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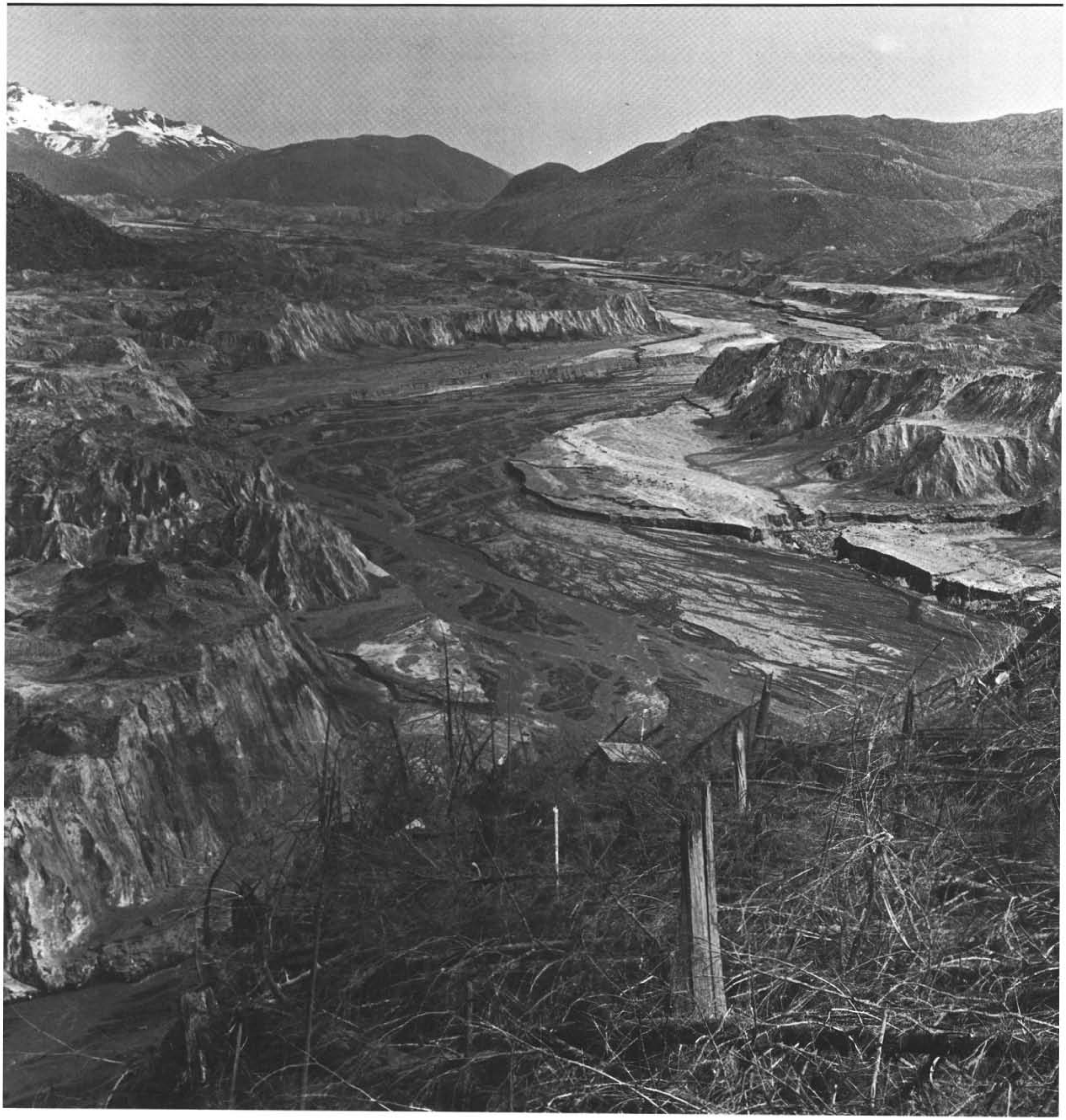

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COVER PHOTO

View from Elk Rock, overlooking the North Fork of the Toutle River, northwest of Mount St. Helens, Washington. Photo shows May 18, 1980, debris avalanche, the North Fork of the Toutle channel, and the March 19, 1982, mudflow in the channel. Field trip guide beginning on next page describes mudflows of both eruptions of Mount St. Helens. (Photo courtesy Lyn Topinka, U.S. Geological Survey, David A. Johnston Cascades Volcano Observatory.)

Department releases new geologic maps

The Oregon Department of Geology and Mineral Industries (DOGAMI) announces the publication of two new maps in its Geological Map Series (GMS).

Map GMS-21, *Map Showing the Geology and Geothermal Resources of the Vale East 7½-Minute Quadrangle*, by D.E. Brown, covers an area of about 56 mi² south and east of Vale, eastern Oregon. This multicolored outcrop map is at a scale of 1:24,000 and shows bedrock units as they are actually exposed at the surface. The map delineates nine surficial and bedrock geologic units and the geologic structure of the quadrangle, both on the map and in the accompanying geologic cross section. Also shown are the locations of 38 wells and springs and data for them such as temperature, geothermal gradient, and heat flow.

