JAN 96

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GEOLOGICAL SOCIETY
OF THE OREGON COUNTRY
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GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

SINCE 1935

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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, and August. 8: pm, Room S17, Crammer Hall, Portland State University. Library: Room S7, open 7:30 pm prior to meetings.

PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00 pm, Room 371, Crammer Hall Portland State University, SW Broadway at SW Mill Street, Portland.

LUNCHEONS: First and Third Fridays each month, except holidays, at noon. Bank of California Tower, 707 SW Washington Street, 4th floor Cafeteria, California Room.

MEMBERSHIP: per year from January 1: Individual - $20.00; Family - $30.00; Junior (under 18 years) $6.00. Write or call Secretary for membership applications. NOTE: application is on this page.

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Geological Interests and hobbies:______________________
Individual: $20.00______________Family: $30.00______________
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VISITORS WELCOME
INFORMATION: 9AM-5PM, 321-6239
after 5PM, 775-6263

VOL. 62, No.1
JANUARY, 1996

JANUARY ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Lunch with members in cafeteria at 11:30 AM, if desired)

Jan. 5: Yellowstone
Lois Sato, GSOC member

Jan. 19: Historical Pottery Sites in Oregon
Harvey Steele, Oregon Archeological Society

FRIDAY EVENING MEETINGS: 8:00 pm Portland State University, Cramer Hall, Rm. **383** (NOTE ROOM CHANGE!)

Jan. 12: Natural History of Capitol Reef
Don Barr, ret. science & photography teacher, GSOC member

Jan. 26: TBA

GEOLOGY SEMINAR: 8:00 PM. Portland State Univ., Cramer Hall, Rm. S-17

Jan. 17: High Lava Plains Seminar leader: Ray Crowe. Please read Ch. 5, pp. 103-120 in Orr, Orr & Baldwin's Geology of Oregon, 4th Ed., before coming to seminar.

YOU'VE ALREADY PAID YOUR DUES? **GOOD FOR YOU!**
YOU **HAVEN'T?** THE DEADLINE IS **JANUARY 31**!!!!!

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES **MUST** BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

THE CALENDAR YEAR FOR THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY BEGINS JANUARY 1 AND ENDS DECEMBER 31. DUES ARE DUE BY THE END OF DECEMBER. DUES NEED TO BE PAID TO BE INCLUDED IN THE NEW MEMBERSHIP ROSTER.

WHAT'S BUGGING THE ENVIRONMENT
by S. Welch

Environmental pollutants such as pesticides, solvents, petroleum products, and other toxic substances can accumulate in the soil and water, threatening the health of plants, animals, and people. For years, scientists have recognized the important role that microorganisms play in biodegrading, or breaking down these substances. A cleanup method called bioremediation uses living organisms (primarily,microorganisms) to degrade environmental pollutants to prevent pollution through waste treatment. This technology has applications in cleaning contaminated sites as well as preventing further contaminated sites by managing pollutants as they are generated.

In many situations, the indigenous organisms (those that occur naturally at the pollution site) can biodegrade contaminants without influence from humans. But some compounds are resistant to biodegradation, presenting challenges for environmental scientists who must design methods to enhance the biodegradation process. Important research is underway to identify microorganisms that attack more efficiently an increased number of compounds, and are capable of doing so under a broad range of conditions. Especially in demand are organism that can tolerate extremes in temperature and pH (acid or basic environments) and the presence of organic solvents.

In some cases, scientists are able to genetically engineer new microbial strains with unique abilities to biodegrade. Scientists engineered a strain of Psuedomonas fluorescens HK 44 with genes for naphthalene degradation and also genes for bioluminescence (firefly-like light emitted by an organism) . The gene for bioluminescence is a reporter gene that causes an easily monitored effect when certain microbial activities occur. In the case of *Psedomonas fluorescens HK44*, when naphthalene and other hydrocarbon pollutants are degraded, light is emitted. Here, bioluminescence is an indicator for monitoring and controlling the progress of biodegradation.

Although microbes can be introduced onto a contaminated site, most of the successful applications of biomediation have been where the environment is modified to stimulate the naturally occurring organism. Cleanup of the *Exxon Valdez* oil spill was one of the largest bioremediation projects in the United States. After the tanker spilled 11 million gallons of crude oil into Prince William Sound in March of 1989, abut 11,000 workers spent the summer attempting to clean 1,000 miles if shoreline. High-pressure water was used wash the rocks, which cost Exxon more than $1 million per day, but which left subsurface oil to recontaminate the shoreline.

During the second stage of cleanup, bioremediation consisted of the application of nitrogen and phosphorus fertilizers to the shoreline. The treatment stimulated the hydrocarbon-degrading microorganism that were abundant in the waters of Prince William Sound. As a result, oil contamination impacted the shoreline for only a couple of years, compared to the possible decade that might have occurred if left untreated. Although the actual cost of bioremediation was only $1 million, the field demonstration (monitoring studies) added $10 million to the bill.

Bioremediation accelerated the biodegradion of oil, but did not completely remove all contamination. Most of the residual oil is bound up in water-soluble asphalt-like materials that are nor expected to impact biological systems but are expected to degrade slowly over time.

Source:

Atlas, RM., 1995, Bioremediation: American Chemical Society, Chemical and Engineering News, v.73, no. 13, pp. 32-42.

Sayler, G.S.,1995. Biomediation:American Chemical Society News, v.73,no.14, pp.32-42.

This article was taken from LITE GEOLOGY, Summer 1995

New Mexico Bureau of and Mineral Resources, New Mexico Tech, 801, Leroy, Socorro, NW 87801

ROCKS FROM SPACE----This guide to meteorites, asteroids and comets is written for rockhounds, astronomy buffs, and the inquiring layperson. ROCKS FROM SPACE tells the story of cosmic debris, including the science , superstition, and tales of people who collect them. The 464--page paperback book costs $20.00 plus shipping, and is available from Mountain Press, 1301 S. Third West, P.O.Box 2399, Missoula, MT 59806. Their toll-free phone number is 1-800-234-5308. The Mountain Press catalog contains various titles on Earth science, gems and minerals natural history, and children's topics.

COMPLETELY FRACTURED GEOLOGY

by Evelyn Pratt

1. basin and range: common household objects, esp. in the kitchen
2. hornblende (music): harmony in the brass section
   bayou: (1) being next to someone (2) (slang) "Is it OK bayou?"
4. Ma: (1) short for Mother (2) all-purpose sound used by goats, sheep, calves, etc.
5. eustatic: really excited, as in "I'm just eustatic about my new boy friend!"
6. histogram: a written record of the growth of some fellow's pedal digit
7. allochthon: an annual competition among safecrackers
8. electric log: fake fir in the fireplace
9. erg: exclamation of disgust, as in "Erg! Brussels sprouts again!"
10. ductile: What a Cockney says when he sees a mallard feeding upside down in a pond; "Hi say, look at that ductile, will ya?"

CORRECT ANSWERS ON PAGE 75

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TIMELY DEVELOPMENTS IN GEOLOGIC AGE DATING

ALEXANDRIA , VA. Time sets the sequence of science of geology apart from almost all other physical and social disciplines. When geoscientists talk about " ancient" history, they are referring to events that may have occurred millions or even billions of years ago. But until the discovery of radioactivity in the late nineteenth century, they could do little more than sequentially record what was revealed in the fossil record. Since theN, geochronologists have made steady progress in the use of isotopic dating techniques to tract the evolution of life on Earth and structural changes in the planet itself. In the November issue of GEOTIMES, three geochronologists discuss new dating techniques which reveal evolutionary patterns from the Quaternary to the Precambrian.

Physicist Chris M. Hall (University of Michigan) reports that both carbon and argon dating methods went through technological revolutions in the 1980s. In "Dating Quarternary Things," he describes how the negative-ion accelerator mass spectrometer (AMS) allows researchers to determine the amount of contamination by separating carbon-14 from similarly massive molecules, such as nitrogen-14. AMS has dramatically reduced the size of sample needed, speeding up the process of obtaining accurate ages, he states. Another breakthrough technique occurred when argon 40/argon-39 dating techniques were combined with low, blank-mass spectrometers and laser-fusion systems.

In the interval between the Quaternary and the Precambrian, the relative ages of sedimentary rocks can be determined by using the evolution of fauna and flora as a measure of time, writes Paul R. Renne of Berkeley Geochronology Center. In "Dating Earth's Middle Ages," he explains that the radioactive decay schemes most useful for dating middle-aged rocks include potassium-argon, rubidium-strontium, uranium-lead, thorium-lead, samarium-neodymium, and fission-track. Each method is useful for various purposes. In U-Pb zircon dating, for example, is most important in the Mesozoic and Paleozoic, while Ar-Ar dating is more important in the Cenozoic and Mesozoic, where the high concentration of potassium often produces measurable radiogenic isotopes. Since boundaries in the geologic time scale tend to be defined by major changes in the fossil record, precise dating of these boundaries -- and of the events that may have caused them -- is one of the most important approaches for investigation the causes of mass extinctions.

Moving back several hundred million years, Thomas Krogh (University of Toronto and Royal Ontario Museum) describes some results from dating zircon in gneisses -- circa 1,700 Ma in northwestern Grenville Province, Ontario -- that have undergone major metamorphism and structural deformation. Krogh explains that although rubidium-strontium dating and uranium-lead dating techniques we utilized, the latter yields the best results. T... problem with Rb/Sr isochron method is that minor mineralogical reactions produce scatter, and in some cases, whole data sets prove themselves unreliable

The article TIMELY DEVELOPMENTS IN GEOLOGIC AGE DATING was written by Victor van Beuren:E-mail: vvb@agi.umd.edu. The article was taken from America Online and Inernet.

CORRECT DEFINITIONS adapted from Dictionary of Geological Terms, 1984 edited by Bates & Jackson; also Random House Dictionary, 2nd Edition

1. basin and range: landscape characterized by a series of tilted fault block mountains with broad basins between
2. hornblende: a black amphibole common in acidic and intermediate igneous rocks and in metamorphic rocks
3. bayou: a sluggish stream winding through coastal swamps or river deltas
4. Ma: abbreviated Latin phrase signifying millions of years of age
5. eustatic: of or pertaining to worldwide changes of sea level
6. histogram: a vertical-bar graph in which the height of the bars represents how often an event happens, and the width equals class intervals
7. allochthon: a mass of rock that has been moved a long distance from where it originated, commonly by a tectonic process such as overthrusting
8. electric log: a record of electrical measurements in the rock walls of a well that is being drilled
9. erg: a vast area of sand such as those found in parts of the Sahara Desert
10. ductile: description of a rock that can take up to 5-10% deformation before it fractures or faults

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY TO BE INVOLVED IN .ENDING ASSISTANCE FOR THE 1996 "CORDILLERAN SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA MEETING TO BE HELD IN PORTLAND APRIL 21-24.

November 13, 1995. Two weeks ago Professor Michael Cummings of the PSU Geology Department asked if GSOC could lend assistance for the 1996 "Cordilleran Section" (most of the western U.S.) meeting of the Geological Society of America, to be held at the Lloyd Center Red Lion Hotel April 21-24. At each year's conference, in addition to numerous field trips for professionals attending the meeting, they provide scheduled activities for spouses and guests of attendees. GSOC was asked to organize and sponsor those activities. I gave an immediate "yes", since this sort of activity is close to the heart of our Society's mission. I formed a "GSA Committee" to make suggestions. I wish to thank Charlene Holzworth, Eveleyn Pratt, Ken Yost, Bev Vogt, Richard Bartels, Rosemary Kenney, and Cecelia Crater for their work in a committee that met entirely phone. I hope I didn't miss anybody.

The result was seven activities shown below, with the idea that Dr. Cummings would use his experience from prior conventions to decide which ones would be best meet their needs. He chose three: **the Columbia Gorge "short trip", the Garden tour, and the downtown/ West Hills tour**. He believes that there would be demand for only one per day, so they would take place on Monday, Tuesday and Wednesday in the order named. PSU would line up a van and driver for each trip (probably a Geology student) and we would supply the tour Host(s).

I pegged each trip to break even financially about 8 participants. The principal expenses will be the van rental ($27.56 + $.16/mile) and driver ($6.50/hr) and admission fees. One GSOCer must participate, and I hope other ll be willing to participate on a standby basis. Most GSA spouses will register in advance, but we should accept additions up through Sunday, April 21. I wish I could offer the GSOCers on standby price breaks, but I don't see how.

This week I will appoint "trip chairmen" to work out the details of each trip, and possibly serve as Trip Host, and I will keep in touch with Dr. Cummings. I also said that we would have a representative present at the meeting during registration to act as Hospitality in whatever capacity seems appropriate.

The exercise or organizing this activity has already two useful spin-offs. (1) We can extend the committee's activities to 1997, when Portland hosts the national meeting of the Association of Engineering Geologists. I will contact the convention organizer to volunteer our services. (2) I have taken one of Dr. Cummings "rejected" and will turn it into a GSOC field trip. Sometime in March I will lead a Northern Oregon Coast Stratigraphy trip from Tillamook to Cannon Beach.

Clay Kelleher, President GSOC

The three trips planned for spouses are (1) **Columbia River Gorge Scenic Trip**, Monday April 22 , with stops at Crown Point, Multnomah Falls, Bonneville Dam fish hatchery and locks, Cross the Bridge of the Gods and have lunch at Skamania Lodge and a return stop at **Penidleton Woolen Mills and Fort Vancouver National Historic Site.. (2) Portland area gardens--visit four gardens including Leach Botanical Gardens, Crystal Spring for a display of rhododendrons, Rose Gardens and the Berry gardens. (3) Portland downtown and** **:st Hills---Tour of downtown, travel to heights of west downtown to Pittock Mansion, Hoyt Arboretum and Japanese Gardens.**

EVOLUTION OF COMMUNIATION

by Dr. John Eliot Allen
8-15 April, 1995

Proliferation during the last decade of alternate methods of communication assures new breakthroughs in many of the most important aspects of our culture. I suspect that the last twenty years, or even the entire twentieth century will be known as the "Communication Age"

Beginning in prehistoric time, I was able to come up with the following list of possible dates: K = one thousand years)

Prehistoric:

4,000K Primitive language
2,000K face to face speech and messages by voice
6K clay tablets
4K ALPHABET, written language
3K stylus on wax, ink on papyus, on parchment
3K ink on paper (China)
600AD moveable type (Japan)
1450AD PRINTING (Gutenberg), the greatest communication breakhrough for western civilization

Nineteenth century:

1827 microphone (Wheatstone)
1835 calculating machine (Babbage)
1837 telegraph (Morse)
1839 PHOTOGRAPHY (Daguerre)
1850 Pony Express, letter and package mail
1867 typewriter (Glidden)
1876 TELEPHONE (Bell)
1877 phonograph (Edison)
1884 fountain pen (Waterman)
1893 motion picture (Edison)
1895 RADIO (Marconi)
1899 tape recorded (Poulson)

Early within this century we developed:

1906 vacuum tube (de Forest)

1926 TELEVISION (Jenkins)
1927 sound motion pictures)
1938 xerography (Carlson)
1944-47 diode computers (Aiken, Von Neuman)
1947 holograph (Gabor)
1948 TRANSISTOR (Battain)
1955 fiber optics (Xapany)
1970 liquid crystal display (LCD)
1970 bar codes (Plessy)
1970 compact disks (CD)

During the last 30 years there has been an explosion of invention in methods of communication, largely a result of reduction in size of elecctronic chips (transistors).

XEROX, for easy duplicating, followed by FAX,for transmission by phone.

Videotapes, for home access to movies, etc.

Fiber optics, for increassing the number of messages over the same cable

PERSONAL COMPUTERS (PC), with mouse and "windows" for easy access and a multitude of softeware programs, such as spellers, encyclopedias, etc.

modems for telephone connections, followed by E-mail and voice mail.

Printers, first with dot matrix, then laser, then bubble jet, which permitted desk-top publishing

PC's reduced in size to laptops, and "notebooks" developed.

CD ROM compact disk - read only memory, enormous amout of information available on one disk.

SATELLITES, for world-wide transmission of TV and telephone.

INFORMATION SUPERHIGHWAY - with innumerable world-wide computer-telephone destinations on line through Internet and dozens of other networks.

Cyberspace and virtual reality (VR) - who knows what this will ressult in?

This flood of different kinds of information has so recently become available that it has really not had time to be accepted and used by the general public, its possibilities have yet to be really analysed or predicted. Surely these last few years will come to be known as the beginning of the "Communication, or Information Age", as important in the evolution of mankind as the invention ᶠ speech, the alphabet or printing.

FEB 96

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VOL. 62, No. 2
FEBRUARY, 1996

FEBRUARY ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Lunch with members in cafeteria at 11:30 AM, if desired)

Feb. 2: Colorado Plateau: America's Scenic Wonderland
Evelyn Pratt, GSOC member

Feb. 16: Thermal Testing in Newberry Crater
Dave McClain, CE Exploration Co.

FRIDAY EVENING MEETINGS: 8:00 pm Portland State University, Cramer Hall, Rm. 383 (NOTE ROOM CHANGE!)

Feb. 9: The Great Missoula Floods
Richard Waitt, USGS, Cascade Volcano Observatory

Feb. 23: Intracanyon Flows of the Columbia River Basalt in Western Oregon
Dr. Marvin Beeson, PSU Geology Dept.

GEOLOGY SEMINAR: 8:00 PM. Portland State Univ., Cramer Hall, Rm. S-17

Feb. 21: Deschutes-Columbia Plateau Seminar leader: Rosemary Kenney. Please read Ch. 6, pp. 121-137 in Orr, Orr & Baldwin's Geology of Oregon, 4th Ed., before coming to seminar.

All presentations are open to the public, and are free. Questions may be addressed to Clay Kelleher, 321-6239 9AM-5PM, or Evelyn Pratt, 223-2601.

ANNUAL DINNER, MARCH 8,1996, SPEAKER: DR.WILLIAM ORR, PROFESSOR OF GEOLOGY, UNIVERSITY OF OREGON.VANPORT ROOM, SMITH MEMORIAL CENTER, PSU

FIELD TRIP: Clay Kelleher will lead a field trip to the northern Oregon coast March 30-31. Be sure to mark your calendar!

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES **MUST** BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

61ST ANNUAL BANQUET NOTICE

PLACE: VANPORT ROOM, third floor, Smith Memorial Center, Portland State University

DATE: March 8, 1996. **PUT A MARK ON YOUR CALENDER !!!!!!!!!**

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

SPEAKER **Dr. William Orr**, Professor of Geology, University of Oregon will speak on the **"Geology of Pacific Northwest"**

TICKETS: Ticket Chairpersons, Freda and Virgil Scott, 8012 SE Ramona Street, Portland, OR 97207. Send your payment and a self-addressed envelope for return tickets. Tickets will be available at all GSOC meeting. **PLEASE PURCHASE YOUR TICKETS EARLY**. It will help the Banquet Commettee in planning and you have better choice of table spaces.

PRICE: Cost of the banquet ticket is $14.50 each. Bring tickets to the banquet: they will be 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 TO PARK ON THE FIFTH FLOOR!!!!!!!.** ***READ ON***---if you coming early to work on the banquet or you are setting up an exhibit call Rosemary at 221-0757 so you name is on a li at the check station at the entrance to the parking structure. Do not park in spaces marked "Reserved" or "Handicapped". From the 5th floor of the parking garage, a short stairway leads to a foot-bridge across Broadway to the level of the banquet rooms.

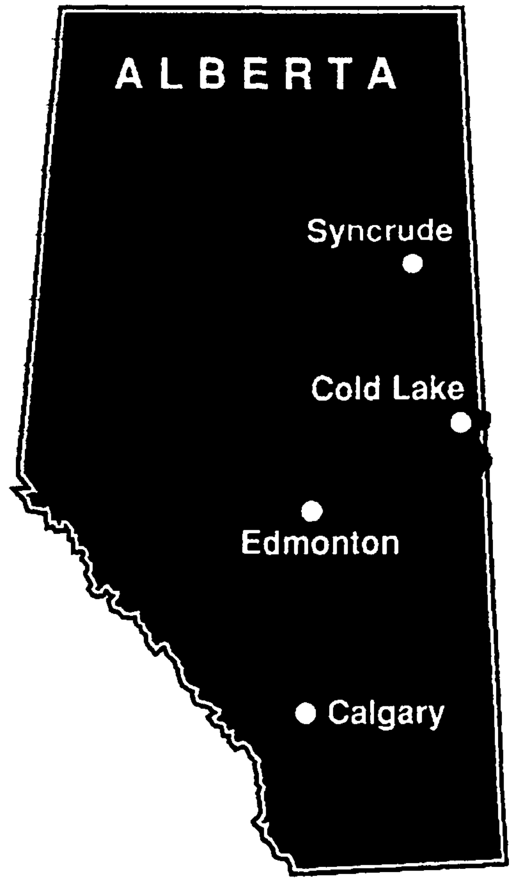
BANQUET SALES TABLE NEEDS GOOD MATERIAL

Proceeds from the sales table at the Annual Banquet go to help meet the expenses of the bamquet. Please bring **EYE CATCHING AND SALABLE** material that will attract purchasers. No large, heavy specimens, please. Limit your material to hand specimens or smaller. Suggested material: minerals, slices of agate, crystals, fossils, thundereggs, tembled agates, geodes, worthwhile books on geology, natural history and jewelry. If you need help in transporting your material to the buillding, phone **Archie Strong** at 244-1488 or Harold and Patricia Moore at 245-0135.

PROVIDE A BANQUET EXHIBIT

Displays for the Annual Banquet on March 8 are eagerly solicited. Exhibits of roc cords. The exhibits, minerals fossils, pictures or any hobby related to geology 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 3:00 p.m. in the afternoon of the banquet. REMEMBER: If coming to set up before 5:30 p.m. you must call Rosemary Kenney at 221-0757 as your name must be on the list at the entrance the parking structure. **No one gets to park early unless his or her name in on the list.**

The following article "Heating Up Cold Lake" taken from THE LAMP, a publication by Exxon Corporation. Permission to reprint the article was given by the Exxon Corporation.



Canada's 'ugly duckling' becomes the swan of oil-sands production

Heating Up Cold Lake

by Ted Bower

Once shunned as industry's ugly duckling, Canada's rich Cold Lake oil sands are the country's second-largest source of crude oil after its giant Syncrude project.

Imperial Oil Limited is drilling 400 wells at Cold Lake at the rate of more than one a day in perhaps the fastest-paced oil field development project in the world.

Production is up 7,000 barrels a day over last year.

Canada's largest oil company expects to raise its Cold Lake production more than 30 percent, from 97,000 barrels daily to 130,000 barrels, by 1997.

The Exxon Corporation affiliate plans to invest $175 million in the current round of drilling. Further investment will boost production from older wells and improve other facilities in years to come.

Deep in the forests of northern Alberta, the company's 2,000 Cold Lake wells already deliver one in 20 barrels of oil produced in Canada. Imperial's single l[illegible]st asset, the field accounts for one t[illegible] of its crude oil production.

Only over the last 10 years has Cold Lake risen to its present prominence and ever more promising future. Most geologists, petroleum engineers and bankers wrote it off years ago as a geologic curiosity beyond the reach of technology, profits and common sense.

Cold Lake's curse has been the quality of its oil – a heavy, highly viscous petroleum almost as thick as asphalt. Its lure has been billions of barrels of bitumen – nearly 20 times the size of Alaska's Prudhoe Bay oil fields.

Yet it is, in fact, exasperatingly difficult to produce tarlike bitumen from oil sands. Imperial started up its first pilot project at Cold Lake in the mid-1960s, heating up the bitumen by injecting steam to make it flow.

Some 20 years later, in 1985, the company drilled enough wells and raised enough steam to extract 25,000 barrels of bitumen a day. The steam, at 575 degrees Fahrenheit, softens the tarry oil to about the thickness of molasses. Then it's pumped 1,500 feet to the surface.

To the surprise of industry skeptics, the company had launched a profitable operation. But after 30 years and almost $400 million spent on research and pilot plants, Imperial Oil celebrated it all as a well-calculated success. The determined Canadians had changed an ugly duckling into a swan.

What's made it grow in a single decade to become the world's largest thermal-recovery project might well be attributed to a setback that the company never long forgets: poised in the early 1980s to go ahead with a mega-sized oil-sands development at Cold Lake, Imperial pulled back when oil prices collapsed.

Instead of proving its critics right, the company deftly recovered with a new plan that became its strategy for developing Cold Lake well into the next century. The key is what Imperial calls "phased development."

Simply put, the company drills only enough wells and builds enough steam-making and processing facilities to produce just enough oil for which there is a market at a profitable price. The phases are developed in pairs, e.g., Phases 7 and 8. Each pair of phases is a separate project that produces about

HUFF AND PUFF

A cluster of wells at Cold Lake works to extract bitumen - a heavy oil as thick as asphalt - from oil sands 1,500 feet below the snow-covered forests of northern Canada. Engineers inject steam at temperatures of 575 degrees Fahrenheit at pressures of almost 1,500 pound per square inch into the oil sands.

The wells "soak" for a month as the intense heat and extreme pressure soften the bitumen to a molasses-like thickness. It is then pumped from the earth with familiar rocking-horse pumps (right). The steam and pump cycle is repeated.

The same wells are used for both steaming and production. The process is called cyclic steam stimulation, or "huff and puff," for the alternating cycle of steam injection and bitumen recovery.

Cold Lake, Canada's second-largest oil-producing operation, is one of the pockets of oil sands in Alberta that hold enough recoverasble bitumen to meet the countrt's needs for 200 years.

20,000 barrels of bitumen a day.

Phases 1 and 2 included 280 wells, central utilities and a processing plant. When oil prices sagged in 1989, Imperial quickly shelved drilling plans and mothballed a central plant and facilities for Phases 9 and 10. Last year, as prices recovered, the light flashed green for those phases.

Taking an economical slice at a time, Imperial still has many slices to take. Starting in the best area, the company has developed only 15 square miles of the 300 square miles it has under lease there. Its leases hold some 38 billion barrels of Cold Lake's estimated 220 billion barrels of oil.

With today's technology, the company says more than 750 million barrels of bitumen are economically recoverable from its holdings. With tomorrow's technology, prospects can only improve.

"Our conviction is that oil sand production can be profitable now despite flat prices and world oversupply," says Howard Dingle, vice president for oil with Imperial's resources division in Calgary. "Price isn't going to save us. We have to do that for ourselves."

Says Cold Lake's operations manager, David Boone, "We have cut unit operating costs more than 50 percent since start-up, from $6 a barrel to under $3 a barrel." Bitumen sales revenue last year reached $273 million from an asset base of $800 million.

Technology is the ticket to lower costs and higher production. Researchers in the 1970s estimated 13 percent of the bitumen could be economically recovered. Through research, Imperial has doubled that rate at Cold Lake.

Investing up to $11 million a year in oil-sands research and pilot programs, the Canadians believe the recovery rate can go much higher.

"To us," says Boone, "research is another form of exploration."

Every day, 97,000 barrels of bitumen are diluted with 27 percent natural gas condensate (liquids) to make the heavy oil thin enough to flow through pipelines. The mixture yields more than 130,000 barrels of what's known as "Cold Lake blend." About 60 percent of it goes by pipeline to markets in the United States. The rest is sold in Canada.

As more refiners in the midwestern United States turned to heavier oils to reduce their costs, demand rose nearly 30 percent over the last six years. Imperial estimates demand for Cold Lake's heavy oil will grow four percent a year through the end of the century.

