JAN 94

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GEOLOGICAL SOCIETY
OF THE OREGON COUNTRY
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ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer, Picnic-August,Banquet-March, Annual Meeting-February.
FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August. 8:00 pm, Rm. S17, Cramer Hall, PSU. Library: Room S7, Open 7:30 P.M. prior to meetings.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00pm, Rm. 371, Cramer Hall, PSU, SW Broadway at SW Mill street, Portland, Oregon.
LUNCHEONS: First and Third Fridays each month, except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland,Oregon
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
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VISITORS WELCOME
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VOLUME 60, NO. 1

CALENDAR OF ACTIVITIES FOR JANUARY, 1994

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

Jan. 14 "Sri Lanka" (in stereo). Presented by Roy Haftorson.

Jan. 28 "Landslides and Life in the Czeck and Slovak Republics"
Speaker: Prof. Scott Burns, Geology Dept. PSU.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon.)

Jan. 7 "Upper Amazon and one of the Large Mountains". Speakers: John and Ruth Checkis.

Jan. 21 To be announced

COMPLETELY FRACTURED GEOLOGY will start again in the February issue of the Geological Newsletter####

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.

Jan. 19 Illustrated talk on Alpine Glaciation.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings)

FIELD TRIPS

February 19, 20, 21. OLYMPIC PENINSULA. Details at end of Newsletter

Louis Oberson, GSOC PAST PRESIDENT would appreciate hearing from GSOC members. His number at his Foster Care Home is 246-3875. Also Mary Lou, his daughter indicated by would like some visits. Please call first. His address is 7245 SW 77th, Portland, Oregon 97223. Louis was a Charter Member of GSOC.

COMPLETELY FRACTURED GEOLOGY will start again with the February, 1994 issue of the Newsletter.

Carol Cole, 1994 Secretary is filling in for **Shirley O'Dell** . Shirley is recovering from surgery. Why not send her a card. 3038 SW Florida Ct. , Unit D, Portland, Oregon 97219

The **Nominating Committee** composed of **Gale Rankin, Chairperson, Don Parks, Charlene Holzwarth, Rosemary Kenney, and Margaret Steere** has proposed the following GSOC members as officers for the **1994-1995** year. Each of those nominated has agreed to accept the office. Election of officers will take place in February.Any additional nominations must be submitted to the secretary in writing over the signatures of at least ten members prior to the 10th day of January. With approval of the nominees, these names shall be published in the February Newsletter and be included on the ballot.

President: **Dr. Donald D. Botteron**
Vice-President: **Clay Kelleher**
Secretary: **Carol Cole**
Treasurer: **Phyllis Thorne**
Director, 3 year: Bill Greere

WELCOME NEW MEMBERS

Bud La Fortune	**Dr. Gerald Schwiebinger**
1327 NE 137th Street	**255 SW Harrison-116-B**
Portland, Oregon 97230	**Portland, Oregon 97201**

PRESIDENT'S FIELD TRIP
Friday, October 1, 1993, Mount Vernon to Portland
Don Parks

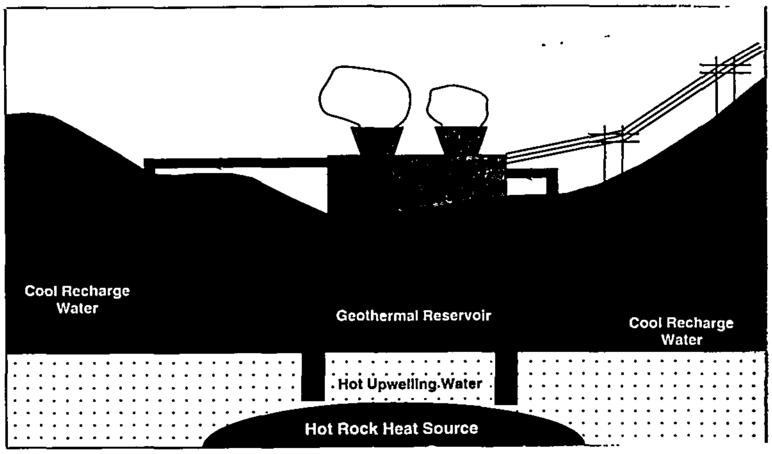
Friday A.M., October 1 and our final breakfast at the Cotton Tree Inn, bus driver Jim is greeted with applause having returned from Seattle with the repaired bus. It's been a beautiful week, superbly planned and conducted. Our luggage is on board, a few are enjoying a final cup from the cappuccino machine and it's farewell to Mount Vernon. Rolling south heading for Seattle, outside a high fog is starting to clear but inside the windows are fogging up. Jim was informed that it was getting mighty cold. He reply was that the workmen must have mixed up the hot and cold air lines when "connecting up". He soon gets controls adjusted and all is O.K.

Coming into Seattle Dr. Whitmer points out Queen Ann Hill a glacial deposit. We slip out of the frustrating traffic and explore sights along Seattle side streets past St. Marks Cathedral and now in low gear we reach Volunteer park at the top of Capital Hill. The water storage tank located in the Park has been an observation deck at the top giving a 360 degree view of the city. The spectacular view is worth the effort - 108 steps each way.

We continued on a brisk tour of the industrial harbor area on the way to Discovery Park with a stop to indulge in our box lunches. Again on our way we stopped briefly in Olympia at the Capital grounds. The Capital sandstone dome is still in place. At Chehalis left I-5 with a short drive to Pe Ell noting the large flood plain and glacial deposition. Continue-ing the loop drive passing through Napavine, Winloch and
Vader. Along the area of the Toutle River we observed the dredging deposits from St. Helens eruption. Rejoined I-5 at Kelso and return home.

ABOUT GEOTHERMAL ENERGY

(The following two articles were taken from **Newberry Geothermal Pilot Project EIS UNDATE** published by Fort Rock Ranger District, Deschutes National Forest, Bend, Oregon. Permission to print these articles was obtained from the publisher.



Geothermal energy is heat energy from deep in the earth. This heat is brought near the surface by deep circulation of groundwater or by movement of molten magma. Geothermal systems are a combination of three components:

* near-surface heat
* fractured or permeable rock, and
* water

There are five main types of geothermal resources, differing in the extent to which they have each of the above components:

Hydrothermal resources-these contain all three components. As shown in the drawing above, water is heated by fractured rock or by circulating along faults in the earth's crust. Since all geothermal resources developed so far are hydrothermal resources, the words hydrothermal and geothermal are often used interchangeably. The geothermal project proposed at Newberry Volcano hopes to find and tap a hydrothermnal reservoir. Hot water and steam is discovered and brought to the surface by drilling wells. Steam can be used directly to power a turbine, or the heat in the water can be transferred to another fluid, which is converted to a gas to drive a turbine. The spent geothermal fluid is reinjected into the earth.

Low-temperature hydrothermal-these are hydrothermal resources at temperatures too low to generate electricity. District heating systems in Klamath Falls and Boise use low-temperature hydrothermal reservoirs. This also includes taking advantage of the relatively constant temperature of the ground by using ground-coupled heat pumps to heat and cool buildings and residences.

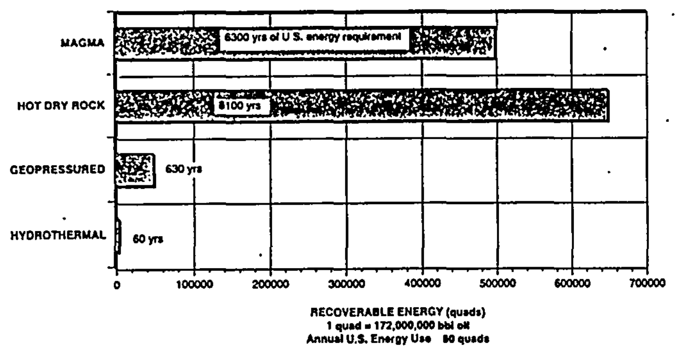
Hot dry rock resources-relatively few places have the water and permeable rock necessary for hydrothermal. But if one drills deep enough (typically 5 to 10 miles, less in some places) the earth is hot enough everywhere to produce electricity. Technology is being developed to artificially fracture the rock, inject water or some other fluid, and bring the fluid back to the surface to extract the heat.

Magma resources-these are similar to hot dry rock resources, except heat from molten magma would be tapped directly by drilling into near-surface intrusions. This is another technology being investigated for future use.

Geopressured resources- here we have hydrothermal resources under pressure, often also containing natural gas. New power plants are being developed to exploit energy from heat, water pressure, and natural gas. This kind of resource is typically found in oil-producing areas like the Gulf Coast of Texas and Louisiana, and may see commercial use in the future.

GEOTHERMAL — U.S. RESOURCE BASE

Potential Contribution to U.S. Energy Supply



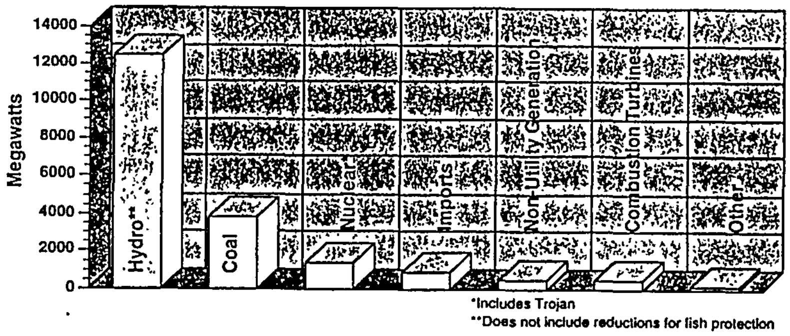
This graph shows how many years each of the four major geothermal resources would last if it had to supply all the energy needed in the U.S.

Source National Research Council, 1987
USGS Circular 790, 1979

Where are geothermal resources found?

Geothermal resources occur throughout the U.S., but are most abundant and the hottest in the western third of the country. These resources are often found in areas like Newberry where there has been recent volcanic activity. Hot springs and fumaroles are other surface indications of hydrothermal systems. Some promising sites in the Pacific Northwest for hydrothermal are shown on the map below.

Northwest Energy Sources



*Includes Trojan
**Does not include reductions for fish protection

A geothermal exploration program usually begins with surface surveys, geophysical testing, and drilling small (4- to 6-inch) diameter exploration wells. In the Newberry area, exploration wells will likely be thousands of feet deep and may cost several hundred thousand dollars each to drill. If a good prospect is found, the next step is drilling and flow-testing a full-size well, which may cost several million dollars. There is no guarantee this well will find high enough temperatures or enough fluid for power production. In the current power market, a reservoir must be hotter than about 300°F and wells must be shallower than about 10,000 feet to be economical.

How much can geothermal contribute?

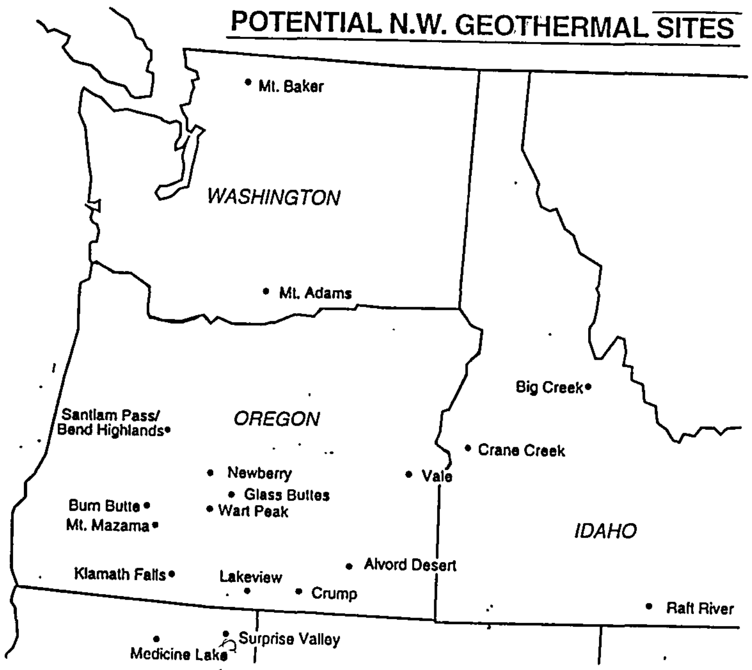
About 5800 megawatts (MW) of thermal power (the equivalent of six Bonneville Dams) is used worldwide (a megawatt serves the needs of about 500 households). Another 80,000 MW could be developed over the next two decades at sites already identified. About 3,000 MW has been installed in the U.S. This is less than one percent of our total energy production.

The U.S. Energy Information Administration estimates be developed in this country by the year 2010. More is possible if development accelerates or technology improves. Since high-temperatures resources are relatively rare, the potential contribution of low-temperature geothermal could be many times greater. If even a small portion of the earth's available energy could be tapped, the U.S. cold be supplied with several thousand years of electricity.

Where does central Oregon's energy come from now?

The Bend-La Pine-Sisters area is served by two publicly owned utilities--Central Electric Cooperative-- and an investor owner utility , Pacific Power and Light. Central and Midstate-currently purchase all their power from the Bonneville Power Administration. About 85 percent of BPA's power is generated at dams on the Columbia River and its tributaries. PP&L gets about 23 percent of its power from

hydro, with the rest coming from coal plants and other sources. None of these
utilities has significant generating resources in central Oregon. The only large areas are Portland General Electric's Round Butte and Pelton Dam Projects on the Deschutes River near Madas.



Energy from the Newberry Geothermal Project would feed into the BPA transmission system at or near La Pine.
The 33-megawatt power plant would supply about 15,000 families. Because central Oregon has few local sources of power, the project could be thought of as serving local needs, although this is not strictly accurate. The Northwest system is much like an intricate system of water pipes. Where a given drop of water originating at a particular source gets used depends upon interactions between all the users and all the other water sources in the system. The same goes for each electron generated by a power plant. So even though Central Oregon clearly imports all its electricity, the source of power could be any of the power plants connected to the transmission grid.

Where does the Pacific Northwest's energy come from now?
Most of the Northwest's electricity comes from hydro (60 percent), with coal also supplying a significant share (19 percent). The rest comes from nuclear, combustion turbines, imports, and other sources (see graph). because natural gas is presently very cheap, many utilities are meeting increasing demand with new gas-fired combustion turbines

Is geothermal a new technology?

Geothermal is not a new technology, it is just new to the Northwest. Earth energy has been used to generate electricity since 1904, when the first steam engine was installed at Larderello, Italy. By the early 1940s, Larderello was generating 130 MW.

It was destroyed during World War II, but has since been rebuilt to over 400 MW. The first U.S geothermal power plant was built in 1960 at The Geysers, which is about 70 miles north of San Francisco. Since then, Over 70 plants have been have been built in California, Nevada and Utah. Low-temperature geothermal has heated most of Reykjavik, the capital of Iceland, for decades.

Actually, geothermal is not even that new to the Northwest. It has been used for space heating in Boise, Idaho for more than a century, and in Klarmath Falls for almost as long. The power plant technology is considered mature. Exploration and drilling technologies continue to be refined, and are the main target of efforts to reduce the costs of developing geothermal.

How does it compare to other energy sources?

Geothermal is similar to renewable resources like wind and hydro. All three depend on a fuel supply which is essentially free and therefore not subject to future price increases. Geothermal also tends to be one of the most reliable energy sources, because--unlike wind and solar--the fuel supply does not depend on the weather. Geothermal plants built in the last decade have proven to be extremely dependable, even compared to "old" technologies like coal and nuclear. Because it has high capital costs, geothermal tends to be more expensive in the short run than gas-fired combustion turbines but it has a high potential for being cost-effective over the long term. The high potential prompted the Northwest Power Planning Council and BPA to initiate the geothermal pilot program. ⊕⊕

Why Newberry Volcano?

What makes the Newberry area such a desirable location for the development of geothermal energy?

Exploration for geothermal energy in central Oregon began in 1974 when leasing first became available on federal land. Now, 19 years later, exploration and research have demonstrated that high temperatures exist under Newberry Volcano.

In 1974, the Bureau of Land Management (the federal agency which manages geothermal leasing) was flooded with lease applications for about 500,000 acres of land on the Deschutes National Forest, including the Newberry Volcano area. After the preparation of environmental analyses and resolution of administrative issues, the first leases were issued in 1982. By 1987,185 leases covered 338,000 acres. But by

August 1993, the number of leases fell to 87, covering 90,000 acres. This drop was mostly the result of exploration and research that more clearly defined the best geothermal prospects, with Newberry Volcano being at the top of the list. Now, Newberry is recognized as one of the five top geothermal prospects in the United States.

A Good Geothermal Prospect

An old rule of thumb says that, in volcano country, if the volcanoes are less than one million years old and if there are great piles of volcanic deposits, the area is a good geothermal prospect. Newberry more than qualifies on both counts.

Exploration activities that have proved most valuable are geological mapping and temperature gradient (TG) drill holes. Numerous geophysical and geochemical studies have also provided important information. The U.S. Geological Survey (USGS) began mapping the geology of Newberry Volcano in 1976. In 1981, the USGS completed a TG hole in the center of Newberry Crater. The 3057-foot hole became a point of major interest when the temperature at the bottom was measured at 509 degrees Fahrenheit. The hole also produced steam for 20 hours during one of the tests.

In 1988, a major research journal (the Journal of Geophysical Research) devoted a special section to the geology and geophysics of Newberry Volcano. These and other research articles supported the view that Newberry Volcano was a very promising geothermal prospect.

About 34 TG holes have been drilled into Newberry Volcano. Early holes were shallow (a few hundred feet deep) and disappointing. They showed no significant change in temperature with depth. When it became clear that drilling would have to go quite deep to find increased temperatures, geothermal explorers changed to small-diameter "core" drills of up to 4 inches. By about 1980, core drilling became the preferred method of drilling TG holes. So far, about 12 core holes have been drilled deeper than 2000 feet, with the deepest at 5000 feet

More Evidence from Drilling

Drilling has provided the best evidence to date for the high geothermal potential of Newberry Volcano. Projections of temperatures beyond the bottom of each hole suggest that temperatures adequate for electrical production lie between 5000 and 10,000 feet under the flanks of the volcano.

This leads us to where we are now, with the U.S. Forest Service, Bureau of Land Management and Bonneville Power Administration evaluating the proposal by CE Exploration to prove the existence of a geothermal reservoir capable of supporting the production of electricity.⊕

BOOK REVIEW:

Handbook of Rocks, Minerals and Gems
by Walter Schumann
(Houghton Mifflin Co., 1993, 380 pages,
Soft cover - $18.95; Hard cover - $35.00).
by Don Barr, GSOC

This new and well written reference book for the beginner and advanced rock, mineral and gemstone collector is now available at good bookstores.

Several criteria that are needed for a good reference book include (1) being attractive enough to catch the eye of the collector, (2) being easy to use in identifying the specimens, (3)having good illustrations and diagrams, and (4) being easy to read and handle. This new handbook meets all these criteria.

"The Handbook of Rocks, Minerals-and Gemstones" begins with a chapter titled 'The Science of Minerals' which is a good introduction to the subject for the beginner and an excellent review for the more advanced collector. The book has a clear and informative description of the rocks, minerals- and gemstones along with more than 600 photographs. The high quality photographs are of specimens that you might find, not of beautiful museum spccimens that would be of little help to the searcher.

The format of this book is defined by the title "Handbook" and is small enough to carrry in the field. All the photographs are accurate and the specimens shown are approximately life size. The author covers every mineral and gem you would expect to find in a handbook plus the 142 pages describing rocks with text and pictures.

This publication is divided into three sections with the first section on rocks, the second on minerals, and the third on gemstones, Each chapter leads to the next chapter in a logical order.

The section on rocks is broken down into five groups of rocks and includes diagrams that show relative concentrations of rock-forming minerals to help in identification of specimens.

The next section deals with minerals-formng minerals and gem-forming minerals. Here the author uses constituent elements along with good photographs to identify the minerals.

The third section on gemstones is divided into precious and semi-precious gemstones. The author again uses keys with specific elements to identify the gemstone. A good set of pictures of gemstones is included.

Each chapter builds on previous ones so that when you get to gemstones you will have a background of minerals, and elements that make up the gemstone.

The "Handbook of Rocks, Minerals and Gemstones" is a good reference for the collectors library whether the collector is interested in gemstones, minerals or rocks.⊕

TO THE EDITOR:

I read with much interest the article "Geologists Select the Great Books of Geology" that appeared in the December Newsletter. As you know, about 900 geology departments were contacted and the professors were asked to list imporant books related to the geological sciences, other than texts, that every geolgist should read.

The authors selected 42 out of almost 500 titles submitted based on their being cited five or more times. The list is an impressive one and I am going to make an effort to read some of these, especially those by Gould and McPhee. My only concern is that the compendium does not include books which discuss anything related to mineral exploration and development i.e., economic geology. After all, most professional geologists even today are employed by mining or petroleum companies. If the geology departments around the country trained only those majors who were not expecting to go into mineral exploration after they had graduated, the universities could decrease their staffs by one-half to two-thirds and save a lot of money.

The point I am making is that the Triplehorns should also have polled the much larger fraternity of working geoscienst outside the halls of academia in order to obtain a broader and more valid concensus on what we consider to be important books in geology. For example, professional geologists as well as interested laymen should read two fairly recent books by Walt Youngquist, "Investing in Natural Resources" and "Mineral Resources and the Destinies of Nations." Another excellent but very technical treatise is "Metal Deposits in Relation to Plate Tectonics" by F. J. Sawkins.

Mineral deposits, including oil and natural gas, are the basis of our civilized culture. Without such products, we would still be living in the stone age. I believe it is important, therefore, for all of us to appreciate how much we owe to the geological fraternity that has expended so much time and effort down through the years to provide us with these basic commodities. The books I have noted above provide that kind of information and should lead to a better understanding of the impact that mineral exploration and development has on our everyday lives.

Best regards, Andy Corcoran
Retires State Geologist of Oregon⊕

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TO THE EDITOR:

A letter From Paul Lawson, concerning the article on thundereggs appearing in the November 1993 Geological Newsletter, Vol.59, No.11---Paul indicated that he was updating the information on thundereggs and that information would appear in the Newsletter at a later date. He included the following as additional sources of information on thundereggs.

Additional sources of information on Thundereggs

The July issue of *Oregon Geology* (v. 51, no. 4, p. 87-89) contained a short article on Thundereggs in Oregon that has also been made available to the public as a colored brochure. A list of references containing additional information about Thundereggs for those readers who would like to learn more about them is printed below.

Brown, R.W., 1957, Plantlike features in thunder-eggs and geodes: Washington, D.C., Smithsonian Institution Report for 1956, p. 329-339.

Crippen, R.A., 1948, Unusual concretions from Templeton, San Luis Obispo County, California: California Journal of Mines and Geology, v. 44, no. 3, p. 249-252.

Dake, H.C., 1951, The agate book: Portland, Oreg., Mineralogist Publishing Company, 64 p.

Dake, H.C., Fleener, F.L., and Wilson, B.H., 1938, Quartz family minerals: New York, Whittlesey House, 304 p.

Dake, H.C., and MacLachlan, D., 1962, Northwest gem trails (3rd ed.): Mentone, Calif., Gembooks, 95 p.

Farrington, O.C., 1927, Agate: Physical properties and origin: Chicago, Ill., Field Museum of Natural History Leaflet 8, p. 105-123.

Foshag, W.F., 1926, The minerals of Obsidian Cliff, Yellowstone National Park, and their origin: Washington, D.C., Proceedings of the United States National Museum, v. 68, art. 17, p. 1-18.

Gaertner, H., 1971, Achate, steinerne Wunder der Natur: Friedrichsdorf, Germany, Alles + Brillant, 71 p.

Highland Rock and Gift Shop, 1982, The rockhound's map of Oregon: Bend, Oreg., map with text on reverse side.

Kunz, G.F., 1893, Precious stones, *in* Day, D.T., geologist-in-charge, Mineral resources of the United States, 1892: U.S. Geological Survey, p. 776.

Leiper, H., ed., 1966, The agates of North America: The Lapidary Journal, 95 p.

McMullen, D.E., 1975, Oregon under foot: Portland, Oreg., Oregon Museum of Science and Industry Press, 60 p.

Oregon Agate and Mineral Society, 1978, Map of Oregon gem locations: Portland, Oreg., map with text on reverse side.

Oregon Department of Geology and Mineral Industries, 1965, Thunderegg: Oregon's state rock: Oregon Department of Geology and Mineral Industries, Ore Bin, v. 27, no. 10, p. 189-194.

Oregon Department of Transportation, Highway Division, (n.d.), Oregon rocks, fossils, and minerals and where to find them: Salem, Oreg., brochure with map, text, and photos.

Quick, L., 1963, The book of agates: Philadelphia, Chilton Books, 232 p.

Rieman, H.M., 1971, Thunder eggs: The Lapidary Journal, v. 24, no. 10, p. 1328-1335.

Rodgers, J.R., 1969, The rockhound's map of Oregon: Portland, Oreg., map with text on reverse side.

Rodgers, P.R., 1975, Agate collecting in Britain: London, B.T. Batsford, Ltd., 96 p.

Ross, C.S., 1941, Origin and geometric form of chalcedony-filled spherulites from Oregon: American Mineralogist, v. 26, no. 12, p. 727-732.

Sinkankas, J., 1959, Gemstones of North America: New York, Van Nostrand Reinhold Company, p. 115, 309-311.

———1976, Gemstones of North America, v. II: New York, Van Nostrand Reinhold Company, p. 52, 53, 235-237.

Smith, K.L., 1988, Opals from Opal Butte, Oregon: Gems and Mineralogy, v. 24, no. 4, p. 229-236.

Staples, L.W., 1965, Origin and history of the thunder egg: Oregon Department of Geology and Mineral Industries, Ore Bin, v. 27, no. 10, p. 195-204.

USDA Forest Service, in cooperation with the U.S. Bureau of Land Management and the Prineville-Crook County Chamber of Commerce, 1969, Central Oregon rockhound guide: Map with photos and text on back.

Wheeley, H., 1976, Take your pick to Agate Creek: Melbourne, Australia, Gemcraft Publications, Ltd., 72 p.

Wright, B., 1984, Native silica: London, England, Wyman and Sons, 263 p.

—Paul F. Lawson

Tours To Anywhere

The Geological Society of the Oregon Country presents

PRESIDENTS' WEEKEND ON THE OLYMPIC PENINSULA

February 19 - 21, 1994

$230.00 per person sharing twin; $291.00 single

Join Esther Kennedy and Dr. John Whitmer as they examine the "core rocks" of the Olympic Peninsula and Crescent Formation, the basaltic ocean crust which over-rode the core rocks in the subduction zone, and was lifted up by them.

<u>February 19</u> - Board our coach at the Raz Transportation shop at 7:30 am or Red Lion Lloyd Center at 8:00 am for this three day trip into one of the more popular remote areas of the Pacific Northwest. Our destination is Forks on the western side of the peninsula. (box lunch included)

<u>February 20</u> - Today we travel between Forks and Port Townsend and will include Neah Bay, time permitting. Overnight at the Harborside Inn, Port Townsend. (box lunch included)

<u>February 21</u> - It's home to Portland today following Hood Canal and I-5 back into the city. (box lunch included)

TOUR PRICE INCLUDES: Private chartered motorcoach, 2 nights hotel, 3 box lunches, coffee on the coach, handling of 1 suitcase per person, taxes and gratuities on all services listed.

NOT INCLUDED: Meals, other than listed in the itinerary and items of a personal nature such as wine, liquor telephone calls and maid gratuities.

Please turn to the back

---------------------------cut here---------------------------

RESERVATIONS BY MAIL PRESIDENTS' WEEKEND

NAME ____

ADDRESS ____

CITY ______________________ STATE ______ ZIP ___________

PHONE (__________) ______________________

Enclosed please find my check in the amount of $ ___________

as deposit for ________ person(s). I will be accompanied by

__________________________.

A DEPOSIT of $50.00 per person is required to confirm reservations on this tour.

FINAL PAYMENT will be due Friday, January 14, 1994. Reservations after January 14 will be accepted on a space available basis only and must be accompanied by full payment.

CANCELLATIONS and REFUNDS: A full refund will be made on all cancellations received prior to the final payment due date. Cancellations after the final payment due date will receive a refund less any unrecoverable expenses. No refunds for any missed services after commencement of the tour.

Make check payable to: Tours To Anywhere

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Portland, OR 97225

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THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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Bob Richmond 282-3817

Annual banquet
Chairperson:Susan Barrett639-4583

ACTIVITIES

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LUNCHEONS: First and Third Fridays each month, except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland,Oregon
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
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VOLUME 60, NO. 2

CALENDAR OF ACTIVITIES FOR FEBRUARY, 1994

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

Feb. 11 "Geology of the Solar System". Speaker: Ken Cameron of the Haggart Observatory in Tualatin.

Feb. 25 "Pet Rocks". Presentation by Rosemary Young who is an accomplished photographer.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon.)

Feb. 4 To be announced

Feb. 18 To be announced

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.

Feb. 16 "Matamorphism and Deformation". Presented by Richard Bartels.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings).

FIELD TRIPS

Feb.19, 20, 21. Participants will receive instructions and health slip by mail.

Mar. 11 Annual Banquet.

DUES ARE DUE. Dues are due on January 1 each year. In the past dues were due on March 1. Please take note of this change.

HANCOCK FIELD STATION RETREAT dates are May 13,14,15 and 16. Information will appear in the April and May **NEWSLETTER**. 37 GSOCS participated last year. All invited.

ALL GSOC CHAIRPERSONS: Have you yearly committee reports ready to hand to the President at the February 25th Business Meeting.

59th ANNUAL BANQUET NOTICE

PLACE: Grand Ballroom , third floor, Smith Memorial Center, Portland State University

DATE: Friday, March 11, 1994. **PUT A MARK ON YOUR CALENDAR!!!!!!!!!**

TIME: 5 :30 p.m. Grand Ballroom open for viewing exhibits and purchasing items from the sales table. Dinner at 6:30 p.m. sharp.

CHAIRPERSON Bruce, Sue Barrett, and Lois Sato

SPEAKER: **JOHN WHITMER** , will speak **on OREGON HAS EVERYTHING!!!!** GSOC member, retired Psychiatrist, Veteran's Hos[pital in Tacoma, Washington, Editor, Northwest Geological Society, Seattle, Washington, teaches two classes aweek in Adult Education, , Bellview Community College.

TICKETS: Ticket chairpersons, Freda and Virgil Scott, 8012 SE Ramona Street, Portland, Oregon 97207. Send a stamped, self-addressed envelope for the return tickets. Tickets will be available at all GSOC meetings. **PLEASE PURCHASE YOU TICKETS EARLY. It will be a help to the Banquet Committee and you have a better choice of table spaces.**

PRICE: Cost of the banquet tickets is $14.00 each. Bring tickets to banquet: they will collected at . the table.

PARKING: The 5th floor of the parking structure No. 1 1872 SW Broadway, between SW Harrison and SW Hall Streets, has been reserved from 5:30 p.m. for GSOC members attending the banquet. BE SURE YOU PARK ON THE FIFTH FLOOR!!!!!!! **READ ON--if you'r coming early to work on the banquet or your are setting up an exhibit before 5:30 you must call Rosemary Kenney at 221-0757 so your name is on a list at the check station at the entrance to the parking structure.** Do not park in the spaces marked " Reserved" or "Handicapped". From the 5th floor structure, a short stairway leads to a foot-bridge across Broadway to the level of the Banquet rooms.

BANQUET SALES TABLE NEEDS GOOD MATERIAL

Proceeds from the sales table at the Annual Banquet go to help meet expenses of the banquet. Please bring **SALABLE** material that will attract purchasers and be treasured by them. No large, heavy specimens, please. Limit your material to hand specimens or smaller. Suggested materials: minerals, slices of agate, crystals, fossils, thundereggs, tumbled agates, geodes, worthwhile books on geology or natural history and jewelry. If you need help in transporting your material to the building, phone Archie Strong at 244-1488 or Harold and Patricia Moore at 254-0135.

