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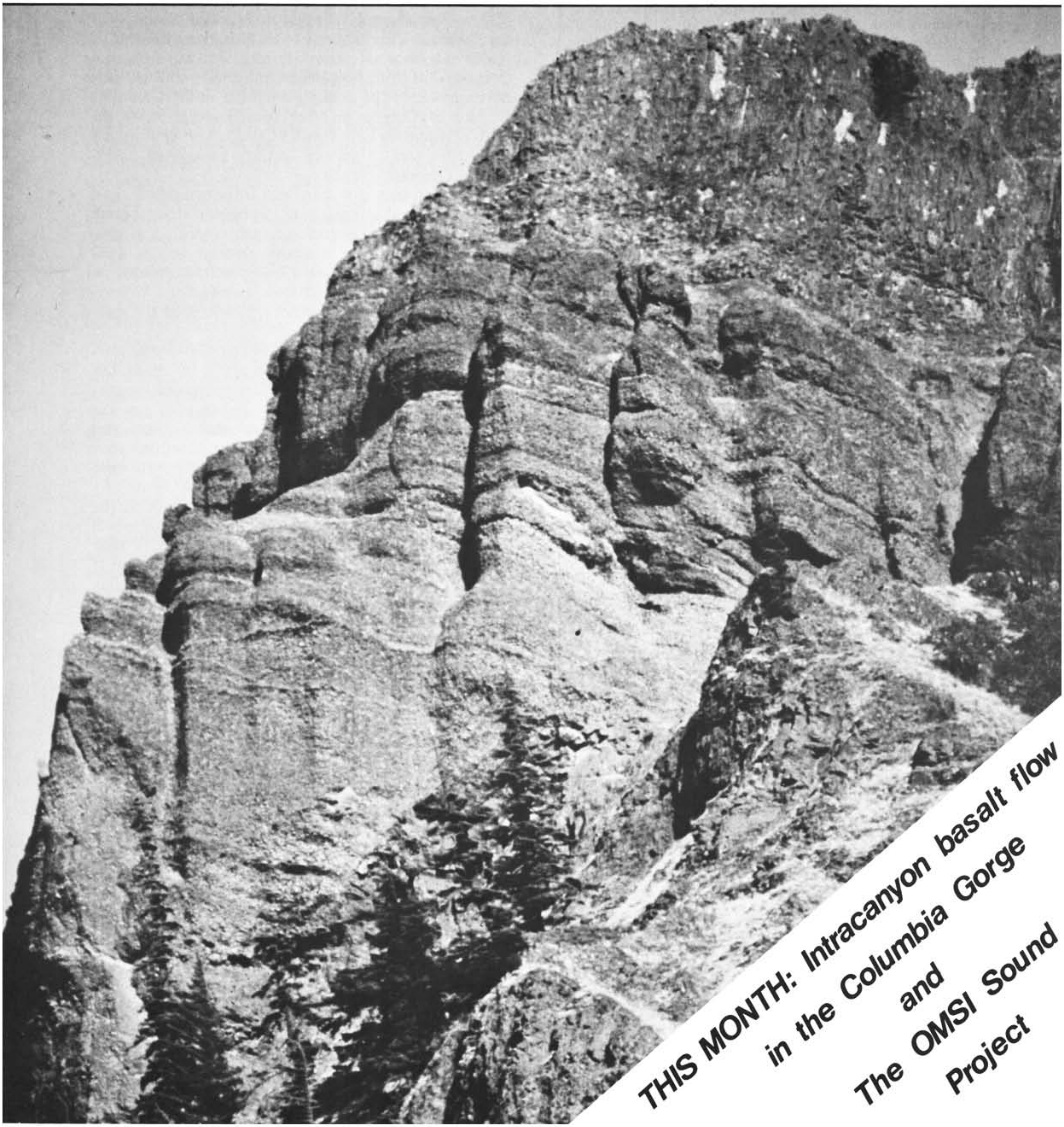

THIS MONTH: Intracanyon basalt flow in the Columbia Gorge and The OMSI Sound Project

# OREGON GEOLOGY

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**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

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## COVER PHOTO

Mitchell Point, in the Columbia River Gorge, as seen from rest area of east-bound lane of I-84, just east of mile post 58 and 2.4 mi east of Viento State Park. Article beginning on next page discusses this intracanyon flow of the Pomona Member of the Columbia River Basalt Group.

## Looking ahead:

We wish to thank you, our *Oregon Geology* readers, for your interest and support during the past, geologically eventful year.

For next year, we have scheduled a variety of interesting articles on such subjects as (1) the subduction-related origin of the volcanic rocks of the Eocene Clarno Formation near Cherry Creek, Oregon; (2) paleobotany of the Clarno Nut Beds; (3) fossil soils in the Clarno Formation; (4) the petrology and stratigraphy of the Portland Hills Silt—a Pacific Northwest loess; (5) a major Cretaceous discontinuity in north-central Oregon; and (6) the regional stratigraphy and tectonic environment of the Dalles Formation in the Columbia Plateau of Oregon and the formal elevation of the Dalles Formation to the Dalles Group. Also planned is a field trip guide to the pre-Tertiary geology of northeastern Oregon.

We also intend to keep you informed on oil, gas, geothermal, and mineral exploration and development in the State. As new geologic, geophysical, and geochemical data become available through our publications and other outlets, we will inform you. As always, we will print annual summaries, news of the Department, book reviews, and other geologic news throughout the year.

We strive always to make *Oregon Geology* a clearinghouse of geologic information about the State, but meeting this objective also requires continued support and input from you, our readers. Tell us what you like and what you don't like. Tell us what subjects you would like presented in future issues. Send us your news, your articles, your geologic photographs for consideration—for this is your magazine too.

In these inflationary days, costs of producing the magazine continue to increase. A larger circulation will help us keep our costs per copy down. So if your subscription is about to expire, remember to renew it. If you always read a library or borrowed copy, now may be the time to start your own subscription. If you have a friend who is interested in geology, why not give him (or her) a gift subscription to *Oregon Geology*?

Next year should be another great year for *Oregon Geology.* □

## CONTENTS

# Pomona Member of the Columbia River Basalt Group: an intracanyon flow in the Columbia River Gorge, Oregon

*by James Lee Anderson, U.S. Geological Survey, P.O. Box 341, The Dalles, Oregon 97058*

## ABSTRACT

The Pomona Member of the Saddle Mountains Basalt (Columbia River Basalt Group) occurs as an intracanyon flow greater than 75 m (250 ft) thick along the south side of the Columbia River Gorge beween Mitchell Point and Shellrock Mountain, Oregon. Best exposures are at Mitchell Point, where this flow caps more than 70 m (230 ft) of cobble conglomerate that partially fills a canyon cut into flows of the underlying Frenchman Springs Member. These exposures provide a necessary link between outcrops of the Pomona Member in the Columbia Plateau and western Washington. Post-Frenchman Springs, pre-Pomona canyon cutting implies deformation in the ancestral Cascade Range between about 14.5 and 12 million years ago.

