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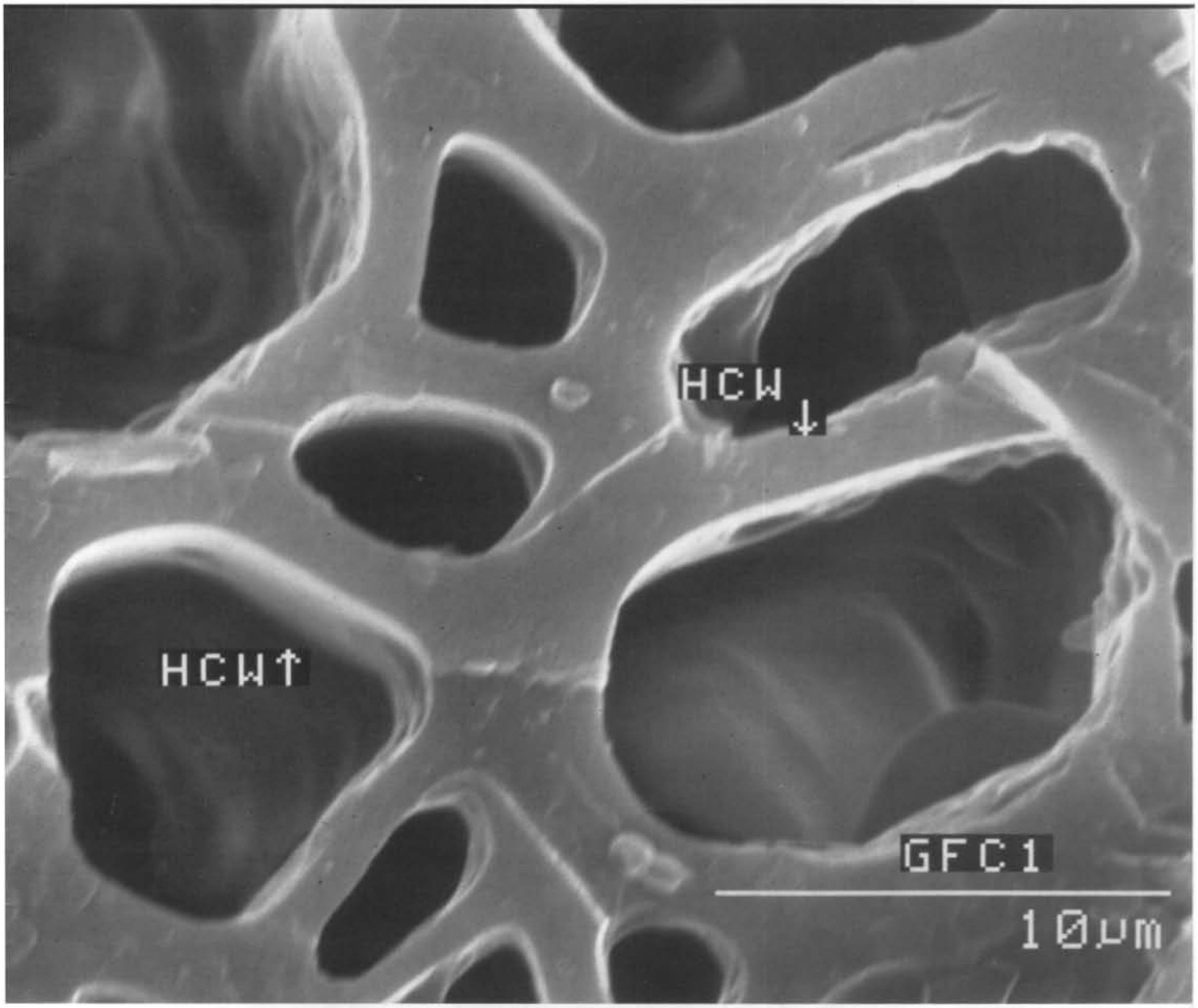

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Information for contributors

Oregon Geology is designed to reach a wide spectrum of readers interested in the geology and mineral industry of Oregon. Manuscript contributions are invited on both technical and general-interest subjects relating to Oregon geology. Two copies of the manuscript should be submitted, typed double-spaced throughout (including references) and on one side of the paper only. If manuscript was prepared on common word-processing equipment, an ASCII file copy on 5-in. diskette may be submitted in addition to the paper copies. Graphic illustrations should be camera-ready; photographs should be black-and-white glossies. All figures should be clearly marked, and all figure captions should be typed together on a separate sheet of paper.

The style to be followed is generally that of U.S. Geological Survey publications. (See the USGS manual *Suggestions to Authors*, 6th ed., 1978 or recent issues of *Oregon Geology*.) The bibliography should be limited to references cited. Authors are responsible for the accuracy of the bibliographic references. Names of reviewers should be included in the acknowledgments.

Authors will receive 20 complimentary copies of the issue containing their contribution. Manuscripts, news, notices, and meeting announcements should be sent to Beverly F. Vogt, Publications Manager, at the Portland office of the Oregon Department of Geology and Mineral Industries.

Cover photo

Cell structure of carbonized wood as seen in a scanning electron microscope. The wood was carbonized in a recent forest fire in southern Oregon and shows evidence of homogenized cell walls (HCW). Ivan Gall, in his article beginning on page 109, investigates the value of HCW in fossil charcoal from sedimentary rocks as an indicator of ash-flow deposits.

OIL AND GAS NEWS

Drilling underway at Mist Gas Field

During July, Nahama and Weagant Energy Company of Bakersfield, California, began a multi-well drilling program at the Mist Gas Field, Columbia County, Oregon. The first well drilled, Columbia County 44-8-64, located in the SE¼ sec. 8, T. 6 N., R. 4 W., reached a total depth of 1,810 ft and is an indicated successful gas discovery that currently is suspended, awaiting production testing. The next well drilled, Columbia County 23-35-75, located in the SW¼ sec. 35, T. 7 N., R. 5 W., reached a total depth of 3,374 ft and was plugged and abandoned. Drilling operations are currently underway at the Columbia County 34-31-65 located in the SE¼ sec. 31, T. 6 N., R. 5 W. Taylor Drilling Company, Chehalis, Washington, is the drilling contractor.

Production tests on gas wells

During July and August, Oregon Natural Gas Development Corporation and ARCO conducted long-term production tests on three gas wells located at the southern end of the Mist Gas Field. These wells, the ARCO CFI 23-15, the ARCO CFI 31-16, and the ARCO Columbia County 42-8, contain gas with a low BTU content and were tested to determine whether they are currently capable of economic utilization.

NWPA elects board

The Northwest Petroleum Association (NWPA) announced the results of the elections of the Board for 1991-1992. The officers now are Lanny Fisk, President; Jack Meyer, Vice President; John Newhouse, Secretary; Vijai Shukla, Treasurer; and Barbara Portwood, Past President. Directors are Peter Hales, Western Washington; Phil Brogan, Eastern Oregon and Washington; Margene Hamer, Land; Beth-Karan Kaye, Legal; and Nancy Ketrenos and Dan Wermiel, At-large.

The NWPA is an organization of persons interested in oil, gas and geothermal energy resources in the Pacific Northwest. Meetings with a speaker are held each month, and an annual field symposium is held each fall. Contact the NWPA, P.O. Box 6679, Portland, OR 97228-6679, for further information.

Recent permits

Permit no.	Operator, well, API number	Location	Status, proposed total depth (ft)
462	Nahama & Weagant Oregon 31-36-66 36-007-00023	NE¼ sec. 36 T. 6 N., R. 6 W. Clatsop County	Permit; 2,430.
463	Nahama & Weagant CC 34-8-64 36-009-00288	SE¼ sec. 8 T. 6 N., R. 4 W. Columbia County	Application; 1,350.
464	Nahama & Weagant CER 12-26-64 36-009-00289	NW¼ sec. 26 T. 6 N., R. 4 W. Columbia County	Application; 2,790.
465	Nahama & Weagant CER 31-26-64 36-009-00290	NE¼ sec. 26 T. 6 N., R. 4 W. Columbia County	Application; 3,120.
466	Nahama & Weagant CC 23-19-65 36-009-00291	SW¼ sec. 19 T. 6 N., R. 5 W. Columbia County	Application; 3,000.
467	Nahama & Weagant Johnston 11-30-65 36-009-00292	NW¼ sec. 30 T. 6 N., R. 6 W. Columbia County	Application; 2,700.

□

Oregon's gold coast*

by Gary Meier, 1625 Henderson Avenue, D-12, Eugene, Oregon 97403-2323

"Gold in Oregon's beach sands!"—so announced the Oregon and California newspapers in the spring of 1853, leading to a rush that would soon have thousands of determined argonauts converging on Oregon's South Coast.

The spark that ignited the commotion occurred a couple of months earlier, when California-bound prospectors John and Peter Groslius discovered rich amounts of fine gold in a stretch of black sand at Whisky Run Creek, north of the Coquille River. The brothers Groslius tried to work their claim quietly, but, as is the nature of such things, word of their discovery soon got out, and the rush was on.

The beach at Whisky Run, previously a secluded place of solitude with only the sound of the surf to break the quiet, became a circus of boisterous activity in the summer of '53. Hundreds of claims were staked up and down the beach, and a raucous tent-and-shack city named Randolph sprang into being on the bluff above. Within weeks of the boom camp's establishment, it had stores, saloons, lodging houses, and restaurants.

Newspapers such as the San Francisco *Alta California* fueled the golden fire with claims that the Oregon beach miners were cleaning $75 to $100 a day from their sluice boxes. So glorious were the reports of the new-found bonanza that even sailors on the supply ships from San Francisco were not immune. When the schooner *Cecil* arrived at Port Orford loaded with provisions for the miners, nearly the entire crew abandoned ship to work the beach near Whisky Run. Though accurate records are lacking, the Oregon Department of Geology and Mineral Industries estimates that between $80,000 and $100,000 in gold was taken out of the original Whisky Run claim.

The beach gold was found in dark deposits of heavy sand—mineral concentrate which had originally washed down from the streams and creeks of the Coast Range into the ocean. Subsequent wave action during high tides and storms brought the mineralized black sand back onto the beaches. Unknown at the time, the gold-bearing deposits also contained platinum and chromite (chrome ore).

The gold was in the form of fine grains, unlike the large flakes and nuggets found inland. To capture this "flour" gold, beach miners used various imaginative methods. The most common device was a long, riffled sluice box. Water was run through the sloping trough, and at the top end black sand was shoveled in. The heavier gold caught in the riffles, while the lighter, finer particles washed down to the lower end of the sluice box. There, thin copper plates coated with quicksilver caught and held the gold (a process called amalgamation), allowing the other material to wash away. Most of the gold, however, was trapped in the riffles. William V. Wells, who visited the Whisky Run diggings, wrote: ". . . we found the bottom of the trough sparkling with innumerable minute specks of gold. . . . It was a crystal brook, with golden pavement."

Where creek water was unavailable on the beach, miners used water from the ocean. When the tide was low they set up operations in the shallow surf, laboriously shoveling black sand into their sluice boxes and washing it down with countless buckets of saltwater. As the tide rose, the men moved everything back in stages until they were at the high-tide line. Then they would slowly follow the tide back down as it receded.

Other South Coast gold discoveries followed the Whisky Run bonanza in that magical summer of 1853. Valuable claims were staked on the beaches north and south of the mouth of the Rogue River, and colorfully named gold camps grew overnight—Elizabethtown, Hogtown, Ophir. On the south side of the Rogue, amidst a profusion of sluice boxes and claim stakes, the tent city of Sebastopol sprang up, later called Ellensburg, and still later, appropriately, Gold Beach.

Mining the beach north of Newport with an 1890's "Long Tom" sluice box. Photo courtesy Lincoln County Historical Society.

Farther down the coast, beach gold operations were profitable at the mouths of the Pistol, Chetco, Winchuck, and Smith Rivers as well as the creeks in between.

North of the Rogue River, rich gold strikes were made in the black sand deposits at Euchre Creek (Ophir), the mouths of the Elk and Sixes Rivers, and in the long sweep of the Cape Blanco beach.

Joseph H. McVay, an Oregon Coast pioneer, mined beach claims from Port Orford to the Rogue River in 1854. He later wrote: "In passing along the coast one could see in every little rivulet that came gushing from the banks particles of shining gold, rolling along with the black sand, and it seemed that we had truly arrived at an El Dorado."

The problem with this beach El Dorado, however, was the capriciousness of the ocean. What the sea brings in, the sea takes out. It was a constant frustration to the beach miners to wake in the morning and find that the tides had wiped away their black sand deposits. Rich pay streaks were covered over with thick white sand or entirely swept back into the ocean.

* This article appeared first in the March/April 1991 issue of *Oregon Coast* and is reprinted here with permission of the author.

The "Million Dollar Beach," south of Whisky Run Creek. Each rivulet showed the sparkle of gold in the sunlight in 1853.

Shallow black beach sands today, as shown here in Whisky Run Creek, are a far cry from the deep deposits of the 1850's—but they still contain traces of gold.

At Whisky Run in the spring of 1854, just a year after news of the first Oregon Coast gold discovery leaked to the world, a great slashing storm hit the beach. It obliterated most of the black sand deposits, destroyed networks of sluice boxes and flumes, and left in its wake dunes of worthless, ordinary white sand. The rich Whisky Run strike was over. Although some mining continued with each new gold-bearing deposit through the years, the original bonanza was never repeated. The bluff city of Randolph was soon abandoned and relocated at another site. The miners scattered to other beaches to work their new claims or went a mile or two inland, where gold was being discovered in ancient elevated beach terraces.

Fortunately, the ocean often relented after sweeping away miners' black sand hopes, redepositing new stretches of valuable concentrate on South Coast beaches, where waiting miners worked feverishly to extract the golden treasure before it was again taken from them.

In 1890, Oregon historian Frances Fuller Victor visited Coos and Curry Counties and reported that beach gold mining was still paying "fair wages." A number of beach placer mines became well-known into this century as profitable enterprises, including the Kalamazoo Ocean Beach Mine at Ophir, the Sixes Beach Placer at the mouth of that river, the Collins Mine north of Wedderburn, and the Blanco Blacksand Mine on the beach at Cape Blanco.

Gold discoveries were made on the beach north of Newport in the mid-1890's and again in 1911. Beach mining activity slowed somewhat in the 1920's, though a number of Coos and Curry gold mines were producing good profits from shafts deep in the ancient beach terraces inland. Some of the gold-rich black sand in mines such as the famous Pioneer Mine off Seven Devils Road, the Chickamin, the Independence, and the Eagle Mines were from 3 to 10 ft thick and hundreds of feet long. Several Oregon Coast newspapers, particularly the *Port Orford News* and the *Curry County Reporter*, carried advertisements for national gold buyers.

With the depression in the 1930's came a resurgence in beach mining, and the shores of Coos and Curry Counties were again dotted with miners' tents and campfires. More than a few hard-pressed families survived those difficult times, at least in part, by the gold they carefully gleaned from beach black sand deposits.

It is estimated that several million dollars in fine gold was mined from Oregon's beaches from 1853 until World War II. During the war, all gold mining in the United States was temporarily halted by Order L-208, designed to divert gold miners into seeking copper and other metals needed for the war effort. The order was rescinded after the war, but the high cost of operating and the restrictive $35-per-ounce government-controlled gold price kept most of the mines from reopening. One notable exception was the Cape Blanco Beach Mine, run by Carl Hopping in the 1930's and by successive owners until the late 1960's.

