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VOLCANOES OF THE PORTLAND AREA, OREGON

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Introduction

In our present concern with possible volcanic activity in the Cascades, it seems appropriate to summarize what we know about past volcanic activity in the Portland area and its possible structural significance. A recent paper (Allen, 1974) noted that several vents and lava tubes on the west side of the Portland Hills represented the westernmost group of large Plio-Pleistocene centers of volcanic activity in the Northwest.

This, however, by no means suggested the total extent of late volcanism in the Portland area. Within a 13-mile radius of Kelly Butte (Plate 1) there are over 32 volcanic vents; within a 20-mile radius centered at Troutdale there are 90 volcanic centers. Most of these were originally small cinder cones like Pilot Butte and Lava Butte near Bend, Oregon, but some of them, such as Mount Sylvania in southwest Portland, Highland Butte 10 miles southeast of Oregon City, and Larch Mountain south of the Columbia River Gorge, were low, broad lava domes of the type called "shield volcanoes."

The densest concentration of volcanic vents lies west of the town of Boring, where 20 centers occur within an area of about 36 square miles. Because of this grouping near Boring, Ray Treasher (1942) first gave the name "Boring lava" to the lava, cinders, and ash which emanated from volcanic centers in the Portland area within a time span of from perhaps 10 million to less than 1 million years ago (Trimble, 1963). Some, like Bob's Mountain in Washington, may be very young indeed.*

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*More exact dating of the Boring Lava is urgently needed. Potassium-argon analyses are very expensive, but even five or six would help to determine the age range. Beeson (pers. commun., 1975) and his students have already determined from geochemical studies that Boring Lava from different localities falls into at least three types - a suggestion that its extrusion might span a long time range.

Photo 1. Looking east from Portland Heights toward Mount Hood. At least eight vents of Boring Lava are shown in east Portland and several more in the distance. (Photo courtesy State Highway Division)

Trimble (1963) mapped the areal extent of the Boring lava in the Portland area and mentioned (p. 36-42) that it erupted from 30 centers, but gave the exact location of only a few vents. Geomorphologic study of the new $7\frac{1}{2}$-minute quadrangles (not available to Trimble) allows fairly accurate location of many of these and also other vents. The degree of assurance attributed to the identification given is indicated by the legend symbols (certain, probable, possible) used on Plate 1.

I wish to thank my colleagues at Portland State University for their suggestions while I was writing this paper and for their careful review of it.

Types of Volcanoes

Depending upon the viscosity of the lava, and, in turn, upon the chemical composition and gas content, molten volcanic material may produce a variety of different landforms (MacDonald, 1972; Williams, 1948). Figure 1 summarizes these variations in form which accompany differences in gas content, viscosity, and composition. As the silica content in the magma increases from basalt to andesite to rhyolite, the violence of the eruption usually increases along with the viscosity in the order presented.

The Boring Lava landforms are restricted to types 2 and 3 (Figure 1). The type of activity was well described by Foshag and Jenaro (1956) in their paper on the birth and development of a recent volcano, Paricutin, in central Mexico. Between 1943 and 1947, the volcano built up to over 1,000 feet and emitted lava flows from its base that eventually totalled a thickness of 500 to 800 feet and covered over 10 square miles.

Volcanism in the Paricutin area (Figure 2-B) during the last 100,000 years has nearly duplicated what occurred in the Portland area a million or more years ago. Like the northern Willamette Valley, the Paricutin area lies adjacent to a line of great composite volcanoes which extends for 500 miles.

Identification Procedures

In identifying the Portland area vents on topographic maps, judgments were made as to the degree of erosion of the original landform. For example, relatively recent cinder cones (e.g., Bob's Mountain, No. 9, Plate 1) show a crater outlined by an arcuate ridge, usually lower on one side as the result of breaching by erosion. Within the vent area of a cinder cone, there is frequently a hardened plug of massive lava surrounded by outward-dipping layers of cinders which are less resistant to erosion than the plug. Upon further erosion, if the plug stood high within the cone, the resistant plug may eventually stand out as a distinct promontory above the lava surrounding the cone. If the plug did not rise above the lava, erosion of the cone may leave only the dome of lava. The latter is true for many of the Portland area vents. Since the period of activity in the Portland area lasted for

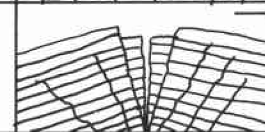
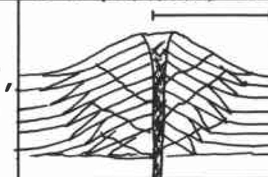
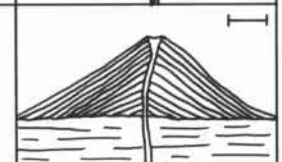
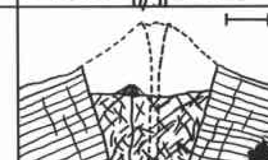
Type	Characteristics	Examples	Sketches
1. Flood or plateau basalt	Very liquid lava; flows very widespread; emitted from fractures	Columbia River Plateau	One mile: 
2. Shield volcano	Liquid lava emitted from a central vent; large; sometimes has a collapse caldera	Larch Mtn., Sylvania, Highland Butte, Hawaiian volcanoes	
3. Cinder cone	Explosive liquid lava; small; emitted from a central vent; if continued long enough, may build up shield volcano	Mount Tabor, Mount Zion, Chamberlain Hill, Pilot Butte, Lava Butte	
4. Composite volcano	More viscous lavas, much explosive (pyroclastic) debris; large, emitted from a central vent	Mount Hood, Mount St. Helens	
5. Plug dome	Very viscous lava; relatively small; can be explosive; commonly occurs adjacent to craters of composite volcanoes	Mount Lassen, Shastina, around Crater Lake, Mono Craters	
6. Caldera	Very large composite volcano collapsed after an explosive period; frequently associated with plug domes	Crater Lake, Newberry Caldera	

Figure 1. Types of volcanoes including examples and sketches.

perhaps 10 million years, all degrees of erosion have shaped the present landforms. An excessive degree of erosion may leave considerable doubt as to the identification. Indeed, a number of the vents in the "possible" category may represent upland remnants of a larger shield which has been dissected by radial streams.

