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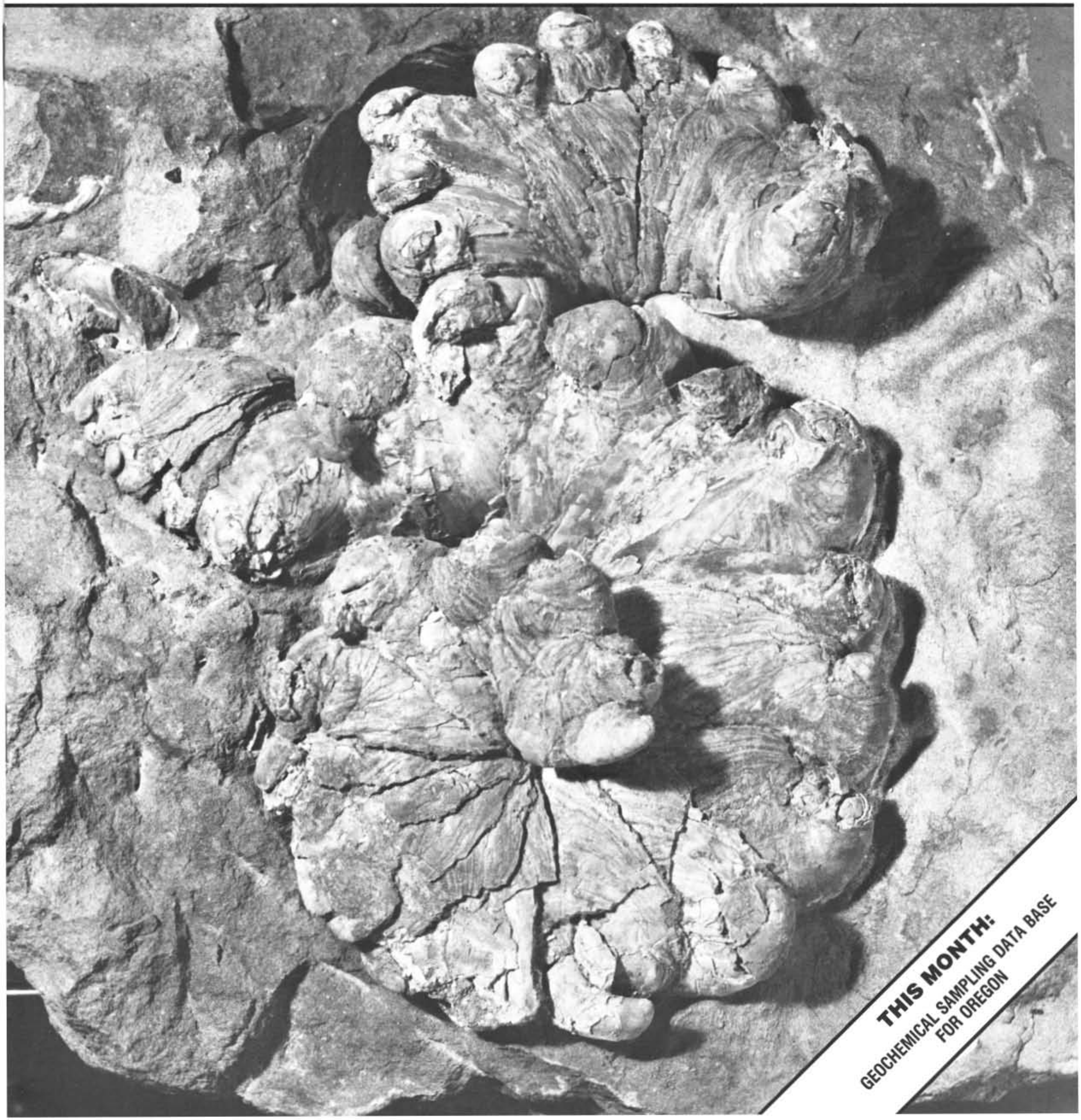

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Information for contributors

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

The style to be followed is generally that of U.S. Geological Survey publications (see the USGS manual *Suggestions to Authors*, 6th ed., 1978). The bibliography should be limited to "References Cited." Authors are responsible for the accuracy of their bibliographic references. Names of reviewers should be included in the "Acknowledgments."