Map GMS-23, *Geologic Map of the Sheridan Quadrangle, Polk and Yamhill Counties, Oregon*, by M.E. Brownfield, covers the Sheridan 7½-minute quadrangle, which includes the cities of Sheridan and Willamina and straddles the border between Polk and Yamhill Counties, western Oregon. The map shows eight bedrock and surficial geologic units, geologic structure, numerous fossil localities, and a geologic cross section. Also included is a discussion of the stratigraphy, structure, and economic geology of the map area, along with a list of the fossil locations. The geologic investigation of the Sheridan quadrangle was part of a regional stratigraphic study in the northern Oregon Coast Range to assess the potential for oil and gas. While no oil and gas exploration holes have been drilled in the quadrangle so far, significant stratigraphic and paleontologic information obtained in this study indicates that the Yamhill Formation is a potential source rock for petroleum.

Both maps are available from the Portland office of the Oregon Department of Geology and Mineral Industries, 1005 State Office Building, Portland, OR 97201, at a price of $5 each. Orders under $50 require prepayment. □

Lasmanis named State Geologist for Washington

Raymond Lasmanis has been named new State Geologist for the state of Washington, with responsibility for directing the Natural Resources Department's Division of Geology and Earth Resources. This division oversees oil and gas drilling and exploration and surface mining in Washington as well as mapping of the state's geologic resources.

Lasmanis, former assistant secretary and exploration manager with Canadian Superior Ltd., has also worked for Pine Point Mines Ltd. and Cominco American Inc. His 14-year service with Canadian Superior included management of the West End gold production in Idaho and the Tonzona coal project in Alaska.

Lasmanis, who succeeds Ted Livingston, started his new duties on July 14. □

CONTENTS

Mount St. Helens road log: A visit to the lower Toutle and Cowlitz River drainages to observe the sedimentology, transported trees, and other effects of mudflows resulting from the eruptions of May 18, 1980, and March 19, 1982*

by William J. Fritz, Department of Geology, Georgia State University, Atlanta, Georgia 30303; Lanny H. Fisk, Department of Geological Sciences, Loma Linda University, Riverside, California 92515; and Sylvia Harrison, Department of Geology, University of Montana, Missoula, Montana 59812

INTRODUCTION

Shortly after the explosive eruption of Mount St. Helens on May 18, 1980, devastating mudflows moved down the Toutle River drainage, into the Cowlitz River, and on to the Columbia, causing widespread braiding due to the high sediment load. These mudflows were then reworked by streams, leaving a record of alluvial volcaniclastic sedimentation. A second series of mudflows that can be seen at stops indicated in this road log was generated by an eruption late on March 19, 1982 (Simon, 1982).

Mudflows were not unexpected and, in fact, had been suggested by Crandell and Mullineaux (1978) as potential hazards from any future eruptions. However, the stream systems most likely to be affected and the general magnitudes of the anticipated flows were matters of conjecture (Cummans, 1981), generating considerable discussion among volcano observers in the weeks immediately preceding the major eruption and following the mountain's initial early warnings.

* Prepared August 1981 and April 1982.

This road log describes features of mudflows and associated alluvial deposits resulting from the 1980 and 1982 eruptions and follows, in reverse direction, the route of the mudflows, pointing out significant geological features to the participant. At designated stops en route (Figure 1), we have indicated some important sedimentological features, many of which are even now being removed by natural erosion and by the U.S. Army Corps of Engineers as part of their stream stabilization program. Barring near-future mudflows to cover and preserve these features, within only a few years they will undoubtedly be completely destroyed. Thus, due to the ephemeral nature of the mudflow deposits, the extremely high precipitation, large spring run-offs, and the rapid growth and rejuvenation of vegetation, some features described in this road log may not remain for a very long period of time. How-