Oregon's beaches still beckon recreational prospectors, though the deposits of black sand these days are thin and scattered. But with patience and a sharp eye, it is still possible to find "color" in your gold pan at many locations on the south coast. Although the Oregon Department of Geology and Mineral Industries has not made an estimate of coastal gold reserves, it has stated that deposits suitable for recreational prospecting will continue to form here and there along the coast.

And who knows when the great Pacific storm tides might again bring large pay streaks of black sand to Whisky Run? □

Tips for beach prospecting

Black sand deposits on Oregon's beaches are not what they once were, but they can still be found and often contain particles of gold. Here are some likely places to prospect:

Coos County

- Sacchi, Agate, and Merchants Beaches—off Seven Devils Road, north of Bandon
- Whisky Run Beach—Seven Devils Road
- All beaches and mouths of streams between Bandon and the Curry County line north of Langlois

Curry County

- Cape Blanco—north and south beaches
- Beaches in area of Port Orford
- All beaches from Humbug Mountain south to the California border, especially near Ophir, Gold Beach, Hunter's Creek, Pistol River, and Chetco River

Lincoln County

- Beaches north of Yaquina Bay, from Newport to Beverly Beach State Park

Be watchful for claim markers on inland streams. Do not prospect on marked claims. If you use ocean water for panning, **face the ocean!** Be alert for sneaker waves and floating driftwood.

Good Luck! □

Initial results from the 1990 geothermal drilling program at Santiam Pass, Cascade Range, Oregon.

by Brittain Hill and George Priest, Oregon Department of Geology and Mineral Industries, Portland, Oregon 97201-5528, and David Blackwell, Southern Methodist University, Dallas, Texas 75275

ABSTRACT

Drilling of a 929-m geothermal assessment hole near Santiam Pass in the Oregon Cascades has provided new information on the thermal regime and geology of the High Cascades. An unequilibrated, maximum geothermal gradient of 120 °C/km occurs in the bottom 20 m of the hole, with presumed background gradients of ~60 °C/km measured in the lower 200 m. Mafic lavas and dikes are the dominant rock types in the core, and a K-Ar date of 1.8 Ma at the bottom of the hole is consistent with the observed paleomagnetic stratigraphy. Regional correlations with drill core data indicate that a fault with ~440 m vertical displacement is buried within 16 km west of the drill site and that vertical displacement on the Green Ridge fault zone 18 km east of Santiam Pass must exceed 1 km.

INTRODUCTION

A 929-m geothermal observation hole has been drilled at 4,800-ft elevation on the axis of the Oregon Cascade Range near Santiam Pass (Figure 1). The Santiam Pass site 77-24 was chosen to assess the geothermal resource potential along the axis of High Cascade volcanism away from major volcanic centers. The scientific goals of this project were to obtain tem-

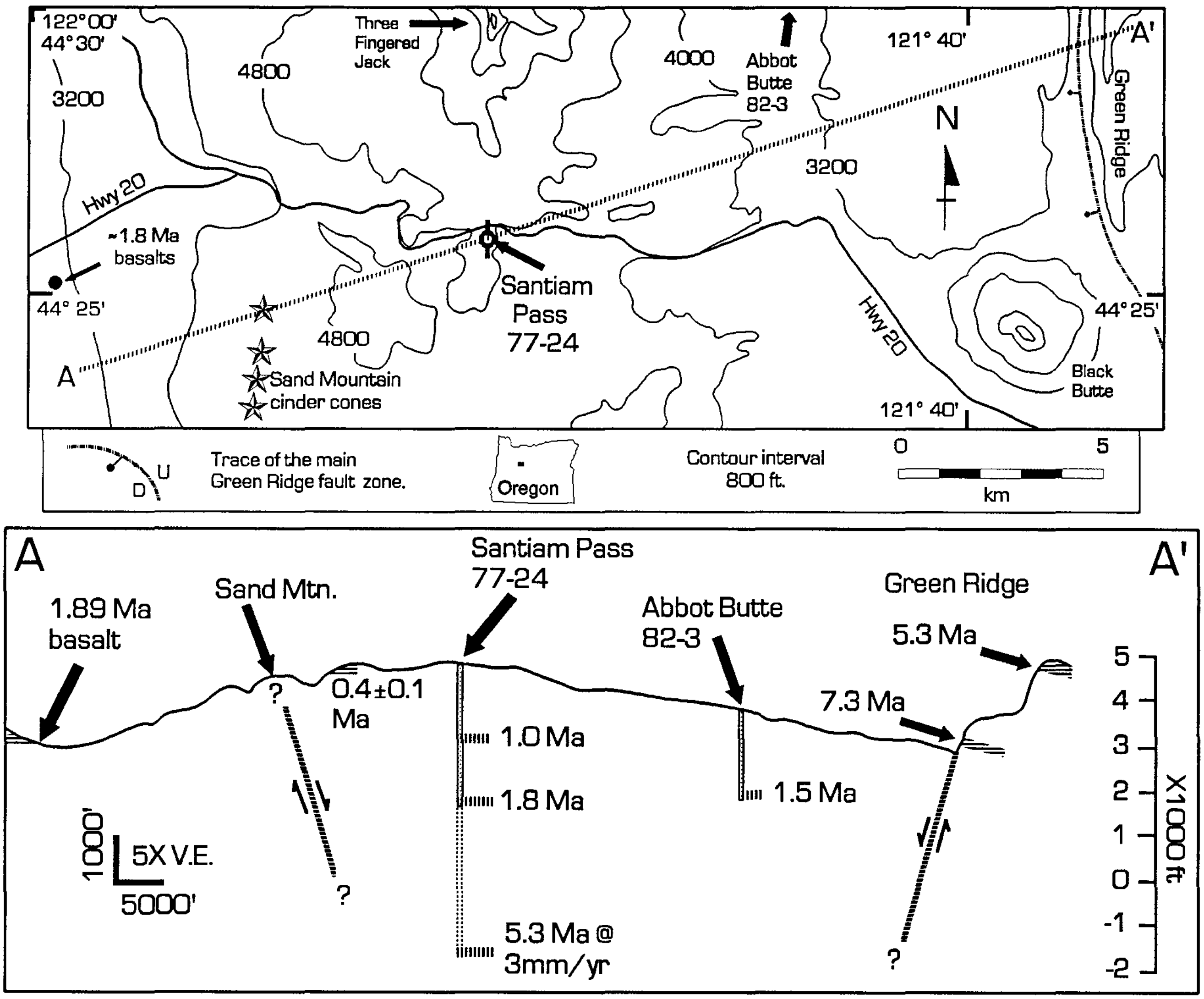

Figure 1. Generalized location map and cross section of the Santiam Pass area of the Oregon Cascade Range. K-Ar dates from Armstrong and others (1975), Black and others (1987), Priest and others (1989), and this study. UNOCAL well Abbott Butte 82-3 projected into the cross section from north of the map area. Interval below 1.8 Ma in Santiam Pass 77-24 shows estimated depth to 5.3-Ma rocks using a deposition rate of 3 mm/yr.

perature-gradient, heat-flow, hydrologic, and lithologic data that were not available from nearby shallow (~100-m) drill holes. Funding for this project was provided through a U.S. Department of Energy Geothermal Research Grant (DE-FG07-89ID12834) to the Oregon Department of Geology and Mineral Industries (DOGAMI) and a one-third cost share from Oxbow Geothermal Corporation of Reno, Nevada. This report summarizes the initial results of the drilling program. Final results will be published later in a DOGAMI open-file report.

DRILLING OPERATIONS

The upper 140 m of the hole were rotary drilled in the fall of 1989 by Woytec Drilling Company. The upper 11 m were cased with 27.3-cm-inside-diameter (id) surface pipe, with 10.2-cm-id conductor cemented in the hole from the surface to 140 m. Diamond core drilling was done by Tonto Drilling Services under the direction of Oxbow Geothermal and DOGAMI. The hole was drilled from 140 m to total depth using HQ (10.2-cm-outside-diameter) diamond core rods, with >99.5 percent core recovery. Drilling operations commenced on August 10, 1990, and proceeded at an average daily rate of 28 m per day with no significant delays. Total drilling costs, including rotary drilling of the upper 140 m, were approximately $224,000; core drilling costs averaged ~$250/m, and rotary costs were ~$200/m. The hole was conditioned with heavy drilling mud and completed on September 14, 1990, with 4.8-cm-id, water-filled black pipe to total depth. Final site reclamation and abandonment will occur in the fall of 1991 after a final temperature log has been acquired.

GEOTHERMAL DATA

Caliper and sonic logs were run before completion, and natural gamma-ray and temperature logs were run on September 19, 1990. An additional temperature log was run on September 27, 1990, which had a nonequilibrated bottom hole temperature of 24 °C. Bottom-hole temperatures measured during drilling were always less than 20 °C. Temperature recovery between the September 19 and 27 logs was about 1 °C to 1.5 °C between 160 and 180 m and below 900 m, with no change in temperature observed between 180 and 900 m. The lack of recovery between 180 and 900 m strongly indicates that this interval represents a zone of ground-water flow that resulted in rapid thermal reequilibration after drilling disturbance. Geothermal gradients measured on September 27, 1990 (Figure 2), were about 15 °C/km from 160 to 700 m, about 60 °C/km from 700 to 900 m, and about 120 °C/km from 905 to 920 m. Bottom-hole temperatures measured during drilling were used to constrain the geothermal gradients in the hole above 900 m. The hole will be logged at least once more before abandonment.

GEOLOGIC DATA

Rocks encountered during drilling consisted of ~95 percent basalt to basaltic andesite flows and dikes, with ~5 percent volcanic sediments. Most of the units in the upper 514 m are basaltic andesites ($SiO_2 \approx 54$ percent) with reversed paleomagnetic directions. A thick (95-m) basaltic andesite flow at 502 m has a K-Ar age of 1.00±0.03 Ma (Table 1). Basalt and basaltic andesite flows with normal paleomagnetic directions extend from 514 to 643 m and overlie a ~0.5-m-thick paleosol. The paleosol caps a paleomagnetically reversed section of basaltic andesites, basalts, and intercalated volcanic sediments that extends to total depth (929 m). A porphyritic basaltic andesite flow at 928 m has a K-Ar age of 1.81±0.05 Ma (Table 1). Disseminated, low-grade zeolitic(?) alteration is also present in the lower ~100 m of the core. Detailed core studies, including petrographic analysis, measurement of thermal conductivity, and major and trace element analyses, are currently in progress.

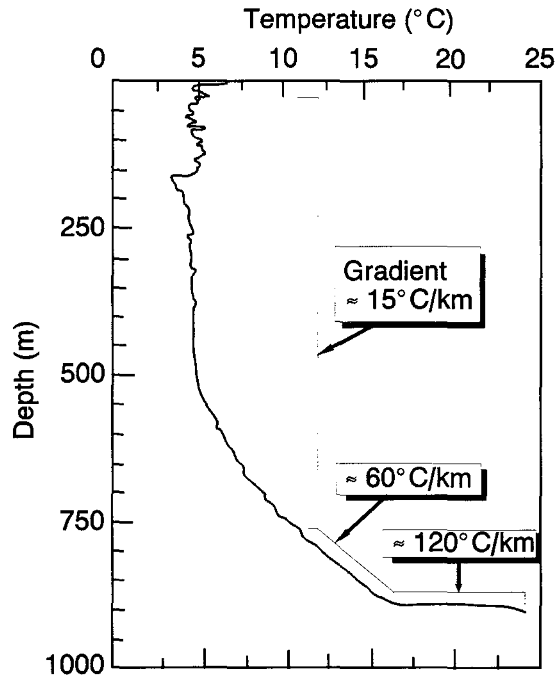

Figure 2: Temperature-depth plot for Santiam Pass 77-24. Hole was logged 13 days after completion (September 27, 1990) with water-filled iron pipe.

REGIONAL CORRELATIONS

Mafic flows of about 1.8 Ma are exposed 16 km west of the drill site (Black and others, 1987), at elevations of ~3,200 ft (Figure 1). If these flows are correlative with the ~1.8-Ma mafic flows in the Santiam Pass core (and assuming the flows are horizontal), then there is a minimum vertical displacement of 440 m between these units. This displacement may be associated with the north-striking structure that apparently controlled emplacement of the Sand Mountain cinder cones (Figure 1) and is the most prominent tectonic(?) feature in that area.

Drilling by UNOCAL Geothermal near Abbot Butte (~3,600-ft elevation) encountered 1.5-Ma basalt at a depth of 748 m (Priest and others, 1989), which indicates no significant (≥100-m) vertical displacement between the Santiam Pass and Abbot Butte drill holes. Mafic flows of about 5.3 Ma are exposed 19 km east of the drill site at the top of Green Ridge (~4,800-ft elevation) (Smith, 1986), which represents the eastern margin of the High Cascade graben (Smith and others, 1987). Offset between the top of Green Ridge and the base of the well Santiam Pass 77-24 indicates that at least 1 km of vertical displacement is associated with the Green Ridge fault zone. Rates of deposition average 5 mm/yr in the Santiam Pass core, 3.5 mm/yr in the Abbot Butte core, and 3.2 mm/yr at Green Ridge. Under the assumption that there was continuous deposition of 3 mm/yr from 5.3 Ma to 1.8 Ma, 5.3-Ma rocks correlative with Green Ridge may be located >1 km beneath the bottom of Santiam Pass 77-24. Faulting at Green Ridge associated with the High Cascade graben may thus have involved >2 km vertical displacement.

ACKNOWLEDGMENTS

Dick Benoit, Oxbow Geothermal, supervised the drilling operations and provided valuable support for overcoming many of the logistical and financial problem associated with this study. Gerald Black, DOGAMI, provided detailed lithology logs of the UNOCAL Abbot Butte hole. We thank Howard Ross, University of Utah Research Institute; Bob Spafford, Southern Methodist Uni-

Table 1. *Whole-rock K-Ar data, Santiam Pass 77-24. Isotopic ratios determined at Oregon State University, R. Duncan, principal investigator. Decay constants:* $\lambda_e = 0.581 x10^{-10} yr^{-1}$, $\lambda_\beta = 4.962 x10^{-10} yr^{-1}$, *and* $^{40}K/K_{total} = 1.167 x10^{-4}$ *mol/mol.*

Depth (m)	Sample weight (g)	K[1] (weight percent)	$^{40}Ar_{rad}$ $x10^{-12}$ mol/g	$^{40}Ar_{rad}$ (percent)	Age (m.y.) ($\pm 1\sigma$)	Comments
502	4.94	0.76	1.32	15.6	1.00±0.03	Basaltic andesite flow at 1,647 ft
698	4.93	0.66	1.04	6.1	0.91±0.06	Basaltic andesite flow, Ar loss(?)
928	5.13	0.45	1.41	9.1	1.81±0.05	Basal basaltic andesite flow(?)

[1] K determined by atomic absorption spectrometry at University of Oregon, C. McBirney, analyst.

versity; Peter Hooper and Richard Conrey, Washington State University; and Robert Duncan, Oregon State University, for their analytical support, and UNOCAL Geothermal for providing core from Abbot Butte 82-3. Discussions with Edward Taylor, David Sherrod, Gerald Black and Richard Conrey clarified many of the regional interpretations of this project.

