creek on Grouse Flat; Wenaha River

possibly along northwest-trending faults, such as the Squaw Canyon fault, or joints. The streams in Subzone 3B are essentially all subsequent (Table 1). Tope Creek, in the southeast corner of the area, flows N. 20° E., parallel to the strike of the northeast-trending faults, and is probably following a minor joint or fault along which no measurable vertical offset is apparent. Squaw Canyon is formed primarily along the Squaw Canyon fault. Accelerated erosion in response to vertical displacement along the faults has removed most of the Wenaha flow from the plateau surface. Remnants of the flow remain as small, isolated hills over much of Subzone 3B. Incision of streams into the uplifted blocks has exposed the thickest section of Grande Ronde Basalts found anywhere in Zones 2 and 3.

Grande Ronde River

The Grande Ronde River was considered by Russell (1897) to be an antecedent stream, a conclusion with which the present study is in agreement. Locally, however, the river has been deflected by younger features. Horseshoe Bend, the northeasternmost meander within the area, was formed in part along the Horseshoe Bend fault (Figures 1 and 2). The fact that several meanders bordering Zone 3 have northwest-trending arms developed at the mouths of northwest-trending subsequent streams, most notably, Mud and Courtney Creeks (Figure 1), strongly suggests structural control of these portions of the meanders. The anomalously straight, east-flowing stretch of the Grande Ronde River just upstream from its confluence with Wildcat Creek (Figure 1) is less obviously related to the structural trends described so far. The same is true for the relatively straight east-flowing lower 2.5 km (1.5 mi) of the Wenaha River (Figure 1). There are no measurable vertical offsets of the basalts on either side of the rivers along these two sections. These two straight stretches could be controlled by joints or minor faults.

Well-formed entrenched meanders are a striking feature of the Grande Ronde River (Figure 1). Such extensive meandering does not occur in other rivers in the region, including the Snake River into which the Grande Ronde flows 63 km (39 mi) by river and 30 km (18 mi) by air downstream from the area discussed in this article. Lupher and Warren (1942) suggest the meanders may be related in some way to intracanyon lavas which may have blocked the Snake River shortly downstream from the mouth of the Grande Ronde River. They also indicate that the course of the ancestral Snake River did meander downstream from the Grande Ronde River to a degree perhaps comparable to the Grande Ronde during its earlier stages of entrenchment. They suggest that the intracanyon flows in the area may have destroyed these earlier meanders of the Snake River.

Hunt (1967) presents a brief discussion of meandering stream courses on certain streams of the Columbia Plateau, including the Grande Ronde River. He concludes that streams flowing down structural dips develop straight courses and those flowing along or across structures tend to meander. He also suggests that some drainage patterns may be relicts of conditions that no longer exist.

Vallier and Hooper (1976) also relate the straightness of the Snake River and the meandering of the lower Grande Ronde River to the former's following dominant northwest-trending structures and the latter's crossing those trends. They indicate that the incision was due either to uplift resulting from drag along a major northeast-trending vertical fault or uplift of the Blue Mountains after the rivers had cut their channels to near sea level.

Within the study area, meanders are well developed where the Grande Ronde River crosses the structural grain, such as at Horseshoe Bend, but are also well formed where the river runs essentially parallel to prominent fault trends. Also, if meanders along the ancestral Snake River did exist north (downstream) of the mouth of the Grande Ronde River, as implied by Lupher and Warren (1942), then the hypothesis of Vallier and Hooper (1976) is not entirely adequate.

The Grande Ronde River differs from the Snake River in two important aspects: (1) The Grande Ronde encountered thick, sedimentary interbeds early during downcutting, and (2) it has not yet cut down to pre-Tertiary rocks in the meandering, lower 120 km (74 mi) of its course (Swanson and others, 1977; Walker, 1979). The Grande Ronde River probably began to meander across the relatively flat plateau surface prior to deformation. It was able to maintain or re-establish a meandering course during early stages of folding and after extrusion of the last upper Yakima Basalt Subgroup flows (Wenaha and Buford flows and stratigraphic equivalents).