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

COVER PHOTO

A natural accumulation cluster of the "slipper shell" *Crepidula princeps* Conrad. Specimens are from the lower Empire Formation at Coos Bay, Oregon, and are assigned to the Graysian Molluscan Stage (late Miocene). The snail *Crepidula* occurs in clusters for reproduction purposes and because, as a filter feeder who must live above the sediment-water interface, it settles and grows on the shells of other *Crepidula* individuals. Usually the clusters form neat circles of 20-30 cm in diameter with some 20-25 individuals in an imbricate (fallen-domino) configuration. This cluster of 43 individuals in an S-shape is exceptionally large and reflects low sedimentation rates in low-energy, shallow marine water. Photo by John M. Armentrout, Mobil Oil Co., Dallas, Texas, made available by William N. Orr, University of Oregon.

OIL AND GAS NEWS

Mist Gas Field

Only 21 days after completion of Busch 14-15, Reichhold Energy completed another well at Mist Gas Field. Columbia County 43-27, in SE¼ sec. 27, T. 6 N., R. 5 W., was tested on September 1, 1984 at a rate of 1.4 MMcfd of gas. Total depth of the well is 2,441 ft. This is the fourth completed well in the south extension of the field.

Two Taylor Drilling Company rigs have been busy at Mist for the past several weeks. While one drilled and completed Columbia County 43-27, the other drilled Adams 32-34 in NE¼ sec. 34, T. 7 N., R. 5 W. The well was a dry hole with a total depth of 3,284 ft but is now being redrilled.

Reichhold is also redrilling another well at Mist, this one a former producer. The well, Paul 34-32 in SE¼ sec. 32, T. 7 N., R. 5 W., produced 469 MMcf of gas from April 1983 to June 1984. Water production became a problem, so the redrill was started the week of September 9.

Douglas County

Hutchins and Marrs Great Discovery 2, in NW¼ sec. 20, T. 30 S., R. 9 W., was drilled to 3,510 ft and is now idle. The operator may deepen the well.

Meanwhile, Amoco Production Company has moved a Peter Bawden rig to the Weyerhaeuser 1-13 location in SW¼ sec. 13, T. 25 S., R. 9 W. The drilling of this 13,500-ft well will occur concurrently with the drilling of the company's Grays Harbor, Washington well.

Mist gas production

Month	Total Mcf	Field avg. Btu	Total therms
April 1984	162,808	969	1,577,168
May 1984	221,884	952	2,113,191
June 1984	253,489	955	2,421,239
July 1984	268,749	961	2,566,107
Cumulative field production through July 1984	17,891,097		

□

State Capitol mineral display features Oregon fossils

The Newport Agate Society has provided and installed a display of Oregon fossils that can now be seen in the State Capitol display case of the Oregon Council of Rock and Mineral Clubs. Contributions from 16 members of the Society were arranged in 47 groups by Julia Hughes, Lynn Weimer, and Henry Norman.

The display of fossils includes Chione and Andara clams, shark's teeth, mammal and dolphin vertebrae, a turtle, a crab, a scallop, coral, Toredo worm holes in carbonized wood, and a large specimen of crystallized fish replacement. Most of the fossils are from Lincoln County, but Clatsop, Polk, and Wasco Counties are also represented.

The display will remain on exhibit the usual three-month period, until the end of November, and will be followed by displays from the Columbia-Willamette Faceters' Guild of Portland, the Portland Earth Science Organization, and the Roxy Ann Gem and Mineral Club of Medford. □

Geochemical sampling data base for Oregon

by J.J. Gray, Oregon Department of Geology and Mineral Industries

This report lists the references constituting the data base of geochemical sampling in Oregon. The location map identifies the sampled areas and keys them to the references or groups of references in the list.

Geochemical sampling data of value to mineral exploration in Oregon have been collected and published for almost the last twenty years by several Federal agencies and by the Oregon Department of Geology and Mineral Industries (DOGAMI). From some sampling programs, only summaries or abbreviated reports were published. In those cases, raw data should be available through the authors of the reports from the publishing agencies.

Most of the published reports and some unpublished data are on file and available for inspection at the DOGAMI office, 1005 State Office Building, Portland, OR 97201, phone (503) 229-5580. Use this address also to purchase published DOGAMI reports. Obtain copies of publications or data from other agencies at the following addresses:

U.S. Bureau of Land Management: *Unpublished data:* U.S. Bureau of Land Management, P.O. Box 2965, Portland, OR 97208, phone (503) 231-6951. Contact person, Durga Rimal.

