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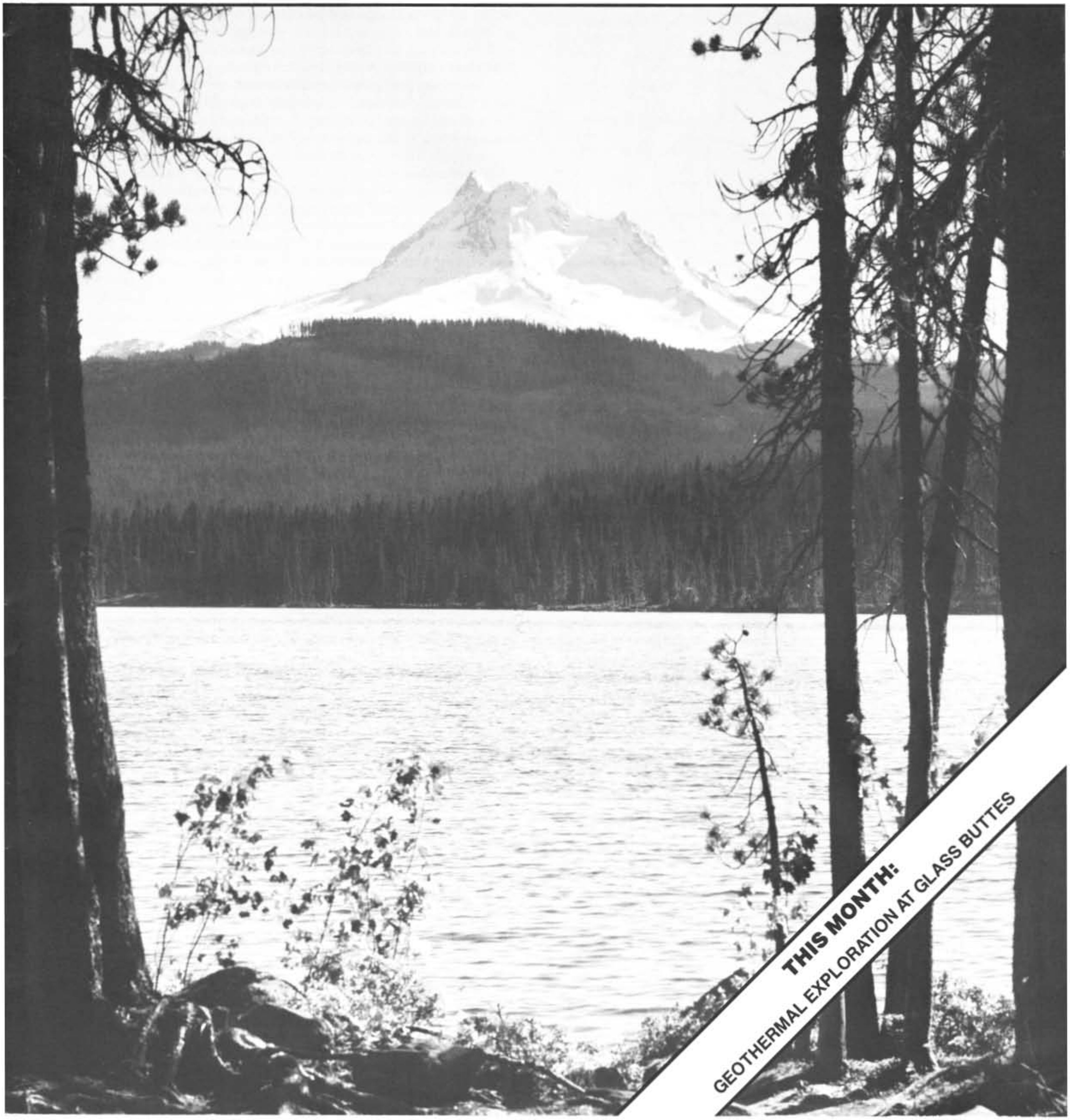

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COVER PHOTO

North flank of Mount Jefferson, central Oregon Cascade Range, viewed across Olallie Lake. Geology and geothermal resources of the central Cascades are the subject of a new DOGAMI publication announced on page 22. (State Highway Division photograph)

OIL AND GAS NEWS

Mist Gas Field: New producer

The last well to be drilled in 1983, Reichhold Energy's Columbia County 23-22, was completed to production. The well, 1.5 mi south of the nearest production to date in the field, is located in sec. 22, T. 6 N., R. 5 W., and was completed on December 20, 1983. The total depth of the well was 2,028 ft, and the tested rate was 3 million cfd. The well is significant as the only new gas producer of the year as well as being a new pool discovery. Offset wells have not yet been located.

Mist Gas Field: New well

Reichhold Energy has spudded a new well in the Mist Gas Field: Crown Zellerbach 23-26, located in sec. 26, T. 6 N., R. 4 W. The well was spudded on January 5, 1984, and has a proposed total depth of 4,000 ft. The well will be 7 mi southeast of production.

1983 production total

Preliminary gas production figures indicate that during the year, 3,871,019 Mcf of gas was produced from the Mist Gas Field. Reichhold Energy Corporation is the operator of all the producing wells. A complete summary of 1983 drilling and production will appear in the March 1984 issue of *Oregon Geology*.

Recent permits

Permit no.	Operator, well, API number	Location	Status, proposed total depth (ft)
255	Reichhold Energy Corp. Columbia County 13-34A 009-00123	SW¼ sec. 34 T. 7 N., R. 5 W. Columbia County	Application; 2,800.

□

Wilderness studies announced

The U.S. Bureau of Mines has announced its plans for mineral-assessment studies in proposed wilderness areas on federal (BLM) lands in Oregon during 1984. Anybody who has mineral interests or mining claims in any of the areas listed below is invited to contact the appropriate project leader at the Western Field Operations Center, U.S. Bureau of Mines, 360 East 3rd, Spokane, WA 99202, phone (509) 456-5350.