The river was able to increase greatly the breadth and shorten the radii of its meanders during the period of time it cut through the sedimentary interbed that lies beneath the Wenaha flow. The undercutting of the Wenaha flow must have been extensive when the river cut laterally within the underlying sedimentary interbed, as shown by the many large, isolated landslide blocks of the Wenaha flow scattered across the river terraces developed within the sedimentary interbed and underlying flow top.

During uplift of the Blue Mountains, these well-formed meanders became entrenched into the presentday, deep inner canyons of the Grande Ronde River. The absence of more massive and resistant pre-Tertiary rocks along the course of the river allowed preservation of its meanders during entrenchment. Lateral erosion along flow contacts, scoria tops, and closely jointed rock is significantly easier than in more massive igneous and metamorphic rocks, such as those exposed along the Snake River upstream of the mouth of the Grande Ronde River (see Newcomb's map, 1970). This is clearly evident along the Imnaha River, which has cut into large blocks of pre-Tertiary rocks at scattered localities along its length. The canyon of the Imnaha narrows markedly within the pre-Tertiary rocks, compared to its width within the intervening areas of basalt (W. Kleck, 1978, personal communication, my own observations).

Moderate meandering does occur along portions of some of these basalt stretches. The Limekiln fault just upstream from the mouth of the Grande Ronde River marks the downstream end of continuous exposures of pre-Tertiary rocks along the Snake River (Newcomb, 1970; Swanson and others, 1979; Walker, 1979). It is downstream from this point where, as Lupher and Warren (1942) suggest, the ancestral Snake did contain meanders which were subsequently destroyed by intracanyon lavas.

The Grande Ronde River may initially have begun to meander due to its crossing of the predominantly northwest-trending Basin and Range structures, as proposed by Hunt (1967) and Vallier and Hooper (1976). I believe, however, that the river was able to increase and maintain these meanders because of the conditions presented above. The depth attained by downcutting prior to the main uplift of the Blue Mountains is a very important factor. The uplift must have been relatively rapid, as is indicated, among other evidence, by the fact that the meanders are entrenched rather than ingrown (Rich, 1914). If uplift and entrenchment had occurred before the river cut through the interbeds, its meanders would be less well developed, if present at all.

CONCLUSIONS

The topography and stream courses within the area exhibit pronounced structural control. The topographically higher northern one-third of the area coincides with the anticlinal Blue Mountains uplift, and the lower southern portion consists of a broad synclinal basin. Most of the streams are consequent, having developed either on the initial plateau surface (antecedent) prior to deformation or else after initiation of deformation but without pronounced structural control. Many of the lesser streams are subsequent, at least in part flowing along tectonically produced or accentuated weak zones.

The striking and regionally unique entrenched meanders of the Grande Ronde River formed on the original, undeformed plateau surface and were able to enlarge early during downcutting when a thick sedimentary interbed was encountered. During entrenchment in response to regional uplift, the meanders were preserved largely because the river did not encounter the more resistant basement rocks lying stratigraphically below the Columbia River Basalt Group during downcutting along its entire lower course (Ross, 1978, 1980). Northwest-trending faults and joints across which the river flows also assisted in the development of the meanders. During the period of uplift, the broadly meandering Grande Ronde River was entrenched into the deep, narrow, and spectacular canyon through which it flows today.

ACKNOWLEDGMENTS

R.W. Jones and W.A. Newman reviewed the manuscript and offered many helpful suggestions. This investigation is part of a larger project by the author (1978) that was sponsored in part by Rockwell Hanford Operations and the Northwest Colleges and Universities for Science (NORCUS) under the United States Department of Energy Contracts EY-77-C-06-1030 and EY-76-F-06-2225, respectively. Financial assistance was also provided by two Grants-in-Aid of Research from the Society of the Sigma Xi.

REFERENCES CITED

Hunt, C.B., 1967, Physiography of the United States: San Francisco, Calif., W.H. Freeman and Co., 480 p.

Lupher, R.L., and Warren, W.C., 1942, The Asotin stage of the Snake River Canyon near Lewiston, Idaho: Journal of Geology, v. 50, no. 7, p. 866-881.

Newcomb, R.C., 1970, Tectonic structure of the main part of the basalt of the Columbia River Group, Washington, Oregon, and Idaho: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-587, scale 1:500,000.