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Black, G.L., Woller, N.M., and Ferns, M.L., 1987, Geologic map of the Crescent Mountain area, Linn County, Oregon: Oregon Department of Geology and Mineral Industries Geological Map Series GMS-47.

Priest, G.R., Black, G.L., Mattinson, J.M., and Damon, P.E., 1989, Implications of new isotopic age data from drill holes in the Oregon Cascades [abs.]: EOS, v. 70, no. 43, p. 1299.

Smith, G.A., 1986 [completed 1985], Stratigraphy, sedimentology, and petrology of Neogene rocks in the Deschutes basin, central Oregon: A record of continental-margin volcanism and its influence on fluvial sedimentation in an arc-adjacent basin: Corvallis, Oreg., Oregon State University doctoral dissertation, 467 p.

Smith, G.A., Snee, L.W., and Taylor, E.M., 1987, Stratigraphic, sedimentologic, and petrologic record of late Miocene subsidence of the central Oregon High Cascades: Geology, v. 15, no. 5, p. 389-392. □

Geologic maps released

Two new geologic maps that describe in detail the geology and natural-resource potential of a portion of the Owyhee region in eastern Oregon have been released by the Oregon Department of Geology and Mineral Industries (DOGAMI). In addition to gold and silver and minerals associated with hydrothermal mineralization, the studies identify basalt and previously unreported low-grade limestone among the mineral resources of the study areas.

Geology and mineral resources map of the Vines Hill Quadrangle, Malheur County, Oregon, by Howard C. Brooks. DOGAMI Geological Map Series GMS-63, one two-color geologic map, scale 1:24,000. Price $5.

Geology and mineral resources map of the South Mountain Quadrangle, Malheur County, Oregon, by James G. Evans. DOGAMI Geological Map Series GMS-67, two plates (one two-color geologic map, scale 1:24,000, and one sheet containing geologic cross sections and geochemical data). Price $6.

Production of the maps was funded jointly by DOGAMI, the Oregon State Lottery, and the COGEOMAP Program of the U.S. Geological Survey as part of a cooperative effort to map the west half of the 1° by 2° Boise sheet in eastern Oregon. The two quadrangles are located in the northwestern corner of the Boise Sheet, southwest of the city of Vale and along the Malheur River.

Along with the geologic maps and cross sections, the new publications include brief discussions of the geology, structure, and the mineral and ground-water resources. Results of geochemical analyses of samples are also presented in tabulated form.

The rocks exposed in the area reflect a geologic history that reaches back about 15 million years to the Miocene and are dominantly the products of volcanic activity. Later during the Miocene, which ended around 5 million years ago, and into the Pliocene epoch, tectonic and erosional effects produced basins and lakes that left sedimentary deposits behind. Hydrothermal activity related to volcanism or deep-reaching faults continues in the area even today.

Both publications are now available at the Oregon Department of Geology and Mineral Industries, 910 State Office Building, 1400 SW Fifth Avenue, Portland; Oregon 97201-5528. Orders may be charged to credit cards by mail, FAX, or phone. FAX number is (503) 229-5639. Orders under $50 require prepayment except for credit-card orders. □

DOGAMI needs volunteers

The Oregon Department of Geology and Mineral Industries (DOGAMI) will be expanding its sales office when it moves to the new State Office Building in late February 1992. The new sales/information center, which will be located on the ground floor of the new building, will feature natural resource and outdoor recreation publications, brochures, maps, computer data, and information from DOGAMI, other state agencies, federal agencies, and other sources.

Because of its proximity to the convention center, the Lloyd Center, and MAX, Portland's light-rail system, the new facility is expected to handle a greater volume of customers, including tourists, than in the current sales office—and we believe that people serving in the new facility will have a real opportunity to introduce both Oregonians and tourists to many of the natural wonders of the state.

We need volunteers to help staff the sales/information center. Volunteers will have opportunities to meet the public, answer questions, sell publications, help maintain the store, help with computers—all the things that will tell Oregonians and tourists about Oregon's natural resources and outdoor recreational opportunities.

If you are interested in becoming a DOGAMI volunteer, you may select the type of activity you want to do, your hours, and the days you will help us. You might consider working with a friend—or job sharing if you want to make a smaller time commitment. Training for the store will start in January. If you like people, have interest or expertise in some aspect of Oregon's natural resources such as geology, plants, wildlife, birds, or forestry, want to learn more about any such subjects, or just would like an opportunity to provide service to Oregonians and tourists, contact Beverly Vogt, DOGAMI, 910 State Office Building, Portland OR 97201, phone (503) 229-5580. □

The case of the inverted auriferous paleotorrent—exotic quartzite gravels on Wallowa Mountain peaks

by John Eliot Allen, Department of Geology, Portland State University, Portland, Oregon 97207-0751

INTRODUCTION

"The Wallowa Mountains consist of a core of Triassic and Jurassic volcanic and sedimentary rocks that were intruded and deformed by Cretaceous(?) granodiorite intrusive rocks. After uplift and erosion unroofed the Cretaceous(?) batholith, the area was covered by Miocene basalt flows of the Columbia River Group. Further uplift and erosion, including intense sculpture by alpine glaciation, removed basalt from about a third of the range and gave it its present form" (Weis and others, 1976, p. E-9).

While mapping in 1938 the contacts of basalt over granodiorite along the western ridges of the Wallowa Mountains, Herb Harper and I climbed up more than 1,000 m (3,500 ft) over a map distance of 4 km (2.5 mi) from the Lostine River, along Bowman Creek and past Chimney and Hobo Lakes to the summit height of 2,692 m (8,831 ft) of Lookout Mountain. Beneath the 46 m (150 ft) of basalt that caps the granite peak, we found a thick bed of quartzite-bearing gravels, cobbles, and giant boulders. These gravels have haunted me ever since.

"TERTIARY GRAVELS"

Our description of this locality and the basal lava contacts elsewhere in the Wallowa Mountains was as follows:

"The Columbia River flowed out upon and covered a gently rolling, late mature surface with a relief of from 500 to 1,500 ft. A rather deeply weathered granitic soil mantled the old terrain, and this thick weathered zone occasionally remains, as on the slopes northeast of Aneroid Lake and around the Great Northern Mines west of Glacier Peak. Gravels are found at several places along the contact. Just east of Lookout Mountain, a bed of early Tertiary stream gravels up to 30 ft in thickness lies upon the granite and under the basalt. It is composed of round, waterworn boulders, up to 3 ft in diameter, of quartzite, aplite, and other metamorphic and igneous types of rock. The quartzite boulders are nearly all scarred with crescentic chatter marks and make up over 20 percent of the bed" (Smith and Allen, 1941, p. 19).

"AURIFEROUS GRAVELS"

The incentive for this paper comes from Robert McKenzie of Pendleton, who several years ago described to me the Jim White Ridge Placer Mine, 11 km (7 mi) due west of Lookout Mountain, and who recently called to see if I could tell him who Jim White was and when the mining there had taken place. I couldn't, but I am hoping some reader may write and tell us.

In pursuing this, a reference (Weis and others, 1976) turned up that located seven other occurrences of quartzite gravels in the western Wallowa Mountains, distributed over an area of nearly 390 km^2 (150 mi^2) at elevations from 1,402 to 2,658 m (4,600–8,720 ft).

Table 1 and Figure 1 list and locate these high-level quartzite-bearing gravels mapped by the U.S. Geological Survey and the U.S. Bureau of Mines during the early 1970's in an investigation of the mineral resources of the Eagle Cap Wilderness. The gravels are discussed as follows:

"Coarse boulder gravel occurs at several places in the Wallowa Mountains. Most outcrop areas cover only a few hundred square feet; a notable exception is on Jim White Ridge, where more than a square mile is underlain by gravel. All deposits are on a pre-Miocene erosion surface that was preserved beneath basalt flows of the Columbia River Group until Holocene erosion exhumed the underlying rock. Most deposits are on weathered and disaggregated batholithic rock at the edges of scattered basalt remnants along ridge crests.

"The boulders are as much as 60 cm (2 ft) in diameter and are typically very well rounded. Many show abundant percussion

Table 1. *Occurrences of quartzite gravels in the western Wallowa Mountains. Compiled from Weis and others (1976)*

	Name	Location	Elevation	Comments
1.	Lookout Mountain	SW¼ sec. 21, T. 3 S., R. 43 E.	2,692 m (8,831 ft)	Gravels at 2,637 m (8,650 ft)
2.	Jim White Ridge placer	NE¼ sec. 21, T. 3 S., R. 42 E. (7 mi due W. of no. 1)	2,073 m (6,800 ft)	Gravels 55 m (180 ft) thick, extend to NNW. for 2 mi along the top of the ridge
3.	Threemile Creek	Sec. 10, T. 3 S., R. 42 E. (2 mi N. and 5 mi W. of no. 1)	2,042 m (6,700 ft)	—
4.	Burger Pass	Sec. 12, T. 5 S., R. 42 E. (10 mi S. and 3 mi W. of no. 1)	2,377 m (7,800 ft)	—
5.	Buck Creek	Sec. 10, T. 5 S., R. 42 E. (2 mi W. of no. 4)	1,829 m (6,000 ft)	—
6.	Bone Ridge placer	Center sec. 1, T. 3 S., R. 41 E. (4 mi NW. of no. 2)	1,402 m (4,600 ft)	Quartzite boulders up to 0.6-m (2-ft) diameter
7.	Cached Lake	SW¼ sec. 19, T. 5 S., R. 44 E. (on ridge to S. of lake)	2,487 m (8,160 ft)	—
8.	Elkhorn Ridge	NE¼ sec. 22, T. 4 S., R. 43 E.	2,658 m (8,720 ft)	—

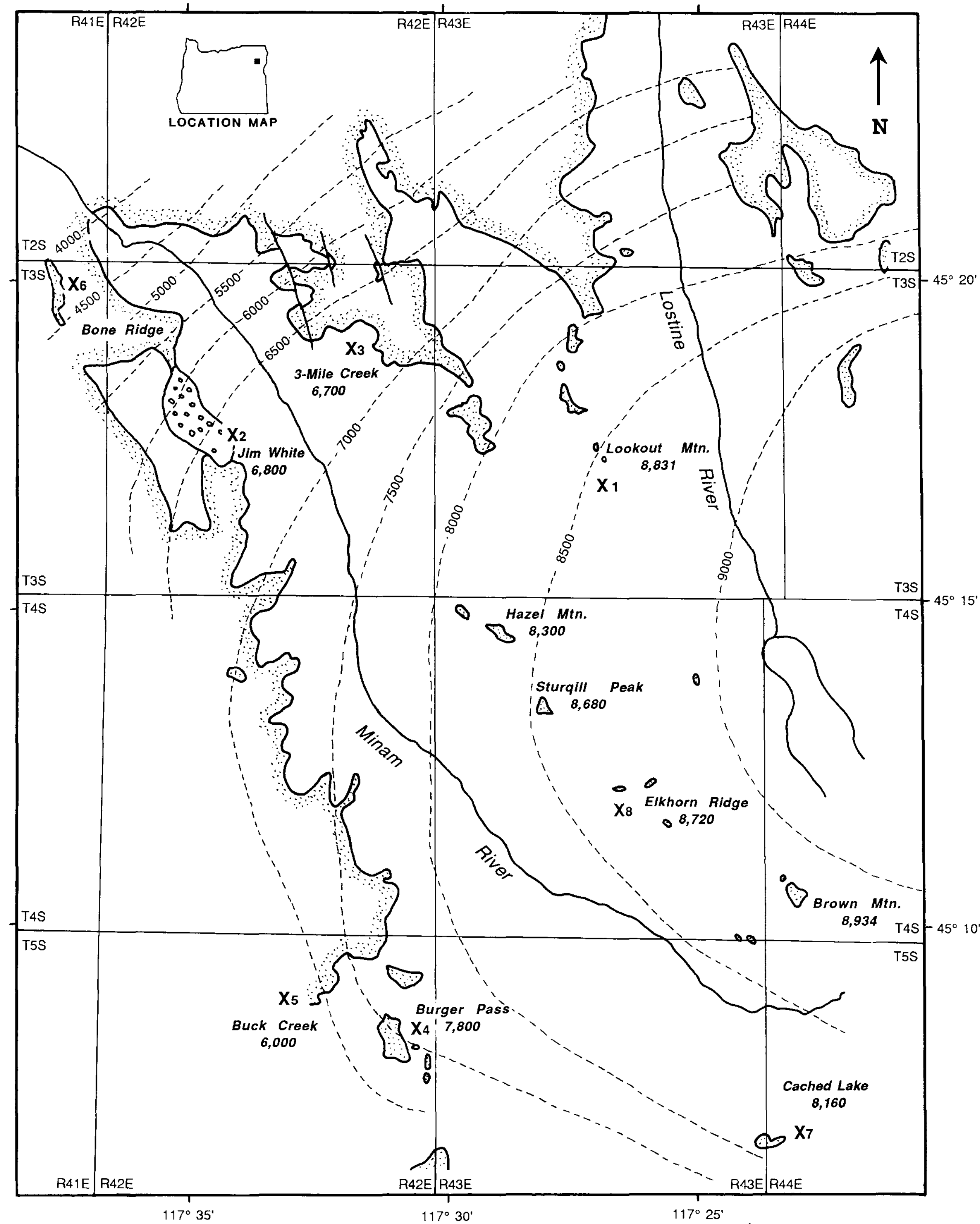

Figure 1. Map of the western part of the northern Wallowa Mountains, showing the location of the contacts of basalt (fine stipple) over granodiorite and eight locations (X1-X8) of quartzitic gravels (circles at Jim White Ridge placer, X2) at these contacts. An attempt has been made to draw 500-ft contours upon this subbasalt surface. See also Table 1. After Weis and others, 1976, Pls. 1 and 2.

marks, indicating transport in a torrential stream. Several lithologies are represented. An exposure on the ridge south of Cached Lake contains representatives of most of the rock types found in the older Triassic rocks. In most deposits, however, more than 90 percent of the boulders are quartzite. F.C. Armstrong, who visited some of the occurrences with Weis during the field work, pointed out the striking similarity between some of these quartzites and some lower Paleozoic quartzites that have been mapped in southeastern Idaho. . . . No nearby source for the quartzite has been recognized. Other lithologies present include gneisses that resemble metamorphic rocks in west-central Idaho, but these are only sparingly represented.

"Placer gold has been reported in association with some of the gravel deposits, but with the exception of the one on Jim White Ridge, the deposits contain insufficient yardage" (Weis and others, 1976, p. 15-16).

DISCUSSION

What was the lower Miocene topography like? Was the uplift of the Wallowas uniform, or did it tilt, arch, or dome the area? Was this torrent a Snake or Columbia paleoriver? What is the provenance of the gravels? Can the gradient of a torrential paleoriver be distinguished from the difference in elevation resulting from arching and upfaulting of the Wallowa Mountains? Can widely scattered gravels be deposited by one river?

When in 1938 the Oregon Department of Geology and Mineral Industries mapped the northern Wallowas (Smith and Allen, 1941) on a Forest Service Atlas map with 500-ft contour intervals, it was impossible to contour the prebasalt topography in any detail. In 1970, 1971, and 1972 Weis mapped on 15-minute quadrangle maps published in 1954 and 1957, and these maps had contour intervals of 40 and 80 ft. Figure 1 is compiled from the maps of Weis and others (1976) to show the contacts beneath the Columbia River basalt, the location and elevation of the gravels, and contours drawn on the prebasalt surface.