## INTRODUCTION

The Pomona Member of the Saddle Mountains Basalt of the Miocene Columbia River Basalt Group has been found both east and west of the present-day Cascade Range. Geologists have long wondered where—and indeed if—it flowed from east to west through the area now covered by mountains. A lava flow in the Kelso-Cathlamet area (Kienle, 1971; Snavely and others, 1973) in southwest Washington is chemically, petrographically, and paleomagnetically identical to the widespread Pomona Member of the Columbia Plateau (Schmincke, 1967; Swanson and others, 1979a). Until now, however, no Pomona outcrops have been located in the broad intervening region, more than 120 km (74 mi) wide, that includes the Willamette lowland, the Cascade Range, and the Hood River Valley (Anderson, 1978; Timm, 1979; Beeson and Moran, 1979). The absence of local sources for the Pomona Member west of the Cascade Range and the presence of known vents in the eastern Columbia Plateau (Camp, *in* Swanson and others, 1979b) support the theory of a pathway through the late Miocene mountains connecting the two areas. It is the purpose of this paper to present the first direct evidence that the Pomona Member crossed the ancestral Cascade Range as an intracanyon flow.

| SUBGROUP | FORMATION | MEMBER |
|---|---|---|
| YAKIMA BASALT | SADDLE MTNS BASALT | POMONA* |
| | WANAPUM BASALT | PRIEST RAPIDS* |
| | | FRENCHMAN SPRINGS |
| | GRANDE RONDE BASALT | |

*indicates intracanyon flow

*Figure 1. Columbia River Basalt Group stratigraphy in western Oregon.*

Many older flows of the Columbia River Basalt Group, identified as part of the Grande Ronde Basalt and Frenchman Springs Member of the Wanapum Basalt (Beeson and Moran, 1979), appear to have entered western Oregon in a generally conformable manner during middle to late Miocene time (Figure 1). The apparent absence of significant erosion between eruptions suggests little or no coeval deformation. These flows poured through a broad lowland, at least 75 km (47 mi) wide, across the site of the present Cascade Range (Figure 2). However, about 14 million years ago, the geography changed significantly, probably as a result of folding and faulting. After this time, flows were essentially restricted to the confines of narrow canyons cut by the ancestral Columbia River into older units of the Columbia River Basalt Group. The oldest flow yet recognized that reflects this change is the Priest Rapids Member (Wanapum Basalt) which fills a canyon at Crown Point in the Columbia River Gorge (Waters, 1973) and in the Bull Run Watershed (Vogt, in progress).

## POMONA INTRACANYON FLOW

The Pomona Member, about 12 million years old, also occurs as an intracanyon flow. Excellent exposures up to 75 m (250 ft) thick are present along the south side of the Gorge from 0.8 km (0.5 mi) east of Mitchell Point westward for 10 km (6 mi) to the vicinity of Shellrock Mountain (Figure 3). The outcrops in the Mitchell Point area are the most spectacular and the most accessible, since they are adjacent to Interstate I-84 near river level. Mitchell Point constitutes a record of up to four million years of Columbia River Basalt Group volcanism, beginning at road level (elev. 28 m [94 ft]) in Grande Ronde Basalt (16 to 15 m.y.) and ending at the summit

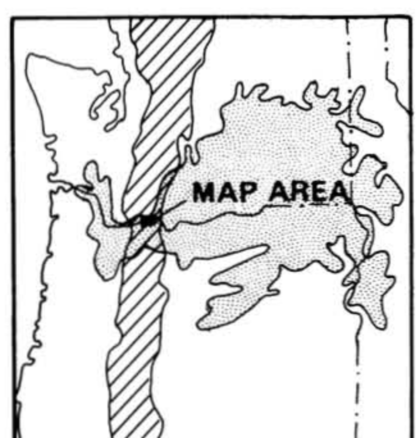


*Figure 2. Regional distribution of Columbia River Basalt Group (stippled), shown relative to the Cascade Range (hachured). "MAP AREA" refers to Figure 3. Basalt data after Waters (1961).*

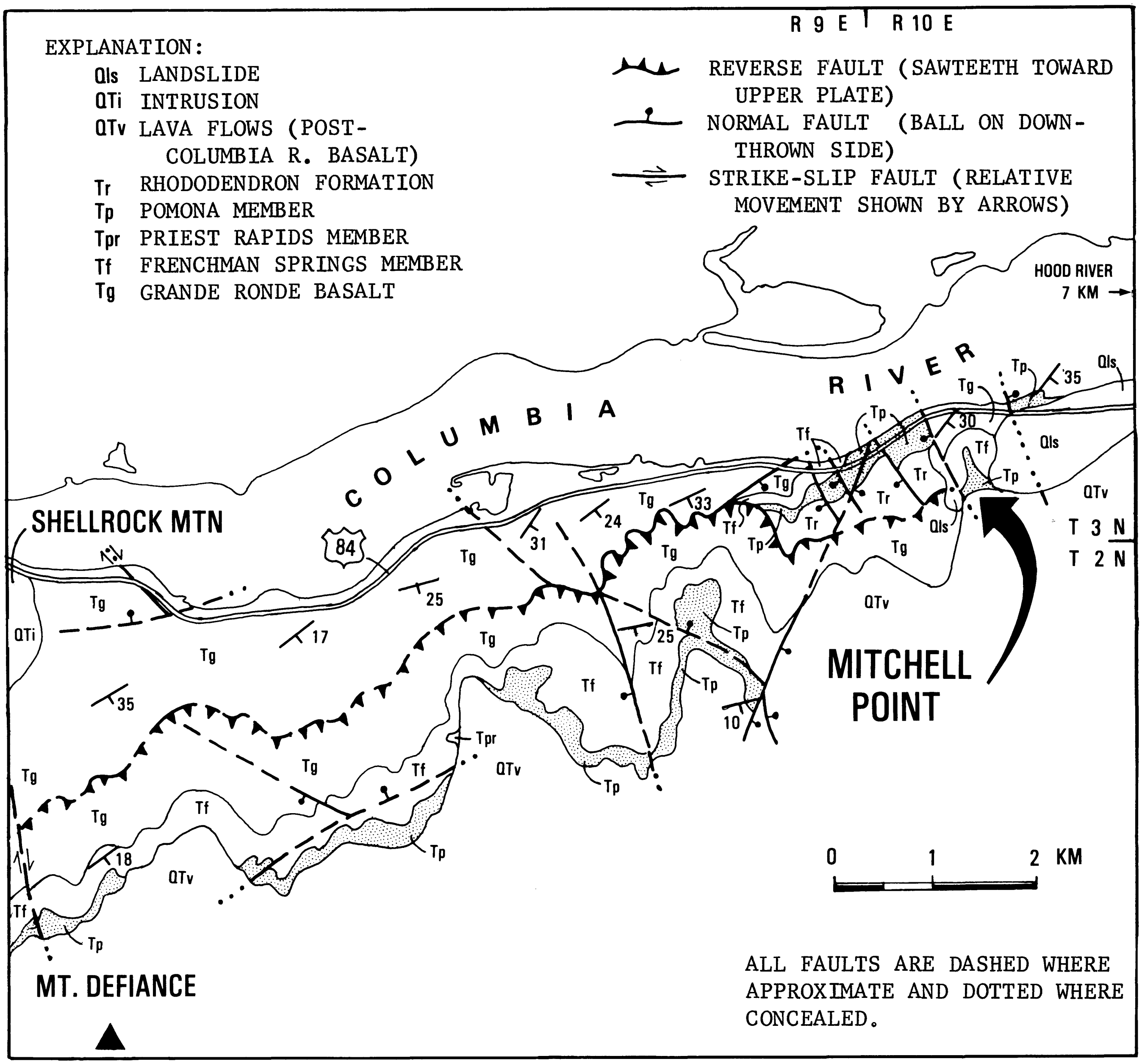


*Figure 3. Preliminary geologic map of the Columbia River Gorge between Mitchell Point and Shellrock Mountain. Note distribution of Pomona Member (stippled).*

(elev. 353.4 m [1,178 ft]) in the Pomona Member (12 m.y.) (Figure 4).