In summary, the symbols on Plate 1 define the degrees of assurance as follows:

<u>Certain:</u> Crater rim remnants, massive vent lavas or pyroclastics exposed, isolated promontories at elevations equal to or above adjacent areas.

<u>Probable:</u> Pronounced promontories equal in elevation or only slightly lower than other possible sources; sloping for considerable distances away from the summits.

<u>Possible:</u> Low promontories within a dissected shield area, lower in elevation than others.

Lavas and Pyroclastics

"The Boring lava is composed mainly of basaltic flow rocks, but locally contains tuff-breccia, ash, tuff, cinders and scoriaceous phases" (Trimble, 1963, p. 38). The Boring Lava, originating in the Portland area, is quite different from Yakima Basalt (Columbia River Basalt), which originated outside the area. The Boring, as compared to the Yakima, is gray rather than dark gray to black, and the jointing is generally massive or blocky rather than columnar or brickbat. Still more characteristic of the Boring Lava, as seen in thin section, is the meshwork of minute plagioclase laths (pilotaxitic texture) commonly with open spaces between the laths (diktytaxitic texture). The Boring Lava contains olivine, rare in Yakima Basalt, and there is a very distinct geochemical difference between the two types of lavas (Beeson, personal communication 1975).

Location of Vents

Because of the necessarily small scale of Plate 1, Table 1 was compiled; it lists the vents on the map by legal subdivisions (section, township, and range), gives their elevation, and indicates the U.S. Geological Survey maps upon which they were located.

Density of Vents and Possible Structural Patterns

Eight-five of the vents in the Portland area are shown on Figure 2-A. For comparison, Figure 2-B shows 175 vents in the Paricutin area (Williams, 1950, pl. 8), and Figure 2-C shows 205 vents in the Newberry Crater quadrangle (Williams, 1957). The squares in all three figures are 6 miles on a side (36 square miles) and the number within each square represents the

Table 1. Location and elevation of 95 vents, including multiple vents, in the Portland area

Map No.	Name	Location Sec. T. Range	Quadrangle	Elevation
North of the Columbia River (17 vents)				
1	Green Mountain	SE2, 2N, 3E	Camas 15'	804
2	Brunner Hill (2 vents)	SE23, 2N, 3E	Camas 15'	680
3	Prune Hill (W)	NE 8, 1N, 3E	Camas $7\frac{1}{2}$'	555
4	Prune Hill (E)*	SE 9, 1N, 3E	Camas $7\frac{1}{2}$'	610
5	Mount Norway (2)	SE34, 2N, 4E	Camas 15'	1,111
6	Nichol's Hill	NE 2, 1N, 4E	Camas 15'	1,113
7	Bear Prairie	SE24, 2N, 4E	Bridal Veil 15'	1,300
8	Pohl's Hill	SE19, 2N, 5E	Bridal Veil 15'	1,395
9	Bob's Mountain	NW22, 2N, 5E	Bridal Veil 15'	2,110
10	Bob's Mountain (S)	NE15, 2N, 5E	Bridal Veil 15'	1,690
11	Bob's Mountain (N)	W$\frac{1}{2}$22, 2N, 5E	Bridal Veil 15'	1,775
12	Unnamed	SW18, 2N, 6E	Bridal Veil 15'	2,785
13	Unnamed	SE24, 2N, 5E	Bridal Veil 15'	2,550
14	Mount Pleasant	NE18, 1N, 5E	Bridal Veil 15'	1,010
15	Mount Zion	SW9, 1N, 5E	Bridal Veil 15'	1,465
West of the Willamette River (14 vents)				
16	Unnamed	NE21, 1N, 1W	Linnton $7\frac{1}{2}$'	455
17	Unnamed	NE27, 1N, 1W	Linnton $7\frac{1}{2}$'	650
18	Unnamed	NW27, 1N, 1W	Linnton $7\frac{1}{2}$'	505
19	Unnamed	SW27, 1N, 1W	Linnton $7\frac{1}{2}$'	550
20	Unnamed	SE27, 1N, 1W	Linnton $7\frac{1}{2}$'	565
21	TV Hill	C 36, 1N, 1W	Linnton $7\frac{1}{2}$'	1,275
22	Swede Hill	NW1, 1S, 1W	Linnton $7\frac{1}{2}$'	995
23	Unnamed	NW1, 1S, 1W	Linnton $7\frac{1}{2}$'	974
24	Elk Point (2)	SE 1, 1S, 1W	Portland $7\frac{1}{2}$'	975
25	Mount Sylvania (2)	SW32, 1S, 1E	Lake Oswego $7\frac{1}{2}$'	975
26	Cook's Butte (2)	SW 16, 2S, 1E	Lake Oswego $7\frac{1}{2}$'	718
East of Willamette River and north of Powell Valley Road (Hwy 26) (19 vents)				
27	Mount Tabor*	NW5, 1S, 2E	Mount Tabor $7\frac{1}{2}$'	535
28	Rocky Butte (2)	NE 28, 1N, 2E	Mount Tabor $7\frac{1}{2}$'	612
29	Kelly Butte (2)*	NE 9, 1S, 2E	Mount Tabor $7\frac{1}{2}$'	400
30	Chamberlain Hill	NW32, 1N, 4E	Bridal Veil 15'	890
31	Ross Mountain	SE 31, 1N, 5E	Bridal Veil 15'	1,380
32	Pepper Mountain (2)	NE34, 1N, 5E	Bridal Veil 15'	2,137
33	Devil's Rest (2)	NE24, 1N, 5E	Bridal Veil 15'	2,450
34	Larch Mountain	NE32, 1N, 6E	Bridal Veil 15'	4,056