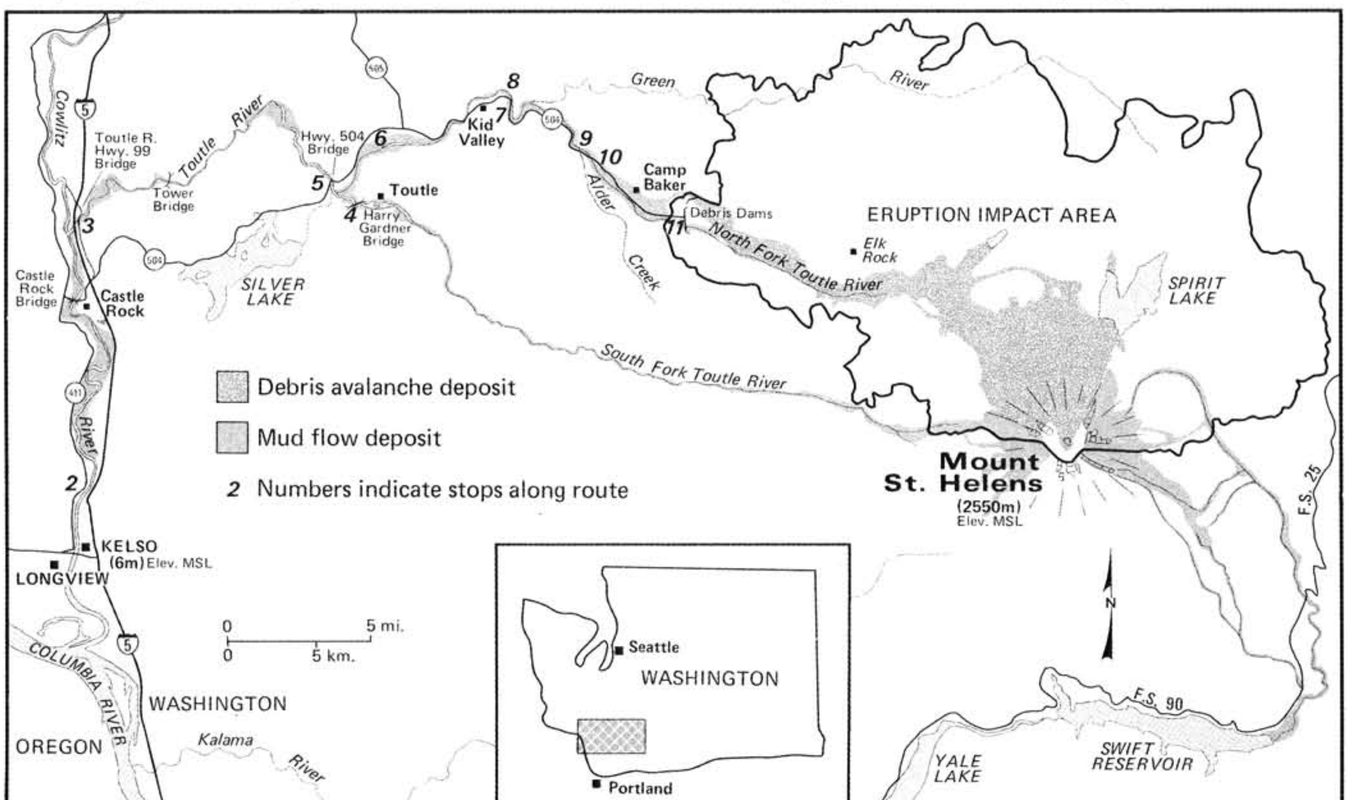

Figure 1. Location map of the Mount St. Helens area showing route taken for this field guide. (Modified from Fritz, 1980, and Cummans, 1981.)

ever, if any features are preserved from Mount St. Helens, they will be these lowland mudflow deposits and not the devastated highlands.

The mudflows produced by eruptions of Mount St. Helens provide a ready modern environment that helps geologists understand volcaniclastic deposition in the geologic record. Some areas in the northwestern United States that contain Tertiary age rocks similar to those described in this road log are the Eocene Absaroka Volcanic Supergroup in the Yellowstone Park region, the Challis Volcanics of central Idaho, and the Clarno volcanic deposits in central Oregon. Emphasis in this road log is thus placed on those features suited for preservation in the record and also on areas that will help in interpreting past environments.

Please notice the constantly changing sedimentary structures while hiking across point bars of the Toutle and Cowlitz Rivers. Some readily observable sedimentary structures include grading, straight-crested ripples, linguoid-lunate ripples, megadunes, antidunes, and tangential cross-bedding.

Another interesting feature is the fining of the mudflow away from the mountain. Along the Cowlitz River, reworked mudflows are composed of well-sorted silt to coarse sand. Upstream, the deposits coarsen to pebbles on the Toutle River and include boulders 1-2 m in diameter upstream from Toutle. The lower portions of the mudflow generally contain grain-supported clasts of several distinct rock types, while those nearer the source area have large boulders supported in a matrix of pebbles and coarse sand. One apparent exception to this fining downstream is the inclusion of pebble pumice lenses in otherwise well-sorted sand. The pumice clasts, due to their low density, were floated and transported by flow conditions that normally are competent to move only silt or sand. In some areas along the route of this road log, small lakes or slack water ponds were produced by overbank flooding. These ponds should be ready sites for preservation of leaves and other plant material.

Also emphasized in our road log are the voluminous quantities of logs, stumps, and plant debris transported by mudflows of both 1980 and 1982. Surprisingly, many of the stumps that were broken short by the blast or by prior logging and that have wide root systems remain upright even after considerable transport along the Toutle and Cowlitz Rivers (Fritz, 1980; Fritz and Moore, 1981). Many of the stumps contain an accumulation of fine rootlets and root-entwined boulders and would be difficult to distinguish, after burial, from the trees buried in place along the rivers. Unlike the short broken stumps, long trees were carried and deposited in large, horizontally oriented log jams.

In providing for some of the historical details in this road log, we are highly dependent on Cummans (1981), whose report we suggest you read before proceeding. You may also find articles by Fritz (1980), Youd and Wilson (1980), Fritz and Moore (1981), and Lombard and others (1981) and maps by the U.S. Geological Survey (1980) and the U.S. Forest Service and others (1981) to be of help. Figure 1 shows the route of this road log. If you wish to follow this road log while driving south from Seattle, drive south on Interstate 5 to Kelso, Washington, take Exit 39 (Highway 4), and enter the road log at the 40.4-mi mark. The majority of the features described here are outside of any controlled zones around the mountain. If you wish to proceed beyond the 83.4-mi comment (Stop 8) into the Red or Blue Zones, please obtain the proper authorization before proceeding.