U.S. Bureau of Mines: *Published reports:* Branch of Production and Distribution, Division of Publication, U.S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh, PA 15213, phone (412) 621-4500. *Unpublished data:* Western Field Operations Center, U.S. Bureau of Mines, East 360 Third Avenue, Spokane, WA 99202, phone (509) 456-5350.

U.S. Department of Energy, National Uranium Resource Evaluation (NURE) program: *Published reports and maps:* Open-File Services Section, Building 41, MS 306, P.O. Box 25046, U.S. Geological Survey, Federal Center, Denver, CO 80225, phone (303) 236-7476. *Magnetic tapes (Airborne Radiometric and Magnetic Survey data; Hydrogeochemical and Stream Sediment Reconnaissance data):* USGS EROS Data Center, User Services, Sioux Falls, SD 57198. Contact person, B.F. Molnia, phone (605) 594-6142.

U.S. Geological Survey: *Published open-file reports:* Open-File Services Section, Branch of Distribution, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225, phone (303) 236-7476. *All other publications:* Public Inquiries Office, U.S. Geological Survey, 678 U.S. Courthouse, West 920 Riverside Avenue, Spokane, WA 99201, phone (509) 456-2524. (This is the northwest regional office; many other USGS offices throughout the nation offer the same services.) *Unpublished data;* U.S. Geological Survey, 345 Middlefield Road, Mail Stop 93, Menlo Park, CA 94025, phone (415) 323-8111.

The currently available 13,000-15,000 geochemical analyses are from only about one-third of the land area in Oregon. The remainder of the state has not been sampled. In the available studies, the density of sampling, thoroughness of analysis, and level of detection vary from study to study.

TABLE OF REFERENCES

SA = Number of samples assayed
EA = Maximum number of elements assayed
NR = No raw data published; see introduction

AREA 1
Causey, J.D., 1982, Mineral resources of the Mount Hood Wilderness, Clackamas and Hood River Counties, Oregon: U.S. Bureau of Mines Open-File Report MLA 37-82. (NR)

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AREA 2
Wollenberg, H.A., Brown, R.E., Bowman, H.R., and Strisower, B., 1979, Geochemical studies of rocks, water, and gases at Mt. Hood, Oregon: Oregon Department of Geology and Mineral Industries Open-File Report O-79-2. (SA 43; EA 31)

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AREA 3
Rimal, D., 1983, Preliminary geochemical data on some BLM-administered lands including Wilderness Study Areas in Oregon and Washington: U.S. Bureau of Land Management, Portland, Oregon, unpublished report. (SA 302; EA 21)

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AREA 5
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Weis, P.L., Gualtieri, J.L., Cannon, W.F., Tuchek, E.T., McMahan, A.B., and Federspiel, F.E., 1976, Mineral resources of the Eagle Cap Wilderness and adjacent areas, Oregon: U.S. Geological Survey Bulletin 1385-E. (NR)

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Hyndman, P.C., 1983, Mineral investigation of the Homestead RARE II area (No. 8291), Baker and Wallowa Counties, Oregon: U.S. Bureau of Mines Open-File Report MLA 76-83. (NR)

Mayerle, R.T., 1982, Mineral investigation of the Lick Creek RARE II area (No. 6285), Wallowa and Baker Counties, Oregon: U.S. Bureau of Mines Open-File Report MLA 120-82. (NR)

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AREA 10
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Walker, G.W., 1982, Mineral resource potential of the Olallie Roadless Area, Marion and Jefferson Counties, Oregon: U.S. Geological Survey Open-File Report 82-885. (NR)