* Top of hill is Troutdale Formation

Table 1, continued

Map No.	Name	Location	Quadrangle	Elevation
East of Willamette River and north of Powell Valley Road (continued)				
35	Unnamed	SW26, 1N,6E	Bridal Veil 15'	3,820
36	Palmer Peak	NE13, 1N,6E	Bridal Veil 15'	4,010
37	Nesmith Point	NE12, 1N,6E	Bridal Veil 15'	3,880
38	Unnamed	SE10, 1S, 5E	Cherryville 15'	1,780
39	Unnamed	NW23, 1S,5E	Cherryville 15'	2,280
40	Walker Peak	NE 24, 1S,5E	Cherryville 15'	2,450
41	Lookout Point	NE 13, 1S,5E	Cherryville 15'	2,645
42	Powell Butte*	NW13, 1S,2E	Gladstone $7\frac{1}{2}$'	560
43	Mount Scott (2)	W$\frac{1}{2}$ 27, 1S,2E	Gladstone $7\frac{1}{2}$'	1,095
44	Cemetery	SE 22, 1S, 2E	Gladstone $7\frac{1}{2}$'	910
45	Unnamed	SW24, 1S, 2E	Gladstone $7\frac{1}{2}$'	810
46	Scout Camp (3)	N$\frac{1}{2}$36, 1S, 2E	Gladstone $7\frac{1}{2}$'	945
47	Unnamed	SE 35, 1S, 2E	Gladstone $7\frac{1}{2}$'	866
48	Mount Talbert*	NW 3, 2S, 2E	Gladstone $7\frac{1}{2}$'	745
49	Unnamed (2)	SE 18, 1S, 3E	Damascus $7\frac{1}{2}$'	635
50	Unnamed	NE 21, 1S, 3E	Damascus $7\frac{1}{2}$'	995
51	Unnamed	SW21, 1S, 3E	Damascus $7\frac{1}{2}$'	997
52	Unnamed	N$\frac{1}{2}$ 22, 1S,3E	Damascus $7\frac{1}{2}$'	925
53	Unnamed	NW28,1S, 3E	Damascus $7\frac{1}{2}$'	1,129
54	Unnamed	N$\frac{1}{2}$ 27, 1S, 3E	Damascus $7\frac{1}{2}$'	1,085
55	Unnamed	N$\frac{1}{2}$32, 1S, 3E	Damascus $7\frac{1}{2}$'	777
56	Unnamed	N$\frac{1}{2}$33, 1S, 3E	Damascus $7\frac{1}{2}$'	877
57	Unnamed (3)	W$\frac{1}{2}$36, 1S, 3E	Damascus $7\frac{1}{2}$'	1,010
58	Unnamed	SE 30, 3S, 4E	Sandy $7\frac{1}{2}$'	902
59	Unnamed	C 5, 2S, 3E	Damascus $7\frac{1}{2}$'	695
60	Unnamed (2)	W$\frac{1}{2}$ 4, 2S, 3E	Damascus $7\frac{1}{2}$'	840
61	Unnamed	SE 4, 2S, 3E	Damascus $7\frac{1}{2}$'	882
62	Unnamed	NW 8,2S,3E	Damascus $7\frac{1}{2}$'	575
63	Unnamed (2)	NW18,2S,3E	Damascus $7\frac{1}{2}$'	555
64	Unnamed	NW15,2S,3E	Damascus $7\frac{1}{2}$'	830
65	Unnamed (2)	SE 23, 2S,2E	Gladstone $7\frac{1}{2}$'	800
66	Unnamed	SW24, 2S,2E	Gladstone $7\frac{1}{2}$'	825
67	Unnamed	N$\frac{1}{2}$ 27,2S,2E	Oregon City $7\frac{1}{2}$'	580
68	Unnamed	SE 25, 2S,2E	Oregon City $7\frac{1}{2}$'	775
69	Hunsinger Peak	NE 2, 3S, 2E	Oregon City $7\frac{1}{2}$'	657
70	Unnamed	NW17,3S,2E	Redland $7\frac{1}{2}$'	885
71	Unnamed	SW 19,3S,2E	Redland $7\frac{1}{2}$'	835
72	Unnamed	NW31,3S,2E	Redland $7\frac{1}{2}$'	873
73	Highland Butte (4)	E$\frac{1}{2}$ 9, 3S, 2E	Redland $7\frac{1}{2}$'	1,594
74	Lenhart Butte	SW35,2S, 5E	Cherryville 15'	2,117