Senior Vice President for Resources Doug Baldwin already looks ahead to Phases 11 through 14, noting that the incremental cost of each one gets cheaper. "We can develop this bitumen for less than it costs to develop oil from a number of other sources, thanks largely to research and technology," he says. "Cold Lake looks more attractive all the time."

Two thirds of Alberta's conventional oil reserves have been produced. But the western province's oil sands make up one of the three largest crude oil reserves on Earth. Thus, Cold Lake and other oil sands stand to play a growing role in Canada's and Imperial's future.

COMPLETELY FRACTURED GEOLOGY

Ralph & Evelyn Pratt

1. composite cone: a crisp, conical wafer filled with alternating ribbons of chocolate and vanilla ice cream
2. effluent: referring to a man who travels by air, as in "Effluent to town last Saturday."
3. endothermic: pertaining to the end of a college year
4. geologic crust: an attitude professors find among some earth science undergrads
5. Love wave: saying goodbye to one's sweetie
6. lodgment till: what Ann Landers advises against saying to a miserly brother-in-law, "We'll give you lodgment 'til you find another place to stay."
7. provenance: Rhode Island's largest city
8. scoria: what followers of sports are always asking: "What's the scoria?"
9. tsunami: a Japanese delicacy made with raw fish
10. Isotope: hot springs of the Greek God of topography

CORRECT ANSWERS TO "COMPLETELY FRACTURED GEOLOGY" on Page 12

This issue of the Geological Newsletter will begin a new feature--the minutes of the Geological Society of the Oregon Country's Board meetings.

Geological Society of the Oregon Country Board Meeting, December 11, 1995

The meeting was called to order at Esther Kennedy's apartment at 7:25 p.m. The quorum consisted of President Clay Kelleher, Treasurer Phyllis Thorne, Secretary Carol Cole, Directors Booth Joslin and Cecelia Crater, and Past President Esther Kennedy. Absent were Richard Bartels, Don Botteron and Bill Greer. Business Manager Rosemary Kenney also attended.

The October minutes were approved as read.

Phyllis presented the Treasuer's report, briefly as follows: the bills are paid to date. We have remaining: $243.67 in the checking and $5,353.31 in savings.

Old Business

Suzy Sudbrock has graciously agreed to publish the 1996 membership roster, as long as the list is again handed to her on a floppy disk, which Carol agreed to do.

Clay did not mention whether or not he has found Hospitality Chairmen for the upcoming year.

Clay will not be doing a Walk to a Rock field trip soon. He will organize a field trip, however, for late March to the Oregon Coast, a rainy weather field trip.

New Business

The process of voting was discussed, and the by-laws were consulted. As they are unclear about who can vote (Article IV, Section 4) this Board decided that since the nominations for next year's officers are chosen from this year's members, this year's members and the new members will have voting rights. This year's Annual Business Meeting will be Friday night, February 23, 1996. Don Barr, Newsletter Editor, will be doing the labels for the voting members. Esther Kennedy and Phyllis Thorne have taken the responsibility for getting out the ballot mailing. The Secretary brought a past sample to this Board meeting. The ballots will be mailed out between January 10 and February 2.

The PSU Scheduling Office, Karen Robertson, has changed GSOC meetings to Room 383 for the 1996 meeting at $20.00 per time. Clay will look at this room tomorrow to see if it will be satisfactory, and will call Don Barr to get any room change into this month's newsletter mailing in time for the next general meeting. Room 371 has been given to a larger group for the upcoming year.

It is noted that if the room number is changed, the Secretary will need to change the Brochures information (and remember to use Landscape computer format this time.

On January 1, 1996 or there abouts, the Treasurer will release the names to the Secretary of those who have paid for 1996 memberships.

The 1996 Board nominations were published in the December newsletter, per our by-laws, as follows: President: Richard Bartels, Vice President: Paul Brown, Secretary: vacancy, Treasure: Phyllis Thorne, Director: Ray Crowe to fill Booth Joslin's position. Additional names were discussed for the Secretary's position, which Clay will get to this year's nominating committee.

The 1996 Banquet Chairman will again be Evelyn Pratt, who gave Clay the following details. All of the 1996 banquet activities will be held in the former Exhibits room, which has been reserved for $75.00 for March 8th , the second Friday in March. We will have exhibits, dinner and a speaker, as before.

The board ratified de facto hard work by several GSOCers for the committee that Clay hosts for the upcoming Geological Society of America, Cordilleran Section large scale convention to be held April 22, 23, and 24 in Portland at the Red Lion Inn at Lloyd Center. Michael Cummings has asked the Society to provide escorts, set fees, collect fees for spouses and friends who will be attending the meeting with the professionals but who want also to see something of our area. Three good day trips were chosen from suggestions by several GSOCers, meeting by phone, and will be hosted as follows: Charlene Holzwarth, garden town; Don Barr, Columbia River Gorge tour; Evelyn Pratt, Portland downtown and West Hills tour. PSU will provide the vans; GSOC will take any profits from this portion of the events, and will break even if 8 people sign up for each trip. According to Clay, only those who have paid the full convention amount will be eligible to fill in the 15 places if the vans are not filled. If more vans are needed, PSU will provide them, and PSU's insurance will be in force for these events.

The next Board meeting will be directly after the annual Business Meeting February 23rd for new bank signatures, to approve the Treasurer's responsibility for bill paying and to set the date and place for the new Board's first meeting.

There being no further business, the meeting was adjourned at 8:40 p.m. for welcome refreshments.

Respectfully submitted

Carol Cole
Secretary

CORRECT DEFINITIONS for COMPLETELY **FRACTURED GEOLOGY** adapted from Dictionary of Geological Terms, 1984 ed. by Bates & Jackson

1. composite cone: a stratovolcano, partly lava and partly pyroclastics such as ash and lapilli
2. effluent: (1) a stream that flows out of a lake (2) a liquid discharged as waste, such as contaminated water from a factory or sewage outfall
3. endothermic: pertaining to a chemical reaction which absorbs heat
4. geologic crust: the outermost layer of the earth
5. Love wave: a horizontal surface wave that travels crosswise to the direction from which the wave originates
6. lodgment (or lodgement) till: compact, easily split drift deposited from the under side of a glacier, having stones oriented with their long axes parallel to the glacier's direction of movement
7. provenance: a place of origin; specifically, the area that the sediments in a sedimentary rock came from
8. scoria: a spongy-textured cindery crust on the surface of lava flows
9. tsunami: a great sea wave produced by a submarine earthquake or volcanic eruption
10. isotope: elements having the identical number of protons in their nuclei, but differing in the number of their neutrons. Isotopes have the same atomic number, differing atomic weights, and almost but not quite the same chemical properties. Different isotopes of the same element have different radioactive behavior.

MAR 96

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GEOLOGICAL SOCIETY
OF THE OREGON COUNTRY
P.O BOX 907
PORTLAND, OR 97207

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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, and August. 8: pm, Room S17, Crammer Hall, Portland State University. Library: Room S7, open 7:30 pm prior to meetings.

PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00 pm, Room 383, Crammer Hall Portland State University, SW Broadway at SW Mill Street, Portland.

LUNCHEONS: First and Third Fridays each month, except holidays, at noon. Bank of California Tower, 707 SW Washington Street, 4th floor Cafeteria, California Room.

MEMBERSHIP: per year from January 1: Individual - $20.00; Family - $30.00; Junior (under 18 years) $6.00. Write or call Secretary for membership applications. NOTE: application is on this page.

PUBLICATIONS: THE GEOLOGICAL NEWSLETTER,(ISSN 0270 54511) published monthly and mailed to each member. Subscriptions available to libraries and organizations $10.00 per year. Individual subscriptions $13.00 per 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 price list.

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THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY.

Name:____________________ Spouse____________________
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Address:____________________
City:________________ State__________ Zip__________
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Geological Interests and hobbies:____________________
Individual: $20.00________________ Family: $30.00________________
Junior, under 18, not included with family membership: $6.00________________
Make check payable to : The Geological Society of the Oregon Country
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GEOLOGICAL NEWSLETTER

THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY
P.O. BOX 907, PORTLAND, OR. 97207

VISITORS WELCOME
INFORMATION: 9AM-5PM, 321-6239
after 5PM, 775-6263

VOL. 62, No. 3
MARCH, 1996

MARCH ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Lunch with members in cafeteria at 11:30 AM, if desired)

Mar. 1: A Backward Glance at Southwest Parks: 1983
Lois Sato, GSOC member

Mar. 15: 360° of Mt. St. Helens
Phil Johnson, GSOC member

FRIDAY EVENING MEETINGS: 8:00 pm Portland State University, Cramer Hall

ANNUAL DINNER: MARCH 8, 1996
WILLIAM ORR: "GEOLOGY OF THE PACIFIC NORTHWEST"
Vanport Room, Smith Memorial Center, PSU

Mar. 22: The Great Missoula Floods (rescheduled)
Richard Waitt, USGS, Cascade Volcano Observatory
ROOM 371 - this meeting only! Large room needed due to heavy demand.

GEOLOGY SEMINAR: 8:00 PM, Portland State U., Cramer Hall, Rm. S-17

Mar. 20 (Wed.): Cascade Mountains. Seminar leader: Don Barr. Before the seminar, please read Ch. 7, pp. 141-165 in Orr, Orr & Baldwin's Geology of Oregon, 4th Ed.

March 30-31. NORTH OREGON COAST FIELD TRIP

(Back up date, April 13-14 in case of seriously inclement weather)

Join us for a 2 unhurried days of geology between Astoria and Tillamook, including several stops at scenic State Parks. Caravan departs Camp 18 parking lot located at Elsie on Highway 26 at 10:00 a.m. Saturday. There will be an overnight stay at Seaside and ending at 4:00 p.m. on Sunday. Field trip costs include 2 lunches, park admissions, and field trip guide. Cost to members is $20.00 each, non-members $25.00 each, with surplus donated to GSOC. Other meal, transportation and lodging at the participants expense. Advance registration REQUIRED) with field trip leader. Resgistraion is by sending a check including your name, address and telephone number. Indicate on your registration if you can supply or need a ride. Deadline for registration is March 27. We will send further written information including full itinerary, social gatherings and recommended lodging and restaurants. For more information , phone Clay Kelleher at his office(321-6239) or at home (775-6263.

March 29 P3 gathering. Details at a later date.

Presentations are free and open to the public. Questions may be addressed to Clay Kelleher, 321-6239, 9AM-5PM; 775-6263 after 5 PM; or to Evelyn Pratt, 223-2601.

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES MUST BE SUBMITTED TO THE CALENDAR EDITOR BY THE 15TH OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

Memorial

Louis Edward Oberson, Past President

Louis Oberson was born April 25, 1904, In Lancaster, Washington, and lived in Portland since 1925. He was a member of Westminister United Presbyterian Church and taught biology at Roosevelt High School until 1969. He later worked with the Multnomah County Outdoor Education School. Louis was a charter member of the Geological Society of the Oregon Country, an active member of the Portland Garden Club, and an very productive gardener at his home. He was President of the Geological Society of the Oregon Country.

His wife of 50 years , Viola, also served as President of the Society died in 1989. Surviving are his daughter, Mary Lou Oberson of Portland; sisters, Lena Colby of Sunnyside, Washington, Marguerite Robinson and Ethel Mae Silvera, both of Tacoma, and Marie Wattenbarger of Milwaukie; brother, Henry of Kirkland, Washington. The family suggests remembrances be to the Geological Society of the Oregon Country.

Wallace R. McClung, Past President

Wallace McClung was born April 6, 1920 in Portland, Oregon. He was a 1942 University of Oregon graduate, and he served in the Army Air Corps. He worked as a bank auditor for seven years and worked as an advertising salesman for Ramsey Signs until his retirement in 1982. Wally was a active member of the Geological Society of the Oregon Country serving as Editor, Field Trip Leader and as President. He was also a tour guide at the Japanese Gardens and helped one day a week at The Nature of the Northwest Information Center.

He married Sylvia Ann Daniels-Barendrick in 1950. She died in 1982. He then married his current wife, Eleanor. Survivors include his wife; sons, Gregory of Eagle Grove and Stephen of Lafayette; and daughter, Jan Smith of Portland. The family suggests remembrances to the Geological Society of Oregon or the Japanese Gardens.

COMPLETELY FRACTURED GEOLOGY

by Jean Murray & Evelyn Pratt

1. aphotic: a plant louse's nervous spasm
2. argillite: a synthetic fabric used in plaid socks
3. belemnite: answer to "When will the cats get collars with bells on them?"
4. limonite: a cool summer drink made from citrus fruit
5. carbonate: what a body builder eats a lot of to "bulk up"
6. artesian: a female watercolor artist
7. chalicothere: one of a series of square dance calls - "Chalico right, chalico left! Chalico here,
8. conodont: a jailbird's incisors
9. connate water: runoff from a spruce or fir tree
10. crossopterygian: an angry eye doctor

SELECTED COMMENTS ON THE VEGETATION AND FLORA OF MARY'S PEAK, BENTON COUNTY

by Robert E.Frenkel and Esther H.G. McEvoy

A publication of the Native Plant Society Of Oregon

Marys Peak (4,097 ft.) is the highest point in the Coast Range. Situated 13 miles southwest of Corvallis, the peak is a prominent landmark for the central Willamette Valley. A road, initiated in 1938 by WPA and CCC crews, was completed in 1941 and provides access to a campground and parking area a few hundred feet below the summit. One can also climb the north slope of the trail from a road head at Woods Creek at 1800 feet. A fire lookout was formerly located at the summit and, today, several emergencies were used for microwave installations. The Forest Service established Marys Peak Scenic Botanical Special Interest Area encompassing 1,285 acres featuring a scenic and botanical complex embracing an intensive grassland, xeric "rock garden", noble fir forest, and panoramic view (U.S. Forest Service 1980). The summit has been a lodestone for botanists because of its diverse flora and distinctive vegetation.

Marys Peak is capped by an erosion resistant Mid-Tertiary sill intruding Eocene sandstones which overlie early Eocene Siletz River Volcanics. The peak is bounded by several northeast and southeast ending faults. One can see the volcanic basement rocks in cuts along the first few miles of Mary's Peak road. An exemplary exposure of fine textured sandstone (Flournoy Formation (formerly Tyee) is 6.6 miles from the beginning of the Mary's Peak Road. Parker Creek waterfall displays the erosion resistant gabbro forming the Mary's Peak sill. The intrusive rock elsewhere grades into a granophyric diorite which makes up the coarse parent material for the grassland and rock garden(Lawrance et al. 1980).

Extending elevationally slightly above the Western Hemlock Zone, the summit area embraces several vegetational types which were first described by Merkle (1951(. Summit north slopes are dominated by western hemlock, noble fir, and Douglas-fir; east slopes by noble fir and Douglas-fir; south slopes by Douglas-fir; and west slopes by hemlock and Douglas-fir. The grassland, occupying elevations above 3500 feet, is surrounded by a pure noble fir forest, the most extensive stand in the Coast Range. Bordering the meadow on the south · an apron of vine maple. A narrow riparian strip follows Parker Creek which plunges southward from the summit. One of the most interesting vegetation types on the peak is the "rock garden", a lithosolic (thin soil) community with a south and southwestern exposure.

The area has been frequently burned as evidenced by tree age structure, snags, and fire scars. A burn about 35 years ago margins the south slope. Abetted by forest canopy openings for the road and older campground, wind damage has been severe. The apparent logging at the summit is a salvage operation for two recent blowdowns. The summit has snow cover until early April with drifts to early June. Damage has been caused by ATV's and also by snowmobiles.

Two recent studies have been documented significant features in the summit area. Billy Snow (1984) identifies four plant communities in the grassland including three community phases:

1. Festuca rubra-Agrostis diegoensis-Carex californica community which dominates the grassland and consisting of three phases:

a. Dry phase, a species poor assemblage on south slopes.

b. Forb Phase, a forb-rich assemblage on west slopes dominated by Pteridium aguilinum.

c. Disturbed Phase, with combinations of forbes and grasses and some ruderals.

2. Senecio triangularis community on north slopes including and interesting snowbed assemblage with Erythronium grandiflorum and Anenome lyallii,

3. Iris tenax community, a species ricly inclusion in an otherwise species-poor grass-sedge meadow.

4. Xerophytic Rock Garden community, a lithosolic community on the southwest slope with many spring- flowering forbs.

Terresa McGee (1985) analyzed the stability of the boundary (ecotone) between the noble fir forest with specific reference to tree invasion. She recognized four boundary types within which active noble fir tree invasion is progressing. Tree invasion is controlled by by such environmental factors as light and moisture as well as competitive factors. The moist Festuca/Elymus-Agrostis boundary type was most susceptible to invasion while the Festuca/Carex type was least susceptible . When grass-land sod was distrubed, trees could become estasblished as they also did with excessive moisture. Peak estzblishment years coincided with heavy sping snowpack, low rainfall and late summer rain. The role of fire in maintaining the distinctiveness of the grassland was unclear. In the short term, the grassland appears stable but stability is problematical in the longer term (>50 years).

Marys Peak is of especial floristic interest because of its isolation and elevation in the Coast Range. Detling (1953) examined several sites, including Mary Peak, of disjunct species with xeric affinities west of the Casacades. He hypothesized that during the warm dry period that prevailed between 6,000 and 4,000 years ago, a xeric flora advanced from southern and eastern Oregon into more mesic northwestern Oregon. Subsequently, xeric species persisted in thin-soil habitats on mountain tops with the advance of more moist and cooler conditions. For example, Lupinus lepidus was thought to have come from central Oregon, and Erigonum umbellatum from the Rogue area. The affinities of the flora with more northern and more montane elements is suggested by the dominance of noble fir and such small assemblages as a snowbed community with Erythronium grandflorum

Literature Cited:

Detling, L.E. 1953. Relict islands of xeric flora west of the Cascade Mountains in Oregon. Madrono 12:39-47.

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Snow, B.D. 1984. Plant communities of the grassy balds of Marys Peak, Oregon. M.S.thesis, Oregon State University, Corvallis

U.S.Forest Service. 1980. Marys Peak Scenic Botanical Plan. USDA Forest Service, Siuslaw National Forest, Corvallis.

Ed. A geologic field trip to Marys Peak would be a wonderful experience. Dr. Broderson, Western College of Education lead the GSOCs a few years back

CENTER FINDS USES FOR THIN FILMS.

By Kathy King,with Peter Caughey, Stan Gorton, Julie Jargon and Jim ScottArticle from the University of Colorado Alumni magazine "Summit"

University researchers have developed a new type of membrane that can withstand high temperatures and harsh environments, paving the way for its use in industries ranging from large -scale fuel production to environmental cleaanup.

The membranes are made of a zeolite, a crystalline substance commonly used as a detergent builder and purifier, says chemical engineering Professor Richard Noble of the Center For Separations Using Thin Films. The group at Colorado University faculty and students is the first in the world to grow the untra-thin layers of zeolite crystals on the inside walls of small ceramic and stainless-steel tubes, opening the door for their manufacture and use on an industrial scale.

Similar in structure and appearance to the crystals in geode rocks, zeolite crystals contain tiny pores about the size of small molecules, he explains. Gas and vapor molecules are "cued up" by the zeolite membranes, which reject larger one and allow smaller one targeted for removal to pass through the pores.

"These membranes have been shown to be resistant to intense heat and acidic conditions," he says. "They will work in environments where other membranes or chemical processes will not."

The membranes could be used for tasks like removing nitrogen from natural gas, since nitrogen dilutes the heating value of the fuel, he notes. Zeolite membranes also could be used to capture another fuel, hydrogen, from hydrocarbons, or for removing noxious chemicals from pollution sources.

CORRECT DEFINITIONS TO "COMPLETELY FRACTURED GEOLOGY"

by E. Pratt, adapted from AGI Dictionary of Geological Terms, 3rd Ed.; Bates & Jackson

1. aphotic: a term describing that part of the ocean in which there isn't enough light for photosynthesis
2. argillite: pertaining to clay or clay minerals
3. belemnite: an extinct mollusk related to squids, octopuses, and cuttlefish, known from its cigar-shaped fossils which were part of its internal skeleton
4. limonite: a field term for a group of brown ferric oxides formed by the weathering of iron-bearing minerals; it is found in varied forms, and colors yellow clays and soils
5. carbonate: a mineral compound characterized by the carbon-oxygen combination $-CO_3$
6. artesian: term describing ground water that is under enough pressure to rise above the aquifer containing it
7. chalicothere: a horselike Eocene fossil with a sloping back and three-toed feet
8. conodont: half of the jaw of a Paleozoic wormlike marine fossil
9. connate water: water trapped in the small spaces between grains in a sedimentary rock at the time the rock was deposited
10. crossopterygian: one of an order of lobe-finned, bony fishes, the ancestors of the first land animals

Gold dredges in the Sumpter Valley

by Bert Webber, Research Photojournalist, P.O. Box 11, Medford, ˀR 97501

That antique gold dredge sitting in its pond at Sumpter, Oregon, resembles a dilapidated and abandoned five-story hotel. But it was not always that way. This Yuba-type dredge started life in 1935, was forced to shut down during World War II, then resumed churning the soil in the Sumpter Valley until August 1954.

In the history of dredging for gold, the Sumpter Dredge was not the largest, but it was certainly at the "large" end for size, on a list of dredges. It is 120 ft long and 52 ft wide. Its overall length, with its stacker, makes this engineering contraption 216 ft long.

The Sumpter Dredge worked as many as 23 men but not all of them at any one time. A large crew was necessary as the dredge worked 24 hours a day and nearly seven days a week. The time off line was for knockdown of the jigs and sluices once a week to remove the gold.

The gold dredge, also called a "dredger," is a weird-appearing apparatus that some claim resembles a giant praying mantis. It creaks, clatters, and emits horrendous groans and screams as it digs rocks and sand from the bottom of a river or pond. After digesting this muck in its bowels, it keeps what it seeks, gold, then spews the residue out its back side leaving mountains of rocks.

As to the potential effectiveness of dredging, which is a method of operating a large number of sluice boxes at one time, the *Encyclopedia Britannica* declared its sluice "considered to be the best contrivance for washing gold gravels."

The gold dredge is indeed a complicated system of motors ˀnd/or engines, winches, miles of cable, hydraulically operated ˀevices, sluice boxes, quicksilver recovery units, shaking jigs, water pumps, sand- and water-discharge plumbing, and a conveyor stacker that dumps the leftovers far out behind the dredge.

Although some early dredges worked in rivers, most worked in their own ponds. When a dredge-master decided to change digging sites, the dredge moved and took its pond with it.

The Sumpter Dredge pumped 3,000 gallons of water per minute from its pond. The water was supplied by one 6-in. and two 10-in. pumps to six 24-in. American jigs and sluice boxes for gold recovery.

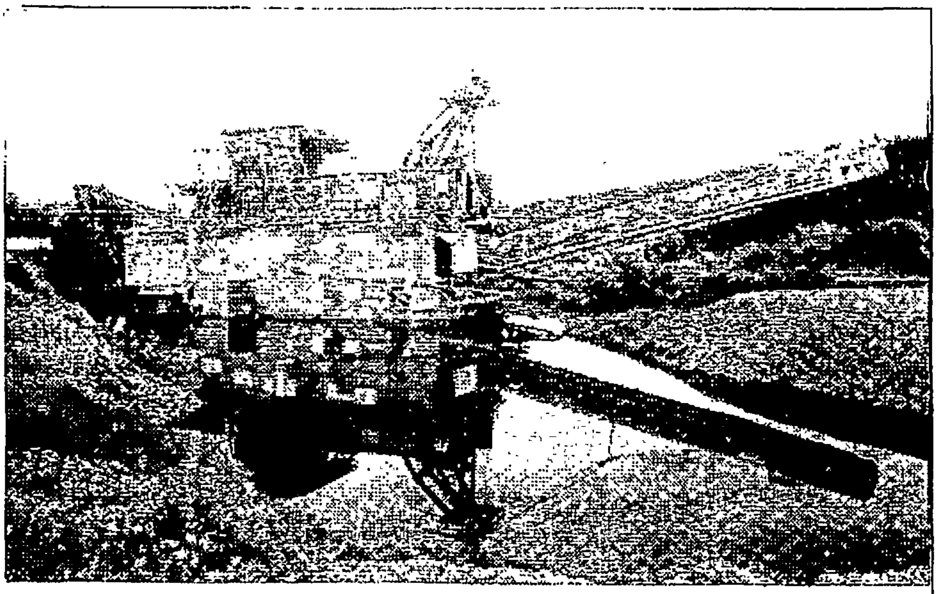
A dredge works on the principle of the bucket line. The Sumpter dredge used 72 cast-iron buckets, each holding 9 cubic feet and weighing a ton. The rate-of-dig was 25 buckets per minute. At this rate, an average month's dredging moved 280,000 cubic yards of earth.

Various dredges used various sources of power. The earliest were steam driven, using cord wood for fuel. Some were gasoline powered, then came diesel. But the most dependable fuel was electricity. When a dredging operation was off somewhere in the mountains, such as the Sumpter Dredge, the operators built a power house, then strung miles of wire to the dredge. For this dredge, the power line was 12 mi long. The bucket line was powered with a 250-hp motor on the end of the 23,000-volt power line from the portable substation at the edge of the pond.

To be historically accurate, one should point out that the present dredge, the potentate of the new Sumpter Valley Dredge State Park, is actually the third Yuba dredge in this valley.

Sumpter No. 1 started digging, moving downstream, in the Powder River on January 13, 1913. It finally ground to a stop on July 23, 1924. The bones of its hull can be seen at the present time right where it stopped: in the swamp just a few feet from the "Dredge Depot" of the Sumpter Valley Restoration Railroad. This is a few hundred yards south of the ghost town of McEwan on Highway 7. As of this writing, no interpretative sign tells the visitor what this scrap pile of old timbers represents.

Sumpter No. 2 operated between October 1915 and 1923. It worked upstream from the town of Sumpter on Cracker Creek in the direction of Bourne. After its work was finished, it was carefully dismantled, except for the hull, and its parts were shipped in 18 railroad cars to a buyer near Liberty, Washington. Here the dredge was reassembled on a new hull. This location is just off Highway 97, a short distance north of Ellensburg. The dredge, now renamed "Liberty Dredge," started scooping up muck on February 22, 1926. But alas, the dredge proved too big for the job, so it was moved to another site close by. Liberty Dredge could bite through a 65-ft bank, but it worked only 71 days, until it was confronted by a 200-ft bank of heavy rock, which it could not conquer. That mining venture folded. The equipment from the dredge was sold and the hull left to the elements. Substantial remains of the structure, now collapsed but still sitting in its pond, are easily found.