Rich, J.L., 1914, Certain types of stream valleys and their meaning: Journal of Geology, v. 22, p. 469-497.

Ross, M.E., 1975, The structure of Yakima basalts in a portion of the Grande Ronde River region of northeastern Oregon and southeastern Washington: Geological Society of America Abstracts with Programs, v. 7, no. 5, p. 638-639.

——— 1978, Stratigraphy, structure, and petrology of Columbia River basalt in a portion of the Grande Ronde River-Blue Mountains area of Oregon and Washington: Moscow, Idaho, University of Idaho doctoral dissertation (also Richland, Wash., Rockwell Hanford Operations, RHO-SA-58), 460 p.

——— 1979, Large-scale strike-slip faulting of Columbia River basalt in northeast Oregon: Geological Society of America Abstracts with Programs, v. 11, no. 1, p. 51.

——— 1980, Stratigraphy, structure, and petrology of Columbia River basalt in a portion of the Grande Ronde River-Blue Mountains area of Oregon and Washington [abs.]: Oregon Geology, v. 42, no. 1, p. 17-18.

Russell, I.C., 1897, A reconnaissance in southeastern Washington: U.S. Geological Survey Water-Supply Paper 4, p. 1-76.

(Continued, p. 174)

Geothermal drilling continues at a steady pace

The Department issued 11 permits for geothermal exploration in the first part of 1980. The number of permits appears to be down from last year, but this is because a recent change in the law allows temperature gradient holes to be drilled to a depth of 2,000 ft instead of 500 ft. Therefore, a well that would have formerly been called a geothermal well can now be drilled under a blanket prospect well permit. Geothermal wells require a separate permit for each hole.

No commercial geothermal discoveries have yet been announced, but the recent spectacular eruptions of Mount St. Helens confirm geologists' belief that there is usable heat energy in the Cascade Range. Most drilling thus far in Oregon has been for temperature gradient data. If thermal anomalies are found by gradient drilling or geophysical methods, then deep holes will be put down. This type drilling could get under way in 1981.

Table 1. *Geothermal permits issued since April 1980*

Permit number	Operator	Well name	Location	Status
Geothermal Well #81	NW Geothermal Corp.	Site 7-A Old Maid Flat (Mt. Hood)	Center sec. 15, T. 2 S., R. 8 E. Clackamas County	Drilling at 400 ft, Aug. 6, 1980.
Prospect Well #62	Chevron Resources	–	Alvord Desert Harney County	Preparing to drill 31 500-ft temperature gradient holes.
Prospect Well #63	Robert Dollar Co.	–	Klamath Falls Klamath County	Proposed to drill one 500-ft temperature gradient hole.
Prospect Well #64	Amax Exploration Co.	–	Bully Creek Malheur County	Proposed to drill 3 2,000-ft temperature gradient holes.
Prospect Well #65	Anadarko Production Co.	–	Alvord Desert Harney County	Proposed to drill 11 temperature gradient holes between 500 and 2,000 ft in depth.
Prospect Well #66	Phillips Petroleum Co.	–	Glass Buttes Lake County	Drilled one 2,000-ft temperature gradient hole. Spudded second hole on Aug. 4, 1980.
Prospect Well #67	Hunt Energy Co.	–	Owyhee Reservoir Malheur County	Began drilling on a 23-hole temperature gradient program June 17, 1980.
Prospect Well #68	Oregon Dept. of Geology and Mineral Industries	–	Central Cascades Clackamas and Lane Counties	Have drilled 12 500-ft temperature gradient holes since beginning of June 1980.
Prospect Well #69	Chevron Resources	–	South Warner Valley Lake County	Proposed to drill several 2,000-ft temperature gradient holes.
Prospect Well #70	Chevron Resources	–	S. Crump Lake Lake County	Began drilling on a 17-hole temperature gradient program in early August 1980. Depth will range from 500 to 2,000 ft.