* Top of hill is Troutdale Formation

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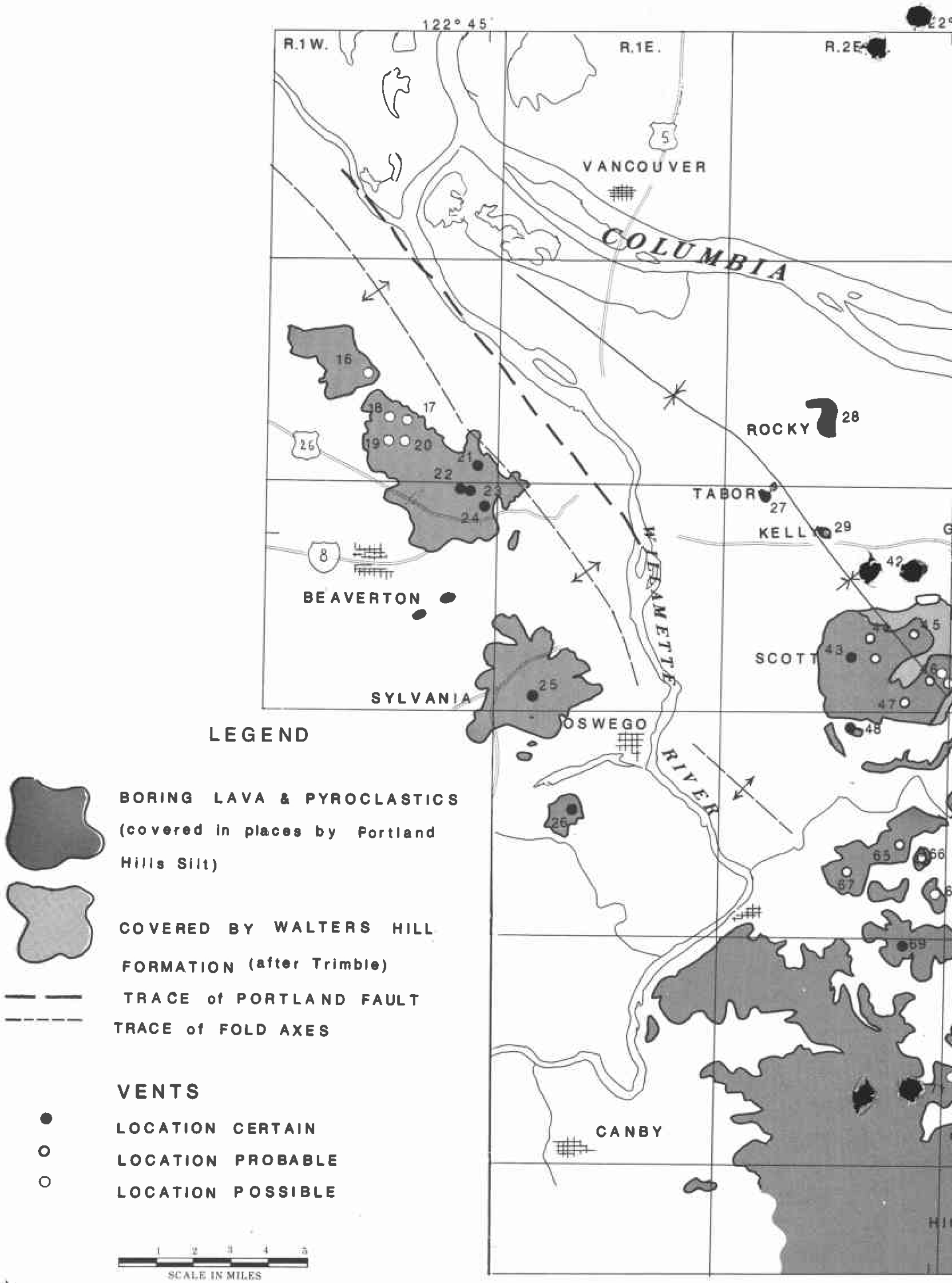
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SCOTT
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SYLVANIA
OSWEGO
WILLAMETTE
RIVER
26
65
66
67
68
69
CANBY
LEGEND
BORING LAVA & PYROCLASTICS (covered in places by Portland Hills Silt)
COVERED BY WALTERS HILL FORMATION (after Trimble)
TRACE of PORTLAND FAULT
TRACE of FOLD AXES
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LOCATION PROBABLE
LOCATION POSSIBLE
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SCALE IN MILES