The cover photograph of this month's magazine shows the intracanyon flow at Mitchell Point. An unconformity is clearly exposed at the top of the Frenchman Springs Member, defining a channel filled with gravel, ranging from about 8 m (26 ft) deep on the south to more than 70 m (230 ft) deep on the north (Figure 5). The flow underlying the gravel on the south is the uppermost flow of a three-flow Frenchman Springs sequence, while the flow on the north is the basal flow. Frenchman Springs overlain by gravel is exposed at highway level west of Mitchell Point (Figure 6). The ancient river channel may have been much deeper farther north, but erosion by the present Columbia River has removed any record of that part of the canyon. The gravel deposit consists of well-cemented basaltic cobble conglomerate with a sandstone matrix (Sceva, 1966). In the conglomerate are also rare quartzite pebbles, scattered wood fragments, and thin lenses of micaceous sandstone. The conglomerate contains abundant angular blocks derived from the Frenchman Springs Member along the channel wall and is therefore the product of caving during alluviation. A palagonite sand deposit 1.5 to 3 m (5 to 10 ft) thick occurs at the base of the Pomona Member; very few pillows are present.

The Pomona Member contains both acicular and equant phenocrysts of plagioclase occurring as single crystals 0.25 to 1.0 cm (0.1 to 0.4 in.) long. This bimodality of crystal habit sets the Pomona apart from underlying flows. Other diagnostic properties include reversed magnetic polarity and distinctive major oxide chemistry (Table 1). The chemical composition of the Pomona Member is relatively lower in FeO, $TiO_2$, $P_2O_5$, and $K_2O$, and higher in MgO and CaO than other flows in the section. The jointing of the Pomona resembles that of numerous flows of Grande Ronde Basalt in the area, a characteristic that may explain why the intracanyon relation-

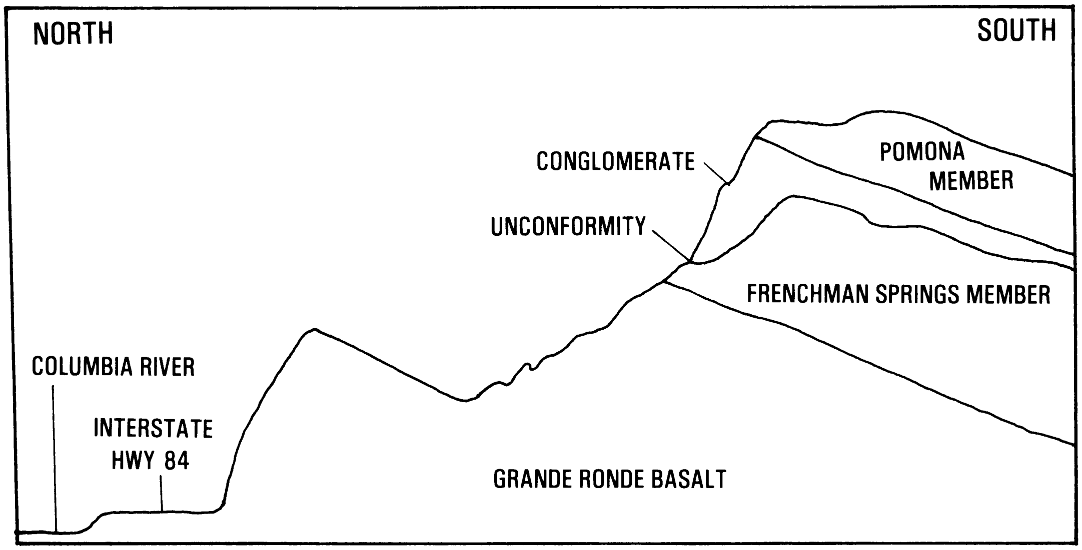


*Figure 4. Diagrammatic cross section through Mitchell Point.*

ship was not previously recognized (Wells and Peck, 1961; Sceva, 1966; Kienle, 1971; Waters, 1973; Beaulieu, 1977).

The Pomona and earlier flows appear to have been deformed at the same time; the basalt dips 25° to 30° SE and is cut by numerous faults (Figure 3), making it difficult to estimate minimum canyon width. The horizontal component of net slip on the northeast-trending reverse fault in Figure 3, for example, is greater than 1 km (0.6 mi) near Mitchell Point, effectively narrowing the distribution of the Pomona Member.

## DISCUSSION

The exposures at Mitchell Point and farther west answer some important questions but raise others. The Pomona Member left the Columbia Plateau along a channel nearly parallel to the present Columbia River. However, the problem of where it entered the Willamette lowland in western Oregon or Washington prior to reaching the known exposures in the Kelso-Cathlamet area is still unresolved. The close proximity of the Pomona intracanyon flow to the present Columbia River suggests that exposures that were once downstream from Shellrock Mountain may have been largely removed by erosion.

Another interesting question involves the contrast between the nature of the Pomona and Priest Rapids intracanyon flows at Mitchell Point and Crown Point, respectively. Palagonite sand is much more abundant at Crown Point, where the Priest Rapids appears to have a much greater overall thickness than does the Pomona. A possible explanation is that Mitchell Point is somewhat south of the deepest part of the river channel filled by the Pomona; under this interpretation, the thick gravel at Mitchell Point could represent a gravel bar or an earlier course of the river. Quartzite represents only a small fraction in the pre-Pomona gravels versus a much greater percentage in post-Pomona Troutdale gravels. This could imply a less extensive drainage network in pre-Pomona time, a

Table 1. *Average major oxide compositions of members of the Columbia River Basalt Group in the Mitchell Point area of the Columbia River Gorge compared with averages of the same members in the Columbia Plateau *†* *(all analyses in weight percent)*

| Chemical type | Pomona | | Frenchman Springs | | High MgO Grande Ronde | | Low MgO Grande Ronde | |
|---|---|---|---|---|---|---|---|---|
| | Gorge | Plateau | Gorge | Plateau | Gorge | Plateau | Gorge | Plateau |
| Oxide | (5)** | (30)** | (4)** | (8)** | (10)** | (13)** | (9)** | (8)** |
| $SiO_2$ | 51.60 | 51.88 | 51.68 | 52.29 | 53.89 | 53.78 | 55.50 | 55.94 |
| $Al_2O_3$ | 15.39 | 14.88 | 14.25 | 13.21 | 15.13 | 14.43 | 14.89 | 14.04 |
| FeO*** | 10.77 | 10.55 | 14.56 | 14.38 | 11.64 | 11.35 | 12.21 | 11.77 |
| MgO | 6.81 | 6.96 | 3.97 | 4.04 | 4.86 | 5.25 | 3.63 | 3.36 |
| CaO | 10.47 | 10.67 | 7.91 | 7.90 | 8.35 | 9.07 | 7.28 | 6.88 |
| $Na_2O$ | 2.27 | 2.36 | 2.51 | 2.67 | 2.62 | 2.83 | 2.83 | 3.14 |
| $K_2O$ | 0.65 | 0.64 | 1.37 | 1.41 | 1.15 | 1.05 | 1.79 | 1.99 |
| $TiO_2$ | 1.63 | 1.62 | 2.98 | 3.17 | 1.82 | 1.78 | 2.03 | 2.27 |
| $P_2O_5$ | 0.24 | 0.25 | 0.55 | 0.71 | 0.29 | 0.28 | 0.32 | 0.43 |
| MnO | 0.19 | 0.17 | 0.22 | 0.22 | 0.21 | 0.19 | 0.20 | 0.19 |

* Plateau averages from Swanson and others, 1979a.
** Number of analyses used in computing average.
*** Total iron.
† Gorge analyses are XRF determinations by P.R. Hooper, Washington State University, Pullman, Wash.