Since the basalt covering a granodiorite topography would be thicker above a paleovalley, erosion during postbasalt uplift of the Wallowas would tend to invert the topographic relief. The quartzite gravels, therefore, should be and generally are found beneath basalt cappings along ridge crests. Lines of isolated basalt cappings on ridges in this part of the Wallowas generally trend northwesterly. If these represent inverted topography, they suggest northwest-trending valleys.

Rough contouring from the elevations at the basalt-granodiorite contacts taken from Weis and others (1976) indicates a low dome, which crests at the center of the east edge of the map in Figure 1 and whose slopes steepen toward the north, northwest, and southwest. This domal pattern suggests regional uplift, not stream gradients. Alignments of the ridge cappings is at least in part due to the present-day radial drainage pattern developed on this dome. The 500-ft contouring is too coarse to show paleoriver valleys and gradients.

The large size of the quartzite boulders and the polish and crescentic chatter or percussion marks upon them indicate violent rolling and impacts in swiftly moving torrents. The river or rivers must have been large with relatively straight courses, rather than meandering late-mature or old-age streams, in spite of the relatively subdued topography.

Geologists have always assumed that the quartzite component of the upper Miocene to Pliocene Troutdale Formation came down the Columbia River from the quartzites in the Precambrian Belt terrane of the Canadian Rockies. In Weis and others (1976, p. 16), Weis is mentioned as having learned of strikingly similar quartzites in southeastern Idaho, which might suggest a paleo-Snake or Salmon rather than Columbia River.

Such a paleoriver, however, is not indicated by work done farther north, in Washington: Fecht and others (1987) have established that it is not likely that the Snake or Columbia was here at this time, and Hooper and Swanson describe the eruption of Imnaha Basalt of the Columbia River Basalt Group in these words:

"Thick lava flows filled deep valleys north and south of the Seven Devils/Wallowa Mountains divide . . . to a depth of nearly 700 m, with only the tops of the original mountains remaining above the lava plain" (Hooper and Swanson, 1987, p. 202).

The widespread, scattered distribution of the quartzite gravel localities in the Wallowas at first suggests meandering across a flood plain, but this seems to be ruled out by the size of the boulders. Another possibility, that the scattered nature of the gravel localities indicates more than one river branch, seems to be ruled out by the distant source of the quartzites: they must have been deposited along the main stem of the ancestral river. This helps justify a third hypothesis: that only one great river periodically occupied braided channels within a broad valley.

Figure 2 presents a cartoon of this model: a broad valley in which violent floods deposited coarse gravels in braided channels of a heavily overloaded major river. Refinement of this "outrageous hypothesis" will need more field work, including, it is hoped, provenance studies of these gravels and the reported occurrences of similar gravels in Idaho, as well as the "auriferous gravels " in this and other parts of Oregon.

CONCLUSIONS

Obviously, no firm conclusions can be drawn from this rather

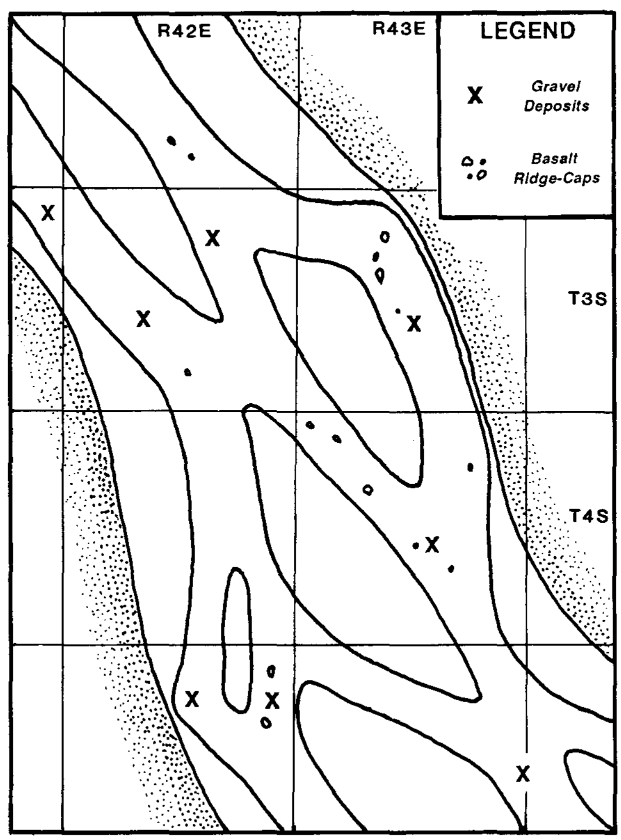

Figure 2. Cartoon of the western part of the northern Wallowa Mountains in early Miocene time. The area is crossed by a broad paleovalley, occupied by the braided channels of a broad, northwest-flowing, and periodically torrential major river. Stipples indicates walls of valley, X the locations of gravels. Dots in valley indicate location of other basalt ridge cappings.

skimpy and hypothetical study. No directional features (cross bedding, shingling, orientation of clasts, etc.) in the gravels have been described. No mention has been made of the presence or ingredients in a sand or silt fraction (except gold). No petrographic study has been done. Reported similar gravels in Idaho have not been investigated. Possible gradients and velocities have not been calculated by use of the Hjulstrom equation and curves.

Similar placers containing quartzite boulders have been mined for gold at numerous localities in northeastern Oregon. I once collected half a ton of silicified stumps of the fossil *Tempskya* from the old placer mine at the ghost town of Greenhorn, 48 km (30 mi) due west of Baker, near the summit of the Greenhorn Mountains, above 2,134-m (7,000-ft) elevation.

The main purpose of this paper is to stimulate further research on the interesting subject of the pre-Columbia River Basalt Group topography of northeastern Oregon.

ACKNOWLEDGMENTS

I deeply appreciate the help of Paul Weis, Paul Hammond, Scott Burns, and especially Robert Carson, all of whom reviewed drafts of the manuscript, helped point out my mistakes, and made important suggestions.

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Significant Oregon earthquakes in 1991

Oregonians felt two earthquakes in July. The first of these was located within the Gorda Plate off the coast of Oregon, 110 km (68 mi) west of Brookings. This Richter magnitude (M) 6.6 (Mw=6.7) event occurred at 7:50 p.m. local time on July 12, 1991, and was felt in many communities in western Oregon. The epicenter was at lat 42°7.28′N., long 125°50.82′W., with a focal depth estimated at 10 km. The focal mechanism indicates left-lateral strike-slip movement. Although the earthquake was felt over a wide area, no significant damage was reported. This is attributable to the fact that the epicenter was located so far out to sea.

The second earthquake was actually the second of a series of six earthquakes, but it was the only one of them that was felt. This (felt) event occurred at 2:04 a.m. local time on July 22, 1991, and was assigned a Richter magnitude of 3.5. The epicenter was at lat 45°38.94′N., long 122°50.46′W., with a focal depth of 17 km. These coordinates place the epicenter in the Tualatin Mountains west of Sauvie Island between the towns of Holbrook and Folkenberg in Multnomah County. Preliminary analysis of the focal mechanism indicates reverse-fault-type movement with a strong component of right-lateral strike slip.

The first earthquake of the series occurred before the "main shock," at 10:23 p.m. on July 21 and had a magnitude of 2.4. The four "aftershocks" occurred on July 22 at 2:11, 4:45, 5:28, and 9:34 a.m. with magnitudes ranging from 2.1 to 2.4. Some minor damage such as cracked plaster and broken glass was reported.

Earlier this year, on March 5, a magnitude 3.1 earthquake occurred across the Columbia River in Washington between Woodland and Vancouver. The epicenter was at lat 45°46.96′N., long 122°40.74′W. This earthquake occurred at 12:41 p.m. local time and was felt by some people in the Portland area.

These earthquakes serve as a gentle reminder that Oregon is indeed earthquake country, but they do not foretell an imminent damaging earthquake. The wide area over which a M=3.5 earthquake was felt strongly enough to awaken people indicates that many areas of the Portland metropolitan area respond strongly to low-level ground shaking.

Information about these earthquakes was obtained from the University of Washington and Oregon State University and by reviewing media reports and personal conversations. □

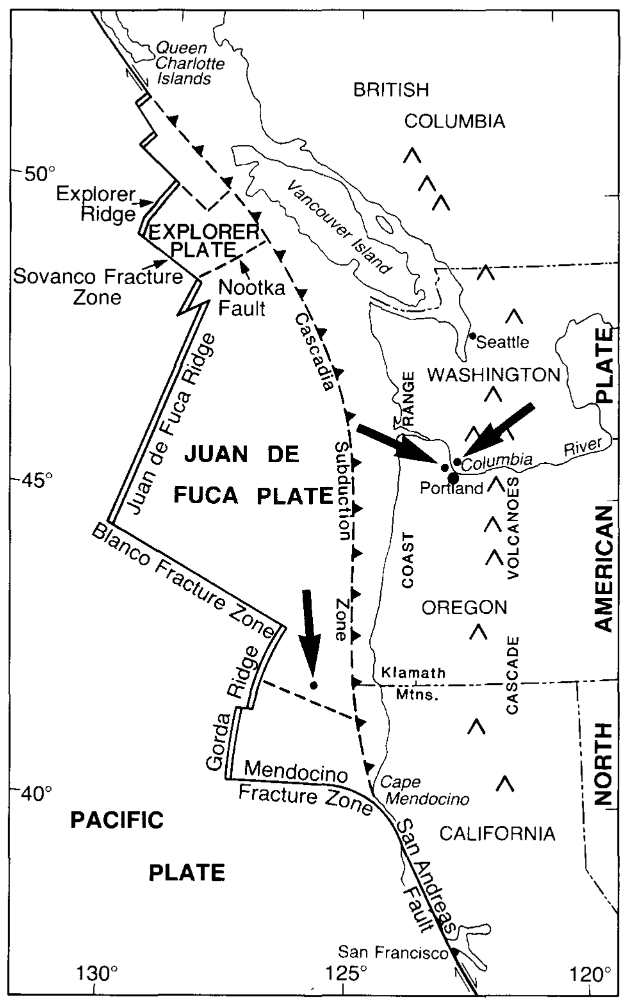

Plate-tectonic map of the Pacific Northwest and the adjacent sea floor. Arrows indicate the locations of the earthquakes discussed in the report.

Senate bills address earthquake safety, drilling regulation

Senate Bills (SB) 96 and 888 were passed by the 1991 Legislature and have become law.

SB 96 establishes the Seismic Safety Policy Advisory Commission by statute, thereby making it permanent. It specifies membership to include eight state agencies, among them Building Codes, Geology, and Transportation, two members of the legislature, a structural engineer, a representative of school districts, one of utilities, and one member each of city government and county government. This wide array of membership is needed in policy guidance to address all three major aspects of earthquakes: risk identification, mitigation, and post-earthquake response. The commission is also directed to work as much as possible with existing institutions and agencies.

In addition, SB 96 gives the Building Codes Agency permissive guidance to consider rules for such things as requiring site-specific studies for large buildings, selective installation of accelerographs, a review of site-specific earthquake risk assessments, and public access to pertinent earthquake risk data.

Finally, the bill also provides for education in earthquake safety awareness in schools.

Senate Bill 888 affects permit fees for the drilling of oil and gas and geothermal wells in Oregon and the validity period of geothermal drilling permits. The bill provides that permit fees, to be set by the Governing Board of the Oregon Department of Geology and Mineral Industries, shall not exceed $250 for a permit-application or permit-renewal fee and $500 for an annual fee on active permits. It also provides that a geothermal permit shall remain valid for one year from the date of issue and may be renewed for a period of one year. □

Hazard conference announced

A conference on "Coastal Natural Hazards—Science, Engineering, and Public Policy" will be held October 1-3, 1991, at the Hotel Newport at Agate Beach in Newport, Oregon. It is sponsored by the Oregon State University Extension Sea Grant College Program, the Oregon Department of Land Conservation and Development, the Oregon Department of Geology and Mineral Industries, the Oregon State Parks and Recreation Department, the Oregon Division of State Lands, and the Oregon Coastal Zone Management Association.

Earthquakes, beach and sea cliff erosion, flooding, landslides, tsunamis, coastal subsidence, sea level rise—these natural hazards affecting the way people live, work, and play on the Pacific Northwest coast will be the subject of the conference. The issues addressed will include what scientists and engineers are learning about these hazards and what their research implies for coastal residents, visitors, and the protection of public beaches and private property along the oceanfront.

The conference is aimed at policy makers and officials as well as people who own, develop, evaluate, or sell coastal property and people who are involved in public-interest groups.

The conference will begin on the afternoon of October 1 with a field trip to observe regional geology, erosion, landslides, shore protection, and earthquake evidence. On October 2, three all-day panels will focus on (1) earthquake, tsunami, and landslide hazards; (2) coastal processes and hazards related to erosion and sand transport; and (3) shore protection and engineering. The morning of October 3 will be occupied with presentations and focus groups on the policy implications of coastal hazards science and engineering.

Further information is available from Ginny Domka, Oceanography Administration Building 104, College of Oceanography, Oregon State University, Corvallis, OR 97331-5503, phone (503) 737-3771 (mornings only). □

EEZ symposium to be held in Portland

The 1991 Exclusive Economic Zone (EEZ) Symposium will be held in Portland on November 5-7 at the Portland Hilton Hotel under the title "Working Together in the Pacific EEZ." It is sponsored by the USGS-NOAA Joint Office for Mapping and Research (JOMAR) and the Association of American State Geologists and will be hosted by the Oregon Department of Geology and Mineral Industries (DOGAMI).

This is the fifth in a series of biennial symposia held since the issuance of the EEZ Proclamation in 1983. Previous symposia have been held in the Washington, D.C., area and have focused on EEZ mapping and research from a national perspective. The intention of the 1991 Symposium is to begin the process of refining the specific interests and activities within each of the EEZ subregions (East Coast, Gulf of Mexico, West Coast, Alaska, and Islands) and to involve to a greater extent the active mapping and research programs in those geographical areas in the mission of JOMAR.

The symposium will focus on working relationships and partnerships for research and mapping in the Pacific EEZ and how they affect implementation of the ten-year national effort to characterize the seafloor/subsoil of the EEZ. Specific objectives include (1) to identify priorities for seafloor mapping and research, primarily in the Pacific EEZ but in other regions as well; (2) to recommend specific products and services necessary to meet these priorities; (3) to summarize progress in seafloor mapping and research in the Pacific EEZ; (4) to foster discussion regarding the management and dissemination of data and information relating to the seafloor of the EEZ and to identify requirements for standardization and exchange of digital mapping products; and (5) to recommend regional implementation and coordination approaches, including cooperative projects and the roles of the federal, state, academic, and private sectors.

An exhibit of research and mapping results is planned as an integral part of the symposium. Space is available, and interested participants with displays, exhibits, or posters are encouraged to contact the following for further information: USGS-NOAA Joint Office for Mapping and Research (JOMAR), 915 National Center, Reston, VA 22092, phone (703) 648-6525.

A block of rooms has been reserved at the Portland Hilton Hotel at $60 per night for singles and $80 per night for doubles. Registration deadline for the blocked rooms is October 4.