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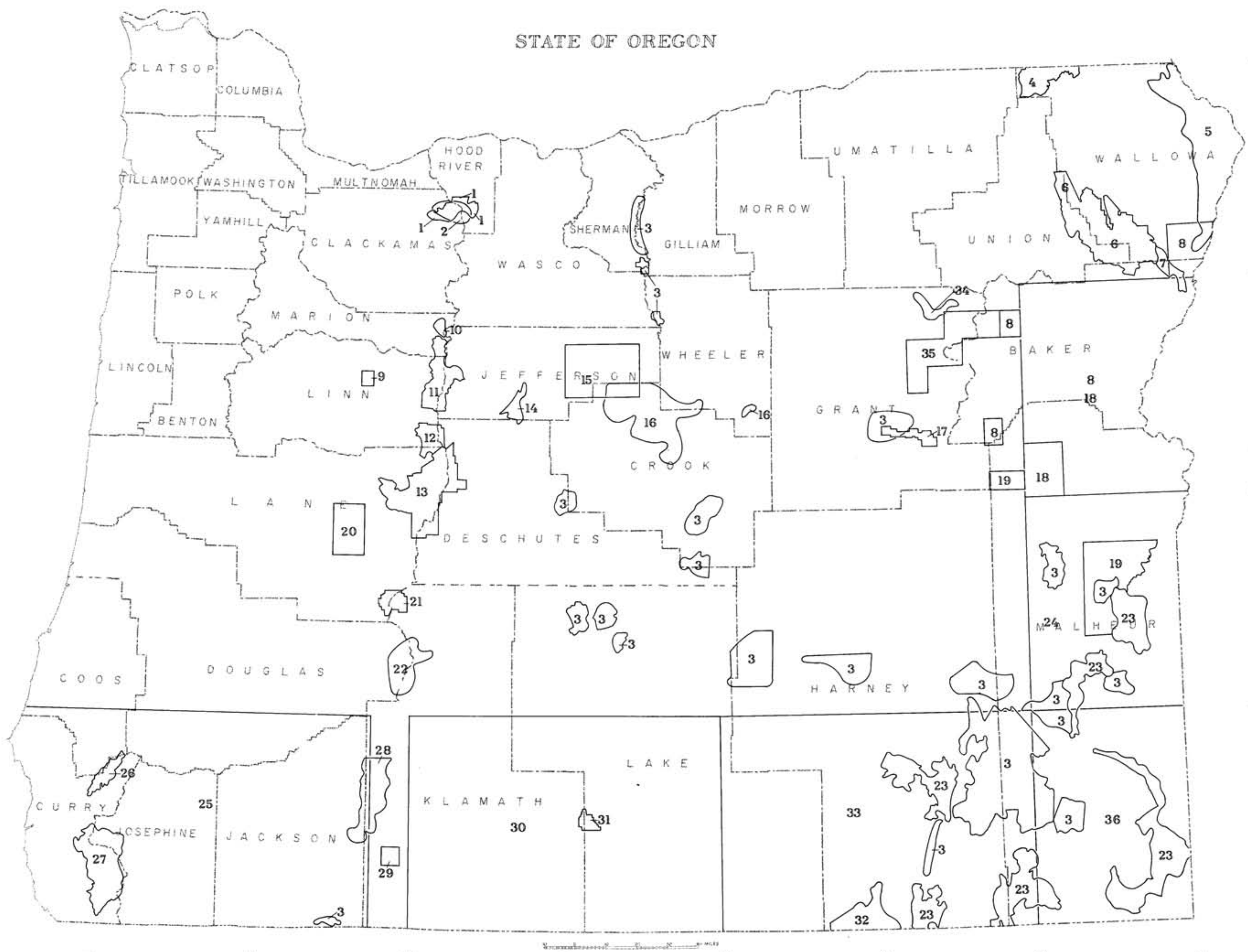

Oregon's geochemical sampling data base. Numbers correspond to area numbers in Table of References.

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AREA 35
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Understanding thermal energy and dynamic processes in subduction-related volcanic arcs: Proposed studies in the Cascades

by George R. Priest, Oregon Department of Geology and Mineral Industries, and David D. Blackwell, Southern Methodist University, Dallas, Texas 75275

INTRODUCTION

It is hard to overstate the importance of subduction-related volcanic arcs in the geologic record and in the record of historic earthquakes and volcanic eruptions. Subduction-related terranes appear to be represented in the geologic record from the Archeozoic to modern times and account for much of the world's volcanic activity. Convergent plate margins stretching for thousands of miles around the Pacific, the Caribbean, the Indian Ocean, and the Mediterranean have some of the most active volcanoes and largest geothermal systems in the world. Many of the world's largest hydrothermal ore deposits are associated with calc-alkaline magmas injected into the crust as a result of the subduction process. The enormous deposits in the Andes, Indonesia, Japan, western North America, and other areas around the Pacific Ocean are examples.