Table 2. *Work done in 1980 under existing geothermal permits*

Permit number	Operator	Well name	Location	Depth (ft)	Remarks
Geothermal Well #10	U.S. Dept. of Energy (NW Natural Gas Co.)	Old Maid Flat Retest (Mt. Hood)	Sec. 15, T. 2 S., R. 8 E. Clackamas County	4,006 TD	Ran formation test, took core. Results were negative.
Geothermal Well #45	U.S. Geological Survey	Newberry Crater 2	SW¼ sec. 31, T. 21 S., R. 31 E. Deschutes County	2,076	Monitoring temperatures.
Geothermal Well #46	Ore-Ida Foods (USDOE grant)	Well 1	NE¼ sec. 3, T. 18 S., R. 47 E. Malheur County	10,050	Monitoring temperature, contemplating additional tests.
Geothermal Well #70	U.S. Geological Survey	Pucci Chair Lift (Mt. Hood)	Sec. 7, T. 3 S., R. 9 E. Clackamas County	2,000	Will deepen to 4,000 ft.
Geothermal Well #80	Chevron Resources	Jordan 1	NW¼ sec. 9, T. 18 S., R. 43 E. Malheur County	2,820 TD	Plugged and abandoned in Feb. 1980.
Prospect Well #34	SUNOCO Energy Development Co.	–	Austin Hot Springs Mt. Hood National Forest	–	Plan to drill 10 500-ft temperature gradient holes in 1980.
Prospect Well #35	SUNOCO Energy Development Co.	–	Central Cascades Willamette National Forest	–	Plan to drill 10 500-ft temperature gradient holes in 1980.
Prospect Well #47	NW Geothermal Corp. (NW Natural Gas Co.)	McGee Creek 1	Mt. Hood area Clackamas County	2,000 TD	Deepened original hole from 770 to 2,000 ft in 1980.
Prospect Well #58	Union Oil Co.	Alvord Desert	Harney County	2,000	Plan to drill one 2,000-ft temperature gradient hole in 1980. □

Updated list of Oregon oil and gas records now available

The Oregon Department of Geology and Mineral Industries (DOGAMI) has completed an updated summary of its oil and gas well records. DOGAMI's Miscellaneous Paper 8, entitled *Available Well Records of Oil and Gas Exploration in Oregon*, is now available in its fourth revised edition.

The paper lists all available well records of oil and gas exploration drilled in Oregon between 1909 and March 1980 in tabular form by county. For each well, the table indicates company and well name; location, date, and depth of the well; and nature and availability of lithologic descriptions, logs, surveys, and samples kept in the DOGAMI collection. An orientation map of Oregon showing the Township and Range system is included to aid the reader in locating the wells. The preface also lists addresses of firms that can provide copies of the complete well records.

Price of the revised Miscellaneous Paper 8 is $2.00. Address orders to the Oregon Department of Geology and Mineral Industries, 1069 State Office Building, Portland, OR 97201. Payment must accompany orders of less than $20.00. □

Civilization exists through geological consent, subject to change without notice.

– Will Durant, via John Allen and the GSOC Newsletter

Newton accepts new position with Northwest Natural Gas

Vernon C. Newton, Jr., petroleum engineer with the Oregon Department of Geology and Mineral Industries for the past 23 years, resigned in August to join Northwest Natural Gas Company. He was the first petroleum engineer hired by the state to regulate exploratory drilling as the search for oil and gas in Oregon intensified during the 1950's. After passage of the Oregon Geothermal Act in 1971, his responsibility was extended to include geothermal drilling.

While he was with the Department, he organized records files of wells drilled in the state and established a sample library, both of which have been used considerably by industry geologists, consultants, and researchers. He authored six major reports on oil and gas exploration in Oregon, the last of which will be released early next year as Oil and Gas Investigation No. 6, *Prospects for Oil and Gas in the Coos Basin, Western Coos, Douglas, and Lane Counties, Oregon.* His study of the oil and gas prospects of the upper Nehalem basin drew attention to the Mist area, where commercial deposits of natural gas were discovered in 1979.

Newton contributed numerous articles to the Department's monthly magazine and to industry journals. He also assisted with investigations of six nuclear power sites and four chemical disposal sites in Oregon.

Vernon C. Newton, Jr.