Please proceed with caution while walking on mudflow surfaces. Many appear deceptively firm but are unstable and muddy due to thixiotropic behavior, meaning that they may turn to a liquid if jarred repeatedly. The more recent the mudflow, the more likely it is to display this behavior.

Note: The boundaries of the Red and Blue Zones may change in the course of time. Readers should also be aware that conditions may be dangerous anywhere around the volcano. Visitors should never approach the area without up-to-date information.

ROAD LOG

Total miles	Increment miles	Comments
00.0		START OF ROAD LOG: Northbound on I-5, at the Oregon-Washington state line in the center of the Interstate Bridge over the Columbia River.
	18.0	
18.0		Cross East Fork of the Lewis River.
	1.6	
19.6		North Fork of the Lewis River. It is interesting to speculate that if the blast of the major eruption had been to the east or south, the entire Lewis River might look like the Toutle River drainage.
	1.4	
21		STOP 1: The visitors center 0.5 mi east of the freeway in Woodland (Highway 503, Exit 21) contains some good photographs of Mount St. Helens. You can purchase the map by U.S. Forest Service and others (1981) here. Note that the round-trip mileage from the freeway is not included in the road log; persons bypassing this stop use the indicated mileage.
	2.5	
23.5		Marine basalts of the upper Eocene Hatchet Formation (probably equivalent to the Goble Volcanic Series of Oregon [Roberts, 1958]) exposed in road cuts on the east side of I-5. This will be the major ridge-forming rock type exposed in road cuts for the next 12-14 mi. McKee (1972) provides an interesting discussion of rocks exposed in this area.
	3.0	
26.5		View of Trojan nuclear power plant to the north.
	5.0	
31.5		Outcrop of Pliocene Troutdale Formation sandstone and conglomerate exposed in a quarry on the east side of I-5. This formation represents deposition by the ancestral Columbia River.
	8.9	
40.4		Take Kelso Exit 39, Highway 4, off I-5 just past bridge over the Coweman River.
	0.5	
40.9		Turn west (left) on Allen Street – State Highway 4. Note Volcano Center and St. Helens World – commercialization of a catastrophe.
	0.2	
41.1		Pile of St. Helens ash dredged out of the Cowlitz River on left. Continue straight at intersection where Highway 4 turns right.
	0.8	
41.9		Bridge over Cowlitz River.
	0.1	
42.0		Turn north (right) on Highway 411. Cowlitz River on the right shows effects of mudflows and subsequent dredging. Transported trees and mudflow deposits from the 1980 and 1982 eruptions can be seen on the east bank.
	0.9	
42.9		Accumulation of transported trees on east bank

Figure 2. Point bar on the lower Cowlitz River at STOP 2. Grassy covered area in the foreground is a vegetated portion of the 1980 mudflow. The point bar is composed of fine-grained sand and silt reworked by the 1982 mudflow. Note the transported stumps and logs.

Figure 3. Upright stump transported by the 1980 mudflow on the lower Cowlitz River at STOP 2. Note fine-grained sediment size.

of river. Note upright transported stump.

1.1

44.0 Lots of transported stumps and logs on a point bar on the east side of the river. Note fine-grained nature (silt and fine sand) of the sediment.

0.1

44.1 Ash and mudflow debris dredged out of the river can be seen in piles on the left.

2.5

46.6 STOP 2: Stop at pullout on east side of Highway 411 at intersection with King Road to the west. Massive dredging operation on the east (right) bank of the Cowlitz River. Note transported upright stumps in the river and a diagonal log just upstream (Figures 2 and 3). Does it stump you as to how they got there? This is a good place to hike down to the river to observe grain size (Figure 4), sedimentary structures, and transported trees from the 1980 and 1982 mudflows. Continue north on Highway 411.

1.7

48.3 Note mudflow deposits in farm fields in this small valley. It is understandable why these people were nervous the afternoon and evening of May 18, 1980!

4.2

52.5 Bridge over Arkansas Creek. Mudflows now vegetated with green grass on the right were initially covered with logs and debris that have since been removed by your U.S. Army Corps of Engineers. Also, the road you are driving on was destroyed by the 1980 mudflow and has been replaced. Most of the green fields in this area are re-vegetated mudflow deposits from the 1980 eruption.

0.7

53.2 Turn east (right) at intersection with Highway P.H. No. 10. Heavy equipment is being used in clean-up operations.

0.3

53.5 Cross Cowlitz River. Enter Castle Rock, Washington, on "A" Street.

0.4

53.9 Turn north (left) on Huntington Avenue.

0.6

54.5 Pull-off on the left. This portion of the road was nearly washed out by the 1982 mudflow. Observe the transported wood on point bars of the Cowlitz River and deposits from both mudflows. The green fields across the river are 1980 mudflows.

0.2

54.7 Turn north on I-5 toward Seattle.

0.5

55.2 Mud-cracked undisturbed swamp filled with water-sedimented ash. This swamp illustrates lacustrine sedimentation in a volcaniclastic terrain. Are we observing fossilization?

1.4

56.6 Bridge of Toutle River. The bare area was covered with trees killed by the hot mudflows and with transported trees. These have since been logged.