##

PROVIDE A BANQUET EXHIBIT

Displays for the Annual Banquet on March 12 are eagerly solicited. Exhibits of rocks, minerals, fossils, books, pictures or any hobby collection (geological or otherwise) are suitable. Please call Charlene Holzwarth at 284-3444 so space can be reserved . If possible, bring your own lamps and extension cords. The Exhibit Room will be open for setting up your material by 3:30 in the afternoon of the banquet. Hand truck is available. If coming to set up before 5:30 you must call Rosemary Kenney at 221-0757 as your name must be on a list at the entrance to the parking structure. **No one gets to park early without your name on the list.**

WELCOME NEW MEMBERS

John B. Pipkorn
P.O. Box 940698
Maitland, Florida 32794-0698

Ray Crowe
8622 North Lombard
Portland, Oregon 97203

COMPLETELY FRACTURED GEOLOGY

Evelyn Pratt

1. **RHYOLITE:** a low-calorie Irish whiskey
2. **DELTAIC:** what Della's doctor told her "Deltaic two spirin and call me in the morning."
3. **VITREOUS:** extremely evil and bad; "You vitreous fiend, you!"
4. **TRICLINIC** triclinic: a medical office sponsored by three counties
5. **SEISMOLOGIST:** a mother who specializes in making children's clothes fit
6. **NUNATAK:** hunger pangs at lunch time
7. **ARKOSIC:** not feeling well on Noah's boat
8. **DIORITE:** (1) a medication for high blood pressure that makes a person keep track of where the bathroom is,or (2) an ailment that makes a person keep track of where the bathroom is
9. **DRUMLIN:** a percussion instrument used by a tiny person
10. **BRECCIA:** a business term used by certain insurance firms in Chicago: "You pay up or I breccia you face!"

CORRECT ANSWERS TO COMPLETELY FRACTURED GEOLOGY ON PAGE -12---

BORAX LAKE: THE GEOLOGY

by Don Salzer

Permission to print this article taken from Nature Conservency publication ***THE OREGON CHAPTER*** *NEWSLETTER*, **Michele Glazer, Editor**

With the closing date for acquisition of Borax Lake just behind us, we can celebrate the completion of the first critical step in the protection of one of the most significant conservation projects the Oregon Field Office has yet undertaken. However, like all of our projects, full protection for Borax Lake relies on a costly long-term commitment to research, monitoring, and management.

Borax Lake is part of a complex and not yet clearly understood geothermal system; because there are species completely dependent on the lake for their existence and because the lake is under increasing pressure from human activity, a better understanding of the geology and underlying geothermal system in the Borax Lake area is crucial.

In the spring of 1991, the Bonneville Power Administration (BPA) funded research to improve our knowledge of the geothermal resource in the Alvord Basin. Dr. Michael L. Cummings, a professor in the Department of Geology at Portland State University, and graduate student Anna St. John recently completed this research examining the hydro-geochemical and geomorphic characteristics of the Alvord Valley. Their findings have advanced our understanding of the Alvord Basin geothermal system and led to a radically different picture of how Borax Lake was formed.

Borax Lake is an unusual geologic feature. Rather sitting at the low point of the valley floor like most lakes, it sits atop a mound that is 25 feet higher than the surrounding valley floor. It was thought that the mound resulted from an accumulation of sodium borate and other minerals around the edges of Borax Lake, and that it had developed gradually over thousands of years .Cummings and St. John offer a completely different view of how the Borax Lake mound was formed. Their research shows that the mound is an erosional remnant that held its ground while the surrounding landscape eroded.

Through a combination of field surveys and the detailed analysis of samples collected at Borax Lake Cummings and St. John provide the first detailed description of the composition of the mound that holds Borax Lake. Core samples taken from different parts of the mound reveal that much of the mound is made of nearly pure diatomite. Diatomite is formed mainly from the shells of microscopic algae called diatoms. On the flanks of the mound the diatomite is overlaid with a layer of stiff, clay-rich sediments. On the top of the mound, the diatomite occurs under a thin layer of hard siliceous material known as sinter. Sinter deposits also occur around the edge and the bottom of Borax Lake.

The formation of the hard sinter layer is the key step in the evolution of Borax Lake. It is known that sinter forms when geothermal waters become super- saturated with a substance called "amorphous silica."

Water chemistry analysis by Cummings and St. John indicates that the geothermal fluids in the lake are no longer supersaturated with amorphous silica so that sinter is no longer being formed. They postulate that sinter formation may have occurred only briefly in the history of Borax Lake, most likely around the time that glacial Lake Alvord was drying up 10,000 years ago. At that time, the floor of Lake Alvord likely consisted of thick layers of fine-grained sediments. The diatomite layer that underlies the sinter may have resulted from diatom blooms near a hot spring venting into Lake Alvord.

During the last 10,000 years, the climate of southeastern Oregon has alternated between periods of extreme dryness and periods of higher moisture. During dry periods, the fine-grained sediments in the Alvord Basin were eroded by the wind. Cummings and St. John estimate that up to 18 feet of fine-grained sediments may have been removed from the Borax Lake portion of the Alvord Basin. The sinter layer around the perimeter of Borax Lake served as a resistant cap preventing erosion of the fine-grained sediments underlying the sinter. Thus, Cummings and St. John postulate that the present surface of Borax Lake represents the floor of glacial Lake Alvord.

In addition to proposing a radically different perspective on the formation of Borax Lake Cummings and St. John have generated much new information about the underlying geothermal resource in the Alvord basin. Their investigations included studies at Mickey Springs and Alvord Hot Springs, the two other main hot spring areas in the Alvord Basin in addition to Borax Lake. Based on chemical and isotope geothermometers, they estimated geothermal reservoir temperatures of 335-400° F for the sites.

Data from Cummings and St. John's study do not preclude the presence of a single large deep reservoir system discharging at these three springs. Whether the hot spring areas discharge thermal fluid from one large reservoir or from three separate reservoirs can only be determined by drilling and a chemical and isotopic comparison of well discharges with thermal spring discharges and drill core and cuttings. Further studies will be needed to explore the connections among these systems, and between Borax Lake and the area about one mile southwest of the lake that Anadarko Petroleum Corporation is assessing for geothermal development. In 1989, Anadarko drilled a 1,500 foot deep exploration well at a site on BLM land one mile from the lake. It plans to drill two additional wells and deepen the existing one sometime this fall. More accurate and detailed information on the geology of the area and the nature of the underlying geothermal system will help us assess the risks of geothermal development on the Borax Lake system.

The designated critical habitat for the federally listed Borax Lake chub (Gila boraxobius) is directly dependent on the discharge of thermal fluids in Borax Lake. Exploration for geothermal resources or development of a geothermal resource must occur within a framework that ensures protection of this critical habitat.

$564,000 is needed for the purchase and long-term protection and management of Borax Lake. Contributions from Conservancy members and friends will be critical in the coming months. Please join us in protecting this tremendous new preserve.

Questions and Answers About Stream Meanders ·

Dave Love
Environmental Geologist, NMBM&MR

What does meander mean?

Stream meanders are one of the most-notable and intriguing aspects of many drainages in New Mexico (Fig. 1).Meanders are the sinuous paths many streams take back and forth along their course.

What determines a stream's path?

The formation and persistence of stream meanders depends on several factors related to the development of streams over geologic time as well as physical principles of energy use and self-regulation in complicated systems. All streams operate within an area called a watershed, and all streams have a history. Streams gather and move water and sediment in their headwaters, transport and temporarily store sediments downstream, and distribute water and sediments at their mouths. The removal and movement of sediment is called erosion while the storage of sediment is called deposition. All stream systems consist of channels and adjacent flood plains. The movement of water and sediment requires work to be done (energy is used to move masses of water and sediment across the landscape). The amount of work depends primarily on the amount of water and the gradient (vertical drop per horizontal distance) of the stream. Through time, streams adjust their gradients, velocities, sediment loads, stream-bed roughness, widths, depths,and pathways. Streams that meander have a common range in gradients, sediment loads, and amounts of mud in banks and beds, each determined by the streams' history and adjustments made along the way.

How are meanders described?

Meanders consist of straight and curved segments of a channel. The banks of the curved bends are described as outside, or concave banks and inside, or convex banks. Convex banks are commonly called point bars. The pattern of meanders along a valley (Fig. 2) can be described by 1) sinuosity, or the ratio of channel length to straight-line length, 2) wavelength, or distance between repetitive arcs of channel, and 3) radius of curvature, the length of the radius of an arc of a circle drawn around the tightest part of a meander loop. Sinuosities may range from 1.1 to more than 22. The wavelength of most meanders is seven to ten times the channel width. Radii of curvature are only two to three times the channel width; Stream meanders commony follow paths that show the minimum variation in changes in direction along the channel length. Such curves are known mathematically as "sine-generated" curves. Sine-generated curves describe the most probable path between two points (straight line is not the most probable path between two points when you only know you're headed generally down hill).

Does the sine-generated Meander Follow the laziest path?

A sine-generated curve is also the curve that minimizes the work in forming a bend. The form of meanders within a stream valley is the result of a balance between doing the least amount of work and equalizing the distribution of work between two points. In other words, the work done along each segment of the stream is uniform; while a minimum amount of total work is done.

What determines the shape of the stream?

The shape of the stream bottom along meandering streams, as most anglers and canoeists know, consists of shallow riffles and bars along straight channel segments between meander bends and deeper pools in the meander bends themselves. The pools are deepest along the outer edges of the meander and are shallow on the inside bank or point bar (Fig. 2). Water and bottom-moving sediment flow fairly uniformly down the straight riffles, but the bulk of the water and bottom- moving sediment separate and reorganize as both move through the bend. The water tries to continue flowing straight, but as the bank forces it to turn, it crosses to the outer bank, piles up and moves more quickly around the outside of the bend. Deep cross-channel currents are set up in a counter-balanced motion to move some water back toward the slower- moving side near the inner bank of the channel. As a result, there is a net corkscrew-like motion of water in the deeper part of the channel around the bend. The corkscrew motion erodes the outside of the bend, and helps move coarse sediment along the channel in fast- moving water. Both water and sediment spread out at the downstream end of the bend and enter the next riffle. Secondary eddies are also set up along the sides of the meanders, moving some water across the channel or even upstream. The slower moving water on the inside of the bend tends to deposit sediment on the point bar.

Once a meander forms, is it stable? The corkscrew movement of water, erosion of the outer bank, and deposition along the point bar mean that through time, the meander shifts laterally, eroding the outside bank and building the inside bank. Meanders along major streams in New Mexico may move several meters per year, both in a cross-valley direction and in a down-valley direction.

What happens when meanders move?

Because meander loops tend to move across and down valley, some loops may overtake others, causing channels to cut across narrow parts of the meander loops and form a new pathway. The process is called neck cutoff (Fig. 2) and the abandoned meander loop is called an oxbow (Fig. 2). Cutoff can also happen during floods when high water takes short cuts across low parts of the stabilized point bar. This process is called chute cutoff.

What happens when stream meanders erode downward?

Many stream channels and even canyons and valleys in New Mexico have become incised into the underlying rock or sediment, while the stream maintained a meandering pattern. As a result the meanders have become entrenched, with high arroyo walls or bedrock cliffs towering above present stream channels (Fig. 3). These features reflect the persistence of meandering stream flow for long periods of time.

Suggested Reading:

Bloom, A.L., 1978, Geomorphology, a sustematic analysis of Late Cenozoic landforms: Prentice-Hall, Englewood Cliffs, N.J. 510 pp.

Dietrich, W.E., and Smith, J.D., Processes controlling the equilibrium bed morphology in river meanders, *in* J.E.Glover and others, (ed.), River meandering, proceedings of the Conference Rivers '83: American Society of Civil Engineers, New York, pp. 759-769.

Leopold, L.B., and Langbein, W.B., 1966, River meanders: Scientific American, v.214, no.6, pp.60-70.

Schumm, S.A., 1977, The fluvial sustem: John Wiley and Sons, New York, 338pp.

The article, ***Questions and Answers About Stream Meanders*** ,was taken from LITE GEOLOGY, New Mexico Bureau of Mines and Mineral Resources, Summer 1993.

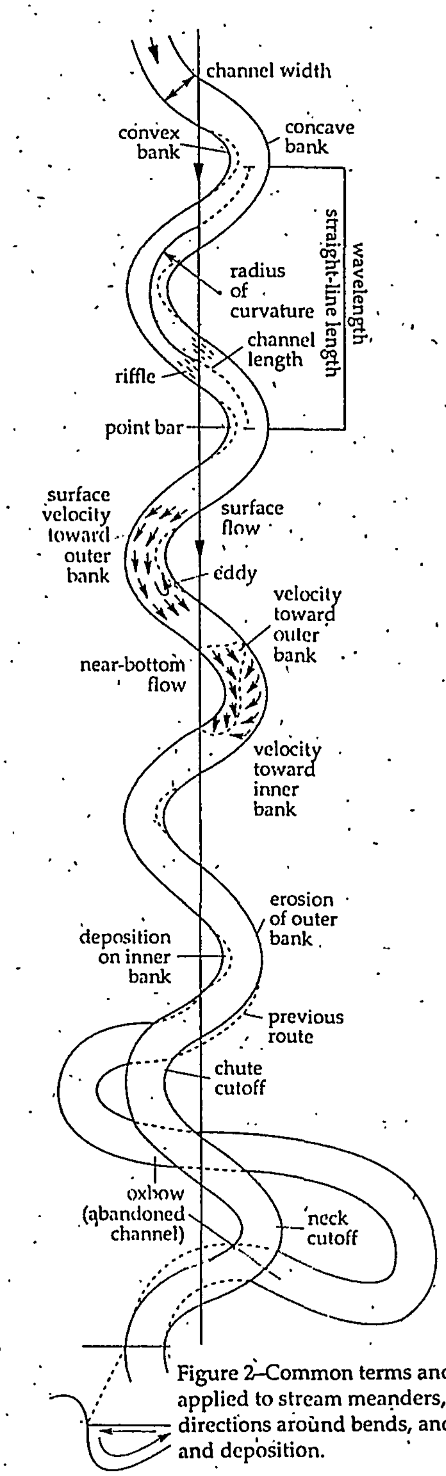

Figure 2–Common terms and measurements applied to stream meanders, water flow directions around bends, and places of erosion and deposition.

ANSWERS TO COMPLETEY FRACTURED GEOLOGY from AGI's Dictionary of Geological Terms, 3rd Ed.

1. **RHYOLITE**: a high-silica volcanic rock, often light-colored with flow texture; the xtrusive equivalent of granite.

2. **DELTAIC**: of or pertaining to a delta, the nearly flat alluvial tract of land at the mouth of a river

3. **VITREOUS**: glassy-looking

4. **TRICLINIC**: one of six crystal systems; the least symmetrical of the six

5. **SEISMOLOGIST**: one who uses earthquake analysis in prediction or exploration

6. **NUNATALE:** a large knob of bedrock projecting above the surface of a glacier

7. ARKOSIC: refers to sandstone with a lot feldspar in it; typically derived from weathered granite

8. **DIORITE** : refers to rocks intermediate between granite and gabbro, the intrusive equivalents of andesite

9. **DRUMLIN:** a smoothly rounded, longish hill made out of glacial till

10. BRECCIA: a rock with angular broken pieces held togetogether by somethi ng sharp finer grained; a sort of conglomerate with sharp stones instead of round stones

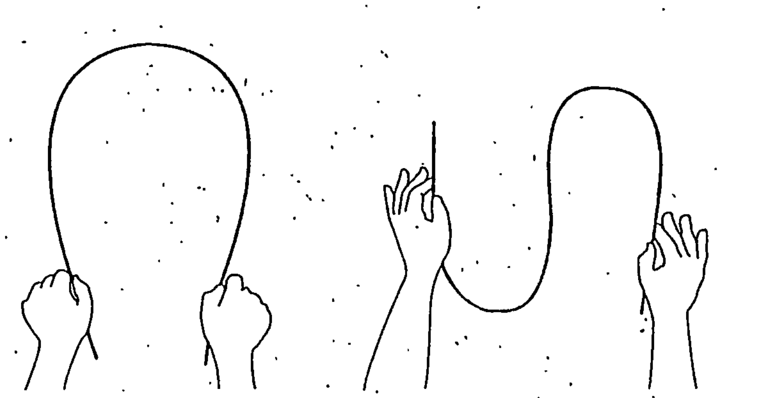

Figure 4–Bends formed by steel tape (redrawn from Leopold and Wolman, 1966).

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LUNCHEONS: First and Third Fridays each month, except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland,Oregon
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VOLUME 60, NO. 3

CALENDAR OF ACTIVITIES FOR MARCH, 1994

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

March 11 59th Annual Banquet. 5:30 P.M., Grand Ballroom, third floor, Smith Memorial Center, Portland State University.

CORRECTION - Speaker John Whitmer's topic will be "THE OREGON COUNTRY HAS EVERYTHING".

March 25 "Above and Below Down Under". Presentation by Carol A. Cole and Candace Pratt.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon.)

March 4 "Rocks, Lichen and Fungi". Presented by Maggie Rogers.

March 18 To be announced.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.)

March 16 Continuation of "Metamorphism and Deformation" by Richard Bartels.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings).

FIELD TRIPS

Hancock Field Station Retreat, May 13,14,15 and 16. Additional information will appear in the April and May newsletters.

JAMES HALL - GIANT OF GEOLOGY

by Andy Corcoran, Past President, GSOC

Although some people may argue, it seems to me that the "Golden Age" of field geology in this country has passed. All of the states have now been geologically mapped at a scale of 1:250,000 (six miles to the inch) or better. Most of the work being done these days involves ever more detailed studies of smaller and smaller areas that were originally mapped 20 or more years ago. I don't mean to say that additional work isn't needed because many regions are so geologically complex that people will be attempting to understand their stratigraphic and structural relationships for many years to come. Because the science of geology is highly interpretive, no one has yet produced an absolutely perfect geologic map and in all likelihood, no one ever will. I feel fortunate, however, to, have lived and worked at a time when there were virgin areas in this country as yet untouched by a geologic hammer and to have participated in producing the first geologic map of this state. in which each of us was required to give a paper about a "geologic great."

While I was a graduate student at the University of Oregon many years ago, I took a graduate seminar in "Giants of Geology" in which each of us was required to give a paper about a "geologic great." I became more interested in knowing more about some of the men who started mapping in this country back at the beginning when the science of geology was in its infancy. I chose James Hall of New York state.

In the early 1830's several states began to establish geologic surveys primarily for the purpose of knowing about the mineral resources under their lands. For example, with the advent of the steam engine, there was great interest in developing the coal deposits of the country to provide fuel for the boilers.

In 1836, New York organized a state survey with a staff of four geologists and the same number of assistants. One of the latter was a young man named James Hall. He was born in 1811, less than a quarter century after the death of James Hutton, the so-called "father of geology". He graduated from Rensselaer School in 1832, having majored in geology and chemistry. Although unemployed, he immediatey began working in the Helderberg Mountains of southwestern New York, studying the local startigraphy and collecting fossils. Four years later when the new state survey was established, Hall was made an assistant to Ebenezer Evans to study and map the Adirondack Mountains. The two men did not get along well together, and in 1837 the 26 year old Hall was reassigned to southwestern New York as a full geologist/ paleontologist in order to continue the work he had begun earlier.

The Helderberg Escarpment is composed of relatively undisturbed homoclinal sequence of sedimentary rock ranging in age from Cambrian through Devonian. Most of the section was amazingly rich in marine invertebrate fossils and provided him with the opportunity to establish an early reputation as a paleontologist of international renown. When Charles Lyell, the famous English geologist, came to this country in 1841, one of the first men he wanted to see was James Hall. Hall's first report, a quarto of 683 pages was published in 1843. On the practical side, he was able to show, unfortunately, that Pennsylvanian coal measures did not extend northward into New York. He established some native names as "Oriskany", "Niagara", and "Genesee" for a series of strata. He was also one of the early "uniformatarians" in proclaiming that the earth's history was one of gradual change, and not a sequence of catastrophies advocated by other geologists at that time.

Hall, however, was especially interested in completing his descriptions of the fossils he had collected in this region and having them published. As can be imagined state legislators are usually somewhat reluctant to fund studies as esoteric as paleontology, but Hall was quite a forceful man and exceedingly persuasive when he wanted to be. To say that he was headstrong was an understatement He bullied legislators, abused scientific competitors, punched the noses of his assistants, and kept a loaded shotgun in the laboratory near his table. But he was a dedicated worker! With the help of a number of field assistants and draftsmen over the years, he was able to publish eight thick volumes describing the fossil fauna from southwestern New York, the last one being completed in 1894.

On a broader scale, James Hall has become known as the founder of the "geosyncline" concept. In 1859 he recorded his great discovery that the folded Paleozoic marine section exposed in the Appalachian Mountains reached a thickness of as much as 40,000 feet, and yet all were clearly deposited in relatively shallow waters. This implied that the thick sequence of sediments were laid down on a subsiding crust or downwarp many miles in length. Such elongated belts of long-continued subsidence and sedimentation, which more or less kept up with depression of he crust, are now called geosnyclines. These geosynclinal sequences subsequently became folded into mountain ranges we see today in various parts of the world, a geologic process that puzzled many geologists until the more recent theories of plate tectonics and ocean floor spreading seem to provide the answers.

James Hall died in 1898, just four years after his Paleontology was completed and sixty-two years after his first appointment as state geologist. He had founded American stratigraphy, had put invertebrate paleontology on its feet in this country and had kept it there when neither the universities nor federal government could do so. As one his biographers notes, " He had, of course, no real successor. Entering science when even New York held bits of its frontier, he did not leave until factories, suburbs, and System had arrived." He was a true "giant of geology."

References:

Fenton, Carroll Lane, and Fenton, Mildred Adams, 1956, Giants of Geology, Doubleday and Co. Inc.,New York, 337 p.⊕

THIS LAND IS US

by John Oliver

This article was published in the Western State College Alumni Quarterly, Summer, 1993. Permission to print it in the Geological Society Newsletter given by the Alumni Association.

Man has built upon his heritage, a heritage laid down over eons and through myriad adversities. The Willamette Valley, squeezed between the two mountain ranges in all that tectonic muscling, has become home to generations of humans.

For Dr. Ray Brodersen, one of Western's professors of geology, it is as sure as night follows day that mankind's actions are shaped by the forces that formed the mountains and the seas. To most of use the forces are camouflaged, more subtle, but to a tuned eye it is clear that we have geologic change as well as human forebears. They are, to use an old phrase, plain as the noses on out faces.

Take the magnificent Willamette Valley, for instance-lush, fertile, productive of grains, fruit, grass seed, a farmer's paradise. It was "only natural" that pioneer farmers knew instantly that they found their new home here.

"Only natural..."

Dr. Broderson phrases it differently: "The Willamette Valley is a structural depression between the Coast and Cascade Mountain ranges." A pretty stony description of one's ancestors.

Yet, from the beginning he traces the ancestral geologic history. "The Coast Range is comprised of broadly folded sedimentary rocks and interbedded lava flows, both of which accumulated below the level of the sea. Some segments didn't even form here, but originated as oceanic crust hundreds of miles to the west."

"The process that folded these sedimentary rocks and the process that rafted segments of the oceanic crust stemmed from an expanding zone located in the eastern part of the Pacific Ocean."

"That structure remains and is called the Juan de Fuca Ridge," he explains. "And it is the relative motion of a plate easterly from the ridge sliding beneath the edge of the continent that is responsible for the uplift and the deformation of the Coast Range and the downward buckling of the Willamette Valley as well as the volcanism and deformation of the Cascades."

Again, a rather harsh description of our forebears. However, Dr. Broderson is dealing with skeletal remains at this point.

That " structural depression" filled with sediment , from the ocean at first, then from the rivers. And the scene became ripe for human life "

The fertile soils of the Willamette Valley are developed on the flood plains of the Willamette River and its tributaries and on the benches or terraces of older surfaces that were the levels of the flood plains in times past.

"The nature of the sediment combining with the region's climate resulted in the fertility of the region that attracted the pioneer farms. The lush overgrowth of conifer forests on the Coast and Cascade ranges provided another attractive natural resource." Moreover, "The natural north-flowing drainage of the Willamette River provided important water transportation. The roads and railroads that came later continued to parallel the major drainages."

Thus, with man placed on the land, Brodersen's thesis becomes plainer. Man has built upon his heritage, a heritage laid down over eons and through myriad adversities. The Willamette Valley, squeezed between the two mountain ranges in all that tectonic muscling, has become home to generations of humans. Brodersen adds another dimension, noting the particular setting of Salem, "...a broad basin in which layers dip centrally down from the east off the Cascades, down from the west off the south Salem hills and the Eola Hills," and which opens to the north toward Woodburn.

The west facing slopes of these hills "are quite steep and locally subject to landslide," and the recent earthquake in March in Molalla and on-going studies indicate that, although the Pacific Northwest generally and the Willamette Valley in particular have been considered "safe," there is seismic activity in the region. That ancestral Juan de Fuca plate lying offshore, but moving easterly, is a key player in this seismic action. "Stress," says Brodersen," is envisioned to accumulate in the brittle crust of the continent till the strength of the rocks is exceeded, rupture occurs and energy is released." In other words, Earthquake.

Fortunately, the magnitudes of historic earthquakes have been low to moderate, but, adds Brodersen, "History does not guarantee the future."

"The likelihood of earthquakes has not increased," he says,"only our knowledge and appreciation have improved a little bit."

The natural beauty, diversity and hospitality of the region remain, but to a simple-minded geologist the land seems to shape culture. The pressures of population growth and technology create significant challenges and opportunities wherever human-kind treats the land in ways that are inappropriate and short-sighted."

Dr. Ray Broderson is known to many of the GSOCs as a speaker for evening programs, a Banquet speaker and a leader in organizing the President's Campout to the High Sierras⊕

Completely Fractured Geology

by Evelyn Pratt, Past President, GSOC

1. **VARVE:** energy and enthusiasm

2. **SINISTRAL:** in old-time melodramas, an adjective describing the villain

3. **AGONIC LINE:** the way a suffering patient complains to a nurse so she'll take care of him faster

4. **TEPHRA:** a plastic coating on pots and pans

5. **ESKER:** part of reply to the question, "Ask that girl if she'll go out with me" - "Esker yourself."

6. **INLIER:** someone who tells fibs indoors

7. **ISLAND ARC:** what Noah said when asked why he steered the boat toward Mt. Ararat

8. **CRATON :** refers to a rickety vehicle, as in "He shouldn't drive that craton the freeway."

9. **ION EXCHANGE:** the act of swapping small appliances

10 .**SANIDINES:** said when Santa has lunch

CORRECT ANSWERS TO COMPLETELY FRACTURED GEOLOGY ON P. 18

Potentially New Species of Pond Turtle Discovered in Columbia River Gorge

by Joel Preston Smith, 4736 SE 45th Avenue, Portland, OR 97206

The deadly Pleistocene floods that buried Portland under nearly 400 ft of water, inundated the Willamette Valley as far south as Eugene, and scoured an area the size of the state of Delaware (approximately 2 000 mi^2) clean of all soil and vegetation may prove to be a creative force as well. (References to details of the floods from Allen and others, 1986).

Dan C. Holland. director of the Western Aquatic Turtle Research Consortium in Corvallis, believes the "Bretz floods" may have geographically isolated several rare populations of pond turtles found on the basalt ridges of the Columbia River Gorge. Holland believes the populations, which are currently classified as Western pond turtles, *Clemmys marmorata*. warrant listing as a new species (Holland, personal communication, 1993).

Holland, a herpetologist who has studied pond turtles in the west for more than 20 years, says the Gorge turtles are extremely difficult to tell apart from Western pond turtles. unless the animal is in hand. The forelimbs of older Western pond turtles are, for the most for the most part, charcoal colored. The forelimbs of the Gorge turtle bear charcoal scales with pale yellow and thus have a slightly lighter appearance.

Just above the hind limbs, on folds of skin attached to the carapace (the upper shell). all these turtles bear a small scale called the "inguinal shield." In Gorge turtles, this is about half the size of the one found in Western pond turtles.

Less than 200 individuals of the potentially new species occur in a total of three locations in the Gorge. Two of the populations are in Washington; the third occurs in Oregon. In all cases, the pond turtles are found at elevations above the high-water mark postulated for the Bretz floods when they raced through the sections of the Gorge where turtles occur.

J. Harlen Bretz, the geologist for whom the catastrophic floods are named, first noted the erosive force of a massive Pleistocene flood in western Washington which he named the "Spokane flood" (Bretz, 1923). In subsequent papers, Bretz outlined how a series of cataclysms about 13,000 years ago carved the Channeled Scablands of Washington, fathered hundreds of hanging valleys and deserted plunge pools, and rafted hundreds of erratics (weighing up to 200 tons) as far south as Eugene. (personal communication, 1993).

Many geologists now believe that as many as 40 floods may have broken out from ancient Lake Missoula, a Pleistocene lake in western Montana formed (and reformed) when glacial ice repeatedly plugged the Clark Fork River. The 500 mi^3 that surged from the lake covered - at least in the largest of the floods - 16,000 mi^3 of Montana, Idaho, Washington and Oregon and stripped 150 ft of soil and loess from portions of the Columbia Plateau.

In the upper Columbia River Gorge, as John E.Allen puts it simply, “Anything under a thousand feet in elevation was wiped out” (personal communication, 1993).

Holland believes that the turtle populations high atop the basalt ridges of the gorge may have narrowly escaped the floods, which in some areas brought a 1000-ft-high wall of water racing through the Gorge. Sheltered and thus isolated, the turtles may have been genetically cut off from other populations by the disaster, says Holland. He notes that the nearest populations of Western pond turtles occur more than 60 miles away from the Gorge populations.

Holland who received his doctorate in 1992 in environmental and evolutionary biology from the University of Southwestern Louisiana for his study of the relationship between the geographic distance (and isolation) and morphological divergence in Western pond turtles, says he may propose naming the Gorge turtles after Bretz. Before the Gorge turtles would be accepted as a new species by the scientific community, Holland's findings would have to be published in a scientific journal and stand up to scientific scrutiny. Oregon's only other native turtle, the painted turtle (*Chrysemys picta belli*), shares a place on the Oregon state sensitive species list with the Western pond turtle.

Holland says that Bretz' work laid the foundation for his theory which attempts to explain how Gorge turtles were differentiated from Western pond turtles in a process called "speciation" the development of a new species through the geographic isolation of a population.

Isolation through geologic events is nothing new in natural history. Holland points out that the two species of Kaibab squirrels now present m the Grand Canyon (one species on the north rim, one on the south) are believed to have been derived from a singled parent species. The gene pool of squirrels, as the theory goes was literally bisected in the ancient past by the downcutting of the Colorado River and the creation of the Grand Canyon.

Volcanism and orogeny, through time, have also acted as agents of geographic isolation, Holland notes.

"When we look at patterns of differentiation in species," Holland continues", it’s rare that you point out a specific geological event, and its even rarer that you can point out the timing. This is one of the better documented cases we have."

To determine the extent to which the Gorge turtles vary from other pond turtles, Holland used a technique called "discriminate function analysis" a statistical system of calculating how far certain sets of variables deviate from other sets. By measuring variables (such as the size of the inguinal shield) not related to differences in sex or age, Holland came up with 13 variables in the Gorge turtles that, he says, set them distinctly apart from Western pond turtles.

"No matter how I did the calculations, the Gorge turtles always came up different,". Holland explained.

If Darwin would have known about the Bretz turtles, perhaps his principal fears in publishing *The Origin of the Species* would have been put to rest. Darwin noted in his 1859 text that the absence of intermediary links between the species, in the geological record, formed a strong argument against the theory of evolution. (Darwin citations from Darwin, 1958).

Darwin noted that the principal of competition made quick work of parent species. " In all cases, the new and improved forms of life tend to supplant the old and unimproved forms."

Darwin stated that the record, due to its "extreme imperfection," failed to preserve evolutionary links between parent species and more recently evolved species. " Geology assuredly does not reveal any such finely graduated organic chain, " Darwin said. "And this perhaps, is the most obvious and serious objection which can be urged against the theory."

But then Darwin never met the Bretz pond turtle. The Gorge turtles may, at the minimum, be considered intermediary forms, but their presence in the geologic record is illustrated in print, not in the strata. The "Bretz" turtle - is eventually classified as a distinct species - may seem as extremely rare, close link to a still-existing parent species, an animal that perhaps would be relieved Darwin of his principal worry.

Darwin would have appreciated the irony: the catastrophic Bretz floods providing a near-perfect geological record in regard to the isolation of the Gorge populations and the floods themselves being the cause of the genetic isolation. "We continually forget how large the world is, compared with the area over which our geological formations have been carefully examined," Darwin noted, "we forget that groups of species may elsewhere have long existed."

REFERENCES CITED

Allen, J E. Burns. M., and Sargent, S.C., 1986, Cataclysms on the Columbia. A layman's guide to the featuresures produced by the catastrophic Bretz floods in the Pacific Northwest, Oreg., Timber Press, 211 p., specifically, p. 3, 27, 28, 6, 63, 103, 104).

Bretz, J,H,,1923, Channeled scablands of the Columbia Plateau: Journal of Geology, V. 31, No. 8, p. 617-649.