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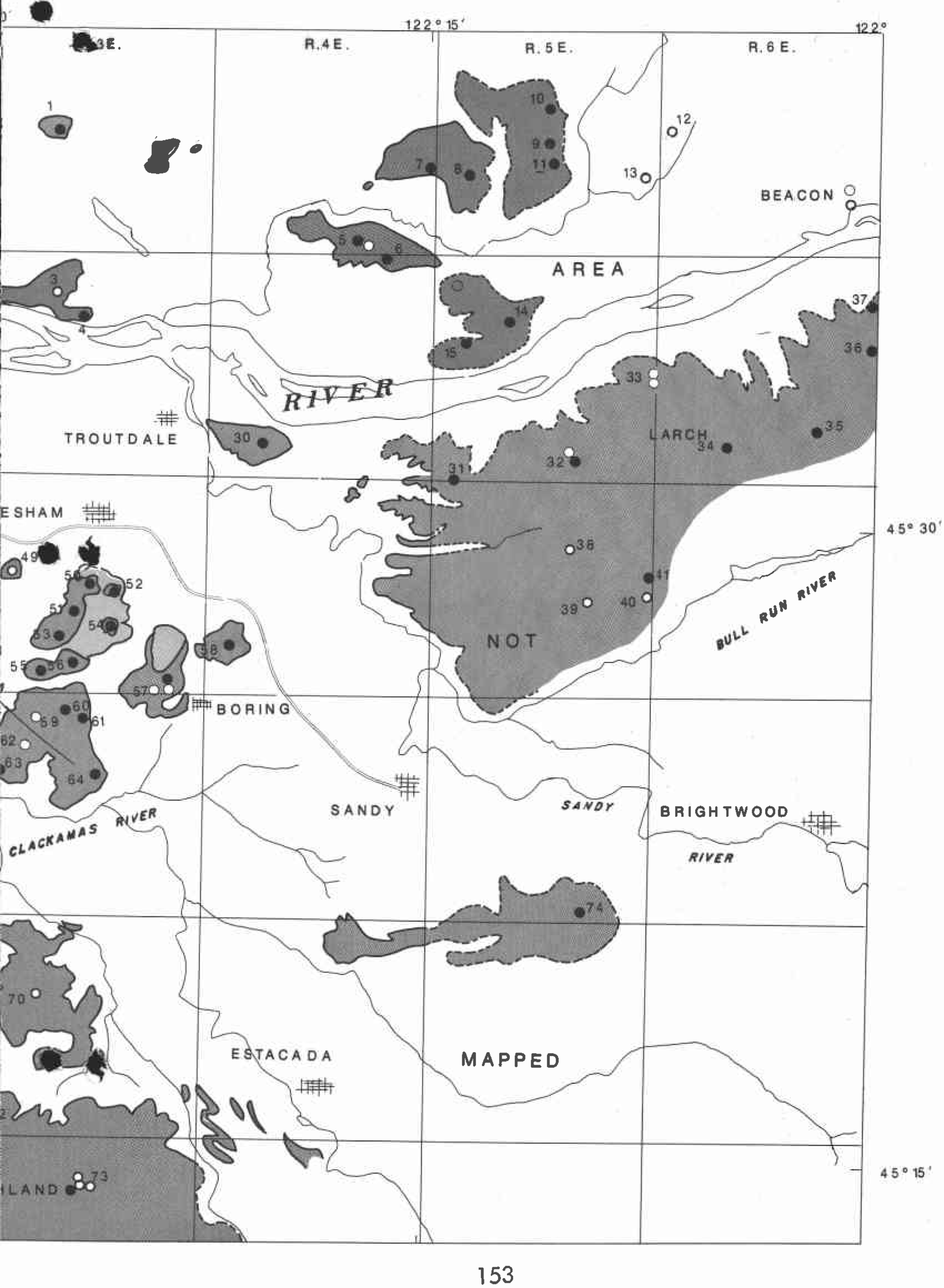
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BEACON
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NOT
BORING
SANDY
SANDY
BRIGHTWOOD
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CLACKAMAS RIVER
ESTACADA
MAPPED
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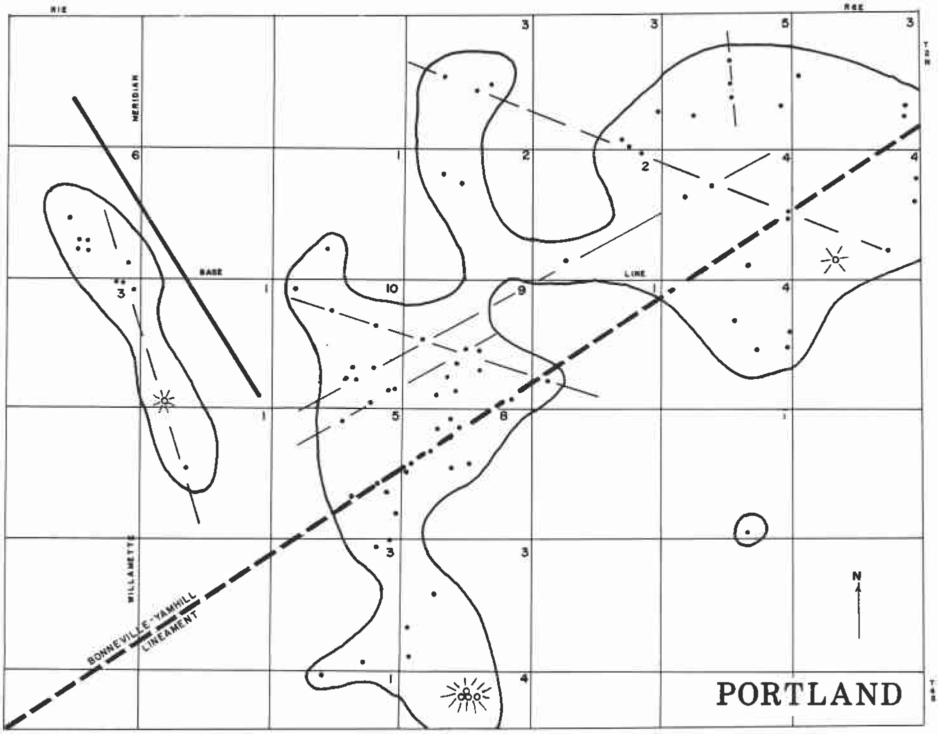
MERIDIAN
BASE
LINE
WILLAMETTE
BONNEVILLE-YAMHILL LINEAMENT
PORTLAND