0.8

57.4 Take Exit 52—Toutle Park Road.

0.1

57.5 Turn right at stop sign toward Toutle River Viewpoint on Old Pacific Highway.

0.2

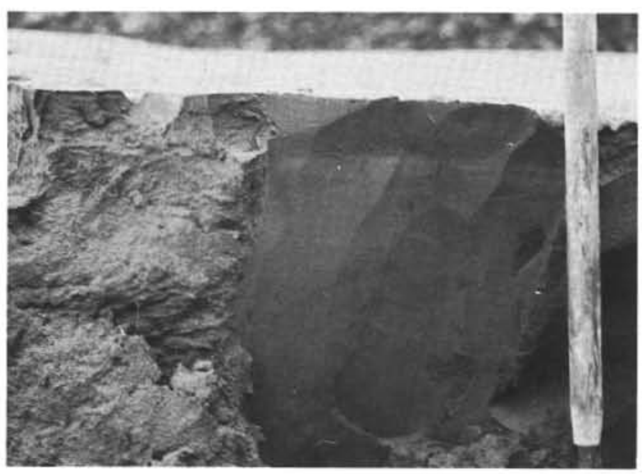

Figure 4. Exposure of fine-grained tuffaceous sandstone and siltstone deposited at STOP 2 by the 1982 mudflow on the lower Cowlitz River.

Figure 5. Lens of pebble-size rounded pumice clast in 1980 mudflow deposits at STOP 3.

57.7 STOP 3: Bridge over Toutle River. Stop to observe sedimentary features of the mudflows such as alluvial cut-and-fill, channel bars, point bars, small straight-crested and linguoid-lunate ripples, megaripples, cross-bedding, and pumice-clast lenses (Figure 5). Note transported stumps and logs. In this area, 1980 mudflow deposits were cut by flow from the 1982 eruption.

How high was the water level here on May 18, 1980? (Hint: Look at the trees and bridge pillars.) Proceed south on the Old Pacific Highway.

2.0

59.7 Do you recognize the swamp on the right? (If not, review the road log).

0.5

60.2 Turn east (left) on Highway 504 towards Toutle, Washington. Optional stop to buy a St. Helens Frisbee. On this narrow road watch for logging trucks carrying St. Helens' harvest.

10.3

70.5 Enter outskirts of Toutle, Wash.

0.7

71.2 Turn right on South Toutle Road.

0.6

71.8 Mobile home rolled by mudflow.

0.3

72.1 House buried by mudflow. Should people whose homes were destroyed in this area be allowed to rebuild? This is a real question that the county and state are facing. Note transported jumble of stumps and logs mixed with trees killed and buried in situ. How could you tell the transported trees from the ones preserved in place after preservation in the fossil record?

0.2

72.3 STOP 4: Bridge over the South Fork of the Toutle River. Stop to observe the mixture of transported and in situ stumps and logs. How does the grain