Darwin, C.R., 1958, The origin of species: New York, Mentor Books, 497 p. (Specifically, p/ 287,288,305).

The above article Potentially new species of pond turtle discovered in Columbia River Gorge was taken from Oregon Geology, Volume 56, Number 1, January 1994

Correct answers to COMPLETELY FRACTURED GEOLOGY, adapted from Dictionary of Geological Terms, ed. by Bates & Jackson for AGI

1. **VARVE**: a pair of thin sedimentary layers deposited in a glacial lake in one year's time
2. **SINISTRAL** inclined to the left
3. **AGONIC LINE**: a line on the earth's surface wherethere is no magnetic declination and a compass needle points toward true north
4. **TEPHRA**: all the fragments of rock ejected from a volcano
5. **ESKER** a gravelly ridge deposited and left behind by a stream flowing under a retreating glacier
6. **INLIER** a group of rocks surrounded by younger rocks
7. **ISLAND ARC**: a curved chain of islands rising from the deep-sea floor and near a continent
8. **CRATON** a stable part of the earth's crust that has been little deformed for a long time
9. **ION EXCHANGE** ion exchange: swapping of charged atoms in a crystal for different charged atoms in solution without destroying the crystal's structure
10. **SANIDINES** alkali feldspars found as clear glassy crystals in unaltered acid volcanic rocks

THE GEOLOGICAL NEWSLETTER

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ANNUAL EVENTS: President's Field Trip-summer. Picnic-August. Banquet-March. Annual Meeting - February,**FIELD TRIPS**: Usually one per month, via private car, caravan or chartered bus.**GEOLOGY SEMINARS**: Third Wednesday, except June, July, August. 8:00 p.m. Room S17 in Cramer Hall, PSU Library :Room S7, open 7:30 p.m. prior to evening meeting .**PROGRAMS:** Evenings: Second and Fourth Fridays each month, 8:oop.m. Room 371. Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon **LUNCHEONS**: First and third Fridays each month, except holidays, at noon, Standard Plaza Cafeteria, third floor, Room A, 1100 SW Sixth Ave. Portland Oregon. **MEMBERSHIP:** per year from January 1: Individual, $15.00, Family $25.00, Junior (under 18) $6.00. Writew secretary ffor membership applications.**PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year (add $3.00 postage for foreign subscribers) Individual subscriptions at $13.00 a year. Single copies $1.00. Order from the Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon 97207. **TRIP LOGS**: Write to same address for price list.

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VOLUME 60, NO. 4

CALENDAR OF ACTIVITIES FOR APRIL, 1994

FRIDAY NIGHT LECTURES, (Cramer Hall, PSU, Room 371, 8:00 P.M.

April 8 To be announced.

April 22 Impact of Longwell Mining On A Shallow Bedrock Acquifer in Illinois
Presented by Tom Pattee, student North Illinois U.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th. floor. Social Hr., cafeteria 11:30 A. M. Program, California Rm. at 12:00 noon.)

April 1 Costa Rica, Bridge Between Two Continents

April 15 To be announced.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.

April 20 Continuation of "Metamorphism and Deformation" by Richard Bartels.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. Prior to evening meetings)

HANCOCK FIELD STATION RETREAT, MAY 13,14,15, and 16. Information to be in the May NEWSLETTER.

BOARD ACTIONS:

FRIDAY EVENING MEETINGS. There will be only one evening meeting a month beginning May 1994. It will be announced at an evening meeting if the meeting will take place the second or fourth Friday of the month.

FRIDAY NOON LUNCHEONS: There will be a noon luncheon on the third Friday every month. The first Friday of the month will be on volunteer basis.

PRESIDENT'S CAMPOUT: will take place in September - date to be determined.

INCISED MEANDERS - NEGLECTED CLUES TO OREGON COASTAL TERRACE PROBLEMS

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

ABSTRACT

During the last decade, geologists have determined that from three to two and a half million years ago global sea level was relatively stable, at an elevation 25 to 35 meters higher than today. Much or all of the Arctic Ocean was seasonally ice-free; and the Antarctic ice sheet was as much as one-third smaller than it is today.

Correlation of this late Pliocene half-million year long submergence of western Oregon with high-level wide-valley stages (now terraces) and meandering courses (now incised meanders) in the Coast Range valleys, may help date terraces and Condon's Willamette Sound.

This paper proposes a research project to determine whether study of topographic maps of western Oregon will assist such correlations.

INTRODUCTION

Thomas Condon was right when he proposed a Willamette Sound. A submergence of 25 to 35 meters as proposed by Cronin and Dowsett (1993) could have flooded the Willamette Valley, and for half a million years the rivers of western Oregon could have widened their valleys and developed meanders far inland. Many western Oregon topographic maps display evidence of past high sea levels suggested by incised meanders and terraces formed at several elevations.

Determination of the age and origin of these valley features is not simple. Sea level change is only one possibilty. Differential erosion can produce structural terraces. Vertical diastrophic movements, as well as folding and faulting (as in the Klamath Mountains) surely affects the elevation, slope and continuity of these landforms. Rates of uplift vary along the coast, so that different sections of a terraces may have elevations that vary by hundreds of feet.

Terraces along the Oregon coast were early recognized by Condon (1871) and Diller (1896). General descriptions were given by

Diller (1901, 1902, 1903), and later by Smith (1933) and Pardee (1934), who first suggested that marine terraces are warped along th coast north and south of Coos Bay.

Later, Griggs (1945), Allen & Baldwin (1944), and Baldwin (1945) postulated up to 250 feet of differential terrace warping, and cited examples of fault offset of terrace sediments. They also gave formation names to the sediments on top of the terraces, as did Trimble (1963) in the Portland area. Palmer (1967) summarized the status of terrace research at that time. Frye (1976), Kennedy, et al. (1982), Muhs, et al.(1990) and Mulder (1992) discuss only the late Pleistocene terraces.

Although Oregon terraces have been studied and restudied, with the exception of Diller (1896) few writers have discussed upland geomorphic surfaces and high-level broad-valley cross-profiles. Only Trimble (1963, p.56) barely mentions incised meanders. This proposed study therefor suggests an additional dimension derived from the older geomorphic record left by Pliocene sea level changes.

River basins			30-minute quads to be studied
Columbia			Portland, Camas
	Sandy		
	Willamette		
		Clackamas	Sandy, Oregon City
		Molalla	Molalla, Colton
		Santiam	Salem, Albany
		Yamhill	Beaverton, Hillsboro
		Tualatin	Forest Grove
Necanicum			Cannon Beach, Saddle Mountain
North Fork			
Nehalem			Nehalem, Enright
Miami			
Kilchis			
Little North Fork			
Wilson			Tillamook, Blaine
Trask			
Tillamook			
Nestucca			
Little Nestucca			
Siletz			Hebo, Grande Ronde,
Yaquina			Cape Foulweather, Euchre Mt.
Alsea			Valsetz
Yachats			
Siuslaw			Yaquina, Toledo, Marys Peak
Smith			Walport, Tidwwater, Alsea
Umpqua			Heceta Head, Mapleton, Blachley
Coos et al			Siltcoos, Goodwin
			Reedsport, Scottsburg
Coquille			Coos Bay, Ivers Peak

Sixes	
Elk	
Rogue, Applegate, et al	Bandon, Myrtle Point?
Pistol	
Chetco	Cape Blanco, Langlois, Powers Port Orford, Agness, Marial Gold Beach, Collier Butte Pearsoll Pk., Cape Ferrelo, Mt. Emily, Chetco Pk.

TABLE 1.
River basins and topographic maps of coastal Oregon

Thirty minute quadrangles of the lower part of river drainage basins which may show geomorphic features indicating uplift or previous higher sea levels.

SUGGESTED METHODS OF STUDY

Locate rivers with incised meaders on maps in Table 1. For each river find the "high-valley-wall" indexes, which is are the elevations of the <u>lowest</u> straight contour lines parallel to the main course of the river. Find the high-valley gradient by dividing the index elevation by the distance between index changes. Compare with the present meandering river gradient.

How far does the 100-foot contour go upstream (a quick determination of gradient). Construct longitudinal profiles of each river. Study 7 1/2 minute quadrangles?

PRELIMINARY COMMENTS

<u>Lower Willamette & Sandy Rivers -</u> East Portland lies upon a series of at least 3 terraces that step up eastward at 100, 200, 350 feet (Trimble 1963), and rise to 500 (above Corbett Station) and over 600 feet at Corbett. Cronin's average elevation is 30 meters (100 feet).

The best example of incised meanders and terraces on the Sandy and Clackamas Rivers are at elevations from 200 to 350 feet. Well developed terraces on the lower Sandy River are at 200-550 feet (Estacada Formation), 300-600 feet (Gresham Formation), 65--750 feet (Springwater Formation).

<u>Upper Willamette Valley -</u> Terraces between Sheridan and McMinnville. See papers by Allison (1935), and Parsons (1970).

Coos and Coquille Rivers - Griggs (1945) cites terraces at 50 feet (Whiskey Run), 150-170 feet (Pioneer), and 300-350 feet (Seven Devils).

Klamath Mountains - Diller (1902) describes terraces at 50, 150, 300, 600, 1,000 and 1,500 feet; with a peneplain at 2,000 feet. He also recognized eight stages of erosion and eight instancess of faulting, uplift and subsidence that produced high upland surfaces during the last 10 million years.

Allen (Time Travel, 27 April 1986) discusses Diller's paper, and the compound cross profiles of the Rogue and Applegate Rivers and their tributaries, which freqently have narrow inner gorges with almost vertical walls rising several hundred feet. Above the inner gorge are sloping benches up to half a mile wide, locally know as "prairies", which rise gently to perhaps 1,000 feet in elevation. A still higher set of prairies was formed during an earlier stage of standstill.

Kennedy, G. L., (1983) proposed that the Pleistocene uplift of the Klamaths proceeded at a steady rate of 984.3 feet per million years, or slightly less than 1 foot per 1,000 years. The age of Diller's terraces would then be: 50 feet in 50,000 years; 150 feet in 150,000 years; 300 feet in 300,000 years; 600 feet in 600,000 years; 1,000 feet in 1,000,000; 1,500 feet in 1,500,000 years; and 2,500 feet in 2,500,000 years.

Cronin's 25 t0 35 meter (82 to 115 feet) half million year long stillstand, which ended 2.5 million years ago, may be represented by the Klamath peneplain or by the uppermost broad valley stage.

REFERENCES

Allison, Ira S., 1935, Late Pleistocene topographic correlations on Pacific Coast: (abst) Pan-American Geologist, v. 63, n. 4, p. 310.

Baldwin, E. M., 1945, Some revisions of late Cenozoic stratigraphy of the southern Oregon coast: Jour, Geol., v. 53, p. 35-46.

Cronin, Thomas N, and Dowsett, Harry J., 1993, Prism, warm climates of the Pliocene: Geotimes, v. 38, n. 11, p. 17-19.

Diller, J. S., 1902, Topographic development of the Klamath Mountains: U.S. Geol. Survey Bull. n. 196, p. 1-69.

--------------, 1902, Port Orford Folio, Oregon: U.S. Geol. Survey, Geologic atlas of the U.S., n. 89, 10 p.

Frye, W. H,, 1976, Stratigraphy and petrography of late

Quaternary terraces around Tillamook Bay, Oregon: M. S. thesis, University of Oregon, 112. p.

Griggs, A. B., 1945?, Chromite-bearing sands of the southern part of the coast of Oregon: U.S. Geol. Survey Bull. 945-E, 150 p.

Kennedy, G. L., et al., 1982, Aminostratigraphic and faunal correlation of late Quaternary marine terraces, Pacific Coast, USA: Nature, vb. 299 (5883), p. 545-547.

Muhs, Daniel R., et al., 1990, Age estimates and uplift rates for late Pleistocene marine terraces - southern Oregon portion of Cascade forearc: Jour. Geophys. Res., v. 95, n. B5, p. 6685-6698.

Mulder, R. A., 1992, Regional tectonic deformation of the northern Oregon coast as recorded by Pleistocene marine terraces, M. S. thesis, Portland State University, 96 p.

Parsons, R. B., Balster, C. A., and Ness, A. O., 1970, Soil developement and geomorphic surfaces, Willamette Valley, Oregon: Soil Sci. Soc. Am. Proc., v. 34, p. 485-9.

Palmer, 1967, Marine terraces of California, Oregon and Washington: PhD dissertation, University of California at Los Angeles, 379 p.

Trimble, D. E., 1963, Geology of Portland, Oregon, and adjacent areas: U. S. Geol. Survey Bull. 1119, p.119.

Terraces/75
29 January, 1994.

DOGAMI THANKS GSOC VOLUNTEERS

GSOC members have made a substantial gift of their time as volunteers to the Oregon Department of Geology and Mineral Industries (DOGAMI) since the volunteer program began in 1991.

First GSOC members to volunteer at DOGAMI were Margaret Steere and Rosemary Kenney, who originally began working in the library. Since that time, Margaret has put the photograph file in order and has been working on a computerized thesis bibliography. Rosemary began by organizing mine file reports but when the Nature of Oregon Information Center opened shifted her activities there.

Rosemary has been joined at the Information Center by GSOC volunteers Wally McClung, Archie Strong, Phyllis Thorne, and Shirley O'Dell each of whom has contributed his or her own unique talents to the Center, doing such things as maintaining inventory, filling orders, answering questions, and doing the many things that Center manager Don Haines cannot handle alone. These GSOC members have been a wonderful resource because they have a vast store of knowledge about Oregon that they repeatedly draw on as they answer questions.

At the GSOC annual banquet, when I was talking about volunteers, I neglected to mention Phyllis Thorne, who, in addition to working at the Center each week, has spent more time going from grocery store to grocery store, looking for empty boxes of a certain size and shape that have been perfect for storing all the brochures the Center carries. Thanks to Phyllis, no additional money had to be spent on storage boxes, the Center storeroom is now orderly, and brochures stay clean and neat until they are needed on the shelves.

Clay Kelleher has also been contributing time to DOGAMI, but instead of working in the library or the Center has been helping Dr. Matthew Mabey do geophysical surveys in the Scotts Mills area.

Needless to say, all these contributions of time, energy, and ideas have helped DOGAMI immensely, and we thank all of the GSOC volunteers from the bottom of our Departmental heart. In addition to helping us, you have also given us new friendships, and perhaps that is the best gift of all. Anyone else who is interested in volunteering should call me at (503) 731-4100.

Beverly F. Vogt, DOGAMI

MAY ~~93~~ 94

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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OF THE OREGON COUNTRY
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Volunteers

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Cecelia Crater 235-5158

Volunteer Speakers Bureau
Bob Richmond 282-3817

Annual Banquet
Chairperson-Sue Barrett 639-4583

ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer. Picnic-August. Banquet-March. Annual Meeting - February,**FIELD TRIPS**: Usually one per month, via private car, caravan or chartered bus.**GEOLOGY SEMINARS**: Third Wednesday, except June, July, August. 8:00 p.m. Room S17 in Cramer Hall, PSU Library :Room S7, open 7:30 p.m. prior to evening meeting .**PROGRAMS:** Evenings: Second Friday each month, 8:00 p.m. Room 371. Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon **LUNCHEONS**: First and third Fridays each month, except holidays, at noon, Standard Plaza Cafeteria, third floor. Room A, 1100 SW Sixth Ave. Portland Oregon. **MEMBERSHIP:** per year from January 1: Individual, $15.00, Family $25.00, Junior (under 18) $6.00. Write secretary for membership applications.**PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year (add $3.00 postage for foreign subscribers) Individual subscriptions at $13.00 a year. Single copies $1.00. Order from the Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon 97207. **TRIP LOGS**: Write to same address for price list.

THE GEOLOGICAL NEWSLETTER

The Geological Society of the Oregon Country

VISITORS WELCOME
INFORMATION PHONE 284-4320

VOLUME 60, NO. 4

FRIDAY NIGHT LECTURES, (Cramer Hall, PSU, Room 371, 8:00 P.M.

May 27 To be announced at the April 22 Friday Evening meeting.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th. Floor. Social hour., 11:30 A.M. Program, California Room at 12:00 noon.

May 6 Dr. Donald Botteron will show geologic slide taken by Paul Howell, GSOC member.

May 20 Kenneth Jones, U.S. Soil Conservation Service will present a program titled " Water Supply Forecasting and Modeling"

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.

MAY 17 Continuation of "Metamorphism and Deformation" by Richard Bartels, GSOC.

GSOC Library , PSU, Room S-7, Open 7:00 - 8:00 P.M.. Prior to evening meetings

Notes from the Board to the Membership:

Your Board met and thoroughly discussed the 1994 meeting schedule as per our by-laws and we voted at the March Board meeting to try the following for one year: Evening meetings: one a month because 1. our membership numbers are down and 48 speakers a year to speak to 20 people seemed excessive (24 evenings, 24 luncheons), and 2. A straw poll showed that while everyone wanted 2 evening meetings per month, no one was coming forth to take over the library, refreshments, picking up the speaker and his/her accouterments, etc. The 2nd Friday was picked as being most available throughout the year (no Thanksgiving break, etc.). However, May and September meetings hereby fall on field trip times. As of this deadline, Clay is trying to find a speaker for Friday, May 27th so we'll have one meeting a month - if available, this will be announced at the Friday, April 22 meeting. Luncheon Meetings: Lois Sato has agreed to co-chair luncheon meetings with Evelyn Pratt, with Lois finding speakers for the 1st Fridays and Evelyn for the 3rd Fridays each month. These will be firm commitments in time for inclusion in the Newsletter by the 15th of the month, to eliminate any more "To Be Announced" programs. If you are willing to give a program or can recommend a speaker, please call either Evelyn or Lois. Thank you!

HANCOCK FIELD STATION FIELD TRIP ON PAGE 26.

HANCOCK FIELD STATION ANNUAL RETREAT MAY 13,14,15,16

LOCATION: Hancock Field Station, located between the towns of Antelope and Fossil on Highway 218. It is two miles east of Clarno and the crossing of the John Day River. Watch for the sign HANCOCK FIELD STATION on the north side of the road.

TIME: Meet anytime in the afternoon of the 13th at the Station.First meal will be evening meal.

COST: $23.00 per day. Money will be collected by the leader at the camp.

INSTRUCTIONS: Bring warm sleeping bag. Extra blankets a good idea. Don't forget toothbrush, soap, towels, hiking boots, sunglasses, G-pick, binoculars, and clothing for any kind of weather.

ACTIVITIES: Some walking and some travel by car for geology, sightseeing and flowers

LEADERS: Don and Dorothy Barr. In case we can't go, Dr Walter Sunderlund will be the leader.

HAPPY HOUR: Every afternoon at 4:00 p.m. Please bring goodies.

IMPORTANT; IF YOU'RE GOING ON THIS TRIP PLEASE CALL DON BARR, 246-2785 BY MAY 8th I NEED TO INFORM THE STATION OF NUMBERS.

MORE IMPORTANT--KEEP YOUR GAS TANKS FULL-NO GAS IN FOSSIL AFTER NOON ON SATURDAY

COMPLETELY FRACTURED GEOLOGY

EVELYN PRATT

1. siderite: answer to a furniture mover who asks where to put something: "Siderite down here."
2. couloir: a really neat armed conflict.
3. adamantine: what the fans shout when their team is one player short.
4. zircon: Paris police told a tourist who bought the Eiffel Tower that he'd been a victim of "Zircon game."
5. muscovite: a domesticated South American duck.
6. histogram: what the boy told his grandmother when she gingerly picked up his frog: "Leggo of histogram!"
7. carat: an orange root vegetable
8. cryology: study of what makes babies unhappy.
9. isotropic: what the Brazilian torch singer said. he was
10. klippe: to cut an article out of a magazine

TSUNAMI - "Big Wave in the Harbor"

From an article by Klaus Jacob in Die Zeit, overseas edition, no.30 (July 30), 1993, p.13, excerpted by Klaus K. Neuendorf. Addition informa tion from the Department of Geology and Mineral Industries This article appeared in OREGON GEOLOGY, Volume 56, Number 2, March 1994.

The most recent major tsunami event struck Japan not long ago in late evening of July 12, 1993, a strong earthquake had just finished shaking the buildings on the small Japanese island of Okushiri, and many of them had collapsed. Seismologists later determined the earthquake magnitude to have been ML 7.8 (Richter scale). As soon as the shaking subsided, fishermen ran to the harbor to look after their boats, the basis of their subsistence. It was only then that the real catastrophe hit them: A wave 8 m (26 ft) high crashed into the harbor and wiped out men and boats alike. A tsunami had been triggered by the earthquake and had rolled over Japan's coasts. A preliminary estimate counted at least 200 people killed by the combination of earthquake and wave.

The Japanese have always lived on a restless piece of the Earth's crust and are used to the hazards of volcanic eruptions, earthquakes and tsunamis. However, these giant breakers, which can reach heights of up to 30 m (100 ft), threaten not only Japan but all countries that have sea coasts, even around the Mediterranean. Indeed, Scientists suspect that it was a tsunami related to the explosion of the Santorini volcano that extinguished the Minoan civilization around 1500 B .C. And as recently as 1992, for example, towns in Nicaragua and Indonesia were devastated by 10- to 20-m (30- to 60-ft) tsunami waves.

We are not completely helpless against these forces of nature any more. As early as 1948, the first tsunami-alert service [the Pacific Tsunami Warning Center in Honolulu, Hawaii] began operations in the Pacific region, and others followed soon. When a strong earthquake is registered, the observers check to see whether their network's tidal gauges report any unusual water levels. If the sea level rises or falls more than normally, danger is imminent. Checking water levels is still an essential tool, because not every earthquake sets the sea in motion. A tsunami wave is generated only when the earthquake lifts the sea floor and pushes the water up as in a piston. If, on the other hand, two crustal blocks slide past each other in a horizontal motion, there is no danger. Thus, earthquakes along the infamous San Andreas fault in California leave the sea unruffled.

This fact was still unknown to pioneer seismologist T.A. Jagger more than half a century ago, when he acting alone-warned the fishermen of Hawaii, after a strong earthquake in distant Kamchatka had set off a tsunami. In 1923, he was celebrated as a hero because his alarm had saved lives and fishing vessels. After that early success, however, one false alarm followed another, when the seismometers in Jagger's observatory again and again registered strong motions.

In his day, Pioneer Jagger had to notify the fishermen himself whenever his indicators pointed toward high tides. Today, warning networks sound the alarm with all imaginable media involvement. Radio and television promptly go on the air with announcements. Thanks to modern electronics, everything clicks in a matter of just minutes: Data are delivered from the most remote seismograph and tidal gauging stations, computers then calculate the epicenter and the magnitude of the earthquake. The path of the tsunami is determined, and the alert is passed on to the media.

During the tsunami of last July, everybody in Japan could watch on the screen at what time the tsunami would hit which coasts. Television programs displayed maps on which endangered coastal areas would be shown blinking red and yellow. Unfortunately, the warning came too late for the people on the island of Okushiri: They were too close to the epicenter of the tsunami-triggering earthquake, less than 100 km (60 mi) away. To cover that distance, the tsunami needed just a few minutes.

A tsunami can be as fast as a jet plane and just as predictably on schedule. It is a curious phenomenon: Its speed depends entirely on the depth of the water. In a sea that is 4,000 m (13,000 ft) deep, it reaches a speed of 720 km (240 mi) per hour; if the sea floordrops to 6,000 m (20,000 ft), it speeds up to 870 km (260 mi) per hour. At the coast, it slows down abruptly. That is why it is easy for warning services to calculate the tsunami path. In almost no time at all, a computer can deliver the time of arrival for all coastal areas if the sea-floor relief is stored in its memory and if it knows where the earthquake originated.

Another peculiarity of a tsunami is that it is hardly felt on the open sea. As wild as it may act on the coast, on the high seas it is rather tame. If one of its waves reaches a height of 2 m (7 ft) out on the ocean, it is already a big and dangerous tsunami. The wave does not approach as a big breaker: the sea level rises gradually, as if in slow motion, and falls again just as languidly. Ships' crews do not notice any of the spectacular action, because the crests of the waves are 100 km (60 mi) and more apart from each other. Such a wave resembles more the tidal heave caused by the moon rather than the choppiness caused by wind or storm.

Yet, in its inexorable advance, such an inconspicuous bulge of water, this sleeping giant. can cover thousands of miles and often crosses the entire Pacific Ocean. After the severe Alaska earthquake of 1964, a tsunami caused great damage as far away as California. at a distance of about 3,000 km (2,000 mi), where it arrived after 4 hours. One of the most devastating tsunamis arose in June of 1896, after an earthquake had shaken Japan. The tsunami ran toward the east, across the Pacific, overran Hawaii. crashed against the west coast of America, rebounded, and crossed the Pacific a second time, reaching coasts as far away as Australia and New Zealand. And it did all that in just one day.

It is only at the coast that a tsunami reveals its dramatic nature. Here, the wave rises to an impressive height and flings its entire force against the land. Few buildings can withstand the impact of such water masses. In April 1946, on an island in the Aleutians, even a lighthouse built of massive reinforced concrete and sitting 10 m (30 ft) above sea level collapsed. When the waters had dissipated, nothing was left of it but its foundation.

Bays are particularly endangered. Shores that converge at an acute angle focus the power of the entering water masses as a magnifying glass focuses light. The big breakers grow into massive, towering walls of water. All record flood levels have been measured in bays. That also means that a tsunami wreaks its worst havoc just where ports and cities are often located. That is why the Japanese have named the devastating flood "tsunami -"big wave in the harbor."

In some bays, the giant waves may even reinforce each other. Hilo on Hawaii is known for this phenomenon: The first wave hits the coast, rebounds, and reinforces the second wave that arrives perhaps half an hour later. Each successive wave increases the water turbulence, so that often the maximum flood level is not reached until the third or fourth wave at a time when in other places the all-clear signal has long been given.

In times past, a tsunami always hit people unawares. Thus it was, for example, on June 15, 1896, when a Japanese fishing village was celebrating a happy feast on the beach. The reveling company would not let its fun be spoiled by an earthquake that shook the ground slightly. The celebration continued even when, shortly after the sea withdrew with a soft smacking noises much farther than at normal low tide. A wide stretch of beach went dry; fish were flopping on the moist sand. One hour later, the festivities came to a sudden end. The sea returned with a roar. A wave front seven storics high rushed in and buried the entire village.

Nowadays, modern technology turns the catastrophe of nature into a media spectacle. But early warnings often tempt curiosity seekers to drive to the coast in order to experience the show close up. In 1964, on the California beaches, the spectators were joined even by police sent to organize a quick evacuation. To look catastrophe in the eye is a gamble with death: over 100 people died

ADVICE TO OREGONIANS

The Oregon coast is vulnerable to tsunamis generated in two different ways: (I) by undersea earthquakes occurring thousands of miles away from Oregon, and (2) by undersea earthquakes occurring just offshore. Tsunamis generated by

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CENTER

earthquakes occurring far away will take hours to reach the Oregon coast, leaving adequate time for official warning.

But tsunamis generated by earthquakes occurring just offshore may strike the coast within minutes of the earthquake before official warning is possible. The only warning that may occur is the earthquake itself. Therefore. anyone living along the Oregon coast or visiting it should remember the following rules:

1. If you feel an earthquake when you are on the coast, protect yourself from the effects of the earthquake by dropping, covering. and holding on if you are indoors or by staying away from objects that may fall if you are outside-until the earthquake is over.

2. Then, even though you have been frightened or hurt by the earthquake, if you are in a low-lying area that could be affected by tsunamis, you must immediately move inland or to high ground. Tsunamis can travel upstream in coastal estuaries, with damaging waves extending farther inland than the immediate coast. Evacuate on foot if possible because of traffic jams and probable earthquake damage to roads and bridges. If you are unable to reach safe ground, the third floor or higher of a reinforced concrete building may offer protection, but such a building should be used only as a last resort. Do not wait for official warning, because the tsunami may strike before authorities have time to issue a warning or all power may be out, leaving warning systems nonfunctional.

3. Do not return to shore after the first wave. Additional waves may arrive up to several hours later, be higher, and go farther inland. People have died because they survived the first wave and thought it was safe to return to the shore. Wait until officials tell you the tsunami danger has passed.

4. If you are camping on or near the beach, you may have to immediately abandon your recreational vehicle or campsite to move inland or to high ground to save your life.

5. Never go to the beach to watch for a tsunami. Tsunamis move faster than a person can run. Also, incoming traffic hampers safe and timely evacuation of coastal areas.

6. If you see a sudden or unexpected rise or fall in coastal water, a tsunami may be approaching. Move inland or to high ground as quickly as possible.

7. Stay tuned to your radio, marine radio, NOAA weather radio, or television station during a tsunami emergency for instructions from authorities.

8. Make disaster plans with your family before a disaster occurs. Family members should be trained so they will know what to do on their own to protect themselves from an earthquake, where to go to survive a tsunami, and whom outside the disaster area to contact in case they are separated from each other by a disaster.

EDITOR'S NOTE

The Oregon Department of Geology and Mineral Industries, is preparing a brochure about tsunami hazards along the coast and what to do in ease of an offshore earthquake and accompaning tsunami. The brochure will be available in April. For copies contact any of the Department offices listed on the first page (page 26) of this issue

(OREGON GEOLOGY, Volume 56, Number 2, March , 1994. Also: The curent issue of the Smithsonian has an interesting article on tsunamis on p. 28-39.

PICTURES FROM THE 1994 GSOC BANQUET

1. Dr. Walter Sunderlund presenting award to Louis Oberson . Louis's daughter also in picture.
2. Dr. Don Botteron giving incoming President's address.
3. Dr. John Whitmer and Charlene Holzwarth receiving awards.
4. Dr. Sunderlund giving the large pick to Dr. Botteron who keeps it for the year.
5. Dr. Whitmer , main speaker for the evening presenting his talk.
6. Past President's group--some Past President's missing.
7. GSOC Charter members, Louis Oberson, Kenneth Phillips, and Mildred Phillips.
8. Dr. Sunderlund presenting award to Charlene Holswarth.
9. Dr. Sunderlund presenting Dr. Whitmer an award.
10. Part of The Nature of Oregon DOGAMI display

CORRECT DEFINATIONS TO COMPLETELY FRACTURED GEOLOGY

adapted from Dictionary of Geological Terms, Ed. by Bates & Jackson for AGI

1. siderite: a brownish calcitic ore of iron; also an iron-nickel meteorite
2. couloir: a gorge or gully in the mountains
3. adamantine: referring to diamonds, as 'adamantine luster'
4. zircon: a silicate mineral found in many kinds of rocks
5. muscovite: a light-colored mica common in gneiss, schist, granites, and sedimentary rocks

6. histogram: a vertical bar graph showing how often something happens; the higher the bar, the oftener the occurrence
7. carat: 0.2 gram; used to measure precious gems
8. cryology: glaciology
9. isotropic: refers to a crystal n whose properties stay the same in all crystallographic directions: example - a salt cube
10. klippe: an isolated erosional remnant of rock from a thrust sheet.

MEMORIAL

Ruth Eliot Johnson passed away March 10, 1993 at the age of 94. She was a GSOC member since 1957.

PRESIDENT ESTHER KENNEDY'S REPORT AT THE ANNUAL BANQUET, FEBRUARY 25, 1994

President Esther Kennedy presided at eight Exective Board Meetings and sixteen of the eighteen evening lectures

Clay Kelleher, chairman of the luncheon meetings and Richard Bartels , chairman of the evening seminars presented interesting programs for a dedicated following.

We supported the Geology Department at PSU by donating four hundred dollars for student summer field studies and five hundred dollars for the geology computer lab.

The Society sponsored five field trips , one to the coast led by Dr. Paul Hammond , and another all day trip to Mount St. Helens.

Donald and Dorothy Barr guided thirty-seven GSOCs through a four day trip at Hancock Field Station.

The President's seven day field trip was attended by 40 GSOCers interested in the geology of the Puget Lowlands and the north Cascade Highlands in Washington State.

The three day trip to the Olympics was a continuation of the study of Washington geology.

The annual pinic in August , this year was held at Dr. Sunderlund's home where the GSOCs ate well, and visited with horses, a foal, donkey, goats, dogs.

For me it was a great year. I would have liked to have aquired more participating new members. A big thank you to all for your assistance. It was a pleasure to serve.

ANNUAL BUSINESS MEETING REPORT

The annual business meeting was called to order by the new president, Donald Botteron (Esther Kennedy was not available for this meeting). The ballots were counted and the results reported to the members with the following elected: The vote was ceretified by unanimous vote of present members and the ballots then destroyed.