Wilderness Study Area	Project Leader	Estimated time in field
Pueblo Mountains	Steven R. Munts	05/29/84-08/30/84
High Steens	Leon E. Esparza	06/12/84-08/30/84
Little Blitzen Gorge	Thomas J. Peters	09/04/84-09/13/84
Owyhee Canyon	Mitch J. Linne	05/29/84-07/19/84
Honeycomb	Douglas R. Scott	07/24/84-09/23/84

All the areas involved were included in a recent mineral-assessment study by the Oregon Department of Geology and Mineral Industries (Open-File Report O-83-2), which identified some areas with anomalous metal values. □

CONTENTS

Geothermal exploration at Glass Buttes, Oregon*

by Keith E. Johnson and Eugene V. Ciancanelli, Cascadia Exploration Corporation, 3358 Apostol Road, Escondido, CA 92025

ABSTRACT

Glass Buttes is a Pliocene-Pleistocene bimodal volcanic center located in central Oregon along the Brothers fault zone. The silicic volcanic rocks were erupted within a northwest-trending graben. Hydrothermally altered rocks prove the former presence of a high-temperature geothermal system. Data from temperature-gradient wells define a thermal anomaly of about 8 sq mi located adjacent to the alteration within an area which has undergone subsidence. The temperatures and gradients measured are sufficient to suggest the possible presence of commercial geothermal temperatures at a depth of less than 10,000 ft.

INTRODUCTION

This paper is based largely upon the exploration efforts of the Vulcan Geothermal Group which holds federal geothermal leases at Glass Buttes. Various reports completed by Cascadia Exploration and other consultants to the Vulcan Group form the basis for this paper.

Phillips Petroleum and the Vulcan Geothermal Group separately filed lease applications at Glass Buttes in 1974. At that time, geologic information on the area was scant, but several factors contributed to the attractiveness of Glass Buttes. These included the presence of a volcanic center, the abundance of silicic volcanic rocks, the presence of hydrothermal alteration and mercury mineralization, the existence of numerous Cenozoic faults, and a reported warm well in the area.

The earliest geothermal exploration at Glass Buttes was sponsored by the Oregon Department of Geology and Mineral Industries (DOGAMI). This preliminary work involved an electrical resistivity survey and temperature-gradient measurements (Hull, 1976; Bowen and others, 1977; Hull and others, 1977). Phillips Petroleum conducted geothermal research from 1977 to 1980, including geologic mapping, geophysical surveys, and temperature-gradient wells. The Vulcan Group began its exploration in 1978 with geologic mapping (Ciancanelli and Emmet, 1979). Gradient drilling in 1979 was followed by additional drilling and a soil-mercury survey in 1981 (Geothermal Services, Inc., 1979, 1981; Ciancanelli and Johnson, 1981). This paper outlines the major conclusions of these investigations.

GEOLOGY

Glass Buttes is located in the High Lava Plains province of Oregon (Figure 1). This province marks the northern border of the Basin and Range province and is dominated by late Miocene to Pleistocene volcanic rocks. These rocks probably overlie older Paleozoic to Tertiary rocks which crop out within the Basin and Range to the south and within isolated areas to the north. Late Tertiary and Quaternary silicic volcanic rocks of the High Lava Plains were shown by Walker (1974) to display a systematic progression in age, becoming younger to the west. The most recent rhyolitic volcanism in this trend occurs at Newberry volcano.

The most striking structural feature of the High Lava Plains is the west-northwest-trending Brothers fault zone (Walker, 1969). This zone of en echelon faults contains most of the silicic volcanic centers within the High Lava Plains. The faults of the Brothers fault zone display normal offsets, although some authors have suggested right-lateral motion along the zone (e.g., Lawrence, 1976). The presence of such a distinct tectonic feature spatially coincident with numerous volcanic centers strongly suggests the Brothers fault zone is a deep-seated structure.

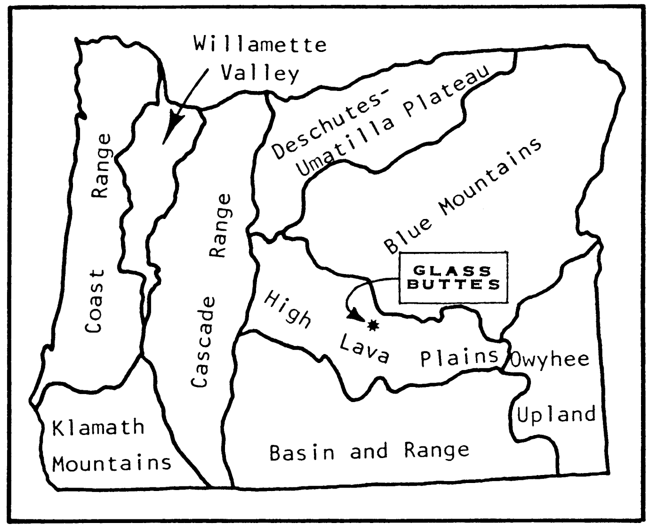

Figure 1. Index map showing the location of Glass Buttes and the physiographic provinces of Oregon.

Rock units of the Glass Buttes area can be divided into four major groups (Ciancanelli and Emmet, 1979) that differentiate three periods of volcanism. Although three periods are suggested, temporal overlap of the periods is probable. Within each group, several different units were mapped, but for clarity, only the four major groups are shown in Figure 2. The four rock groups are as follows:

1. **Pre-Glass Buttes volcanic rocks.** These are the oldest rocks exposed in the area and are probably early Pliocene or older. The rocks of this group are nearly all olivine-bearing basalt flows that comprise the flat-lying area surrounding Glass Buttes. Also included within this group are two interbedded welded-tuff units located in the eastern portion of the area. The welded-tuff units are tentatively correlated with the Devine Canyon and the Wagontire Mountain welded tuffs (Greene, 1973; Walker and Swanson, 1968).