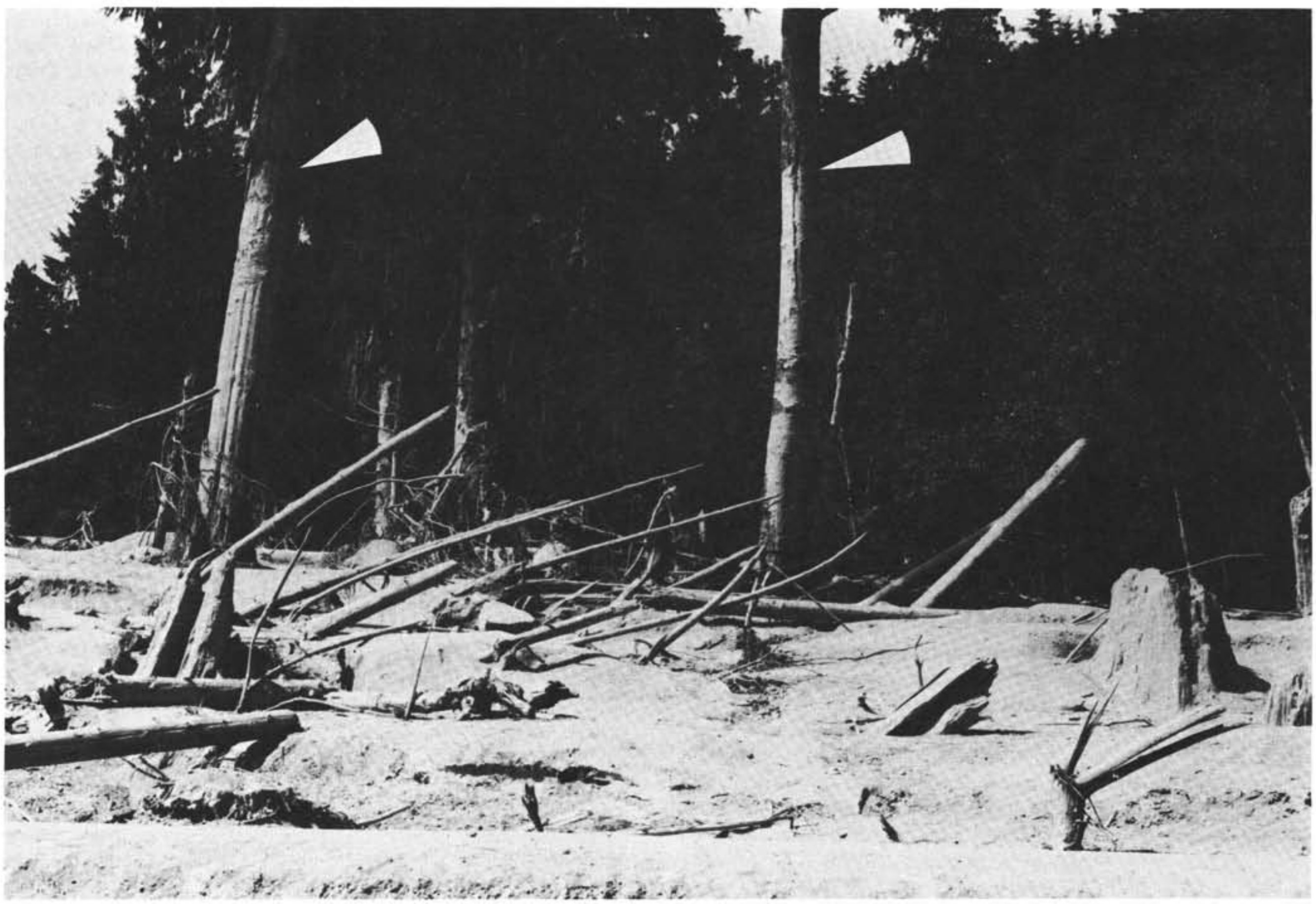

Figure 6. Mixture of transported and in situ stumps and logs buried at STOP 5 by the mudflow. Arrows point to the 1980 mudflow level.

Figure 7. Upright stump transported by the 1980 mudflow and deposited upright in the center of Highway 504 near STOP 5. (From Fritz, 1980.)

size of the mudflows compare with that observed at STOP 2? Compare the sedimentation here with that along the North Fork of the Toutle. It appears that the 1982 mudflows did not affect this area. Turn around and head back west on South Toutle Road.

0.9

73.2 Turn right on Highway 504.

0.2

73.4 STOP 5: Pull off on old road to observe bridge washed out by mudflow and mixtures of transported and in-place logs and stumps buried by the mudflows (Figure 6). For those who still doubt that stumps can be transported and deposited upright, please observe upright stump (Figure 7) in the center of the old road (see Fritz, 1980). Note coarser grain size of sediments as compared to STOP 1. Continue north on 504.

0.6

74.0 Bridge over the Toutle River—CAUTION—this is a temporary one-way bridge. Note large boulders and numerous upright transported stumps. While continuing east along north bank of river, watch for mudflow deposits. Plans call for rebuilding the old bridge. When this occurs, you will need to adjust mileage beyond the point to account for abandonment of the loop across the temporary bridge. There is a place to pull off and stop to observe features just across the temporary bridge.

1.6

75.6 STOP 6: Good view of stream-reworked mudflows and buried upright stumps (Figure 8). Stop at viewpoint parking lot. Notice that the mudflows are much coarser grained here than they are downstream. Here they consist of gravel, cobble, boulder, and coarse sand conglomerate (Figure 9).

2.2

77.8 Keep right on Highway 504 at intersection with Highway 505.

1.7

79.5 Good viewpoint of transported stumps. Would you have wanted to be standing in the road here on May 18 to watch the eruption and the spectacular mudflows? See cliffs on the left for indications of mudflow levels. There are many pullouts and viewpoints from here on for optional stops to observe mudflow deposition along the North Fork of the Toutle River.

1.0

80.5 This is not, repeat **not**, part of the blowdown zone —it represents activity by *Homo sapiens.*

2.5

83 STOP 7: You have arrived at the boundary of the Blue Zone (previously the Red Zone boundary). Part of Highway 504 is washed out and im-

Figure 8. Upright-transported stump buried in alluvial deposits of reworked mudflow material at STOP 6. Note layering, coarse cobble grain size, and sedimentary features in the exposure.

passable 600 ft beyond the barricade. By walking down to the washed-out portion, you can observe the depositional sequence resulting from the 1982 mudflows. Head back west on Highway 504.

0.4

83.4 STOP 8: Turn right into viewpoint parking. Several houses and cars partially buried by the 1980 mudflow are still preserved here.

This is the end of the first portion of the road log. Return to Portland via Highway 504 to Interstate 5. For those persons with the proper entry permits and off-road vehicles, a second portion of the road log starts at the viewpoint at STOP 8 and continues to the new Red Zone (as of March 1982) at the earth dam above Camp Baker. This portion of the trip shows much coarser grained deposition and thicker sequences of both the 1980 and 1982 mudflow. Please note that all roads in the second portion are dirt logging roads with a high volume of heavy-equipment traffic. Many of the bridges and sections of the road are subject to washout. IT IS IMPERATIVE THAT YOU CHECK WITH THE AUTHORITIES FOR PERMITS AND A REPORT ON THE STATUS OF THE VOLCANO AND ROAD CONDITIONS BEFORE PROCEEDING.

Figure 9. Graded bed of conglomerate produced by the 1982 mudflow upstream from STOP 6. Shovel is 32 in. long.