President:	Donald Bottern
Vice-President:	Clay Kelleher
Secretary:	Carol Cole
Treasurer:	Phyllis Thorne
Board Member:	Bill Greere

Reports from all committees were handed in to the secretary; they are available for perusal by any member of the GSOC.

After the business meeting , the meeting was turned over to the program chairman for the introduction of the guest speaker

Esther Kennedy
President GSOC for 1993-1994

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY
PREPOSED BUDGET 1994

Balance forward Savings and Checking Accounts: Treasurer's Report 12/31/93		7057.56
Projected Income		
Interest on Savings	125.00	
Membership Dues	2,500.00	
Nesletter/Publications	300.00	
Micellaneous Sales/Hospitality	30 0.00	3,225.00
		10,282.56
Projected Expenses:		
Rent/Portland State University	500.00	
Newsletter/Publications (Includes Postmaster expense; Postage/Supplies/Editor expenses)	2,200.00	
Guest Speakers and Luncheon Expenses	350.00	
Administrative Includes insurance/repairs/supplies/post office box	800.00	
Scholarship Portland Station University	400.00	
Library	50.00	4,300.00
		5,982.56

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(Friday evenings)
Volunteers 221-0757
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Volunteers

Telephone:Cecelia Crater 235-5158

Volunteer Speakers Bureau:
Bob Richmond 282-3817

Programs:
(Luncheons)
Evelyn Pratt 223-2601
Lois Sato 654-7671
(Evenings)
Clay Kelleher 775-6263

ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer; Picnic-August;Banquet-March, Annual Meeting-February.FIELD TRIPS: Usually one per month, private car, caravan or chartered bus.GEOLOGY SEMINARS: Third Wednesday, except June, July, August. 8:00 pm. Rm. S17, Cramer Hall, PSU. Library: Rm S7, Open 7:30 pm prior to meetings.PROGRAMS: Evenings: Second and fourth Friday evenings each month, 8:00 pm, Rm 371, Cramer Hall, PSU, SW Broadway at SW Mill St., Portland, Oregon.LUNCHEONS: First and Third Fridays monthly except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor California Rm, Portland.MEMBERSHIP:per year from January 1: Individual-$15.00, Family-$25.00, Junior(under 18)-$6.00. Write or call Secretary for applications.PUBLICATIONS: THE GEOLOGICAL NEWSLETTER (ISSN 0270 5451),published monthly and mailed to each member. Subscriptions available to libraries and organizations $10.00 year. Individual subscriptions $13.00 year. Single copies $1.00. Order from Geological Society of the Oregon Country,P.O.Box 907,Portland, Oregon 97207.TRIP LOGS: Write to the same address for names and price list.

THE GEOLOGICAL NEWSLETTER

The Geological Society of the Oregon Country

VISITORS WELCOME
INFORMATION PHONE 284 4320

VOLUME 60, .NO.6

FRIDAY NIGHT LECTURES: Cramer Hall, Portland State University, Room 371, 8:00 P.M.

June 10 Lectures by the two students of the PSU Geology Department that received stipends from the GSOCS. Randy Anderson will discuss **Geothermal Exploration in the Northern Malheur County of Oregon** . Margot Truini will present her findings on the **Paleofluvial Systems in Northern Malheur County of Oregon**. Both these students worked on these projects during the summer of 1993.

June 24 **To be announced**

FRIDAY LUNCHEONS: Bank of California Tower, 707 SW Washington, 4th floor. Social hour, 11:30 A.M. Program in the California Room at 12:00 noon.

June 3 **Arizona and California Deserts .** Slide program presented by Don Barr, Past President, GSOC

June 17 Randall Kester will show slides of the **Owhyee River Country.**

SEMINAR: No seminar for the months of June, July and August.

IF NEW OR OLD MEMBERS OF GSOC WANT AN UPDATED MEMBERSHIP CARD, CALL THE SECRETARY, CAROL COLE AT 223-2619.

FIELD TRIP REPORT OF MAY 13,14,15,16 TO THE HANCOCK FIELD STATION. THE PARTICIPANTS TRAVELED)N THE ROAD TO HORSE HEAVEN MINE ,(MERCURY MINE), UP JOHN DAY RIVER TO VIEW A SERIES OF)IKES, HUGE LAND SLIDES OF JOHN DAY AND COLUMBIA RIVER BASALTS. THE WEATHER WAS GREAT 'OTH FRIDAY AND SATURDAY, BUT TURN AS SLIGHT BIT NASTY ON SUNDAY WITH RAIN, SLEET, SNOW ON HE WAY TO MADRAS TO VISIT WITH MEL ASHWILL AND HIS FOSSIL MUSEUM. LATER IN THE DAY WE PENT TIME AT RICHARDS TO COLLECT THUNDEREGGS, BUT WET DIGGING PRVENTED THE COLLECTING. ATURALLY A HAPPY HOUR WAS PARTICIPATED BY ALL EACH AFTERNOON AT 4. THE GROUP SAW FEW OWERS THIS YEAR DUE TO LACK OF RAIN.

COMPLETELY FRACTURED GEOLOGY

by Evelyn Pratt

1. **Vug:** what the foreign computer programmer said: "Ay haff found ay vug in der system!"

2. **Gangue**: a group of rowdies

3. **Lineament:** a popular external cure for aches and pains

4. **Gyre**: Part of a question asked of a personnel manager: "Why'd gyre that guy?"

5. **Trachyte:** a platter with a wind toy on it

6. **Microcline:** What an actor calls the last thing he says in his deathbed scene

7. **Welded tuff**: the metal parts of a car don't fall apart because this has been done to them

8. **Silicate:** a foolish girl

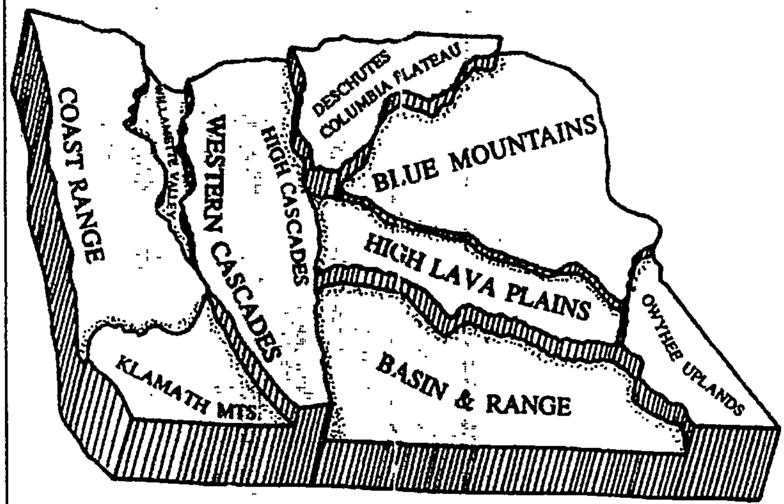
9. **Xenoblast**: a wild party for a Greek philosopherscene of an explosion:

10. **Grus**: description of a dancer: "She's very grusful."

OREGON'S GEOLOGIC TREASURES SCENERY FOSSILS ROCKHOUNDING AND GOLD PANNING

The material contained in this article has been taken from the publication of the same name and published by the Oregon Department of Geology and Mineral Industries. Their publication contains more information and may be obtained from DOGMI. Suite 965, The Nature of Oregon Information Center, 800 NE Oregon Street, Portland, OR. 97232.

Finding fossils in Oregon is not so much a question of where to look for them as where not to look. Fossils are rare in the High Plains and High Cascades, but even there , some of the lakes are famous for their fossils. Many of the



sedimentary rocks in eastern Oregon contain fossil leaves or bones. Leaf fossils are abundant in the rocks at the far side of the athletic field at the Wheeler High School in the town of Fossil. Although it is rare to find a complete animal fossil, a search of the river beds may turn up chips or even teeth. In western Oregon, the sedimentary rocks are primarily marine in origin often contain fossil clams and snails. An occasional shark's tooth or crab can also be found. Marine fossils are also abundant near the town of Vernonia and along the central to south-central Oregon coast.

Collecting is permissible within the highway right-of-way, unless excavation is destructive to the roadcut, and on private land with the owner's aproval. Collecting is prohibited or a collecting permit is necessary to collect fossils on state and federal lands and in parks. Collection is pro-hibited in the John Day Fossil Beds National Monument/

The Oregon landscape has been shaped by plate tectonics and millions of years of volcanic activity. Visitors will find many opportunities to examine its scenic geology and see and collect samples of minerals, rocks, and fossils. Oregon can be divided into the following geologic provinces:

The Blue Mountains province is made up of separate "exotic terranes"-areas that were prefabricated elsewhere and scooped up by North America as it moved west toward the Pacific. Fossils found in this province reveal their foreign origins. Placer and lode gold mines were active here in the past, and towns such as John Day and Baker City and the Sumpter gold dredge are vivid reminders of the Bl Mountain's gold mining heritage.

The High Lava Plains province has some of the most recent faulting and youngest volcanic activity in Oregon. Well preserved in a high desert climate, volcanic features such as Newberry Crater, Lava Butte, and Fort Rock stand out above the plains.

The Basin and Range province and the Owyhee Uplands province of southeasten Oregon both lie in a region that has been stretched, or extended, almost 100 percent from its original width in the last 10 million years. Evidences of this extension are massive fault block mountains such as Steens and Hart Mountains with intervening basins containing such features as the Alvord Desert or Abert Lake. Intense volcanic and hot-spring activity over millions of years has produced jasperoids that are prized by rock hounds and fine-grained gold deposits that may eventually be mined.

Between 14 and 16 million years ago, "fissure" eruptions in eastern Washington, eastern Oregon, and western Idaho produced enormous volumes of molten Columbia River basalt that flowed like water west into the Deschutes Columbia Plateau province in eastern Washington and northeasten Oregon, with some lava continuing to flow as far west as the Pacific Ocean via the ancestral Columbia River valley. As the basalt cooled and congealed, it formed the columnar cliffs that dominate the landscape today. Erosion by the Columbia River has exposed a particularly spectacular sequence of these rocks in the Columbia River Gorge on Oregon's northern boundary.

The Cascade province is actually made up of two volcanic regions, the older, broader, and deeply eroded Western Cascades and the dominating, snow-capped peaks of the younger and more easterly volcanoes of the High Cascades, such as Mount Hood, Mount Jefferson, and the Three Sisters (North, Middle, and South Sister). Another High Cascade peak, Mount Mazama was destroyed about 6,800 ,ears ago by a catastrophic eruption that left a deep caldera ater filled by what is now Crater Lake.

he Willamette Valley province fills the area between the ›ast Range and the Cascades. The valley forms a catch sin, and the sediments collected in it record multiple Ice e floods that originated in Montana and spread across the blands of eastern Washington and northeastern Oregon. flood waters poured via the Columbia River through Cascades and backed up into the Willlamette Valley re eventually draining to the Pacific Ocean.

heavily vegetated, elongated Cascade Range province varied geologic history. Its basement was formed by a ic island chain that collided with North America 50 million years ago. The ancient volcanoes form the scenic headlands along the coast, and the sediments that have accumulated around them contain marine fossils that help unravel the area's complicated geologic story.

The Klamath Mountain province consists of four north-south trending belts of metamorphic and igneous rocks that formed in an oceanic setting and subsequently collided with the North American continent more than 150 million years ago. Complexly folded and faulted rocks are bounded by belts of sparsely vegetated greenish-black bands of serpentinite. Oregon Caves National Monument lies within an normous fault-bounded block of marble. The historic gold-rush town of Jacksonville remains today as evidence of the area's colorful gold-mining history.

GEOLOGIC SIGHTSEEING

1. Steens Mountain, 60 miles south of Burns in southeastern Oregon: In summer, you can drive to the top of this 9,670-ft-htgh fault block mountain to look over the Alvord Desert more than 5,000 ft below. Other unusual geologic features in the area include Diamond Craters, which has an extraordinarly collection of volcanic features, and glaciated Kiger Gorge on Steens Mountain. For more information contact the Bums BLM, HC 74-12533 Highway 20 West, OR 97738, phone (503) 573-5241.

2. Hells Canyon, along the northeastern boundary of Oregon: Deeper than the Grand Canyon, Hells Canyon presents different vistas because of the kinds of rocks exposed by erosion. While the Colorado cut the Grand Canyon through ancient continental rocks, the Snake River cut Hells Canyon through a chain of volcanic islands that had been smashed against the westward moving North American continent .For information contact Wallowa Whitman National Forest, Hells Canyon National Recreation Area,88401. Highway 82, Enterprise OR 97828, phonr (503) 426-4978

Lava Butte, Newberry Crater, Fort Rock, and Hole in-the-Ground, central Oregon, along Highways 97 and 31 south of Bend: A collection of relatively recent volcanic features including volcanoes, cinder cones, buried forests, obsidian flows, lava tubes and a large explosion crater. For information, contact Deschutes National Forest, 1645 Highway 20E, Bend, OR 97701, phone (503) 388-2715; Lava Lands, phone (503) 593-2421; or Newberry National Volcanic Monument, phone (503) 385-7439.

4. John Day Country, John Day Fossil Beds National Monument, Sheep Rock Overlook, and Picture Corge in central Oregon on Highway 26 west from John Day and north on Highway 19: A drive through historic gold mining

country, lava flows, colorful volcanic ash and ash-flow deposits, and fossil-rich volcanic sediments.

5 . Mount Hood loop. including the Columbia River Gorge the Hood River Valley, and Mount Hood, leading along the northern boundaary of Oregon on Interstste 1-84, Highway 35, and Highway 26: One of the world's most scenic highway loops. through a gorge cut by the Columbia River, along the fault- and volcano-bounded Hood River Vallley, and up the flanks of Mount Hood. For infonnation, contsct Columbia River Gorge Natioal Scenic Area,902 Wwo Ave.,Suite 200, Hood River, OR 97031, phone (503) 386-2333; or Mount Hood National Forest, 29SS NW Division St., Gresham, OR 97030, phone (503) 666-0700.

6. McKenzie Pass Highway, across the Cascades along Highways 242 and 126 between Sisters and Eugene: A view of volcanoes. lava flows, cinder cones, and the Dee Wright Volcano Observatory.

7. Ecola State Park, Hatstack Rock and Neahkshnie Mountain, along Highway 101 on the northern Oregon coast: Spectacular views of volcanic headlands, sea stacks, and enormous landslide at Ecola.

8. State Parks of Cape Arago, Sunset bay, and Shore Acres. near Coos Bay on the southern Oregon coast, along Highway 101: Dipping sedimentary rocks, some with concretions and others with coal seams in Marine terraces.

9. Oregon Caves Natlonal Monument; in the Siskiyou Mountains of southwest, Oregon, 20 miles east of Cave Junction on Highway 46: Carved in a marble in the Applegate Group of late Trassic age, the cave features a 75-minute tour of pillars, stalacties and stalagmites. For information, contact Oregon Caves National Monument, PO Box 128, Cave Junction, OR 97523, phone 503-592-3400.

10. Crater Lake National Park, in southwest Oregon, with year-round access on the south via Highway 62: World famous, 1,900-ft-deep lake lies in the caldera of what is left of once a 12,000-ft-high Mount Mazama, which was destroyed by a catastrophic eruption about 6,800 years ago. For information, contact Superintendent, Crater Lake National Park, Box 7, Crater Lake, OR 97604, phone (503) 594-2211.

HIGH ADVENTURE ON THE TIBETAN PLATEAU

by Nelia Dunbar, Nelia DunbarAnalytic~l Geochemist, NMBM~MR

This article appeared in "Light Geology", is published quarterly by the New Mexico Bureau of Mines and Mineral Resources

Research takes geologists to some unusual places, but few as exotic and remote as the Tibetan Plateau . This plateau is an area of the Earth's crust that has startling and uniformly high elevation, averaging 5000 meters (16,500 ft) over a land mass roughly one half the size of the United States. Uplift of the Tibetan Plateau is known to have been caused by the tectonic (due to movement of different parts of the Earth's crust) collision of the Indian crustal plate with the Asian crustal plate, a collision that also caused the very high Himalayan Mountains, of which Mt. Everest is the highest peak. However, the timing of uplift of the Tibetan Plateau relative to the plate collision is not well known, and different types of geological evidence have given contradictory results. The Tibetan Plateau is the only place in the world where geologically recent uplift is combined with dry climate, resultant barren landscape, and pristine.rocks that allow many types of detailed studies of uplift rates. Better understanding of this process in Tibet will help geologists understand the prbcess of crustal uplift in other parts of the world that are geologically more difficult to study, such as the Colorado Plateau area of northwestern New Mexico

When Dr. Fred Philiips, Dr. William McIntosh and I (all of New Mexico Institute of Mining and Technology) embarked on an expedition to the Tibetan Plateau to collect samples for a new and innovative method of determining uplift rates, little did we suspect the kind of adventure that awaited us. We spent three weeks in one of the remotest parts of the world, walking miles every day with a band of 50 donkeys carrying our camp on their backs, encountering wild yaks, antelope and wolves, and sampling rocks fom tiny volcanoes along the shores of cobalt blue lakes with white salty beaches.

Our journey began in Beijing, China, where we met our six Chinese colleagues, and traveled by air and over land to a small village, Pulu, in the foothills of the Kunlun Mountains in western China, which form the northern boundary of the Tibetan Plateau. In Pulu, we met our 1(Uighar (wee-gur) guides, the local inhabihnts of the area and their 50 donkeys. From there, we proceeded on foot u the Pulu Gorge , a very deep and steep-walled valley th leads over the Kunlun Mountains onto the Tibetan Plate We only travelled during the morning and early afterno because the level of the glacially-fed river that flowed in bottom of the gorge would rise sharply in mid-afterno filling the narrow floor of the gorge, and covering our with icy, rushing water. This dramatic and sudden incr in water level was caused by warm daytime tempera that resulted in a greater amount of glacial melting and runoff in the surrounding mountains, which increased the supply of water to the stream. We limited our ascent rate to between 600 and 700 m per day (2000-2300 ft), to allow our bodies to acclimatize to the unusually high elevations at which we were travelling. After 4 days of walking, we reached the 5100 m (16,800 ft) pass into the uninhabited and remote Aksu Basin where our field work was carried out . The Aksu Basin is ringed by high peaks and is not drained by any rivers. Hence, any precipitation that falls in the basin accumulates in one of three lakes, which are extremeiy salty due to continual evaporation of water in the dry climate.

The ten days that we spent camped in the Aksu basin were devoted to sampling young volcanic rocks that may yield some clues to the uplift rate of the Tibetan Plateau. A number of small volcanic centers consisting of 100-300 m (30~1000 ft) -high cinder cones and associated lava flows were present in several different areas of Aksu basin. The upper surfaces of the lava flows are characterized by a hawaiian-style pahoehoe (ropy) structure that formed as the flow erupted. Samples of pahoehoe surface from a number of lava flows, as well as the dense interior of flows were taken and returned to New Mexico for a variety of analyses.

Two types of analyses are necessary in the investigation of our Tibetan samples in order to define uplift rates. The first involves determination of the true age of eruption of the volcanic rock by measuring the abundance of isotopes of the clement argon that is produced by natural radioactive decay of the element potassium within the rock (an isotope is an atom with same number of protons, but different number of neutrons, and thus different atomic weight, as ınother atom of the same element). The amount of the ırgon isotope that is present in the rock is proportional to he rock's age, and will be precisely measured by Dr. Iclntosh at the New Mexico Geochronological Research ıboratory, a cooperative project of Los Alamos National boratory, New Mexico Bureau of Mines and Mineral sources and New Mexico Tech. The second part of the ılytical approach involves a method called chlorine-36 ng, which was largely developed by Dr. Fred Phillips. isotope chlorine-36 in a rock is produced mainly by ral cosmic-ray bombardment.

ıs, the amount of chlorine-36 in the outer surface of a is proportional to the age of the rock, but also is ly dependent on the rock's elevationa because the atmosphere acts as a filter to cosmic radiation. For e you would be exposed to many more cosmic rays of Mount Everest than at sea level. We should be determine the elevation history of the rock since it ned by: 1)measuring the chlorine-36 content of the pahoehoe surfaces of the Tibetan volcanic rocks that were exposed to cosmic radiation since they were erupted; 2) knowing the true age of the rock by measurement of the argon isotopes; and 3) knowlng how. the elevation affects the abundance of cosmic rays. For example, if a lava flow on the Tibetan Plateau was erupted at a low elevation and was subsequently uplifted to its current high elevation, we would expect to find a lot less chlorine-36 in the rock than if it had been at high elevation since the time of eruption. So, a combination of low-tech field work in a remote area, and high-tech analyses in our New Mexico laboratories may yield important clues to tectonic processes within the Earth's crust.

The implications of determining uplift rates of the Tibetan Plateau are far- reaching. As mentioned earlier, studying rocks that were uplifted in geologically recent time can help us understand older uplifts, such as are present in some areas of New Mexico. Furthermore, large uplifted areas of the Earth's crust can have an impact on global climate. An uplifted area of the crust results in local cooler temperatures that can cause greater local snowpack and changes in global atmospheric circulation. Chemical weathering of minerals that erode rapidly from high, cold altitude to warmer lower elevations can reduce CO_2 levels in the atmosphere, which can have the effect of moderating natural "greenhouse effect" (proposed global warming caused by CO_2 buildup in Earth's atmosphere). Characterizing the uplift rate of the Tibetan Plateau, where timing of climatic variation is relatively well-understood, will help show the effect of crustal uplift on climate and will help decipher past records of uplift and climatic variation, such as those in the Rocky Mountains and Sierra Nevada Ranges of the western United States.

This research project is funded by the Geographic Society, and New Mexico Tech.

CORRECT ANSWERS TO "COMPLETELY FRACTURED GEOLOGY",

adapted from AGI's Dictionary of Geological Terms, 3rd Ed.

1. **Vug:** a small cavity in a rock, lined with crystals that are different from those found in the rock
2. **Gangue**: the worthless rock in an ore
3. **Lineament**: a linear feature in a region, believed to have something to do with structure underneath
4. **Gyre**: ringlike systems of ocean currents, turning

clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere

5. **Trachyte:** a fine-grained volcanic rock with larger crystal "lumps" or phenocrysts

6. Microcline: one of the feldspars, a common rock-forming mineral in granites

7. **Welded tuff**: a product of volcanic eruption in which heat, weight, and hot gases have united glass shards into rock

8. **Silicate:** a compound of silicon dioxide which forms much of the earth's crust

9. **Xenoblast**: a mineral that grew in a rock during metamorphism without being able to develop its crystal faces

10 **Grus**: a pile of angular, coarse-grained fragments resulting from the disintegration of a granitic rock

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY
TREASURER'S REPORT FOR 1993

Balance forward 12/31/92		
Checking Account, US Nat. Bank #0253-319	3,080.48	
Savings Account, Bank of America #21184-00895	4,984.57	
Adjusted Balance 12/31/92		8,065.05
RECEIPTS 1993:		
Interest Bank of America Savings Account	126.66	
Membership Dues	2,922.00	
Memorials	25.00	
Newsletter and Publications	326.73	
Administrative and Miscellaneous	349.67	
1992 Campout Refund	218.80	
Banquet Ticket Sales	1,526.00	5,494.86
		13,559.91
EXPENDITURES 1993:		
PSU Rent	459.00	
Newsletter and Publications	2,005.44	
Guest Speakers /Honorariums	417.69	
Administrative Expense	758.87	
Scholarship/Geology Department PSU and Gift	900.00	
Library	88.00	
Campout Expense	500.00	
Banquet Cost	1,373.35	6,502.35
		7,057.56
Bank of America Savings Account Balance 12/31/93	5,111.23	
U.S. National Bank Account Balance 12/31/93	1,946.33	7,057.56

Phyllis M. Thorne

Phyllis M. Thorne, Treasurer

Your Interim Library Staff has made a shelf list check of the GSOC Library and has found the following books missing. Please check your reading material at home to see if you might have any of the following. We would appreciate your returning the books so we can complete our inventory. Thank you.

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THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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THE GEOLOGICAL NEWSLETTER

The Geological Society of the Oregon Country

VOLUME 60, NO. 7

VISITORS WELCOME

INFORMATION PHONE 284 4320

FRIDAY NIGHT LECTURES: Cramer Hall, Portland State University, Room 371, 8:00 P.M.

July 8 **Dick Pugh, Science Teacher, Portland Public Schools and expert on meteors. Mr. Pugh's title for the talk is "Where the Sky Fell Down and Under the Outback." The talk is based on his experiences as a participant with the 1990 Australian Crater Expedition.**

July 22 **Dave Codero, Earth Science Instructor at Lower Columbia College, Longview, Washington. "Possible Predecessor to the Missoula Floods" is the title of Mr. Codero's talk.**

FRIDAY LUNCHEONS: Bank of California Tower, 707 SW Washington, 4th floor. Social Hour, 11:30 A.M. Program in the California Room at 12:00 noon

July 1 No meeting

July 15 Paul Vadeone, Soil Conservation Service will present a program "Ground Water pollution".

PRESIDENT'S FIELD TRIP: September 10-17. Details in soon.

The Society thanks Susan Sudbrock and Arthur Springer, GSOC members for publishing the GSOC MEMBERSHIP ROSTER, 1994

Flowing in Columbia Stopped 1872!

Reprinted with permission from "The Oregon Scientist, v.7, no.1 (Spring 1994) p.11.
and Printed in Oregon Geology, Volume 56, Number 3, May 1994.

This report from "Best of the Old Northwest" [1980, Paddlewheel Press, P.O. Box 230220, Tigard, Oregon 97281], by Marge Davenport, is a collection of stories gathered from family records, old books, and papers from early days in the Northwest. Since there were no seismographs and probably no geologists in the Northwest in those early times, documentation of catastrophic events is difficult.

Suddenly, in 1872, the Columbia River stopped flowing! It was a quiet, calm night when the big earthquake hit the North Cascades. To the few residents, the travelers, and the Indians in the area, it seemed that the world was coming to an end.

The ground rocked and shook as if it was going to buck the few little cabins of the pioneers off the face of the earth. Trees swayed and snapped. Dogs howled, and the screams of terrified Indians echoed through their camps. A family near where the town of Entiat, Washington, would be founded testified in family records to the severity of the quake. The rumbling, roaring noise that accompanied the quake was deafening, they said.

Then, just as the quake began to subside and the noise stopped, there was a deafening roar, as if the surrounding mountains were collapsing.

Indeed, that was exactly what was happening. The mountain just north of the family's cabin, composed of granite interlaced with layers of volcanic ash, had split in half, and millions of tons of rocks and earth crashed thousands of feet below into the mighty Columbia River-to become an earth dam blocking its flow!

Because there were few residents in the area and because those who had settled there lived in small frame wooden buildings, no casualties were recorded the night of the big quake, but many strange things were reported.

When Indian women went to the river to get water the next morning from their camp near Wenatchee, they found the river had dried up and vanished.

A Yakima pioneer said two large cracks had opened up along a ridge east of the Columbia River, and oil was pouring out of the cracks and running down the mountain.

At Lake Wenatchee, where a pack train carrying supplies to a railroad survey party was camped, the packers reported huge boulders rumbled down Dirty Face Mountain and plunged into the lake.

At another spot, this near Chelan Landing, a huge geyser shot high into the air and continued to flow for months before its pressure was reduced and it became a mere spring. The Columbia River's flow continued to be dammed for several days, and everyone within traveling distance came to see the phenomenon. Fortunately, when the dam finally began to weaken and burst, those ahead of the wall of water that rushed down the valley were able to scurry to safety

No effect at Portland?

At Portland, there is no recorded effect of the damming of the Columbia. although when the dam burst, it must have had some influence on the water level downstream. However, persons living along the river at that time built well back from the shores because of frequent flooding, and even a significant difference in water levels probably was not unusual.

Besides, the Snake, Yakima, John Day, Deschutes, and other large rivers join the Columbia before it reaches Portland, so the river probably just dropped slowly for several days and then surged as if from snow melt or cloudburst when the dam water was released.

Severe earthquakes were evidently more frequent in the Northwest in the 1800s, but because there were no recording instruments, because population was sparse, and communication was mostly by word of mouth, reports are vague as to their exact intensity. The next year after the North Cascades quake that dammed the Columbia River, a severe quake was reported at Fort Klamath to the south. This quake hit in the early morning and knocked people and animals to the ground.

An officer at the Fort, writing about the quake, said there were two hard shocks lasting about five to ten seconds each. Every pane of glass in windows at the Fort was broken, he said, but the frame wooden buildings did not suffer much damage.⊕

The June issue of the NEWSLETTER contained a list of books that missing from the GSOC Library. If you know anything about the missing books or know what

might have happened to them please inform the librarians.

Receding Floodwaters Expose Fossils

This article was printed in the New Mexico Bureau of Mines and Mineral Resources publication, "Lite Geology

The devastating flooding in the summer of 1993 caused widespread destruction in the Midwest. However, receding floodwaters revealed some remarkable surprises that are more than 300 million years old at the Coralville and Saylorville dams in Iowa. During the peak of the flooding, the Iowa River flowed for the first time over the Coralville Dam spillway. A campground and some roads below the spillway were washed away along with a 15-foot-thick layer of ice-age sediments that left Devonian bedrock exposed. The limestone bedrock reveals hundreds of fossils from the Devonian era, which is also known as the "age of fishes." According to the Army Corps of Engineers, 250,000 visitors have viewed the impressive showing of brachiopods, crinoids, and corals at this site.

The Des Moines River flowed over the Saylorville Dam spillway, cutting a 70 foot-deep path--loosely referred to as "Saylorville Canyon" by local geologists--below the dam that sliced into a wide variety of Quaternary and Pennsylvanian sediments. Exposed fossils include plants as well as brachiopods and crinoids.

Fossil enthusiasts in New Mexico can view an exposure of dinosaur tracks in the dam spillway of Clayton Lake State Park near Seneca. This area was once on the western shore of a vast, ancient sea. At least eight different dinosaurs left their tracks in the muddy shoreline; the tracks were then covered up for millions of years. During construction of the dam in 1955, all but the last three inches of overlying sediments were removed. Finally, in the early 1980s, the tracks were exposed when water was allowed over the spillway. The footprints are most easily visible in the oblique light that appears in the morning and late afternoon.⊕

THE HISTORY OF ROCK TAPESTRIES

by Ruth Pitman, Artist,
Member of Oregon Agate and Mineral Society.

This article appeared in Northwest Federation of Mineral Societies News Letter, June 1993.

The artist began creating her rock tapestries 35 years ago. Each tapestry is composed of thousands upon thousands of pin head sized rocks and minerals.

The first few years the rock was hammered on an anvil and screened to proper size. (This was very tedious and time consuming.) A small rock crusher was made for her and still is being used to crush the rock. Some of the rocks must be screened 60 to 100 times to obtain the pin head size required.

The picture is sketched on a heavy linen-type paper, which is bonded to masonite. The rock particles are glued, one at a time, to the masonite, using an epoxy cement specially developed for the job. There is no easy way to complete the project. Each fragment of rock is picked up with tweezers and set in its place.

Each tapestry takes between 1500 and 2500 hours to finish.

The rocks and minerals are all natural colors. There are no dyed materials used in the tapestries. They must be hunted in the field, traded for with other rock hounds and some must be purchased from shops.

When the picture is completed, it is lightly sprayed with Krylon to prevent oxidation, which might change the colors. It is then framed and ready for exhibit.

For proper perspective, step back ten feet or more to view the tapestries. The artist works with over 3,000 shades of rock. Some of the materials used in the tapestries are as follows: Aventurine, Azurite, Bloodstone, Chrysocolla, Common Opal, Coral, Garnet, Jade, Jasper, Lapis-Lazuli, Malachite, Marble, Petrified Wood, Rhodonite, Rhodochrosite, Turquoise. ⊕

Editor's note: These tapestries have been on display at Oregon Agate and Mineral February and October Shows.

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NATIONAL NATURAL LANDMARKS PROGRAM IN THE PACIFIC NORTHWEST REGION

BY

Stephen T. Gibbons
National Park Service
83 S.King Street, Suite 212
Seattle, Washington 98104

The National Natural Landmarks Program was established in 1962 by Secretary of the Interior Stewart Udall under the authority of the Historic Sites, Buildings, and Antiquities Act of 1935. National Natural Landmarks (NNL) are nationally significant areas that have been so designated by the Secretary of the Interior. To be nationally significant, a site must be one of the best examples of a type of biotic community or geologic feature in its physiographic province. Examples include terrestrial and aquatic ecosystems, as well as features, exposures, and landforms that record active geologic processes and fossil evidence of biological evolution.

The goal of the NNL Program is to identify, recognize, and encourage protection of sites containing outstanding examples of geological and ecological components of the nation's landscape. The landmarks have been designated on both public and private land; the program is designed to obtain concurrence of the owner or administrator for the landmark's status.