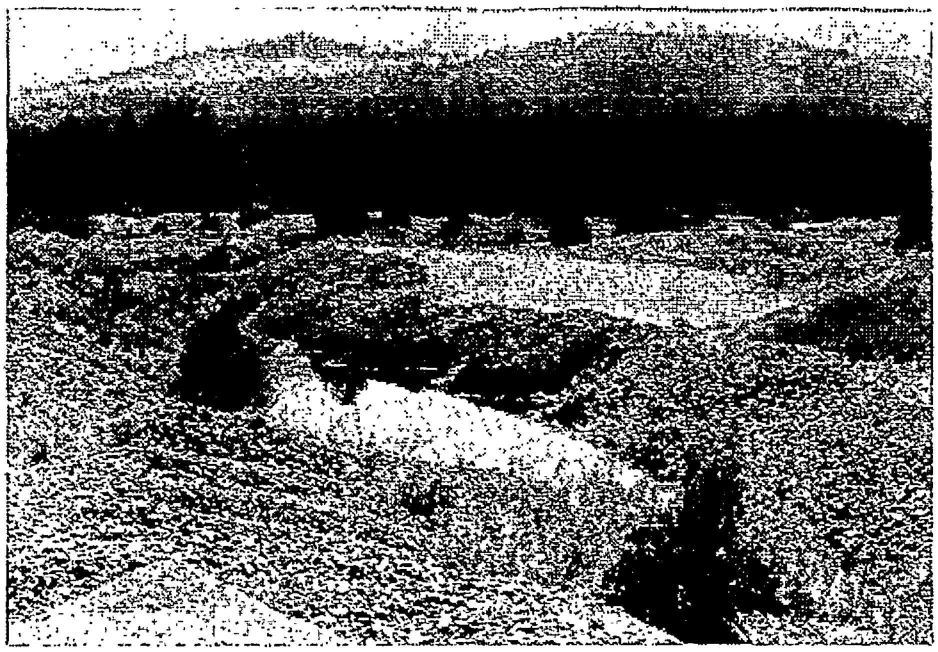


Sumpter Dredge No. 3 is the attraction of the new Sumpter Valley Dredge State Park, in Sumpter, Oregon. The State Parks Department bought the rare 1,250-ton machine for $195,000 in 1994. Photo taken June 1994.

Dredge No. 3, the dredge that is now the center of the new State Park at Sumpter, had for its machinery the parts from the original No. 1 dredge. After the final shutdown in 1954, much of the machinery was removed. Because of the huge costs involved in setting up a dredge, it takes years of digging to pay off the investment before profits can be taken. Not all dredge operations are profitable. For Sumpter Valley Dredge No. 3, the setting-up cost was $300,000, but it took out $45 million in gold.

When the Oregon State Parks people complete their reclamation project, the dredge will be a monumental triumph for their rejuvenation efforts and will allow visitors to tour this magnificent, giant Rube Goldberg apparatus. Already, the town of Sumpter is visited by thousands of people who just like to walk around the perimeter of the dredge's pond and gawk at the quiet monster.

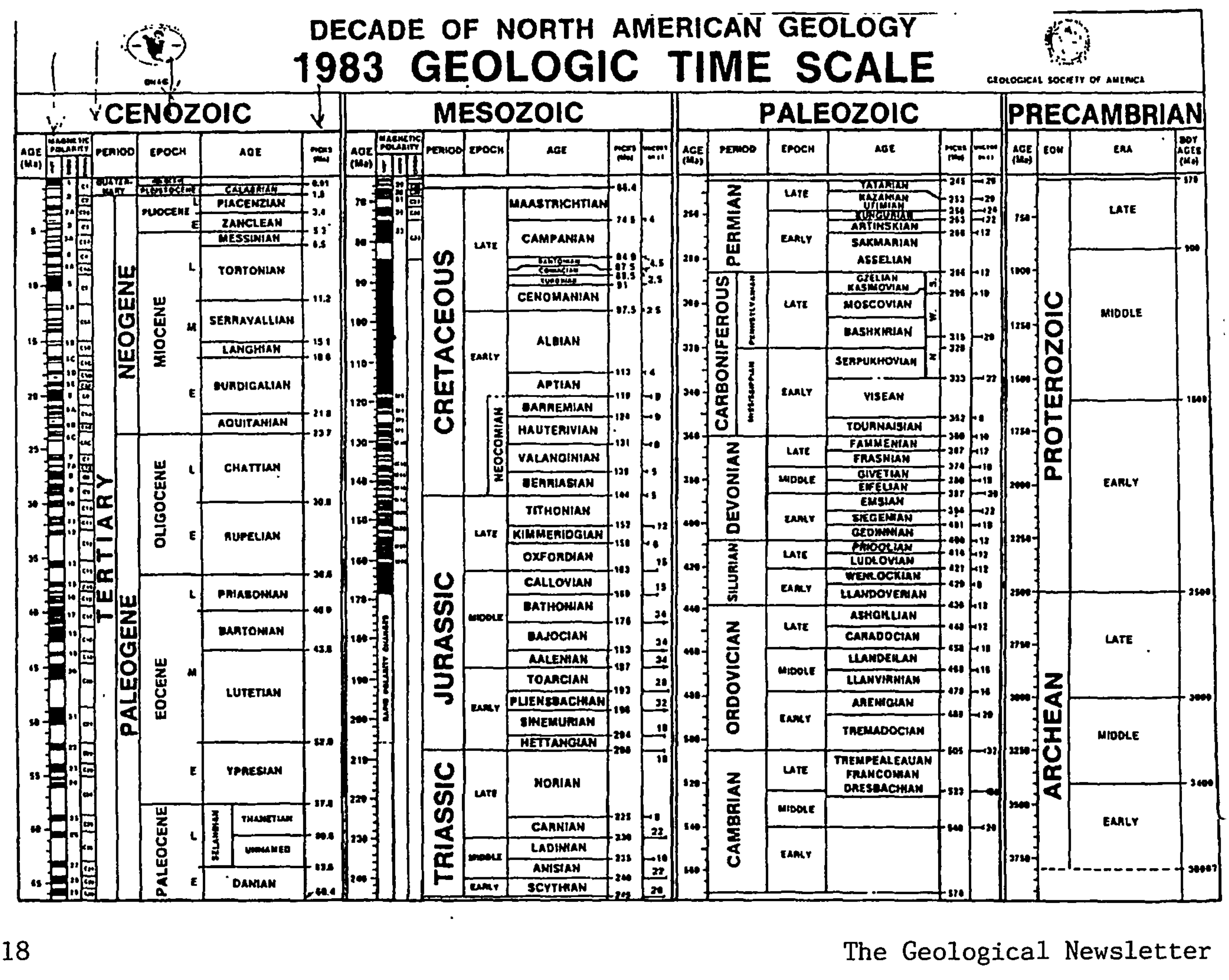
Dredging continues today. In California, the Yuba Dredge No. 21 operates 24 hours a day, seven days a week in the Yuba Gold Field about 50 miles northeast of Sacramento. This operation of Cal Sierra Development, Inc., has been there for 16 years. The Yuba No. 21 makes Sumpter Dredge seem a miniature, for No. 21 is 453 ft long and 101 ft high. Its present dig is in its own pond 48 ft below the surface of surrounding terrain. The buckets, 20 cubic feet each (Sumpter Dredge buckets are 9 cu. ft.), dig 140 ft below water level, which makes the dig reach 187 ft below the surrounding land, one of the deepest in the world. ☐



The beautiful alpine Sumpter Valley was transformed into a gigantic gravel pit, as the dredge moved across the land digging out its gold-- $45 million worth of it. Photo taken in July of 1993.

The author, Bert Webber, has also written a book on the subject of dredges,* Dredging For Gold—Documentary, *which was published by Webb Research Group Publishers in 1994.
—ed.

The article "Gold dredges in the Sumpter Valley" was taken from Oregon Geology, vol. 57, No.2 1995



APR 96

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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after 5PM, 775-6263

VOL. 62, No. 4
APRIL, 1996

APRIL ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Lunch with members in cafeteria at 11:30 AM, if desired)

Apr. 5: Landscapes in Arid Regions
Richard Bartels, GSOC President

Apr. 19: Superstition Mountains of Arizona
Rosemary Kenney, GSOC member

FRIDAY EVENING MEETINGS: 8:00 pm Portland State University, Cramer Hall, Room 383

Apr. 12: Jurassic Ammonites in Western North America
David Taylor, Northwest Museum of Natural History

Apr. 26: TBA

GEOLOGY SEMINAR: 8:00 PM, Portland State U., Cramer Hall, Rm. S-17

Apr. 17 (Wed.): Coast Range Seminar leader: Clay Kelleher. Before the seminar, please read Ch. 8, pp. 167-200 in Orr, Orr & Baldwin's Geology of Oregon, 4th Ed.

FIELD TRIPS, GSA: For spouses and guests of GSA Meeting attendees; GSOC members welcome to unfilled trips. Times: 8:30 AM-4:30 PM. Costs include box lunches, transportation, admission fees. Trips will probably start at the Red Lion Hotel, 1000 NE Multnomah (just S of Lloyd Center).

Monday, Apr. 22: Columbia Gorge Nat'l Scenic Area. $20. Leader: Don Barr.
Tuesday, Apr. 23: Portland Area Gardens. $24. Leader: Charlene Holzwarth.
Wednesday, Apr. 24: Portland Downtown and West Hills. $22. Leader: Evelyn Pratt.

FIELD TRIPS, GSOC:

Saturday, May 11: Landslides In and Near Portland. Leader: Scott Burns.
Saturday, June 15: Walk to a Rock: Building Stones of Downtown Portland. Leader: Clay Kelleher

Presentations are free and open to the public. Questions may be addressed to Clay Kelleher, 321-6239, 9AM-5PM; 775-6263 after 5 PM; or to Evelyn Pratt, 223-2601.

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES MUST BE SUBMITTED TO THE CALENDAR EDITOR BY THE 15TH OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

Expected tsunami amplitudes off the Tillamook County, Oregon, coast following a major Cascadia subduction zone earthquake

Paul M. Whitmore, Alaska Tsunami Warning Center, NOAA/NWS, 910 South Felton Street, Palmer, Alaska 99645

As evidence accumulates indicating that the Cascadia subduction zone has produced major earthquakes and that at least some of the earthquakes were followed by large tsunamis (e.g., Atwater and Yamaguchi, 1991; Atwater, 1992), emergency planners along the Pacific Northwest coast have been trying to get an idea of how large a wave can be expected. Will it be 1 m, 10 m, or 100 m high?

One method of estimating the potential wave height is through numerical modeling of the earthquake source and tsunami propagation. Given a hypothetical set of earthquake source parameters, the sea-floor displacement can be computed. This displacement produces the sea-level perturbation that provides the impetus for a tsunami.

Whitmore (1993) computed wave amplitudes and currents at 131 sites along the North American coast for three hypothetical Cascadia subduction zone earthquakes. Here, the same tsunami modeling technique is used as in that study, and eight additional sites in Tillamook County, Oregon, are examined. The three earthquakes modeled in the original study were $M_W = 8.8$, 8.5, and 7.8. In this study only the magnitude 8.8 quake, which ruptures from the South Gorda plate to the subduction zone bend off the Washington coast (Weaver and Shedlock, 1989), is examined as that produced the largest tsunami along the Oregon coast. The tsunami model used here, described by Kowalik and Whitmore (1991), can determine the tsunami amplitude near the coast. The inundation level or runup of the tsunami is not computed. Amplitude can be thought of as the water column height over mean sea level at a point near the coast. Runup, though, is the vertical elevation which the tsunami reaches as it inundates the shore. Runup elevation often varies from the wave amplitude. Factors such as the beach slope, wave period, and beach roughness cause the runup to be higher or lower than the wave amplitude near the coast.

The fault parameters for the $M_W = 8.8$ earthquake are moment = 2.0E29 dyne-cm, strike = 358°, dip = 13°, slip = 90°, length = 650 km, width = 80 km, and fault bottom depth = 20 km. These were taken from studies of the Cascadia subduction zone by Spence and others (1985), Weaver and Baker (1988), Weaver and Shedlock (1989), and Savage and others (1991) and are explained further in Whitmore (1993). Static sea-floor displacement is computed from these parameters by dislocation formulae (Okada, 1985) and is

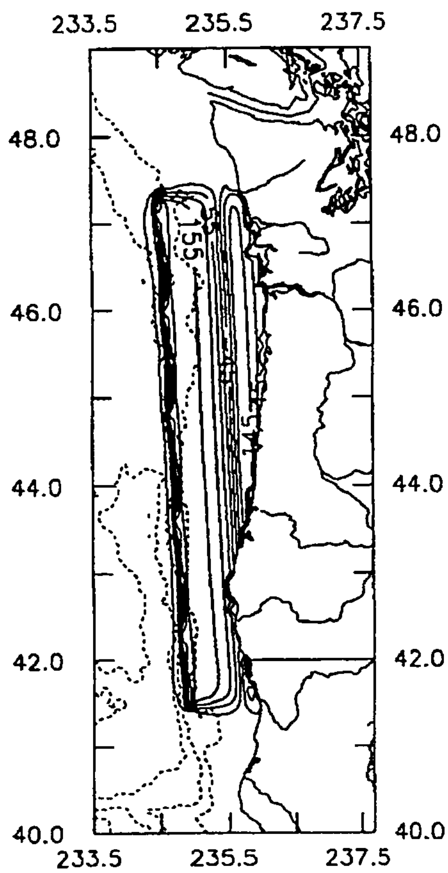

Figure 1. Vertical sea-floor displacement computed for $M_W = 8.8$ earthquake. Contour interval is 0.5 m. Maximum uplift is 3.7 m, while maximum subsidence near coast is 1.8 m. Dashed lines are bathymetric contours with a 1,000-m increment.

shown in Figure 1. This is a typical subduction-zone, underthrusting pattern with uplift seaward of the trench and subsidence toward the continent. Maximum uplift is near 3.7 m, and subsidence along the coast is up to 1.8 m. The computed subsidence compares well with paleoseismic studies which indicate coseismic subsidence of 1.0–1.5 m along the northern Oregon coast (Darienzo and Peterson, 1990).

The nonlinear, shallow-water equations of motion and continuity equation are used to model the tsunami, given the initial sea-level configuration defined by sea-floor displacement. Friction is accounted for in shallow water (i.e., continental-shelf depths). An explicit-in-time finite difference technique is used to solve the equations. This finite differ-

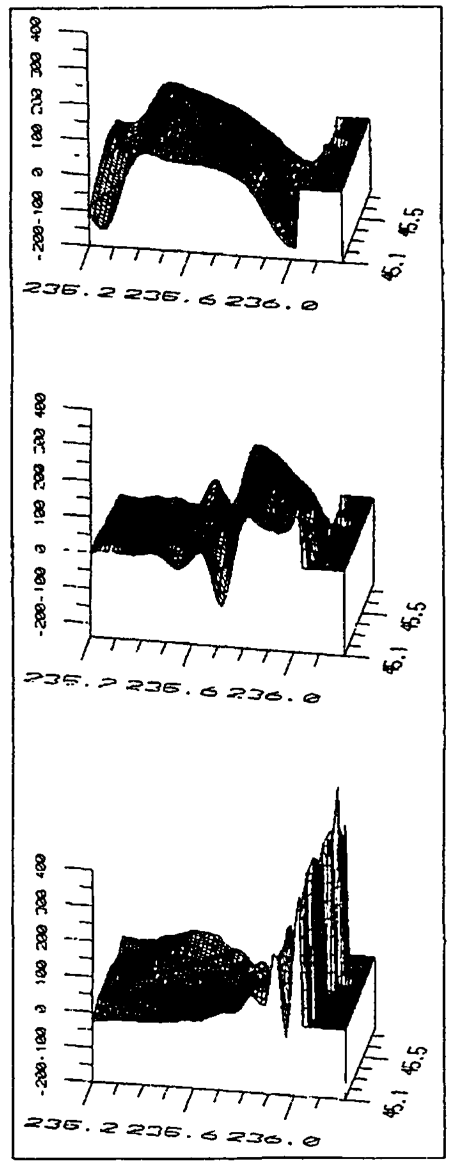

Figure 2. Time slices of the tsunami impinging on the Tillamook County coast at 10, 20, and 30 minutes after generation. Vertical scale is greatly exaggerated.

ence technique and the basic equations are explained in greater detail in Kowalik and Whitmore (1991). Briefly, the model computes a new north/south velocity, east/west velocity, and sea level at each grid point based on the old velocities and sea level every 11 seconds. This produces a "motion picture" of the wave with 11 seconds between frames. Figure 2 shows the tsunami as it moves to-

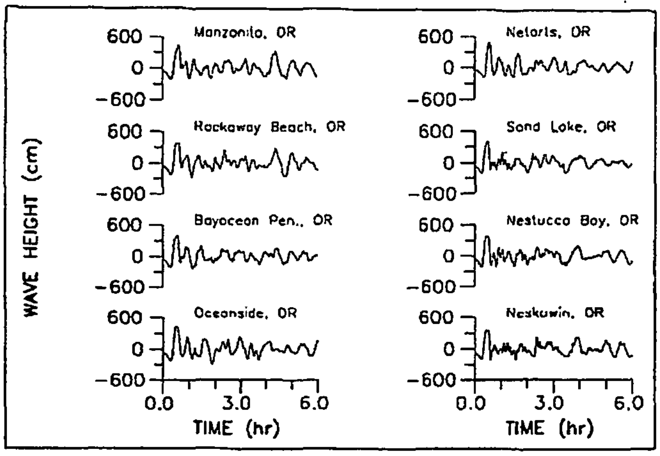

Figure 3. Modeled tsunamis at eight sites in Tillamook County, Oregon (locations shown in Figure 4 and Table 1).

Table 1. *Maximum modeled tsunami amplitudes along the coast of Tillamook County, Oregon*

Site	Lat (°N.)	Long (°W.)	Amplitude (m)
Manzanita	45.72	123.95	5.01
Rockaway Beach	45.62	123.97	4.45
Bayocean Peninsula	45.53	123.97	4.71
Oceanside	45.45	123.97	5.08
Netarts	45.43	123.95	5.53
Sand Lake	45.28	123.98	4.85
Nestucca Bay	45.18	123.98	4.67
Neskowin	45.12	124.00	4.35

ward the Oregon coast. The tsunami inundates the shore when the coast is reached. The model used here, though, does not account for this inundation. Pure reflection is assumed at the coast.

Shuto and others (1985) showed that 10 to 20 grid points per tsunami wavelength are necessary to accurately reproduce a wave numerically. This is accomplished here by using an edited version of the NOAA ETOPO5 five-minute bathymetry grid over the open ocean and a more detailed one-minute grid over the continental shelf where wavelengths decrease. At 45°N., a 1′ x 1′ grid has a spacing of approximately 1.3 km x 1.8 km. The two grids dynamically interact with each other at the five-minute to one-minute boundary. Some places along the coast such as within Tillamook Bay require higher detail than provided in the one-minute grid. This model can be considered accurate only along the outer coast, where one minute accurately defines the coastline and bathymetries.

Modeled tsunamis at eight sites along the Tillamook County coast are shown in Figure 3. In all cases, the initial wave is the largest of the tsunami series, although significant waves continue for over six hours. The first wave arrives about 23 minutes after the earthquake and is preceded by a recession. The time between successive crests varies from less than eight minutes to over an hour. The maximum zero-to-peak amplitude at these eight sites is 5.53 m at Netarts. This amplitude includes apparent amplitude due to subsidence at the site. Table 1 and Figure 4 summarize the maximum zero-to-peak amplitudes inclusive of local subsidence.

Several potential sources of error could modify the computed tsunami amplitude. The main factors controlling amplitude are size, configuration, and location of the source. Here the source is a simple planar fault with uniform slip. Other complexities such as submarine landslides, secondary faulting, nonuniform slip, faulting through the sedimentary wedge, or variations in the fault parameters could produce large local variations. The numerical model will also introduce some error. Problems such as locally insufficient resolution, pure reflection assumed at the coast, and variations in the tsunami from the assumed shallow-water wave behavior can cause differences between an actual tsunami and a model. Even with these possible sources of error, the results computed here should give planners along the coast a good ballpark figure.

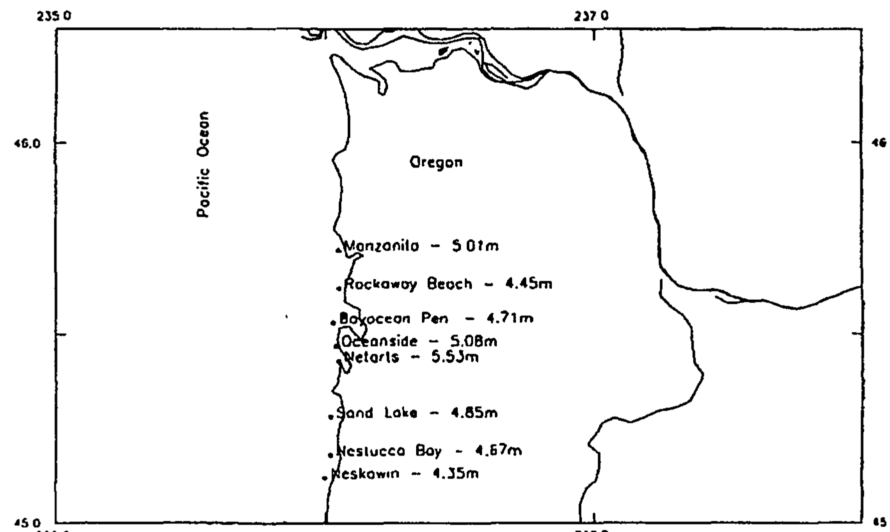

Figure 4. Maximum modeled tsunami amplitudes. These amplitudes are zero-to-peak with the local subsidence included. For example, the computed amplitude at Netarts is 4.91 m relative to the initial sea level. The source dislocation formulae predict a subsidence of 0.62 m at that point, producing 5.53 m total amplitude.

The largest population center along this coast is Tillamook. The tsunami could not be accurately modeled at Tillamook due to the narrow entrance to Tillamook Bay and the bay's extensive mud flats. Considering that there are 2 mi of land and over 1 mi of mud flats at low tide between Tillamook and the bay, the tsunami danger at Tillamook can be considered low. However, river frontage should be considered dangerous as a small surge up the rivers may occur.

NOTE: The amplitudes given in this paper should be considered preliminary pending a national tsunami inundation modeling effort.

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COMPLETELY FRACTURED GEOLOGY

by John, George, & Ralph Pratt

1. **asthenosphere**: a protective globe around a Greek art object
2. **batholith**: a stone bathtub
3. **caliche**: a Chinese nut grown in California
4. **hyaline**: a high-voltage transmission cable
5. **lacuna**: a quadruped related to the llama
6. **level of zero amplitude**: Lawyer talk, as in: "My client couldn't have committed the crime, for he was then at a level of zero amplitude." English translation: He was asleep.
7. **moment magnitude**: a legal term meaning "Just a sec..."
8. **riprap**: very fast conversation by a really with-it disk jockey
9. **tonalite**: a LOT of diet food
10. **surficial**: polite answer to "How many more trout am I allowed to catch?" "Sur,ficial you want."

HOW MINERALS REGULATE EARTH'S CHEMICAL MACHINERY

ALEXANDRIA, VA - - Mineral surfaces play basic roles in regulating Earth's chemical machinery, writes Michael J. Hocella Jr., the September issue of GEOTIMES. By governing the long-term evolution of the earth's surface, they make the natural world the way it is and dictate how we can use it. Hocella's views are supported by Grant F.Ferris, a Canadian geologist/microbiologist with the University of Toronto, and Willie Harris, a soil scientist from the University of Florida. Their feature articles focus on career opportunities in mineral-surface science, biomineralogy, and weathering sequences within the soils.

Barely known 20 years ago, mineral-surface science now commands the level of research dollars that promises solid employment potential, writes Hocella in " Mineral Scratches New Surfaces." Although a late bloomer, mineral-surface science is moving into the fast lane, he states, thanks to recent inventions such as the scanning tunnel microscope. Mineral- surface now has major subdivisions that form cornerstones of electronic, computer, adhesion lubrication, and catalysis industries. The discipli has direct applications to environmental science, soil science, mineral physics and biomineralogy.

Biological mineral precipitation, the ability of living organisms to form minerals, is not exclusive to humans and advanced plant forms, writes Grant Harris. Bacteria, too, form a enormous variety of minerals - - including carbonates, phosphates, oxides, sulfides, and silicates as well as silver and gold. In "Microbes to Minerals," Ferris describes how microorganisms produce minerals, and how researchers are studying microbial metal adsorption and mineral precipitation processes to develop passive clean-up procedures for contaminated waters.

Willie Harris relates what can happen to a mineral after it "dies." His article, "Mineral Ghosts - - Clues to Weathering Pathways," traces the dissolution of grains into secondary minerals. This process can culminate in the complete in-si replacement of the original grain. The formation of mineral "ghosts" requires profound shifting and proliferation of mineral boundaries, Harris reports. s weathering progresses, a single crystal may ͜ecome host to several secondary phases, One biotite grain, for instance, can be a virtual apartment complex ? housing kaolinite, vermiculite, goethite, and other minerals.

To "Political Scene," David Applegate describes how Republicans and Democrats are struggling to reform the Mining Act of 1872, which governs how minerals are extracted. The act was created to help settle and develop the West, reports Applegate, a staff member with the Senate Energy and Natural Resources Committee. Today, however, it is a target for environmental and taxpayer groups who see the law as a "giveaway" of national assets to mining companies, many of which are foreign - owned. The intensity of congressional debate underscores mining's continued importance in the economy.

Coming up ... the October issue of GEOTIMES features the annual International ͞irectory of Geoscience Organizations. With more ..t 1,000 listings, it is regarded as a valuable resource by geoscientists worldwide. Up-coming issues for Fall and Winter focus on Geologic Age Dating, Earth-Science Museums and conservation , Natural Hazards, and in February 1996, the Annual Highlights issue, describing new developments in approximately 50 geoscience subdivisions. GEOTIMES is published by the American Geological Institute, a nonprofit federation of 27 member societies representing earth and environmental scientists. AGI also produces GeoRef, an online bibliographic database of more than 1.8 million geological references from 1785 to the present.

The article '*How Minerals Regulate Earth's Chemical Machinery*" was taken AGI, **News From AGI** on the Internet. □

Q: How do you know that this is a fossil of a 43 million-year -old banana?
There was a 43-year-old fossil monkey eating it

THE STORY OF MONTANA AGATE

It has always been a mystery how the peculiar little scenes got inside a rock as hard as agate. It is the claim of geologists that the spots were caused by infinitely minute seams of fissures in the softer parts of the rock being filled with metallic oxides when the world was young. These oxides made four different colors that form various combinations of color when blended together, or appear in single colors in each rock.

The red color is oxide of iron. The black is oxide of manganese. The blue is oxide of nickel. The green is oxide of copper. This theory has been elaborated by the help of high-powered microscopes which show the tracings of little canals so close the naked eye could not detect it, but the oxides remained, staining the rocks in wonderful design. The fern-like and branch effects of trees, grass, and shrubbery, come from the fact that the tiny canals branched out in various subdivisions forming small canals from a common center, and in addition to these canals, the rock became flawed through shrinkage while passing through a period of evaporation which, according to scientists, has taken more than 3 million years to reduce the stones to the hardness of 7 points on the Mohs scale.

These canals and flaws have been perfectly healed by soft silicate formations of which the stone is a part, and the evaporation has caused the oxides to take on such forms as seen on the window after a frosty night.

Technically, Montana agate is know as 'Dendritic' agate, and the moss spots are called 'dendrites.' It is the third hardest stone in the world, and is cut with a diamond saw. There can never be two pieces alike even though cut from the same stone.

"The Story of Montana Agate" was taken from ROCK WRITINGS, a publication of Nevada County Gem and Mineral Society, December 1995.

AMBER DEPOSIT IN NEW JERSEY PROVIDES INSIGHTS ON EARLY LIFE.

By Philip J. Hilts

An American Museum of Natural History expedition - - to New Jersey - - has uncovered one of the richest deposits of amber ever found, with fossils of 100 previously unknown species of insects and plants trapped in the ancient fossilized tree sap.

The fossils include a tiny bouquet of miniature flowers from an oak tree of 90 million years ago; the world's oldest mosquito fossil, with mouth parts tough enough to feed on dinosaurs; the oldest moth in amber, with mouth parts suggesting it was in transition from a biting insect to one that fed on the nectar of flowers; and the oldest biting black fly. The last is the only such insect known from the Cretaceous period and may have tormented duckbills and other dinosaurs along with its colleague in amber, the mosquito.