The Cascade Range is the only presently active subduction-related volcanic arc in the conterminous United States. Active volcanoes related to the arc occur over a distance of over 1,300 km from British Columbia to northern California. The most destructive historic volcanic eruption in the United States occurred in 1980 at Mount St. Helens in the Washington part of the range. Partly because of its unique status, the Cascade Range is also one of the most completely studied volcanic arcs in the world. In spite of the extensive geologic and geophysical data available for the range, the detailed subsurface geology is essentially unknown, because the thick sequences of young volcanic rocks effectively mask structures. The high porosity, permeability, and resistivity and the low seismic velocity of young volcanic rocks in the most active part of the arc make geophysical sounding very difficult.

The only part of the Cascades that has been relatively easy to explore by geophysical techniques is the Western Cascade Range. This Miocene and older volcanic terrane has been diagenetically and hydrothermally altered, greatly decreasing the porosity and permeability of the rocks. Consequently, geophysical techniques have been much more successful in the Western Cascades than in the young volcanic rocks of the High Cascade Range to the east.

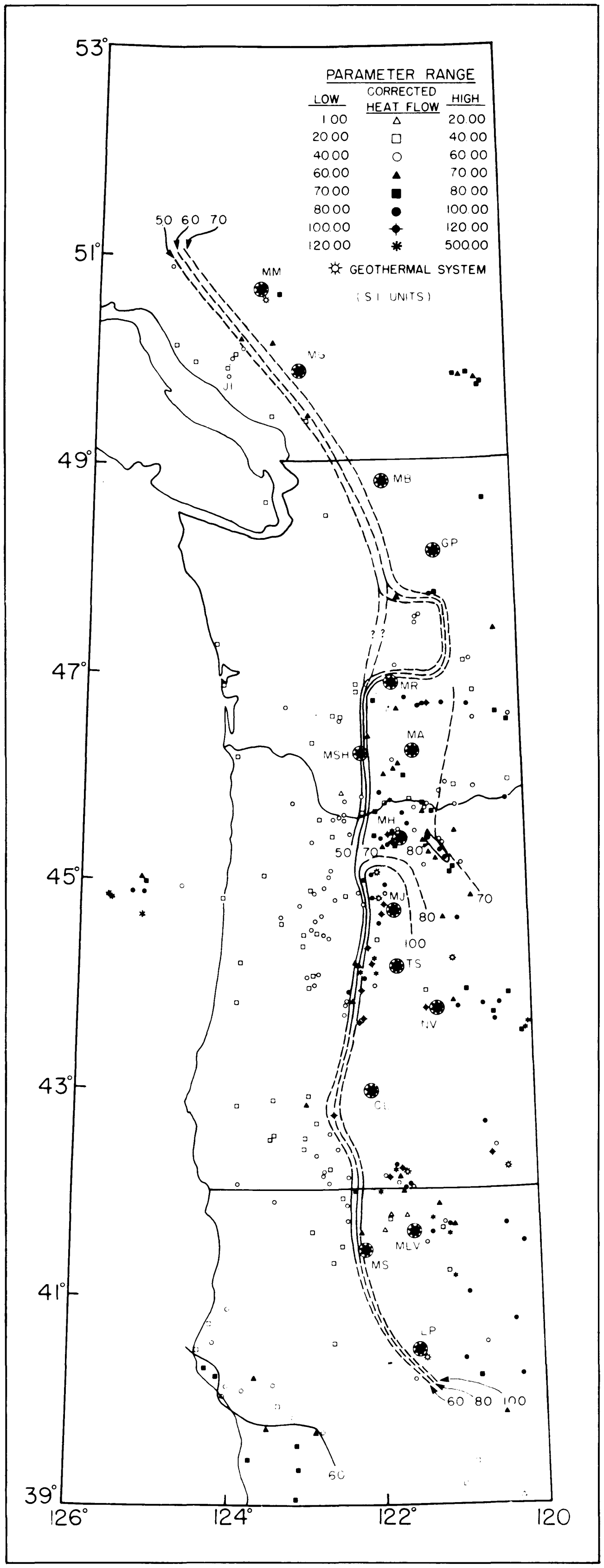
One of the most significant findings from studies of the Western Cascade Range is in the area of heat flow. The results of heat-flow measurements in numerous drill holes indicate that there is a characteristic heat-flow anomaly with a half-width of approximately 10 km on the western side extending from northern California to southern British Columbia (Blackwell and Steele, 1983). Heat flow increases by as much as a factor of 2 or more across the western side of this anomaly, while average geothermal gradients within the main part of the anomaly in the Oregon Cascade Range are about 65° C/km (Blackwell and others, 1978, 1982). Based on interpretation of these data, it appears that temperatures appropriate for partial melting of granitic material should occur at depths on the order of 7 to 10 km under the easternmost part of the Western Cascade Range in Oregon (Blackwell and others, 1978, 1982). These depths are similar to depths estimated for partially molten granitic bodies under silicic volcanic centers such as the Yellowstone, Long Valley, and Valles calderas. Temperatures at equivalent depths beneath the High Cascade Range may be even higher, but thus far, attempts to measure heat flow in the High Cascades have been thwarted by the rapidly circulating shallow ground water that washes away heat flow in the carapace of young volcanic rocks. Lack of reliable heat-flow data in the High Cascade Range is one of the principal reasons that it is not generally included in estimates of the accessible geothermal resource base for the United States. If geothermal systems are present in a significant part of this enormous province, they could dwarf the geothermal potential estimated for the largest silicic volcanic centers in the United States.