Selection Criteria

The determination that a site is one of the best examples of a particular feature in a natural region or physiographic province is based primarily on how well it illustrates the feature and the condition of the specific feature; secondary criteria are its rarity, diversity, and values for science and education.

Studies of the 33 physiographic provinces of the United States and its territories have produced an inventory of potential sites for further evaluation. These sites have a variety of ecological and geological themes. Sites can be added to this inventory through an initial recommendation by outside groups or private citizens. Recommendations quite often come from state natural heritage program inventories or other groups, including The Nature Conservancy.

Desnigation Process

The National Park Service must receive prior approval from the landowner to conduct an on-site evaluation of areas that are highly ranked either in the theme studies or by outside recommendations. The National Park Service contracts with scientists to conduct on-site evaluations. The evaluations gather additional information and compare the site against other similar sites, guided by the national signihcance criteria.

Completed on-site evaluations are peer-reviewed by other scientists and then by the National Park Service. If a site is deemed to fulfill the requirements for NNL status, and if landowners have indicated their consent for designation the Director of the National Park Service then nominates the site to the Secretary of the Interior for designation.During the , the designation process, the National Park Service solicits comment from landowners, from local, State, and Federal government officials, and from other interested groups and individuals. Once designated, the area is listed on the National Registry of Natural Landmarks.

The NNL Program recognizes and encourages voluntary, long-term commitment of public and private owners to protect an area's outstanding values. Owners who voluntarily agree to help protect their landmark property are eligible to receive a certificate and plaque for display at the site.

As of January 1993, 587 NNL sites have been designated. Thirty-four of these sites are in the Pacific Northwest Region: 11 in Idaho, 6 in Oregon, and 17 in Washington shows the location of the Washington sites.

To date, 16 of the 587 sites originally designated as NNLs have been become part of the National Park system. The three landmarks in the Pacific Northwest Region are Cassia Silent City of Rocks (City of Rocks National Reserve) and Hagerman Fauna Sites (Hagerman Fossil Beds National Monument) in Idaho and Point of Arches (Olympic National Park) in Washington

National Natural Landmark Moratorium

On November 28, 1989, the Director of the National Park Service placed a moratorium on the NNL Program, specifically postponing activities related to evaluation, nomination, and designation of new sites for NNL status. The purpose of the moratorium was to allow sufficient time to conduct a thorough review of the program, including regulations and procedures. Attention was also focused on ensuring adequate provisions for landowner notification, rights and consent. The moratorium is still in effect.

Status of the NNL Program

The Washington, D.C., office of the NNL Program has promulgated five initiatives as a result of recent audits:

(1) A proposed rule revising the regulations (36 CFR Part 62) for the NNL Program was published in November 1991. Provisions require landowner consent before conducting an evaluation of property as part of the landmark designation process. Publication of the final

rule is pending; former President Bush placed a freeze on regulatory actions.

(2) A program handbook is being developed to ensure that applicable standards and quality-control procedures for all aspects of the landmark evaluation, nomination, designation, and monitoring process are complete.

(3) A contract to identify and corroborate the names and addresses of all private NNL landowners is nearing completion.

(4) A user-needs analysis of the Natural Landmarks System database was completed, and an update of the database will be completed by April 30, 1993.

(5) A management control system will be operational within 6 months after adoption of the NNL regulations

Program Initiatives for 1993

The Pacific Northwest Regional NNL Program initiated a cooperative agreement with The Nature Conservancy and state natural heritage programs to refine ecological or geological theme studies and develop methodology for comparing and evaluating potential landmark sites throughout the region when the current program moratorium ends. The new study will specifically address potential NNL sites for two of the five remaining themes for the Columbia Plateau Natural Region: Douglas fir forests, and riparian woodlands.

Washington Landmark Sites

(1) Boulder Park and McNeil Canyon Haystack Rocks-These two adjacent sites contain the greatest concentration and best examples of glacial erratics on the Columbia Plateau, possibly in the entire United States. The boulders provide important evidence for glacial erosion and transport, as well as the direction of movement and distribution of glaciers on the Columbia Plateau during the last glaciation.

(2) Davls Canyon-The site is one of the least disturbed and most extensive examples of antelope bitterbrush (P'urshia tridentata) Idaho fescue (Festuca idahoensis) shrub steppe remaining on the Columbia Plateau.

(3) Drumheller Channels-The site is a spectacular tract of butte-and-basin scabland and provides excellent geomorphic evidence for late Pleistocene catastrophic floods on the Columbia Plateau.

(4) Glnkgo Petrifled Forest-Two features make this petrified forest distinctive: the large number of genera and species represented, and the unusual preservation of fossils in lava flows.

(5) Grand Coulee is the largest coulee in the Columbia Plateau and is probably the world's finest example of a recessional cataract gorge.

(6) Grande Ronde Feeder Dikes-The feeder dikes are known at only a few places. The best exposures are in this area along the north side of the Grande Ronde River. The dikes fed the voluminous Miocene lava flows of the Columbia Plateau of southeastern Washington and northeastern Oregon.

(7) Grande Ronde Goosenecks-The lower course of the Grande Ronde River has many excellent examples of entrenched meanders or goosenecks. These features record regional uplift and forced entrenchment of a stream in its pre-uplift meandering pattern. Two localities along the Grande Ronde make up the landmark.

(8) Mima Mounds-This landmark contains superb examples of mound topography in the North Pacific Border natural region.

(9) Nisqually Delta-The delta supports one of the five best known examples of the Washington-Oregon Salt Marsh Subtheme of the Temperate Coastal Salt Marsh Theme in the North Pacihc Border Region. It is a major resting area for migratory waterfowl in the southern Puget Sound region

(10) Polnt of Arches-The landmark contains spectacular examples of the results of shoreline erosion. It also has a nearly pristine environmental spectrum ranging from rocky tideland to climax upland vegetation.

(11) Rose Creek Preserve-The preserve constitutes the best remaining example of the aspen (Populus tremuloides) phase of the hawthorn (Crataegus douglasii)/ cow parsnip (Heracleum lanatum) habitat type.

(12) Sims Corner Eskers and Kames-This site contains the best examples of Pleistocene ice stagnation landforms in the Columbia Plateau and western United States. Although the Great Lakes region and New England contain similar features, those at Sims Corner are well preserved thanks to the arid climate.

(13) Steptoe and Kamlak Buttes-Steptoe Butte is the type example of a steptoe, an isolated hill or mountain surrounded by lava flows. Kamiak Butte is an excellent place from which to view the Palouse country and loess.

(14) The Great Gravel Bar of Moses Coulee-This is perhaps the largest example of bars created by outburst floods on the channeled scabland. The bars are well preserved and have only sparse vegetative cover.

(15) Umtanum Ridge Water Gap-Water gaps have been cut through several anticlinal ridges between Ellensburg and Yakima by the antecedent Yakima River. State Route

821 passes through the gap, where folded rocks illustrate results of tectonic stress and stream cutting.

(16) Wallula Gap glacial outburst waters that crossed the Channeled Scablands during the Spokane floods were channeled through Wallula Gap. For several weeks, as much as 200 m^3 of water per day were delivered to a gap that could discharge less than 40 m^3 per day. Ponded water filled the Pasco Basin and the Yakima and Touchet valleys to form temporary Lake Lewis.

(17) Withrow Moraine and Jameson Lake Drumlin Field- Withrow Moraine is the only Ice Age terminal moraine in the Columbia Plateau natural region. The drumlin field is the best example of those features within the natural region. Together they provide dramatic evidence of depositional and erosional processes that acompany continental glaciation.⊕

This article appeared in Washington Geology, Washington Department of Natural Resources, Division of Geology anEarth Resources, Vol 21, No.1, March 1993

EDITOR: I will list the Oregon Landmark Sites in the August Newsletter/

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UPPER AND LOWER TABLE ROCKS, JACKSON COUNTY, OREGON

by
Joan Seevers and Darren Borgias

The following article was an excerpt from "Kalmiopsis", Journal of the Native Plant Society of Oregon, vol. 3, 1993 by Rosemary Kenney, Past President, GSOC.

Two prominent buttes, Upper and Lower Table Rocks, rise abruptly above the north bank of the Rogue River in Jackson Country, Oregon, just north of Medford. The vista from the top is spectacular. Mt. McLoughlin dominates the Cascade Range to the east. To the south and west are the geologically complex Siskiyou Mountains. The Rocks offer a combination of native plant communities, endemic wildflowers, unusual animals and interesting geology.

The Rocks, shaped like horseshoes in aerial view, are the eroded remnants of an andesitic lava flow. Recent investigations suggest that the flow originated east of Prospect in the nearby Cascade Range. The flow, radiometrically dated at 9.6 million years, filled the pre-historic Rogue River canyon carved through the Payne Cliff Formation. Over millions of years, the surrounding valley floor eroded from the more resistant andesite. The 125- foot thick andesite layer originally filled the valley bottom. It now perches as isolated caps of mesa-buttes 800 feet above the basin floor, a classic example of oxbow meanders of the ancient river. The nearly level surfaces of Table Rocks stretch linearly, in horseshoe shape for several miles, approximately 300 acres on Lower Table Rock and 500 acres on Upper table Rock. Both have nearly vertical cliffs in places and display the vertical columnar jointing typical of lava flows.

The flat, table-like surface of Table Rocks has patterned ground - broad shallow depressions, round soil mounds and convex stony flats with linear mounds. Vernal pools form in depressions where underlying andesite bedrock prevents the downward movement of rain water. Patterned ground is a regionally significant landform that occurs only where a shallow layer of soil lies over an impervious substrate or waterlogged basement. Either can create a temporary perched water table. There is a hypothesis that pocket gophers or other fossorial rodents work the soil to accumulate the mounds. Other theories propose seismic tremors, periglacial freeze-thaw phenomena or wind deposition.

Soils on Table Rocks derive predominantly from colluvium. They range from extremely plastic and sticky clays through loamier soils. When rain falls, sticky clay mud around the lower and mid slopes cling tenaciously to boots. Later the soil dries and shrinks, leaving gapping cracks in the surface. ⊕

FRACTURED GEOLOGY BY EVELYN PRATT WILL BE BACK NEXT MONTH

Booth Joslin is in charge of GSOC equipment. He is asking for help in locating the 2nd 35 mm projector. If you know where it is please call him at 636-2384.

AUG 94

THE GEOLOGICAL NEWSLETTER

GSOC

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ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer. Picnic-August. Banquet-March. Annual Meeting - February,**FIELD TRIPS**: Usually one per month, via private car, caravan or chartered bus.**GEOLOGY SEMINARS**: Third Wednesday, except June, July, August. 8:00 p.m. Room S17 in Cramer Hall, PSU Library :Room S7, open 7:30 p.m. prior to evening meeting .**PROGRAMS:** Evenings: Second and Fourth Fridays each month, 8:00 p.m. Room 371. Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon **LUNCHEONS**: First and third Fridays each month, except holidays, at noon, Standard Plaza Cafeteria, third floor, Room A, 1100 SW Sixth Ave. Portland Oregon. **MEMBERSHIP:** per year from January 1: Individual, $15.00, Family $25.00, Junior (under 18) $6.00. Write secretary for membership applications.**PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year (add $3.00 postage for foreign subscribers) Individual subscriptions at $13.00 a year. Single copies $1.00. Order from the Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon 97207. **TRIP LOGS**: Write to same address for price list.

GEOLOGICAL NEWSLETTER
The Geological Society of the Oregon Country

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FRIDAY NIGHT LECTURES: Cramer Hall, Portland State University, Room 371, 8:00 P.M.

August 12 NO MEETING

August 26 To be announced

FRIDAY LUNCHEONS : Bank of California Tower, 707 SW Washington, 4th floor. Social Hour, 11:30 A.M. Program in the California Room at 12:00 noon.

NO MEETINGS IN AUGUST

SEMINAR: NO SEMINARS IN AUGUST

ANNUAL GSOC PICNIC. ******NOTE DATE: SATURDAY , AUGUST 20 MAP IS ENCLOSED IN THIS NEWSLETTER.

PRESIDENT'S FIELD TRIP (CAMPOUT) SEPTEMBER 10-17.
NORTHEASTERN OREGON, LEADER ELLEN BISHOP MORRIS. ALL INFORMATION ABOUT PRESIDENT,S CAMPOUT ENCLOSED IN THIS NEWSLETTER

MEMORIAL

F. McNeal Fahrion , Past President GSOC died June 13, 1994. Neal and his wife joined GSOC in 1969. He worked for the Port of Portland for 35 years. He was also a member of the Mason and Scottish Rite.

PROSPECTING WITH POPPIES

The California poppy (Eschscholzia californica) blooms brilliantly in the spring, and is known to grow in abundance where the ground is mineralized with copper. This is dramatically illustrated near the San Manuel mine located in an area north of Tucson, Arizona, where the copper-mineralized ground supports a profuse crop of California poppies: however, the stand abruptly terminates at a major fault line where the mineralized ground is adjacent to non-mineralized ground. Prospectors can use the California poppy not only as a copper indicator, but also to provide clues about the presence of gold, silver, and other minerals often associated with copper.⊕

Lapidary Journal, November 1992, Facets, p. 10.

COMPLETELY FRACTURED GEOLOGY
EVELYN PRATT

1. **amygdule**: air battle between two Russian fighter planes
2. **barite**: country way of indicating direction; "When ya git to the fork in the road, just barite."
3. **diapir:** what the worried teenager said after his first date; "Diapir too eager?"
4. **rhythmites**: tiny eight-legged pests that infest certain musical instruments
5. **marl**: ethical, as in "He had a strong marl upbringing."
6. **fissility**: something built to perform a certain function, such as a research fissility.
7. **poikilothermal**: refers to a couple of pounds of hot Hawaiian food
8. **rille**: genuine, actual
9. **cuesta:** part of a statement relating to expenses; "Let's hope those repairs don't cuesta lot of money."
10. **syntaxis:** what we pay for wine, cigarettes, and other non-virtuous commodities

CORRECT ANSWERS ON P. 48

GEOLOGY OF THE PORTLAND AREA,OREGON by R.E.Corcoran, Past President GSOC

Introduction

The Portland area has had a most interesting geologic history. The basaltic hills of west Portland, the Boring hills to the southeast, and the little cinder cone on the flank of Mt. Tabor give our city a character not seen elsewhere in a metropolitan area of this size. Portland has the distinction of having the only volcanoes within its city boundaries.

Fortunately the geology of this area is not so complex that it cannot be reasonably understood by the interested layman as well as the professional geoscientist. A number of geologic reports have been written on the area over the past 90 years beginning with a report by Thomas Condon the latter part of the l9th century. Many of these reports are now out of print however, so this brief summary has been prepared to assist you in developing your geologic map. The following descriptions of the geology of the Portland area are taken largely from the U.S. Geological Bulletin by Trimble (1963) because it is the most recent detailed survey.

Skamanla Volcanics (Tsv)

The oldest rocks in the area are altered basalt and basaltic andesite flows and associated pyroclastics that are exposed extensively in the Cascade Mountains north of the Columbia River. The name is taken from the type locality in Skamania County, Washington. Other names for these volcanic rocks are: Goble Volcanics and Ohanapecosh Formation. In the Portland area the Skanania Volcanics are exposed only in the vicinity of Lackamas Lake, Washington in the northeastern part of your map. Altered lavas that probably are a part of the

Skamania Volcanics crop out in the Willamette River near New Era just south of your map. The volcanic formation is probably several thousand feet thick.

The age of the Skamania Volcanics has not been determined precisely by radioactive dating, but is probably late Eocene to Oligocene. Fossil floras of both Eocene and Oligocene age have been found in water-laid sediments associated with the Skamania Volcanics at two localities in southern Washington.

Columbia River Basalt (Tcr)

In the Portland area the Skamania Volcanics are overlain mainly by Columbia River Basalt. These lavas constitute a thick series of flows that originated from fissures several hundred miles to the east in Washington and Oregon. During a two-milllion-year period they covered more than 50,000 square miles in these two states plus Idaho. A number of reports and articles have been written about this tremenduous flood of basaltic lava flows because they are so extensively exposed along the Columbia River, the type area. One result of these studies has been to raise the unit to "Group" status and subdivide it iinto a number of new formations and members.

The Columbia River Basalt underlies most of the Portland Hills (called "Tualatin Mountains by Trimble) as well as several other ridges both to the west and south. The flows dip beneath Portland and lie at depth of about 1,000 feet east of the Willamette River. They rise again farther east and appear at the surface a few miles east of Troutdale along the Columbia River. The "Group" has an aggregate thickness of about 5000 feet near its source; it is probably less than 1,000 feet thick in the Portland area.

Radioactive age dates determine for these lava flows range from 14 to 16 million years. This means that the lavas are early to middle Miocene in Age.

Troutdale Formation (Tt)

The Troutdale Formation, including the Sandy River Mudstone, lies unconformably on the older lavas of the Columbia River Basalt. The best exposures of the Troutdale are along the Sandy River upstream from the town that gave it its name. The Formation consists of mudstone, siltstone, claystone, sandstone, and conglomerate. This wide variety of sedimentary rock types indicates a great variation in depositional environment in this part of Oregon during Pliocene time. In addition to cutcrops along the Sandy River, the Troutdale Formation is also well exposed on both sides of the Columbia River east of Washougal and Troutdale. Another locality is an old gravel quarry on northwest Cornell Road above downtown Portland where one can collect representative samples of the pebbles and cobbles that make up the conglomerate facies of the Formation. Of particular interest are the quartzite pehbles. Quartzite beds do not occur in Oregon, so these "foreign" rocks must have been brought down down and deposited by the ancestral Columbia River from quartzite outcrops somewhere in northeastern Washington or Canada.

A Pliocene age for the Troutdale Formation (and Sandy River mudstone) is based on the identification of fossil flora found in some of the finer-grained sedimentary strata within this unit. The Formation is believed to be approximately 1,000 to 1,500 feet thick.

Boring Lava (Qtb)

In late Tertiary and early Quatemary time scores of Volcanoes erupted in the Portland area. The products of this volcanic episode were named the Boring Lava for their occurrence near the town of Boring. All of the basaltic flows and minor pyroclastic rocks are of local origin, and none of the lava spread far from its eruptive source . The source areas are still visible around the Portland area because there has been little erosion or alteration to destroy them. Mt. Scott, Mt. Tabor (in part). and Mt. Sylvania are a few examples of Boring Lava Volcanoes.

Quatemary deposits mantle about 50 percent of the Portland area. The material is mostly water-deposited sediments. The rivers that transported this material must have had a fairly high carrying capacity because the sediments are predominantly bouldery cobble gravel with lesser amounts of sand, silt, and clay. The three stratigraphic units which Trimble named Springwater, Estacada, and Gresham Formations (from their respective type localities) are grouped as one sedimentary unit for this exercise and are referred to as "Terrace Deposits". In the area of your map they occur along and between the Sandy and Clackamas Rivers. Their similar genesis and lithology make it difficult to distinguish them in the field.

Portland Hills Silt

The blanket of yellowish-brown clayey sandy silt that covers a large part of west Portland is believed to be mainly of loessial (wind-deposited) origin. Although it can be found east of the Willamette River on some of the higher areas, it is most extensive on the Portland Hills west of downtown Portland at elevations between 300 and 1,500 feet. Thickness is estimated to be 55 feet and it thins away from the Columbia River flood plain.

The Portland Hills Silt is essentialy structureless and shows no stratification typical of water-laid deposits. Pebbles found locally in the silt are believed to represent slope-wash material introduced from nearby outcrops of the Troutdale Formation.

In past years, a considerable amount has been written on the origin of the Portland Hills Silt as to whether it is a loess deposit, a water-laid deposit, a residual weathering product of basalt, or a combination of all three. The general consensus today is that the silt is mostly, if not all, wind-laid material; and that it was blown in from the Columbia River Basin. Trimble shows it on his map by means of an overprint pattern.

Spokane Flood Gravel (Qlg) and (Qs)

The valley floors of the Lower Columbia, Willamette, and Tualatin Rivers are almost covered by unconsolidated gravel, sand, silt, and clay that are interpreted as deposits of late Pleistocene (?) age. Many years ago J. Harlan Bretz proposed that these water-laid deposits were brought in by a flood of far greater proportions than any in historic times. It has come to be referred to as the Spokane Flood, named for the city nearest its origin. Dr. J. E. Allen, who recently described this spectacular event in his book "The Magnificent Gateway", suggests that as many as 40 separate floods poured down the Gorge over a period of 2,000 years. It is recommended that everyone read his book in order to obtain a better understanding of how these floods originated and the dramatic erosional and depositional effects that resulted.

Recent Alluvium (Qal)

Alluvial deposits of sand, silt, and gravel of Holocene (Recent) age cover the flood plains of the Columbia and Willamette Rivers and some of their tributaries. The upper limit of the alluvium in the vicinity of Portland is at about 50 feet above sea level along the larger rivers, and it rises to higher elevations along the tributaries.⊕

SUGGESTED READING

Allen, J. E., 1979, The Magnificent Gateway: Press, Forest Grove, Oregon

Allen, J. E., 1975, Volcanoes of the Portland area, Oregon: The ORE BDN, vol. 37, no.

Allison, I. S., 1978, Late Pleistocene sediments and floods in the Willamette Valley: The ORE BIN, vol. 37, nos. 11 and 12

Balsillie, J. H. and Bcwen, G. T., 1971, Evidence for the Portland Hills fault: The ORE BIN, vol. 33, no. 6

Lentz, R. R., 1981, The petrology and stratigraphy of the Portland Hills Silt: Oregon Geology, vol. 43, no. 1

Schlicker, H. G., and Deacon, R. J., 1967, Engineering Geology of the Tualatin Valley region, Oregon:Oregon Dept. of Geology and Mineral Industries Bull. 60

Trimble, D. E., 1963, Geology of Portland, Oregon, and adjacent areas: U.S. Geological Survey Bull.1119

Correct answers to <u>COMPLETELY FRACTURED GEOLOGY</u>, mostly adapted from <u>Dictionary of Geological Terms</u> ed. by Bates & Jackson for AGI

1. **amygdule**: a gas cavity in an igneous rock which is filled with secondary minerals such as zeolites, calcite, or quartz

2. **barite**: barium sulfate, the principal ore of barium; used as a filler in paper and textiles, and added to paints and drilling mud

3. **diapir**: a dome or anticlinal fold, the overlying rocks of which have been ruptured by the squeezing-up of the plastic core material

4. **rhythmite**: one of a series of beds developed by regularly recurring sedimentation

5. **marl:** an old term for unconsolidated earthy deposits with shell fragments in them

6. **fissility**: the property of splitting easily along closely spaced parallel planes, as in shale or schist

7. **poikilothermal**: cold-blooded, such as reptiles and amphibians

8. **rille**: youthful, steep-walled, trenchlike valleys on the moon and other planetary bodies

9. **cuesta**: a ridge with a long gentle slope on one side conforming with the dip of the underlying strata, and a steep face on the other side formed by the outcrop of the resistant bed1

10. **syntaxis**: a sharp bend in an orogenic belt accompanied by a separation into several ranges.

DECADE OF NORTH AMERICAN GEOLOGY
1983 GEOLOGIC TIME SCALE

DNAG — GEOLOGICAL SOCIETY OF AMERICA

CENOZOIC

PERIOD		EPOCH		AGE	PICKS (Ma)
QUATERNARY		HOLOCENE			0.01
		PLEISTOCENE		CALABRIAN	1.6
TERTIARY	NEOGENE	PLIOCENE	L	PIACENZIAN	3.4
			E	ZANCLEAN	5.3
		MIOCENE	L	MESSINIAN	6.5
				TORTONIAN	11.2
			M	SERRAVALLIAN	15.1
				LANGHIAN	16.6
			E	BURDIGALIAN	21.8
				AQUITANIAN	23.7
	PALEOGENE	OLIGOCENE	L	CHATTIAN	30.0
			E	RUPELIAN	36.6
		EOCENE	L	PRIABONIAN	40.0
				BARTONIAN	43.6
			M	LUTETIAN	52.0
			E	YPRESIAN	57.8
		PALEOCENE	L	SELANDIAN: THANETIAN	60.6
				SELANDIAN: UNNAMED	63.6
			E	DANIAN	66.4

MESOZOIC

PERIOD	EPOCH	AGE	PICKS (Ma)	UNCERT. (m.y.)
			66.4	
CRETACEOUS	LATE	MAASTRICHTIAN	74.5	4
		CAMPANIAN	84.0	4.5
		SANTONIAN	87.5	
		CONIACIAN	88.5	2.5
		TURONIAN	91	
		CENOMANIAN	97.5	2.5
	EARLY	ALBIAN	113	4
		APTIAN	119	10
	NEOCOMIAN	BARREMIAN	124	9
		HAUTERIVIAN	131	8
		VALANGINIAN	138	5
		BERRIASIAN	144	5
JURASSIC	LATE	TITHONIAN	152	12
		KIMMERIDGIAN	156	6
		OXFORDIAN	163	15
	MIDDLE	CALLOVIAN	169	15
		BATHONIAN	176	34
		BAJOCIAN	183	34
		AALENIAN	187	34
	EARLY	TOARCIAN	193	28
		PLIENSBACHIAN	198	32
		SINEMURIAN	204	18
		HETTANGIAN	208	18
TRIASSIC	LATE	NORIAN	225	8
		CARNIAN	230	22
	MIDDLE	LADINIAN	235	10
		ANISIAN	240	22
	EARLY	SCYTHIAN	245	20

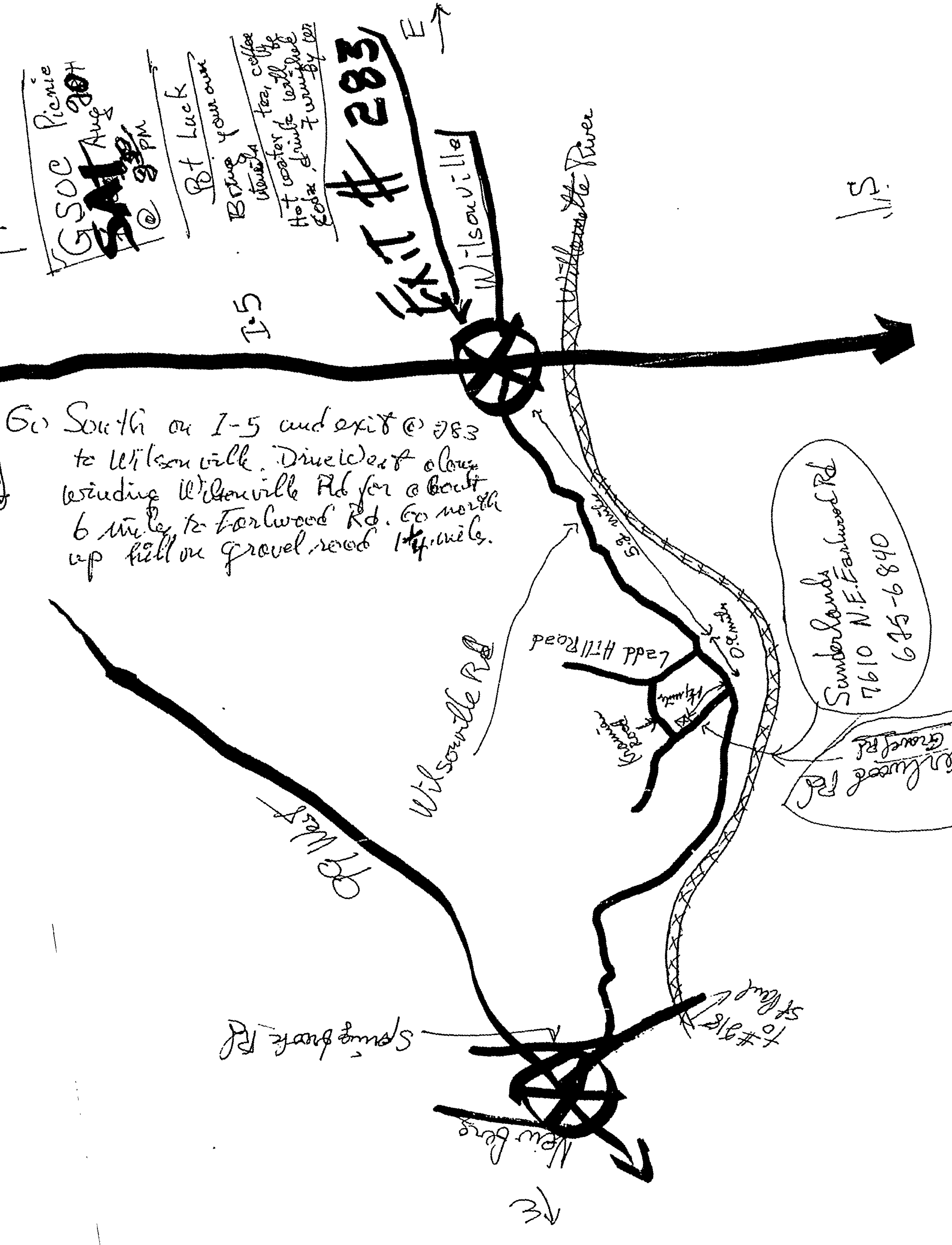
RAPID POLARITY CHANGES

PALEOZOIC

PERIOD		EPOCH	AGE		PICKS (Ma)	UNCERT. (m.y.)
PERMIAN		LATE	TATARIAN		245	20
			KAZANIAN		253	20
			UFIMIAN		258	24
		EARLY	KUNGURIAN		263	22
			ARTINSKIAN		268	12
			SAKMARIAN			
			ASSELIAN		286	12
CARBONIFEROUS	PENNSYLVANIAN	LATE	GZELIAN	S		
			KASIMOVIAN		296	10
			MOSCOVIAN	W		
			BASHKIRIAN		315	20
	MISSISSIPPIAN		SERPUKHOVIAN	N	320	
		EARLY			333	22
			VISEAN		352	8
			TOURNAISIAN		360	10
DEVONIAN		LATE	FAMMENIAN		367	12
			FRASNIAN		374	18
		MIDDLE	GIVETIAN		380	18
			EIFELIAN		387	28
		EARLY	EMSIAN		394	22
			SIEGENIAN		401	18
			GEDINNIAN		408	12
SILURIAN		LATE	PRIDOLIAN		414	12
			LUDLOVIAN		421	12
		EARLY	WENLOCKIAN		428	8
			LLANDOVERIAN		438	12
ORDOVICIAN		LATE	ASHGILLIAN		448	12
			CARADOCIAN		458	16
		MIDDLE	LLANDEILAN		468	16
			LLANVIRNIAN		478	16
		EARLY	ARENIGIAN		488	20
			TREMADOCIAN		505	32
CAMBRIAN		LATE	TREMPEALEAUAN FRANCONIAN DRESBACHIAN		523	[illegible]
		MIDDLE			540	28
		EARLY			570	

PRECAMBRIAN

EON	ERA	BDY. AGES (Ma)
		570
PROTEROZOIC	LATE	900
	MIDDLE	1600
	EARLY	2500
ARCHEAN	LATE	3000
	MIDDLE	3400
	EARLY	3800?



Go South on I-5 and exit @ 283 to Wilsonville. Drive West along winding Wilsonville Rd for about 6 miles to Earlwood Rd. Go north up hill on gravel road 1 1/4 miles.

SEP 94

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer. Picnic-August. Banquet-March. Annual Meeting - February,**FIELD TRIPS**: Usually one per month, via private car, caravan or chartered bus.**GEOLOGY SEMINARS**: Third Wednesday, except June, July, August. 8:00 p.m. Room S17 in Cramer Hall, PSU Library :Room S7, open 7:30 p.m. prior to evening meeting .**PROGRAMS:** Evenings: Second and Fourth Fridays each month, 8:00 p.m. Room 371. Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon **LUNCHEONS**: First and third Fridays each month, except holidays, at noon, Bank of California Tower, fourth floor, California Room, 707 SW Washington, Portland Oregon. **MEMBERSHIP:** per year from January 1: Individual, $15.00, Family $25.00, Junior (under 18) $6.00. Write secretary for membership applications.**PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year (add $12.00 postage for foreign subscribers) Individual subscriptions at $13.00 a year. Single copies $1.00. Order from the Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon 97207. **TRIP LOGS**: Write to same address for price list.

GEOLOGICAL NEWSLETTER

The Geological Society of the Oregon Country

P.O. BOX 907 PORTLAND, OR 97207

VISITORS WELCOME | VOLUME 60, NO.9
INFORMATION PHONE 284-4320 | SEPTEMBER 1994

SEPTEMBER ACTIVITIES

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 p.m.)