2. **Glass Buttes silicic volcanic rocks.** Most of the rocks comprising the Glass Buttes area are silicic rocks including rhyolite and rhyodacite flows and tuffs. A series of silicic domes form the elongate west-northwest-trending pattern of silicic volcanism at Glass Buttes. Post-volcanic erosion leading to poor exposures and the great petrographic diversity within individual rock units and flows deter accurate mapping of all individual units within this group. Most of Glass Buttes consists of a mappable unit composed of rhyolite flows that appear in outcrop as flow-banded or pumiceous rhyolite. Below the surface, however, is reddish-brown obsidian. The bulk of silicic volcanism is probably Pliocene, based upon an age of 4.9 ± 0.3 m.y. (Walker, 1974) for the main silicic unit of the area. A few mappable individual rhyolite and dacite units overlie this main unit, suggesting some silicic volcanism after 4.9 m.y. B.P.

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* Reprinted with permission from *Geothermal Resources Council Transactions*, v. 7 (1983), p. 169-174. This volume, which contains the transactions of the 1983 annual meeting in Portland, Oregon, is available from Geothermal Resources Council, P.O. Box 1350, Davis, CA 95617. Price is $33 (10 percent discount for GRC members), plus $3.50 shipping and handling.

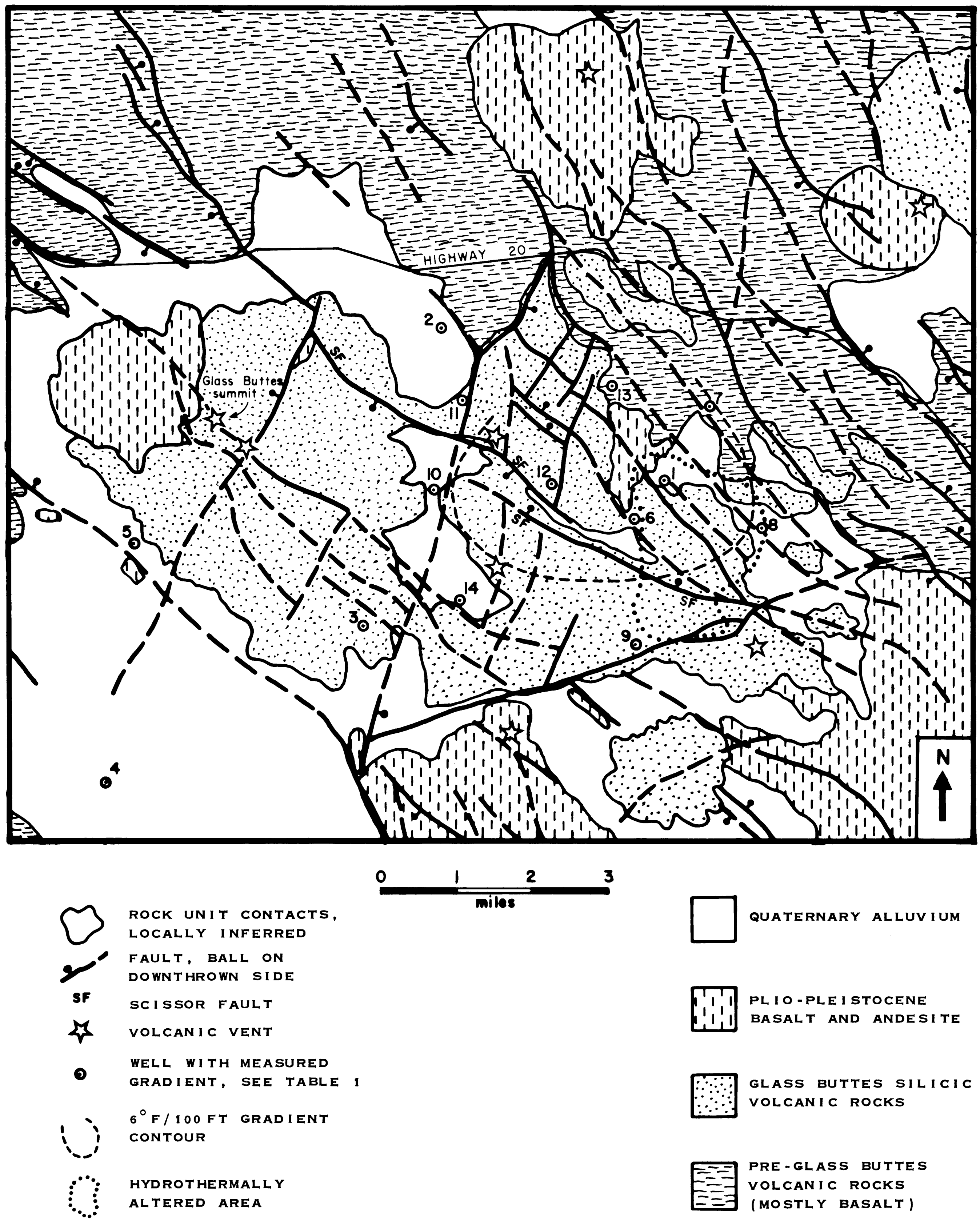

Figure 2. Generalized geologic map of the Glass Buttes area. A high-altitude photograph was used as a base map. Some distortion is present. Simplified from Ciancanelli and Johnson (1981).

3. **Plio-Pleistocene basalt and andesite.** This group of rocks forms a crude ring around the central silicic volcanic rocks, partially separating them from the older Tertiary olivine basalt flows. Although the Plio-Pleistocene basalt flows are very similar in outcrop to the older basalt flows, they do differ petrographically, and the younger basalt is more porphyritic. A large andesite flow present on the northwest flank of Glass Buttes is part of this rock group and was apparently erupted during the waning stages of silicic volcanism. Also included within this group are several basalt cinder cones within or near the younger porphyritic basalt flows. These cones probably represent vents for the younger basalt and suggest a ring-fracture system around the Glass Buttes silicic domes.