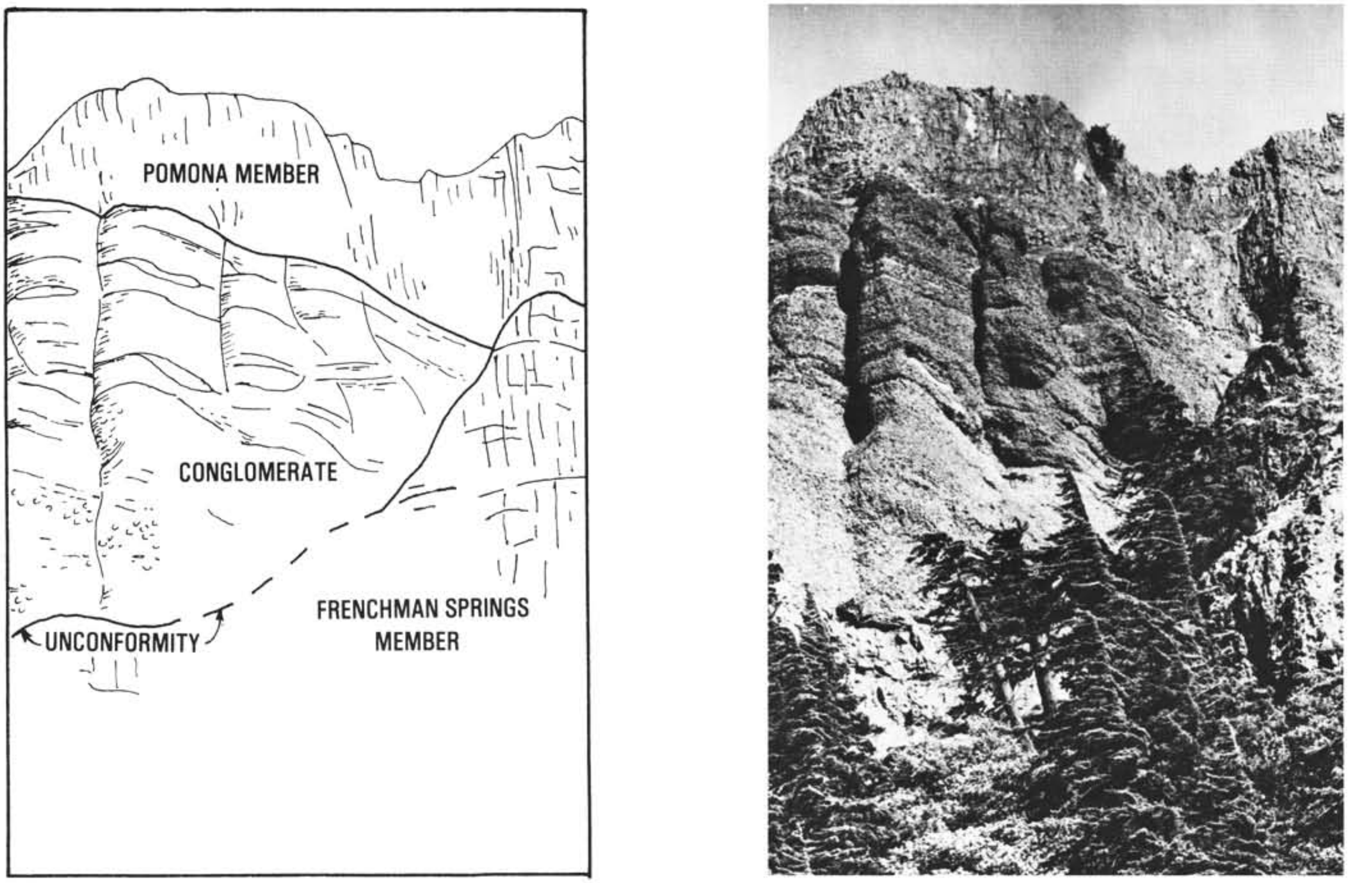


*Figure 5. Diagram of photograph showing edge of pre-Pomona canyon and gravel fill.*

*Figure 6. Pre-Pomona basaltic conglomerate overlying Frenchman Springs Member. Mitchell Point is at left in background.*

*Figure 7. Closeup of basaltic cobble conglomerate containing rare quartzite pebbles.*

change in provenance, or dilution with locally derived basalt detritus during canyon cutting. The alluviated channel at Mitchell Point suggests one or more base level changes in pre-Pomona, post-Frenchman Springs time, conceivably related to regional tectonism in the ancient Cascades 14.5 to 12 million years ago. More data on the distribution of the Pomona Member will help to define the amount of uplift and the nature of deformation in the Cascade Range during the past 12 million years. Work to further determine this distribution is continuing.


## ACKNOWLEDGMENTS

Donald A. Swanson, U.S. Geological Survey, Menlo Park, California; Marvin H. Beeson, Portland State University, Portland, Oregon; and Susan M. Price, Rockwell Hanford Operations, Richland, Washington, reviewed this manuscript and provided valuable comments. Geologic mapping was performed under U.S. Geological Survey-U.S. Department of Energy Interagency Agreement EY-78-1-06-1078. The mapping is part of the regional geologic studies effort of the Basalt Waste Isolation Project administered by Rockwell Hanford Operations for the U.S. Department of Energy.


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# Endowment fund established at OSU Geology Department

The Daniel G. Emrick Estate has established an endowment fund of $55,579.71 for the Department of Geology, Oregon State University. Income from this fund will be used in support of departmental field trips and field work. □

**REMEMBER** to send us your forwarding address when you move. Notifying the Post Office is not enough, because second class mail is not forwarded to you. So keep in touch with us. □

# OMSI Sound Project: the acoustic effects of the Mount St. Helens eruption on May 18, 1980

*by Clara Fairfield, Curator and Exhibits Designer, Oregon Museum of Science and Industry, 4015 S.W. Canyon Road, Portland, Oregon 97221*

One of the many studies currently underway in connection with the May 18 blast of Mount St. Helens is being conducted by the Oregon Museum of Science and Industry (OMSI). The project involves a compilation of more than 1,200 reports from individuals in the Northwest who either heard or felt the cataclysmic eruption and, what is equally important, from those who did *not* hear or feel the sound or shock waves. Preliminary findings are summarized in the following article. OMSI is anxious to hear from any other individuals who experienced acoustic effects related to the eruption. —Ed.