Among the other finds from the New Jersey complex of sites are the oldest mushroom, the oldest bee and a feather that is the oldest record of a terrestrial bird in North America.

Dr. David Grimaldi, curator and chairman of the entomology department at the American Museum of Natural History, who led the expedition to the secret New Jersey site, said the previously undescribed species, all extinct, were found in 80 pounds of amber drawn out of mud.

The ambers came from a sites in central New Jersey where the clay is especially deep and rich, containing streaks of peaty black material that are the remains of plants and other organic material. It is in these rich black stripes that the amber was found.

What is most interesting to scientists is that the site has amber dating 90 million years to 94 million years. This means that all the amber-preserved species came from the age of dinosaurs and from the era when flowers first began to proliferate. At the time, insects were beginning to use flowers as food, and flowers found the insects useful in carrying pollen,

An article describing the world's oldest preserved flowers, written by Dr. Grimaldi and his colleagues, Kevin Nixon and William Crepet of Cornell University, is to be published in the American Journal of Botany. It notes that the three flowers in the little bouquet are the only known flowers preserved from the Cretaceous period, which ended 65 million years ago.

One reason the fossil flowers are important is that the flowering plants that arose during the Cretaceous eventually took over the earth's continents, dominating the landscapes in their number and importance ecosystems.

Until now, the study of plants from the Cretaceous has depended solely on impressions of flowers and pollen. Curiously, the flowers and some of the other fossils found at the New Jersey site are miniatures - - the flowers and their stem together are no more than half an inch long.

The article "Amber deposits in New Jersey provides insights on early life" was printed in the Oregonian on February 1, 1996. Permission was granted to use it in this newsletter.

CORRECT DEFINITIONS TO "COMPLETELY FRACTURED GEOLOGY"

E. Pratt, adapted from AGI Dictionary of Geological Terms, 3rd Ed.; Bates & Jackson

1. asthenosphere: the weak layer about 100 km below the crust and upper mantle, where earthquake waves are greatly weakened and magma may be generated
2. batholith: an igneous intrusion with more than 40 sq. mi. of surface exposure and no known floor
3. caliche: a New World term used for any of seve whitish sediments; in SW U.S., gravel or sand cement by calcium carbonate
4. hyaline: transparent, like glass
5. lacuna: the missing interval in an unconformity, representing an interruption in the stratographic record, such as the absence of rocks between the Triassic and the Eocene
6. level of zero amplitude: the deepest place below the earth's surface that is affected by seasonal temperature changes
7. moment magnitude: M_w ; a measurement which uses long seismic waves to determine the size of a fault rupture that produced an earthquake; the only measurement that computes how big the cause of an earthquake is at its source, rather than measuring its effects on the earth's surface (from Science News, 10/15/94)
8. riprap: a man-made mass of large pieces of broken rock used to prevent erosion of a slope
9. tonalite: quartz diorite, an intrusive form of andesite with more quartz than diorite usually has
10. surficial: pertaining to or lying in or on the earth's surface

MAY 96

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GEOLOGICAL NEWSLETTER

THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY
P.O. BOX 907, PORTLAND, OR. 97207

VISITORS WELCOME
INFORMATION: 9AM-5PM, 321-6239
after 5PM, 775-6263

VOL. 62, No. 5
MAY, 1996

MAY ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Lunch with members in cafeteria at 11:30 AM, if desired)

May 3: Glaciated Landscapes
Richard Bartels, GSOC President

May 17: Geology of the Northern Oregon Coast
Clay Kelleher, Field Trip Leader and Past President of GSOC

FRIDAY EVENING MEETINGS: 8:00 pm Portland State University, Cramer Hall, Rm. 383

May 10: Landslides of the Portland Area
Dr. Scott Burns, Geology Dept., PSU

May 24: TBA

GEOLOGY SEMINAR: 8:00 PM, Portland State U., Cramer Hall, Rm. S-17

May 15 (Wed.): Willamette Valley. Richard Bartels. Before the seminar, please read Ch. 9, pp. 203-221in Orr, Orr & Baldwin's Geology of Oregon, 4th Ed.

Presentations are free and open to the public. Questions may be addressed to Clay Kelleher, 321-6239 9 AM-5 PM or 775-6263 after 5 PM; or to Evelyn Pratt, 223-2601.

FIELD TRIPS:

Saturday, May 11: Landslides of the Portland Area. Leader: Dr. Scott Burns, PSU Geology Dept. Meet at NE corner of Cramer Hall BEFORE departure time at 9:00 AM. Transportation will be by PSU van. Cost is $5.00 - a real bargain! Send check for $5.00 for each person, made out to PSU Geology Field Trip, to Portland State Geology Dept.

Stops will be made at Washington Park, Zoo, Canyon Ct., Skyline Cemetery, Fairview Blvd., Fairmount Blvd., Cornell Rd., Thompson Dr., Germantown Rd., and at the Dodson slide in the Columbia River Gorge.

Saturday, June 15: Walk to a Rock: Building Stones of Downtown Portland. Leader: Clay Kelleher

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES **MUST** BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

WALKING ON WATER

Sharon Fen, the Conservancy's newest Oregon preserve, protects a rare ecosystem called a quaking fen, is perched high above a southwest Oregon valley amid jumbled geology. Four college chums who bought it 25 years ago have decided that an extraordinary place should be handed down to future generations just the way it is.

---

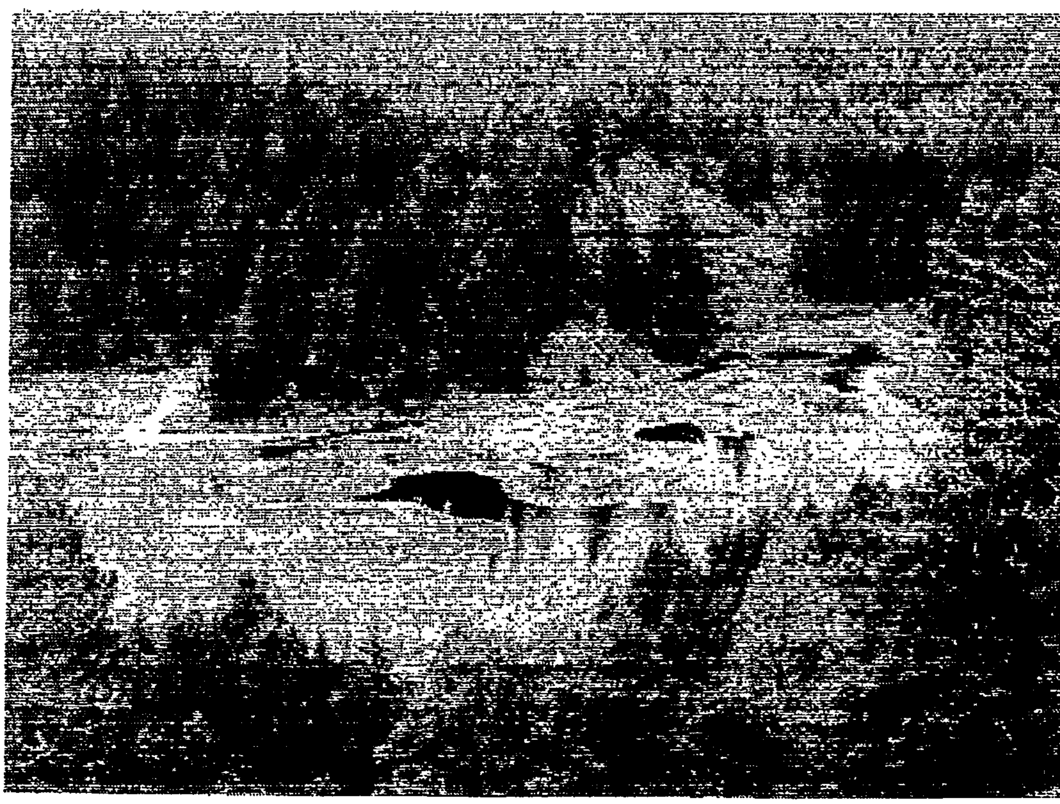
by Stephen Anderson, Editor, Nature Conservancy of Oregon Newsletter, Spring 1996

The Nature Conservancy's newest Oregon preserve is nothing like you've ever seen. Remote and hard to reach, Sharon Fen might have been just another jewel of a high mountain lake, tucked into a shoulder of Grizzly Peak a few miles northwest of Ashland, quietly surrounded by fir and pine forest. Except, amazingly, it's mostly covered by a floating mat of vegetation that's thick enough to walk on. And, technically, it's not a lake, it's a fen.

between solid ground and a lake. You can walk on water here, and it raises all kinds of questions about what lives in this ecosystem, how it got here an how its survives."

Some questions can be answered by John Christy, wetland ecologist for the Conservancy's nature heritage program, who has studied and led field trips to the site. " It's a superb example of a 'floating' or 'quaking' fen," he says. "Remarkably, there's also a nearby 'floating' or quaking 'bog' called Quarter Section Lake, and the two are at opposite ends of the nutrient spectrum. Both are the largest of their kind known in Oregon.

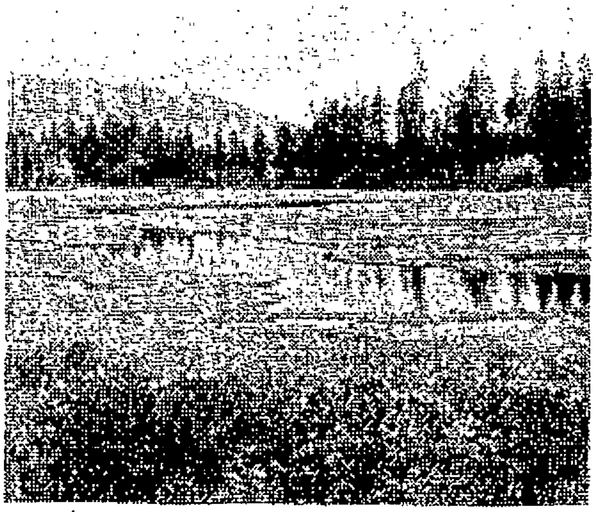
As Christy explains it, wetland aficionados have recently adopted terminology that classifies peat-forming wetlands based on their nutrient status. Under this classification, a bog is a nutrient-poor, peat-forming wetland that gets its nutrients mostly from precipitation. Bogs in Oregon are characterized by a distinct species of sphagnum moss (*Sphagnum fuscum*) that acidifies its



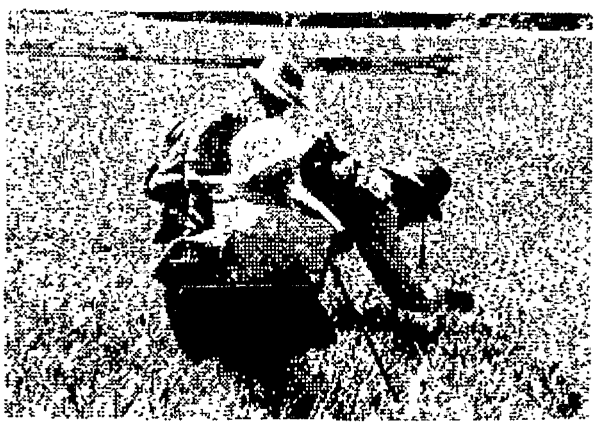
The Conservancy's 54th Oregon preserve is Sharon Fen, a highly unusual wetland ecosystem found in the foothills of the Cascade northwest of Ashland.

"It's a very special place that few people know,", says Darken Barges, Conservation ecologist for southwestern Oregon. "It challenges the distinction

surroundings in its struggle to capture nutrients. On the opposite end of the nutrient spectrum, a fen is a nutrient-rich peat-forming wetland that gets most of its nutrients from groundwater or runoff from uplands. Fens in Oregon have mats of several ¨stinct species of "brown moss" and flowering ᵣ₄ants, but very little sphagnum moss.



A quaking fen is characterized by floating mats of aquatic vegetation thick enough to walk on. Even elk are known by their tracks to frequent Sharon Fen. A pair of sandhill cranes was observed nesting their recently



Ecologist John Christy (bending) and biologist Frank Lang (background) lead a field trip to Sharon Fen, joined by Ginny Post.

At Sharon Fen, the floating mat of vegetation grows in from the edges and covers most of the lake's 20-acre surface. " It quakes and billows as you walk on it, much like a water bed. A misstep can suddenly put you up to the armpits in startlingly cold water," says Christy, speaking from experience. The floating mat of vegetation is actually a mosaic of plant communities, including stands of bog buckbean and bulrush, nutrient-rich "brown moss" fen, sedge fen and beds of aquatic vegetation.

ˆ˜aran Fen also testifies to some impressive ˍ ological events. "The area contains sag ponds and slump blocks on a grand scale, some of the best examples I've seen in the Western Cascades," says Frank Hladky, geologist for Oregon Department of Geology and Mineral Industries. As Hladky tells it, one or more geological cataclysms created the unique conditions for Sharon Fen perhaps 500 years ago. Triggered by an earthquake or by the sheer weight of rain-soaked soils, a massive earthslide of fractured volcanic rock, interbedded with volcanic ash and greasy clay, gave way and roared down toward the valley below. The sliding block plowed soil and house-sized boulders in front of it, coming to rest at the foot of a newly exposed 400-foot cliff. A newly hummocked landscape was formed, below which spread an apron of undulating ground and boulder fields. Forest eventually reestablished on the new terrain. As numerous depressions began to fill with water, a variety of lakes and ponds developed.

Sharon Fen Preserve and its surroundings host a number of important elements of biological diversity in the southern Cascades. The many wetlands in the area, which include seasonal ponds, spring-fed sedge fens and willow swamps, are significant because they include a great variety of vegetation types, compressed into a small area constrained by landslide topography. Surrounding forests have been repeatedly logged for Douglas fir, ponderosa and sugar pine, but a remnant stand of mixed conifer old growth remains on a nearly inaccessible rocky terrace above Sharon Fen, isolated both above and below by scarps of Dead Indian Plateau.

Conservancy staff are developing long-term management plans for the new preserve. Plant and wildlife populations will be carefully monitored to judge the health of the ecosystem, and the occurrence of non-native species will be assessed. Research and educational field trips are the only anticipated human impacts. Restoration of the surrounding forests is a subject for continued planning and cooperation with neighbors.

The U.S.Bureau of Land Management owns parts of several wetlands in the basin as well as the old-growth forest to the north. The wetlands are to be protected under guidelines of the Northwest Forest Plan. The agency is also focused on restoring natural conditions in the forest, which has become congested with young white fir due to fire suppression. Private owners of other significant wetlands and forested lands in the basin include some who are establishing a conservation trust to guide management of their lands.

The new Sharon Fen Preserve, Oregon's 54th, is a project of ***Forever Oregon*** conservation campaign. The compaigng committee is working to raise $311,000 to cover costs of the purchase and, in addition, a natural heritage endowment and stewardship endowment for long-term management of the preserve. The name "Sharon Fen" is still unofficial and subject to change. Some locals call it Sharon Lake, but despite its uniqueness and charm, it has no name on maps.

Permission to reprint the article WALKING ON WATER was granted by the Nature Conservancy of Oregon.

IN MEMORIAM

Shirley O'Dell long time member of GSOC died March 30, 1996. She was born in Minneapolis, Minnesota, 1920, and moved to Portland, Oregon in 1947, where she lived most of her life. She worked as a secretary at Charles F. Berg, at an investment company, and at Columbia Grain Company. After she retired, she did volunteer work at St. Vincent's Medical Center Gift Shop and at Nature of the Northwest Information Center. She was a member of GSOC for more than 30 years, and held various elective and appointive offices, such as secretary and auditor. She was an avid world-wide traveler, being very interested in people and different cultures. She is survived by one brother and many friends.

USGS studies of earthquakes and faults and tsunami potential in the Pacific Northwest. Cascada

Reconnaissance high resolution data were collected in the Columbia River between Astoria, OR and Washougal, WA, in areas where faults are inferred to cross or coincide with the Columbia River and tributary channels or rivers. Onshore, fault esposures are concealed beneath vegetation, urban sprawl, or young river deposits Offshore the seismic reflection profiles show evidence for faulting of recent river deposits over the Portland Hills and Firn Hill faults. In other areas, including the Frontal fault zone, the Clatskanie fault zone, and areas near Portland, relatively recent faulting is suggested, bu not confirmed by dipping and/or truncated reflectors. The data were released in an open-file report, and the results have led to planning for more extensive geophysical surveys in the region.

Paleo-tsunami deposits were identified in coastal lake and esturaine deposits at several sites in the Pacific Northwest, some of which contain evidence for sudden coseismic subsidence and tsunami deposition 300 years ago along the Cascadia coast. Analyses of a core from the north side of the Seattle fault identified rupture as occurring about 1100 years ago. The studies are part of a larger, ongoing USGS and university studies that are studying the 300 BP and 1100 BP seismic events, and are important to delineating the seismic history of the Pacific Northwest.

Computor simulations were made of the magnitudes of tsunamis that may be caused by tsunami earthquakes occurring on known faults of Washington, Oregon and northern California continental margins. Earthquakes on these faults are capable of producing surprisingly large loca tsunamis for both wave magnitude and resulting run-ups. The calculated magnitudes are similar to magnitudes for other tsunamis that, in recent years (1992-1994), have killed hundreds of people and cause extensive damage to coastal facilities in other areas of the worls such as Nicaragua, Japan, Indonesia, and Russia

The article *OFFSHORE EARTHQUAKES AND LANDSLIDE* was taken off the Internet, USGS Hazards Page, Pacific Marine Geology

A LANDSLIDE DECISION

In the Great Landslide Case, Sammel L. Clemens told a story about a pratical joke played on a newly arrived U.S. Attorney for the territory of Nevada. The fictitious case devised by the local citizens involved two ranching neighbors who disputed claims to the same piece of property. It seems that a rancher named Mr. Morgan lived on a steep mountainside uphill from a fellow rancher, Mr. Hyde. Well, a terrible landslide transporte Morgan's ranch--- all of it--- downslope and onto the exact area occupied by Hyde's place, covering it " to a depth of about thirty eight feet." Mr. Hyde was able to -cape the event. When he returned to the site of his erred ranch he discoovered a happy Morgan, who refused to leave, laying claim to his newly placed cabin, fences, cattle, and barns. He said he was just occupying what was his, and "he's going to keep it--likes it bettr'n he did when he was higher up the hill."

Lawyers were engaged on both sides of the complaint, the U.S. Attorney taking Mr. Hyde's case. The judge listened to an onslaught of witnesses who overwhelming supprted the side of Mr. Hyde.

What was the verdict? The judge, who was part of the ruse, conceded that although the bulk of the evidence favored Mr. Hyde, he ruled...." Heaven in its inscrutable wisdom, has seen fit to move this defendant's ranch for a purpose. We are all creatures, and we must submit. If heaven has chosen to favor the defendent Morgan in this marked and wonderful manner; and if Heaven, dissatissffied with the position of the Morgan ranch upon the mountainside, has chosen to move it to a position more eligible and more advantageous to the owner, it ill becomes, insects as we are, to question the legality of the act or inquire into the reasons that prompted it. No--- Heaven created the ranches, and it is Heaven's prerogative to rerrange them, to experiment with them, to ·ft them around at its pleasure. It is for us to submit, .hout repining ...Gentlemen; it is the verdict of this court that the plaintiff, Richard Hyde, has been deprived of his ranch by the visitation of God! And from thiss decesion there is no appeal.

Hyde's lawyer, incensed at the foolish verdict, visited the judge that same night to negotiate a modification of the verdict. After pacing the floor and pondering for more than two hours, the judge smiled and told the lawyer that Hyde's title to his land underneath Morgan's was still as good as it ever has been....and therefore he was of the opinion that Hyde has a right to dig out from under there and ...."

The U.S.Attorney " never waited to hear the end of it. He was always an impatient and irascible man, that way. At the end of two months the fact that he had been played upon with a joke had managed to bore itself, like another Hoosac Tunnel, through the solid admant of his understanding

The article above came from EARTH BRIEFS, New Mexico Bureau of Mine and Resources, Fall, 1995 and from ----from Samuel L.Clemens, ***Roughing It: The Great Landslide Case***

The Geological Society of the Oregon Country 1996 Banquet

The Geological Society of Oregon 1996 Banquet was a great success. Evelyn Pratt and her helpers worked hard at getting the Banquet organized and seeing that all the pieces fitted together to make a successful Banquet. The sales table was successful in selling a variety of material including rock, crystals and reading material. Publications of the Society's President's Campouts was well received. The exhibits were educational and enlightening. The food was excellent. The new board was sworn in by Donald Barr. The passing of the "Two Islands" and the ceremonial miners pick was passed to the incoming President Richard Bartels by outgoing president Clay Kelleher. The evening was capped by a most enlightening lecture by Dr. William Orr, Professor of Geology at University of Oregon.⊕

GSOC BANQUET PICTURES

1. New Board of Directors for 1996-97
Left to right, Ray Crowe, Director 3 years, Phil Johnson, Secretary; Phillis Thorne, Treasurer; Ricard Bartels, President; Dr. Paul Brown Vice-President; speaker of the evening, Dr. William Orr.
2. Charter member, Mildred Phillips.
3. President Richard Bartels, president for 1996-97.
4. Past Presidents, left to right, front row, Dr. Donald Botteron, Clay Kelleher, Eveyln Pratt, Don Parks, back row standing, Dr. Ruth Keen, Archie Strong, Donald Turner, Esther Kennedy, Rosemary Kenney, Andy Corcoran, Donald Barr, Ralph Mason.
5. Clay Kelleher handing Richard Bartels some of the tools of the office.
6. Richard Bartels, President 1996-97 receiving the ceramonial G-Pick from out-going President, Clay Kelleher.
7. Dr. William Orr, 1996 Banquet speaker.
8. Richard Bartels.
9. Beverly Vogt
10. Donald Barr, M.C. giving Clay Kelleher the GSOC G-Pick given to outgoing Presidents.
11. Dr. Donald Botteron and Betty.
12. Dr. Ruth Keen
13. Booth Joslin, properties and P.A. System chairman for 3 years.
14. Dr. Paul Brown, 1996-97 Vice-President and wife, Jacky.
15. Cynthia Kenyon, Donald Barr M.C. and Dorothy Barr .
16. Evelyn Pratt, Chairperson for the 1996 Geological Society of the Oregon Country Annual Banquet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JUN 96

THE GEOLOGICAL NEWSLETTER

GSOC

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Calender: Evelyn Pratt 223-2601

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Rosemary Kenney 221-0757
Assistant: Cecelia Crater 235-5158

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: Evening: Second Friday evening each month, 8:00 pm, Rm 383, 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-$20.00, Family-$30.00, 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.

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VOL. 62, No. 6
JUNE, 1996

JUNE ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Cafeteria is closed permanently.)

June 7: The Changing Columbia
James Ashbaugh, PSU Geography Dept. (ret.) & author

June 21: Lakes and Their Management in Oregon
Mark Sytsma, PSU

FRIDAY EVENING MEETINGS: 8:00 pm Portland State University, Cramer Hall, Rm. 383

June 14: Earthquake Warning
Robert Fryer, Beaverton Fire Dept.

June 28: CANCELLED

Presentations are free and open to the public. Questions may be addressed to Clay Kelleher, 321-6239 9 AM-5 PM or 775-6263 after 5 PM; or to Evelyn Pratt, 223-2601.

FIELD TRIPS:

Saturday, June 15: Walk to a Rock: Building Stones and Monuments of Downtown Portland. Clay Kelleher will lead a free walk from Main St. to Burnside. Meet at PSU between Cramer & Lincoln Halls BEFORE 9:30 AM. Return 2-2:30 PM. For 45-min. "refresher course" on basic rock types, arrive at 8:45 AM.

June ?24-27?: Imperial Tombs of China group tour at Portland Art Museum for GSOC members and guests. 10% discount; seniors $9.50; adults $11.40. Exact date, time by June 1. Only 30 tickets are available, 20 of which must be for seniors (55 years +) Preference given to GSOC members. Call Clay at home, 775-6263, evenings or weekends, for this once-in-a-lifetime exhibit!

August 9-18 President's Field Trip to Northern Washington. Call Richard Bartels, 292-6939, for details.

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES MUST BE SUBMITTED TO THE CALENDAR EDITOR BY THE 15TH OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

FIELD TRIP REPORT - NORTHERN OREGON COAST

by Clay Kelleher, GSOC Field Trip Leader

Twelve GSOC members and guests participated in a two-day field trip between Highway 26 and Tillamook April 13-14, 1996. The writer organized the trip, with the objective of viewing and understanding the major stratgraphic features of this part of Oregon. Strata ranged in age from late Eocene to Mid-Miocene, plus some Pleistocene and Recent features.

The trip was originally scheduled for March 30-31, subject to the condition that the weather forecast on the preceding Thursday did not predict rainy weather. The March 28 forecast predicted rain half of Saturday and all day Sunday, so all registrants were notified of the postponment. The actual weather was cloudy on Saturday, but a deluge on Sunday. One of the sated objectives of the trip was to have a good time, so the change in dates was justified. Only a hardened professional can enjoy geology in a driving rainstorm.) Several of the original registrants could not attend April 13-14, but those who could were rewarded with excellent weather both days.

The field trip guide listed 14 planned stops over the two days, all of which were made remarkably close to schedule. Maps published by Niem and Niem (1985) and Wells and others (1994) provided the basis for interpreting Tertiary strata. Stops included outcrops of the Hamlet Formation, the Cole Mountain Basalt, the Sandstone of Garibaldi, the Smuggler Cove Formation, the Astoria Formation, and two formations within the Columbia River Basalt: the Grande Ronde and the Wanapum. Also two Pleistocene terraces were visited.

In addition the group viewed some of the aftermath of the February 1996 rainstorm, including many fresh landslide scars and logs stranded by high water. The commercial district of the town of Nehalem had been under five feet of water but was back in businesses when this writer visited during field trip reconnaissance two weeks later. Our group noticed how most of the businesses in town require you to walk up 4 or 5 steps to reach their "ground" floor.

The highlight of the trip were visits to three State Parks on Sunday. Oswald West State Park features a quarter-mile walk through old-growth forest on an ancient landslide to a beautiful pocket beach called Smuggler Cove. A well-indurated ("hard" marine unit called the Smuggler Cove Formation dips an unvarying 30-35 degrees northward throughout the park, and would be an excellent area for geology students to learn to use a Brunton Compass. Just a few miles to the north, Hug Point State Park's well-indurated Astoria Formation is substantially folded and faulted. (These same formations exhibited much poorer induration at other locations on the trip, and the presence or absence of Columbia River Basalt invading the sediments was cited as the factor that made the difference, though the exact mechanism was not described.) The final geology stop was at Cape Meares State park, famous for its view of Cannon Beach. Of interest to us were outcrops with contacts between the Astoria Formation and the Columbia River Basalt.

THE GREAT MISSOULA FLOODS

by Ray Crowe, GSOC member

On March 22nd, GSOC members and guests listened to Dr. Richard Waitt, USGS, Cascade Volcano Observatory, give an interesting talk and slide presentation of the Missioula floods that swept across the channeled scablands of eastern Washington at the end of the last Ice Age.

Some years ago, while doing a survey of indigenous insect species, specificially butterflies, I marveled at Dry Falls State Park, looked at Indian rock shelters near Soap Lake, and collected a small rounded granite boulder for the yard from the outskirts of Moses Lake, Washington, where there were tons of unsorted flood deposits lining Airman's Beach. Later we observed the effect of the floods on basalts of the Wallula Gap area of the Columbia River.