00.0 Leave viewpoint parking lot. Turn west (right) on Highway 504.

1.1

1.1 Turn north (left) on dirt road No. 1900. First left past Kidd Valley Store.

0.5

1.6 Stay left on road No. 1900 at junction with road No. 1913.

0.3

1.9 Stay right on road No. 1900 at junction with road No. 1914 to the left.

1.7

3.6 Stay left (uphill) at intersection.

0.4

4.0 Take a hard left at maze of intersections. Stay on the well-traveled road No. 1900.

0.4

4.4 Stay right on No. 1900 at junction with No. 2410-J.

0.4

4.8 Continue straight on No. 1900 at junction with No. 2410-I.

0.6

5.4 Continue straight at intersection.

2.0

7.4 Continue straight on road No. 1900 at maze of intersections of roads No. 2410 and No. 2411. Be sure to check the warning light for possible flood hazard conditions before proceeding down to the stream bottom.

0.6

8.0 Arrive at edge of the North Fork of the Toutle River. Watch for features on the point bars from here on.

0.5

8.5 Turn left over Alder Creek.

0.2

8.7 Good place to stop and view mudflow and associated alluvial deposits.

0.3

9.0 STOP 9: Bridge over the North Fork of the Toutle River. Road now continues on the north bank. There is a good place to stop just across the bridge. From here walk downstream on the point bar to observe stream-reworked volcaniclastic material (Figure 10).

Figure 10. Graded bed of cobble pumice clasts fining upward to coarse sand deposited by the 1982 mudflow near STOP 9.

Figure 11. A braided portion of the North Fork of the Toutle River upstream from the debris dam at STOP 11. Braiding was caused by the high sediment load from the 1982 mudflow debris exposed in the cutbanks. Note the upright-transported stump on the channel bar in the lower right corner of the photo.

0.1

9.1 STOP 10: Stay right at junction with road No. 2500. Just past this intersection is a good place to stop and walk through the aspen grove on the right and down onto a large point bar. All of the trees in this grove were buried 0.5-1 m deep and killed by the 1980 mudflow. Note the new plants and the 1- to 5-cm-thick accumulation of organic debris on the surface. This is the start of the formation of a new soil.

0.7

9.8 Continue straight at intersections.

1.4

11.2 Center of Camp Baker. Excellent view of Mount St. Helens straight up the valley if the weather is clear.

1.4

12.6 Standing trees in the flats are on the very edge of the seared zone of the May 18, 1980, eruption (U.S. Geological Survey, 1980).

0.9

13.5 STOP 11: Boundary of the Red Zone at top of earthen flood control dam. Approximately 3-4 m of sedimentation occurred behind this dam the night of March 19, 1982 (Figure 11). The surface now preserves a good representation of the appearance of the flow. Note the large numbers of horizontal logs and vertical stumps on the surface. Counts taken two weeks after the 1982 eruption showed that 10.2 percent of the transported logs were transported and deposited upright. The horizontal logs were strongly oriented in a downstream direction by the flow. A walk across this surface shows excellent exposures of sedimentary structures. Walk downstream below the dam to observe the depositional sequence in both the 1980 and 1982 flows.

CONCLUSION

In this road log we have attempted to show the readily observable pattern of sedimentation resulting from the May 1980 and March 1982 eruptions of Mount St. Helens. Sedimentary features of these mudflows are extremely useful in understanding older volcaniclastic sediments. Mount St. Helens will likely continue producing mudflows in the near future. These mudflows will alter some of the specific details pointed out in this road log. However, the general patterns of sedimentation and points from which to observe them should remain unchanged.

ACKNOWLEDGMENTS

For the help in the field and for assistance in obtaining Red Zone permits, we thank Anthony Qamar, University of Montana and University of Washington. This work was partially supported by the Dean's Research Fund of the College of Arts and Sciences at Georgia State University. Ernest Fritz kindly provided field vehicles and assistance in the field. We also thank Tom Pierson, U.S. Geological Survey, David A. Johnston Cascades Volcano Observatory, Vancouver, Washington, for reviewing the manuscript.

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Guidebook on requirements for natural resource development

The U.S. Geological Survey has published guidebooks listing state requirements for development of natural resources in 40 states, including Oregon and all other western states.

The guidebooks provide information on how to obtain permits for activities such as drilling wells, mining, or collecting fossils and list and explain briefly the state regulatory requirements governing the development of energy and other natural resources. In addition to regulatory requirements, they outline procedures for permits, leases, and other documents; give estimates of the time and fees needed in obtaining the documents; and list the appropriate state agencies.

The guidebook on Oregon is available at no charge but in limited numbers from the Office of the Governor, State Capitol Building, Salem, OR 97310, attention Pat Amedeo, Room 160, phone (503) 378-3109. After the supply of free copies is gone, the guidebooks may be purchased from the Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Prices are $3.50 for the microfiche version and $13.50 for the paper copy. □

OIL AND GAS NEWS

Columbia County

Reichhold Energy Corporation's Columbia County 43-5, previously reported in July, was suspended June 17 at a total depth of 3,099 ft. The operator plans to re-enter it for redrill in approximately six months. The rig will next move to Columbia County 4, located in sec. 15, T. 6 N., R. 5 W., for redrill. This well, originally completed as a producer, flowed at the rate of 865 Mcfd in May 1979 but was never produced. Subsequent mechanical problems necessitate the redrill.