4. **Tertiary-Quaternary sediments.** Extensive areas of alluvium surround the buttes. The alluvium consists of boulder- to clay-size volcanic material shed from the complex. Local playa deposits are also located on the flat-lying basalt flows which surround the buttes.

A large area of intense hydrothermal alteration is exposed in the eastern portion of Glass Buttes (Figure 2), primarily within the silicic volcanic rocks. The alteration is characterized by silicification, development of hydrothermal clay minerals, and deposition of pyrite and metacinnabar along fractured and brecciated zones (Ciancanelli and Emmet, 1979; Berri and others, 1983). The alteration apparently occurs extensively in the subsurface below the exposed area, as suggested by drill-hole cuttings (Berri and others, 1983). Mining operations at this site have recovered mercury, but the operations are inactive at the present time. The area is a potential target for epithermal gold mineralization.

Structurally, the majority of mappable faults trend in a northwest-southeast direction, parallel or subparallel to the Brothers fault zone (Figure 2) and display normal offsets. The overall structural pattern suggests emplacement of the Glass Buttes domes within a northwest-trending graben (Ciancanelli and Emmet, 1979; Berri and others, 1983). Seemingly, the northwest structural trend represents an "open" fracture set along which magma could rise. Berri and others (1983) note the importance of northwest-trending normal faults as sites of permeable zones within the altered area.

A northwest-trending fault, a scissor fault (Figure 2), may be an important structure related to the thermal anomaly and the distribution of hydrothermal alteration (Ciancanelli and Johnson, 1981). The scissor fault consists of two strands that cut along the northeast side of Glass Buttes and through the southern half of the hydrothermal alteration (Figure 2). The majority of hydrothermal alteration and the central portion of the thermal anomaly lie north of the scissor fault. In the hinge area of the fault where the two fault strands overlap, numerous northeast-trending faults intensely fracture the rhyolite. This area lies in the center of the thermal anomaly.

SOIL-MERCURY SURVEY

With hydrothermal alteration and mercury mineralization in the eastern half of the area, a soil-mercury survey was conducted to determine the surficial distribution of mercury (Ciancanelli and Johnson, 1981). It was hoped that the survey would aid in defining permeable structures and subsurface alteration. After the collection and analysis of over 100 soil samples, however, all samples except a very few contained very low mercury concentrations. The few samples which contained elevated mercury were collected within and immediately adjacent to the exposed hydrothermal alteration.

From the soil-mercury survey, it was concluded that no near-surface alteration is present west of the known area of hydrothermal alteration. During field mapping, it was noted that the contact between intensely altered and unaltered rocks is extremely sharp, rarely more than a few inches or feet across. The mercury geochemistry also established this sharp transition, indicating that the hydrothermal reservoir was a tightly confined system. Volcanic rocks adjacent to or even above the active hydrothermal system may have remained unaltered if permeability was insufficient to allow thermal-water passage into the rock. The soil-mercury sur-

TABLE 1

GRADIENT WELL DATA[a]

FIGURE 2 NUMBER	NAME	LOCATION	DATE MEASURED	MEASURED DEPTH(FT)	MAXIMUM TEMP °F	APPROX. GRADIENT (°F/100 FT)	OPERATOR
1	23/23/27C[b]	27-23S-23E	8/07/73	721	118.1	11.0	DOGAMI
2	BR-75-21	18-23S-23E	9/30/75	205	65.7	7.3	DOGAMI
3	BR-75-22	2-24S-22E	10/02/75	197	64.3	6.7	DOGAMI
4	BR-75-23	20-24S-22E	10/02/75	197	58.0	3.9	DOGAMI
5	Musser Well[b]	32-23S-22E	9/10/79	580	86.9	10.9	Vulcan Group
6	Strat #1	33-23S-23E	2/03/78	1984	200.7	7.4	Phillips Pet.
7	Strat #2	22-23S-23E	11/15/80	1180	104.1	5.7	Phillips Pet.
8	Strat #3	35-23S-23E	?	840	75.9	3.4	Phillips Pet.
9	Strat #4	9-24S-23E	11/15/80	1945	121.7	3.4	Phillips Pet.
10	GB-1	31-23S-23E	9/03/81	1160	96.8	4.8	Vulcan Group
11	GB-16	19-23S-23E	10/19/79	2000	136.4	4.2	Vulcan Group
12	GB-18	29-23S-23E	9/03/81	1290	165.8	10.5	Vulcan Group
13	GB-22	21-23S-23E	1980	400	99.1	12.3	Phillips Pet.
14	GB-31	6-24S-23E	9/03/81	1165	98.4	3.9	Vulcan Group

[a] See text for references.

[b] Previously existing water well. Gradient measured by operator.

vey also demonstrated that, if alteration is present at depth, no mercury is reaching the surface. Soil-mercury appears to be an inappropriate method of geothermal exploration at Glass Buttes.

TEMPERATURE GRADIENTS

Data from two existing water wells and twelve temperature-gradient holes are available for the area (Table 1). The earliest gradient drilling was completed by DOGAMI (Bowen and others, 1977; Hull and others, 1977). Phillips Petroleum drilled numerous shallow wells and four deeper wells. Data for some of these wells were obtained by Cascadia Exploration from Phillips Petroleum in 1980. The Vulcan Geothermal Group also drilled four gradient wells (Geothermal Services, Inc., 1979, 1981). The locations of the wells for which data were available to the authors are shown in Figure 2.