Sept. 9 No meeting because of the President's Campout beginning Sept. 10.

Sept. 23 Joe Walder, Hydrologist with Cascade Volcano Observatory, will talk on: "The Problem of Predicting Glacial Outburst Floods on Mt. Rainier and Elsewhere." Illustrated.

FRIDAY NOON LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hour, 11:30 a.m. Program in California Room at 12:00 noon.)

Sept. 2 No meeting. Labor Day weekend begins

Sept. 16 No meeting. (GSOC members will be on President's Campout.)

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 p.m.)

Sept. 21 Subject: METAMORPHISM. Geologist Richard Bartell will explain how metamorphism affects shales and some of the other fine-grained rocks and why the changes take place during the process to make new kinds of rocks.

If you can't fine your notes from last time, don't worry, new sheets will be passed out.

GSOC LIBRARY (Cramer Hall, PSU. Room S-7. Open prior to evening meetings.)

Note: Esther Kennedy and Phyllis Thorne have put in many day-light hours during the past months as dedicated volunteers working in the GSOC Library. Their goal has been to carry on the work begun by the late Frances Rusche in cataloging and organizing books, pamphlets, and maps. They now invite GSOC members to take note of progress made and urge them to USE THE LIBRARY!

COMPLETELY FRACTURED GEOLOGY
BY EVELYN PRATT

1. **disconformity:** complaining against the norm,as in "Disconformity just isn't my style."
2. **undathem**: lower than they are
3. **Vuggy Porosity**: a musical "hard rock" group popular with geologists
4. **trimlines**: part of a sailor's comment about a pretty girl
5. **bolson:** what the pinsetter at the local alley told the nervous young novice
6. **veined gneiss**: equipped with good-looking blood vessels
7. **borate**: what one South African did at a party - "That Borate all the hors d'oeuvres."
8. **nepheline**: a white crystal used in mothballs
9. **limnic**: a little cut on an arm or leg or tree branch
10. **transverse joint**: a certain bar where people sit around and read poetry

FOR CORRECT ANSWERS, **SEE P. 53**

"PRETTY PEBBLE"

Down where the grinding granites groan
Under the weight of a mile of stone;
Down where the seething magmas boil
Deep urder rock and sand and soil ;
Where gases reach and snatch and clutch,
And change Is wrought by their lightest touch;
A crystal was forged and spread and grew,
Eons ago, when the world was new.

Cradled in icandescent glass,
Fed upon heaving bubblig gas,
Adding by atom and molecule,
Greatening more as the melt grew cool;
Till thin sharp edges, clean and new,
Bounded the facets straight and true;
But this was an infinite age ago,
And reckonless distance deep below.

Then, in the throes of procreant pain
Mother Earth shuddered and heaved amain;
Shattered the crystal through and through
That penetrant vapours might weld anew;
Dulled the faces once so bright,
Crushed and smothered in Plutean night.

As it lay gipped in that awfull stress
Diuturnity passed and the load grew less.

Rivers and raindrops, wind and air,
Had eased the weight that bound it there;
Patiently moving the hills away,
Grain by grain and day by day;
Carving the valleys and piling the sands,
Crumbling the mountains and rearing the lands;
While the cycles passed as seconds fly,
Till the crystal at last lay under the sky,

Now the rays of the hot new sun
Starred and burned till the day was done,
Now the chill of the midnight air
Cooled and checked and cracked it there.
Now the rasp of the wlnd-born sand,
Now the wash of a rain-drop band,
Turn and turn about again
The elements played that slow refrain.

Then flooding torrents, sweeping the brim
Snatched the stone from its rocky rim.
Roaring, whirled and rolled lt away,
Tossed and caught in its monstrous play,
Beat and battered and bruised again,
Carried it on through the level plain,
On to the ocean, there at last
It lay in Protean caverns vast.

Many a frigid fathom below
Eyeless monsters angle slow,
Where phosphorescent horrors glide;
Or over the slippery oozes slide;
And steadily drops an awful rain
Of countless multitudes of slain,
Falling to gaping maws or fright;
Gruesome shapes in an endless night.

Trapped and buried in bathybic slime
The crystal knew no lapse of time,
Till the end of an era dlsturbed its bed
As new land lifted and wide plalns spread
Out from the ancient shore of the sea
Where waves had washed an eternity.

We walked on the beach and I heard you say,
"What a pretty pebble!" and toss it away .

-John Eliot Allen
Field Geologist, Oregon Department
of Geology and Mineral Industries

This poem by John Allen was printed in the Geological Newsletter, Vol.5, No.10, 1939⊕

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SOAPSTONE SLIPS THROUGH TIME

The Chinese have treasured soapstone for centuries and used it to carve their delicate figures. The Eskimos use it to make lamps and cooking pots. In ancient Babylon it was used to make signet rings and other items of jewelry. In North America, the early pioneers used it to make laundry tubs, but this is not why it is called soapstone. The mineral gets its name because of its waxy, polished surface looks and feels like soap.

Geologists classify soapstone as a hydrous magnesium silicate and call it a steatite mineral related to talc. Its main ingredients are magnesium oxide, silicon and moisture. It is one of the softest of stones, easily carved with a knife. Its color may be pearly or bluish gray, milky white or pastel yellow. A few rare examples are a vivid apple green. Some are opaque, others are translucent like foggy glass.

Since early times, artists have treasured its lovely colors and soft carvable qualities. It made durable lining for boilers and electric furnaces because it insulates both heat and electricity. It resists all stain and corrosion. As a filler ingredient, powered soapstone gives a body to certain papers and paints, and a spreading quality to face powder.

Soapstone is classified as a metamorphic rock, a mineral completely altered from its original form by tremendous forces within the earth's crust. The original mineal was probably lava, rich in magnesium and silicates fused in the "furnace" of some ancient volcano. For ages it was buried amid seething activity of growing mountains. Steaming underground water and enormous pressures gradually remodeled and refined its texture. The original material was metamorphosed, completely changed into something different. The various colors were added by traces of magnetite, chlorite mica, and other ingredients that seeped into the recipe.

Considering its long history of hardships, it is not surprising that soapstone has learned how to resist heat, electricity and corrosive acids. But it is surprising that the lovely soft material is not marred by it past experiences.

Most of the world's steatite is mined in North America and both soapstone and talc, somewhat a softer relative are found in western mountains of California. Most massive deposites are in Eastern Appalachian. Near Schyler, VA, the soapstone mines are along a belt 130 miles long and occur in blocks, some thicker that 300 feet and more than 1500 feet long.⊕

This article appeared in the Northwest Newsletter, Official Publication of Northwest Federation of Mineraalogical Societies, no author named.

Correct answers to **COMPLETELY FRACTURED GEOLOGY,** adapted from Dictionary of Geological Terms, ed. by Bates & Jackson, AGI

1. **disconformity**: an erosional break between parallel beds
2. **undathem:** rock units formed where sediment was deposited in a zone of wave action
3. **vuggy porosity**: an area full of pores that are pea-size or larger; usually in limestone
4. **trimline(s):** a sharp boundary at the uppermost level of where a glacier once was
5. **bolson**: in the SW, a flat-floored desert basin into which drainage from surrounding mountains flows
6. **veined gneiss**: a composite gneiss with irregular layering
7. **borate**: a mineral with boron oxide as one of its main components
8. **nepheline**: a feldspar-type mineral found in alkaline igneous rocks
9. **limnic:** pertaining to a body of fresh water
10. **transverse joint**: a fracture that extends crosswise across the strike of strata

PACK RATS REVEAL COSMIC SECRETS BY GEORGE ZAMORA N. M. TECH PUBLIC RELATIONS OFFICE

A New Mexico Tech geoscientist who developed a more accurate method of dating geological deposits by measuring the accumulation of a radioactive element is now using his new method to study ancient pack-rat "middens"--globs of precipitated pack-rat urine containing· twigs, leaves, bones, and whatever else the rodents had dragged to their nests-for evidence of cosmic-ray bombardment of the Earth tens of thousands of years

By measuring radioactive chlorine-36 isotopes in middens found in pack-rat nests, Dr. Fred M. Phillips and his research collborators have tentative proof that the Earth was once subjected to a much stronger exposure of radiation from space. The radioisotope chlorine-36 normally forms when highly energetic cosmic-ray particles strike argon atoms in the atmosphere. The chlorine-36 then falls to the ground in rainwater and is taken up by the roots of plants. When animals such as pack rats eat the plants, they excrete the radioisotope onto the material collected in their nests. Eventually, the urine evaporates and precipitates around the debris, forming a hard, resinous clump, preserving indefinitely a natural "time capsule" record of the chlorine-36 Ievels present when the midden was formed.

Through his pack-rat research, Phillips and his colleagues have found evidence from urine salts found in middens . radiocarbon-dated at 21,000 years old that cosmic-ray fluctuation then was 41% higher than it is now. Chlorine-36 analyzed from a newer sample, dated at 12,000 years ago, indicated a 28% higher flux in the cosmic radiation that once struck the Earth. These findings may support theories that the Earth's protective magnetic field was once weaker, thereby allowing more cosmic rays to penetrate the atmosphere.

Before his pack-rat studies, Phillips focused much of his chlorine-36 research on describing glacial episodes. He dated past advances and retreats of mountain glaciers by measuring the buildup of chlorine-36 on boulders found on the crests of " moraines"—ridges of soil and rock that were deposited by movements of glaciers tens to hundreds of thousands of years .

'Glacial chronologies are important - indicators for global climate studies. Phillips has observed relatively rapid shifts between interglacial and glacial periods in mountain glaciers. Phillips notes that this might be relevant to today's worldwide concern about global warming.⊕

This article appeared in "Lite Geology" New Mexico Bureau of Mines and Mineral Resources.

FINDING FORMATIONS FIT FOR FIRING

by Ralph S. Mason, former State Geologist

(Oregon Geology, Vol.44, No.7, July 1982)

The practice of ceramics has always depended on two basic elements: clay and fuel. The art and the industry of ceramics were born when primitive fire builders discovered that the clay right under their campfires not only turned red but became exceedingly hard. In the centuries that followed this important discovery, the use of fired clay increased and proliferated steadily throughout most of the world.

To be economically viable, clay working must be conducted at a place where there is a source of easily dug clay and a relatively cheap source of fuel. Modern improvements in transportation, both for bulk materials such as clay and for energy such as gas, oil, coal, and electricity, have blurred this historic relationship somewhat, but the low unit value of raw clay still greatly restricts the distance it can be moved from pit to kiln. It is mainly for such economic reasons that history, even pre-history, is firmly on the side of the craft potter who finds and digs his own clay.

Two hundred years ago, itinerant craft potters supplied households with ware made from clay found nearby and fired with wood cut at the site. By and large, settlements tended to locate near streams which provided a ready means of transportation in a land devoid of good roads. The flood plains on which the buildings were erected also supplied clay deposits, composed of clay particles that had been transported and deposited by water. These clays were rather of the common type, but they were readily available; the crude and not very durable wear produced from them was in character with the rough living conditions of the times.

The early-day potter rarely upgraded the clay he dug, since he had little equipment for doing so, and the market was content with the unbeneficiated product. Modern craft potters, however, have a variety of methods at their disposal for improving raw clays and glaze materials. Treatment may include crushing and screening, blunging and decantation, magnetic separation, and blending. But even today, some potters prefer to work with a low-grade clay and to produce ware of refined quality just by applying their skills.

The modern craft potter who wants to dig his own clay has both advantages and disadvantages over his earlier colleagues. On the plus side, the potter has access to a much wider area to look for suitable material, thanks to good roads and the automobile. He also has a great deal of information available in the form of reports and maps, helping him to winnow the potentially good sites from the poor ones. Another plus is a wide choice of digging and drilling equipment which can take much of the drudgery out of searching for and mining the clay.

The disadvantages of digging clay for your own pots pretty much center on the fact that most potters live and work in populated areas where there are many restrictions to prospecting and mining. With patience and effort, however, a

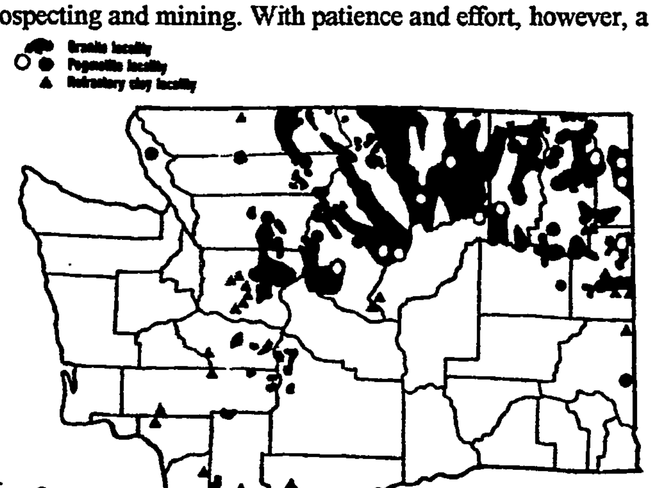

Fig 3.

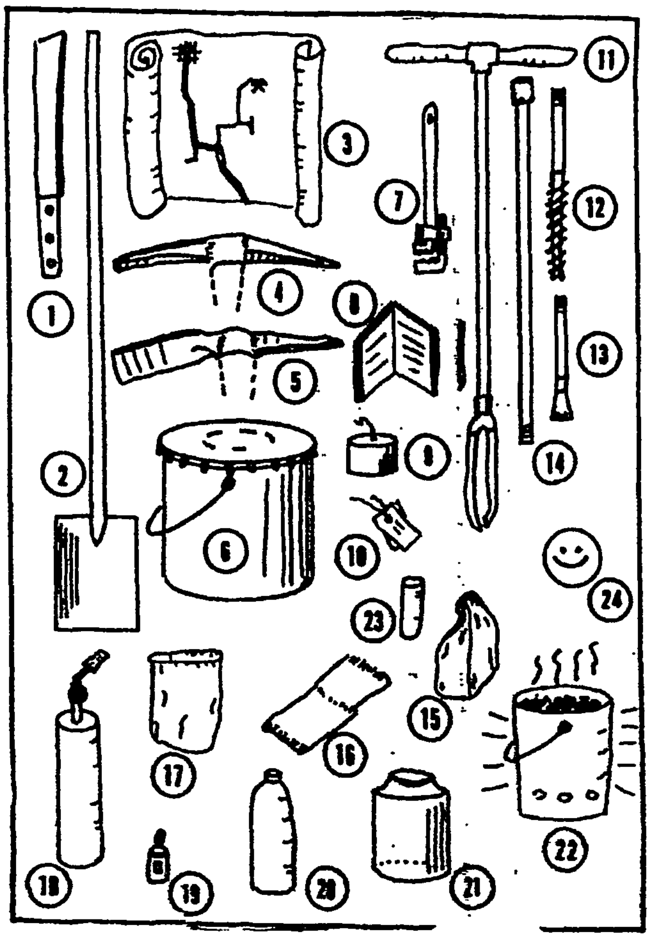

Figure 1

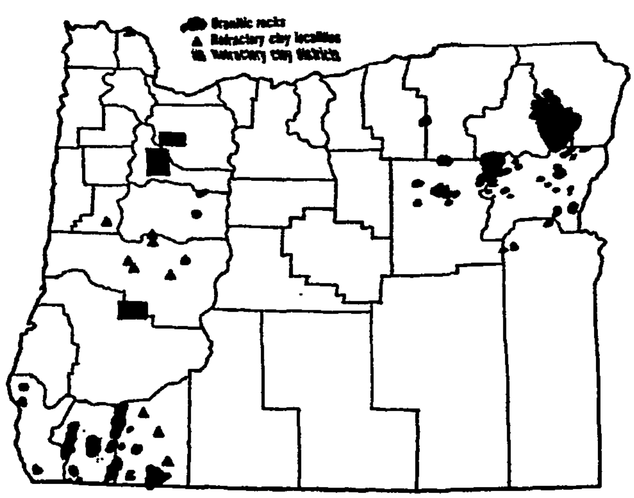

Figure 2. Areas of intrusive rocks and refractory clay districts and localities in Oregon.

Figure l. Typical equipment used for clay prospecting and field testing. (l) Corn knife. (2) Long-handled shovel. (3) Map. (4) Clay pick. (5) Mattock. (6) Plastic bucket with lid. (7) Stillson wrench. (8) Notebook, pencil. (9) String in container. (10) Labels 11) Iwan-type soil auger. 12) Screw auger. (13) Chopping bit. (14) Extra length of pipe, 36 inches. (15) Sack lunch. (16) Old rags or towe/. (17) Cloth or plastic sacks. (18) Propane burner. (19) Dropper bottle with 1:1 HCI acid. (20) Water bottle or canteen. (21) Glass gallon jar, wide-mouth. (22) Old bucket, hibachi, or barbeque. (23) Test tube.
24. Good Manners.

potter can locate areas where there is not only clay but also no serious prohibition to removing it. One other factor must be considered: Digging clay, even with the help of mechanical equipment can be rather strenuous, and a careful assessment of one's physical capabilities should be made.

Populated areas have one feature that can actually help in the search for clay: holes. Civilized countries can almost be rated as to their level of development by the size and number of holes they create. Here is a sampling of holes and excavations that can aid a potter: post holes, power-poles holes, basements, roadcuts, wells, graves, and ditches. Roadcuts generally top the list in being useful, since we have miles of them and the access, in most cases, couldn't be better. The material that comes out of such holes is an excellent indicator of what lies below the surface. If the spoil pile beside a hole looks interesting, grab a sample and run a few field tests, like making a ball and a snake. If these look good, try gritting some material between your teeth. Your teeth, when they are your natural ones, are remarkably sensitive to particle sizes. (The modern porcelain substitute, unfortunately, is quite insensitive to another clay's properties.) A propane torch can be used to make a rough firing test for color and behavior at high temperatures.

Clays passing these tests should be collected and given further examination in the studio. Be sure to keep good records as to where you took your samples; attach labels, tags, or other markings.

There is no sense in looking for something that you know little about. "Know before you go," is excellent advice. Hunting for clay is much like hunting elephants-just as you look for elephants in elephant country, so you look for clay in "clay country." Therefore, before you go off into the countryside looking for some clay, get all the information you possibly can. Check out reports on clay deposits, soil types, and geology; obtain topographic, soil, and geologic maps. If you are unfamiliar with the various clay-forming processes, read a college-level physical geology text on the subject.

Here is a suggested program for obtaining the information you will need: First, determine how far afield you plan on prospecting. Second, buy some detailed maps of the areas you have decided on. The topographic maps published by the U.S. Geological Survey are excellent. They show roads, streams, elevations (by means of contour lines), buildings, dams, power lines, and a land net which shows the legal divisions into sections, townships, and ranges. These maps are sold at many stationery stores, outdoor recreation shops, and state departments of geology. Soil maps published by the U.S. Soil Conservation Service usually cover an entire county and show the distribution of the surface soils, describing each type. County agents and, sometimes, libraries have these maps. Third, go to the appropriate state geology department or state university library and read any reports they have on the geology of your region. If you are unfamiliar with some of the terms used in the publications, pick up a geology text at your bookstore or at the college co-op.

Proper tools are a must for any successful prospecting trip. Figure I shows a suggested list of items to take. Quite possibly some of them will not be needed for your work, and again you may find some additional tools necessary. After a trip or two, you can trim or expand your equipment to fit your needs. Most of the items shown in the illustration can be obtained at hardware stores, particularly shops serving farming communities. Be sure to take your Good Manners with you; they may be the most important tool in the sack.

You are finally ready for your first clay-prospecting trip. You have read reports, have bought some maps and tools, and are itching to go find a deposit of good clay. Now, book learning is essential, but a good practical example of just what a deposit looks like is mighty helpful. A visit to a commercial clay plant in the general area of your interest could be most instructive. There were literally hundreds of clay pits in operation in Oregon and Washington fifty years ago, and many of these were located in bottom land that was frequently flooded.. Records of these operations are usually available in reports issued by either state, provincial, or federal agencies. Unfortunately, quite a few brick and tile plants have succumbed in recent years, but some of their clay pits are still accessible. Take a good look at the clay formation, the overburden, and the general setting in which the deposit is located. Chances are that similar conditions extend away from the pit and that some road cut in the vicinity can yield satisfactory clay.

The removal of some clay from such a spot should cause no problems, since cuts tend to slough down onto the road or drain ditch, and the clay removal does no harm. If in doubt about the propriety of digging along some road, you should talk to the roadmaster or his equivalent. For very small amounts of clay, it is better to let sleeping bureaucrats lie. Sometimes it is necessary to drill to get your samples. The Iwan-type soil auger works well in this service. Wear a sweatshirt or similar garment when drilling, since the auger handles are death on clothing with buttons. Also, do not keep anything in any pockets above your waist-----the pocket contents seem to be attracted to the hole you are drilling, and retrieval can be difficult.

Craft potters who are looking for clays of some higher firing range and lighter color, may be interested in the refractory clay deposits scattered around the countryside, many of which are residual type. Unlike the transported clay deposits found on flood plains and along streams, the residual clays are directly associated with weathered granite and pegmatite and tend to occur in hilly or mountainous terranes.

In Oregon, granitic outcrops are found in the southwestern and northeastern corners of the state, somewhat removed from the population concentrations. In Washington, these same rock formations are more favorably located. extending across large areas of the northern half of the state. Figure 2 shows the distribution of the principal refractory clay localities and districts in Oregon. Also shown are the generalized areas of granitic rocks which, if sufficiently weathered, may form clay deposits of better-than-average quality. A report on the refractory clays of western Oregon by Wilson and Treasher (1938) is listed in the bibliography. Two somewhat similar publications by Wilson (1923) and Wilson and Goodspeed (1934) are also listed. Figure 3 shows the generalized localities for refractory clays, pegmatites, and granite in Washington. Before starting out for those granite-studded hills, please be advised that all granites are not suitable for ceramic clays.

Finally, let me reiterate one bit of advice mentioned above: When you go prostecting be sure and take your Good Manners with you. Good Manners open many doors that otherwise might be slammed tightly shut. Every squre inch of the countryside is owned by somebody, and that somebody might take a very strong exception to your presence unless you conduct yourself most circumspectly. Remember that a low-iron clay is far less importnat than a lead-free clay.

SELECTED REFERENCES TO OREGON AND WASHINGTON CLAYS

Allen, J.E., and Mason, R.S., 1949, Brick and tile industry in Oregon: Oregon Department of GeologY and Mineral Industries Short Paper 19, 28 p.

Kelly, H.l., Strandberg, K.G., and Mueller, J.l., 1956, Ceramic industry development and raw-material resources of Oregon, Washmgton, Idaho, and Montana: U.S. Bureau of Mines Information Circular 7752, 77 p.

Shedd, S., 1910, The clays of the State of Washington, their geology, mineralogy, and technology: Pullman, Wash., State College of Washington, 341 p.

Wilson, H., 1923, The clays and shales of Washington, their technology and uses: Seattle, Wash., University of Washington, Engineering Experiment Station Series Bulletin 18, 224 p.

Wilson, H., and Goodspeed, G.E., 1934, Kaolin and china clay in the Pacific Northwest: Seattle, Wash., University of Washington, Engineering Experiment Station Series Bulletin 76,184 p.

Wilson, H., and Treasher, R.C., 1938, Preliminary report of some of the refractory clays of western Oregon: Oregon Department of Geology and Mineral Industries Bulletin 6, 93

For further references the reader may consult the several bibliographies in Ralph S. Mason's recent book, ***Native Clays and Glazes for North American Potters.*** A Manual for the Utilization of Local Clay and Glaze Materials published by in Portland by Timber Press (see review in ***Oregon Geology*** of February this year July 1982).

This article , Finding Formation Fit For Firing was reprinted from Oregon Geology, Vol.44, No. 7, July 1982, P.79-81.

THE GEOLOGICAL NEWSLETTER

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ANNUAL EVENTS: President's Field Trip-summer. Picnic-August. Banquet-March. Annual Meeting - February,**FIELD TRIPS**: Usually one per month, via private car, caravan or chartered bus.**GEOLOGY SEMINARS**: Third Wednesday, except June, July, August. 8:00 p.m. Room S17 in Cramer Hall, PSU Library :Room S7, open 7:30 p.m. prior to evening meeting .**PROGRAMS:** Evenings: Second and Fourth Fridays each month, 8:00 p.m. Room 371. Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon **LUNCHEONS**: First and third Fridays each month, except holidays, at noon, Bank of California Tower. fourth floor, California Room, 707 SW Washington, Portland Oregon. **MEMBERSHIP:** per year from January 1: Individual, $15.00, Family $25.00, Junior (under 18) $6.00. Write secretary for membership applications.**PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year (add $12.00 postage for foreign subscribers) Individual subscriptions at $13.00 a year. Single copies $1.00. Order from the Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon 97207. **TRIP LOGS**: Write to same address for price list.

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OCTOBER ACTIVITIES

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 p.m.)

Oct. 14 "Landslide Technology Works for Landslides" Illustrated lecture by Charles Hammond.

Oct. 28 "Historic Glacier Retreat, Moraine-dammed Lakes, and Debris Flows -- Three Sisters and Mt. Jefferson Wilderness Areas" Illustrated lecture by Jim O'Connor.

FRIDAY NOON LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social hour, 11:30 a.m. Program in California Room at 12:00 noon)

Oct. 7 Stormwater Sumps in Portland" Illustrated lecture by Michele Lofstra.

Oct. 21 "Australian Safari" Illustrated lecture by Mura Birdsall.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 p,m.)

Oct. 19 "Metamorphism and Deformation of the Okanagan Terrane and Kootenay Arc." Richard Bartell will have slides and rock samples to illustrate his program.

GSOC LIBRARY (Cramer Hall, PSU, Room S-17. Open prior to evening meetings.)

59th ANNUAL THOMAS CONDON LECTURES

The 1994 Condon Lecture will be held at Oregon State University in the LaSells Stewart Center at 8:00 p.m. on Tuesday, October 11, 1994. The lecture is "How Plate Tectonics Changed Our View of the Pacific Northwest," by William R. Dickenson of the University of Arizona. The lecture is free and open to the public. An abstract of the lecture is on page 60 of this Newsletter.

...Why Earthquakes Occur?

A Very Brief History of Seismologyy
by Richard Aster
Assistant Professor of Geophysics,
New Mexico Tech

What is an earthquake? This question probably has been asked ever since human beings have been able to wonder about the natural world. However, comprehensive insight into the causes of earthquakes has only been achieved during the past century, and mostly during the past 50 years.

Predating the scientific era, earthquakes and other natural phenomena were widely ascribed to divine influences (often involving gigantic manifestations of familiar animals). In Japanese tradition, for example, earthquakes were considered to be caused by the stirrings of an enormous catfish, the **namazu**, which lived in the mud beneath the Earth. In Hindu mythology, earthquakes were attributed to the shifting of one or more of the eight great elephants that supported the Earth. In the Old Testament, earthquakes were considered to be the instrunents of a vengeful God. More secular thinkers, such as Aristotle, speculated that earthquakes were the result of winds accumulating in the Earth's interior. Like many of Aristotle's hypotheses, this, combined with the concept of earthly manifestations of God's displeasure with human beings, remained a widespread explanation for earthquakes in Europe throughout the Middle Ages.

Despite subsequent early attempts by natural philosophers during the Age of Reason to associate earthquakes with electrical, atmospheric, or vague subterranean volcanic effects, progress on understanding earthquakes remained ponderously slow throughtout the 17th and 18th centuries. A run of notable earthquakes near populated areas in Europe and the New world [London (1750); Boston (1755) and especially the cataclysmic event near Lisbon (1755)] spurred new interest and observations. A particularly important observation documented during this time was that the destructive force of earthquakes was observed to propagate as a seismic wave. Analogous to ocean or sound waves, but traveling through the solid Earth, seismic waves are sometimes visible to the eye during very strong earthquakes.

Once it became clear to the scientific community that earthquakes were, intimately related to the propagation of seismic waves through the solid Earth understanding progressed relatively rapidly. The first **seismometers**, instruments for quantitatively measuring the motion of the Earth as a function of were constructed by the Englishman John Milne in the 1880s. These instruments were sufficiently sensitive so that seismic signals from large earthquakes could be recorded at quiet sites anywhere in the world. Milne's instruments were eventually deployed throughout the British empire, and the first crude world maps of earthquake source regions, or epicenters, were subsequently obtained.

What was happening at the epicenters that was generating seismic waves? The answer became evident from detailed studies of two notable earthquakes during this period that showed particular large and simple surface ruptures. Investigations into the great 1891 and the 1906 San Francisco earthquakes confirmed that large earthquakes were caused by sudden slippage on zones of low frictional strength (earthquake faults) in the Earth. On such faults, strain energy builds up gradually until some critical strength is overcome and slippage begins. Slip then spreads unstably over a large region and a vast amount of stored energy can be released (the great 1960 Chile earthquake, which was the result of an average of 21 m of slip over a fault-plane area approximately the size of New Mexico, released the energy equivalent-of about a 20,000 megaton bomb!). Most of the energy released during fault-slip goes into local heating and alteration of the fault zone, but a few percent goes into seismic waves that radiate out from the source region and can circle the earth many times. This **elastic rebound** process, in which earthquake faults are gradually loaded, slip suddenly, and then are gradually loaded again, was first formally proposed by the American seismologist Harry Reid following his study of the 1906 San Francisco earthquake. Elastic rebound is an accurate model for most earthquakes and has withstood the test of time.

However, the elastic rebound model begs the question of the ultimate cause of earthquakes. How do earthquake faults form, and where does the energy come from to load these faults in the first place? A comprehensive answer to this question would have to wait another half century and would ultimately involve the overturning of many dearly held global geologic concepts. In 1912, Alfred Wegener postulated his theory of **continental drift**, in which the Earth was not statically cooling, with the continents and ocean basins remaining nearly fixed but where continents somehow moved through the ocean basins, colliding and splitting, building mountain ranges, and generating earthquakes. Wegener's visionary hypothesis, although supported by fossil and geological evidence, particularly in the southern hemisphere, was largely dismissed by the scientific establishment for decades because he was unable to convincingly demonstrate how continents could somehow plow through the rocks of the ocean floor.

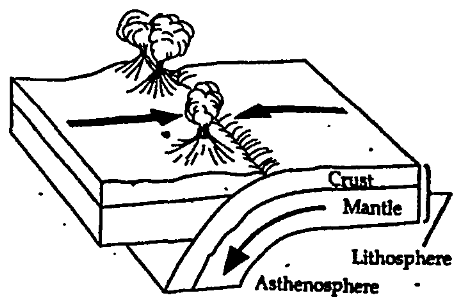
When the first relatively high resolution maps of the global distribution of earthquakes became available in the 1930's, it became abundantly clear that the Earth's seismic activity was not uniformly distributed, as might be predicted by a statically cooling Earth model, but mostly (approximately 90%) occurred in steeply dipping sheets plunging from near the continent/ocean margins to deep beneath the continents, reaching depths of over 600 km near previously unknown major Earth feature, the **global mid-ocean ridge**, a great world encircling volcanic system that supplies new material to the oceans at about the same rate that old oceanic crust disappears in the subduction zones. Although almost entirely hidden beneath the oceans, the mid-ocean ridge does see daylight in a few spots, such as Iceland.

From these and other observations, the present model of **plate tectonics** was assembled by the late 1960's. In it, the Earth's surface is visualized as a collection of a dozen or so thin rigid **lithospheric plates**, each containing **oceanic crust** (approximately 5 to 10 km thick), **continental crust** (approximately 25 to 60 km thick), or both. These plates are carried along at typical speeds of a few centimeters per year by **convection currents** in the underlying **mantle**. Such currents are possible because, although the mantle is overwhelmingly solid, it is capable of slowly flowing like a liquid over geological time. Hot, rising material from the Earth's interior reaches the surface at the mid-oceanic ridge system, while cold material sinks at the subduction zones. The relatively brittle plates together constitute the **lithosphere**, which extends to a depth of approximately 100 km and thus includes the outer crust and part of the upper mantle. The especially ductile zone underlying the lithosphere and extending to a depth of approximately 3~0 km is called the **asthenosphere.**

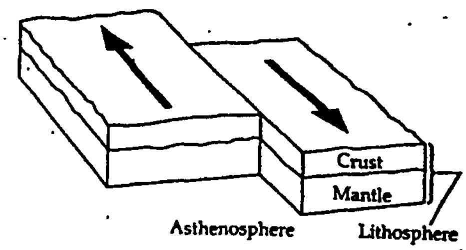
Earthquakes, then, are predominantly found at **plate margins** (Figure 1), where one plate is either plunging beneath another (as in subduction zones), where plates are rubbing side-to-side (as along the San Andreas fault in California), or where plates are pulling apart (as at the mid-ocean ridges). Because the lithosphere plates act like a brittle skin being carried-along by ductile mantle flow, difficulties associated with Wegener's original continental drift hypothesis of continents somehow barging through the ocean basins were overcome in the plate tectonic model and it is now universally accepted. Some of the material that goes down in the subduction zones melts and returns to the surface, spawning large arcs of volcanoes, such as the Aleutian Islands.