A detailed agenda, lists of workshop chairpersons, speakers, and exhibits, and other logistical information will be mailed to all who have preregistered by October 20, 1991. Further technical information is available from Millington Lockwood at JOMAR, phone (703) 648-6525.

Registration information is available from Greg McMurray at DOGAMI, 1400 SW 5th Avenue, Room 910, Portland, OR 97201-5528, phone (503) 229-5580. □

GSA announces annual meeting

The Geological Society of America (GSA) will hold its annual meeting and geoscience exhibition October 21-24, 1991, in the new convention center at San Diego, California.

The theme of this year's meeting is "Global Perspective," and much of the program will be devoted to topics of global change, natural disasters, and the limits of natural resources.

For further information on transportation, housing, and program, contact GSA Headquarters, P.O. Box 9140, Boulder CO 80301, (303) 447-2020 or 1-800-472-1988, FAX 303-447-1133. For air transportation, Cain Travel Group is the official travel agency for the meeting and can be reached at 1-800-346-4747 (MDT business hours). Visitor information is offered by State of California, Visitor Packet, 1-800-862-2543; and San Diego Visitor Information Center, 11 Horton Plaza, San Diego CA 92101, (619) 236-1212. *—GSA news release*

Cell wall structure of carbonized wood as related to ignimbrite deposition

A Robert Ruhl Learning Fellowship Research Project

by Ivan K. Gall, Department of Geology, Southern Oregon State College, Ashland, Oregon 97520

ABSTRACT

Cell-wall structure of carbonized wood fragments from ancient and recent sedimentary deposits was examined in a study using a scanning electron microscope. It has been determined that homogenization of the cell walls, caused by fusion/disappearance of the middle lamellae, is not necessarily indicative of ignimbrite deposition. Four examples of homogenized cell-wall structure were found to exist outside an ashflow depositional environment. A concretion from a nearshore marine mudstone in the Upper Cretaceous Hornbrook Formation yielded a carbonized wood fragment with homogenized cell-wall (HCW) structure. A sample from a log found in its growth position and buried by 2.25 m of hot air-fall tephra, yielded HCW structure. A 2-mm-diameter sample from the Mount St. Helens blast deposit of the May 1980 eruption, yielded both a HCW zone and a zone with the middle lamellae distinctly evident. Three samples of carbonized wood taken from recent forest fires have yielded HCW structure. Samples taken from lacustrine and volcaniclastic deposits contained carbonized fragments with no cell structure evident, due to some combination of size, fragility, burial, compaction, contact metamorphism, or silicification of the wood fragments. The temperature at which this homogenization occurs is under investigation but is believed to occur at approximately 300 °C.

INTRODUCTION

This research project, funded in part by a Robert Ruhl Learning Fellowship, was conducted during the school year of 1990-91 at Southern Oregon State College. The research attempted to determine whether the presence of homogenized cell-wall (HCW) structure found within fragments of carbonized wood is uniquely indicative of ashflow deposition.

The homogenization, presumably the result of thermal fusion of the middle lamellae, primary, and secondary cell walls, takes place at temperatures exceeding 300 °C (Cope and Chaloner, 1980). McGinnes and others (1974) noted that high doses (655 millirad) of gamma radiation elicit the same fused cell wall structure as that found in carbonized wood.

Beall and others (1974), Cope and Chaloner (1980), and McGinnes and others (1974) all noted the apparent fusion, or homogenization, of the cell walls of carbonized wood of many different species. In coalified woody tissue, the middle lamellae are present up to the medium volatile bituminous rank of coal (Cope and Chaloner, 1980). As charcoal is largely unaffected by fungi or other wood-destroying organisms and because anatomical features remain intact during carbonization, the type of wood usually can be identified (Koeppen, 1972).

If fusion of the cell walls can be accomplished by radiation, the question arises as to whether other mechanisms might also produce the same effect. If so, the presence of HCW structure in a volcanic ash deposit may not be conclusive evidence that the deposit is of ash-flow, as opposed to ash-fall, or other, origin. To evaluate this hypothesis, twenty samples were collected from several environments in the southern Oregon area, and samples from Mount St. Helens and from Rock Mesa in Deschutes County, Oregon, were provided by the U.S. Geological Survey. The samples were then examined on a Hitachi S-2100 scanning electron microscope (SEM).

SAMPLE COLLECTION

Seven samples were collected from unequivocal ash-flow deposits from the eruption of Mount Mazama that created Crater Lake. The samples were collected primarily along road cuts of State Highways 138 and 230, northwest of present-day Crater Lake. Muffler (1989) mapped a portion of the sampled area as the Mazama ash flow, and no observations in the field indicated that any of the deposits had been reworked by water, which might have transported fragments of carbonized wood into the deposits. The beds were composed of loose, poorly sorted ash, pumice, and rock fragments (predominantly of basaltic composition) with no distinct layering or bedding (Figure 1).

Figure 1. Deposit of the Mount Mazama ash flow.

Samples GMC 1-7 were collected from the Mount Mazama ashflow. The fragments of carbonized wood, some from carbonized logs up to 25 cm in diameter, displayed prominent growth rings.

Three samples were collected from Shale City, east of Ashland, Oregon. This lacustrine deposit is composed of a finely laminated volcanic ash with interbedded, more resistant, carbon-rich layers. Due to the emplacement of nearby silicic dikes, kerogen was mobilized within the sediments, and some mercury mineralization has occurred in the vicinity.

The samples collected from Shale City (GSC 1-3) consisted of a brilliantly glossy, vitrain-like carbon (as defined by Hickling and Marshall, 1932). It appears homogeneous to the naked eye, occurs in thin bands, and develops a prominent cleavage. No growth rings or wood structure was evident within the vitrain-like carbon. Carbonized leaf imprints are abundant in the deposit.

Two samples (GHC 1-2) were collected from a lower member of the Upper Cretaceous Hornbrook Formation, as mapped by Nilsen and Barats (1984), at an outcrop along Interstate Route 5, 0.5 mi north of the Mount Ashland access road turnoff. The samples were taken from a carbon-rich mudstone deposited in a nearshore marine environment. The carbonized fragments were very small and friable and showed no plant structure. A partially silicified fragment of carbonized wood was found within a concretion.

Samples of carbonized wood were collected from three locations within the Colestin Formation, a volcaniclastic sequence of inter-

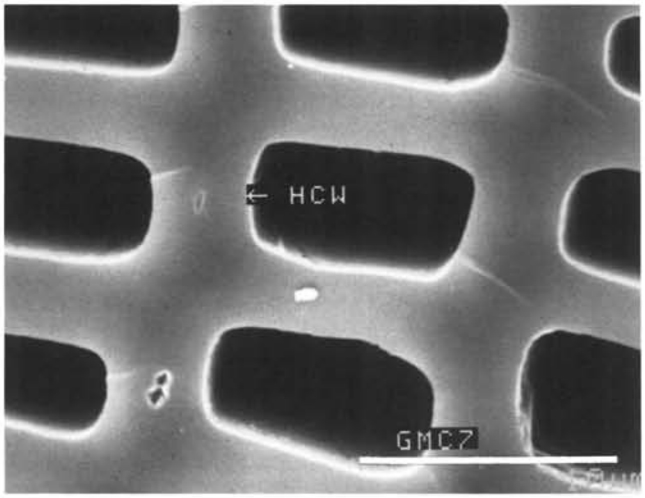

Figure 2. HCW structure in carbonized wood of the Mount Mazama ash flow (Sample GMC 7). Bar = 10 μ.

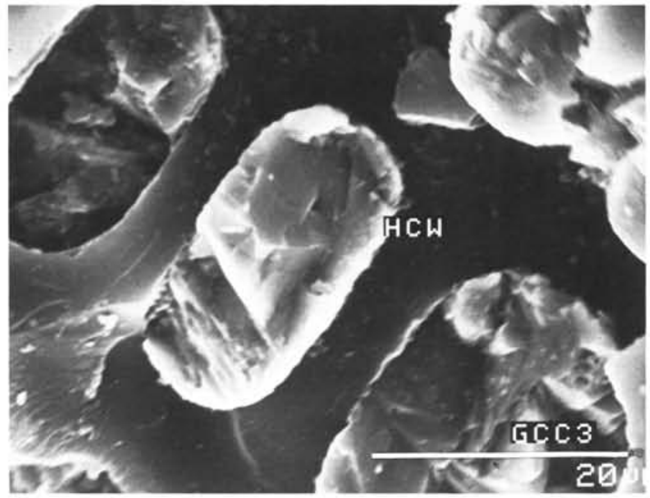

Figure 4. HCW structure in carbonized wood of the Colestin Formation (Sample GCC 3). Bar = 20 μ.

bedded mudflows, ash flows, and air-fall deposits. The first location sampled (GCC 1) was at the junction of the Mount Ashland access road and the Colestin Road turnoff, from a bed mapped by Bestland (1985) as his informal member Tct, a white crystal tuff. Bestland describes this deposit as an ash-flow tuff, citing the presence of HCW structure of contained wood fragments as good evidence of ignimbrite deposition. Samples collected here were lapilli-sized, partially silicified, and of a planar nature, being less than 1 mm thick.

The second location sampled (GCC 2) was at a benched road cut on Interstate Route 5, 2.7 mi north of the California border. Pieces of carbonized, silicified logs were collected from a 5-ft-thick, blocky, jointed, welded ash-flow deposit, also containing flattened pumice fragments. The samples showed indistinct growth rings.

The third sample of the Colestin Formation was collected on the east side of the Interstate Route 5 road cut at the Siskiyou summit, again from Bestland's (1985) informal Tct member. The sample (GCC 3) was taken from a carbonized, partially silicified log with distinct growth rings.

Two samples were provided for the study by the U.S. Geological Survey. One sample was collected from the Mount St. Helens blast deposit and consisted of a mass of inhomogeneous, loose, juvenile, and accidental material. The sample (H87-15A1-2) was taken from a partially charred fragment of wood. The second sample (GU 1) was collected from a charred log found in growth position near Rock Mesa in Deschutes County, Oregon. The log that was found near an eruptive vent had been buried by 2.25 m of coarse, hot air-fall tephra. A radiocarbon age of 2,150±150 years was obtained from the sample.

Three samples of charred wood (GFC 1-3) were collected near Ashland from forested areas recently burned by fires. Growth rings were evident in all three samples.

One sample of silicified wood (GS 1) was examined to determine how the process of silicification may effect cell wall structure. To view an undamaged middle lamella, one sample of raw wood (GRW 1), neither carbonized nor silicified, was examined.

SAMPLE PREPARATION

The samples were mounted on specimen stubs, with a conducting carbon paint as an adhesive, and in most cases oriented so as to give a cross-sectional view of the cell wall structure.

The carbonized pieces of wood have low resistivity, and sputter coating the samples with gold is not necessary (Beall and others,

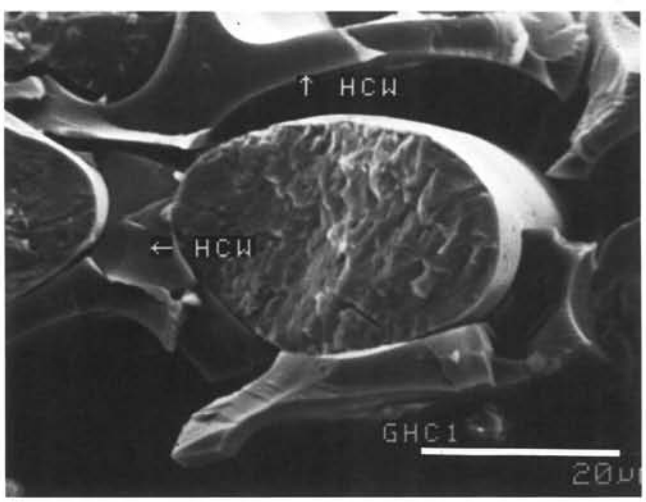

Figure 3. HCW structure in carbonized wood from the Hornbrook Formation, found within a concretion (Sample GHC 2, mislabeled GHC 1). Bar = 20 μ.

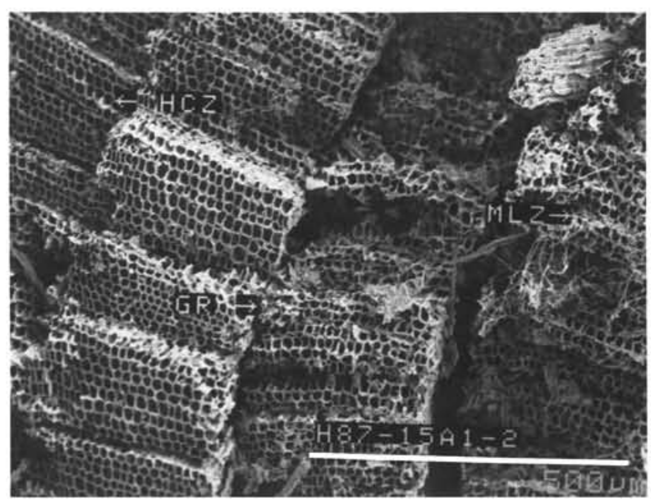

Figure 5. Sample of partially carbonized wood from the Mount St. Helens blast deposit, showing a homogenized-cell zone (HCZ), a zone with middle lamellae still present (MLZ), and the curvature of growth rings (GR) (Sample H87-15A1-2). Bar = 500 μ.

1974). Ali and others (1990) found that wood carbonized at 575 °C was sufficiently conductive so as not to require coating. Because coating the samples enhances the resolution and reduces charging that can lead to image distortion, most samples were coated for 1.5 minutes, with a depositional current of 15 milliampere, on an Emscope SC500 sputter coater.

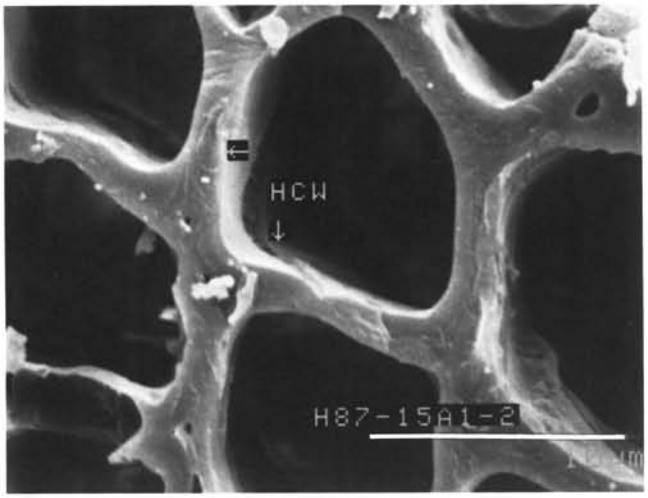

Figure 6. HCW structure in carbonized wood of the sample shown in Figure 6. Bar = 10 µ.

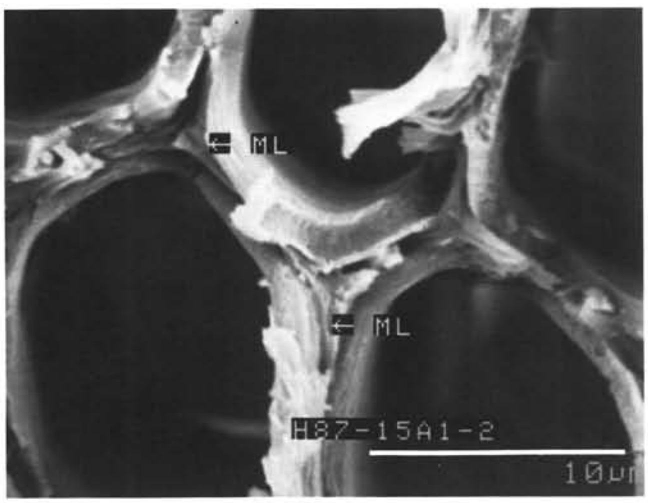

Figure 7. Middle lamellae still present in carbonized wood of the sample shown in Figure 6. Bar = 10 µ.