## INTRODUCTION

In Hamilton, Montana, about 400 mi due east of Mount St. Helens, the sound of the volcano's eruption on May 18 was described as heavy artillery fire very close by. In the San Juan Islands, people wondered if the Canadian Navy was having gunnery practice. Residents along the central Oregon coast thought they were hearing sonic booms, thunder, and dynamiting all rolled into one 15-minute barrage.

Yet, some who were within 10 mi of the mountain heard nothing. Since the author was able to hear this house-shaking, window-rattling noise near Netarts on the Oregon coast, 116 mi distant from Mount St. Helens, she was surprised to learn that her daughter in Portland, only 45 mi distant, had heard nothing at all. Out of the curiosity about this phenomenon the OMSI Sound Project was born.

A request was sent out through the media asking the general public for information on the intensity of the sound, if heard; on shock waves and earth tremors, if felt; on barometric pressure changes, if noted; and on any unusual animal behavior, if observed. The response has been impressive: over 1,200 replies by mail, many phone calls, and questionnaires filled out by OMSI visitors. People sent newspaper clippings, maps, barograms, photos, even samples of ash.

A map exhibit at OMSI has been developed from this information, with blue pins indicating locations where people heard the eruption and yellow pins showing where the sound was not or barely heard and/or felt.

## SOUND PROPAGATION

The "quiet zone" near the volcano turned out to be larger than expected. It extended north-south from near Olympia, Washington, to Albany, Oregon, and east-west from near The Dalles to the coast at Manzanita. To the south, the narrowing of the quiet zone appears to have been related to the crest lines of the Coast Range and the Cascades. Hikers and climbers on Mount Hood, Mount Adams, and Mount Rainier watched the eruption but reported hearing nothing. People in areas near Mount Baker and Mount Jefferson did hear the eruption. Rock slides and avalanches were reported from the North Cascades of Washington.

In Oregon the "loudest zones" appear to have been along the coast from Tillamook to Newport, in central Oregon from Redmond to La Pine, and in southern Oregon in the Medford-Ashland area. In Washington they were along the coast from Ocean Shores to Neah Bay, in the northern parts of Puget Sound and Hood Canal, and on Whidbey Island and the San Juans. In Montana the explosion was heard the loudest east of the Bitterroot Mountains from Hamilton to Flathead Lake and in British Columbia from Victoria to the Cadwellder Range.

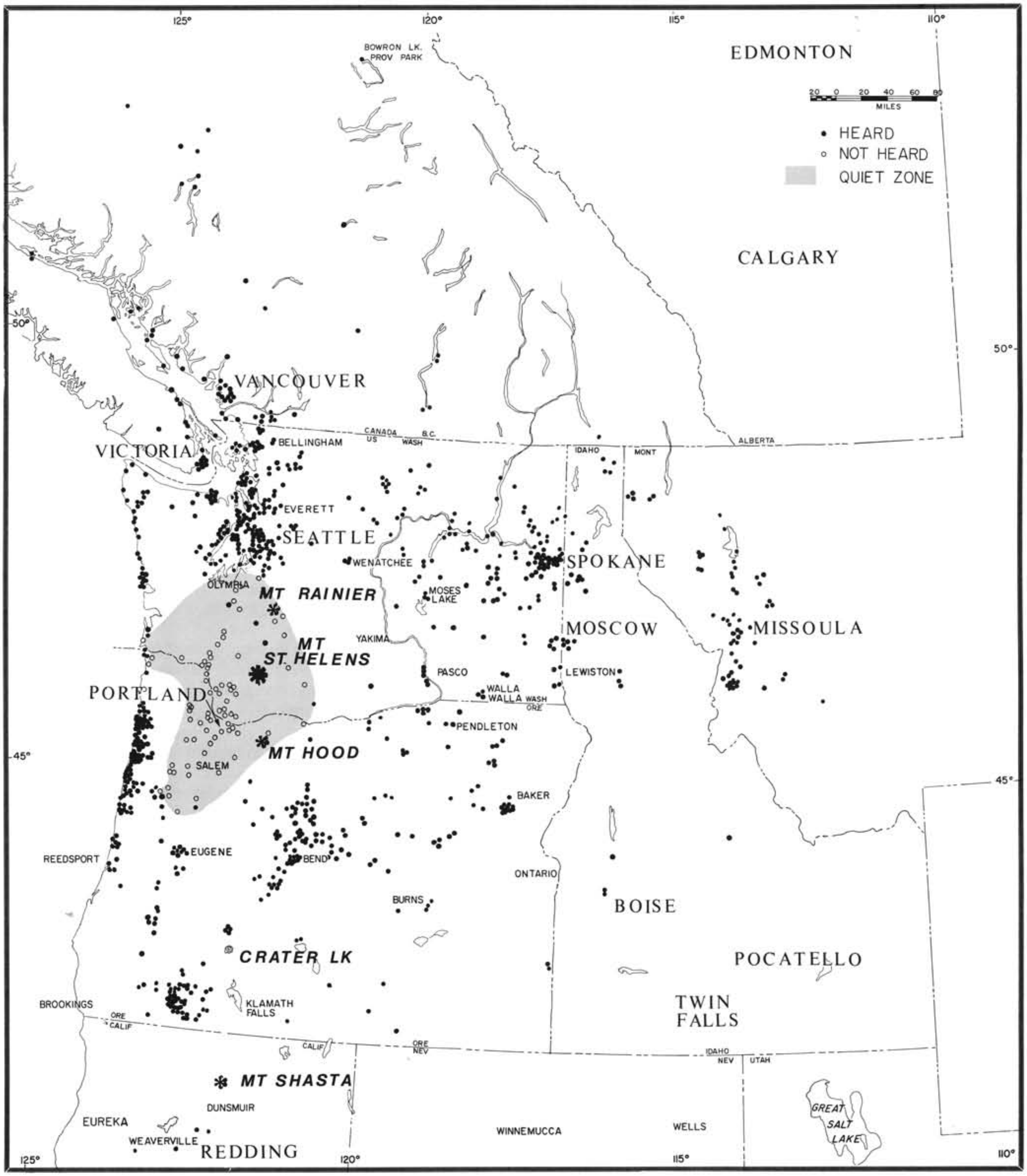
Several known facts and observations are involved in the spreading of the sound of such an explosion: 1. Temperature affects the speed of sound; sound travels faster in warmer air. 2. There is a warm layer of air in the stratosphere that stays at about the 150,000-ft level. 3. When a sound wave reaches a warm layer, the top part of the wave increases in speed, and the path of the wave is refracted, i.e., bent over and directed back toward the ground. 4. If a sound wave is strong enough, it may be refracted at high altitude and reflected by the earth's surface several times. 5. Wind "carries" sound, i.e., sound waves traveling in the same direction as the moving air are less subject to dissipation than those going in other directions. 6. Underground atomic explosions have been known to produce inaudible low-frequency sound waves that can travel around the earth.