RATIONALE FOR SCIENTIFIC DEEP DRILLING IN THE CASCADES

The previously mentioned problems presented by the cover of young volcanic rocks in the Cascades can be solved only by drilling. Experience in drilling in areas such as Newberry Volcano in Oregon has shown that drill holes must generally be 1 km or deeper in order to make meaningful measurements of heat flow in the youngest part of the volcanic arc. Drill holes deeper than 1 km are almost completely lacking in the young volcanic rocks of the High Cascades. In order to directly test the hypothesis that temperatures near the melting point of granitic rocks occur at depths of 7 to 10 km, it would be necessary to drill to these depths. Should the hypothesis prove to be correct, it would have far-reaching consequences for estimates of geothermal potential and for physical models of subduction-related volcanic arcs throughout the world. It would mean that regional zones of very high temperature, possibly molten rock, occur at relatively shallow crustal levels under the entire length of active arcs regardless of the presence or absence of single large volcanoes. Measurements in drill holes in the Cascades would allow calibration of the extensive surface geological and geophysical surveys which could then be applied to other, less well-studied areas of the world. The drilling program would thus test a fundamental hypothesis and provide a standard data base for investigating other similar regions throughout the world.

PROGRAM FOR SCIENTIFIC DRILLING IN THE CASCADES

In recognition of the need for deep scientific drilling in the Cascades, a group of scientists who are actively pursuing research in the province have met several times to plan a proposal. A formative meeting was held at the American Geophysical Union (AGU) conference in San Francisco last December, and a proposal is now in preparation for submission in early 1985. The essential thrust of the proposed project will be a coordinated program of drilling and surface geological and geophysical surveys aimed at a series of east-west transects across the full width of the Cascade Range. The drilling will occur primarily in the young volcanic terrane of the High Cascades and will be completed in two phases. The bulk of the drilling during the first phase will be aimed at reaching depths of between 1.2 and 2.7 km in two transects of four wells each across two contrasting parts of the arc. Some surface surveys and shallower drilling projects are also contemplated during the first phase to characterize two lower-priority east-west transects. The four transects are targeted on the southern Washington Cascades, two localities in the central Oregon Cascade Range, and the northern California Cascades. The first phase would



Heat-flow map of the Cascade Range and adjoining areas (1 Mcal/cm² sec = 41.84 mWm⁻²). From Blackwell and Steele (1983, p. 234).

allow direct testing and modeling of the hydrothermal systems, measurement of the amplitude of the heat-flow anomaly in the High Cascades, and direct sampling of basement rocks to determine the structure, state of stress, and other physical properties. The first phase will also include geologic mapping and a full range of geophysical surveys across both the High Cascades and the Western Cascades to investigate the overall geologic framework of the arc, including the configuration of the subducting oceanic plate and the development of the arc through time. The second phase would be aimed at directly penetrating the source of the regional heat-flow anomaly at depths of 7 to 10 km. The second phase would be an extraordinary scientific and engineering accomplishment and would necessarily be preceded by a lengthy period of research and development. Whereas the proposal currently being prepared deals conceptually with the second phase, work only on the first phase will be addressed in the initial proposal.