Newton served on many committees during his tenure with the Department, including the Governor's Nuclear Siting Task Force, Governor's Task Force on Outer Continental Shelf Development, Governor's Committee on Synthetic Chemicals in the Environment, Colorado School of Mines' Potential Gas Committee, Geothermal Resources Council, Regulatory Practices Committee of Interstate Oil Compact Commission, and the American Petroleum Institute Statistics Committee.

He assisted with legislation for the Oregon Tide and Submerged Lands Act, the Oil and Gas Unitization Law, the Oregon Geothermal Law, and Law for the Underground Storage of Natural Gas. Regulations drafted include rules for offshore core drilling, revised oil and gas rules, geothermal rules, and rules for injection of geothermal fluids.

Until Newton's position is filled, Dennis L. Olmstead, also of the Department, is temporarily assuming most of his duties. □

Tek Rock Club 18th Annual Gem and Mineral Show to be held at OMSI this month

The Tek Rock Club has set October 24-26, 1980, as the dates for its 18th Annual Gem and Mineral Show to be held at the Oregon Museum of Science and Industry (OMSI), Portland, Oregon.

The show includes gems and minerals native to the state of Oregon as well as special collections of petrified wood, sunstone, agate, and jasper from surrounding areas. Gemstones finished by some of the finest amateur lapidaries in the Pacific Northwest will be exhibited.

Hours of the show are Friday, October 24, 9 a.m. to 9 p.m.; Saturday, October 25, 9 a.m. to 5 p.m.; and Sunday, October 26, 9 a.m. to 6 p.m. The show is free to all after the OMSI admission. More information may be obtained from Show Chairman Kit Crayne, 20480 S.W. Florence, Aloha, Oregon 97006; phone (503) 649-4065. □

(Tectonic controls, *continued from p. 171*)

Swanson, D.A., Wright, T.L., Camp, V.E., Gardner, J.N., Helz, R.T., Price, S.A., and Ross, M.E., 1977, Reconnaissance geologic map of the Columbia River Basalt Group, Pullman and Walla Walla quadrangles, southeast Washington and adjacent Idaho: U.S. Geological Survey Open-File Report 77-100, scale 1:250,000.

Vallier, T.L., and Hooper, P.R., 1976, Geologic guide to Hells Canyon, Snake River: Pullman, Wash., Washington State University (Geological Society of America, Cordilleran Section, 72nd annual meeting, field guide no. 5), 38 p.

Walker, G.W., 1973, Contrasting compositions of the youngest Columbia River basalt flows in Union and Wallowa Counties, northeastern Oregon: Geological Society of America Bulletin, v. 84, no. 2, p. 425-429.

— — — 1979, Reconnaissance geologic map of the Oregon part of the Grangeville quadrangle, Baker, Union, Umatilla, and Wallowa Counties, Oregon: U.S. Geological Survey Miscellaneous Investigations Series, Map I-1116, scale 1:250,000. □

PUBLICATIONS ORDER

Omission of price indicates publication is in press. Minimum mail order 50¢. All sales are final. Publications are sent postpaid. Payment must accompany orders of less than $20.00.

Fill in appropriate blanks and send sheet to Department (see address on reverse side).

YOUR NAME ______________________

ADDRESS ______________________

______________________ Zip __________

Amount enclosed $__________

OREGON GEOLOGY

____ Renewal ____ Subscription ____ Gift

____ 1 Year ($4.00) ____ 3 Years ($10.00)

NAME ______________________

ADDRESS ______________________

______________________ ZIP __________

(If Gift, From: ______________________)