Clatsop County

Oregon Natural Gas Development Patton 32-9, located in sec. 9, T. 7 N., R. 8 W., 3 mi east of Olney, is drilling below 7,900 ft. Proposed total depth has been increased from 8,000 to 9,000 ft. Oregon Natural Gas currently has two additional locations in Clatsop County, each with a proposed total depth of 8,000 ft.

Douglas County

Florida Exploration Company 1-4, located near the town of Drain, is drilling ahead. Florida Exploration has three additional locations in Douglas County, each with a proposed total depth of 10,000 ft.

Hearings before the Governing Board

On June 29, a public hearing was held at St. Helens, Oregon, to consider rule changes governing oil and gas drilling and operation, specifically compulsory integration. The proposed changes include the addition of provisions to compensate the operator for financial risks incurred in the event of a discovery when there are unleased parcels in the spacing unit at the time of drilling. The proposed rule changes are currently being studied and will be acted on at the next Governing Board meeting.

Following this hearing, another public hearing was held to amend the interim order of September 29, 1981, integrating and pooling interests in the NE¼ sec. 15, T. 6 N., R. 5 W., Columbia County, Oregon. Reichhold Energy Corporation, the petitioner, proposed that the Board allow them to redrill their Columbia County 4 and to retain certain sums of money from escrow. The amendment to the Interim Order was approved and signed by the Board July 8, 1982.

Recent permits

Permit no.	Operator, well, API	Location	Status
218	Reichhold Energy Corp. Columbia County 32-9 36-009-00104	NE¼ sec. 9 T. 6 N., R. 5 W. Columbia County	Location □

Washington geologists die in plane crash

E. Bates McKee, Jr., Affiliate Professor, and Randall L. Gresens, Associate Professor, both of the Department of Geological Sciences, University of Washington, Seattle, were killed in a light plane crash July 17, 1982, in the Wenatchee Mountains southeast of Wenatchee, Washington. Gresens' wife Mimi was also killed in the crash. McKee, who wrote the book *Cascadia: The Geologic Evolution of the Pacific Northwest*, was owner and pilot of the plane. □

BOOK REVIEW

by Ralph S. Mason, former State Geologist

The Geologic Story of the National Parks and Monuments, *third edition, by David V. Harris. John Wiley & Sons, 1980, 322 p., paperback $21.95.*

Good looks alone do not a good book make. Here is a book which, while concerned with some of the most beautiful scenery in the United States, makes a deliberate point of taking the reader behind the scenes to explain just how all of that wonderful real estate came to be that way. Probably more than 90 percent of all scenery is due to purely geologic processes and formations, and it is this 90 percent that the author takes under his wing.

Author David V. Harris taught for 30 years at Colorado State University, where he developed the geology program and offered one of the first courses in the geology of the national parks in the United States. Before embarking on a park-by-park description, he presents a mini-course in physical and historical geology in a long opening chapter. There is no excuse for not grasping the fundamentals of this body of science after one has read that chapter.

The main body of the book discusses 21 geomorphic provinces with "39 Parks, 30 of the most geologic Monuments, a National Lakeshore, a Seashore, and a National Parkway." Oregon is represented with the Oregon Caves National Monument in the Pacific Border Province and with Crater Lake National Park in the Cascades Province.

Since any discussion of geological phenomena must inevitably include a few special terms, the author has thoughtfully listed them in the glossary-index. A bibliography of selected geologic references contains nearly 400 entries.

The book seems to have at least one illustration per page, often more, approximately one-fourth in color. The cross section through the Grand Canyon has to be one of the finest around and greatly simplifies the vast complexities of the panorama that confronts the visitor. The text is well suited for the average tourist who is curious about the natural forces that created the geologic wonders framed in the view finder of his or her camera. For the armchair tourist, the volume offers enjoyable reading and the best possible alternative to actually being there. For the professional geologist, the book is a handy reference tool in responding to queries from the lay public. It is available from most bookstores, and a copy is available for inspection in the library of the Portland office of the Oregon Department of Geology and Mineral Industries. □

Northern Oregon Cascades geologic map released by PSU

The Earth Sciences Department of Portland State University announces the completion of a new map, *Preliminary Geologic Map and Cross Sections of the Upper Clackamas and North Santiam Rivers Area, Northern Oregon Cascade Range*, by Paul E. Hammond, Kathleen Manning Geyer, and James L. Anderson. The black-and-white ozalid map covers all or parts of six 15-minute quadrangles, including the areas around Austin, Bagby, and Breitenbush Hot Springs. Produced at a scale of 1:62,500, the map shows the areal extent of numerous geologic units, including surficial deposits, intrusions, and 20 volcanic units, ranging in age from about 25 m.y. to Recent. It is printed on a single sheet 67 by 42 in.

Cost of the map is $8 (folded) or $9 (rolled, in tube). Maps may be ordered prepaid from the Department of Earth Sciences, Portland State University, P.O. Box 751, Portland, OR 97207. □

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