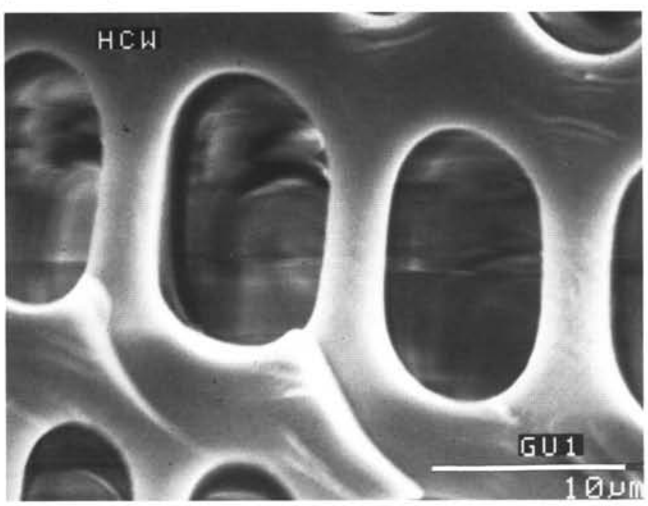

Figure 8. HCW structure in carbonized log found in growth position at Rock Mesa (Sample GU 1). Bar = 10 µ.

SAMPLE EXAMINATION

All of the samples examined from the Mount Mazama ash-flow deposits (GMC 1-7) exhibited HWC structure (Figure 2). The orientation of these samples was facilitated by the presence of growth rings, and all samples showed well-preserved cell structure due to their young age and lack of deep burial and compaction.

The three samples from the Shale City lacustrine environment (GSC 1-3) displayed no preservation of cell structure. It is believed that the original size of the plant fragments incorporated into the sediment was too small for cell structure to survive burial, compaction, and possibly the heating episode accompanying the emplacement of nearby silicic dikes.

The sample of carbonized wood from the marine mudstone (GHC 1) exhibited no cell structure. Here again the small size of the original plant fragments, combined with burial and compaction, erased all evidence of the cell walls and middle lamellae.

The fragment of carbonized wood found within the concretion (GHC 2) featured homogenization of the cell walls (Figure 3). This is the first indication that carbonized wood fragments with homogenized cell wall structure exist outside a depositional environment other than that of an ash flow. It is believed that the formation of the concretion around the carbonized wood fragment was sufficient to preserve cell structure from destruction due to compaction attending burial.

Samples from the Colestin Formation collected at road cuts along the Mount Ashland access road (GCC 1) exhibited no recognizable cell wall structure. The samples were too small or too fragile to survive the burial and compaction.

Samples from the Colestin Formation, collected on Interstate Route 5 at the benched road cut (GCC 2), showed very indistinct cell wall structure. It was not evident as to whether the middle lamellae were present. The samples were silicified, and the silicification, combined with burial and compaction, seems to have obscured the cell structure.

Samples collected from the Colestin Formation at the Siskiyou Pass summit (GCC 3) exhibited cell wall homogenization (Figure 4). These samples were also silicified, but it is believed that the more readily apparent growth rings indicate that the wood has not been subjected to such large degrees of compaction or silicification.

Sample H87-15A1-2 from the Mount St. Helens blast deposit yielded a zone with homogenized cell walls and a zone of cell walls with the middle lamellae intact (Figures 5-7). These two zones were separated by a transitional zone in which the middle lamellae became more apparent toward the center of the tree, as evidenced by the curvature of growth rings.

It is interesting to note that this transition occurred over a distance of approximately 2 mm, suggesting that the occurrence of homogenized cell wall structure within a given deposit is variable over very short distances. Of considerable importance may be the exact circumstances under which the fragment of wood is incorporated into the deposit. A large heat sink may be present in the form of large, cold boulders or cooler exposed bed rock. These may absorb the heat of a hot deposit at a rate rapid enough to hinder the carbonization process of any wood fragments in the immediate vicinity. In contrast, a deposit of dense ash barely at a temperature sufficient to fuse the cell walls may remain hot long enough to thoroughly char the wood.

Sample GU 1, the charred log found in growth position, yielded HCW structure (Figure 8). Here is a third example of HCW structure occurring in a deposit (hot air-fall tephra) other than that of an ash flow. The sample examined came from very near the center

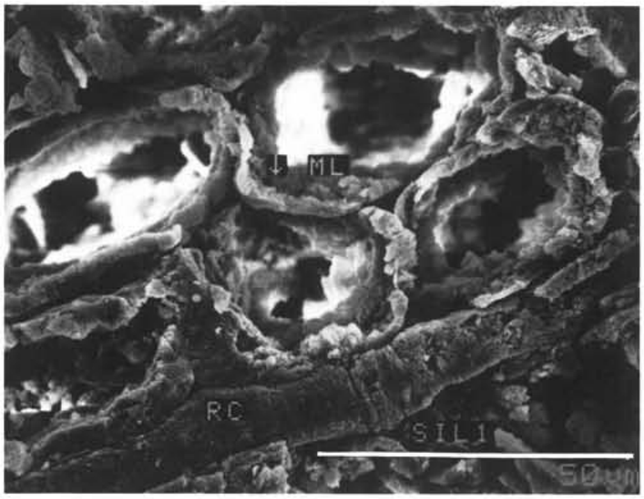

Figure 9. Comparison sample showing effects of silicification on uncarbonized wood. Middle lamellae (ML) are still present (Sample GS 1 [=SIL 1]). RC = ray cell. Bar = 50 μ.

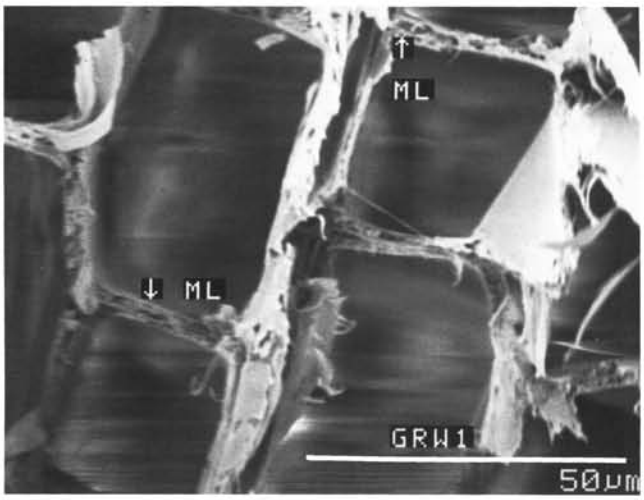

Figure 10. Comparison sample showing distinct middle lamellae (ML) in uncarbonized, unsilicified, raw wood (Sample GRW 1). Bar = 50 μ.

of the tree, as evidenced by the small radii of the growth rings. This fusion of the cell walls at the center of the tree is good evidence that the tephra fall was initially very hot, possibly due to its location near the erupting vent, or that it cooled very slowly, allowing a complete carbonization process to occur.

The three samples of charred wood collected from areas burned by recent forest fires (GFC 1-3) all yielded HCW structure (cover photo). This is a fourth instance in which homogenized cell walls exist in an environment other than that of an ash flow. Forest fires caused by lightning strikes and volcanism have been common as far back as the Paleozoic period (Komarek, 1972). As charred fragments of wood can later be incorporated with ash and other materials in volcaniclastic sediments, confusion between ash-flow deposits and those originating from debris flows or volcanic blasts becomes a distinct possibility.

A difficult problem arises with the sample preparation methods of the partially silicified fragments of carbonized wood. The replacement of the carbon with silica necessitates coating the samples with gold to enhance the conductivity and resolution and to reduce the effects of charging. The silicified samples fracture irregularly across the cell structure and thus leave almost no chance for the occurrence of visible cell structure. Instead of breaking the sample, grinding was tried to achieve a smooth surface for a cross-sectional view of the cell walls. However, the process done with grinding compound on a glass plate appeared to obscure the cell structure with respect to SEM viewing.

The examination of the silicified sample of wood indicated that in this particular case the silicification process did not cause the disappearance of the middle lamellae (Figure 9). The raw wood sample (GRW 1) exhibited excellent cell structure, with the middle lamellae readily apparent (Figure 10).

CONCLUSION

The presence of carbonized wood fragments with homogenized cell walls has been found not to be uniquely indicative of ash-flow deposits. Homogenized cell wall structure has been found in deposits of a nearshore marine mudstone, the Mount St. Helens blast deposit, a log buried by a hot air-fall tephra, and in products of recent, subaerial forest fires. It is possible that other depositional environments containing sediments derived from areas in which forest fires occurred will also contain fragments of carbonized wood with homogenized cell wall structure. As the range of forest fire temperatures is 980-1,650 °C (oral communication, Bill Fransden, Intermountain Fire Science Laboratory, 1990), it would not be surprising to find HWC structure in forest-fire-burned fragments incorporated into a variety of sedimentary and volcaniclastic deposits.

ACKNOWLEDGMENTS

The author would like to express gratitude to Dr. William Purdom, Professor of Geology, Southern Oregon State College, for his assistance and guidance throughout the duration of the research. Also deserving thanks are Doctors D'Allura and Elliott, Professors of Geology, and Doctors Southworth and Nitsos, Professors of Biology, all of Southern Oregon State College. Mr. Marvin Couchland of the U.S. Geological Survey in Vancouver, Washington, deserves thanks for providing samples that were of great value for this study.

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Earth science gains support*

Precollege earth science education received a strong sign of interdisciplinary support from the Council of Scientific Society Presidents (CSSP).

At their fall 1990 meeting in Washington, D.C., the Council members unanimously adopted a resolution recommending that substantial study of the geosciences be made a part of the precollege curriculum in the U.S. and that geoscience be acceptable as a laboratory science for college admission along with biology, chemistry, and physics. The resolution was drafted by Chip Groat, American Geological Institute Executive Director, and introduced by Bonnie Brunkhorst, President, National Science Teachers Association.

CSSP is an organization of elected officers of 57 scientific societies spanning the physical, mathematical, and life sciences. Since 1973, CSSP has served as a strong national voice in support of science and science education and as a forum for open, substantive exchanges on current scientific issues.

For further information, contact R. Eric Leber, Executive Director, Council of Scientific Society Presidents, 1155 16th Street NW, Washington, DC 20036, phone (202) 872-4452.

*Reprinted with permission from *Earth Science Education Connection*, v. 3, no. 1, published by the National Center for Earth Science Education of the American Geological Institute, 4220 King Street, Alexandria, VA 22302-1507, phone (703) 379-2480.

Resolution on Teaching Geoscience at the Precollege Level

Whereas an understanding of the earth's land, water, and atmospheric systems that control our environment and supplies of resources is important to all citizens; and

Whereas the distribution, development, and use of energy and mineral resources around the world have a significant influence on the economy of the United States and our foreign policy; and

Whereas the inhabitability of our cities and coasts and the productivity of our agricultural lands and oceans may be strongly influenced by global climatic change, the disposal of wastes, and the protection of our water supplies; and

Whereas the United States must attract a much larger number of students into scientific careers, and the study of geoscience can provide an effective way to demonstrate the relevance of science to issues that interest and are of concern to students;

Therefore be it resolved that the Council of Scientific Society Presidents strongly recommends that substantial study of the geosciences (e.g., soil science, geology, meteorology, oceanography, astronomy) be made a part of the pre-college curriculum in the United States middle and high schools and that its status as a laboratory science be acceptable for college admission along with biology, chemistry, and physics.

Be it further resolved that geoscience shall be one of the themes for the teaching of science in the elementary schools in our country.

Adopted by The Council of Scientific Society Presidents December 5, 1990.

Earth-science education tools

The following annotated list was compiled by Julie Jackson of the American Geological Institute (AGI) and is reprinted here from the spring 1991 issue of *Blueline*, the newsletter of the American Association of Earth Science Editors (AESE). We hope that you will find this list useful and share it. For the geoscience professional, Jackson adds: "If you ever talk with school or youth groups, SEPM's *Sedimentary Geologist's Guide* . . . and AGI's *Resources* are especially good sources."—*Ed.*

A Sedimentary Geologist's Guide to Helping K-12 Earth Science Teachers: Hints, Ideas, Activities, and Resources, edited by Molly F. Miller, R. Heather Macdonald, Linda E. Okland, Steven R. Roof, and Lauret E. Savoy. The Society for Sedimentary Geology (SEPM) published this useful book in 1990 to encourage geologists to get involved in earth-science education. The book has four sections: "Hints for Successful Class Visits," "Activities for Teachers," "Field Trips and Larger Scale Educational Activities," and "Resources." Order from SEPM, PO Box 4756, Tulsa OK 74159, (918) 743-9765: tape-bound book, 91 pages, $5 plus $1.90 postage/handling.

Earth Science Investigations, edited by Margaret A. Oosterman and Mark T. Schmidt. AGI published this collection of activities for grades 8-12 in fall 1990. The 26 activities were developed by teachers, reviewed by scientists, and tested with students. Each hands-on exercise provides the concepts, vocabulary, and worksheets that students need to complete it, plus an answer key when applicable. Order from AGI, 4220 King Street, Alexandria VA 22302, (703) 379-2480: spiral-bound book, 231 pages, $34.95 plus $4 postage/handling. [See also our earlier announcement in the March 1991 issue of *Oregon Geology*, page 43.—*Ed.*]

Earth Science Research Activities, by James Scannell. Published in 1988, the book is one of four in the series "Explorations in Science." It contains 50 ready-to-use individual and group enrichment activities for grades 8-12. Each has been tested and includes a teacher's guide and answer key. Order from Alpha Publishing Company, 1910 Hidden Point Road, Annapolis MD 21401, (301) 757-5404: spiral-bound book, 273 pages, $35 plus $3.50 postage/handling.

Resources for Earth Science Teachers, 1991, lists 43 sources of earth science reference and enrichment materials including catalogs, publication lists, teacher packets, books, and journals. To get a copy, contact AGI, National Center for Earth Science Education, 4220 King Street, Alexandria VA 22302, (703) 379-2480.

Earthquakes: A Teacher's Package for K-6, a six-unit book, was developed by the National Science Teachers Association (NSTA) with a grant from the Federal Emergency Management Agency (FEMA). It is a complete earthquake curriculum containing activities, lesson plans, line masters, and background information. Order from FEMA, Earthquake Program, Attention Marilyn MacCabe, 500 C Street SW, Washington DC 20472: one free copy to schools (while supplies last). Order additional copies from NSTA (address below, next item): $15 plus $2.50 postage/handling.

Earth: the Water Planet, a book of readings and activities for middle-grade teachers, resulted from a joint project of Horizon Research, Inc., and AGI. Order from NSTA, 1742 Connecticut Avenue NW, Washington DC 20009, (202) 328-5800: $16.50 plus $2.50 postage/handling.