The extensive knowledge gained from the proposed research in the Cascade Range will, when combined with similar data from the proposed Trans-Alaska Lithosphere Investigation (TALI), give an accurate representation of the configuration of the major subducting plates and associated volcanism along the western margin of North America. TALI was recently organized by the U.S. Geological Survey (USGS) and other groups to plan for drilling and areal studies along a north-south transect 1,400 km long across the full width of Alaska.

This article is partly intended as an announcement to tell various funding agencies and potential colleagues of the existence of the organizing group for Cascade scientific drilling. We invite participation from other scientists at this time or in the future as the activities become more specific. A proposal submission is planned for January or February 1985. Anyone interested in participating in this project can obtain information from George R. Priest, Oregon Department of Geology and Mineral Industries (1005 State Office Building, Portland, OR 97201, 503/229-5580). The following persons are coordinating other aspects of the project: (1) Hydrology—Edward A. Sammel, USGS, 345 Middlefield Road, MS 39, Menlo Park, CA 94025. (2) Water chemistry—Robert H. Mariner, USGS, 345 Middlefield Road, MS 27, Menlo Park, CA 94025. (3) Hydrothermal alteration: Geologic studies in the northern California Cascades—Terry E.C. Keith, USGS, MS 910, Branch of Igneous and Geothermal Processes, 345 Middlefield Road, Menlo Park, CA 94025. (4) All work in the southern Washington Cascades—Craig Weaver, USGS Geophysics Program AK-50, University of Washington, Seattle, WA 98195. (5) Heat flow—David D. Blackwell, Geothermal Laboratory, 253 Heroy Building, Southern Methodist University, Dallas, TX 75275. (6) Seismic surveys—Walter Mooney, USGS, MS 77, 345 Middlefield Road, Menlo Park, CA 94025. (7) Gravity and aeromagnetic surveys—Richard Couch, Department of Geophysics, College of Oceanography, Oregon State University, Corvallis, OR 97331. (8) Electrical surveys—Harve Waff, Department of Geology, University of Oregon, Eugene, OR 97403. (9) Electrical surveys—Norman Goldstein, Lawrence Berkeley Laboratory, University of California, Building 50, Room 1140, Berkeley, CA 94720. (10) Well logging—Richard Traeger, Sandia National Laboratory, Division 6241, Albuquerque, NM 87815. (11) Teleseismic residual studies and general seismology—H.M. Iyer and Doug Stauber, USGS, MS 977, 345 Middlefield Road, Menlo Park, CA 94025.

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Blackwell, D.D., Hull, D.A., Bowen, R.G., and Steele, J.L., 1978, Heat flow of Oregon: Oregon Department of Geology and Mineral Industries Special Paper 4, 42 p.

Blackwell, D.D., and Steele, J.L., 1983, A summary of heat-flow studies in the Cascade Range: Geothermal Resources Council Transactions, v. 7, p. 233-236. □

Book review: Geology, 1884 style

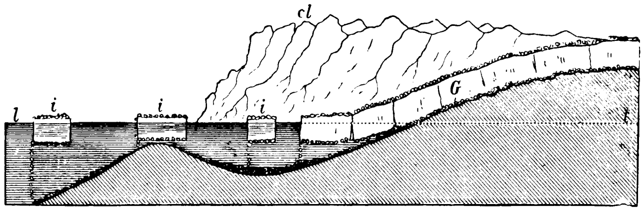
by Ralph S. Mason, former State Geologist

A Compend of Geology, by Joseph Le Conte, Appleton's Science Text Books, American Book Company, New York, 1884, 399 p. $1.20.

The above line of type contains no typographical errors. The 1884 date is correct, and the price was certainly right for the time the book was published. The book, of course, is no longer available, unless you are lucky enough to find one in a used-book store as I did. This work by Le Conte appeared exactly 100 years ago, just two years after the death of Charles Darwin and 11 years after the passing of Louis Agassiz. In it, Le Conte tries to make geology interesting to the pupil by ". . . directing his attention to the various geological phenomena and geological agencies at work now and on every side, and in the most familiar things." *A Compend of Geology* strives mightily to accomplish these goals and, given the strictures of the times, succeeds quite admirably.