Fig. 2A

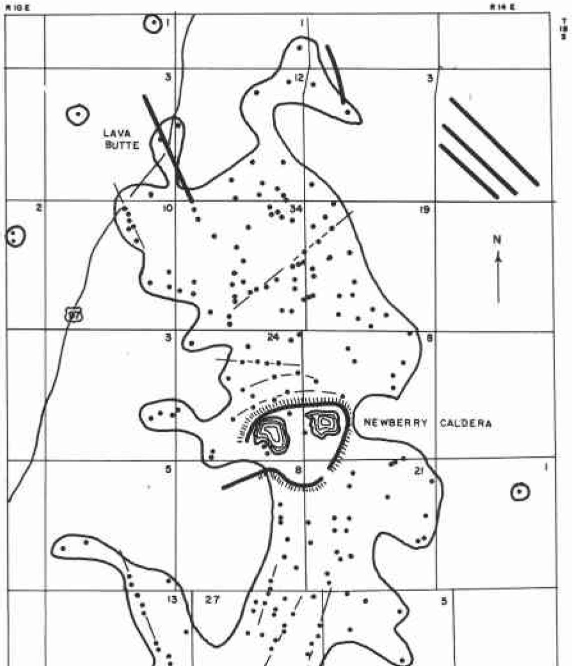
LAVA BUTTE
NEWBERRY CALDERA
NEWBERRY

Fig. 2C

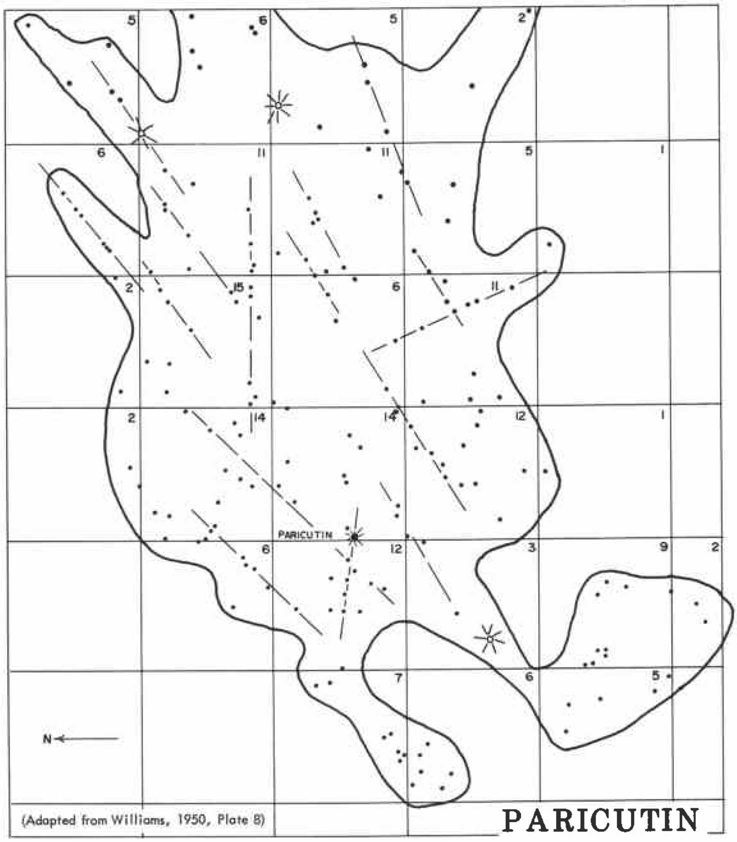

Fig. 2B

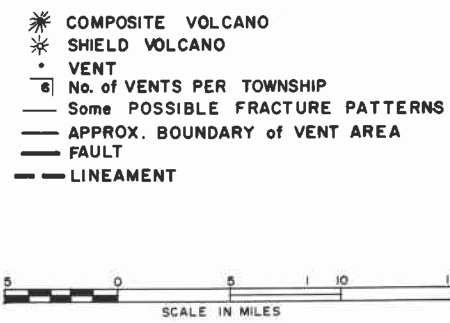

Figure 2. Comparison of vent patterns in: A – Portland area; B – Paricutin area; and C – Newberry Crater area.

number of vents. In the Portland area, there are no more than 10 vents in any one square; at Paricutin there are 15 and at Newberry 34. The average density of vents at Paricutin is thus almost double that of Portland; and Newberry is double that at Paricutin.

Many lineations (possible subjacent faults or fracture patterns) suggested by aligned vents could be drawn. Only a few of the most prominent are shown on Figure 2. It would be possible to program a computer with the location of the vents, to determine the best fits for these and alternate lineaments, and to determine the best probabilities.

One of the most obvious lineations in the Portland area (more than ten vents) corresponds to the Yamhill-Bonneville lineament, first suggested by Hammond (personal communication 1972) from completely different lines of evidence. Other geomorphic evidence also supports alignments in the Portland area (Schmela and Palmer, 1972).

Problems

The conjectural relationships of the possible strain patterns indicated by the lines of vents with such structures as the Portland Hills anticline and Willamette syncline, the (so-called) Portland Hills fault (Benson and Donovan, 1974), or with regional patterns, remains to be explored. The presence or absence of a fault bounding the east side of the Portland Hills has been a subject of controversy for 35 years. It was first suggested by Treasher (1942), but he did not show it on his map. Trimble (1963) did not show it on his map or cross section or mention it even as a possibility. Balsillie and Benson (1971) and Schmela and Palmer (1972) made strong arguments for its presence.

Many volcanic fields around the world are formed in grabens (down-dropped blocks of the Earth's crust). Allen (1966) suggested that the High Cascade volcanoes in Oregon are underlain by such a down-dropped block. If the Portland fault does exist, most of the Portland area lies on the down-faulted block, and the Boring volcanoes are related to the deformation.

Conclusions

1. The late volcanism in the Portland area is more extensive than is generally recognized.

2. Geomorphic studies of volcanic landforms and patterns can contribute structural evidence of value in the development of new geologic concepts.

3. Research is needed on the dating of the Boring Lava and development of the volcanic, geomorphic and structural history of the Portland area.

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COOS BAY COAL REPORT ON OPEN FILE

"Economic Factors Affecting the Mining, Processing, Gasification, and Marketing of Coos Bay Coals," by Ralph S. Mason, Deputy State Geologist, and Paul Hughes, Consultant, has been issued by the Department as open-file report O-75-6. The 61-page report is available for $2.00. Four topographic sheets showing coal reserves are also for sale at $2.00 each.

The report was prepared by the Oregon Department of Geology and Mineral Industries in cooperation with Coos County Board of Commissioners, the U.S. Bureau of Mines Process Evaluation Group, and the Oregon Economic Development Department.

* * * * *

GEOTHERMAL LEASES ISSUED IN LAKE COUNTY

Only four bids were offered July 31 for geothermal leases on 18 parcels of national resource lands in Lake County, Oregon. The bids were opened and accepted by the Bureau of Land Management. The land is within the Crump Geyser Known Geothermal Resource Area (KGRA).

The bids, all submitted by Chevron Oil Co., San Francisco, Calif., ranged from $5.12 to $3.11 per acre for the 9,462 acres in the four parcels. The remaining 14 parcels may be reoffered by BLM at a later date.

The amount bid is the bonus per acre offered the government for a lease. The successful bidder also pays an annual rental of $2.00 per acre for the first five years of the lease. For each of the next five years the rental is the amount of the preceding year, plus an additional $1.00 per acre. Upon production, a royalty is paid instead of rental.

Another group of parcels near Vale, Oregon will be offered by BLM for geothermal leasing on September 25, 1975.

* * * * *

GEOTHERMAL REPORTS ON OPEN FILE

The Department has recently placed two geothermal reports on open file. Copies are available at costs indicated below.

1. "Geothermal Studies and Exploration in Oregon," by R. G. Bowen, D. D. Blackwell, and Donald Hull. Open-file report No. O-75-7.