For Spacious Skies Program is a teacher activity guide for grades K-8. Order from For Spacious Skies, 54 Webb Street, Lexington MA 02173, (617) 862-4289: $6.

How to Construct a Paper Model Showing the Motion That Occurred on the San Andreas Fault During the Loma Prieta, California, Earthquake of October 17, 1989, is available from the U.S. Geological Survey (USGS), Books and Open-File Reports Section, Box 25425, Denver CO 80225, (303) 236-7476: USGS Open-File Report 89-640A, $1.50 for paper copy, $4.50 for microfiche.

Inside Hawaiian Volcanoes, a 25-minute color video, illustrates techniques of monitoring Hawaiian volcanoes. The video, aimed at audiences of all ages, includes spectacular eruption footage. Subsurface features are depicted by cutaway views, models, and computer graphics. Noted volcano cinematographer Maurice Kraft produced the video in collaboration with the USGS and the Smithsonian Institution. Orders must include check or money order (U.S. funds only) made out to Smithsonian Institution. Send to Richard S. Fiske, Natural History Building 119, Smithsonian Institution, Washington DC 20560, (202) 357-1384: videotape, VHS format $20, PAL format $25.

The teacher's guide for **Inside Hawaiian Volcanoes** contains questions and lab exercises. Order from the USGS (address above): USGS Open-file Report 89-685, $3.50 for paper copy, $4 for microfiche.

Oceanography for Landlocked Classrooms, for teachers of grades 7-12, contains easy-to-follow lessons and activities written by marine educators from high schools and universities. Order from National Association of Biology Teachers, 11250 Roger Bacon Drive #19, Reston VA 22090, (703) 471-1134: $15 plus $2 postage/handling.

Water in Your Hands, an imaginative 16-page booklet, uses cartoon characters to help children (grades 4-6) develop awareness of water quality and management problems. The instructor's guide includes activity masters, background information, implementation suggestions, optional activities, and sources of additional information. Order from Soil and Water Conservation Society, 7515 NE Ankeny Road, Ankeny IA 50021-0764, (515) 289-2331 or (800) THE-SOIL: single copies $2, discounts on bulk orders.

(Continued on page 118, **Earth-science education***)*

The man who put Oregon on the Moon: James B. Irwin

Twenty-five years ago, Oregon rocks were studied by a budding astronaut, James B. Irwin, who five years later placed one on the Moon as a personal favor and expression of warm friendship to an Oregon resident. On August 8, 1991, Irwin died at the age of 61 in Colorado.

Irwin visited Oregon when it was the scene of preparation for astronauts for their volcanic field work on the Moon. We revive that history as a tribute to Irwin and a memento to our readers.

Little is known by the general public about the role the geology of Oregon played in the lunar landing and in particular the part Irwin played in actually placing a small piece of Oregon rock on the Moon.

In the mid-1960's, Oregon was selected as the location where astronauts would get experience in working on volcanic terrain similar to what they would encounter on the Moon. The Oregon Department of Geology and Mineral Industries participated in two scientific conferences in connection with the effort, the Lunar Geological Field Conference and the Andesite Conference, and published a guidebook and transactions for each of them (Bulletins 57, 62, and 65 and Open-File Report O-66-1—all out of print now).

Volcanology and especially the "lunar" landscape of central Oregon around Bend created much excitement in those days. The Lunar Geological Field Conference, for example, drew the attention and warm welcome from then Governor Mark O. Hatfield and Bend Mayor Paul Reynolds. University of Oregon volcanologist Professor Lloyd Staples and Jack Green of the cosponsoring New York Academy of Sciences expressed their feeling of being part of space program research: "Comparison of the Earth and the Moon will lead to an understanding of the differences which exist between them. This, in turn, may provide clues to the origin and development of all planetary bodies. . . . The association of crater alignments on the flanks of calderas to the parent caldera, the shear strength of ash flows and falls, the morphology of lava tubes—are all things which deserve careful analysis before manned landing on the Moon."

The feeling is reflected also in the words of then State Geologist Hollis M. Dole describing "the potential of the area, both as an outdoor laboratory for the study of volcanics and as a site for some of the research prerequisite to the establishment of a manned base station on the Moon."

Finally, we reprint here a story by the late Phil F. Brogan from the Bend Bulletin of October 2, 1971, as it was published in DOGAMI's *Ore Bin* of November 1971. We regret that we cannot reprint also the picture of the rock on the surface of the Moon with Jim Irwin's dedication and signature:

Central Oregon rock rests on the Moon

There is a bit of rock from central Oregon on the bright Moon these nights as the orb circles the Earth. It was placed there by NASA Astronaut James B. Irwin who, with David R. Scott and Alfred M. Worden, was aboard Apollo 15 on the highly successful mission this past summer.

The story of how the Oregon rock, a splinter from a chunk of dacite near Devil's Lake on the Cascade Lakes Highway west of Bend, found an eternal resting place on the Moon starts with a dinner honoring the 16 astronauts who were guests of Bend in 1966.

Various Bend residents were hosts to the astronauts at a welcoming party at the Bend Golf Club. Floyd E. Watson, Bend building inspector, was host to Irwin and during the evening got well acquainted with him.

In time, Watson forgot the astronauts' dinner. Then in July 1971, in the list of astronauts for the Apollo 15 mission to the Moon was Irwin, graduate of the U.S. Naval Academy and University of Michigan.

Watson immediately wrote to Irwin, congratulating him on his appointment to the Apollo 15 command, adding "I am sending you a small sliver of central Oregon lava which I hope you will be able to deliver to the Moon for me. I have five grandchildren who would be eternally grateful to you." One of the grandsons hopes someday to enter the space program and fly to another planet.

Watson little expected to hear from the busy astronaut. Then came a letter from Irwin, who had toured the base of the Apennine Mountains on the Moon, ridden with Commander Scott over rugged moonscape, driven an $8-million "moon buggy" to the brink of an awesome rill, and studied billion-year-old rocks.

The letter was brief: "I did carry your sliver of lava to the Moon and left it there. I took a picture of the location and will send it to you as soon as it has been properly mounted."

The picture, autographed by Astronaut Irwin, had an arrow pointing to a small black object on the silvery lunar dust. That object was from a tongue of lava which ages ago flowed to the edge of the Devil's Lake basin. Irwin dropped the bit of rock on the Moon on July 31, 1971.

The story of the Oregon rock that found its way to the Moon aboard Apollo 15 may not be at an end. The Devil's Lake area is in the Bend District of the Deschutes National Forest. Ranger Jack R. Krieger is considering marking the spot, adjacent to the highway, with a roadside sign. That sign, if approved, might read:

"A piece of rock from this site was placed on the Moon in July 1971 by Apollo 15 astronauts."

—John D. Beaulieu
Deputy State Geologist

BOOK REVIEW

by John Eliot Allen, Emeritus Professor of Geology, Portland State University, Portland, Oregon 97207-0751

Volcanoes of North America, United States and Canada, compiled and edited by Charles A. Wood and Jürgen Kienle. Cambridge University Press, 1990, ISBN 0-521-36469-8, 354 p., $70.

Wood and Kienle have accomplished a remarkable feat in persuading 81 authorities to write, especially for this volume, succinct descriptions of 262 volcanoes and volcanic fields, located in 12 western states of the U.S. and in Canada.

Author Wood explains in his introduction that the many volcanoes of Mexico, Central America, and the Caribbean, although undeniably in North America, were left out because their tectonic settings are distinctly different and their history of exploration and understanding is separate from volcano studies in the United States and Canada. He suggests a companion volume on *Volcanoes of Latin America.*

The book includes only those volcanoes that are morphologically distinct and younger than 5 million years. And while a few small volcanic fields that should be included are not, because of a nearly total lack of information, the material that is presented is enough to show that, as Wood states, "There are more volcanoes in North America than anyone would have imagined . . . Additionally, the diversity of processes that built the volcanoes includes virtually all those described in textbooks."

A volcano index includes, in italic type, the names of 458 additional volcanoes that are mentioned but not specifically described. An author index lists the contributions made by each writer.

The 8½-by-11-inch-sized pages of this hardback book allow maps and photographs to illustrate most of the descriptions. The type is large and easy to read, and most maps are well readable (a few have been reduced so much that some readers may need a magnifier). Some photographs are a little hazy, due perhaps to the use of unglossed paper.

Three successive parts of the book describe the volcanoes of Alaska, Canada, and western United States, the latter including New Mexico, Colorado, and Wyoming as the easternmost states. Each of these parts begins with a discussion of the regional volcano tectonics (in addition, Hawaii is given a separate tectonic discussion), followed by a table of contents that also serves as a sequential volcano index for that part.

The Cascade Range in Oregon contains more than 3,000 shield volcanoes and cinder cones, often as yet unstudied, many of them not even named. This situation necessitated a deviation from the usual treatment of the book in that these volcanoes are not described separately; rather their features are briefly presented in a series of regional descriptions, mainly the High Cascade areas between the major peaks.

Each description begins with a block of statistical data, usually consisting of type, geographic coordinates, elevation, dimensions, eruptive history, and composition, for example:

NEWBERRY
Oregon

Type: Shield
Lat/Long: 43.68°N, 121.25°W
Elevation: 2,434 m
Relief: ~1,100 m
Volcano/Caldera Diameter: ~40/5x7 km
Eruptive History: 0.5 Ma to ~1,300 yr BP
Composition: Basalt to rhyolite

Next is a more detailed narrative description varying from 500 to 2,000 words. Because the book is intended to be understood by general geologists, details of geochemistry, isotopes, tephra layers, flow morphologies, and eruption histories are generally not given. The description is followed by a very handy paragraph on "How to get there" and, finally, one or two bibliographic references that are intended to introduce the reader to the available literature.

Alaska, with 93 pages containing more than 100 descriptions (predominantly in the Aleutian Islands), has two to three times the 42 pages and 34 descriptions allotted to Oregon. Although the editors suggested that inevitably some volcanoes and fields may have been overlooked, no omissions are immediately apparent. □

Volcano News to be revived

In the beginning there was *Volcano News*, an interdisciplinary forum where volcanophiles of all stripes—professional and amateur, "hard" and "soft" scientists alike—could exchange information. *Volcano News* unfortunately became extinct when editor-publisher Chuck Wood became involved in editing *Volcanoes of North America.*

Janet Cullen Tanaka, a former contributing associate editor of *Volcano News*, is planning the publication of a new interdisciplinary newsletter to cover all facets of volcano studies from geophysics to emergency management.

Persons interested in contributing articles or in subscribing, or both, are invited to contact Janet as soon as possible at PO Box 405, Issaquah, WA 98027-0405, or by phone between 10:00 a.m. and 10:00 p.m. (Pacific Time) at (206) 392-7858. □

Job-opportunity newsletter announced

Beginning in September 1991, *Earth Science Opportunities* will offer its services to earth scientists. It is conceived as a monthly newsletter that will print current employment opportunities as well as internship, fellowship, and grant announcements free of charge. Submissions may be sent by mail, e-mail, or modem and may include graphics, if these are submitted as Macintosh PICT files.

The venture is an attempt to provide a consolidated forum for job listings in all areas related to the earth sciences, alleviating the current situation where job seekers need to search a considerable number of different publications that may or may not include announcements in their particular fields of expertise.

Earth Science Opportunities is offered for subscription at $24.95 for six months, $44.95 for one year, or $84.95 for two years. International rates are available on request. Subscriptions should be sent and checks made payable to Editor, Earth Science Opportunities, 2089 Rt. 9, Cape May Court House, NJ 08210. The editor can be reached at (609) 624-9337; the phone number for modem and e-mail information is (609) 624-0608. □

USGS new style guide available

The U.S. Geological Survey (USGS) has released the seventh edition of its *Suggestions to Authors* (STA 7), a guidebook for writers, reviewers, editors, typists, and other persons helping to prepare materials for publication—originally within the USGS but by now also in many other places where geologic research is written up and published.

The 8½-by-11-inch book has 289 pages. The text is loosened up with a great many illustrations and cartoons. Paperbound copies can be purchased for $18 from USGS regional offices with over-the-counter sales, such as the Northwest Region Earth Science Information Center in Spokane, Washington (phone 509-353-2524); the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402; and Printing Office book stores. □

MINERAL EXPLORATION ACTIVITY

MAJOR MINERAL EXPLORATION ACTIVITY

County, date	Project name, company	Project location	Metal	Status
Baker 1990	Baboon Creek Chemstar Lime, Inc.	T. 19 S. R. 38 E.	Lime-stone	Expl
Baker 1990	Cracker Creek Mine Bourne Mining Co.	T. 8 S. R. 37 E.	Gold	Expl
Baker 1991	Cave Creek Nerco Exploration	Tps. 11, 12 S. R. 42 E.	Gold	App
Baker 1991	Gold Ridge Mine Golconda Resources	T. 12 S. R. 43 E.	Gold	Expl
Baker 1991*	Lower Granview Earth Search Sciences	T. 14 S. R. 37 E.	Gold	App
Baker 1992	Pole Creek Placer Dome U.S.	T. 13 S. R. 36 E.	Gold, silver	Expl
Coos 1991*	Seven Devils Oreg. Resources Corp.	Tps. 2, 7 S. R. 4 W.	Gold	Expl com
Crook 1988	Bear Creek Freeport McMoRan	Tps. 18, 19 S. R. 18 E.	Gold	Expl
Crook 1991	Bear Creek Project Coeur Explorations	T. 18 S. R. 18 E.	Gold	Expl
Grant 1991*	Buffalo Mine American Amex	T. 8 S. R. 35½ E.	Gold	App
Grant 1991*	Canyon Mtn. Cammtex International	T. 13 S. R. 32 E.	Gold	Expl
Grant 1992	Standard Mine Bear Paw Mining	T. 12 S. R. 33 E.	Gold, copper	Expl
Harney 1990	Pine Creek Battle Mtn. Exploratn.	T. 20 S. R. 34 E.	Gold	Expl
Harney 1991*	Flagstaff Butte Noranda Exploration	Tps. 3, 9 S. R. 37 E.	Gold	App
Jefferson 1991	Red Jacket Bond Gold	Tps. 9, 10 S. R. 17 E.	Gold	App
Josephine 1990	Martha Property Cambiex USA	T. 33 S. R. 5 W.	Gold	Expl
Lake 1988	Quartz Mountain Wavecrest Resources.	T. 37 S. R. 16 E.	Gold	Expl
Lake 1990	Glass Butte Galactic Services	Tps. 23, 24 S. R. 23 E.	Gold	Expl
Lake 1991*	8th Drilling Series Wavecrest Resources	T. 37 S. R. 17 E.	Gold	Expl
Lincoln 1991	Iron Mtn. Quarry Oreg. St. Highw. Div.	T. 10 S. R. 11 W.	Basalt	App
Linn 1991*	Hogg Rock Oreg. St. Highw. Div.	T. 13 S. R. 7½ E.	Rock	App
Linn 1991*	Quartzville Placer Dome U.S.	T. 11 S. R. 4 E.	Gold, silver	App
Malheur 1988	Grassy Mountain Atlas Precious Metals	T. 22 S. R. 44 E.	Gold	Expl, com
Malheur 1988	Harper Basin Project Amer. Copper & Nickel	T. 21 S. R. 42 E.	Gold	Expl
Malheur 1988	Jessie Page Chevron Resources	T. 25 S. R. 43 E.	Gold	Expl
Malheur 1988	Kerby Malheur Mining	T. 15 S. R. 45 E.	Gold	Expl, com
Malheur 1989	Hope Butte Chevron Resources	T. 17 S. R. 43 E.	Gold	Expl, com