Finally, we must ask where all the energy comes from to keep the plates moving. The answer lies in the Earth's **geothermal heat budget**. The decay of radioactive elements in the mantle (primarily U235, U238, Th232, and K40) generates the bulk of this heat (lesser amounts are believed to come from the Earth's primordial heat and from the accumulation of the solid inner core). The amount of geothermal heat escaping to the Earth's surface is about 1/6000th of the amount of solar energy received and reradiated by the Earth. Thus the ultimate answer as to why earthquakes exist is that Earth has sufficient internal heat to sustain mantle convection and plate tectonics!

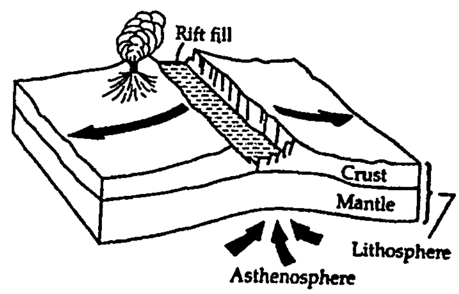
the Pacific rim (about 10% of the way to the center of the ,
This article on "Why Earthquakes Occur "was taken from *Lite Geology*, Spring 1994, a publication of the New Mexico Bureau of Mine and Mineral Resources.



CONVERGENT PLATES



PLATES MOVING PAST EACH OTHER



DIVERGENT PLATES

How Plate Tectonics Changed Our Geologic View of the Pacific Northwest

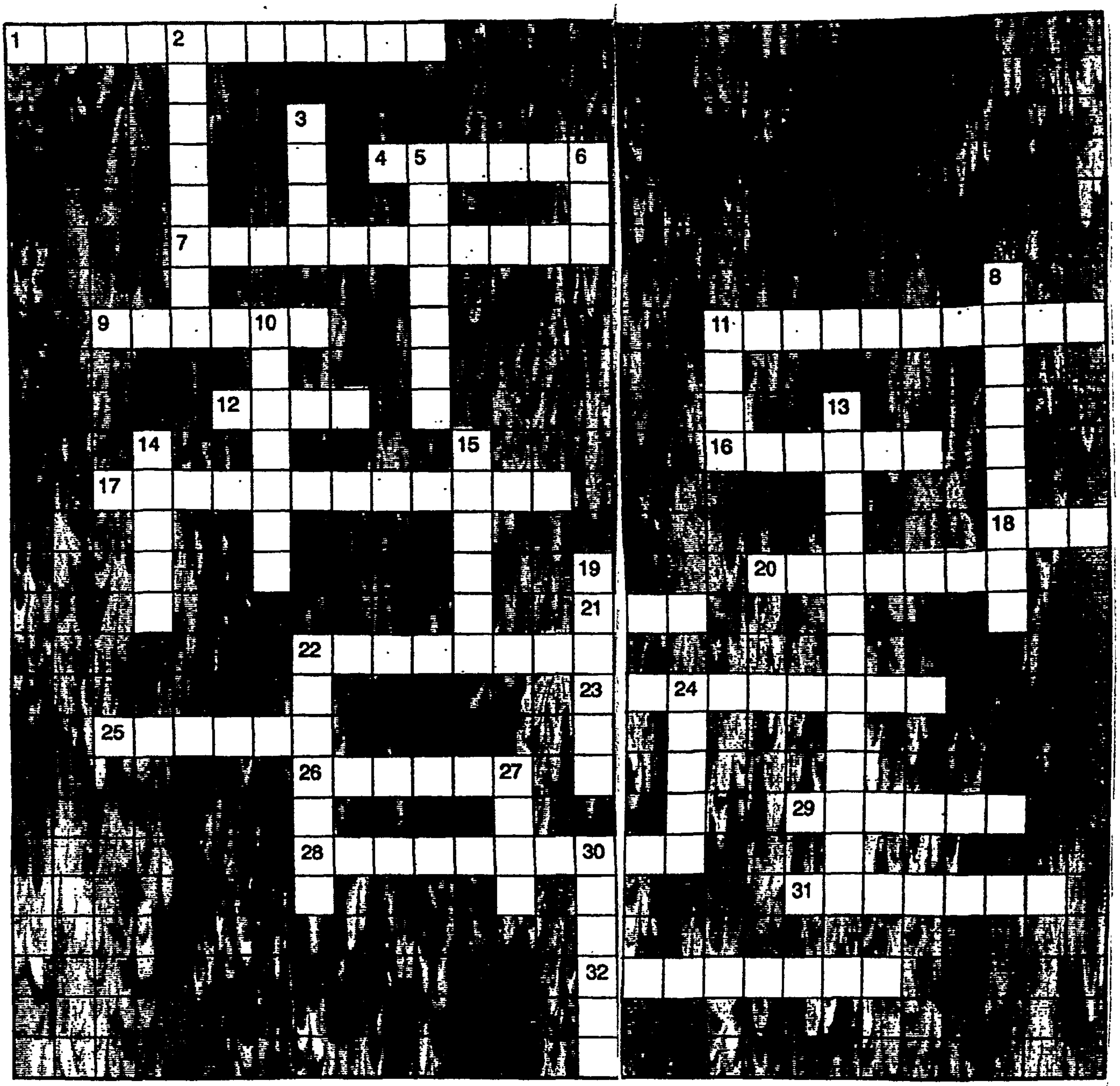
[1994 Condon Lecture by William R. Dickinson]
University of Arizona

Thirty years ago, we knew nearly as much, in a general way, about the geology of the Pacific Northwest as we do today. Certainly, we knew full well where all the volcanoes are, that there are thick Tertiary sediments overlying volcanics in the coastal mountains, where thick pre-Tertiary strata and large granitic bodies are exposed in the Blue Mountains, that persistent lowlands have occupied the Puget-Williamette depression for some time, and also where the high lava plains of the Columbia River Plateau and southeastern Oregon are located. In another sense, however, we knew next to nothing, for we had no clearcut ideas about how these various features relate to one another, nor how they fit into the global scheme of geology. In short, we had a lot of uncorrelated facts in hand, but no coherent theory to explain or understand them.

Plate tectonics, with its drifting continents and spreading seafloors and subduction zones at trenches, began to clear the intellectual air overnight We quickly perceived that the Cascade volcanoes form a magmatic arc paired with an ocffshore subduction zone at the foot of the continental slope, that the linear Puget-Williamette lowland is a forearc trough with counterparts in many places around the Pacific rim, that the Tertiary sequence of the Oregon Coast Range represents an older forearc basin linked to antecedents of the Cascades arc, that the bedrock of the Blue Mountains is not just a huge puzzle but a record of ancient subduction zones and magmatic arcs stretching back 200 million years in time, and that both the Blue Mountains and the Oregon Coast Range have literally wheeled through space like great swinging doors as the continental block has been stretched and twisted by complex plate movements. A geologic history that was fraught with mysterious players we once called geosynclines and mythical events we once called orogenies was converted into an orderly drama of familiar characters engaged in familiar postures repeated many times over, at many locales through Earth history.

And yet, with all our new-found insights, immense scientific challenges remain and geologic observations in the Pacific Northwest are now at the cutting edge of frontier research on topics of global interest. The Cascadia subduction zone happens to be one of the slowest moving in the world, with the downward velocity of the oceanic plate on its way into the mantle only a fraction of typical speeds, and we face the immensely practical task of trying to evaluate the potential earthquake hazard from such an atypically slow subduction system .The abundant Tertiary volcanics of the Pacific Northwest happen to be superb recorders of paleomagnetism, thus revealing past orientations of the lavas with respect to the geographic poles, and provide an almost incomparable means of establishing in detail the gyrations of crustal blocks as plates have danced in the past along the Pacific margin of the continent. The Columbia River Plateau is one of the great flood basalt fields of the world, with eruptions so voluminous and closely spaced as to be almost unimagnable from any human experience during all the time that modern humans have lived on Earth. To be entirely blunt about it, we still have no sure idea why flood basalts are erupted, with various extant hypotheses for their origin ranging from comparatively tame plate-related scenarios, to so-called plumacy involving tall streamers or plumes of hot mantle rising from near the core of the Earth, to speculative bolide impacts onknown extraterrestrial objects that plunged through the crust to trigger magmatism on the requisite grand scale.

The unmistakable lesson of the past half-century of geologic research in the Pacific Northwest is the value of fruitful interaction between observation and theory in understanding the geologic environment, its opportunities and its threats. Practical applications depend as much on adequate theory as on dedicated work, and we can never have too much of either. At one level, science is a grand intellectual game, played by internal rules for its own sake. At another level, however, it is a deadly serious game, for its topic is nothing more nor less than the actual reality with which we find ourselves inextricably enmeshed. We learn that we may understand. If we fail to act upon that understanding, we court disaster, which amounts only to personal failure in a professional life but can be something much more ominous in the world at large.



The crossword puzzle was titled NEW MEXICO RESOURCES CROSSWORD PUZZLE and was printed in Lite Geology published by New Mexico Bureau of Mines and Mineral Resources, Publications office, Socorro, NM 87801. This publication is for educators. I deleated the words New Mexico so the Puzzle would apply to Pacific Northwest. **ANSWERS TO THE CROSSWORD PUZZLE WILL BE IN THE NOVEMBER NEWSLETTER**

RESOURSES CROSSWORD PUZZLE

By William X. Chavez, Jr. Associate Professor of Geological Engineering
New Mexico Tech

ACROSS

1. The physical, biological, and chemical world that surrounds us .

4. Water that moves along the surface and does not seep into the ground during precipitation or snowmelt.

7 .The process involving restoration of the land surface to a productive state following surface mining; required by the Surface Mine and Reclamation Act of 1977.

9. Defined as the "ability to do work;" materials such as petroleum. Coal- and uranium are potential sources.

11. The physical and chemical decomposition of rocks and soil due to agents such as wind, rain, and snow.

12. The end product of the physical and chemical breakdown of rock; resulting in horizons of organic material as well as rock components.

16. A rock made up of potassium salts used for fertilizer as a source of potassium.

17. A term for the study of ancient life.

18. A common term for petroleum.

20. Transportation of weathered materials; results in removal of rock and soils from the site of original depositior

21.A mineral, rock, or soil material that may be mined for profit, using existing technologies and under current economic conditions.

22.Naturally occurring, inorganic crystalline substances having a definite chemical composition or range of compositions and physical characteristics.

23. A type of mine in which narrow elongate areas are excavated in order to mine material(usuallu coal). Reclaimation of mined land can be untdertaken relatively soon after mining.

25. Used to make concrete, composed of complex alumino-silicates and is made from such diverse components as limestone, shale and coal ash.

26. An inert gas

28. Generally as gaseous phase recovered from petroleum extraction, this gas may provide part of the pressure to recover liquid hydrocarbons from oil wells.

29. Extraction of water or mineral commodities from the earth.

31. A glassy volcanic rock containing 2-5% water. Used in filters, insulation, and lightweight materials.

32. An important reason why mineral resources are required by society to' maintain our______ of living.

DOWN

2. A naturally occurring material or land that may be utilized for the benefit of society. Examples: timber, ore and National Parks.

3. A rock formed from organic material, generally derived from woody plants; may contain inorganic matter, (clay,silt, and sulfur compounds.

5. This material provides about 20% of the energy requirements of the U.S.

6. The deposition of sediment in a delta shaped accumulation at the base of a mountain by water, usually during flood-type runoff, results in the formation of an alluvial____.

8. Rock made up of calicum carbonate, with lesser quanities of other carbonates, clays, and perhaps fossil materials; important in the manufacture of cement.

10. Term for the study of the earth.

11. An acronym for the proposed storage site for low-level radioactive wastes.

13. A gaseous substance extracted from wells and an important component of soda pop!

14. An extremely important resource used by all people in all societies; nevertheless, is being mined from some areas without recycling by people.

15. A red metal.

19. Evidence of former life, usually limited to prehistoric life.

22. The main component of natural gas; derived from petroleum wells or from degassing coal beds.

24. Granite, limestone, perlite, and gneiss are examples of ____.

27. The result of the shallow eruption of magma into water-bearing ground; responsible for the formation of volcanic craters.

30. A calcium sulfate mineral mined and used in wallboard and as a soil conditioner. Important mineral in the construction from the Earth.

WORD LIST

coal.oil.paleontology.
gypsum..maar.rocks.helium.limestone
cement.soil.energy.ore.reclamantion.
Minerals.methane.standard
potash.weathering.mining.
environment.resource.WIPP.water.
runoff.copper.erosion.uranium.fossil.
perlite.fan.carbon.dioxide.stripmine.
natural gas

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ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer. Picnic-August. Banquet-March. Annual Meeting - February,**FIELD TRIPS**: Usually one per month, via private car, caravan or chartered bus.**GEOLOGY SEMINARS**: Third Wednesday, except June, July, August. 8:00 p.m. Room S17 in Cramer Hall, PSU Library :Room S7, open 7:30 p.m. prior to evening meeting .**PROGRAMS:** Evenings: Second and Fourth Fridays each month, 8:00 p.m. Room 371. Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon **LUNCHEONS**: First and third Fridays each month, except holidays, at noon, Bank of California Tower, fourth floor, California Room, 707 SW Washington, Portland Oregon. **MEMBERSHIP:** per year from January 1: Individual, $15.00, Family $25.00, Junior (under 18) $6.00. Write secretary for membership applications.**PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year (add $12.00 postage for foreign subscribers) Individual subscriptions at $13.00 a year. Single copies $1.00. Order from the Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon 97207. **TRIP LOGS**: Write to same address for price list.

GEOLOGICAL NEWSLETTER

The Geological Society of the Oregon Country

P.O. BOX 907 PORTLAND, OR 97207

VISITORS WELCOME
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VOLUME 60, NO. 11
NOVEMBER 1994

NOVEMBER ACTIVITIES

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 p.m.)

NOV. 11 No meeting. Portland State will be closed on Veterans Day

NOV. 25 No meeting. Post-turkey day.

FRIDAY NOON LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Lunch hour, 11:30 a.m. Program in California Room at 12:00 noon)

NOV. 4 Slide program on Presidents Campout in northeastern Oregon

NOV. 18 "Exploring the Juan de Fuca Ridge in the Alvin Submersible," by Wayne Colony, Geology Professor, Clark College, Wash.

GEOLOGY SEMINARS (Cramer Hall, PSU, Room S-17, 8:00 p.m.)

NOV. 16 Rock study of sedimentary, volcanic, volcaniclastic, igneous, and metamorphic equivalents -- will include both classification of rocks and study of rock assemblages as indicaators of geologic environments.

FIELD TRIP: SATURDAY NOVEMBER 5. GEOLOGY OF THE LAKE OSWEGO AREA

The day's activities will include a introductory slide show indicating how the Missoula Floods helped shape this area. The field trip will include a visit to the old Prosser Iron Mine, Cook's Butte (a Boring volcano), to view several faults, the large plunge pool developed by the flood water plus other geologic spots.

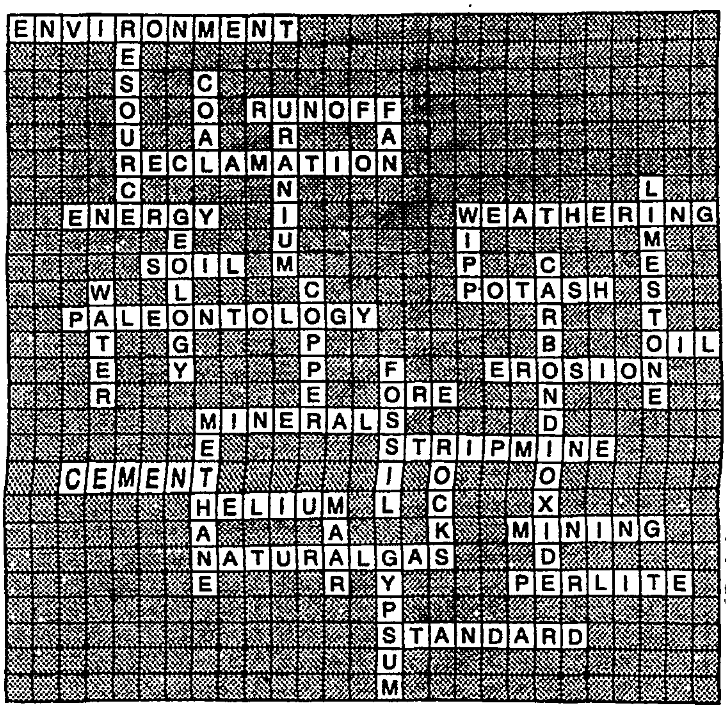
MEET: Tryon Creek State Park Nature House located SW Portland near Lake Osewgo
TIME: 10:00 AM at the Nature House.
LEADER: Don Barr

DRESS FOR THE WEATHER----BRING LUNCH---HOT COFFEE OR WHAT EVER-----AND ANYTHING ELSE THAT MIGHT ADD TO YOUR COMFORT. BREAKUP MID-AFTERNOON.

Donald Botteron appointed the following GSOC members to be on the Nominating Committee to recommend cannidates for the organization's offciers for the year 1995.

Chairman; Donald Barr
Cecelia Crater
Rosemary Kenney
Elinore Olson
Gale Rankin

ANSWERS TO THE CROSSWORD PUZZLE THAT APPEARED IN THE OCTOBER ISSUE OF THE GEOLOGICAL NEWSLETTER



This is the first of the President's Field Trip held in September as reported by several of the trip participants. The other trip reports will appear in the December NEWSLETTER

DAY 1: Portland to La Grande by Donald Turner.

On Saturday, September 10, so bright and clear, some of us boarded the bus at Raz garage on Bertha Boulevard, then rushed to the Red Lion Lloyd Center to finish loading, and departed for the east at 8:45 am.

From Troutdale to Corbett Station, the sliding in the Troutdale Formation was discussed. Then near Cascade Locks, Turner helped explain the Bridge of the Gods and the slide from Table MountaiGreenleaf Peak that blocked the Columbia River about 900 or so years ago. Leaving Cascade Locks we passed remnants of the Wind River Lava flow that blocked the river. At Mosier we departed the freeway for the Rowena Loop. From the Rowena Overlook the Ortley Fault and anticline were discussed. We also listened to Don Parks give the history of this part of the drive. Leaving the Interstate to US-197, then to Columbia View Drive, then drove to Seland Drive. We passed Petersburgto to view a large gravel in the flood deposits at the south end of the Petersburg Delta of the Ice Age Floods. Then on to the town of Fairbanks where we turned around and returned to the freeway. We made our lunch stop at Celilo Park leaving at 1:40 pm. Our group then made a dash for La Grande with rest and coffee stops near Stanfield and at Emigrant Springs State Park. Our next and final stop was at the Best Western Pony Soldier Inn at La Grande.

Thanks to the excellent driving of Tony Daquilanto and the care and guidance of Betty and Don Botteron, all had a grand voyage.

THE NOMINATING COMMITTEE HAS SELECTED THE FOLLOWING GSOC MEMBERS AS OFFICERS FOR THE 1995 YEAR. EACH HAS AGREED TO ACCEPT THE POSITION.

PRESIDENT: CLAY KELLEHER
VICE-PRESIDENT; RICHARD BARTELS
SECRETARY; CAROL COLE
TREASURER; PHYLLIS THORNE
DIRECTOR; CECELIA CRATER

Catastrophic events
created and continue to shape
the western edge of the North American continent.

Geologic catastrophes in the Pacific Northwest

by George W. Moore, Department of Geosciences, Oregon State University, Corvallis, Oregon 97331

The following article was prepared for the Convention Guidebook of the 1993 National Speleological Society Convention at Pendleton, Oregon, and is printed here with the permission of the publishers. — eds.

IN THE BEGINNING

Before the Cambrian Period, the time when most animal groups such as clams and trilobites acquired their hard shells and their remains began to document the fossil record, most of the Pacific Northwest did not yet exist.

The continent of North America has had a long geologic history, and indeed some of the world's oldest rocks crop out in Canada and Greenland. But before the Cambrian Period, North America was attached to Australia and Antarctica along its western side (Figure 1). Only later did the states of Oregon and Washington move in to occupy a continental rift that until then had been firmly closed.

The rifting, the first geologic catastrophe in a long series to affect the Pacific Northwest, started about 700 million years ago during the Precambrian. The tectonic plate bearing Australia and Antarctica (and also India and China on its far side) broke away and began a long swing through the ocean that with other later breakups brought us to the present world scene (Hoffman, 1991).

Continental crust is about 35 km (22 mi) thick, and an open vertical fissure with a new ocean in it did not form at the rift where Australia and Antarctica broke away from North America. The Earth is too weak for that. For more than 20 million years, each incremental expansion of the rift at the future position of Oregon and Washington was followed by massive crustal slides toward it from both sides. Therefore, no crack opened along the rift, but giant faults broke up a wide belt of the flanking terrain. When new oceanic crust finally did begin to form, belts of disrupted continental crust several hundred kilometers wide tapered toward it from each side.

The tapering former edge of North America is well preserved in Nevada, where richly fossiliferous rock layers from younger geologic periods blanket the new continental edge. In the Pacific Northwest, however, later catastrophic geologic events removed that original tapering continental margin and replaced it with alien continental blocks.

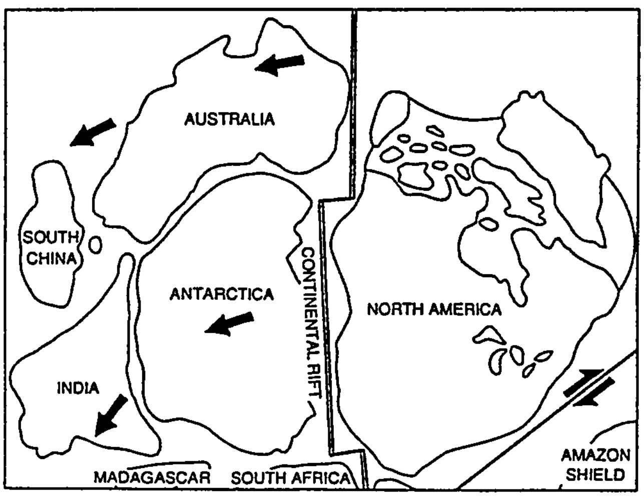


Figure 1. About 700 million years ago during the Precambrian, a continental rift separated North America from a much larger continent. Crustal stretching continued for 20 million years or more. Then a new ocean formed at the rift, and the Pacific Northwest established an anchorage on its North America margin.

GIANT BITES FROM THE CONTINENT

For a long period after the Precambrian breakup, the west coast of North America was tectonically quiet, and sediment banks and organic reefs built steadily seaward. Then, about 250 million years ago during the Triassic (some investigators say it was earlier), a disruption began, perhaps triggered by crustal stretching before the opening of the Atlantic Ocean and the consequent westward drift of the North America Plate (Howell and others, 1987). Sonomia, a large block of the Earth's crust now centered in western Nevada, was swept up and captured by the drifting continental plate of North America (Speed, 1983). This was followed about 200 million years ago, during the Jurassic, by the arrival of yet another big block, Stikinia, now centered in British Columbia (Figure 2).

These crustal blocks, which had formed as volcanic arcs and were plastered against the west side of North America, went a good way toward building the shoreline of North America out to roughly its present position. But after those blocks joined North America, giant bites were taken from the continental edge. In the first of these displacements, about 120 million years ago during the Cretaceous,

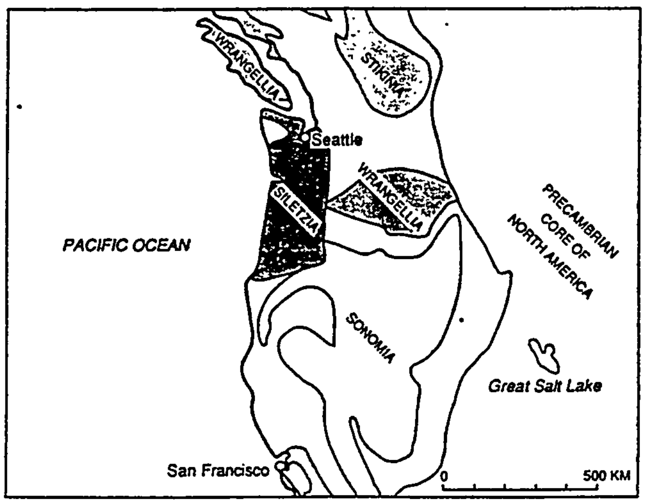


Figure 2. A succession of large blocks, mostly offshore volcanic arcs similar to today's Aleutian Islands, became attached to the Precambrian core of North America. First to arrive was Sonomia, then Stikinia. (Intervening onshore unpatterned areas are sea-floor materials squeezed between the blocks.) After Stikinia joined North America, it moved northward, reexposing the Precambrian core of the continent to the ocean. Into this gap came Wrangellia, the final great island-arc block. Then followed a series of displacements toward the north that separated Wrangellia into several fragments and left behind Siletzia, a tract of ocean floor. Later processes established the Cascade volcanic arc and understuffed and lifted up Siletzia to form the present Coast Range of the Pacific Northwest.

the previously captured Stikinia slipped toward the north, taking with it a part of Sonomia and much of the tapered continental margin of North America that had been left after Australia and Antarctica pulled away. In Idaho, this left a gap where oceanic crust of the Pacific Basin was juxtaposed against the Precambrian core of North America.

The nibbling of the continental edge was interrupted later during the Cretaceous by the arrival of Wrangellia (including the Blue Mountains of Oregon) into the gap at Idaho. Then a final great bite took place about 60 million years ago during the early Tertiary, when nearly all of what was then coastal Oregon and Washington was carried northward toward Alaska (Moore, 1984). This left behind Siletzia, the youngest tract of new ground in the Pacific Northwest.

Baja California of today may serve as a model for these dispersals of large tracts of land from Oregon and Washington. Baja California is moving northwestward along the San Andreas Fault, leaving behind new oceanic crust in the Gulf of California.

Siletzia is made of thin basaltic crust, and like the Gulf of California it, too, initially was a marine gulf underlain by new ground on the sea floor. Soon, however, a subduction zone was established along the margin of the Pacific Northwest, and the Cascade volcanic arc came into being. As part of the establishment of the new subduction zone, a wedge of buoyant sediment and rock was stuffed under the edge of Siletzia's new ground. The wedge lifted the edge of Siletzia above sea level, and today it forms the Coast Range of the Pacific Northwest.

But in eastern Oregon and Washington the land remained low; and sometime later, this interior lowland would become the site of yet another geologic catastrophe.

SWAMPED BY LAVA

About 17 million years ago, during the Miocene, fissures opened in eastern Oregon and Washington and began to deliver tens of thousands of cubic kilometers of basaltic lava to the land surface. Chemical analyses show that the basalt came from the Earth's mantle below the North America Plate. The repeated earlier disruption of the plate in this area may have played a role in the eruptions. Not known, however, is whether oblique crustal stretching related to movement of the San Andreas Fault was sufficient to trigger the lava outpourings (Hooper and Conrey, 1989), or whether a hot spot below the plate caused by large-scale overturn of mantle material was responsible (Duncan and Richards, 1991). The net result, however, was that the 3-km (2-mi)-thick Columbia River Basalt Group, representing one of the world's great flood-basalt provinces and consisting of over 300 individual lava flows, filled in the lowland of eastern Oregon and Washington (Figure 3).

Some individual lava flows ran all the way to the Pacific Ocean, protected from premature solidification by an insulating blanket of already hardened lava at the top of the flow. At the coast, the heavy lava entered the ocean through lava tubes and in places "floated" lighter sediment and sedimentary rocks to create a once-puzzling array of basaltic dikes and sills (Beeson and others, 1979).

Much of the scenic majesty of the Columbia River region owes its origin to these catastrophic outpourings of lava. Where the river has cut into them in the Columbia River Gorge, magnificent waterfalls punctuate the mighty cliffs that line the river.

THEN CAME THE DELUGE

The flood basalt of the Columbia River Basalt Group had long since solidified and begun to be deformed by younger Earth processes, when yet another great catastrophe hit the Pacific Northwest: stupendous floods of water that sculpted the Channeled Scablands in southeastern Washington. About 40 great floods, each containing roughly 2,000 km^3 (500 mi^3) of water and as much as 600 m (2,000 ft) deep, swept across approximately the same area as had been crossed by the basalt flows. They are the Earth's greatest known floods (Figure 4).

About 60 years ago, J Harlen Bretz, a professor of geology at the University of Chicago and the discoverer of the floods, first mapped and published the evidence for massive flooding in the State of Washington (Bretz, 1923). Thus began a long and difficult effort to convince the scientific community that the great floods indeed had occurred. Over the next 30 years, Bretz continued to map the area and to publish his evidence and conclusions, but acceptance of the concept was frustratingly slow. In the meantime, Bretz also did much other research, most notably his classic paper on the then also controversial topic that most limestone caves are formed below the water table (Bretz, 1942).

Part of the problem with Bretz' flood theory was that most people only read about it and never saw the evidence firsthand. Another part was that those who did investigate it were overly steeped in the doctrine of uniformitarianism (geologic processes have uniform intensity), which they interpreted to prohibit any form of geologic catastrophe.

Bretz' opponents were respected, and they were eloquent..Foremost among them was Richard Foster Flint, a former Bretz student (!) and a professor of geology at Yale University. Flint's major contribution was a paper in which he proposed that the Touchet beds, now recognized as the widespread deposits of the floods, were formed by uniformitarian processes of stream deposition beyond the front of an ice sheet during the ice age (Flint, 1938).

Year after teeth-gnashing year passed for J Harlen Bretz, but finally in the 1950s, aerial photographs became widely available. Suddenly, these revealed to everyone the fantastic patterns of giant ripple marks left by the floods (Bretz and others, 1956). Most of the ripples are difficult to recognize on the ground, but on the photographs they show up as giant water-laid dunes with heights measured in the tens of meters and wavelengths in the hundreds.

Bretz at first thought in terms of a single flood. We now know that this concept was derived from the evidence for the final molding of the ripples by the

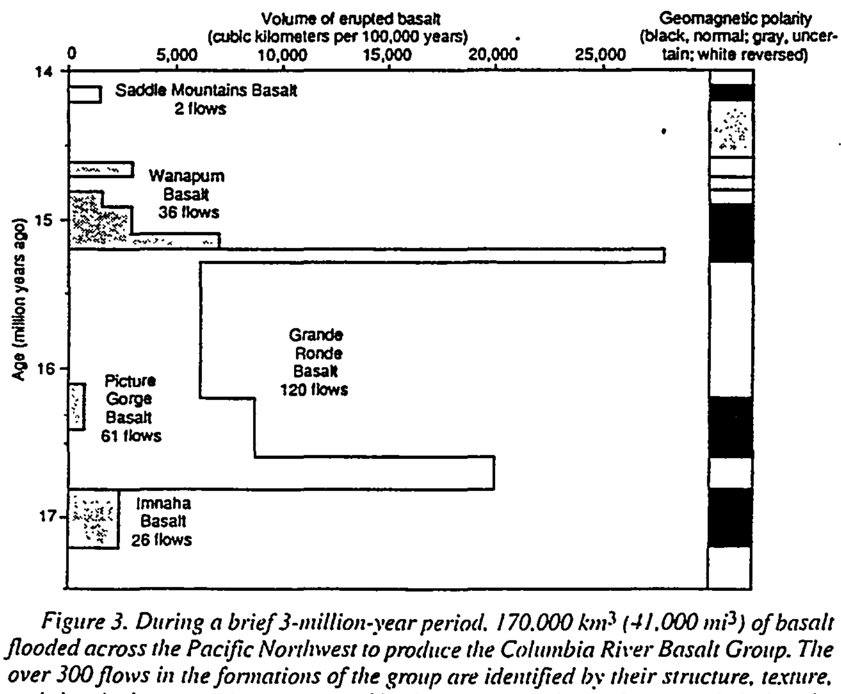


Figure 3. During a brief 3-million-year period, 170,000 km^3 (41,000 mi^3) of basalt flooded across the Pacific Northwest to produce the Columbia River Basalt Group. The over 300 flows in the formations of the group are identified by their structure, texture, and chemical composition, augmented by the magnetic polarity they recorded when the Earth's north and south magnetic poles repeatedly reversed. Abbreviated and simplified illustration based on data from Tolan and others (1989).