A few comments come to mind. One being recession of the escarpments and deepening of the channels, to moderate the appaarent effect of the floods on upstream topography. Dr. Waitt commented on the fact that the ninety or so floods appeared to become smaller and smaller in the later stages of Pleistocene ice advances. I wondered then, if this might be an apparent artifact of coulee widening and deepening over time.. The Niagara Falls escarpment, even in present times, appear to be receding at the rate of about 4 feet per year, the Niagara River eroding in shale and resistent dolomite (6). Obviously as the Ontario Lobe of the Wisconsin Ic Sheet was in full retreat, volume would have been greater, and erosion that much more rapid. As the Missoula floods deepened and widened the channels, making them capable of holding more volume, the effect on upstream topography would seem to lessen from flood to flood. Grand Coulee, the upper section runs for some 20 miles, with 400 foot high walls, and four miles wide. The lower coulee runs another seven miles to Soap Lake, and is only a miles wide with 200 foot walls... 500 foot to the west due to the Coulee Monocline (5). A bit of arithmetic indicates that just on the upper coulee over 8,000,000 cubic yards of material have been removed... a lot of basalt. Must of it scattered across the plains outside of Euphrata. And then consider all of the other coulees in the area, and how much material has been removed over the ages.

One wonders then, just how ancient some of these coulees might be. In an aside, Dr. Waitt commented that there was little evidence of the Missoula floods from early Pleistocene, but in the Puget Sound area, evidence of more ancient glaciation was apparent. It would seem then, that even early in the Pleistocene, floods must have been occurring, deepening channels. Dr. Allen comments that, "Early progressions of ice probably resulted in large recurrent floods 60 and 50 thousand years ago. These were probably even larger than the Bretz Floods which resulted from the very last advance of ice between 15 and 18 thousand years ago, which were of such magnitude that most of the evidence left by the earlier floods have been destroyed (1)."

Dr. Watt had a marvelous collection of slides; many aerial ones that gave an overview of the flood area, showing ancient "ripple-marks," others with varves from ancient lake deposits indicating floods occurring in less than a human generation. Some slides had a series of gravels, grading gradually to sands and silts, their profiles starkly outlined in exposed deposits.

Lake Allison was formed as flood waters backed up and ponded in the Willamette Valley, often littering the landscape with glacial erratics, including the famous Willamette Meteorite. Dr. Allen comments that the, often 100 foot thick Willamette silts, "were probably laid down by the earlier Missoula Floods." Is it reasonable to assume that other early deposits might contain a stratagraphic record of some earlier floods? The Portland Sands and Gravels, often 5-600 feet thick, are suggested as being laid down by the Columbia and Willamette Rivers during the rise in sea level following the "Illinoian" glaciation or the results of a ponded Pleistocene flood or floods (3). I'm personally ignorant of the deposit, but wonder if investigation might reveal some of the type bedding seen in Dr. Waitt's slides, indicating the presence of very early floods.

" Imagine a wall of water 2000 feet high with 500 cubic miles of water behind it, heading with a thundering roar for Spokane and points southwest (2)."Dr. Waitt commented on the existence of Late Pleistocene Clovis hunters from near Wenatchee, but didn't mention what must have been a terrifying experience for human witnesses to the flood. Another group inhabited a rock shelter along the Palouse River, tributary of the Snake. The 14,000 year old human bones found at the (5) Marmes site, might have at one time seen a flood. An Oregonian article, April 5th, 1979, said the bones were the result of a cannibal feast though, and I guess I don't feel quite so sorry for those possible flood victims, debris of their lives carried away by the floodwaters... like the atlatl (spear thrower) found by Dr. Cressman in gravels near the Dalles.

(1) *Cataclysms On The Columbia*, 1986, John Eliot Allen
(2) *Roadside Geology of Washington*, 1984, Alt and Hyndman
(3) *Geology of Oregon*, 1959, Baldwin
(4) *Cascadia*, 1972, McKee
(5) *Catalog of Fossil Hominids of North America*, 1978, Protsch
(6) *Elements of Geology, third edition*, 1972, Zumerge and Nelsen

COMPLETELY FRACTURED GEOLOGY

by Sue & Chris Murray

1. **polysynthetic twinning**: the cloning of a man-made material
2. **migmatite**: metallic ore used for Soviet airplanes
3. **pontic**: (a) a religious higher-up (b) a firm now owned by General Motors
4. **steptoe:** related by marriage to someone's foot
5. **cyclothem**: part of answer to "What do I do with all these tin cans?" "Re-cyclothem!"
6. **tridymite**: a small but powerful agent used to neaten up the landscape
7. **stochastic**: part of reply to a nasty remark, "Well, you don't have to be so stochastic!"
8. **swash mark**: military insignia indicating years of

service
9. **tremolite:** a very small earthquake
10. **petrography**: study of advertising for the oil industry

WHERE DID THE MOON COME FROM?

by Murray Kane
Arizona Gem and Mineral Society

For countless generations people of all ages have looked up at the sky on a clear night, at countless stars and galaxies millions of light years away, and pondered the mysteries of space and infinity. But a much nearer heavenly body, the Moon, has inspired more awe and wonder than any of them, provoking such questions as, "of what kind of rock is it made?", and, "where did it come from?"

The Apollo program answered the first of these questions by bringing actual samples of lunar rocks back to Earth for study. The lunar highlands are composed of a light-colored rock called anorthite, which is composed mostly of plagioclase feldspar. "Thus most of the lunar plagioclases fall within the composition range of anorthite and bytownite; a few are in the range of labradorite" (1) The plagioclase feldspars are sodium-calcium-aluminum silicates. Anorthite is the calcium end member of the series with the formula, $CaAl_2 Si_2 O_8$. The other two varieties contain progressively more sodium, but with more calcium than sodium. Labradorite is the most common of the three in the Earth's rocks. The lunar maria are composed of basalt, which shares honors with granite for being the most common igneous rock on Earth.

Anorthite is abundant in the Earth's very old Pre-Cambrian rocks, underlying large areas in Norway and Russia and the Adirondack Mountains of New York, but it is rare as a younger rock. That indicates that the process that forms igneous rocks has changed somewhat on the Earth with the passage of time.

The Moon's origin is still a moot question for speculation and debate, but only two theories are worth serious consideration. The most favored theory is that the Moon, like the Earth, developed independently from the accretion of cosmic material produced by a supernova 4.6 billion or more years ago. Then, the orbits of those two planetary bodies brought them into such close contact that their mutual gravitational attraction wouldn't let them break away. Thus, the Moon became a satellite of the much larger Earth. The most attractive asset of that theory is its simplicity, but is has discrepancies that we will examine.

The other theory is that the moon is composed of rock material that was pulled out of the Earth by the Sun's gravitational attraction at a time during the Earth's infancy when it was in a mostly molten state. That theory dates all the way back to Jeans and Jeffreys, but even though it sounds fantastic, when it is examined in connection with some of the recently discovered facts, it isn't as shabby as it first appears.

The low density and low iron content of the Moon discredits the theory that the Moon grew by accretion of cosmic material like the Earth and its neighboring planets. These planets are all believed to have a nickel-iron core and here are their densities:

Earth: 5.52
Venus: 5.3
Mars: 3.94 (somewhat in doubt)
Mercury: 5.4
Moon: 3.34

So, as you can see, the Moon is considerably lighter than the inner planets with which it is associated and it has no nickel-iron core.

A lot of the iron it does contain came from the billions of meteorites that have fallen upon it for the past four billion years and so is not an original constituent. If the Moon was formed by the same process that created the inner planets then it should have a much higher density and considerably more iron. So, the logical inference is that the moon was not made by the same process that made the inner planets.

Also, make note of the fact that the Earth is notably denser than any of the other planets; that is significant.

Additionally, it is known from celestial mechanics that the Moon was closer to the Earth in the past than it is now; the radius of its orbit is increasing. (2) That fact supports the theory that the Moon came out of the Earth, but it is not proof.

Perhaps the best circumstantial evidence that the Moon was once part of the Earth is the great density difference between the Moon and the Earth and the fact that the Earth is so much denser than the other inner planets. If the substance of the Moon was incorporated into the Earth, then the density of the Earth would be lower and nearer to the densities of its neighboring planets.

Skeptics will say that if the Moon came out of the Earth, then the Moon should have a density and composition exactly like the density and composition of the Earth. My answer to that is that the Moon was formed only by rock matter that came from the Earth's upper mantle and crust and it did not incorporate any of the heavier substance of the Earth's lower mantle and core. Here is a model of what I think happened during the early history of the Earth after is was formed by the accretion of cosmic material about 4.6 billion years ago:

The Earth was a heterogeneous mass of rocky material containing almost all of the substance that it has today plus the substance that is now the Moon, so its diameter was somewhat greater than its present diameter – a little more than ^ 000 miles. It was solid at first, but it did not stay that way long. "The next stage after accretion of the Earth was one of heating, mainly by radioactivity."(3) "...at 5 x 10 years ago, radiogenic heat production in the Earth would be approximately six times greater than today and most of this heat was contributed by K_{40} and U_{235} , whereas today, these nuclides are greatly diminished in amount and the principal sources of radiogenic heat are U_{238} and Th_{232}

Originally there was about the same amount of U_{235} and U_{238} in the Earth, but U_{235} disintegrates so much faster than U_{238} that there is much less of the former than the latter in the Earth today. So the U_{235} disintegrated, turned itself into the lead isotope Pb_{235} and produced a lot of heat in the process; enough heat to start melting some of the elements. "On this basis, the melting temperature of iron was reached in about 600 million years at a depth of a few hundred kilometers."(3) "The sinking of this large mass of molten iron to the center would transform a considerable amount of gravitational energy into heat, sufficient to raise the temperature of the interior of the Earth by some 2,000 degrees. So, about 4 billion years ago the Earth's interior was a molten mass of rock. At that time the earth developed its density stratification as the heavy elements, iron and nickel, sank to the core and the light lithophile elements, silicon, aluminum, calcium, sodium and potassium, moved toward the surface to form the granitic rocks of the earth's crust. The rock that formed the Earth's crust at that time was probably anorthite, the same kind of rock that crystallized to form the moon's surface 4 billion years ago.

At that time the orbit of the Earth's revolution around the sun was much more elliptical than it is today, and at the times when the Earth was nearest to the Sun the Sun's great gravitational attraction pulled the liquid rock of the Earth's interior toward it in a high tidal bulge. As the Earth passed on its elliptical journey away from the Sun the tidal bulge sank part way back toward the iron core, but each time the earth passed near to the Sun the bulge grew higher and higher until finally the Sun's great attraction pulled it away from the Earth completely and its own gravitation drew the mostly molten mass into a nearly spherical shape and it became the Earth's satellite, the Moon.

The Moon's surface crystallized into the rock anorthite and eventually the entire Moon became solid. But about 3.5 billion years ago the Moon's interior still contained enough liquid rock to flood vast areas of its surface with dark basalt lava to form the Moon's maria, so called by the pioneer astronomers because, seen through their crude, homemade telescopes, they looked like seas.

I hope this article will inspire someone to write a rebuttal favoring the other theory of the Moon's origin. Anyway, it will give you something to think about as you look up to the sky on a clear night and see a bright, beautiful full Moon hanging there mysteriously in space or playing hide-and-seek with you through the clouds.

References:

1. The Lunar Rocks by Brian Mason and William G. Melson, Wiley, p. 38.
2. Geology Today, CRM, Del Mar, CA, p.43.
3. Principles of Geochemistry by Brian Mason,Wiley p. 60.

From The Rockpile, 2/95, via AFMS Newsletter 12/94 and others.

The above article taken from The Rockpile, 2/96, Arizona Gem and Mineral Society. With permission.

In Memorial

George David Brakel died April 12, 1996. George had been a soldier in World War II, and had many exciting experiences. He was an avid reader constantly studying scientific subjects.

He was intensely interested in collecting and working with precious stones, and had special machinery in his home for shaping and polishing them. Many times in February he went to Quartzite, Arizona where hundreds of people with like interests would gather for an annual meeting, and selling and exchanging stones and equipment. He was a lover of nature, the streams, the rocky cliffs , the flowers and the tall trees.

He joined the Geological Society of the Oregon Country, and regularly attend their informative meetings and field trips. He attended many of the 4-day weekend workshops and workparties :t Hancock Field Station.

****

Manuel James Boyes, longtime director of the Oregon State Police Crime Laboratory headquartered at the University of Oregon Medical School, died on Wednesday, May 8 at his home. His adult career included, serving with the U.S. Army in the South Pacific from 1940 1945, graduating from Lewis and Clark College, joined the Oregon State Police in 1949 and served as a trooper until 1955 when he was appointed director of the Oregon State Police Crime Lab. He retired in 1975. After his first wife died in 1988, he married a family friend, Gale Storm Rankin in 1989. The two of them joined the Geological Society of the Oregon Country and explored the natural and scenic areas throughout the state on the Society's field trips, President's Campouts, and the 4-day retreats at Hancock Field Station.

CORRECT DEFINITIONS FOR "COMPLETELY FRACTURED GEOLOGY"

E. Pratt, adapted from AGI Dictionary of Geological Terms, 3rd Ed.; Bates & Jackson

1. polysynthetic twinning: refers to repeated parallel formation of three or more crystals of the same substance; often results in striated crystal faces or cleavage planes
2. migmatite: a rock made of igneous or metamorphic materials which can be told apart with the unaided eye
3. pontic: refers to sediments deposited in deep motionless water, such as black shales and dark limestones deposited in a stagnant basin
4. steptoe: an isolated hill or mountain of older rock surrounded by a lava flow
5. cyclothem: a series of beds deposited during a sedimentary cycle typical of the Pennsylvanian period; nonmarine sediments with coal commonlv occur in the lower half of a cyclothem, mari sediments in the upper half
6. tridymite: a type of quartz occurring as tiny flat scales in acidic volcanic rock cavities
7. stochastic: refers to a process in which the outcome at any particular moment is not absolutely certain
8. swash mark: thin delicate line on a beach showing how far the highest wave advanced
9. tremolite: a white to gray amphibole mineral that occurs in blades or prisms, especially in metamorphic rocks; found in a lot of commercial talc
10. petrography: the branch of geology that deals with the description and systematic classification of (usually) igneous and metamorphic rocks

++++++++++++++++++++DON'T FORGET TO PUT THE DATES FOR THE PRESIDENT'S CAMPOUT ON YOU CALENDER. IT WILL BE AUGUST 9-18. FULL DETAILS WILL BE ANNOUNCED AT ALL MEETINGS AND IN JULY NEWSLETTER.. ADDITIONAL INFORMATION, CALL RICHARD BARTELS, 29?-6939**

JUL 96

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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Calender: Evelyn Pratt 223-2601

Business Manager:
Rosemary Kenney 221-0757
Assistant: Cecelia Crater 235-5158

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: Evening: Second Friday evening each month, 8:00 pm, Rm 383, 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-$20.00, Family-$30.00, 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.

APPLICATION FOR MEMBERSHIP
THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY.

Name:____________________ Spouse____________________

Children under age 18:____________________

Address:____________________

City:________________ State____________ Zip____________

Phone:____________________

Geological Interests and hobbies:____________________

Individual: $20.00________________ Family: $30.00________________

Junior, under 18, not included with family membership: $6.00________________

Make check payable to : The Geological Society of the Oregon Country
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VISITORS WELCOME
INFORMATION: 9AM-5PM, 321-6239
after 5PM, 775-6263

VOL. 62, No. 7
JULY, 1996

JULY ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Cafeteria is closed permanently.)

July 5: Cancelled

July 19: Project at Fish Creek Campground, East of Estacada
Cari Kreshak, archeologist with the Forest Service

FRIDAY EVENING MEETINGS: 8:00 pm Portland State University, Cramer Hall, Rm. 383

July 12: Oregon's Voluntary Well-head Protection Program: Example - Nampa, OR
Tom Pattee

Presentations are free and open to the public. Questions may be addressed to Clay Kelleher, 321-6239 9 AM-5 PM or 775-6263 after 5 PM; or to Evelyn Pratt, 223-2601.

FIELD TRIPS:

August 10-17: President's Field Trip to Northern Washington. See article in this newsletter or call Richard Bartels, 292-6939, for details.

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES **MUST** BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

THE PRESIDENT'S CAMPOUT

Richard Bartels, President AUGUST 10 -17, 1996

WHEN: Leaving Portland on Saturday, August 10
Returning to Portland on Saturday, August 17

WHERE: Through the "Cascade Loop" in Northern and Central Washington.
(1) Two nights in CONCRETE nestled in the shadows of Mt. Baker (Aug. 10 & 11)
(2) Three nights in WINTHROP, the rustic old west town located in the magnificant Methow Valley (Aug 12, 13, & 14), and
(3(Two nights in CASHMERE in Washinton's apple growing capitol along the Wenatchee River and near the Bavarian Village of Leavenworth complete with Alpine scenery (Aug 15 & 16).

GENERAL THEME OF THE CAMPOUT:
Give a general overview of Washington geology but emphasizing the Cretaceous paleogeography of the Insular and Intermontane Superterranes.

DAILY OBJECTIVES:
Sat.- Aug. 10: Introduction to the thrust sheets (nappes) of the Northwest Cascades west of the Straight Creek Fault. Emphasis on the uppermost thrust sheet (Easton Terrane) and its geologic history. Evening in CONCRETE.

Sun-Aug. 11: Continuation of the nature and cause (docking of Wrangellia) of these thrust sheets with emphasis on the Chilliwack Terrane. A glimpse of Quaternary volcanism and contrasts with the Cascade volcanism here in Oregon. Evening in CONCRETE

Mon.- Aug.12: Going east on the Straight Creek Fault, we will study the Triassic-age accreted terraces and the beautiful Skagit Gneisses of the Northern Cascades National Park. We will inish by looking at the nature of Ross Lake Fault Zone, the probable major suture boundary between the Insular Superterrane (the super-terrane from Mexico) and the yet to be visited Intermontane Superterrane (the superterrane from Southern Washington and/or Oregon). Evening in WINTHROP.

The next 2 &1/2 days will be studying the Intermontane Superterrane.

Tue.-Aug 13: This day we will study the stratigraphy of the Jurasssic and Cretaceous Methow Basin. The first basin margin traverse will investigate the Jurassic sedimentary sequence up to and past the Pasayten Fault (the boundary between the Methow Basin and the Okanogan Block where the Late Jurassic, Cretaceous, and Middle Jurassic magmatic arcs reside.). The second traverse will investigate the Cretaceous sedimentary sequence up to the Ross lake Fault Zone (a real knockout of a suture zone) We will consider the timing of events and their influence on sedimentation in the Mesozoic Forearc Basin (the Methow). The evening in WINTHROP with a possible hosting of the "motelers" by the "campers" at Pearrgin Lake State Park.

Wed.-Aug. 14: This full day we will initially look at the Okanogan Block to see the Mesozoic magmatic arcs consisting of an west to east traverse of late Jurassic orthogneisses, Cretaceous batholiths, and Middle Jurassic orthogneisses. This will be followed by searching for the eastern boundary of the transported Intermontane Superterrane. Finally we will arrive at the edge of the Okanogan metamorphic core complex to see the nature of the spectacular detachment on the western boundary of the metamorphic core complex. Evening in WINTHROP.

Thu.-Aug. 15: We will initially traverse some relationships in the southern part of the Methow Basin with the Late Jurassic orthogneisses and other supracrustral units.

Return to the Insular Superterrane.

We will pass back into the Insular Superterrane to see the Chelan Black consisting of migmatized gneisses (equivalent to the Skagit Gneisses) and our first opportunity to view the collisional generated plutons (from docking of Wrangellia). Two additional terranes, the oceanic-derived Mad River Terrane and the Swakane Terrane, whose protolith age is Precambrian, will be briefly studies. Evening in CASHMERE.

Fri.-Aug. 16 This day we will clarify the assembling of the Insular Superterrane by finding its missing component - the forearc basin as represented by the aluminum-rich Chiwaukum Schist. This completes the picture of the Easton Terrane rocks being the subduction zone complex, the Chiwaukum Schist being the forearc basin,and the Peninsular Batholiths which remain in Mexico being the Cretaceous magmatic arc. An addition component of the assembly of the Insular Superterrane is found here in an obducted (thrust over) dismembered oceanic terrane called the Indalls Tectonic Complex. Post-Cretaceous geology of this area is equally exciting with the development of two Eocene-age fault-bounded basin filled with continental sediments - the Chiwaukum Graben and the Swauk Basins. Evening in CASHMERE.

Sat-Aug. 17: We will have some mop-up operations from Friday and return to Portland via the Columbia River Basalt Plateau route, perhaps totally exhausted, laden with samples, but hopefully inspired!!!

LOGISTICS:

Participants **MUST BE MEMBERS OF GSOC** or invited guests by a <u>GSOC</u> participant.
We will have two types of participants. They are:

(1) MOTELERS - those who want the comforts of home, and
(2) CAMPERS - those that prefer camping or would prefer lower total cost.

TRANSPORTATION:

We will utilize 15-passenger vans and perhaps one 7-passenger van if needed. Each 15-passenger van will hold only 10 to 12 participants to allow space for **ONLY ONE SUITCASE** and if camping a small tent plus sleeping bag/pad. **NO PERSONAL AUTOS OR RECREATION VEHICLES**. Currently we have two 15-passenger vans that will be driven by Richard Bartels and Clay Kelleher. We will add vehicles and :ivers as needed.

LODGING:

MOTELERS are responsible for booking and paying for their own rooms. It is easier to have one roommate in a single room. Contact Richard Bartels if you are looking for spare people. SEE LODGING INFO for names, rates, and telephone numbers of the motels further on.

CAMPERS - Richard Bartels will secure adequate camping arrangements for the trip. A slight charge of perhaps $7 to $10 per night.

FOOD:

MOTELERS - breakfast and supper at you own expense in cafes.

CAMPERS - will have breakfast in cafes. Clay Kelleher will organize a group mess for suppers at the campsite. Any volunteer goumet cooks?? Campers will not bring their own stoves, pots, pans, etc.

LUNCHES - will be eaten in the field (bag lunches). We may have some "group" coolers. Rosemary Kenney has graciously volunteered to organize this aspect of the trip. She would like another volunteer and your input.

ROCK SAMPLES: We will collect a "suite of rocks" of adequate size and properly labeled that will serve a dual purpose.

(1) comparative samples during the trip (excellent teaching aids), and
(2) provide a reference collection that could be used as a " rock study" during yhe Geology Seminars this coming year.

It is recommended that personal specimens be kept at a minimum. I advise that a somewhat large hammer be used - these are tough rocks.

FIELD TRIP GUIDE: I will provide a field trip guide for each participant.

CO$T OF TRIP:

TRANSPORTATION COSTS. An eight-day rental of a 15-passenger van for 1200 miles plus absolute total insurance, and 10 miles per gallon fuel efficiency will come to $1050 total. only 10 passengers, this would amount to $105 per participant. Very reasonable.

LODGING COSTS: For motelers, assuming $50 per night for seven nights would amount ot $350 per participant. Campers would expect perhaps $70 in camping fees.

BASIC FEE: To cover the cost of preparation of field trip guide and the scouting trip wouild be $50 per participant.

Total cost for motelers:	Transportation	$105
	Motels	305
	Basic Fee	50
		$460 plus food expenses
Total cost for campers:	Transportation	$105
	Camping Fees	70
	Basic Fee	50
		$225 plus food expenses

DO YOU WANT TO GO? IF SO,

(1) Be sure you have paid membership with the Geological Society of the Oregon County.See "Application For Membership" form on the second page of the Geological Newsletter.

(2) Contact Richard Bartels at (503) 292 6939 in the evening. If you call during the day a message machine will record your name and home telephone number so I can contact you. Please indicate if you are interested in camping or moteling.

(3) If you desire to sleep in motels, you must contact the motels soon for reservations.

MOTELS IN CONCRETE:

We'll be staying in Concrete on the nights of Saturday, August 10 and Sunday August 11. We will stay at : **THE EAGLES NEST MOTEL**

206 East Highway 20, Concrete, WA 98237
Telephone (360) 853-8662
Owner - Pat Treadwell
Quoted Price - $40 per room

If booked, other choice will be:

NORTH CASCADE INN
4284 Highway 20, Concrete, WA 98327
Telephone (360) 853-8870 or 1-800-251-3054
Quoted rates - $40 per room, $5 per additional person.

MOTEL INFORMATION IN WINTHROP:

We will be staying in Winthrop on the nights of Monday, August 12; Tuesday, August 13; and Wednesday August 14. We have two downtown Winthrop motels:, it's your choice.

TRAIL'S END MOTEL
P O Box 189, Winthrop, WA 98862
Telephone (509) 996-2303
Quoted Rates - $58 to $68 per day

THE DUCK BRAND
P O Box 238, Winthrop, WA 98862
Telephone (509) 996-2192
Quoted Rates - $55 to $65 per day

One other location if these become filled:

HOTEL RIO VISTA
285 Riverside Drive, Winthrop, WA 98862
Telephone (509) 996-3535
Rates - do not know, did not visit.

MOTEL INFORMATION IN CASHMERE:

We will be staying in Cashmere on Thursday, August 15 and Friday, August 16.
We will be staying at:

VILLAGE INN MOTEL
229 Cottage Ave, Cashmere, WA 98815
Telephone - 1-800-793-3522 or (509) 782-3522
Quoted Rates: $51 for one bedroom, $57 for two bedroom and 8$ per person for 3rd and 4th person.

his is the only motel in Cashmere

SEE NEXT PAGE

(4) Your imput on group mess for campers can be directed to Clay Kelleher at home, 775-6263, evening c weekends. Your imput on the lucnches can be directed to Rosemary Kenney at 221-0757

COMPLETELY FRACTURED GEOLOGY

E. Pratt

1. seamount: along with sand and water, one of the ingredients of concrete
2. Laramide: a native of a Wyoming town
3. sima: as in, "Some of these puns sima lot weirder than others!"
4. almandite: what an Aussie said about his dessert: "This almondite bread is delicious!"
5. collophane: a kind of clear plastic used around the neck
6. coelocanth: describes a person unable to discern things near ground level
7. crenulation: having to do with stiff petticoats
8. zooplankton: heavy board used to keep animals in captivity
9. epigene: what one newlywed asked the other, "Are you epi,gene?"
10. arrastre: what a police officer threatened to do; "I'm going to arrastre for loitering!"

FROM Dr. Ruth Keen:

RE: People who went on Evelyn Pratts President's Campout who we promised a set of recipes for making Biscottis. I have found them. Give me a call to get them at 222-1430

CORRECTCT DEFINITIONS FOR "COMPLETELY FRACTURED GEOLOGY"

E. Pratt, adapted from AGI Dictionary of Geological Terms, 3rd Ed.; Bates & Jackson

1. seamount: an elevation of the sea floor 1000 meters or higher
2. Laramide: refers to a time of deformation from about 80-90 Ma to 60 Ma, typically recorded in the eastern Rocky Mts., or to the intrusives and ore deposits emplaced then
3. sima: the *si*lica and *ma*gnesia-rich lower layer of the earth's crust, equivalent to the ocean crust and the lower part of the continental crust
4. almandite: same as almandine, an iron-aluminum end member of the garnet group with a deep-red to purplish color, found in metamorphic rocks
5. collophane: any of several massive varieties c apatite, often whitish, making up the bulk of phosphate rock and fossil bone and used as a source of phosphate for fertilizers
6. coelocanth: the only living member of the order of lobe-finned bony fishes which were the ancestors of the first land vertebrates
7. crenulation: very small-scale folding that is superimposed on larger-scale folding; may occur along the cleavage planes of a deformed rock
8. zooplankton: the animal population in a floating, drifting mass of aquatic animals and plants
9. epigene: said of a geologic process, or of its resulting features, occurring at or near the earth's surface
10. arrastre: (Mexican) a mining mill (from New Spanish Dictionary, Nat. Textbook Co.); those we've seen consist of two horizontal circular grinding stones on an axle, the lower stone stationary and the upper with a shaft which can be pulled by a horse or mule

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Assistant: Cecelia Crater 235-5158

ACTIVIES

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 p.m., Room S17, Cramer Hall, Portland State University. Lib : Room S7. Open 7:30 p.m. prior to meetings. **PROGRAMS:** Evening: Second Friday evening each month, 8:00 pm, Room 383, Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon. **LUNCHEONS**: First and Third Fridays monthly at noon except holidays. Bank of California Tower, 707 SW Washington, 4th floor, California Room, Portland, Oregon. **MEMBERSHIP**: per year from January 1: Individual - $20.00, Family - $30.00, Junior (under 18) - $6.00. Write or call Secretary for application. **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. Individual subscriptions $13.00 a tear. 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.