The eruption of May 18 was triggered by an earthquake of magnitude 5.1 on the Richter scale. The following explosions occurred less rapidly than an atomic or high-explosive blast, so that much of the audible sound diminished quickly away from the volcano. The sound and pressure waves which traveled upwards from the explosion, however, were refracted by the warm layer in the stratosphere back down to earth. Interpretation of reported sound intensities shows alternating zones of loudness and quiet at increasing distances from the volcano. This indicates that refraction of the explosion sound occurred at least twice. Local topography such as hills, valleys, deep canyons, cliffs, and water bodies also had an effect on where and how loudly the sound was heard in a given location.

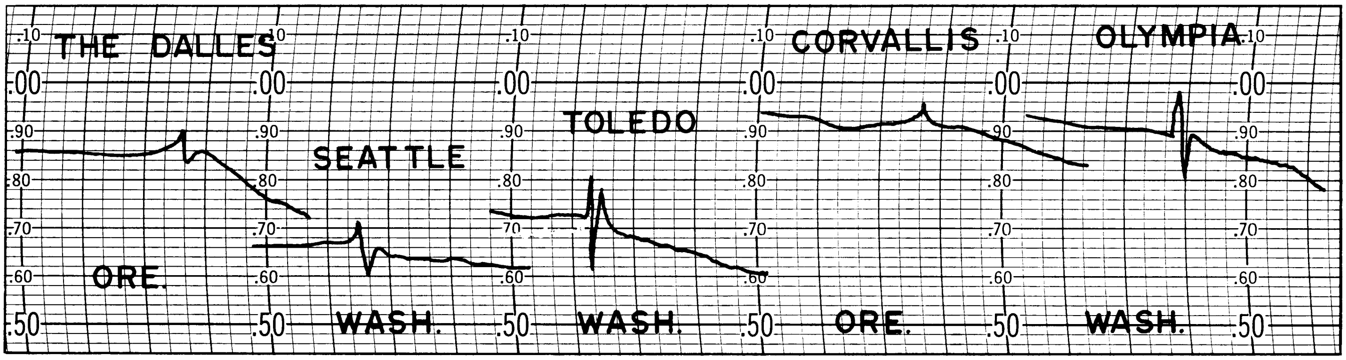
Weather charts show that there was a relatively stable upper air pattern over the entire Pacific Northwest at the time of the explosion. A wind-flow chart for the same day shows strong westerly winds from the surface up to 55,000 ft over the same area. These winds tended to inhibit the spreading of the sound wave to the west.

Finally, recording stations near Washington, D.C., and in New York picked up low frequency sounds several hours after the eruption. Thus we know that these sounds, inaudible to the human ear, were also produced by the eruption.

Sound waves in subsequent eruptions have followed the same pattern as that of May 18, but with much less intensity. Some respondents of the survey are now actually capable of recognizing the sound and identifying the source.




*Map showing locations from which OMSI Sound Project received reports of the acoustic effects of the May 18 eruption of Mount St. Helens. Note quiet zone.*




*Redrafted portions of barograms from various places in the Pacific Northwest, showing the way local barometric pressure was affected by the passage of the sound wave. Note sudden rise and fall in air pressure. Each vertical curved line represents one hour.*

## BAROMETRIC PRESSURE CHANGES

Barometric pressure was affected over a wide area. Not surprisingly, the greatest effects were felt and recorded within a 100-mi radius. However, barograms from as far away as Las Vegas, Nevada, and Helena, Montana, also exhibited a change in barometric pressure.

Letters describing the way curtains were sucked out of windows and storm doors were pulled out of people's hands document the physical evidence of a sudden change in air pressure. Rattling windows were also attributed to this change. Al Frank of the Atmospheric Sciences Department at Oregon State University is studying this aspect of the eruption and has kindly shared barograms and other weather-related findings with this author. The barograms show the passing of the explosion wave by a sudden sharp rise in air pressure and an almost as sudden drop of equal size immediately thereafter.

## SHOCK WAVES AND EARTH TREMORS

Shock wave effects were most commonly described as "whumps" that were felt as well as heard. Houses in the Puget Sound area were "hit with a giant, soft sledge hammer" or a "huge, padded wrecking ball." Numerous people thought someone in the house had fallen down, or someone had driven into the side of the house or garage. In the Portland-Vancouver area, heavy hanging planters, clothes racks, and hanging fireplace tools were seen swaying. Doors slammed or popped open in many locations.

There were many accounts of earth tremors, most within a 100-mi radius. In this area, some people felt the movement but heard either nothing or only the sounds of creaking houses or buildings. Almost everyone who responded had heard windows rattling. There was a report of structural damage from Tillamook, where a garage pulled away from the attached house, and a report of a crack in a garden retaining wall. Residents in travel trailers, campers, and mobile homes all experienced extensive shaking; one reported broken dishes. A number of people were awakened by the movement, and one even fell out of bed.

## ANIMAL REACTIONS

Animal behavior was varied. "Hotrod," a ground squirrel near Hood Canal, dropped his sunflower seeds and dashed for cover moments before the eruption was heard. He was not seen for the rest of the day. There were numerous other reports of this kind about both domestic and wild creatures.

Bird reactions were a favorite subject of letter writers. Pheasants were very "noisy," but song birds became very quiet, with little or no flying and very erratic behavior for hours afterward. Even insects were noticed to be "abruptly still" when the sound waves passed by.

Cattle, horses, pigs, dogs, cats, and geese were restless and disturbed throughout the day. Antelope and deer were observed running from an unseen "spook" to the north, east of Redding, California. One deer ran into the side of a moving pickup truck. Rabbits and porcupines were unusually active in mid-morning in the same area. Carp were seen beaching themselves by the dozen at Pot Holes Reservoir behind O'Sullivan Dam in central Washington. Poor fishing was experienced by many. There were numerous complaints of poor clamming even though there was a favorable low tide.

In addition to the Oregon State University research mentioned above, other studies on the sound phenomenon and barometric pressure changes are underway at Sandia National Laboratories and at the University of Victoria, British Columbia.

## ACKNOWLEDGMENTS

The author would like to express her gratitude to the following people for their help: Dr. John Walls, meteorologist at KOIN-TV; Laird Brodie, Physics Department, Portland State University; and Albert Frank, Oregon State University. A special thanks to Christie Galen, OMSI Research Center, for many hours of aid.

The data collected for this project are available to anyone interested in further research. The author and OMSI would welcome any additional information or comments on the project. □