ORDER FORM – CUT ON DASHED LINE

Available publications

	Price	No. Copies	Amount
MISCELLANEOUS PAPERS			
1. A description of some Oregon rocks and minerals, 1950: Dole	$ 1.00		
4. Laws relating to oil, gas, and geothermal exploration and development in Oregon			
Part 1. Oil and natural gas rules and regulations, 1977, rev. 1980	1.00		
Part 2. Geothermal resources rules and regulations, 1977, rev. 1979	1.00		
5. Oregon's gold placers (reprints), 1954	.50		
6. Oil and gas exploration in Oregon, rev. 1965: Stewart and Newton	3.00		
8. Available well records of oil and gas exploration in Oregon, rev. 1980: Olmstead and Newton	2.00		
11. Collection of articles on meteorites, 1968 (reprints from *The Ore Bin*)	1.50		
13. Index to *The Ore Bin*, 1950-1974	1.50		
14. Thermal springs and wells, 1970: Bowen and Peterson (with 1975 supplement)	1.50		
15. Quicksilver deposits in Oregon, 1971: Brooks	1.50		
16. Mosaic of Oregon from ERTS-1 imagery, 1973	2.50		
18. Proceedings of Citizens' Forum on potential future sources of energy, 1975	2.00		
19. Geothermal exploration studies in Oregon – 1976, 1977	3.00		
20. Investigations of nickel in Oregon, 1978: Ramp	5.00		
GEOLOGIC MAPS			
Geologic map of Galice quadrangle, Oregon, 1953	1.75		
Geologic map of Albany quadrangle, Oregon, 1953	1.00		
Reconnaissance geologic map of Lebanon quadrangle, 1956	1.50		
Geologic map of Bend quadrangle and portion of High Cascade Mountains, 1957	1.50		
Geologic map of Oregon west of 121st meridian, 1961	2.25		
GMS-3: Preliminary geologic map of Durkee quadrangle, Oregon, 1967	2.00		
GMS-4: Oregon gravity maps, onshore and offshore, 1967 (folded)	3.00		
GMS-5: Geologic map of Powers quadrangle, Oregon, 1971	2.00		
GMS-6: Preliminary report on geology of part of Snake River Canyon, 1974	6.50		
GMS-7: Geology of the Oregon part of the Baker quadrangle, Oregon, 1976	3.00		
GMS-8: Complete Bouguer gravity anomaly map, Cascade Mountain Range, central Oregon, 1978	3.00		
GMS-9: Total field aeromagnetic anomaly map, Cascade Mountain Range, central Oregon, 1978	3.00		
GMS-10: Low- to intermediate-temperature thermal springs and wells in Oregon, 1978	2.50		
GMS-12: Geologic map of the Oregon part of the Mineral quadrangle, 1978	2.00		
GMS-13: Geologic map of the Huntington and part of the Olds Ferry quadrangles, Oregon, 1979	3.00		
OIL AND GAS INVESTIGATIONS			
3. Preliminary identifications of foraminifera, General Petroleum Long Bell #1 well	2.00		
4. Preliminary identifications of foraminifera, E.M. Warren Coos County 1-7 well, 1973	2.00		
5. Prospects for natural gas production or underground storage of pipeline gas	5.00		
MISCELLANEOUS PUBLICATIONS			
Landforms of Oregon (17 × 12 inches)	.50		
Mining claims (State laws governing quartz and placer claims)	.50		
Geological highway map, Pacific NW region, Oregon-Washington (published by AAPG)	3.00		
Fifth Gold and Money Session and Gold Technical Session Proceedings, 1975	5.00		
Sixth Gold and Money Session and Gold Technical Session Proceedings, 1978	6.50		
Back issues of *The Ore Bin*	25¢ over the counter; 50¢ mailed		
Colored postcard, *Geology of Oregon*	10¢ each; 3 for 25¢; 7 for 50¢; 15 for 1.00		

OREGON GEOLOGY

1069 State Office Building, Portland, Oregon 97201

Second Class Matter
POSTMASTER: Form 3579 requested

Available publications (continued)