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GEOLOGICAL NEWSLETTER

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VOL. 62, No. 8
AUGUST, 1996

AUGUST ACTIVITIES

FRIDAY NOON MEETING: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Cafeteria is closed permanently.)

Aug. 2: Illustrated Preview of President's Campout
Richard Bartels, GSOC President

Aug. 10-17: **PRESIDENT'S FIELD TRIP**: destination, northern Washington. For details see July Newsletter or call Richard Bartels, 292-6939. It promises to be an excellent opportunity to see a lot of wide-open scenery and NON-igneous rocks! LUNCHES ON CAMPOUT: You are responsible for your own lunches. Restaurants open at 7 AM or earlier. Most have carryout food and will prepare box lunches. Grocery stores are nearby in case you wish to buy food the night before and prepare your own lunch. REMEMBER A THERMOS FOR COFFEE! There will be a cooler for soft drinks. Rosemary.

Aug. 23: **ANNUAL G.S.O.C. PICNIC**: 6:00 PM potluck at Alpenrose Dairy. Hot drink will be provided. Questions? Call Paul Brown, 227-2136.

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES MUST BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

U. S. Geological Survey

National Earthquake Information Center

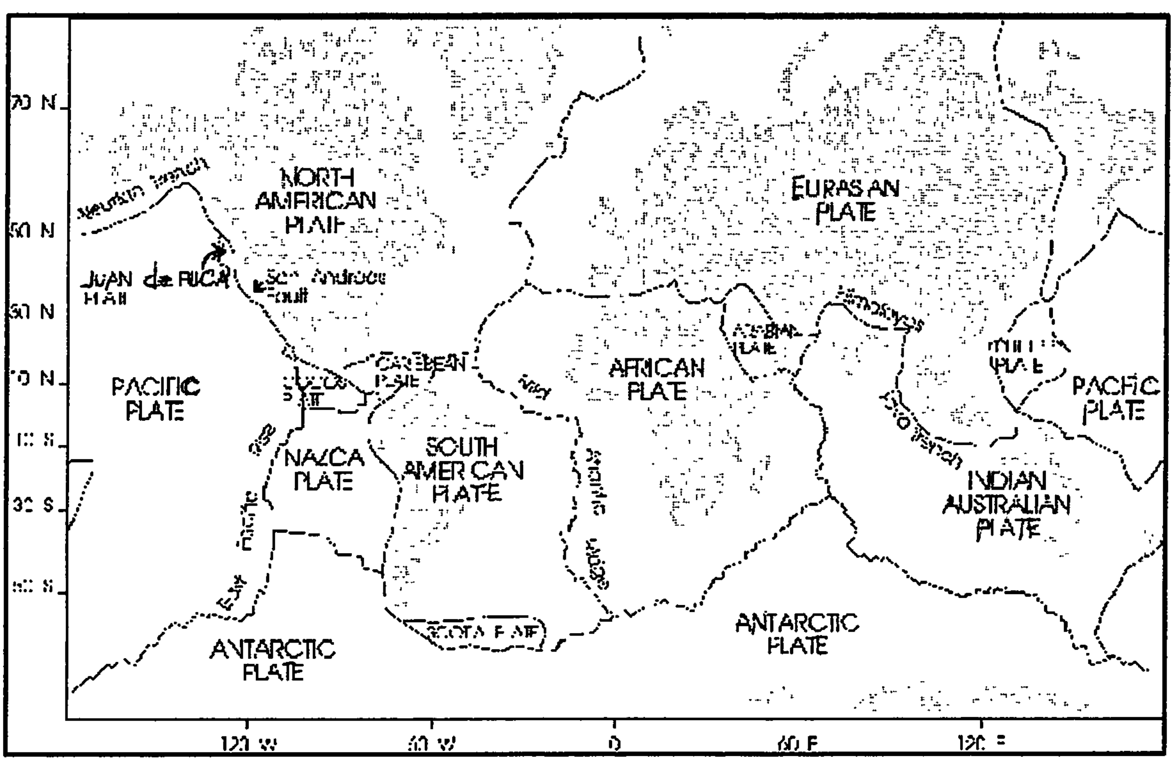
Earthquakes and Plate Tectonics

The world's earthquakes are not randomly distributed over the Earth's surface. They tend to be concentrated in narrow zones. Why is this? And why are volcanoes and mountain ranges also found in these zones, too?

An explanation is to be found in plate tectonics, a concept which has revolutionized thinking in the Earth's sciences in the last 10 years. The theory of plate tectonics combines many of the ideas about continental drift (originally proposed in 1912 by Alfred Wegener in Germany) and sea-floor spreading (suggested originally by Harry Hess of Princeton University).

Plate tectonics tells us that the Earth's rigid outer shell (lithosphere) is broken into a mosaic of oceanic and continental plates which can slide over the plastic aesthenosphere, which is the uppermost layer of the mantle. The plates are in constant motion. Where they interact, along their margins, important geological processes take place, such as the formation of mountain belts, earthquakes, and volcanoes.

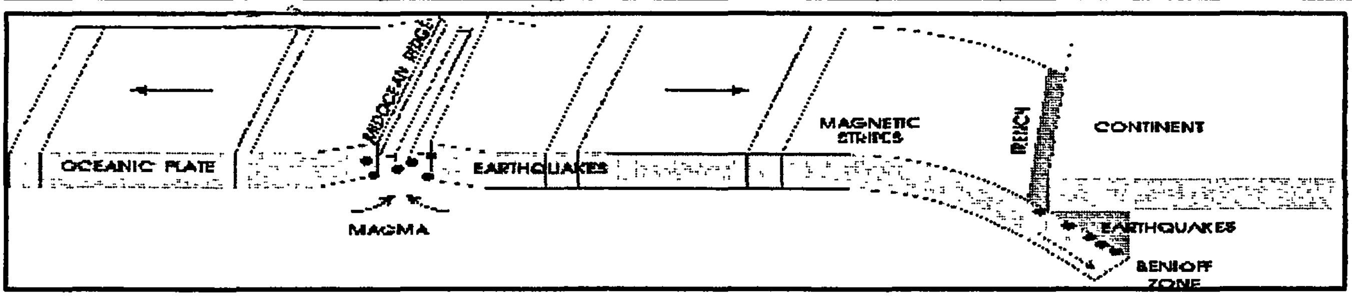
The lithosphere covers the whole Earth. Therefore, ocean plates are also involved, more particularly in the process of sea-floor spreading. This involves the midocean ridges which are a system of narrow submarine cracks that can be traced down the center of the major oceans. The ocean floor is being continuously pulled apart along these midocean ridges. Hot volcanic material rises from the Earth's mantle to fill the gap and continuously forms new oceanic crust. The midocean ridges themselves are broken by offsets know as transform faults.



One of the keys to plate tectonics was the discovery that the Earth's magnetic field has reversed its polarity 170 times in the last 80 million years. As new basaltic material is squeezed up into the midocean cracks and solidifies, it is magnetized according to the polarity of the Earth's magnetic field. If the field reverses its polarity, the strip of new material is magnetized in an opposite sense. As the oceanic floor continues to spread, the new strips of rock are carried away on either side like a conveyer belt.

Using these magnetic strips as evidence of movement, it became obvious that the Earth's surface consisted of a mosaic of crustal plates that were continually jostling one another. If the Earth was not to be blown up like a balloon by the continual influx of new volcanic material at the ocean ridges, then old crust must be destroyed at the same rate where plates collide. The required balanced occurs when plates collide, and one plate is forced under the other to be consumed deep in the mantle.

We now know that there are seven major crustal plates, subdivided into a number of smaller plates. They are about 80 kilometers thick, all in constant motion relative to one another, at rates varying from 10 to 130 millimeters per year. Their pattern is neither symmetrical nor simple. As we learn more and more about the major plates, we find that many complicated and intricate maneuvers are taking place. We learn, too, that most of the geological action - mountains, rift valleys, volcanoes, earthquakes, faulting - is due to different types of interaction at plate boundaries.



How are earthquakes connected with plate tectonics? In 1969, Muawia Barazangi and James Dorman published the locations of all earthquakes which occurred from 1961 to 1967. Most of the earthquakes are confined to narrow belts and these belts define the boundaries of the plates. The interiors of the plates themselves are largely free of large earthquakes, that is, they are aseismic. There are notable exceptions to this. An obvious one is the 1811-1812 earthquakes at New Madrid, Missouri, and another is the 1886 earthquake at Charleston, South Carolina. As yet there is no satisfactory plate tectonic explanation for these isolated events; consequently, we will have to find alternative mechanisms.

Plate tectonics confirms that there are four types of seismic zones. The first follows the line of midocean ridges. Activity is low, and it occurs at very shallow depths. The point is that the lithosphere is very thin and weak at these boundaries, so the strain cannot build up enough to cause large earthquakes. Associated with this type of seismicity is the volcanic activity along the axis of the ridges (for example, Iceland, Azores, Tristan da Cunha).

The second type of earthquake associated with plate tectonics is the shallow-focus event unaccompanied by volcanic activity. The San Andreas fault is a good example of this, so is the Anatolian fault in Northern Turkey. In these faults, two mature plates are scraping by one another. The friction between the plates can be so great that very large strains can build up before they are periodically relieved by large earthquakes. Nevertheless, activity does not always occur along the entire length of the fault during any one earthquake. For instance, the 1906 San Francisco event was caused by breakage only along the northern end of the San Andreas fault.

The third type of earthquake is related to the collision of oceanic and continental plates. One plate is thrust or subducted under the other plate so that a deep ocean trench is produced. In the Philippines, ocean trenches are associated with curved volcanic island arcs on the landward plate, for example the Java trench. Along the Peru - Chile trench, the Pacific plate is being subducted under the South American plate which responds by crumpling to form the Andes. This type of earthquake can be shallow, intermediate, or deep, according to its location on the downgoing lithospheric slab. Such inclined planes of earthquakes are know as Benioff zones.

The fourth type of seismic zone occurs along the boundaries of continental plates. Typical of this is the broad swath of seismicity from Burma to the Mediterranean, crossing the Himalayas, Iran, Turkey, to Gilbraltar. Within this zone, shallow earthquakes are associated with high mountain ranges where intense compression is taking place. Intermediate- and deep-focus earthquakes also occur and are known in the Himalayas and in the Caucasus. The interiors of continental plates are very complex, much more so than island arcs. For instance, we do not yet know the full relationship of the Alps or the East African rift system to the broad picture of plate tectonics.

How can plate tectonics help in earthquake prediction? We have seen that earthquakes occur at the following three kinds of plate boundary: ocean ridges where the plates are pulled apart, margins where the plates scrape past one another, and margins where one plate is thrust under the other. Thus, we can predict the general regions on the Earth's surface where we can expect large earthquakes in the future. We know that each year about 140 earthquakes of magnitude 6 or greater will occur within this area which is 10 percent of the Earth's surface.

But on a worldwide basis we cannot say with much accuracy when these events will occur. The reason is that the processes in plate tetonics have been going on for millions of years. Averaged over this interval, plate motions amount to a several millimeters per year. But at any instant in geologic time, for example, the year 1977, we do not know exactly where we are in the worldwide cycle of strain buildup and strain release. Only by monitoring the stress and strain in small areas, for instance, the San Andreas fault, in great detail can we hope to predict when renewed activity in that part of the place tectonics arena is likely to take place.

In summary, plate tectonics is a blunt, but, nevertheless, strong tool in earthquake prediction. It tells us where 90 percent of the Earth's major earthquakes are likely to occur. It cannot tell us much about exactly when they will occur. For that, we must study in detail the plate boundaries themselves. Perhaps the most important role of plate tectonics is that it is a guide to the use of finer techniques for earthquake prediction.

Further reading

Scientific American, 1976, Continents adrift and continents aground - Reading from Scientific American: San Francisco, W.H. Freeman and Co., 230 p.

Abridged from Earthquake Information Bulletin, vol. 9, no. 6, November - December 1977, by Henry Spall, USGS, Reston, VA.

YELLOWSTONE: RESTLESS VOLCANIC GIANT

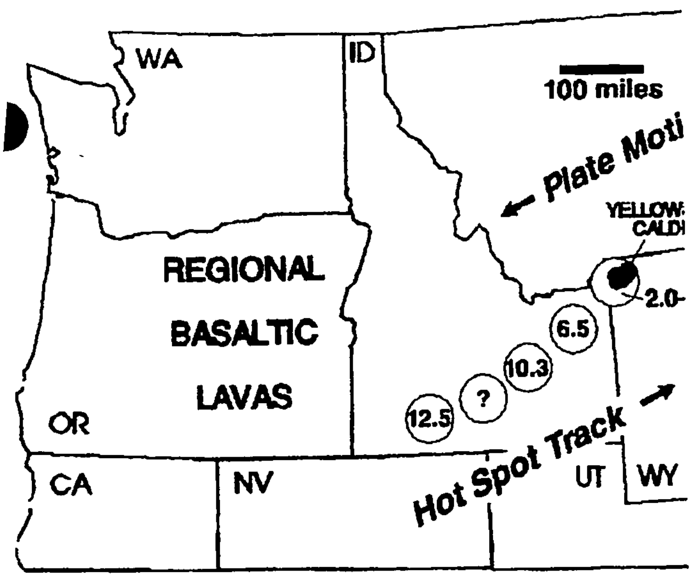
by Daniel Dzurisin, Robert L. Christiansen, and Kenneth L. Pierce | U.S. Geological Survey Open-File Report 95-59

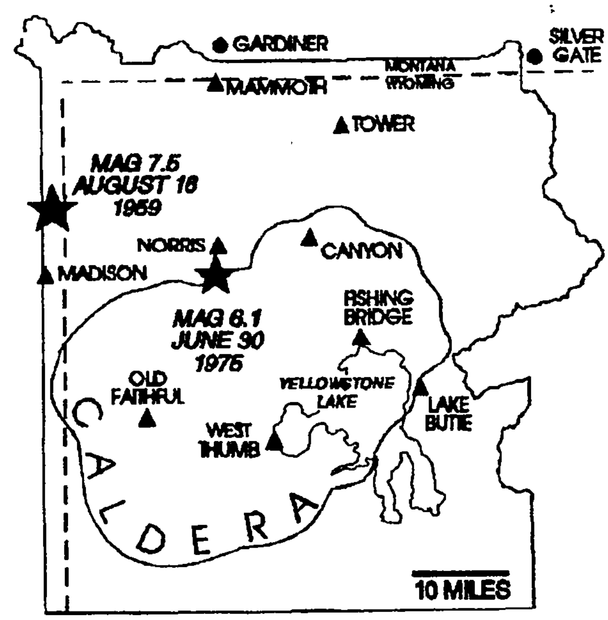
Three million visitors each year marvel at Yellowstone's Rocky Mountain splendor, including its thousands of steaming geysers, shimmering thermal pools, and bubbling mudpots. But the greatest wonder of all goes mostly unnoticed. Hidden underground, powerful volcanic, tectonic, and hydrothermal forces are continually reshaping the landscape of America's first and foremost national park. Symptoms of the underground turmoil include numerous earthquakes (most too small to be felt), uplift and subsidence of the ground surface, and persistent but ever-changing hydrothermal activity. Eventually, the unrest will culminate in another large earthquake or volcanic eruption, both of which have occurred many times before in Yellowstone's geologic past. Scientists from the U.S. Geological Survey and the University of Utah are studying the Yellowstone region to assess the potential hazards from future earthquakes and eruptions and to provide warning if the current level of unrest should intensify.

YELLOWSTONE'S ROOTS

Scientists have traced Yellowstone's origin to a hot spot in the mantle, one of a few dozen such hot spots on Earth. Buoyant material from a hot spot rises through the upper mantle, bringing heat from the Earth's interior closer to the surface. The Yellowstone hot spot impinges on the base of the North American plate, one of several rigid plates that make up the Earth's crust. These plates move a few inches per year with respect to the stationary hot spots and each other, sometimes causing great earthquakes as the plates collide, grind past one another, or split apart.

The Yellowstone hot spot has interacted with the North American plate for perhaps as long as 17 million years, causing widespread outpourings of basalt that bury about 200,000 square miles in Washington, Oregon, California, Nevada, and Idaho under stacks of lava flows half a mile or more thick. Some of the basaltic melt, or magma, produced by the hot spot accumulates near the base of the plate, where its heat melts rocks from the Earth's lower crust. These melts, in turn, rise closer to the surface to form large reservoirs of potentially explosive rhyolite magma. Catastrophic eruptions have partly emptied some of these reservoirs, causing their roofs to collapse. The resulting craters, some of which are more than 30 miles (50 kilometers) across, are known as volcanic calderas. Because the plate was moving an inch or so per year southwestward over the hot spot for millions of years as the calderas formed, groups of calderas are strung out like beads on a string across parts of Idaho and Wyoming (fig. 1).





THE YELLOWSTONE CALDERA

The most recent caldera-forming eruption about 650,000 years ago produced a caldera 53 x 28 miles (85 x 45 kilometers) across in what is now Yellowstone National Park (fig. 2). During that eruption, ground-hugging flows of hot volcanic ash, pumice, and gases swept across an area of more than 3,000 square miles. When these enormous pyroclastic flows finally stopped, they solidified to form a layer of rock called the Lava Creek Tuff. Its volume was about 240 cubic miles (1,000 cubic kilometers), enough material to cover Wyoming with a layer 13 feet thick or the entire conterminous United States with a layer 5 inches thick. The Lava Creek Tuff has been exposed by erosion at Tuff Cliff, a popular Yellowstone attraction along the lower Gibbon River.

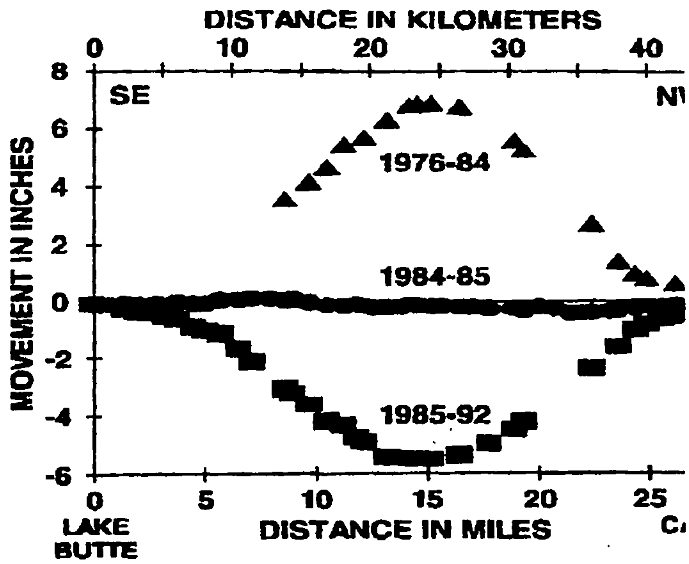
The eruption also shot a column of volcanic ash and gases high into Earth's stratosphere. This volcanic cloud circled the globe many times and affected Earth's climate by reducing the intensity of solar radiation reaching the lower atmosphere and surface. Fine volcanic ash that fell downwind from the eruption site blanketed much of North America. This ash layer is still preserved in deposits as far away as Iowa, where it is a few inches thick, and the Gulf of Mexico, where it is recognizable in drill cores from the sea floor.

Lava flows have since buried and obscured most of the caldera, but the underlying processes responsible for Yellowstone's tremendous volcanic eruptions are still at work. Eventually, another "bead" may be added to Yellowstone's 300-mile-long string of calderas, with global consequences that are beyond human experience and impossible to anticipate fully.

CONTEMPORARY UNREST

In the meantime, the giant is restless. Thousands of small earthquakes rattle the Yellowstone region each year. Most of these are too small to be noticed except by sensitive seismometers, but a few are large enough to cause substantial damage. At least eight magnitude-6 or greater earthquakes have occurred in the Yellowstone region during historical time. The largest of these was the magnitude-7.5 Hebgen Lake earthquake on August 18, 1959, which cost 28 lives and $11 million in damage. The most recent was a magnitude-6.1 earthquake near the Norris geyser basin on June 30, 1975.

Earthquakes are not the only symptom of unrest. Yellowstone's famous hydrothermal system releases heat energy at an average rate of about 4,500 megawatts - about 50 times the planetary average. In addition, repeated surveys show that the ground surface near the center of the Yellowstone caldera rose more than 3 feet from 1923 to 1985, then subsided about 6 inches from 1985 to 1992 (fig. 3). Studies of shorelines near the outlet of Yellowstone Lake show that the caldera's center has risen and fallen 3 times during the past 10,000 years. The total vertical change during each "breath" of the caldera is estimated to be about 65 feet (20 meters).



REASON TO WORRY?

The current rates of seismicity, ground deformation, and hydrothermal activity at Yellowstone, although high by most geologic standards, are probably typical of long time periods between eruptions and therefore not a reason for immediate concern. Potentially damaging earthquakes are likely to continue occurring every few decades, as they have in the recent past. Eventually Yellowstone will erupt again, but there is no indication that an eruption is imminent or what kind of eruption may come next. For the foreseeable future, the same powerful forces that created Yellowstone will continue to animate this slumbering, but restless, volcanic giant.

ADDITIONAL READING

Brantley, S.R., 1994, Volcanoes of the United States: General Interest Publications Geological Survey, U.S. Government Printing Office, Jacket 376-846, 44 pages.

Pierce, K.L., and Morgan, L.A., 1992, The track of the Yellowstone hotspot: volcanis faulting, and uplift: Geological Society of America Memoir 179, pages 1-53.

Smith, R.B., and Christiansen, R.L., 1980, Yellowstone Park as a window on the Earth interior: Scientific American, volume 242, pages 104-117.

Smith, R.B., and Braile, L.W., 1994, The Yellowstone hotspot: Journal of Volcanology Geothermal Research, v. 61, pages 121-187.

THINKING AHEAD TO 1996 SEMINARS

Richard Bartels , Seminar Director would appreciate imput from seminar participants on what subjects the group would like to deal with this 1996 season. Here are several ideas.

1. Using Orr and Orr's ***Geology of the Pacific Northwest***, look at the teritory from British Columbia to the Klamaths and from the Pacific coast to central Idaho.
2. Using Alt and Hyndman's ***Northwest Exposures***, look at what happened here from the Precambrian to the Pleistocene.
3. Using text to determine, study various rock types of the Pacific Northwest..
4. Or????????

SEP 96

THE GEOLOGICAL NEWSLETTER

GSOC

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ACTIVITES

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VOL. 62, No. 9
SEPTEMBER 1996

SEPTEMBER ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Cafeteria is closed permanently.)

Sept. 6: President's Campout: A Supertrip Across the Insular Superterrane
Richard Bartels, GSOC President

Sept. 20: Morocco Impressions
Benton Dailey

FRIDAY EVENING MEETING: 8:00 PM Portland State U., Cramer Hall, Rm. 383

Sept. 13: F. O. P. Traces the Olympic Peninsula's Pleistocene Glaciers: 5/96
Evelyn Pratt

WEDNESDAY EVENING SEMINAR: 8:00 PM Portland State U., Cramer Hall, Rm. S-17

Sept. 25: Topic for this year's seminars to be decided at the Annual Picnic:

1. Pacific Northwest geology by time? Northwest Exposures Alt/Hyndman
2. Pacific Northwest geology by area? Geology of the Pac. NW Orr/Orr
3. Rocks & minerals? Richard Bartels, et al

Thanks for your input!

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES **MUST** BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

POLAR DINOSAURS

by Ray Crowe, GSOC member

The Northwest Museum of Natural History had their annual meeting on June 12th at the Metro Regional Center, with director Dr. Dave Taylor introducing guest speaker, Dr. Richard Thoms, geology professor at PSU. His presentation on Lower Cretaceous dinosaurs once living near both poles was both absorbing and interesting.

Mentioning tracks from the Jurassic of Spitsbergen, Prof Thoms went on to describe a bed found near Umiat on the north slope of the Brooks Range in Alaska. The site, being studied by Dr. Bob Liscomb of the University of Alaska, with the Colville River running swiftly below, was noted for a community of saurians occurring within a few degrees of the North Pole. The mixed bones of browsers, grazers, an *Ankylosaur*, carnivores, a bird-like creature, and even a primitive mammal have been found. *Centrosaurus* (related to *Triceratops*) has also been found in Alberta, Canada, where a group of 18 individuals found together suggest that they traveled in large herds (4). The Hadrosaur *Edmontosaurus*, a duckbilled dinosaur had jaws packed with hundreds of teeth, and were known to eat tree leaves and pine needles; was mostly represented by juvenile individuals, suggesting that they were perhaps drowned by a natural levee breaking or a river crossing. Another of the smaller bird-hipped creatures was noted to have very large eye orbits, suggested feeding at night. Feeding on them was the three-ton carnosaur *Albertosaurus*, measuring up to 30 feet in length and related to *Tyrannosau.* Plant remains determined by paylenologists were of primitive conifers, ferns, rushes, and ginkgo.

Another site described by Professor Thoms, at the opposite end of the world, was in Australia, near Melbourne. The 108 million year old sea-cliff site discovered by Professor Rich in 1900, was also a Late Cretaceous community, surprisingly similar to its Alaskan counterpart. The species, and even family were sometimes different, but the niches were filled by similar species. A slide of an artist's conception included Browsers, carnivores, an Ankylosaur type creature, and even a small eight foot, ostrich like creature was noted, and flying reptiles in the air.

The main question that this talk brings up is...what the heck were all those dinosaurs doing within 15 degrees of the poles? Eating and being eaten it seems. Professor Thoms said that the Earth's axis of inclination remained the same and Continental Drift kept the polar areas of Laurasia and Gondwanaland approximately in the same places as they are today (7); even though there were magnetic shifts of polarity, and the magnetic pole wandered around a bit. The Cretaceous climate was diverse, "The presence of angiosperms in vegetation of the lands points to temperate climate, yet relative warmth and humidity are indicated by the widespread distribution of such plants as the fig and breadfruit, which now are restricted to subtropical or warm temperate climates; along with cycadeoids, these plants occur in Cretaceous rocks of Alaska and Greenland. On the other hand, evidence of Cretaceous glaciation is reported from eastern Austraila (3)."

So if it was warmer then than now near the poles plants and animals would still have to adapt to the three month lightless period above the polar circles. One theory is that, warm or cold blooded, the dinosaurs could have " shut down " for the period in a state of "hibernation". Another is that they migrated. Today we see large scale migration in birds (dinosaur relatives?), butterflies, and larger vertebrates, the migratory behavior "most commonly cited includes climatic changes necessitating annual movements (2)." Even today, the tundra area extending across central Alaska to Labrador is the province of the white spruce (*Picea glauca*) (6), a possible feeding ground for herds of *Edmontosaurus*, browsing north in the spring. like today's caribou...giving birth (dinosaurs also ?), and back south in the fall into warmer climes in Alberta or Montana for the winter...carnosaurs constantly trailing, and watching for the weaker individuals. Perhaps this is when nests are built in Montana, the eggs hatching in the spring in time to make the trek north to the rich feeding grounds of newly evolved flowering plants and trees (5). This could be a 2500 mile jaunt though, and Professor. Thoms comments nat there are many detractors to the theory of nigration.