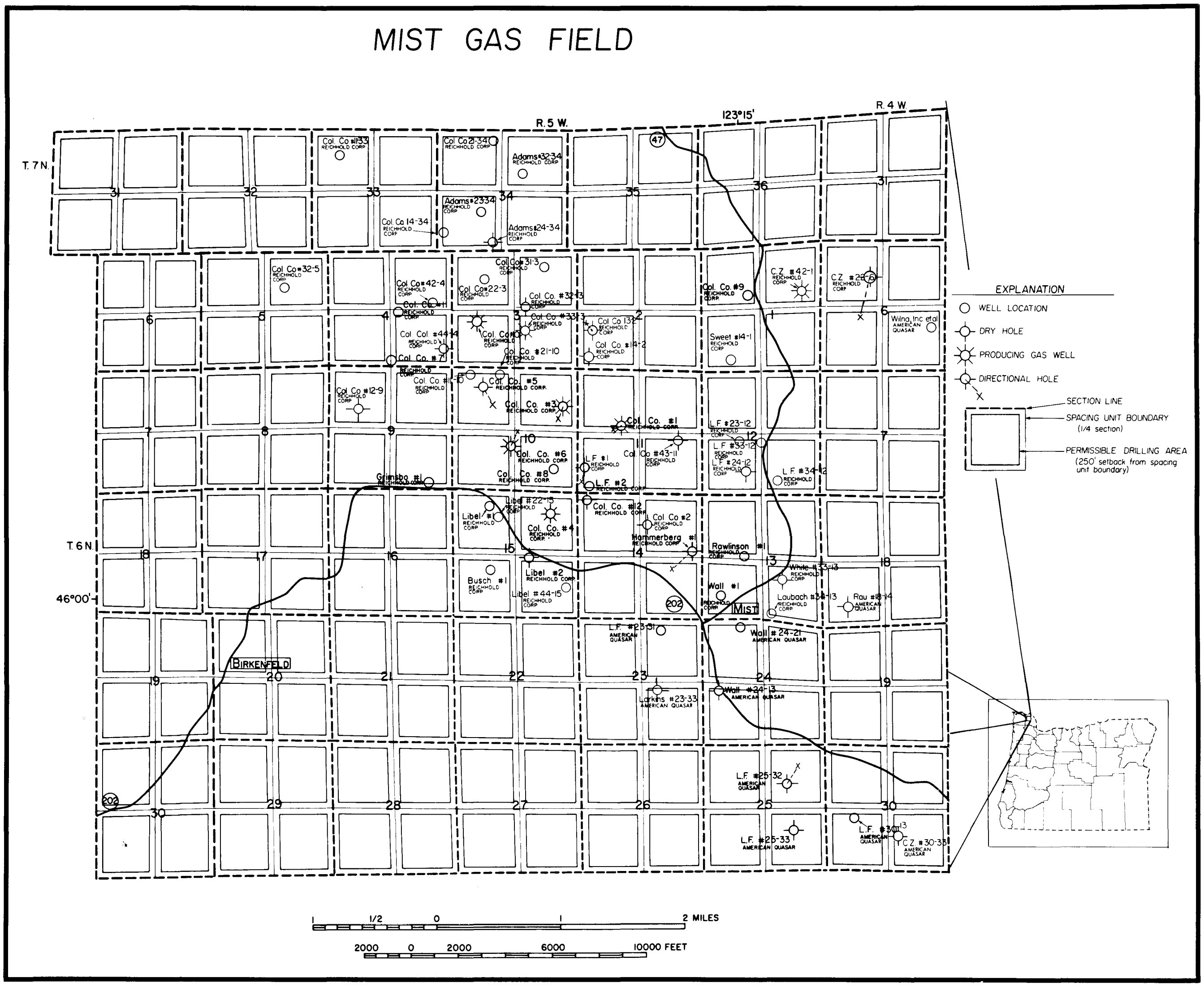
# Exploratory drilling continues at Mist

Oregon's first and only gas field was the site of continued drilling activity during 1980. Since the beginning of the year, one drilling rig has been continuously active, drilling wells for American Quasar Petroleum and for the partnership of Reichhold, Diamond Shamrock, and Northwest Natural Gas Company.

Within the field boundaries shown on the map, Reichhold and its partners drilled two producers this year as well as eleven dry holes and six dry redrills. American Quasar drilled five dry holes and two dry redrills. The redrills consisted of directional holes drilled from the surface location of an existing straight hole.

The average depth of straight holes was 2,969 ft this year, while the redrills averaged 3,177 ft in depth. In the holes drilled during 1980, the target sand, the Clark and Wilson, was penetrated at an average depth of 2,350 ft but was often found to contain water rather than gas. The Mist Gas Field is heavily faulted, resulting in small accumulations of gas separated by areas where the sandstone contains only water. Even the depth to the sand was difficult to predict due to the vertical displacement of up to several hundred feet along the steeply dipping faults.

At present, there are five producing wells in the field, providing over 20 million cubic feet of gas per day, which is between five and ten percent of the demand for gas from the distributor, Northwest Natural Gas Company.



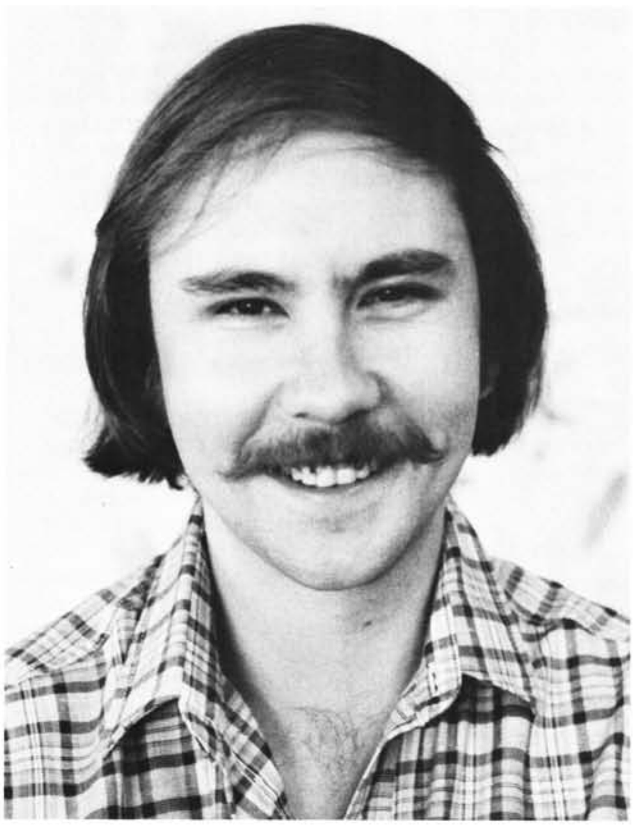

This map of the Mist Gas Field is available from the Department of Geology and Mineral Industries at a scale of 1:24,000 for a price of $5.00. The map is periodically updated.

*—Dennis L. Olmstead, Petroleum Geologist, Oregon Department of Geology and Mineral Industries*

# George Priest to supervise Geothermal Assessment Program

The Oregon Department of Geology and Mineral Industries (DOGAMI) announces the appointment of George R. Priest as the supervisor of its Geothermal Assessment Subprogram. Serving in this capacity, Priest will supervise and direct the Department's efforts to identify and define the geothermal resource base of the State of Oregon and coordinate these efforts with the work of other agencies. DOGAMI's current projects include assessments of various geothermal areas in eastern Oregon, the Western Cascades, and the Mount Hood area.

Priest, a native Oregonian from Klamath Falls, received his education from Oregon State University (B.S. and Ph.D. in geology) and the University of Nevada at Reno (M.S. in geology).



*George R. Priest*

As part of the Department's geothermal research staff since September 1979, Priest has completed considerable geothermal mapping and geothermal assessment work in the Western Cascades. Prior to that time, he was an assistant professor in the Department of Earth Sciences at Portland State University.

Throughout his years of study, Priest found time to develop his industrial experience in a variety of appointments – by such companies as Chevron Resources Company, Hanna Mining Company, Woodward-Clyde and Associates, and Lawrence Livermore Laboratory–in geothermal and mineral exploration, engineering geology, and geochemistry.

He has produced geologic maps, supervised drilling projects, and conducted geophysical surveys for mineral exploration. He has also performed basic geochemical research on the genesis of uranium ore and translated geologic mapping into nontechnical and engineering terminology for applications in planning and construction.