BULLETINS	Price	No. Copies	Amount
33. Bibliography (1st supplement) geology and mineral resources of Oregon, 1947: Allen	1.00	____	____
36. Papers on Tertiary foraminifera: Cushman, Stewart and Stewart, 1949: v. 2	1.25	____	____
44. Bibliography (2nd supplement) geology and mineral resources of Oregon, 1953: Steere	2.00	____	____
46. Ferruginous bauxite deposits, Salem Hills, 1956: Corcoran and Libbey	1.25	____	____
49. Lode mines, Granite mining district, Grant County, Oregon, 1959: Koch	1.00	____	____
53. Bibliography (3rd supplement) geology and mineral resources of Oregon, 1962: Steere and Owen	3.00	____	____
57. Lunar Geological Field Conference guidebook, 1965: Peterson and Groh, editors	3.50	____	____
63. Sixteenth biennial report of the Department, 1966-1968	1.00	____	____
65. Proceedings of Andesite Conference, 1969: (copies)	10.00	____	____
67. Bibliography (4th supplement) geology and mineral resources of Oregon, 1970: Roberts	3.00	____	____
68. Seventeenth biennial report of the Department, 1968-1970	1.00	____	____
71. Geology of selected lava tubes in Bend area, Oregon, 1971: Greeley	2.50	____	____
76. Eighteenth biennial report of the Department, 1970-1972	1.00	____	____
77. Geologic field trips in northern Oregon and southern Washington, 1973	5.00	____	____
78. Bibliography (5th supplement) geology and mineral resources of Oregon, 1973: Roberts	3.00	____	____
81. Environmental geology of Lincoln County, 1973: Schlicker and others	9.00	____	____
82. Geologic hazards of Bull Run Watershed, Multnomah, Clackamas Counties, 1974: Beaulieu	6.50	____	____
83. Eocene stratigraphy of southwestern Oregon, 1974: Baldwin	4.00	____	____
84. Environmental geology of western Linn County, 1974: Beaulieu and others	9.00	____	____
85. Environmental geology of coastal Lane County, 1974: Schlicker and others	9.00	____	____
86. Nineteenth biennial report of the Department, 1972-1974	1.00	____	____
87. Environmental geology of western Coos and Douglas Counties, 1975	9.00	____	____
88. Geology and mineral resources of upper Chetco River drainage, 1975: Ramp	4.00	____	____
89. Geology and mineral resources of Deschutes County, 1976	6.50	____	____
90. Land use geology of western Curry County, 1976: Beaulieu	9.00	____	____
91. Geologic hazards of parts of northern Hood River, Wasco, and Sherman Counties, Oregon, 1977: Beaulieu	8.00	____	____
92. Fossils in Oregon (reprinted from *The Ore Bin*), 1977	4.00	____	____
93. Geology, mineral resources, and rock material of Curry County, Oregon, 1977	7.00	____	____
94. Land use geology of central Jackson County, Oregon, 1977: Beaulieu	9.00	____	____
95. North American ophiolites, 1977	7.00	____	____
96. Magma genesis: AGU Chapman Conference on Partial Melting, 1977	12.50	____	____
97. Bibliography (6th supplement) geology and mineral resources of Oregon, 1971-75, 1978	3.00	____	____
98. Geologic hazards of eastern Benton County, 1979: Bela	9.00	____	____
99. Geologic hazards of northwestern Clackamas County, Oregon, 1979: Schlicker and Finlayson	10.00	____	____
100. Geology and mineral resources of Josephine County, Oregon, 1979: Ramp and Peterson	9.00	____	____
101. Geologic field trips in western Oregon and southwestern Washington, 1980	9.00	____	____
SPECIAL PAPERS			
1. Mission, goals, and purposes of Oregon Department of Geology and Mineral Industries, 1978	2.00	____	____
2. Field geology of SW Broken Top quadrangle, Oregon, 1978: Taylor	3.50	____	____
3. Rock material resources of Clackamas, Columbia, Multnomah, and Washington Counties, Oregon, 1978: Gray and others	7.00	____	____
4. Heat flow of Oregon, 1978: Blackwell, Hull, Bowen, and Steele	3.00	____	____
5. Analysis and forecasts of the demand for rock materials in Oregon, 1979: Friedman and others	3.00	____	____
6. Geology of the La Grande area, Oregon, 1980: Barrash and others	5.00	____	____
7. Pluvial Fort Rock Lake, Lake County, Oregon: Allison	4.00	____	____
8. Geology and geochemistry of the Mt. Hood volcano, 1980: White	2.00	____	____
SHORT PAPERS			
18. Radioactive minerals prospectors should know, 1976: White, Schafer, Peterson	.75	____	____
21. Lightweight aggregate industry in Oregon, 1951: Mason	.25	____	____
24. The Almeda Mine, Josephine County, Oregon, 1967: Libbey	3.00	____	____
25. Petrography, type Rattlesnake Formation, central Oregon, 1976: Enlows	2.00	____	____
27. Rock material resources of Benton County, 1978: Schlicker and others	4.00	____	____