Loss of circulation was common and dramatically impaired the recovery of drill cuttings below about 500 ft. Those cuttings which were recovered from Phillips and Vulcan Group wells were dominated by rhyolite flows, obsidian, perlite, and pumice (Ciancanelli and Johnson, 1981). Gradient well Strat #4 contained abundant basalt and volcaniclastic sediments and was therefore presumed to lie on the southern flank of silicic volcanism. The presence of local subsidence was suggested by examination of the cuttings of the wells north of Strat #4. Thicker alluvial deposits in GB-22 and Strat #2 indicate subsidence in this area relative to areas farther south. This small basin is probably a local feature within the larger northwest-trending graben which encloses Glass Buttes. The thickening Quaternary alluvial deposits indicate relatively recent subsidence and therefore relatively recent fault movement in this small area.

Approximate temperature gradients for each well are shown in Table 1, and temperature profiles are shown in Figure 3. The gradients shown were obtained from assessment of each individual well profile (Ciancanelli and Johnson, 1981). During these assessments, poor correlation was found between the overall gradient of an intermediate to deep well and the gradient determined for the same well in the upper 600 ft. On the basis of this poor correlation, it was determined that gradients from wells less than 1,000 ft deep may not correctly reflect the gradient for that location.

Based upon gradients for the wells, a distinct gradient anomaly was outlined (Ciancanelli and Johnson, 1981) (Figure 2). The anomaly overlaps and lies adjacent to the altered area but cannot be defined to the north due to the lack of wells in that area. The southern edge of the anomaly is defined by lower gradients of 3.4° to 4.8° F/100 ft in Strat #3, Strat #4, GB-31, and GB-1. The central portion of the anomaly contains much higher gradients of 10.5° to 12.3° F/100 ft, as displayed in 23/23/27C, GB-18, and possibly GB-22. The 6° F/100-ft contour shown in Figure 2 encloses approximately 8 sq mi.

Isotherm contour maps constructed for various depths show an anomaly similar to that of the gradient data, although the shape is more elongate in the northwest direction. This northwest trend suggests an affinity to the scissor fault, which lies along the southwest edge of the anomaly. The isotherm maps also offer a weak suggestion of a northwest shift in the anomaly with depth. Regardless of the exact shape, a thermal anomaly is present and is located in the hinge area of the scissor fault where numerous northeast faults cross the predominant northwest trends. Local subsidence in the area of the anomaly is suggested by drill-hole cuttings.

Blackwell (1982) assessed the gradient-well data. From the temperature profiles (Figure 3), he suggested the presence of porous material at shallow and intermediate depths which are intervals of lost circulation. Certainly, loss of circulation was a serious problem, as previously noted. Only perched water tables were intercepted, and the true water table has not yet been reached even in the deepest holes (about 2,000 ft deep). In portions of the gradient wells (below 1,200 ft), the temperature profiles appear to represent conductive gradients.

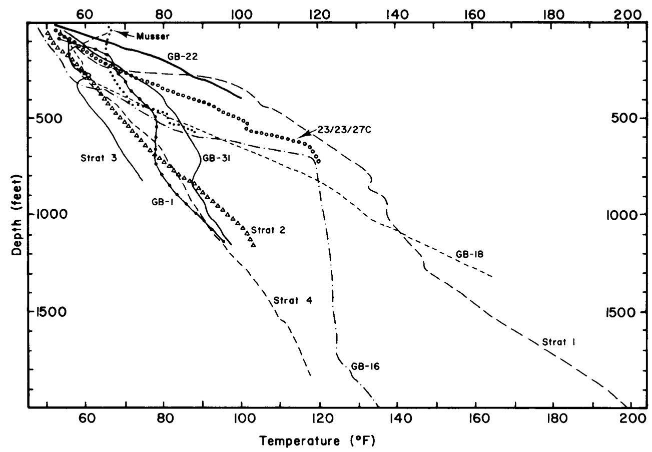

Figure 3. Temperature profiles for various wells of the Glass Buttes area. The final temperature log for each well is shown.

CONCLUSIONS

1. Glass Buttes lies within the northwest-trending Brothers fault zone. This highly fractured zone is probably a deep-seated tectonic feature along which magma has risen in numerous localities.

2. Pliocene to Pleistocene(?) volcanism centered at Glass Buttes was bimodal in character. A central core of silicic volcanism is surrounded by mafic volcanic rocks. Some silicic and probably basaltic volcanism has occurred since 4.9 ± 0.3 m.y. B.P.

3. A large area of hydrothermal alteration and mineralization proves the presence of a high-temperature hydrothermal system at Glass Buttes in the past. A soil-mercury survey indicates no near-surface alteration is present west of the surficially exposed alteration.

4. A thermal-gradient map and isotherm maps (at various depths) define an anomaly of about 8 sq mi. The anomaly is open to the north since data are lacking in that area.

5. The thermal anomaly partially overlaps the surficial hydrothermal alteration and coincides with a local subsiding basin. An identified scissor fault lies along the southwest edge of the anomaly and may represent a controlling structure for the anomaly and a possible underlying geothermal reservoir.

6. The highest temperature encountered in the gradient wells is 210° F at about the 2,000-ft depth. Gradients of over 10° F/100 ft were measured in three wells. If the temperature profiles exhibited in the gradient wells approximate deeper conditions, commercial temperatures for electrical generation would be expected at between 5,000 and 10,000 ft in depth.

ACKNOWLEDGMENTS

The authors wish to thank the Vulcan Geothermal Group for permission to publish the data collected from the exploration program at Glass Buttes. In particular, appreciation is extended to Norman Knowles and Jim Kirker who managed the exploration program.

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(Continued on page 20, **Glass Buttes***)*

A note on some remarkable concretions from the Yamhill Formation, Oregon

Four highly unusual, almost two-dimensional concretions were collected by Carl J. Williams in August 1983 from near the type locality of the Yamhill Formation (Baldwin and others, 1955) on Mill Creek in Yamhill County, southwest of Sheridan, Oregon.