What we have then is a possible scenario like that seen in the early 1900's of east Africa...millions of animals maybe moving in concert to another area for feeding. Picture the annual trek of the wildebeest and their freshly dropped young, accompanied by giraffe, antelope, zebra, and other species (1). Would a time-machine show something similar in North America? Millions of animals, dinosaurs, moving from one area to another, feeding on the new vegetation as it sprouted on trees or the ground, drowning in their rush to cross great rivers...another of life's great mystries

Prof. Thoms finished the lecture with a humorous slide of a dinosaur carrying a sign, "REPENT-THE CENEZOIC IS COMING." And ended the talk with a couple of comments on a possible comet/asteroid ending the Age Of Dinosaurs.

(1) Attenborough, David, *The Living Planet*, 1984

(2) Klopfer, P.H., *An Introduction To Animal havior*, 1974

(3) Moore, RC., *Introduction To Historical Geology*, 1958

(4) Sattler, H.R, *The Illustrated Dinosaur Dictionary*, 1983

(5) Pan Terra, Inc., *A Correlated History Of Earth*, 1994

(6) Seddon, Brian, *Introduction to Biogeography*, 1971

(7) Wilson, J.T. (introduction) *ContinentsAdrift*, 1972

A Rock Grows Up

by R. and M. Goodrich. Lake Oswego, Oregon., GeoOuest Publishing, 56 p., $9.95.

A Rock Grows Up is the title of a children's book, created by Lake Oswego high school teacher Michael Goodrich and his wife Randi and delightfully illustrated b Michele Han, honor student at Lake Oswego High hool. The book introduces earth science concepts in h a way that they become appealing and easily comprehensible to children at the elementary school level.

Following the story of Barry Basalt, the rock that grows up, young readers of the large-print book meet a dozen charactors-family members and neighbors-that represent rocks and rock-forming minerals, such as Larry Gneiss and Annie Augite. They all participate in the great geologic cycle of rock formation and decomposition that starts in the asthenosphere below a sea-floor spreading ridge and leads through plate subduction, volcanism, weathering, sedimentation and metamorphosis-from formlessness into form and back.

The whimsical pictures of the characters in the story are accompanied by schematic block diagrams that illustrate the geologic processes as they occur in the earth from the Juan de Fuca Plate to the Cascade Range-once even to Picture Gorge. In this sense, the book addresses children of Oregon and, to a lesser extent, the Pacific Northwest, conveying the framework of basic geology these children can experience at home.

The about 50 pages of the book include also a glossary of geologic terms and an index, also a list of significant technical books that introduce the teacher to the geology of the Pacific Northwest and to the major processes touched upon in the story of Barry Basalt. A bit of caution is advised following the pronunciation aids given throughout the text and the glossary. A teacher may want to try them before introducing them to children of the Northwest.

A Rock Grows Up is conceived as a teaching tool and thus accompanied by more teaching aids: a curriculum for student activities in lab exercises, coloring, and creative writing and with more materials for the use of the teacher ($7.95). The authors also offer a kit containing tagged samples of the rocks and minerals of the story ($14.95).

The book and accompanying materials are available from the publishers, GeoOuest Publishing, P.O. Box 1665 Lake Oswego, OR 97035, phone (503) 635-4420; or from The Nature of the Northwest Information Center on ground floor of the State Office Building

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Volcanic Arcs and Vegetation

Jeffrey A. Myers
Department of Geological Sciences
University of California
Santa Barbara, CA 93106

Introduction

Many of us who were students of paleobotany during the mid-1980s vividly recall the appearance in 1987 of Wolfe and Wehr's partial monograph of the middle Eocene Republic flora. At Republic, temperate plants (including pine, spruce, fir, gooseberry, blackberry, hawthorn, maple, linden, and many others) co-occurred with extinct members of plant families now limited to the tropics (such as *Barghoornia* in the Burseaceae or torchwood family), confirming that Eocene forests were compositionally unlike any known today.

The Republic flora is also interesting because, despite the almost 50 million years since it grew, many living temperate genera were present. Previously it had been thought that the temperate (or *microthermal*) families, which represent numerical and taxonomic dominants in modern mid-latitude forests, diversified primarily in response to climate cooling during or after the Oligocene (33–24 million years ago). That diverse forms in some of these families grew at Republic during the warmest interval of the Tertiary came as a surprise.

Wolfe (1972, 1977) had long suggested that "uplands" of the Pacific Northwest were refuges for microthermal groups excluded from the "lowlands" during the Eocene Warm Period (roughly 57.5–48 million years ago).

Republic provides the best evidence to date that this was indeed the case and that some of these groups underwent dramatic diversification in the moist upland forests. Where, when, why, and particularly how these lineages diversified so readily and apparently so rapidly remain some of the most intriguing questions in paleobotany.

An understanding of the interaction among geological/geomorphological processes, climate, and evolutionary constraints and advantages of the plant lineages growing at the time may help answer these questions. However, scientists have a much better understanding of the biology of plants and of the pattern of climate change during the Tertiary than they do of the geological and geomorphic processes that shape Earth's landscape. A real need exists for detailed microstratigraphic/sedimentological and taphonomic analysis of paleofloras in order to understand them in the context of landscape-level physical processes and regional settings. Many paleo- botanical publications vastly oversimplify the physical landscape even at the largest and most fundamental scale.

For example, even the term 'upland', as used in the paleobotanical literature, is somewhat vague because it ignores the processes by which topographic features form and change through time. When, as paleobotanists, we think of uplands, we very likely envision mountains, and it is likely that we think of these mountains as essentially static geomorphic features over significant periods of geologic time.

Paleofloras are, of course, not preserved on mountains, but in much lower elevation depositional basins, which are commonly associated with mountains. The paleobotanical record is a direct consequence of geological processes that control the sedimentology and stratigraphy of basin fill. Mountains are dynamic features that form and change quickly in geological time, ultimately erode, and are not preserved in the record, although they have a profound impact on the surrounding environment while they exist. These impacts—on topography, on local climate, and on site ecology both in the mountains themselves *and in the basins surrounding them*—are primary controls on regional vegetation.

One major result of the mountain–basin relationship is that vegetation presumed to have been growing at high elevation rarely makes it into the fossil record. Any understanding of what ancient high-elevation vegetation really looked like should be considered speculative at best. However, paleofloras from certain types of basins associated with volcanic mountain chains of convergent continental margins, including the Republic flora, may fit into the rare category of true 'upland' floras. Some paleofloras of comparable age possibly grew at higher elevations than Republic, but it is at Republic that we see the most dramatic expression of middle Eocene temperate forest richness.

The Interior Arc and Its Vegetation

Volcanic arcs are mountain chains of composite stratovolcanoes (Cascade-type volcanoes), which are produced by t[illegible] melting of subducted oceanic crust at convergent (subductio[illegible]) continental margins. All upland middle Eocene paleofloras from western North America, including Republic, occur in basins associated with what is often called the Eocene Interior Arc. This arc extended from central British Columbia, south through eastern Washington (the Republic graben), Idaho (the Challis Group), and western Montana and Wyoming (the Absaroka Group), and ended in northern Utah—essentially the region slightly west of the modern Northern Rocky Mountains Province. It was the dominant topographic feature in northwestern North America between about 50 million and about 40 million years ago, when arc magmatism shifted westward to form the Western Cascade arc.

Because of their intermediate magmatic composition and their characteristic modes of eruption, stratocones tend to be large features that can form quickly (in tens to hundreds of years) and erode rapidly. Basins associated with arcs typically host outstanding fossil plant assemblages because they experience rapid rates of subsidence while simultaneously receiving massive fine sediment input from volcanic sources directly associated with them. Furthermore, arc basins form *within and directly adjacent to* the arc edifices, thus producing the unusual circumstances of depositional basins associated with mountains. The result is a setting optimal for the preservation of delicate plant material and one that potentially includes vegetation from true upland habitats.

What did the Eocene Interior Arc look like? Some of t[illegible] middle Eocene arc volcanic centers, like the Absaroka vo[illegible]canic province, included very large and possibly long-lived composite stratocones with moderate-elevation intervening basins. Other centers, like the Clarno volcanic field in central gon, consisted of smaller, short-lived cones on a low-lying lscape (White and Robinson, 1992). The Republic flora deposited within a graben associated with active volca-s, which were possibly similar to those of the Clarno field.

In general, most arc settings consist of volcanic edifices summits on the order of 500 to 1,000 meters above the rounding landscape. In this respect, the volcanoes resemble gher elevation 'islands' in a lower elevation 'sea'. If the re-onal landscape has been tectonically uplifted, the interven-g 'sea' may lie several thousand meters above actual sea vel, although most are at only a few hundred meters in ele-ation. The Republic graben probably lay between 800 and ,500 meters during the middle Eocene, which is relatively igh for an arc basin.

Only recently have scientists begun to understand the sedi-nentary record of arc-associated basins (for example, Smith, 1991). It is in the sedimentary record of the arc basins that paleobotanists must look for evidence about the environment in which arc vegetation grew and how the environment and the vegetation that inhabited it changed through time. The arc basin sedimentary sequence is shaped by two primary variables: (1) the size, volume, construction, and persistence through time of the volcanic sediment source, which determines the magnitude, periodicity, and style of volcanic sedimentation in the basins; and (2) the subsidence history of the basin and the distance between the basin and the volcanogenic sediment source, which determines which portion of the available sediment is actually preserved. Of course, plant debris incorporated into the sediment delivery system represents a part of the 'sediment' deposited in the basins. The interpretation of *where* and *when* the basin fill originated with respect to the volcanic sediment source largely determines what information can potentially be obtained from the plant debris enclosed within it. ı work is the province of volcaniclastic sedimentologists ... stratigraphers, along with plant paleotaphonomists.

While not always the case, the paleobotanical record of many arc basins is often skewed toward vegetation growing during eruptive epochs (intervals of heightened volcanic activity which may last as long as a few thousand years) and to specific horizons deposited just prior to, during, or immediately after individual eruptions. This is simply because the processes by which sediment is transported and deposited are more favorable for plant preservation during eruptive periods than between them and because the sedimentary pile of many arc basins is dominated by massive amounts of minimally reworked debris stripped from the volcano flanks within a few decades to, at most, a hundred or so years after eruptions.

In arc basins relatively far from the volcanic sediment source (such as the Green River Basin, Utah, or the Republic graben) this material is of fine grain sizes and deposited over many years. In contrast, basins very close to the volcanoes are dominated by coarser, more rapidly deposited debris (for example, the Eocene Copper Basin in Nevada [Axelrod, 1966] and the Germer flora of Idaho [Edelman, 1975]).

While habitats near vents experience frequent and profound devastation from eruptions, more distant habitats are minimally disturbed except in the very largest eruptions. The net effect is to produce a fossil record that is punctuated in time and highly variable over distances on the order of a few kilometers. This heterogeneity reflects both variability in the g vegetational matrix and variability in the processes by ...ch plant debris enters the sedimentary record.

Unless the elevational thermal gradient has changed radically since the Eocene, many stratocones of the Interior Arc must have been high enough to have supported microthermal vegetation on their upper slopes. Recall, though, that the actual arc edifices erode and do not enter the record. What does enter the stratigraphic record is the vegetation growing in the basins adjacent to the volcanoes. If the basins lay at relatively high elevations, they may have supported uniform microthermal forests. However, it is unlikely that many arc basins lay high enough during the Eocene Warm Period.

The diverse forests of Republic include a mix of plants from historically microthermal and megathermal lineages, suggesting that the Republic graben lay somewhere in the ecotone between temperate and tropical vegetation. Presumably, true microthermal forest occupied higher elevation sites while tropical vegetation may have occurred at lower elevations and (or) closer to the ocean.

Most interesting is that at Republic, for the first time in the Tertiary paleobotanical record, one sees the intergradation of microthermal and megathermal vegetation to produce extremely diverse forests composed of plants with disparate and complex vegetational histories. The germane questions are: How did this massive intergradation occur? and Why did some families diversify so readily at this time?

There is some evidence that microthermal floral elements can enter warmer forests as successional colonizers. For example, Wang (1961) found that successional colonizers of disturbed tropical forest in mainland China produce a woody vegetation with a decidedly more 'temperate' composition than minimally disturbed forest of the same region.

The colonizing woody vegetation of the Mount St. Helens debris avalanche deposit includes as dominants alder, willow, blackberry, blueberry, elderberry, maple, and other forms represented in abundance in the Republic flora. (Keep in mind that even 'minimally disturbed' vegetation of coastal Washington is temperate today.) These plants are notable for either their ability to resprout from vegetative fragments or their particularly effective dispersal mechanisms (Viers, 1987). Farther from the vent, similar colonizing woody vegetation occurs within lahar-devastated river channels, whereas the surrounding forest is essentially unaffected. It may be that some microthermal elements from higher, cooler stratocones of the Interior Arc entered the lower arc basins by colonizing volcanically disturbed habitat and that some of these intergraded with the later stage 'climax' vegetation.

My work on the 33.9-million-year-old Cedarville floras of northeastern California (Myers, 1993), provides tantalizing evidence that this may be the case. At Cedarville vegetational and floristic differences between multiple, well-correlated, coeval paleoassemblages are significant. The distribution of vegetational associations is not climatically induced (the thermal and moisture parameters of all sites are essentially identical) but is microsite controlled. Geological evidence suggests that Cedarville microsites colonized by broadleaved, primarily deciduous vegetation (dominated by microthermal elements) were regularly devastated by volcaniclastic debris. Sites farther from the volcanic source supported predominantly evergreen broadleaved vegetation with strong tropical floristic ties and appear not to have been highly disturbed.

Sedimentological and microstratigraphic study at Cedarville reveals cyclical vegetational changes within short stratigraphic sequences. Horizons with a high percentage of juvenile volcanic detritus contain the fossils of ferns. Fern fossils are replaced upsection by a low-diversity vegetation dominated by 'weedy' trees and vines. Moving upward in the section lamina by lamina, one sees the low-diversity 'weedy' trees gradually replaced by a diverse temperate forest not dissimilar to that at Republic. Between four and six cycles of vegetational change have been recognized in a 1-meter-thick sequence of rock.

The predictable cyclicity of vegetational change, and particularly the association of 'fern episodes' with juvenile pyroclastic debris, tempts the suggestion that the vegetational cycles mark repeated events of volcanic devastation and recovery, although other explanations are equally plausible. Hence, while there is some evidence that 'temperate' forest might enter warmer lowland sites through colonization of volcanically disturbed habitat, it is difficult to determine the actual cause of the vegetational relations from the fossil record.

A similar repeated lithological cyclicity occurs in the Republic sequence, although as yet no one has attempted a lamina-by-lamina correlation of lithological changes with changes in associated plant fossils.

Mechanisms of Floral and Vegetational Change in the Interior Arc

From the brief discussion above, it is clear that the formation of plant preservational sites in or adjacent to volcanic centers of the Eocene Interior Arc allowed for the fossilization of vegetation that hitherto had not entered the Tertiary western North American paleobotanical record. While this vegetation may not have been actually growing at high elevation, it would have reflected the landscape dynamics influenced by the arc and would have experienced vegetational exchange with the higher elevation volcanic centers. That voluminous arc volcanism in isolated upland centers would very likely have forced high rates of vegetational change has been suggested previously (Kruckeberg, 1987; Wolfe, 1987; Myers, 1993; Myers and Fisher, 1994).

The formation of a series of volcanic centers in western North America during the Eocene Warm Period would have provided biogeographic and evolutionary opportunities for microthermal lineages restricted from the tropical lowlands. Microthermal groups, like the Rosaceae, almost certainly would have been restricted to cooler habitats of *widely spaced and isolated* volcanic centers. Migration between these centers would have been by chance (by wind or animal vectors or by other means) and perhaps infrequent. The potential for speciation in isolation would have been high. This leads to the suggestion that diverse forests composed of floristic elements with different histories (like that at Republic during the middle Eocene) could evolve and accrue diversity through the continued intermixing of relicts and neoendemics in a geologically complex and dynamic landscape like that of a volcanic arc. While volcanic arcs are not the only environment in which this might happen, the extremely dynamic and unstable geological system of volcanic arcs could be a particularly effective pump driving floristic diversification and vegetational mixing.

One way for paleobotanists to test this idea would be to place arc vegetation into the context of what geologists can interpret about the processes by which volcanism shapes the physical and vegetational landscape, by which vegetation is taphonomically sampled and sorted (with particular emphasis on where and when this occurred with respect to the volcanoes and the timing of eruptions), and by which the basinal sediment pile is formed. Such work is time consuming and must be conducted on a lamina-by-lamina scale at several coeval sites. If combined with careful whole-organism taxonomic and paleoecological analysis, such information could begin to yield a picture of how and why vegetation and lineages changed through time in arc settings.

Given the occurrence of multiple, widely spaced, and well dated floras at Republic and their unique vegetational and floristic associations, Republic would be an ideal laboratory for this type of integrative study.

Acknowledgments

The ideas proposed here are an outgrowth of Myer's work with Richard V. Fisher, emeritus professor, U.C. Santa Barbara, whose unique insight into the processes by which explosive volcanism shapes the Earth's landscapes and sedimentary record has immense value to paleobotanists.

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THE GEOLOGICAL NEWSLETTER

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THE GEOLOGICAL NEWSLETTER

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;** Fourth Wednesday , except June, July, August. 8:00 p.m., Room S17, Cramer Hall, Portland State University. Library: Room S7. Open 7:30 p.m. prior to meetings. **PROGRAMS**: Evening:: Second Friday evening each month, 8::00 pm, Room 371, Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon. **LUNCHEONS**: First and Third Fridays monthly at noon except holidays. Bank of California Tower, 707 SW Washington, 4th floor, California Room, Portland, Oregon. **MEMBERSHIP**: per ear from January 1: Individual - $20.00, Famil;y - $30.00, Junior (under 18) - $6.00. Write or call the Secretary for application. **PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISS 0270 5451), published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year. Individual subscriptions $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 the same address for names and price list.

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VOL. 62, No. 10
OCTOBER 1996

OCTOBER ACTIVITIES

FRIDAY NOON MEETINGS: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Cafeteria is closed permanently.)

Oct. 4: President's Campout II: Intermontane Superterrane: A Lost Coherent Terrane from Oregon? Slides from GSOC participants + Richard Bartels, GSOC President

Oct. 18: Lab Analysis to Authenticate Art and Antiques
Harvey Steele, U. S. Customs, ret.

FRIDAY EVENING MEETING: 8:00 PM Portland State U., Cramer Hall, Rm. 371

Oct 11: Volcanic Hazards of Mt. Rainier
Dr. Kevin Scott, hydrologist with Cascades Volcano Observatory

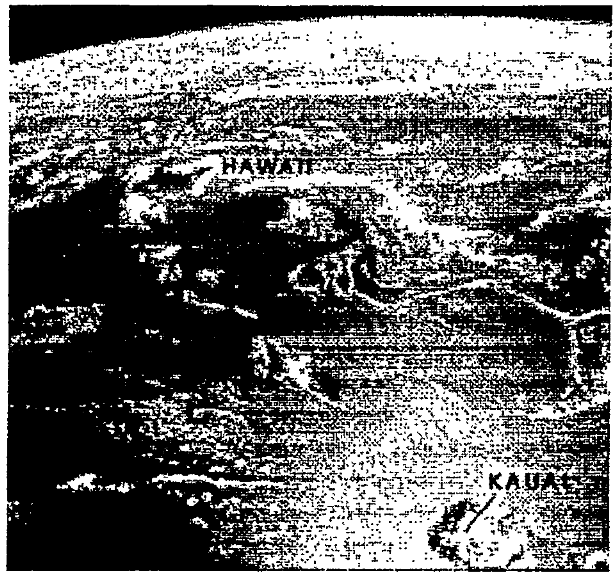
WEDNESDAY EVENING SEMINAR: 8:00 PM PSU, Cramer Hall, Rm. S-17

Oct. 23: Petrology of Plate Tectonics
Richard Bartels, GSOC President

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES **MUST** BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

"Hotspots": Mantle thermal plumes

The vast majority of earthquakes and volcanic eruptions occur near plate boundaries, but there are some exceptions. For example, the Hawaiian Islands, which are entirely of volcanic origin, have formed in the middle of the Pacific Ocean more than 3,200 km from the nearest plate boundary. How do the Hawaiian Islands and other volcanoes that form in the interior of plates fit into the plate-tectonics picture?

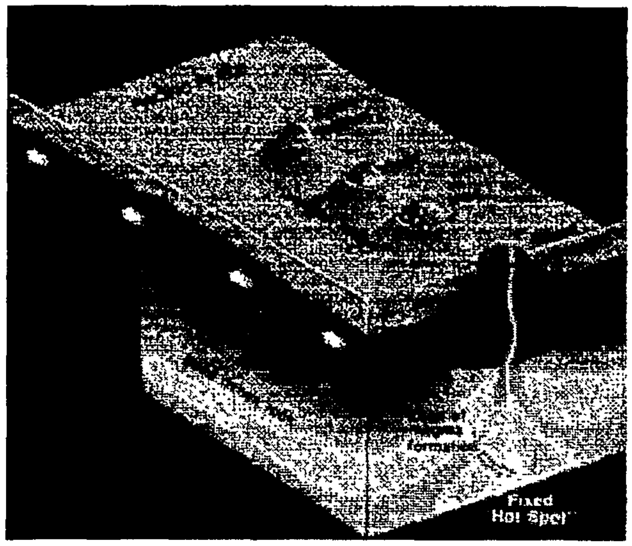


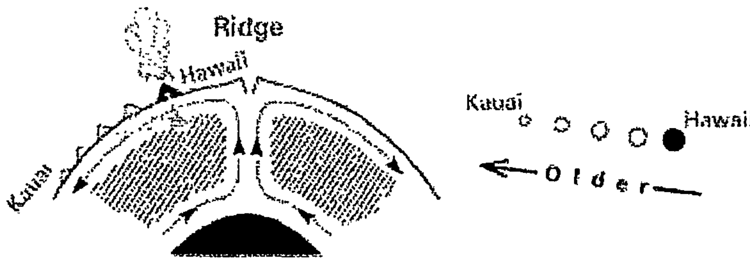
Space Shuttle photograph of the Hawaiian Islands, the southernmost part of the long volcanic trail of the "Hawaiian hotspot" (see text). Kauai is in the lower right corner (edge) and the Big Island of Hawaii in the upper left corner. Note the curvature of the Earth (top edge). (Photograph courtesy of NASA.)

In 1963, J. Tuzo Wilson, the Canadian geophysicist who discovered transform faults, came up with an ingenious idea that became known as the "hotspot" theory. Wilson noted that in certain locations around the world, such as Hawaii, volcanism has been active for very long periods of time. This could only happen, he reasoned, if relatively small, long-lasting, and exceptionally hot regions -- called *hotspots* -- existed below the plates that would provide localized sources of high heat energy *(thermal plumes)* to sustain volcanism. Specifically, Wilson hypothesized that the distinctive linear shape of the Hawaiian Island-Emperor Seamounts chain resulted from the Pacific Plate moving over a deep, stationary hotspot in the mantle, located beneath the present-day position of the Island of Hawaii. Heat from this hotspot produced a persistent source of magma by partly melting the overriding Pacific Plate. The magma, which is lighter than the surrounding solid rock, then rises through the mantle and crust to erupt onto the seafloor, forming an active seamount. Over time, countless eruptions cause the seamount to grow until it finally emerges above sea level to form an island volcano. Wilson suggested that continuing plate movement eventually carries the island beyond the hotspot, cutting it off from the magma source, and volcanism ceases. As one island volcano becomes extinct, another develops over the hotspot, and the cycle is repeated. This process of volcano growth and death, over many millions of years, has left a long trail of volcanic islands and seamounts across the Pacific Ocean floor.

According to Wilson's hotspot theory, the volcanoes of the Hawaiian chain should get progressively older and become more eroded the farther they travel beyond the hotspot. The oldest volcanic rocks on Kauai, the northwesternmost inhabited Hawaiian island, are about 5.5 million years old and are deeply eroded. By comparison, on the "Big Island" of Hawaii -- southeasternmost in the chain and presumably still positioned over the hotspot -- the oldest exposed rocks are less than 0.7 million years old and new volcanic rock is continually being formed.

Artist's conception of the movement of the Pacific Plate over the fixed Hawaiian "Hot Spot," illustrating the formation of the Hawaiian Ridge-Emperor Seamount Chain. (Modified from a drawing provided by Maurice Krafft, Centre de Volcanologie, France). Below: *J. Tuzo Wilson's original diagram (slightly modified), published in 1963, to show his proposed origin of the Hawaiian Islands. (Reproduced with permission of the* Canadian Journal of Physics.*)*





(a) Section (b) Plan

The possibility that the Hawaiian Islands become younger to the southeast was suspected by the ancient Hawaiians, long before any scientific studies were done. During their voyages, sea-faring Hawaiians noticed the differences in erosion, soil formation, and vegetation and recognized that the islands to the northwest (Niihau and Kauai) were older than those to the southeast (Maui and Hawaii). This idea was handed down from generation to generation in the legends of Pele, the fiery Goddess of Volcanoes. Pele originally lived on Kauai. When her older sister Namakaokahai, the Goddess of the Sea, attacked her, Pele fled to the Island of Oahu. When she was forced by Namakaokahai to flee again, Pele moved southeast to Maui and finally to Hawaii, where she now lives in the Halemaumau Crater at the summit of Kilauea Volcano. The mythical flight of Pele from Kauai to Hawaii, which alludes to the eternal struggle between the growth of volcanic islands from eruptions and their later erosion by ocean waves, is consistent with geologic evidence obtained centuries later that clearly shows the islands becoming younger from northwest to southeast.

Although Hawaii is perhaps the best known hotspot, others are thought to exist beneath the oceans and continents. More than a hundred hotspots beneath the Earth's crust have been active during the past 10 million years. Most of these are located under plate interiors (for example, the African Plate), but some occur near diverging plate boundaries. Some are concentrated near the mid-oceanic ridge system, such as beneath Iceland, the Azores, and the Galapagos Islands.

A few hotspots are thought to exist below the North American Plate. Perhaps the best known is the hotspot presumed to exist under the continental crust in the region of Yellowstone National Park in northwestern Wyoming. Here are several *calderas* (large craters formed by the ground collapse accompanying explosive volcanism) that were produced by three gigantic eruptions during the past two million years, the most recent of which occurred about 600,000 years ago. Ash deposits from these powerful eruptions have been mapped as far away as Iowa, Missouri, Texas, and even northern Mexico. The thermal energy of the presumed Yellowstone hotspot fuels more than 10,000 hot pools and springs, geysers (like Old Faithful), and bubbling *mudpots* (pools of boiling mud). A large body of magma, capped by a *hydrothermal system* (a zone of pressurized steam and hot water), still exists beneath the caldera. Recent surveys demonstrate that parts of the Yellowstone region rise and fall by as much as 1 cm each year, indicating the area is still geologically restless. However, these measurable ground movements, which most likely reflect hydrothermal pressure changes, do not necessarily signal renewed volcanic activity in the area.