   The report is a 65-page summary of geothermal data gathered by the Department between 1972 and 1975 under a U.S. Bureau of Mines contract. Some of the information has previously been issued as open-file or published progress reports. As an outcome of the project, six anomalously high heat-flow areas were identified. The report contains temperature data from 140 bore holes and 5 deep holes drilled for the project and from 81 pre-drilled holes and 6 monitor wells. $2.00

2. "An estimate of southeast Oregon's geothermal potential," by Deborah Miles Fisher. Open-file report O-75-8.

   The 9-page report demonstrates the feasibility of adapting methods used by oil companies for calculating petroleum reserves to estimating geothermal resources in an untested area. Calculations are based on a comparison with statistics from The Geysers, an operating geothermal field in California. $1.00

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REICHHOLD ABANDONS FIRST HOLE, PLANS THREE MORE

Reichhold Energy Corp., Tacoma, Washington abandoned its "NNG-Crown Zellerbach 1" test hole near Tillamook at 5,557 feet in July and moved to a second site near McCoy in Polk County. The company has been issued 4 permits by the State Department of Geology and Mineral Industries.

Permit No. 65 API 36-052-00004 NNG-Crown Zellerbach 1	NE$\frac{1}{4}$ sec. 22, 2S, 10W Tillamook County	Abandoned at 5,557'
Permit No. 66 API 36-053-00021 NNG-Finn 1	SW$\frac{1}{4}$ sec. 17, 6S, 4W Polk County	Drilling; projected depth 7,000'
Permit No. 67 API 36-047-00007 NNG - Merrill 1	SW$\frac{1}{4}$ sec. 24, 8S, 4W Marion County	Location ready
Permit No. 68 API 36-009-00006 NNG-Crown Zellerbach 2	NW$\frac{1}{4}$ sec. 8, 4N, 3W Columbia County	Location ready

These drilling ventures are being done under a partnership arrangement between Reichhold Energy Corp. and Northwest Natural Gas Co. Both companies operate industries within the state; Reichhold manufactures fertilizer from natural gas, and Northwest Natural distributes gas in western Oregon.

Well records on drilling in Oregon are required to be kept confidential for two years after completion or abandonment but then are opened to the public.

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KLEPPE NOMINATED TO BE INTERIOR SECRETARY

On September 9, President Ford nominated Thomas S. Kleppe of North Dakota to be Secretary of the Interior. The nomination has been referred to the Senate Interior and Insular Affairs Committee, but no hearings have been scheduled on his confirmation.

Kleppe is presently Administrator of the Small Business Administration and served in the U.S. House of Representatives from 1967 to 1971. Kleppe was a member of the House Agriculture Committee during his four years in Congress.

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SOUTHWESTERN OREGON MINING ACTIVITY

During the past few months there has been a considerable amount of small-scale gold placer mining in southwestern Oregon. Most of this work is done by individuals using portable equipment to extract nuggets from small gravel deposits in the stream beds.

Mining companies continue to show interest in exploring for large deposits containing gold, silver, and copper. Ranchers Exploration and Development Corp. is conducting an exploration drilling program on the copper prospects near Bolivar Mountain northwest of Grants Pass. This mineralized area has been known for many years, but to date no one has been successful in outlining a sufficiently large ore body to warrant development.

American Selco, Inc. is drilling on the old Turner-Albright copper deposit in southwestern Josephine Company. A small amount of gold was produced at the Turner-Albright property many years ago, and if the price of copper goes up and sufficient tonnage is discovered the mine may be reactivated.

Interest remains high in exploration for and development of nickel in the extensive areas of ultramafic rock. Chromite is also receiving attention by mining companies in southwestern Oregon.

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HAVE YOU FOUND A METEORITE?

The Oregon Museum of Science and Industry (OMSI) at Portland and the Center for Meteorite Studies at the Arizona State University in Tempe, Arizona 85281 are cooperating in a program to facilitate the discovery of meteorites in the Pacific Northwest's unexplored meteorite areas and also to lend assistance in such discovery all across the nation. Meteorites are still occasionally dropping at random from the skies today, just as they have for an enormous length of time in the past. As these fragments come from remote regions in outer space where they have been in a condition of cosmic preservation for thousands of millions of years, the strange pieces of sky stone and iron offer scientists much information about their history and origin, and in a related way, also information about the history and origin of the solar system and of the earth. Thus meteorites provide valuable research material as well as being intersting relics for museum display or a rockhound's cabinet.

If you are fortunate enough to find a meteorite, notify OMSI or the Oregon Department of Geology and Mineral Industries.

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AVAILABLE PUBLICATIONS

(Please include remittance with order; postage free. All sales are final - no returns. Upon request, a complete list of Department publications, including out-of-print, will be mailed.)