The disk-shaped concretions occur near a zone of ordinary, light yellowish-gray (5*Y* 8/1*), ellipsoidal calcareous concretions, from 5 to 8 cm in diameter and from 1 to 2 cm thick, in a highly foraminiferal, obscurely color-laminated, olive-gray (5*Y* 4/1) mudstone.

The newly found specimens are light olive-gray, nearly circular, and almost perfectly flat disks with a maximum thickness of little more than 1 mm and diameters of 40, 43, 60, and 100 mm. They are calcareous, and, in reflected light, the partly radiating structure of the calcite crystals which impregnated the mudstone is easily visible.

Unusual, ultrathin concretion from the Yamhill Formation

These concretions were formed along planar fractures inclined about 25° to the color bedding in the mudstone, so that the laminations show across the diameter of the concretions. Therefore, they were emplaced at a later stage of ground-water deposition than the ordinary concretions, which are parallel to the bedding.

* Terminology describing color taken from Rock-Color Chart prepared by Rock-Color Chart Committee and sold by Geological Society of America, Boulder, CO 80301.

Marine geology in U.S. faces challenge of new frontier

March 10, 1984, will be the first anniversary of the presidential proclamation that extended the national domain for seabed resources to 200 nautical miles off the coasts of the continental United States and U.S.-related islands. This newly created U.S. Exclusive Economic Zone (EEZ) is approximately one and two-thirds larger than the corresponding onshore area. The proclamation means that the nation now claims jurisdiction over the mineral and energy resources believed to be contained within the nearly four billion acres of largely unexplored ocean bottom.

Assessment and development of minerals in the EEZ have been made a key part of the program of the U.S. Department of the Interior, and three of its agencies, the U.S. Geological Survey (USGS), the U.S. Bureau of Mines (USBM), and the Minerals Management Service, jointly sponsored a symposium in November 1983. A proceedings volume describing the conclusions and recommendations of the symposium will be published and made available to the public. The USGS recently published a description of its exploratory marine geology program ("The Marine Geology Program of the U.S. Geological Survey," USGS Circular 906) and an information booklet entitled "The Exclusive Economic Zone: An Exciting New Frontier."

The resource potential of the EEZ is expected to include petroleum and heavy minerals such as titanium, platinum, gold, and cobalt. Most of the zone, however, is still unexplored; intensified exploration efforts may produce many new discoveries. Such exploration will also benefit the progress of onshore geologic studies by increasing understanding of geologic features that are common to both offshore and onshore geology.

Off the coast of Oregon, the most promising mineral-resource area known so far is the southern end of the Juan de Fuca Ridge, an active sea-floor spreading center that is known to include at least six hot-water vents. These vents deposit polymetallic sulfides that are judged to contain high quantities of zinc and iron and lesser quantities of silver and cadmium. The USBM has analyzed some early samples provided by the USGS and has developed a leaching process to recover silver and zinc from those deposits. One of the analyzed samples contained a zinc concentration high enough for direct processing in a conventional zinc smelter. Details of the sample analyses and leaching tests are described in USBM Technical Progress Report 122, "Cl_2-O_2 Leaching of Massive Sulfide Samples from the Southern Juan de Fuca Ridge, North Pacific Ocean."

If further study shows these deposits are large enough, they may be considered for future mining. Such mining will have to be highly inventive, since sea-floor mining technology is not yet fully developed, and the deposits on the ridge crest are under nearly 8,000 ft of water.

The USBM and USGS reports mentioned above are available free, in single copies, from the following addresses: Publications Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh, PA 15213 (phone 412-621-4500, ext. 342); and Branch of Distribution, U.S. Geological Survey, 604 South Pickett St., Alexandria, VA 22304 (phone 703-756-6141).

—Compiled from USBM and USGS news releases

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John Eliot Allen, Emeritus Professor of Geology, Portland State University

PSU students win awards at Northwest Mining Convention

Two Portland State University students won awards for poster session presentations at the Northwest Mining Association Convention held in Spokane, Washington, last December.

Christine Budai won first prize for her presentation, "Depositional Model of the Antelope Coal Field, Wyoming," and was awarded a Hewlett-Packard programmable calculator.

Christine Budai

Michael Johnson won third prize for his presentation, "Geology, Alteration, and Mineralization of a Silicic Volcanic Center, Glass Buttes, Oregon," and received an award of fifty dollars.

Michael Johnson

Prizes were awarded to the top five of twenty-six poster sessions. The presentations were judged mainly on expertise in the area of study, clarity of presentation, and diagrammatic representation. The winning PSU students are both master's candidates working under Professor M.L. Cummings, Ph.D., Economic Geologist in PSU's Department of Geology. □

Walter Sullivan receives award from earth-science editors

Walter Sullivan, science editor of *The New York Times*, was named recipient of the Association of Earth Science Editors' (AESE) Award for Outstanding Editorial or Publishing Contributions. The award was presented at the association's annual meeting, which was held October 9-12, 1983, in Houston, Texas.

Sullivan, who has served as science editor for the *Times* since 1964, was recognized for his singular achievements in communicating scientific information to the public principally through the newspaper medium.

In addition to his regular contributions to the pages of *The New York Times*, Sullivan has written several books that have served effectively to communicate new scientific concepts to the informed reader. His book *Continents in Motion–The New Earth Debate* (McGraw Hill, 1974) outlines the impact of the concept of global plate tectonics on scientific thought and investigation.

Past award recipients include Philip H. Abelson of the American Institute of Physics, Brian J. Skinner of Yale University, Robert L. Bates of Ohio State University, and Wendell Cochran of the American Geological Institute.