Fossils: Treasures from Oregon's Past

Fossils are the remains of living fhings that have been buried by sediments and eventually hardened into rock

OREGON has many fossil localities. The Clarno Formation in north-central Oregon is famous for its unusual fossilized plants, including nuts and fruits, that are 37 million years old. In Washington County, shark fossils have been found. Along the coast, fossils of sea creatures can be found on beach cliffs. There are tree fossil localities near Molalla. Petrified wood dating back to the time of the dinosaurs has been collected near the town of Greenhorn in Baker County.

Over the years, collectors have donated fossils to DOGAMI. One of these, the George and Jennie Walters fossil collection, is on display at the Nature Of Northwest Information Center in Portland. It contains rare specimens gathered from Oregon and around the world.One of the more interesting fossil is a 30 million year old dentalium or tusk shell. It comes from Columbia County. Tusk shells are long curved tapered tubes. They are shells from scaphopods. Present-day specimens of scaphopods live in deep water. Before Europeans came to the west, native Anericans used tusk shells for tools and money. A 20-million year-old-shell in the collection is quite different from its present-day relatives. The fossil of Trophon oregonsis is about the size of half-inch spikes. It was collected near Depoe Bay.

The collection has a number of fossilized clam shells that were recovered from the Beverly Beach area near Newport. These also date back about 20 million years.

A more recent fossil, which is only 3 million years old, also is on display. It is a scallop shell over a half a foot in diameter. It was recovered near the city of Coos Bay. Marine fossils are found on land because marine sediments have been pushup above sea level by the same forces that cause earthquakes.

Dinosaur fossils occur in Oregon, but they are very rare. Dinosaur fossls are found in sediments that are at least 60 million years old. A recent find in Curry County in a beach cliff. "Dinosaur" fossils have been discovered in Crook and Wallowa Counties. They include a fish-lake ichthyosaur, crocodile, and pterosaur.

The Nature of the Northwest Information Center has several books on collecting fossils. A book entitled "Fossils Shells from Oregon Beach Cliffs," by Ellen Moore gives an overview about ages, types, and locations of fossils along the coast. The book can be purchased for $9.95.

DOGAMI's Bulletin 92, "Fossils in Oregon," is a series of reprints taken from "The OreBin" from before 1977. It contains pictures, maps, and descriptions of fossil locations around the state. Many of these locations are easily accessible. They include areas along the Sunset Highway corridor, and around Eugene, Salem, Lincoln County and Coos Bay. The Bulletin is 227 pages long and costs only $5.00.

An excellent publication called :The Handbook of Oregon Plant and Animal Fossils" is out-of-print. The authors , Elizabeth and William Orr, have written a number of books or Northwest geology. The handbook is available at many libraries.

Oldest fossil turtle discovered

On May 14, a prehistoric turtle carapace was collected from rocks of the Oregon Coast Range between Scottsburg and Reedsport by William Orr, professor of geology at the University of Oregon and curator of the Department of Geological Sciences Condon Museum of Geology, and his wife Elizabeth Orr. The turtle remains include the plastron or bottom plates of the shell along with about 30 percent of the top of the carapace. Th animal was originally about 18 in. Iong and is a istant relative of the modern green turtle. Bits and ieces of limb bones and appendages were also covered but not the skull.

This turtle represents the oldest marine (salt-water) turtle found to date in Oregon. It was entombed in what is known as the Tyee Formation, deposited during the Eocene Epoch roughly 48-50 million years ago in a huge delta structure that was developing along the proto-Oregon coast area under semitropical conditions

Recent floods in the vicinity of the site had exposed the fossil-bearing rock. Gary J. Schulz and John H. Seward of the Oregon Department of Forestry made the discovery during a road building project on land of Roseburg Forest Products, Inc. Together with Carey Weatherly of Roseburg Forest Products, Inc., they directed the Orrs to the collecting site and assisted in the extraction and retrieval of some 80 pounds of fossil bearing rock. The specimens are presently undergoing preparation in the Condon Museum laboratory. The preparation includes impregnating the bone with a rapidly hardening lyvinyl-acetate plastic solution and removing much of the of the rock matrix

------*University of Oregon news release*

The article "Oldest fossil turtle discovered" was taken from Oregon Geology, Volume 58,Number 4, July 1996.

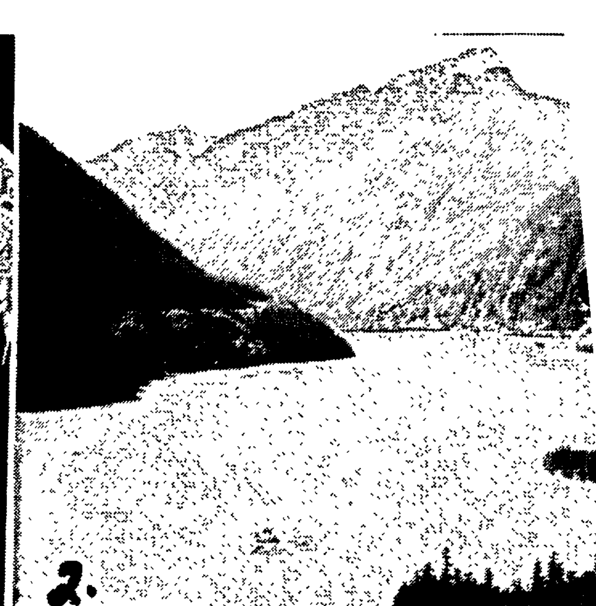
DIATOMACEOUS EARTH

Diatomaceous earth is a powdery natural material formed almost entirely from the skeletons of diatoms, deposited in most cases during the Cenozoic era. It is usually extremely fine in texture and gray or white in color. When pure, diatomaceous earth is composed almost entirely of silicon or silica, but it is often found mixed with clay or organic matter. The material is used extensively as an abrasive, a filtering material, an inert ingredient of explosives, and an insulating material for boilers and steam pipes. When diatomaceous earth is found mpacted into a chalky solid rock, it is known as diatomite or tripoli. Deposits of diatomaceous earth are found in many parts of world. The thickest known deposit, about 300 feet in depth, is in California.

PRESIDENT'S CAMPOUT 1996

The 1996 President's Campout led by President Richard Bartels was greatly enjoyed by a group of GSOCs. The week was spent studying and viewing the geology along the "Cascade Loop" in Northern and Central Washington. There were many stops for short lectures by the President, picture taking, collecting rocks and discussion. The general theme of this year's Campout (some did Camp) was to give an overview of Washington Geology with emphasis on the Cretaceous paleography of the Insular and Intermontane Superterranes. All participants were treated to well-ordered lectures, discussions and beautiful geology led by a enthusiastic geologist, Richard Bartels. The pictures on the next page shows some of the activities and geologic stops of the 8-day trip. Pictures on the next page.

1. Phyllite-Skagit River, Margaret Giddings, Ken Yost, Richard Bartels, Ruth Keen.
2. View of Diablo Lake
3. Lunch at Clear Lake, Ken Yost, Michael Kelleher, Clay Kelleher, Dick Donelson, Cecelia Crater, Margaret Giddings.
4. Slate--bedded chert, Clay Kelleher and Dick Donelson.
5. Twisp Formation, Richard Bartels.
6. Cecelia Crater, Clay Kelleher, , Dick Donelson, Ruth Keen listening to an on the spot lecture by President Bartels.
7. Glacial outwash being held up by Rosemary Kenney.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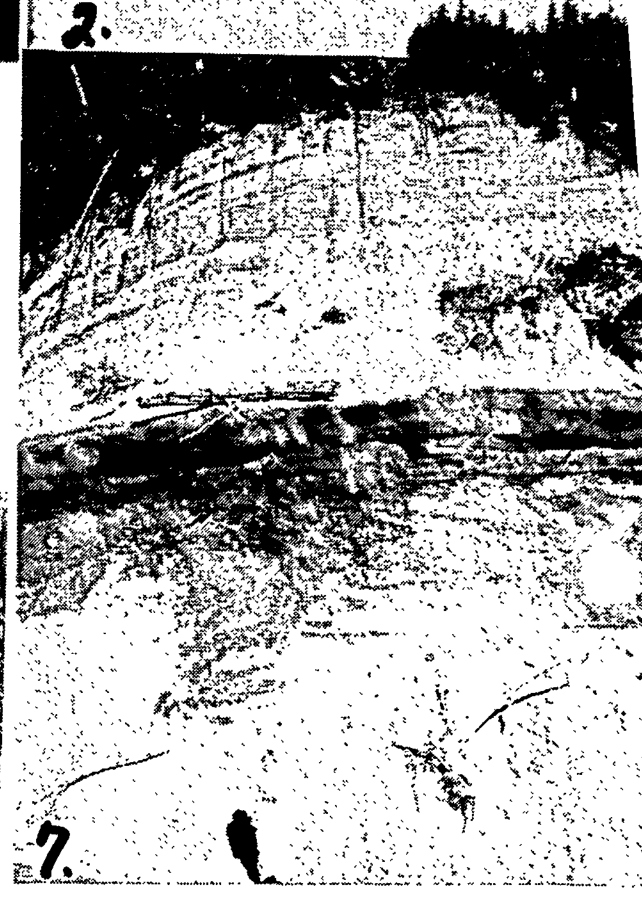
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THE GEOLOGICAL NEWSLETTER

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, private car,caravan or chartered bus. **GEOLOGY SEMINARS;** Fourth Wednesday , except June, July, August. 8:00 p.m., Room S17, Cramer Hall, Portland State University. Library: Room S7. Open 7:30 p.m. prior to meetings. **PROGRAMS**: Evening:: Second Friday evening each month, 8::00 pm, Room 371, Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon. **LUNCHEONS**: First and Third Fridays monthly at noon except holidays. Bank of California Tower, 707 SW Washington, 4th floor, California Room, Portland, Oregon. **MEMBERSHIP**: per ear from January 1: Individual - $20.00, Famil;y - $30.00, Junior (under 18) - $6.00. Write or call the Secretary for application. **PUBLICATIONS**: *THE GEOLOGICAL NEWSLETTER* (ISS 0270 5451), published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year. Individual subscriptions $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 the same address for names and price list.

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VISITORS WELCOME
INFORMATION: 9AM-5PM, 321-6239
after 5PM, 775-6263

VOL. 62, No. 12
DECEMBER 1996

DECEMBER ACTIVITIES

FRIDAY NOON MEETING: 12:00 Bank of Calif. Tower, 707 SW Washington, 4th floor, Calif. Room. (Cafeteria is closed permanently.)

Dec. 6: A Geological Potpourri; or, Name That Place!
Richard Bartels, GSOC President

FRIDAY EVENING MEETING: 8:00 PM Portland State U., Cramer Hall, Rm. 371

Dec. 13: The Yellowstone Hot Spot and Its Oregon Connection
Dr. Paul Hammond, PSU Geology Dept. (ret.)

No WEDNESDAY EVENING SEMINAR this month

ALL ITEMS TO BE PRINTED ON THIS CALENDAR OF ACTIVITIES **MUST** BE SUBMITTED TO THE CALENDAR EDITOR BY THE **15TH** OF THE MONTH. Write or call Evelyn Pratt, 223-2601.

A PCC Community Education course - NORTHWEST LANDMARKS - HOW THEY GOT THAT WAY - will include discussion, hands-on activities, and slides of national parks, monuments, and other places of interest in the Pacific NW. Time: Mondays Jan. 6-Mar. 3, 7 to 9 PM (weather permitting). Place: Rm. 233, Lincoln High School. For more information call instructor Evelyn Pratt, 223-2601.

THE BOARD OF DIRECTORS IS RECOMMENDING THAT ARTICLE XVI, SECTION 2 OF THE BY-LAWS BE AMENDED.

Section 2 reads as follows:

"Section2. The Society shall carry fidelity insurance which undertakes to guarantee the fidelity of the officers and which will indemnify the Society for losses caused by the dishonesty on the part of these persons."

Section 2 (as amended):

"Section2. The Society shall carry fidelity insurance at such time as the cash assets of the Society exceeds $10,000.00. Such insurance is to guarantee the fidelity of the officers and which will indemnify the Society for losses caused by the dishonest on the pat of these persons."

This amendment is recommended by the Board and makes financial sense. The cost of the fidelity insurance has increased from $100.00 to $250.00, and as the Treasurer's reports have indicated, our cash carryover from past years in the checking account is gradually being reduced to zero. We have been just required to withdraw $500.00 from the savings account to cover projected expenses to the end of 1996. As of November 10, 1996, the total sum in the checking and savings accounts is $5,874.16. The amendment is submitted for your consideration and will be included with the ballot for your approval or rejection.

GSOCS needs people to bring cookies for both the Friday evenir meetings and Wednesday Seminars. Those willing to bring cookies please call Rosemary Kenney at 221-0757. Share your great cookies with the rest of the group.

NOMINATIONS FOR OFFICERS FOR GSOC FOR 1997

The nomination committee has selected the following people to be officers for the 1997 year. Each of the following have agreed to take the following positions:

President: Dr. Paul Brown
Vice-president Dr. Walter Sunderland
Secretary: Marilyn Lum
Treasurer: Phyllis Thorne
3 year Director: Bob Richman
2 year Director: Ray Crowe
1 year Director: Cecelia Crater

IN MEMORIUM

Emma Jane Richman, long time member of the GSOCS and wife of Robert Richman died August 11, 1996. She graduated from Grant High School in Portland and attended Maryhurst and Monmouth college before teaching in the Portland Public Schools for 25 years.

COMPLETELY FRACTURED GEOLOGY

Evelyn Pratt

1. **stoss:** a drunk answer to "What shall I do with this empty beer can?" "'S toss it."
2. **diatom**: to give a male cat a color rinse
3. **trona:** as in, "That spoiled brat is trona fit!"
4. **ecosystem**: the equipment a rock star uses to produce sounds that reverberate
5. **miscible**: as in, "That's a lousy film - it's really miscible."
6. **"Pingo!"**: at a church event, the cry of a happy German who has just completed a column of letters
7. hydrate: as in, "Hydrate some of these puns pretty low!"
8. **fall line**: Dior's autumn fashions
9. **oxide**: what quality leather is made from
10. **faceted spur**: a bejeweled part of a rodeo star's footgear

WAS THERE A VOLCANO UNDER ICE IN THE NORTH CASCADES?

Adapted from Wes Hildreth, USGS 7/96 GSA Bulletin, v. 108, #7

, by Evelyn Pratt

A caldera is a basin-shaped depression resulting from the explosion or collapse of a volcano. Its diameter is many times larger than the vent which produced it. Although the Cascade Mountain chain contains over 1800 Quaternary volcanoes, calderas that collapsed in large eruptions during that last couple of million years are rare here. Between Mt. Lassen in California and Meager Mt. in British Columbia only three are recognized. 7000-year-old Crater Lake (ex-Mt. Mazama) is well-known. The 400,000-year-old Rockland Caldera in northern California has been largely obscured by lava from Mt. Lassen. In the early 1990's a third, 1.15-million-year-old Kulshan caldera at the northeast foot of Mt. Baker, was identified. All three have similar pumice compositions, volumes of magma erupted, and sizes of areas of downward settling or subsidence.*

By comparison, most volcanic arcs around the Pacific Ocean rim have many more Quaternary calderas. There are at least 9 in New Zealand; 8 in central Chile; more than 10 in Central America; and over 20 each in Indonesia, Japan, the Kuriles-Kamchatka, and Alaska-Aleutian arcs.

In the 1100-kilometer-long Cascade Range, calderas that formed earlier during the Tertiary are also uncommon. Fewer than 10 have been inferred or recognized. Compared with other volcanic arcs around the Pacific, the Cascades are not particularly unique either in thickness of crust, crustal extension, nor plate convergence. This enigma of their caldera scarcity would make a good topic for further investigation.

Kulshan caldera lies at the northern base of Mt. Baker and just west of Mt. Shuksan, two of Washington's "calendar art" mountains. State Highway 542 winds through Heather Meadows ski area to trailheads at Artist Point overlook, on the caldera rim. When we used to hike there in the '50's we assumed that anything nonvolcanic had some connection with Mt. Shuksan. Mt. Baker got the credit (or blame) for lava and tephra, since it was the biggest thing around that looked like a volcano. Although calderas such as Katmai and Tambora transect earlier stratovolcanoes, and Santorini and Mt. Mazama cut across clusters of them, at Kulshan there is no sign of any precaldera volcanic edifice.

The caldera is a steep-walled 4.5 x 8-kilometer oval, which makes it about 2/3 the area of Crater Lake. It collapsed and filled with over 1000 cubic meters of ignimbrite (rock formed from volcanic ash and other ejecta) during one single catastrophic eruption. In caldera-forming eruptions at Tambora, Krakatau, Katmai, and Pinatubo, collapse and filling took only a few hours; Kulshan was probably similar.

Three distinctive suites of earlier rocks enclose the caldera. Metamorphosed Paleozoic volcanic and sedimentary rocks make up the north and south walls. Mesozoic argillite, sandstone, and conglomerate compose the west wall. Pliocene granodiorite forms the east wall. All of these were downfaulted and shattered during collapse. Within Newberry Crater caldera in central Oregon and Medicine Lake in northern California formed from the collapse of huge basalt shield volcanoes. Both are about as far east of the High Cascades as Portland is from Salem. They seem to be part of Basin & Range extension rather than Cascadian response to eastward plate movement.the caldera, material from each of the suites was incorporated into nearby sectors of ignimbrite as sheets of breccia, large chunks, and dispersed rock fragments.

Up to 120 meters of ash overlie the fine-grained top of the ignimbrite in the southwestern part of the caldera. The ash and ignimbrite are only preserved under later lava flows, so no doubt there was much more before glaciers and streams worked them over. At several exposures near the south rim original surface of the intracaldera ignimbrite is preserved at elevations up to 1800 meters above level, and is overlain by ashy lake sediments. Elsewhere the ignimbrite is incised by many steep gorges that cut down to as low as 800 meters above sea level. Since the observed thickness reaches 1000 meters and the base is not exposed, the volume of ignimbrite that ponded inside the caldera must have been greater - probably much greater - than 30 cubic kilometers. This is more than 30 times the volume of pyroclastics that erupted from Mt. St. Helens in 1980.

Later lavas lie on top of the intracaldera ignimbrite. These have been carved into rugged relief, which makes the Kulshan caldera hard to see. Also, the Cordilleran ice sheet spread south from British Columbia time and again and severely eroded the surrounding landscape. The ice lowered the rim of basement rocks, stripped away any precaldera lavas, removed every vestige of ignimbrite outside the caldera, and helped to produce over 1000 meters of up-and-down relief inside it.

QUATERNARY SUBGLACIAL CALDERA, WASHINGTON

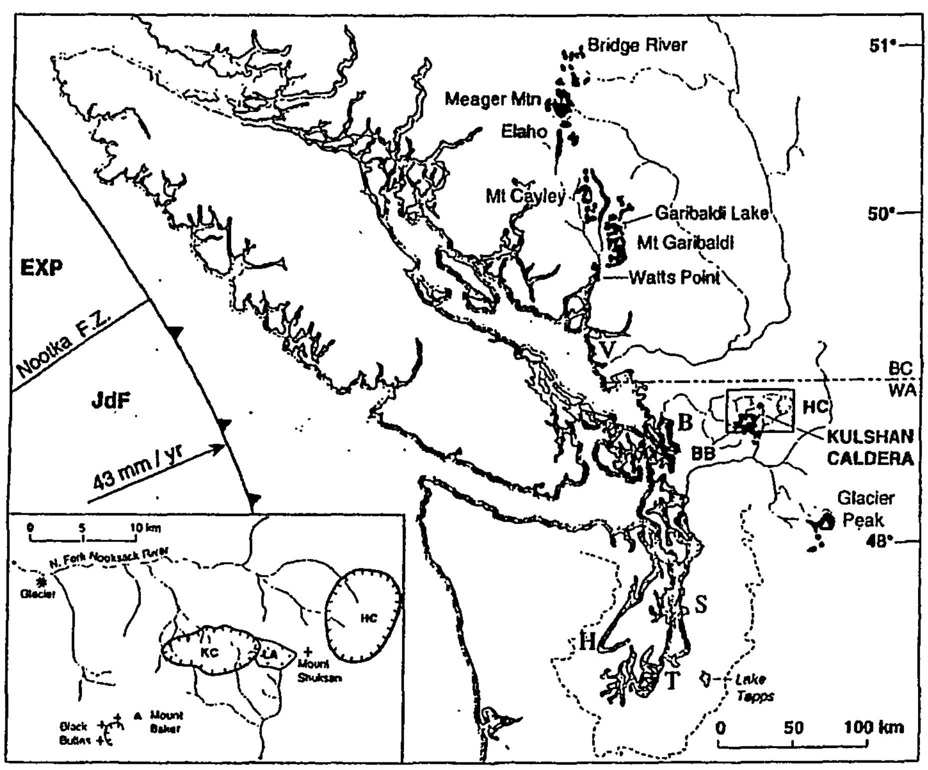

Figure 1. Location of 1.15 Ma Kulshan caldera just northeast of middle Pleistocene–Holocene stratovolcano pair, Black Buttes and Mount Baker (BB), and separated by 7 km from 4 Ma Hannegan caldera (HC), which lies 11 km south of the British Columbia–Washington (BC/WA) border. All volcanic rocks of the Garibaldi volcanic belt, northernmost segment of the Cascade arc, are indicated in black and major centers are labeled. Cities: B = Bellingham, H = Hoodsport, S = Seattle, T = Tacoma, V = Vancouver. Offshore: JdF = Juan de Fuca plate; EXP = Explorer plate. Dashed line surrounding Puget lowland shows maximum extent of Puget lobe of Cordilleran ice sheet during the last glaciation (Thorson, 1980). Inset expands the area investigated, indicating the town of Glacier and the Lake Ann stock (LA) truncated by Kulshan caldera (KC).

As previously mentioned, the three Quaternary eruptions known to have produced calderas in the Cascades had much in common. All generated large volumes of ignimbrite and far-flung layers of pumice fallout. In each event, the dominant pumice was a rather similar rhyodacite. Kulshan caldera's area of downward settling or subsidence, filled by ignimbrite and collapse breccia, is only slightly greater than that which lies inside the ring-fault zone on the bottom of Crater Lake. Although Rockland caldera is poorly exposed, its area of structural subsidence is probably similar to the other two. In the caldera-forming events at least 50 cubic kilometers of magma was blown out of each volcano. When ignimbrite inside the calderas is taken into account the volume was probably considerably more. After collapse, silicic lava flowed inside all three calderas.

However, besides the lack of a precaldera volcano, Kulshan differs from the others in the effects of its glacial environment. Caldera-forming eruptions always produce great volumes of fallout deposits. Ashfall and blasted-out fragments of magma normally represent at least 20% of the total volume erupted. To date, although Kulshan ash probably fell over a vast area of North America, it has been recognized only in the southern Puget lowland. Lake Tapps tephra, found in several locations east of Tacoma and near Hoodsport, is physically and chemically identical with Kulshan intracaldera pumice. Near Tacoma, 200 kilometers from the vent, it is 30 centimeters - about a foot - thick. Presumably the rest of the Kulshan ash was scattered by retreating ice sheets or washed away by their meltwater.

In 1987, when the source of the Lake Tapps tephra was not yet known, Westgate and others studied the ash. They recognized several features characteristic of the interaction of hot magma with water: angular chunks of ignimbrite, few pores or vesicles, and glassy dust on surfaces and in thick-walled bubbles. Lake Tapps tephra either rests directly on glacial outwash from the north, or alternates with lake deposits that are probably derived from the retreating front of the Cordilleran ice sheet's Puget lobe. Kulshan fallout has not been found farther north, and if any outflow was emplaced on top of the glacier it has been totally removed. The Cordilleran ice sheet advanced and retreated from British Columbia several times during the past 2 million years, at one time reaching as far south as Centralia. It is highly probable that the caldera-forming Kulshan eruption started under ice. Quenching and flushing by meltwater and steam and the effects of a collapsing glacial lid or a meltwater lake could account for several unusual characteristics of the ignimbrite inside the caldera. These deposits (1) lack welding; (2) grade upward from coarse to fine massive ash in the upper 200 meters; and (3) are distinguished by uncharacteristically fine pores and vesicles in the pumice. All this evidence points to a huge amount of magma blasting through something with a lot more volume than ordinary groundwater.

We tend to judge geologic catastrophes by their effect on human history. Written records of events in this part of the U.S. have been kept for less than 200 years. Not enough time has elapsed for us to learn firsthand how plate movements have affected the Pacific Northwest. We were astonished by the volume of pyroclastics which spewed out of Mt. St. Helens. Considering the damage done by its melting glaciers' mudflows down the Toutle River and elsewhere around the mountain, how much greater would have been the effect of a many tens of times larger eruption bursting forth through a continental ice sheet!

EVERGLADES: SECRETS OF THE TWO-THOUSAND-YEAR-OLD MUDS

Do buried sediments hold the secrets to a better understanding of what factors -- natural or human -- have triggered changes in the living resources and environment of the Everglades?

"Frankly, we're not sure yet, but we can use pollen grains that have been deposited in the sediments todocument the range of vegetation changes that have occurred in South Florida over the last 2,000 years," said Debra Willard, U.S. Geological Survey research scientist, Reston, Va.

"For example, the pollen of marsh and slough vegetation, such as saw grass, was dominant around Florida Bay for more than a thousand years, until 1950, when mangrove pollen became more abundant,"Dr. Willard said.

"Our biggest challenge will be to find ways to compare 2,000 years of natural change with the human-induced changes of the last 150 years," Willard said. "We hope to put into better perspective the nature of the changes in the Everglades landscape. Perhaps we can help determine whether the more recent changes represent extremes in the natural range of variability or whether they represent responses to human-induced environmental changes."

Willard and USGS co-authors Lisa Weimer and Charles Holmes discussed their findings Monday (October 28, 1996) as part of a special poster exhibit at the annual meeting of the Geological Society of America in Denver.

A team of USGS scientists has been focusing on collecting sediment cores from the Everglades, Florida Bay, and Biscayne Bay, where microscopic fossils may reveal how changes in drainage patterns and land use altered plant and animal communities in the region. A similar effort is underway in the Chesapeake Bay.

Because of the complicated resource management issues, the South Florida Ecosystem Restoration Program was developed as an intergovernmental effort to regain and maintain the natural South Florida ecosystem. The USGS is assisting the program by providing unbiased, scientific information to aid decisions by resource managers in planning restoration of the region. The USGS effort includes providing geologic, hydrologic, biologic and cartographic data relating to the mainland of South Florida, Florida Bay, Biscayne Bay, and the Florida Keys and Reef system.

- * * USGS * * *

Correct definitions to "COMPLETELY FRACTURED GEOLOGY",

adapted from AGI Dictionary of Geologic Terms, 3rd Edition, Bates & Jackson;

by Evelyn Pratt

1. **stoss:** the side of a hill which faces the direction from which a glacier came
2. **diatom**: a tiny single-celled water plant related to algae, with a silica shell
3. **trona**: a white mineral found in salty residues; a major source of sodium compounds
4. **ecosystem**: an environment with its organisms
5. **miscible**: two or more phases that, when brought together, can mix and form one phase; example: antifreeze is completely miscible with water
6. **pingo:** a large frost-mound of soil-covered ice found in areas with permafrost
7. **hydrate**: a mineral compound in which water is part of the chemical composition
8. **fall line**: an imaginary line connecting waterfalls on adjacent near-parallel rivers, marking the points where these rivers descend suddenly from highland to lowland; the limit of navigability
9. **oxide:** a mineral compound in which oxygen is linked with a metal
10. **faceted spur**: a ridge with an inverted-V face produced by a fault or a glacier