As a teacher and researcher, Priest has concentrated particularly on volcanology, igneous petrology, and geochemistry. His publications include several papers on the eruptive history and geochemisry of the Little Walker volcanic center in California and a chapter on latites and quartz latites in *Volcanoes and Volcanology*, R. Fairbridge and J. Green, eds., published by Dowden, Hutchinson, and Ross, Inc. His work now will focus on the volcanic and tectonic controls of geothermal systems throughout the State of Oregon. □

## Atmospheric effects of Mount St. Helens eruption

Early questions as to whether the volcanic activity of Mount St. Helens, especially the May 18 eruption, would influence the climate of the earth are being addressed gradually.

In the October 16 issue of *Nature*, European researchers M. Ackerman, C. Lippens, and M. Lechevallier of the Institut d'Aéronomie Spatiale de Belgique present preliminary results of photographic observations of the stratosphere.

Comparison of observations on October 10, 1979; May 7, 1980; and June 5, 1980, indicates an abrupt increase of solar radiance on the latest of these dates: after the May 18 eruption and probably shortly after the volcanic material had crossed the Atlantic and arrived over Europe. The increase, by a factor of three, appeared between 15 and 16 km of altitude (about 49,000-52,500 ft), with a sharp cutoff at the upper boundary of the layer.

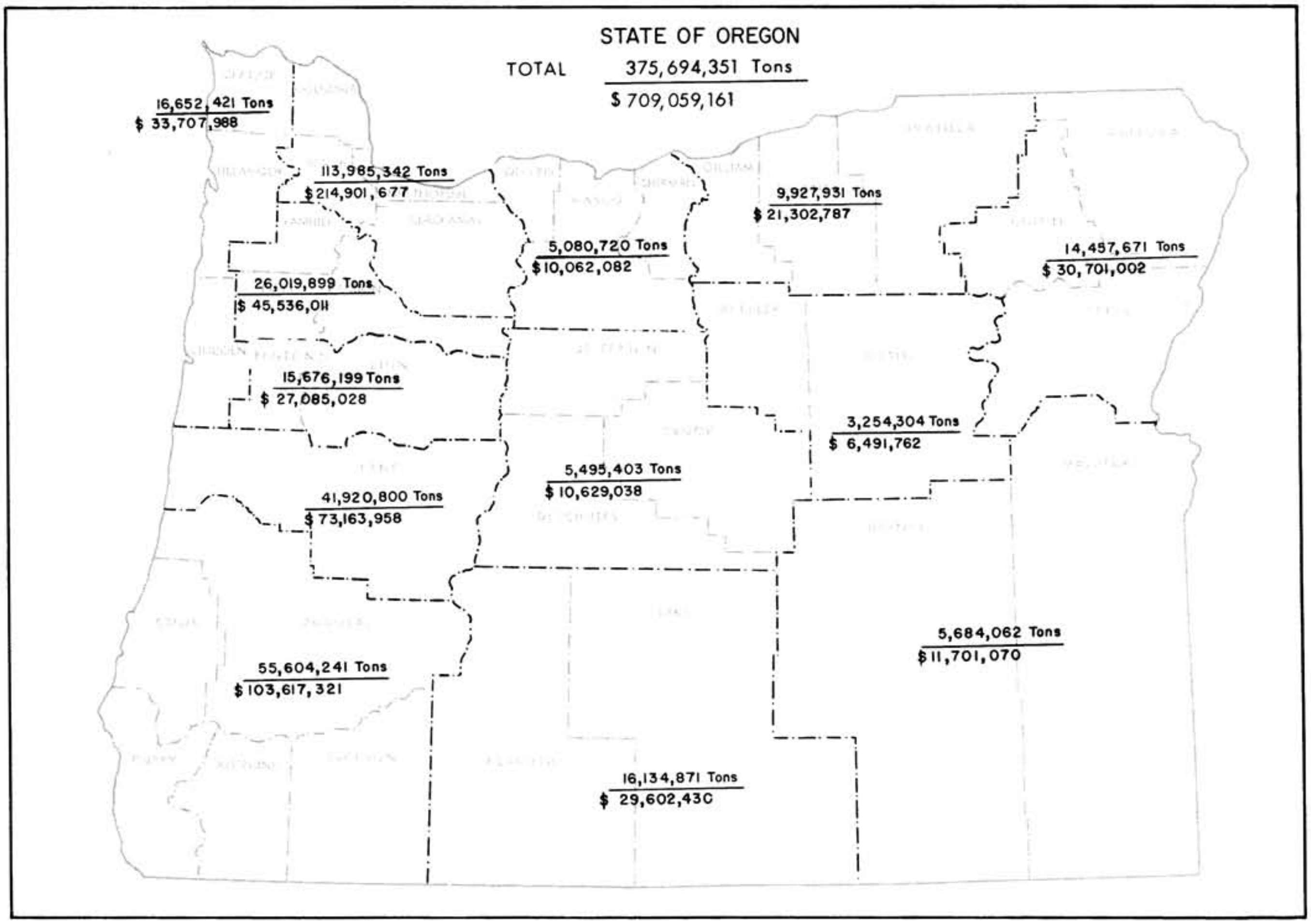
The radiance increase is interpreted as an increase of stratospheric aerosol caused by wide horizontal spreading of material from Mount St. Helens. While more observations are necessary to permit more definite conclusions, the present results indicate the possibility that absorption and reflection of solar energy by the increased stratospheric aerosol layer will cause a slight drop in average temperatures below.

*–Klaus Neuendorf, Editor-Librarian, Oregon Department of Geology and Mineral Industries*

# Large volume of rock material produced in Oregon during last ten years

During the 10-year period from 1970 through 1979, the rock material industry in Oregon produced 376 million tons of sand and gravel and stone (including road metal cinders), worth a total of $709 million. These figures mean that during that time 164 tons of sand, gravel, and crushed rock were mined and processed for each of the 2.3 million men, women, and children in the State.

The $709 million value, equal to $308 for each Oregonian, represents the value of the rock material at the mine site before it was shipped. Transportation from the quarry to the consumer doubles the value of all the tonnage. Twenty-five percent (94 million tons) of the rock material went into the manufacture of concrete; therefore, about $30 for each of those 94 million tons, representing the costs of mixing, transporting, and




*Production tonnages and dollar values of sand and gravel and crushed rock produced in market areas in Oregon from 1970 through 1979. These numbers are based on U.S. Bureau of Mines figures. The Oregon total includes U.S. Forest Service total output of 45,800,487 tons worth $90,557,007 that was reported for the State as a whole and could therefore not be assigned to individual counties.*

As the map indicates, output was not uniform throughout the State. Twice as much rock material was mined and consumed in the Portland area as in the next largest marketing area, even though that area, the southwest corner of the State, has over three times the land surface. Production is generally related to size of population, and since most of Oregon's population is west of the Cascades, 82 percent of the total rock material output was also west of the Cascades.

placing the concrete, can also be added to the pit price and transportation costs. The addition of these other costs means that the total value of the rock materials industry, the largest mineral industry in Oregon, was actually $4.2 billion, which was equal to $1,800 for each Oregon man, woman, and child.

*—Jerry J. Gray, Economic Geologist, Oregon Department of Geology and Mineral Industries*

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