The Association of Earth Science Editors is a member society of the American Geological Institute. It was founded in 1967 to foster education and to promote the interchange of ideas on general and specific problems of selection, editing, and publishing in the earth sciences. The association numbers about 350 members, most of whom work in the United States and Canada. Its next annual meeting will be held October 8-10, 1984, in Portland, Oregon. □

(**Glass Buttes**, *continued from page 18)*

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NWMA elects new leaders

The Northwest Mining Association (NWMA), an organization that represents the interests of the minerals industry in Alaska, Idaho, Montana, Oregon, Washington, and western Canada, elected new officers for 1984 at its 89th annual convention in Spokane, Washington, in December 1983.

The 1984 president is George D. Tikkanen, Vice President for Mining and Exploration, Cominco American Inc. Lees J. Burrows, Blue Bore Inc.; Eberhard Schmidt, Amoco Minerals Co.; and Karl W. Mote were elected First, Second, and Third Vice Presidents, respectively.

New trustees are Earl H. Bennett, Idaho Bureau of Mines and Geology; Bonnie Butler Bunning, Washington State Department of Natural Resources; Eugene Callahan, Coeur d'Alene Mines Corp.; Martin W. Dippold, Cominco American Inc.; Gene K. Ealy, Hecla Mining Co.; Ray W. Hammitt, Amoco Minerals Co.; Buster LaMoure, U.S. Forest Service; Fred. H. Lightner, Pegasus Gold Corp; Joseph F. McAleer, Molycorp Inc.; Gregory E. McKelvey, Cominco American Inc.; Walter C. Meyers, Amselco Exploration Inc.; and Philip J. Rush, American Copper and Nickel Co., Inc. □

Northwest Petroleum Association expands scope of activities

The Northwest Petroleum Association (formerly the Northwest Association of Petroleum Landmen) has expanded its membership to include all those engaged in energy resource exploration, development, and management. The Association's goal is to promote communication and education among its members, government, and the Northwest community. The Association will also promote exploration in the Northwest.

Officers for 1983-84 are Garth T. Tallman, Tallman & Associates, President; Vern C. Newton, Consulting Geologist, Vice-President; Barbara B. Portwood, Oregon Natural Gas Development Corporation, Secretary; and Ron L. Hordichok, Northwest Natural Gas Company, Treasurer. Directors are Wesley G. Bruer, Consulting Geologist, Bert B. Mueller, Reichhold Energy Corporation, and S. Kyle Huber, Huber & Associates.

Those persons interested in membership should call (503) 226-4211, extension 4308, or write to Barbara B. Portwood, Secretary, Northwest Petroleum Association, 220 N.W. Second Avenue, Portland, OR 97209. □

Isochron/West features index to K-Ar age determinations in Oregon

The August 1983 issue of *Isochron/West* features a paper entitled "Index to K-Ar Determinations for the State of Oregon," by Robin B. Fiebelkorn, George W. Walker, Norman S. MacLeod, Edwin H. McKee, and James G. Smith, all of the U.S. Geological Survey (USGS). The report includes a 38-page table of all the available potassium-argon age determinations on rocks and minerals in the State of Oregon by county. The age determinations came from published reports and unpublished USGS and non-USGS investigations through December of 1982. Index maps showing sample locations from various parts of the state are included in the back of the paper.

Isochron/West is sponsored jointly by the New Mexico Bureau of Mines and Mineral Resources and the Nevada Bureau of Mines and Geology. Single issues of the magazine are available for $2 and may be purchased from *Isochron/West*, c/o New Mexico Bureau of Mines and Mineral Resources, Campus Station, Socorro, New Mexico 87801. □

USGS offers publications on national parks

A detailed list of the reports and maps of the U.S. Geological Survey (USGS) that describe the geologic processes that shaped the varied landscapes and scenic beauty of the national parks is available to the public.

As visitors travel through the scenic park areas, they are treated to spectacular vistas such as Old Faithful Geyser in Yellowstone National Park, Yosemite's El Capitan, or the deep gorge of the Grand Canyon that tell a long and exciting history in their exposed rocks. The USGS has published a variety of maps and reports on these and other scenic wonders to help people understand the processes that have created them.

The detailed list describes 64 selected publications on 40 national parks and includes information on the availability of each publication and ordering instructions. Publications range from special topographic maps to geologic maps and professional papers that focus on a specific aspect of the geology in an area and include materials suitable for both technical and nontechnical audiences.

Copies of the list are available free upon request from the Geologic Inquiries Group, U.S. Geological Survey, 907 National Center, Reston, VA 22092. The list is also available over the counter at the 10 USGS Public Inquiries Offices; the one for the Orgon region is at 678 U.S. Courthouse, West 920 Riverside Ave., Spokane, WA 99201, phone (509) 456-2524. □

AGI tabulates numbers of geology students

In its monthly newsletter *Geospectrum*, the American Geological Institute (AGI) published results of an annual study of student enrollment in geoscience departments. Conducted by AGI's Nick Claudy, editor of the *Directory of Geoscience Departments*, the study produced the following information:

Of the 560 degree-granting departments in the United States and Canada, 478 returned his questionnaires.... For 1982-83, the total number of geoscience students at all levels in the U.S. was 47,301, or 6.4 percent more than the year before. Male enrollment rose 6.7 percent, female, 5.5 percent.... The U.S. had 36,893 undergraduate majors (up 7.4 percent), 7,511 master's candidates (up 2.2 percent), and 2,897 Ph.D. candidates (up 5 percent).... Of the total geoscience enrollment, geology accounted for 34,884 (74 percent).... In earth-science teaching, enrollment rose for the first time in nine years, by 3.5 percent.... Degrees totaled 9,586 (1.8 percent more men, 3.5 percent more women).... Bachelor candidates were up by 5.4 percent; masters down by 7.2 percent; doctors down by 3.9 percent.... The total for minority students rose from 1,224 to 1,240, up 1.3 percent. American Indians and native Alaskans rose 113.5 percent, and Asians and Pacific Islanders 18.6 percent. But Hispanic numbers fell 3.4 percent and American Blacks 17.1 percent.... Only 202 degrees were awarded to members of minority groups, meaning even more trouble ahead for companies and schools concerned with equal-opportunity quotas. □

Lecture on Thomas Condon available in print

The life of Oregon's pioneer paleontologist and early state geologist Thomas Condon was the subject of the Sixth Annual Helen Oliver Memorial Lecture at the First Congregational Church in Portland on October 29, 1983. The lecture was given by Egbert S. Oliver, Emeritus Professor of English at Portland State University.