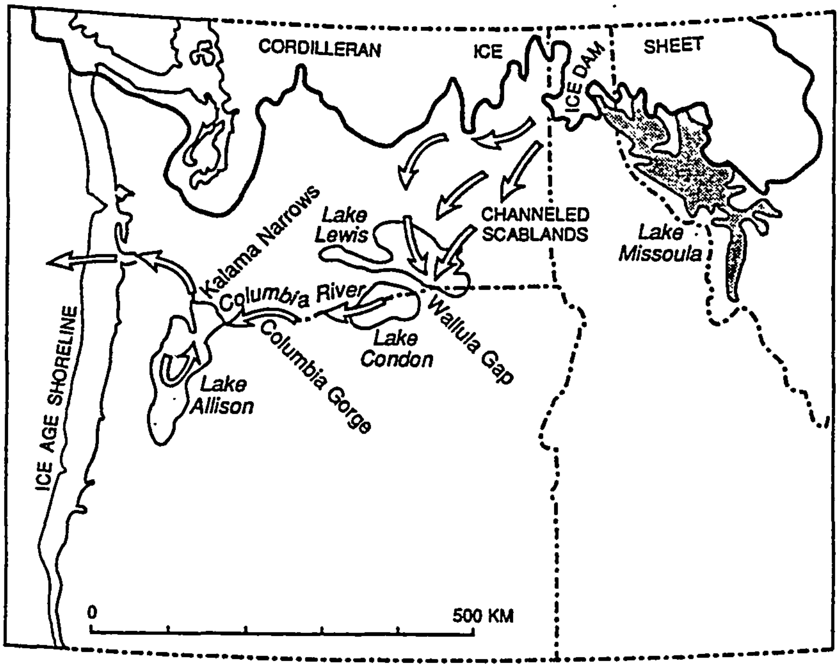


Figure 4. From 15,000 to 13,000 years ago during the ice age, a lobe of the Cordilleran Ice Sheet dammed Lake Missoula in Montana. When the lake reached a depth of 600 m (2,000 ft), its water floated the ice of the dam, flushing the lake water through the Pacific Northwest. Behind constrictions along the Columbia River valley, the water created giant temporary lakes. Where it rushed across high ground, it scoured out channels and laid down giant gravel ripples.

final flood in a long sequence. After later field work, he recognized that more than one flood had taken place, probably one for each major glacial stage. We now know, from the Touchet beds (cover photo) and other evidence, that 40 stupendous floods stripped off the surface of the Channeled Scablands and laid down the giant ripples and other deposits (Waitt, 1985).

The floods came from ancient Lake Missoula in Montana. A lobe of the Cordilleran Ice Sheet closed off the outlet to the lake with an ice dam. After a few decades with the dam in place, the lake filled, and when it reached a depth of about 600 m (2,000 ft), the water started to float the ice dam. Immediately, the dam burst, and the water of Lake Missoula swept down toward the state of Washington.

After each flood, the glacial lobe again moved slowly across the outlet, water filled the lake, the dam floated and burst, and the cycle was repeated—repeated 40 times. So, although they were catastrophic, these floods, recurring again and again over a period of 2,000 years, had a uniform intensity; hence they are, after all, an example of the doctrine of uniformitarianism.

ERUPTION PAST AND EARTHQUAKE FUTURE

Today, the Pacific Northwest has its own offshore tectonic plate, the Juan de Fuca Plate, and its own subduction zone (Figure 5). Subduction zones are notorious for two important types of geologic catastrophes: explosive volcanic eruptions and great earthquakes. The Pacific Northwest has had a long sequence of both.

The Juan de Fuca Plate moves eastward toward the coast and then curves downward and penetrates hundreds of kilometers into the lower mantle (Figure 6). At the same time, the North America Plate moves westward. One might think that the plates collide forcefully, but that is not so (Moore, 1992). The North America Plate overrides and pushes down the curve of the Juan de Fuca Plate and does not butt directly against it.

The lava of volcanic arcs above subduction zones differs from basalt delivered directly from the Earth's mantle in two important respects: it is lighter in color, and it is more viscous. Whereas highly fluid basaltic lava flows freely as a liquid—and makes the world's lava caves—the viscosity of subduction-zone lava causes it to push up into bulbous domes and then to explode violently. The most recent volcanic catastrophe of this sort in the Pacific Northwest was the eruption of Mount St. Helens in 1980.

About two months before the massive eruption May 18th at 8:32 a.m., which killed 57 people and devastated an area seven times the size of Manhattan Island, Mount St. Helens underwent several minor eruptions and began to swell measurably. The experts assumed that the activity would increase only gradually, and they laid out what then was considered a generous safety zone. But the swelling led to a bulge on the north side of the mountain, and on the day of the climactic eruption, the north side suddenly began to slide downward. The slip surface intersected the magma chamber within the mountain, and the unloading of the top abruptly released gas pressure inside.

The resulting explosion, similar to uncorking a champagne bottle, was wholly unexpected in size and force. Within seconds, a shock wave had turned a clear morning into deep overcast. A blast sped down the slope of the mountain at 330 km (200 mi) per hour, followed by a debris avalanche made of the former north side of the mountain and including giant blocks of glacial ice from the summit. An eruptive plume shot 16 km (10 mi) into the stratosphere and continued jetting steadily for the next nine hours. Mudflows of volcanic ash swept down the river valleys all the way to the Columbia River, 80 km (50 mi) away, disrupting river navigation for many months afterward.

The 1980 catastrophe at Mount St. Helens is the world's best studied volcanic eruption. We now know that magma depressurized and released by giant landslides has been common at other volcanoes elsewhere in the world, and the new knowledge will help to reduce the loss of life from such eruptions worldwide (Lipman and Mullineaux, 1981). But what about the other notorious natural hazard of a subduction zone? Should the Pacific Northwest expect a great earthquake in the future?

In historic time, Oregon and Washington have never had a great earthquake, that is, an earthquake larger than magnitude 7.5. And in Oregon even moderate-sized earthquakes are rare. This was long thought to be a good state of affairs, but we now know that a seismic gap of this sort is dangerous. The Pacific Northwest is waiting for a catastrophic earthquake.

American Indian tradition held that many lives were lost during a change in land level and the arrival of a great wave (now recognized as a tsunami) that took place not long before European fur traders arrived in the Pacific Northwest (Swan, 1870). Recent study on the basis of submerged coastal marshes and tree-ring dating shows, with an uncertainty of about 20 years, that this last great earthquake took place in 1680 (Atwater, 1987).

The experts know approximately when the last great earthquake occurred in the Pacific Northwest, but they are less certain about the interval between the great earthquakes. Intensive research continues on this topic, and several pre-1680 earthquakes have been identified. What remains uncertain is whether any preceding earthquakes were missed, because this is a critical ingredient in determining the recurrence interval and hence the probability of such an event soon. The best evidence now available points to a recurrence interval of 300 to 500 years. Hence, the Pacific Northwest should look for a great earthquake anytime from now to 200 years from now.

Future research may sharpen this estimate, and in the meantime building codes are being strengthened, and the public is being made

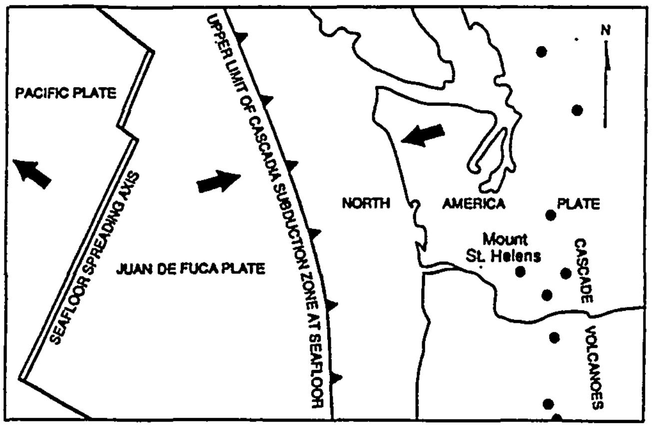


Figure 5. The Juan de Fuca Plate moves toward North America and bends down at the Cascadia subduction zone to produce the Cascade volcanoes and great subduction-zone earthquakes.

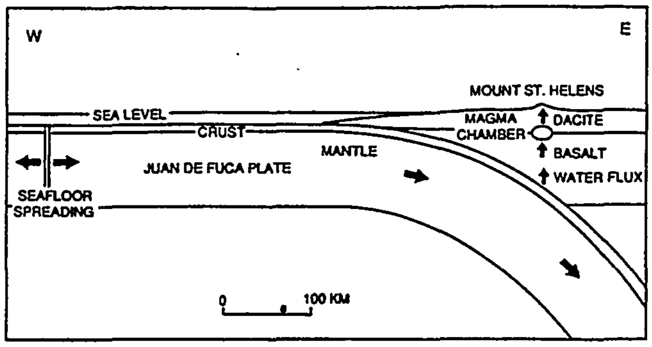


Figure 6. Cross section across the margin of the Pacific Northwest showing the downward bending of the Juan de Fuca Plate. Heat and water from the crust generate dark-colored basaltic magma in the overlying mantle, which in turn produces lighter colored magma below the volcanoes by the settling out of heavy, dark-colored minerals to change the composition of the remaining liquid.

aware of steps that can be taken before, during, and after a great earthquake to reduce the danger.

The good news about subduction-zone earthquakes is that the fault slip surface is relatively far away, 50 to 100 km (30–60 mi) below the surface. This reduces the earthquake intensity. The bad news is that the slip zone is relatively long: in the worst case, all the way from British Columbia to northern California. This leads to a long period of shaking, up to four minutes, which can shake down buildings or send down landslides that might have survived briefer earthquakes.

Let's hope that all the right things are being done to thoroughly understand the next geologic catastrophe in the Pacific Northwest, so as to reduce its effects and make it a small one for us. As we have seen, it will join a long history of catastrophes, some of which were very large indeed.

REFERENCES CITED

Atwater, B.F., 1987, Evidence for great Holocene earthquakes along the outer coast of Washington State: Science, v. 236, p. 942–944.

Beeson, M.H., Perttu, R. and Perttu, J., 1979, The origin of the Miocene basalts of coastal Oregon and Washington: An alternative hypothesis: Oregon Geology, v. 41, no. 10, p. 159–166.

Bretz, J H., 1923, The Channeled scablands of the Columbia Plateau: Journal of Geology, v. 31, no. 8, p. 617–649.

Bretz, J H., 1942, Vadose and phreatic features of limestone caverns: Journal of Geology, v. 50, no. 6, p. 675–811.

Bretz, J H., Smith, H.T.U., and Neff, G.E., 1956, Channeled Scabland of Washington: New data and interpretations: Geological Society of America Bulletin, v. 67, no. 8, p. 957–1049.

Duncan, R.A., and Richards, M.A., 1991, Hotspots, mantle plumes, flood basalts, and true polar wander: Reviews of Geophysics, v. 29, p. 31–50.

Flint, R.F., 1938, Origin of the Cheney-Palouse scabland tract, Washington: Geological Society of America Bulletin, v. 49, no. 3, p. 461–523.

Hoffman, P.F., 1991, Did the breakout of Laurentia turn Gondwanaland inside out?: Science, v. 252, p. 1409–1412.

Hooper, P.R., Conrey, R.M., 1989, A model for the tectonic setting of the Columbia River basalt eruptions, *in* Reidel, S.P., and Hooper, P.R., eds., Volcanism and tectonism in the Columbia River flood-basalt province: Geological Society of America Special Paper 239, p. 293–306.

Howell, D.G., Moore, G.W., and Wiley, T.J., 1987, Tectonics and basin evolution of western North America—an overview, *in* Scholl, D.W., Grantz, A., and Vedder, J.G., eds., Geology and resource potential of the continental margin of western North America and adjacent ocean basins—Beaufort Sea to Baja California: Circum-Pacific Council for Energy and Mineral Resources Earth Science Series, v. 6, p. 1–15.

Lipman, P.W., and Mullineaux, D.R., eds., 1981, The 1980 eruptions of Mount St. Helens, Washington: U.S. Geological Survey Professional Paper 1250, 844 p.

Moore, G.W., 1984, Tertiary dismemberment of western North America: Third Circum-Pacific Energy and Mineral Resources Conference, Transactions, p. 607–612.

———1992, Explanatory notes for the plate-tectonic map of the Circum-Pacific region: U.S. Geological Survey Circum-Pacific Map Series CP–41, 20 p.

Speed, R.C., 1983, Evolution of the sialic margin in the central and western United States, *in* Watkins, J.S., and Drake, C.L., eds., Continental margin geology: American Association of Petroleum Geologists Memoir 34, p. 457–468.

Swan, J.G., 1870, The Indians of Cape Flattery, at the entrance to the Strait of Juan de Fuca, Washington Territory: Smithsonian Contributions to Knowledge, v. 14, 108 p.

Tolan, T.L., Reidel, S.P., Beeson, M.H., Anderson, J.L., Fecht, K.R., Swanson, D.A., 1989, Revisions to the estimates of the areal extent and volume of the Columbia River Basalt Group, *in* Reidel, S.P., and Hooper, P.R., eds., Volcanism and tectonism in the Columbia River flood-basalt province: Geological Society of America Special Paper 239, p. 1–20.

Waitt, R.B., 1985, Case for periodic, colossal jökulhlaups from Pleistocene glacial Lake Missoula: Geological Society of America Bulletin, v. 96, no 10, p. 1271–1286. □

THE MEANING OF "ONE INCH OF RAIN"

An acre of ground contains 43,560 square feet. Consequently, a rainfall of one inch over an acre of ground would mean as a total of 6,272,640 cubic inches of water. This is the equivalent of 3, 630 cubic feet.

A a cubic foot of puire water weighs about 62.4 pounds, the exact amount varing with the density, it follows that the weight of a uniform coating of one inch of water over one acre of surface would be 226,512 pounds of 113-1/4 short tons.

The weight of 1 U.S.gallon of pure water is 8.345 pounds. Consequently a rainfall of 1 inch over 1 acre of ground would mean 27,143 gallons of water.

----From the 1969 World Almanac

DEC 94

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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(Geology Seminar)
Volunteers

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Volunteer Speakers Bureau
Bob Richmond 282-3817

Annual Banquet
Chairperson-Sue Barrett 639-4583

ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer. Picnic-August. Banquet-March. Annual Meeting - February,**FIELD TRIPS**: Usually one per month, via private car, caravan or chartered bus.**GEOLOGY SEMINARS**: Third Wednesday, except June, July, August. 8:00 p.m. Room S17 in Cramer Hall, PSU Library :Room S7, open 7:30 p.m. prior to evening meeting .**PROGRAMS:** Evenings: Second and Fourth Fridays each month, 8:00 p.m. Room 371. Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon **LUNCHEONS**: First and third Fridays each month, except holidays, at noon, Bank of California Tower, fourth floor, California Room, 707 SW Washington, Portland Oregon. **MEMBERSHIP:** per year from January 1: Individual, $15.00, Family $25.00, Junior (under 18) $6.00. Write secretary for membership applications.**PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year (add $12.00 postage for foreign subscribers) Individual subscriptions at $13.00 a year. Single copies $1.00. Order from the Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon 97207. **TRIP LOGS**: Write to same address for price list.

GEOLOGICAL NEWSLETTER

The Geological Society of the Oregon Country

P.O. BOX 907 PORTLAND, OR 97207

VISITORS WELCOME
INFORMATION PHONE 284-4320

VOLUME 60, NO. 12
DECEMBER 1994

DECEMBER ACTIVITIES

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 p.m.)

DEC. 9 ILLUSTRATED REVIEW OF THE SEPTEMBER 1994 GSOC PRESIDENT'S "CAMPOUT" IN NORTHEASTERN OREGON, by GSOC members

DEC. 23 NO MEETING. Santa says to mend your sock before you hang it up.

FRIDAY NOON LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor, Lunch hour 11:30 a.m. Program in California Room at 12:00 noon)

DEC. 2 GEOLOGICAL RAMBLE THROUGH THE "OREGON COUNTRY" illustrated, by Don Barr

DEC 16 TURKEY -- LAND OF ANTIQUITY, illustrated, by Rosemary Kenney

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 p.m.)

DEC. 21 NO MEETING. NEXT SEMINAR WILL BE HELD JANUARY 18, 1995

GSOC LIBRARY (Cramer Hall, PSU, Room S-7) Open prior to Friday night meetings.

M E R R Y C H R I S T M A S

DUES ARE DUE------DUES ARE DUE

As a new President is soon to be elected, it would be great if he had a list of willing volunteers to fill the positions that help make the GSOCS run.

LOOKING AHEAD FOR THE HANCOCK RETREAT- – THIS ACTIVITY WILL TAKE PLACE MAY 12-14 AT THE CASCADE SCIENCE CENTER LOCATED NEAR REDMOND, OREGON

GSOC PRESIDENT'S FIELD TRIP - NORTHEAST OREGON SEPTEMBER 10-17,1994

DAY ONE APPEARED IN NOVEMBER NEWSLETTER

DAY 2, HOT SPRINGS, FAULTS, AND THE OLYMPIC WALLOWA LINEAMENT, LA GRAND, OREGON TO ENTERPRISE, OREGON BY BILL GREER

At 8:45 A.M. Tony Daqlantro, our Raz bus driver, had our bus ready to load in the Pony Soldier Motor Inn parking lot at Enterprise.

Ellen Morris Bishop, our geologist escort, joined us. Ellen stayed with our group through Friday and provided in-depth information on history, economy, and ecology as well as geology. A major concern that morning was the impact of major forest fires that had been burning in the area for weeks. It turned out that the forest fire problems had only a minor impact on our itinerary.

Our first stop was at the Union County Museum in Union, Oregon. The museum contains interesting displays of early settler and native American culture as well as a display of salmon spawning. Ellen gave us a comprehensive overview of geology of the northwest Oregon using maps in the museum.

We next traveled from Union back towards La Grand to visit the Ladd Marsh Overlook. This took us by the former Spa-Hot Lake which has a 185 F hot spring. Hot springs in the La Grand valley are lined along faults that form the trapezoid shaped down dropped valley or graben. This down faulting started about 6 million years ago. The faults are right lateral strike slip faults associated with the "OWL". "OWL" stands for the Olympic Wallowa Lineament, a major tectonic feature of the Pacific Northwest. For geologic details please refer to the reference number one on page 69, the Olympic Wallowa Lineament. "OWL" runs through the Grand Ronde valley, Milton Freewater, Oregon and the Hanford Nuclear Reservation.

The hills bordering the Grand Ronde valley are covered by andesite that is younger than Columbia River Basalt and is associatedwith the "OWL "fault system. Crushed rock made from this 6 to 13 million year old andesite on the local road system was so hard it caused many tire blowouts. It is no longer used for road surfacing. We passed Elgin on our way to inspect the Columbia River Basalts exposed in the new road cuts along the Minum River grade. The Boise Cascade Lumber Mill in Elgin is cutting logs hauled in from Idaho.

Rock exposed in the new road cuts on the Minum grade is 15 million years old Grand Ronde Basalt. These are fine grained and contain some interesting tree casts. Average time between major flows was 5000 years. The lava was very fluid and flowed at a rate of about 2 miles an hour. There are impressive layers of clay and soil pink to red in color between flows. We stopped at the Minum Rest Area in the Wallowa River Canyon about a mile down stream from the paved highway. We had several deer for company during lunch. Across the river was the Union Pacific Railroad that runs from La Grand to Enterprise. At this point the Wallow River had cut through many layers of Columbia River Basalt. Ellen told us that salmon are at the survival level in the Wallowa River.

Just outside of Enterprise we stopped at the Wallowa-Whitman National Forest Visitors Center. Ellen Bishop gave our group an overview of the Wallowa Mountains geology from the viewing deck of the Visitor Center. She had provided the input used for the public display on the geology of the area at the Visitor Center. The north side of the Wallowas has been uplifted 7000 feet along the Wallowa Fault. The north side of the Wallowas was uplifted the most. The group then saw an excellent TV cassette program in the Visitors Center, on the geology of the Wallowa Mountain-Hells Canyon area.

We checked into the Wilderness Inn in Enterprise. Ellen gave a very interesting talk on the geology of the area at supper held at Toma's Restaurant, Enterprise. This closed a long and eventful day.

Reference #1. Notes on the Geology of Northeast Oregon, Ellen Morris Bishop.

DAY 3, ENTERPRISE TO JOSEPH, GRANDE RONDE CANYON, AND MOUNT HOWARD BY CHERRI BRINDA

At 9:15 aboard our coach we departed from Enterprise for Joesph, now hailed as an art community - home of the sculpture "Promised Land", work of David Emanuel. Our first stop was south of Joseph at the Chief Joseph Monument with an overview of Wallowa Lake and classical moraines. Pink Columbia River basalt outcropped on one of the higher peaks here. It was not clear if this was a designated Indian burial ground.

In as much as our tram ride to the top of Mount Howard was delayed, due to unannounced change in winter schedules, our highly spirited group boarded the bus and were off to view basalt dikes in the Grande Ronde Canyon. In near by Flora, irrigation and dam construction uncovered Indian artifacts and pioneer tools of some note. Rolling in a pasture of black Clydesales pastured for pictures, on the Strangle Ranch herds of buffalo grazed and a coyote still in his tracks watched our passing. Large "Sod bumps" along the way may have been a feature of the Pleistocene or related to erratic quaking. We took a break from this flat plateau for lunch at Joesph Creek Canyon, birth place of the younger Joesph. The 2400 foot drop is marked by many basalt flows from about 15 millions ago. The creek flows into the Grande Ronde and then north into the Snake River.

At last, in four passenger gondolas, within 15 minutes we were at the top of Mount Howard. Wallowa Lake was spectacular. The Seven Devils of Idaho were to the east. Here scrubly White Bark Pine swaying is controlled by blasting winds. Original seeds blew to this area from tree stands down hill some time after the last glacial age. Desert Parsley is indigenous on this peak and only one other place in the world.

On the ground again deer roamed about for a hand out, one even poked his head and rack into a visitor's trunk. For him it was business as usual, for others it was an opportunity.

It was an awesome overview from Buck Horn Lookout into the Imnaha River Canyon made by flood basalts beginning 15 million years ago. Some lava built cones and some flowed from fissures within the lava so thick and stable it had been assessed for nuclear disposal waste sites. This day we also discussed the Hurwal and Martinbridge Formations and retrieve excellent specimens

DAY 4, LOSTINE RIVER, NORTH SIDE OF WALLOWA-SEVEN DEVILS VOLCANIC ARC TERRANE, MARTIN BRIDGE LIMESTONE AND HURWAL FORMATION, BY ROSEMARY KENNEY

The day started out rainy but didn't stop us. Our first trip was up the Lostine River to see the greenstone. Along the north side of the oceanic crust lies the Wallowa-Seven Devils Volcanic Arc Terrane made up of Clover Creek Greenstone of Permian age, overlain by Martin Bridge Limestone and Hurwal Formation. The Martin Bridge Formation makes up the precipitous east wall of the Lostine River Valley, and has been turned into marble. In some places along the Lostine River it has been quarried for building stone or for burnt lime. During Pleistocene there were nine large glaciers in the Wallowa Mountains. The Lostine Glacier was the largest, 22 miles long and 2500 feet thick. This glacier carved the Lostine River basin before it retreated and melted.

The Hurwal Formation, which overlies the Martin Bridge Limestone, is a series of argillaceous beds which make up many of the crests of the Wallowa Mountains. It contains hard black hornfels, also shaly and slaty beds of sandstone and quartzite and some limestone. In some places it is 5,000 feet thick.

After picking up a few samples of rocks (the bus is getting heavy, - and here it is, only the fourth day!), we started toward Hat Point to view the Snake River Canyon. Hat Point had been used for a staging area to fight forest fires and the road had been closed until yesterday. We drove through acres of blackened trees. The name Hat Point originated from a cowboy losing his hat in the bush. A nearby stream was named Hat Creek.

The highest point near its headwaters was named Hat Point.

From the summit of He Devil Peak in Idaho to the depths of the Snake River bed is approximately 8,000 feet, 1,000 feet deeper than the Grand canyon of the Colorado. At Hat Point, the depth is 5,620 feet. The Permian to Cretaceous exposed in the canyon walls were deposited long before the Snake River Canyon existed. The canyon has coarse-grained intrusive masses of Permian, Triassic, Jurassic and Cretaceous ages, also dikes connected with the Columbia River Basalt group. These rocks were broken and shattered by folding and faulting, then later intruded by granite batholiths 160 to 75 million years ago. A long period of erosion stripped the sediments off the batholiths. They were then covered with flow after flow of lavas. As the area rose, rivers from the mountains cut down through the layers of rock to create a deep gorge. For almost two-thirds of its route, the Snake River flows through the dark-colored Miocene basalts of the Columbia River group, which are up to 6,000 feet thick in places.

On our return to Enterprise, we followed the Imnaha River stopping to look at more basalt. The Imnaha Basalt, the oldest of the Columbia River lavas, originated from vents and fissures along the Snake and Imnaha rivers, about 24 million years ago. This was overlain by the Grande Ronde basalts about 16.5 million years ago with a frequency of a large flow about 10,000 years to 1 million years. Some of these flows were so runny that they reached the Pacific Ocean. We learned that the Imnaha lava is coarse-grained with medium large crystals. The Grande Ronde lava is fine-grained with no crystals. After collecting samples, the bus got heavier and heavier.

DAY 5, MOVE TO BAKER CITY AREA, HELL'S CANYON OVERLOOK, OXBOW AREA, CORNUCOPIA MINING DISTRICT, AND POWDER RIVER VALLEY, BY PRESIDENT DONALD BOTTERON

Today we move our center of activities to Baker City after several days in Enterprise.

Our first trip took us up to Hell's Canyon Overlook, a trip made easier for Tony, our driver, by a smooth and freshly surfaced road We were well south of the most spectacular parts of the canyon, but a great variety and beauty spreads out before us , with display boards along the trail to explain the formations we see.

Leaving this view from a high level, we head for the center of the earth - but not much on a percentage basis - by the way of the Oxbow area. We had planned to have lunch at Oxbow, but there was hardly enough room to move the bus, let alone park and give some time for a picnic. Giving up, we crossed the Snake River into Idaho and headed down river, north, to the Hell's Canyon dam where we crossed back into Oregon for lunch by the mouth of an old lava tube. Much of the rock along the way was greenstone about the deepest rock I have ever seen. Faults, dikes, and a great variety of rocks and formations greeted us along the drive back toward Oxbow.
(I think Ellen and Tony hurried us along the road to lunch to get us from getting too cranky, but we then took our time with many stops on the way back up the river).

My youth along the bright white limestone cliffs along the east bank of the Mississippi River gave me an impression of limestone which now had to change. Martin Bridge limestone was a surprise to
me, being quite black in many cases. It background: old coral reefs from island arcs, plunged deep by the crowding of land masses, then partly marbleized as it comes back to the surface with some land movements. In cases it was intruded by veins of white limestone-marble (more weight for the bus).

Along the way in this area we were regaled by a multitude of tales by Ray, a local miner-geologist friend of Ellen's. He poured out much geology for us, but interspersed it with so many striking tales that it was hard to keep things in order. Ray left us on our return to Oxbow, but only to pick up his car and dog, after which he drove on to the Cornucopia area ahead of us.
With Ray back on the bus we traveled up Pine Creek into the Cornucopia mining area, with much discussion of the tasks of mining and tales of notable experiences.

Well along in the afternoon we returned Ray to his dog and car and headed for Baker City. One not very geological lesson came when Tony noted his fuel level was low and getting all the way to Baker City might be a tight squeeze. It seems when you let a diesel bus run out of fuel the problems you face are nearly as great as those of redoing the brake system of a passenger car -- so we stopped in the town of Halfway and took on a few barrels of diesel fuel.

Much of this leg was driving up the Powder River valley with a pause to look at the Powder River landslide (which ought to look much better in a few years) and on to our Baker City motel. New rooms, new ways to get lost, and a new dining area with more dinners of too much food. And so it goes, as one of my favorite columnists says.

DAY 6 , THROUGH THE SOUTHERN PART OF THE BAKER TERRANE

BY MARGARET STEERE

On our fifth day with Ellen Bishop we traveled southeast from Baker on I-84 into the southern part of the Baker Terrane. We turned off at Durkee (a place to pass through quickly !) and went up Burnt River, stopping at a lot of outcrops, where Ellen, with mightily blows of her sledge hammer , produced samples for everyone. We saw that the rocks occurred in large blocks rather than in a chaotic melange as in Elkhorn Ridge north of Sumpter. In fact, the Burnt River Schist was so extensive that, as Ellen explained, it was most likely stuffed on the island arc rather than subducted under it. Also, it lacked the mineral glaucophane, a criterion for high compression in a subduction process. Other terrane rock included phyllite, folded in four ways, ocean-floor greenstones, stretched granite, and limestone from knockers separated from a once-continuous layer. Ellen pointed out her discovery of a wedge of Elkhorn Ridge Argillite which proved the same origin for both parts of the Baker Terrane.

On the return trip to Durkee, we had a close encounter with some Mountain Sheep that darted across the road and disappeared Back on I-84 we continued southeast across Cenozoic rocks and lake beds. Farther on we crossed the Connor Creek Fault, a major structure that separates Paleozoic-Triassic Terrane rocks from Jurassic Weatherby Formation. We zipped past the cement plant at Lime, which is no longer operating. On arrival at Farewell Bend State park, We found a beautiful , green oasis and ate lunch on the bank of the Snake River, which, in this part of its course, glides by serenely in a wide valley.

After lunch we headed north on the old US Highway to Huntington, which lies in another part of the Blue Mountains arc complex called the Old Ferry Terrane. Its relation to other terranes is yet to be solved, Ellen told us. Rocks sampled from the roadcut near Huntington were green stones of the Triassic-Jurassic age, representing part of the Huntington Volcanic arc and underlying sediments of the Weatherby Formation.

On the way back to Baker, Don Turner finally got in some railroad words with a story of the "million dollar" tunnel we had just passed that contained enough gold in the rock removed to finance the whole operation. One more rock stop was made on the old highway near Lime to look for fossils in crystalline limestone. The one lucky person was Esther Kennedy, who found a piece of crinoid stem.

THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY.

AIMS AND OBJECTIVES

(1) To provide facilities and leadership for members of the Society to study geology, particularly the geology of the Oregon Country.

(2) To establish and maintain a library of geological publications.

(3) To support and promote geologic study and research, and to designate, preserve and interpret the important geologic features of the Oregon Country.

MEMBERSHIP QUALIFICATIONS

INDIVIDUAL DUES: A person of age 18 or older, shall receive a Newsletter and have one vote.

FAMILY MEMBERSHIP: Adult family members shall receive on Newsletter subscription and have two votes.

JUNIOR MEMBERSHIP: A person under age 18, not included in a family membership, shall receive a Newsletter subscription, but may not vote or hold elective office. For membership application turn to to Page 74

Friday evening we were joined for dinner by Ellen and her husband Dave and their friends, after which Ellen treated us to a slide program on the geology we had covered during the week and summarized that fascinating story of how eastern Oregon became attached to the continent.

Our five days with Ellen, plus having her book to refer to, made for a geologically rewarding experience for all of us and lots of fun besides. Now things like grabens, basalt flows, terranes and volcanic arcs have lost a lot of their mystery.

++

EARTHQUAKES IN FLORIDA ????

We have received from Laurette Kenney, an Honorary Life Member of the GSOC, a note and news clipping about earthquakes in the state of Florida. A listing of earthquakes in the United States of some years ago reported that there were no reported earthquakes in the state of Florida, but the Miami News reports that since 1870 there have been about 50 earth movements reported by the Florida Geological Survey.

This report turns out to be a bit like UFO reports, in that nearly all of them could be directly attributable to blasting, military actions, or other noisy events. There remain six events which can be definitely be classified as earthquakes, but in this period of time none were rated as really serious producers of any great damage.

A more novel sidelight was a huge wave that inundated parts of Daytona Beach on 3 July 1992. Seismographs showed nothing at that time. However, a boater off Datyona Beach reported seeing a meteorite plunge into the ocean in the distance, and some time later he experienced the wave passing him. University astronomers checked the reports and compared the timing with some of their own. Their conclusion was that a meteorite three feet in diameter had plunged into the ocean and caused the wave. One could shudder to think what might have happened in the state of Florida if the meteorite had come in over land and in a populated area,

Donald Botteron

APPLICATION FOR MEMBERSHIP
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SPOUSES FIRST NAME________________________________
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____
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GEOLOGICAL INTERESTS AND
HOBBIES____

REMITTANCE OF $____________________________**FOR DUES IS ATTACHED**
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