BULLETINS

26. Soil: Its origin, destruction, preservation, 1944: Twenhofel. $0.45
33. Bibliography (1st suppl.) geology and mineral resources of Oregon, 1947: Allen . 1.00
35. Geology of Dallas and Valsetz quadrangles, Oregon, rev. 1964: Baldwin . . . 3.00
36. Papers on Tertiary foraminifera: Cushman, Stewart & Stewart. vol. 1-$1.00; vol. 2-1.25
39. Geology and mineralization of Morning mine region, 1948: Allen and Thayer . . 1.00
44. Bibliography (2nd suppl.) geology and mineral resources of Oregon, 1953: Steere. 1.00
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
52. Chromite in southwestern Oregon, 1961: Ramp 5.00
53. Bibliography (3rd suppl.) geology and mineral resources of Oregon,1962:Steere,Owen 3.00
57. Lunar Geological Field Conf. guidebook, 1965: Peterson and Groh, editors . . 3.50
60. Engineering geology of Tualatin Valley region, 1967: Schlicker and Deacon . . 7.50
61. Gold and silver in Oregon, 1968: Brooks and Ramp 7.50
62. Andesite Conference Guidebook, 1968: Dole 3.50
64. Geology, mineral, and water resources of Oregon, 1969 . . . . 3.00
65. Proceedings of the Andesite Conference, 1969: McBirney, editor (photocopy) . . 10.00
66. Geology and mineral resources of Klamath and Lake Counties, 1970. . . . . 6.50
67. Bibliography (4th suppl.) geology and mineral industries, 1970: Roberts . . . 3.00
68. Seventeenth biennial report of the Department, 1968-1970 . . . . 1.00
69. Geology of the southwestern Oregon Coast, 1971: Dott 4.00
70. Geologic formations of western Oregon, 1971: Beaulieu 2.00
71. Geology of selected lava tubes in the Bend area, 1971: Greeley 2.50
72. Geology of Mitchell quadrangle, Wheeler County, 1972: Oles and Enlows . . 3.00
73. Geologic formations of eastern Oregon, 1972: Beaulieu 2.00
75. Geology, mineral resources of Douglas County, 1972: Ramp 3.00
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 suppl.) geology and mineral industries, 1973: Roberts and others 3.00
79. Environmental geology inland Tillamook Clatsop Counties, 1973: Beaulieu. . . 7.00
80. Geology and mineral resources of Coos County, 1973: Baldwin and others . . . 6.00
81. Environmental geology of Lincoln County, 1973: Schlicker and others 9.00
82. Geol. Hazards of Bull Run Watershed, Mult. Clackamas Counties, 1974: Beaulieu 6.50
83. Eocene stratigraphy of southwestern Oregon, 1974: Baldwin 4.00
84. Environmental geology of western Linn Co., 1974: Beaulieu and others. . . . 12.00
85. Environmental geology of coastal Lane Co., 1974: Schlicker and others . . . 12.00
86. Nineteenth biennial report of the Department, 1972-1974 . . . . 1.00
87. Environmental geology of western Coos and Douglas Counties, Oregon, 1975 . . in press
88. Geology and mineral resources of upper Chetco River drainage, 1975: Ramp . . in press

GEOLOGIC MAPS

Geologic map of Oregon west of 121st meridian, 1961: Wells and Peck $2.00; mailed - 2.50
Geologic map of Oregon (12" x 9"), 1969: Walker and King 0.25
Geologic map of Albany quadrangle, Oregon, 1953: Allison (from Bulletin 37) . . . 1.00
Geologic map of Galice quadrangle, Oregon, 1953: Wells and Walker 1.50
Geologic map of Lebanon quadrangle, Oregon, 1956: Allison and Felts 1.50
Geologic map of Bend quadrangle, and portion of High Cascade Mtns., 1957: Williams 1.50
GMS-1: Geologic map of the Sparta quadrangle, Oregon, 1962: Prostka 2.00
GMS-2: Geologic map, Mitchell Butte quadrangle, Oregon: 1962 . . . . . . 2.00
GMS-3: Preliminary geologic map, Durkee quadrangle, Oregon, 1967: Prostka . . 2.00
GMS-4: Gravity maps, Oregon onshore & offshore; [set only]: at counter $3.00, mailed 3.50
GMS-5: Geology of the Powers quadrangle, 1971: Baldwin and Hess 2.00
GMS-6: Preliminary report, geology of part of Snake River Canyon, 1974: Vallier. . 6.50

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Available Publications, Continued:

SHORT PAPERS

18. Radioactive minerals prospectors should know, 1955: White and Schafer $0.30
19. Brick and tile industry in Oregon, 1949: Allen and Mason 0.20
21. Lightweight aggregate industry in Oregon, 1951: Mason 0.25
24. The Almeda mine, Josephine County, Oregon, 1967: Libbey . . . . 3.[illegible]

MISCELLANEOUS PAPERS

1. Description of some Oregon rocks and minerals, 1950: Dole 1.00
2. Oregon mineral deposits map (22 x 34 inches) and key (reprinted 1973): 1.00
4. Rules and regulations for conservation of oil and natural gas (rev. 1962) 1.00
5. Oregon's gold placers (reprints), 1954 . . . . 0.50
6. Oil and gas exploration in Oregon, rev. 1965: Stewart and Newton 3.00
7. Bibliography of theses on Oregon geology, 1959: Schlicker 0.50
   (Supplement) Bibliography of theses, 1959 to Dec. 31, 1965: Roberts 0.50
8. Available well records of oil and gas exploration in Oregon, rev. 1963: Newton . 1.00
11. A collection of articles on meteorites, 1968 (reprints from The ORE BIN) 1.50
12. Index to published geologic mapping in Oregon, 1968: Corcoran 0.50
13. Index to The ORE BIN, 1950-1974. . . . . in prep
14. Thermal springs and wells, 1970: Bowen and Peterson 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

OIL AND GAS INVESTIGATIONS

1. Petroleum geology, western Snake River basin, 1963: Newton and Corcoran . . . 3.50
2. Subsurface geology, lower Columbia and Willamette basins, 1969: Newton . . . 3.50
3. Prelim. identifications of foraminifera, General Petroleum Long Bell No. 1 well . . 2.00
4. Prelim. identifications of foraminifera, E. M. Warren Coos Co. 1-7 well: Rau . . 2.[illegible]

MISCELLANEOUS PUBLICATIONS

Landforms of Oregon: a physiographic sketch (17" x 22"), 1941 . . . . 0.25
Mining claims (State laws governing quartz and placer claims) 0.50
Oregon base map (22" x 30"). 0.50
Geologic time chart for Oregon, 1961 . . . . free
Postcard - geology of Oregon, in color . . . . 10¢ each; 3 - 25¢; 7 - 50¢; 15 - 1.00
The ORE BIN - Annual subscription . . . . ($8.00 for 3 yrs.) 3.00
Available back issues, each . . . . 25¢; mailed 0.35
Accumulated index - see Misc. Paper 13