The printed lecture, "Thomas Condon of Oregon," is now available for $2 as an illustrated booklet at the bookstore of the Oregon Historical Society, 1230 SW Park Ave., Portland, OR 97205. □

NEW DOGAMI PUBLICATIONS

Four new reports were released by the Oregon Department of Geology and Mineral Industries (DOGAMI) during January. They are described below and are available for purchase or inspection at the DOGAMI offices in Portland, Baker, and Grants Pass, whose addresses are listed in the box on page 14. Prepayment is required for all orders under $50.

Released January 1, 1984:

FIFTH ANNUAL REPORT OF THE STATE MAP ADVISORY COMMITTEE FOR OREGON, 1983, by J.D. Beaulieu, Committee Chairman. DOGAMI Open-File Report O-84-1, $2.00.

The State Map Advisory Committee is composed of representatives from federal and state agencies and universities and is charged by Executive Order to identify the state's needs in the area of mapping and to coordinate all mapping efforts for maximum efficiency. The committee gives direction to mapping projects in Oregon and has as its major long-term objectives the completion of the 7½-minute topographic map series and the coordinated development of a digital map data base for the state.

This 39-page report contains summaries of the committee's activities, meetings, and workshops and of the progress of digital mapping by state agencies in 1983; statistical summaries of the year's mapping accomplishments; and the report of the Resident Cartographer to the State of Oregon. It also includes a membership and selected mailing list and the Governor's Executive Order on the reorganization of the committee.

A key factor of the committee's success is the work of the Resident Cartographer to the State of Oregon. This position was created by a cooperative agreement between the U.S. Geological Survey and the State of Oregon. One of the past year's accomplishments for the committee and the Resident Cartographer was the recent completion of a two-volume set of Oregon geographic names – a computerized compilation of all the geographic names which appear on topographic maps of Oregon.

Released January 3, 1984:

MINERAL POTENTIAL OF THE FALL CREEK MINING DISTRICT: A GEOLOGICAL-GEOCHEMICAL SURVEY, by J.J. Gray and D.A. Berri. DOGAMI Open-File Report O-83-5, $6.00.

More widespread mineralization than had been known before in the area and a likely economic potential for gold and silver were found in the study of the Fall Creek district north of Oakridge in Lane County, an old mining area that produced gold for some time in the past between 1901 and 1931. The report was prepared for the U.S. Forest Service (USFS) and was intended to assist the USFS in the planning and management of that part of the Willamette National Forest which is located in the Sardine Butte 15-minute quadrangle.

In the survey, information on known mineral deposits was reviewed and updated, a geologic map of the Sardine Butte quadrangle was prepared (scale 1:62,500), zones of alteration were mapped, and 124 stream-sediment and rock-chip samples were analyzed geochemically for gold, silver, arsenic, copper, mercury, molybdenum, lead, and zinc. The 32-page report is accompanied by one map and two microfiche, the latter containing raw analytical data and computer-generated statistical analyses of the data.

Released January 6, 1984:

SURVEY OF POTENTIAL GEOTHERMAL EXPLORATION SITES AT NEWBERRY VOLCANO, DESCHUTES COUNTY, OREGON, edited by G.R. Priest, B.F. Vogt, and G.L. Black. DOGAMI Open-File Report O-83-3, $20.00.

View of Newberry caldera, looking south.

Newberry volcano, located south of Bend in central Oregon and best known for the two lakes, Paulina and East Lakes, in its caldera, may possess significant geothermal resources under both the caldera itself and large areas of the volcano's flanks. That is the main conclusion of a variety of studies undertaken by DOGAMI for the Bonneville Power Administration.

The report consists of 174 pages of text, illustrations, and appendices and is accompanied by eight blackline maps. It compiles and interprets the available geologic, hydrologic, geochemical, and geophysical data on the volcano and concludes with detailed recommendations for further geothermal exploration. For the study, new aeromagnetic and gravity maps were interpreted by A. Griscom and C.W. Roberts of the U.S. Geological Survey; D.D. Blackwell and J.L. Steele of Southern Methodist University developed numerous theoretical conductive and convective heat-flow models for a wide range of possible magmatic heat sources; and in a new soil-mercury survey 1,641 samples were analyzed and plotted on a soil-mercury contour map that covers most of the 500 sq mi of Newberry volcano.

Released January 13, 1984:

GEOLOGY AND GEOTHERMAL RESOURCES OF THE CENTRAL OREGON CASCADE RANGE, edited by G.R. Priest and B.F. Vogt. DOGAMI Special Paper 15, $11.00.

The results of six years of geologic and geothermal research on the central Oregon Cascade Range have been compiled and analyzed in this study. It contains contributions by many researchers, both from DOGAMI and universities in Utah and Texas, and was funded primarily by the U.S. Department of Energy.

The 124-page publication includes four new one-color and two-color maps (two in the text, two as separate plates) of central Cascade areas that are of particular interest for geothermal exploration. It provides numerous new K-Ar dates and chemical analyses of volcanic rocks and tabulates and interprets all of the publicly available heat-flow data for the entire Oregon Cascade Range. A final chapter discusses geothermal exploration targets and techniques for the central Cascades.

From all current geologic, geochemical, and geophysical data, the report develops a volcano-tectonic model for the study area, concluding that Basin and Range spreading processes have strongly affected the central Cascades during the last 8 to 10 million years and possibly earlier. □

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