MAJOR MINERAL EXPLORATION ACTIVITY (continued)

County, date	Project name, company	Project location	Metal	Status
Malheur 1990	Ali/Alk Atlas Precious Metals	T. 17 S. R. 45 E.	Gold	Expl
Malheur 1990	Buck Gulch Teague Mineral Prod.	T. 23 S. R. 46 E.	Ben-tonite	Expl
Malheur 1990	Calavera NERCO Exploration	T. 21 S. R. 45 E.	Gold	Expl
Malheur 1990	Cow Valley Butte Cambiex USA, Inc.	T. 14 S. R. 40 E.	Gold	Expl
Malheur 1990	Freezeout Western Mining Corp.	T. 23 S. R. 42 E.	Gold	Expl
Malheur 1990	Goldfinger Site Noranda Exploration	T. 25 S. R. 45 E.	Gold	Expl
Malheur 1990	Grassy Mtn. Regional Atlas Precious Metals	T. 22 S. R. 44 E.	Gold	Expl
Malheur 1990	Katey Claims Asarco, Inc.	Tps. 24, 25 S. Rs. 44, 46 E.	Gold	Expl
Malheur 1990	KRB Placer Dome U.S.	T. 25 S. R. 43 E.	Gold	App
Malheur 1990	Lava Project Battle Mtn. Exploratn.	T. 29 S. R. 45 E.	Gold	Expl
Malheur 1990	Mahogany Project Chevron Resources	T. 26 S. R. 46 E.	Gold	App
Malheur 1990	Racey Project Billiton Minerals USA	T. 13 S. R. 41 E.	Gold	Expl
Malheur 1990	Sand Hollow Noranda Exploration	T. 24 S. R. 43 E.	Gold	Expl
Malheur 1990	Stockade Mountain BHP-Utah Internatl.	T. 26 S. Rs. 38, 39 E.	Gold	Expl
Malheur 1990	Stockade Project Phelps Dodge Mining	Tps. 25, 26 S. R. 38 E.	Gold	Expl
Malheur 1991*	Bannock Atlas Precious Metals	T. 25 S. R. 45 E.	Gold	App
Malheur 1991	Big Red Ron Johnson	T. 20 S. R. 44 E.	Gold	Expl
Malheur 1991*	Birch Creek Ronald Willden	T. 15 S. R. 44 E.	Gold	App
Malheur 1991*	Deer Butte Atlas Precious Metals	T. 21 S. R. 45 E.	Gold	App
Malheur 1991*	Harper Basin Atlas Precious Metals	T. 21 S. R. 42 E.	Gold	App
Malheur 1991	Lucky G Sunshine Prec. Metals	T. 22 S. R. 44 E.	Gold	App
Malheur 1991	Rhinehardt Site Atlas Precious Metals	Tps. 18, 19 S. R. 45 E.	Gold	Expl
Malheur 1991	Sagebrush Gulch Kennecott Exploration	Tps. 21, 22 S. R. 44	Gold	App
Malheur 1991	Silver Claims Sunshine Prec. Metals	T. 23 S. R. 43 E.	Gold	App
Malheur 1991	White Mountain D.E. White Mtn. Mining	T. 18 S. R. 41 E.	Dia-toms	App
Marion 1990	Bornite Project Plexus Resources	T. 8 S. R. 3 E.	Copper	App com

Explanations: App=application being processed. Expl=Exploration permit issued. Veg=Vegetation permit. Com=Interagency coordinating committee formed, baseline data collection started. Date=Date application was received or permit issued. *=New site

Status changes

During July, Oregon Resources Corporation joined the list of companies for which an interagency coordinating committee is appropriate. As yet, no meeting of the new committee has been scheduled. Due to a decrease in activity, the coordinating committee for Chevron's Hope Butte Project was disbanded.

Regulatory issues

Numerous bills relating to mining were introduced during the legislative session. House Bill (HB) 2244, significantly modified by the Governor's Mine Work Group, a multi-interest-based committee, passed unanimously out of the House Agriculture, Forestry, and Natural Resources subcommittee, was passed by the Legislature, and has become law by the Governor's signature.

Hearings have been held by the Department of Environmental Quality on its proposed water quality regulations for large-scale mining operations. Comments made during the hearings will be reviewed, before the rules are presented to the Environmental Quality Commission for adoption.

Questions or comments should be directed to Gary Lynch or Allen Throop in the Mined Land Reclamation Office of the Oregon Department of Geology and Mineral Industries, 1534 Queen Avenue SE, Albany, OR 97321, telephone (503) 967-2039. □

Governor signs landmark mining bill

At a ceremony held July 31, 1991, in her office in Salem, Governor Barbara Roberts signed into law HB 2244, regulating chemical heap-leach gold mining in Oregon.

"This is a tough, practical piece of legislation," the Governor said. "We've worked hard on this. It's a solid bill that will demand adherence to strict environmental standards while establishing a fair, workable process for industry to develop this mineral resource."

A mining work group convened by the Governor's Office devoted long hours to the bill throughout the recently completed legislative session to hammer out a compromise acceptable to both environmentalists and industry. The group was chaired by the Governor's senior policy advisor for natural resources, Martha Pagel, and included representatives of both groups as well as state agencies.

HB 2244 creates a comprehensive application process for companies seeking to develop heap-leach mining operations, under the guidance of the Oregon Department of Geology and Mineral Industries (DOGAMI). Such operations have been proposed in eastern Oregon. The legislation requires that any chemical-process mining operations use "the best available, practicable, and necessary technology" to meet tough environmental requirements. It stipulates that there be no net loss of habitat value for fish and wildlife and requires reclamation of the site after development to protect human health and safety as well as wildlife. The bill also requires a complete environmental assessment of every project, as well as a thorough socio-economic assessment.

The legislation provides extensive opportunities for public input and information throughout the application process and sets a procedure for administrative and judicial review.

"I'm proud of this bill," Governor Roberts said. "This has been an important priority for me, and I congratulate the members of the legislature as well as the industry and environmental groups who have proven by this that we can work together to solve tough environmental problems while allowing responsible development of our natural resources."

—*Governor's Office news release*

New mining law to be implemented

House Bill (HB) 2244, recently passed by the 1991 session of the Oregon Legislature and signed by Governor Barbara Roberts, provides for major changes in the regulation of chemical-process mine operations, specifically those operations that use the cyanide processing methods.

The bill was a consensus bill on many points. The consensus was built in the Governor's Mine Work Group chaired by Martha Pagel. The group consisted of representatives of state agencies, legislators, legislative committee staff, environmental groups, and industry. It is safe to say that no group was entirely satisfied with the outcome, but all left the "table" believing they could live with HB 2244.

Key provisions of the bill include (1) a site-specific environmental evaluation including a cumulative impact analysis; (2) a socioeconomic analysis for use by local communities; (3) several public input opportunities during the state permitting process; (4) backfill analysis on a case-by-case basis; (5) stringent wildlife protection and mitigation provisions; (6) a project-specific coordination group that will meet in the local area; (7) establishment of an interagency, interdisciplinary technical review team; (8) a consolidated application; (9) a consolidated public hearing on draft permits and contested cases if needed; and (10) a new judicial review procedure designed specifically for this process.

Copies of the bill may be obtained from the Bill Center located in the State Capitol Building in Salem (503-378-8551).

The bill also requires the Oregon Department of Geology and Mineral Industries (DOGAMI) to complete rules for procedural aspects by September 30, 1991. Draft rules were made available to interested parties by August 23, 1991.

Hearings were held September 9, 1991, in Ontario, Malheur County, and September 10, 1991, in Portland.

Those wishing a personal copy of the draft rules should contact the Albany office at (503) 967-2039. Costs associated with mailing such copies will be passed on to the recipients. Copies will also be accessible for review at the following public libraries:

Salem Public Library
585 Liberty Street SE
Salem, OR 97309-5010

Eugene Public Library
100 West 13th Avenue
Eugene, OR 97401-3484

Jackson County Library
413 W. Mail Street
Medford, OR 97501-2730

Lake County Library
513 Center Street
Lakeview, OR 97630-1582

Deschutes County Library
507 NW Wall Street
Bend, OR 97701-2698

Harney County Library
80 West "D"
Burns, OR 97720-1299

Malheur County Library
388 SW 2nd Avenue
Ontario, OR 97914-2712

Emma Humphrey Library
150 A Street E.
Vale, OR 97918-1345

In addition, HB 2244 rules are available for review at all DOGAMI offices. See addresses listed in the box on page 98 of this issue of *Oregon Geology*. □

Brooks retires

Howard C. Brooks, Resident Geologist in the Baker City Field Office of the Oregon Department of Geology and Mineral Industries, has entered his well-earned retirement.

Brooks served DOGAMI at the field office for 35 years and in the process has become a venerable authority on Oregon geology, especially in Oregon's northeast.

Photo courtesy Jeff Durham, Oregon Trail Electric Coop, Baker City

Howard C. Brooks

Brooks has shared the results of his work by authoring or co-authoring nearly two publications—reports, books, maps, articles—for every year in office. These include comprehensive studies of gold and silver, quicksilver, and limestone in all of Oregon and were brought to a certain summation in his co-authorship and co-editorship of two books, published by the U.S. Geological Survey, on the geology of the Blue Mountains region. And he plans to continue to publish and contribute to publications.

A native of Idaho, Brooks received his geologic education at Idaho State College (B.S. 1953) and the Mackay School of Mines in Reno, Nevada (M.S. 1956). Before joining DOGAMI, he worked for Westvaco Mineral Development Department, Division of FMC Corp., and in the Nevada Mining Analytical Laboratory.

Brooks enjoys the unusual distinction of having served as member of the U.S. Bureau of Land Management Advisory Board for the Burns district. He also served the Northwest Mining Association as Trustee. In Baker City, he served on the City Council and is currently member of the Baker County Planning Commission and works with the Oregon Trail Interpretative Center and the Oregon Trail Regional Museum. He is also serving on the Baker City Golf Board and, if he has any time left, will certainly continue polishing his already fairly polished golf game. □

***(Earth-science education,** continued from page 114)*

The USGS also offers **Make Your Own Paper Model of a Volcano**, the pattern for a three-dimensional paper model of a volcano with a cutaway look at its insides. It was designed by USGS cartographer Tau Rho Alpha of Menlo Park and is accompanied by explanatory text by Menlo Park education officer Leslie C. Gordon.

The components of the paper model of the volcano come as a two-sheet report on heavy paper. The pattern and instructions on how to cut and paste them to make the 5x2x2¾-inch model are on one sheet. The "Educator's Guide" on the other sheet includes a brief description of volcano types, questions for further study, vocabulary, and a list of suggested reading.

The model is USGS Open-File Report 91-115A and available for $1.50 (paper) or $4 (microfiche) from the USGS at the address mentioned above (see "How to Construct . . .," page 113).

The report is available also on a 3.5-inch diskette that can be used in Macintosh computers to see an animated eruption, to change patterns on the model, and to print out copies of the model on paper (Open-File Report 91-115B, $10). □

***(Gall—Appendix,** continued from page 112)*

APPENDIX: List and description of samples studied

GMC 1: Location: Junction of Hwys. 62 and 230. Sample taken from the Mount Mazama ash flow and associated with pumice fragments, ash, and rounded pebbles. Abundant pieces of small (<3 cm in diameter) carbonized wood.

GMC 2: Location: Hwy. 138 at Clearwater Falls Campground turnoff. Sample taken from the Mount Mazama ash flow, and associated with pumice fragments and ash. Rootlets from the surface grow within the fragments of carbonized wood.

GMC 3: Location: Milepost 73, Hwy. 138 at Lake Creek, north side of road. Sample from the Mount Mazama ash flow; ample rock fragments within deposit. Sample of carbonized wood from a carbonized log.

GMC 4: Location: Milepost 73, Hwy. 138 at Lake Creek, south side of road. Sample from the Mount Mazama ash flow; scarcity of pumice and rock fragments; all pebbles appear to be of basaltic composition. No indication of layering or laminations.

GMC 5: Location: Hwy. 230, 4 mi north of junction with Hwy. 62, west side of road. Sample taken from the Mount Mazama ash flow; large pumice fragments up to 10 cm in diameter with distinctive pink-tan color of the ash flow; no bedding or laminations apparent. Outcrop located at the top of a rise, away from stream drainages.

GMC 6: Location: Hwy. 230, 1.3 mi north of junction with Hwy. 62, near Bybee Creek. Sample of carbonized wood from the Mount Mazama ash flow.

GMC 7: Location: Hwy. 230, 0.1 mi north of junction with Hwy. 62. Sample taken from the Mount Mazama ash flow, and composed of a carbonized log with growth rings still evident.

GHC 1: Location: Interstate 5 road cut, 0.5 mi north of Mount Ashland exit, southbound lane. Sample from the Upper Cretaceous Hornbrook Formation, from a nearshore marine mudstone. Carbonized pieces composed of very small (<3cm in diameter), friable, homogeneous fragments.

GHC 2: Location: Interstate 5 road cut, 0.5 mi north of Mount Ashland exit, southbound lane. Sample from the Upper Cretaceous Hornbrook Formation, from a nearshore marine mudstone. Sample of carbonized wood, with growth rings indistinct, found within a concretion; the sample appears to be partially silicified.

GCC 1: Location: Junction of Colestin Road and Mount Ashland access road. Sample of lapilli-sized, planar, carbonized wood from the Colestin Formation, from a bed mapped by Bestland (1985) as a white, crystal ash-flow tuff (informal member Tct).

GCC 2: Location: Interstate 5, 2.7 mi north of California border, northbound lane, benched road cut. Sample from the Colestin Formation, from a 5-ft-thick welded tuff containing carbonized logs and flattened pumice fragments. The logs are partially silicified and show indistinct growth rings.

GCC 3: Location: Interstate 5, northbound lane at Siskiyou Pass summit road cut. Sample taken from Bestland's (1985) informal Tct member of the Colestin Formation, from a partially silicified carbonized log. Growth rings are distinct in the sample.

GSC 1-3: Location: Abandoned Shale City pit, accessed from Dead Indian Hwy., east of Ashland. Samples taken from a finely laminated lacustrine deposit, composed of volcanic ash with interbedded, more resistant, carbon-rich beds. Samples consist of a glossy, homogeneous, highly cleaved carbon, occurring in thin bands and isolated fragments.

GU 1: Location: Rock Mesa, near South Sister, Deschutes County, Oregon. Sample obtained from the U.S.Geological Survey, Vancouver, Washington. Sample from carbonized log found in growth position and buried by 2.25 m of hot air-fall tephra. Sample site located near the volcanic vent, attested to by the coarseness of the fragments comprising the deposit.

H87-15A1-2: Windy Ridge, northeast of Mount St. Helens. Sample taken from the Mount St. Helens blast deposit. The blast deposit is composed of loose, friable, juvenile, and accidental material.

GFC 1-3: Location: Ashland, Oregon, recent forest-fire burn areas; all three samples taken from charred logs.

GS 1 (= SIL 1): Comparison sample of silicified wood for study of silification.

GRW 1: Comparison sample of raw wood, not silicified or carbonized, for examination of undamaged middle lamellae. □

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