Joseph Le Conte was born in Georgia of Huguenot descendants. After his graduation from Franklin College, he received a degree in medicine from the New York College of Physicians and Surgeons in 1845. Four years later, however, he entered Harvard, where he began studying natural history under Louis Agassiz and became interested in geology. After teaching at various universities, Le Conte was appointed professor of geology and natural history at the University of California in 1851, remaining there until his death in 1901. Le Conte's *Elements of Geology*, first published in 1878, went through five editions and was generally regarded as the standard geologic text during its long life. His *Compend* is derived almost entirely from this earlier and far more detailed work and is directed to students that are not geology majors. The term "compend" comes from the Latin for "a saving" or "a short way," a brief summary in comparison to the voluminous *Elements*.

Illustrations for *Compend* are all copper plate and consist for the most part either of scenic views at ground level or of hypothetical cross-sections. One charming picture shows a large glacier entering the sea and "calving" perfectly rectangular blocks of ice, each capped with a layer of even-size "bowlders." Any views approximating present-day low-angle oblique aerial photographs are labeled "perspective." Many hours must have been spent creating the illustrations, and various geologic features are presented in such a manner that the reader will have little difficulty in identifying what is being highlighted. In these figures, most extraneous material has been deleted, and, as further insurance against misunderstanding, the point of interest is also given an identifying symbol. All of this effort to clarify the point is in contrast to some of the muddy black-and-white photographs blown up from 35-mm slides that are used in some current textbooks to explain geologic phenomena. On the other hand, it is doubtful that many students of a century ago would have been able to identify a geologic feature in the field after viewing the often highly stylized rendition of it appearing in Le Conte's text.



Ideal section of a fiord and glacier, forming icebergs. l,l,sea level; G, glacier; i,i,i, icebergs; cl, cliffs. (From Le Conte, 1884, p. 56)

The Nineteenth Century: A time of discovery

"It was the best of times,
It was the worst of times,
It was the age of wisdom, . . ."

These lines from Charles Dickens' *A Tale of Two Cities*, written in 1859, seem prophetic indeed, coinciding as they do with Charles Darwin's publication of his monumental *Origin of Species* near the half-way point of a century of profound advances in scientific thought. Modern geologic theory developed largely from work done in two cultural centers during this period – Paris and London – also the two cities referred to in Dickens' work.

The Chronology shown below includes only a few of the dozens of significant events related to geology that occured during the nineteenth century.

CHRONOLOGY

1795	Hutton	Published theory of the Earth
1807	———	Geological Society of London formed
1815	Lamarck	Established invertebrate phylum
1815	William Smith	Geologic map of England completed
1821	Cuvier	Founder of vertebrate paleontology
1830	Lyell	Published *Principles of Geology*
1840	Agassiz	Published studies on glaciers
1841	Forbes	Invented first practical seismometer
1855	Maury	Founded science of oceanography
1859	Darwin	Published *Origin of Species*
1869	Powell	Published report on trip down Colorado
1877	Dana	Published first edition of *Textbook of Mineralogy*
1878	Le Conte	Published *Elements of Geology*
1879	———	U.S. Geological Survey founded
1884	Le Conte	Published *A Compend of Geology*
1888	———	Geological Society of America founded
1894	Brunton	Patented Brunton pocket transit
1898	Curie	Discovered radium

Oregon is mentioned in the book: Le Conte talks, for example, of the Tertiary coal found in Coos Bay. In another section, he ends his discussion of basalt columns found at various places around the world with this statement: "But the finest (basalt columns) in this country are the basaltic cliffs of the Columbia and Des Chutes Rivers in Oregon." He is, of course, describing columns developed in flows of the Columbia River Basalt Group.

The first chapter of *Compend* is devoted to the "Atmospheric Agencies," geologic processes often relegated to the latter pages of modern texts on physical geology. Le Conte apparently gauged his readers correctly, realizing that many of them had close ties to the soil through agrarian pursuits and rural living. Weathering and formation of soil are discussed in detail, with one cross-section, for example, bearing labels of (a) "sound rock" and (b) "rotten rock." Subsequent chapters, all under the general heading of "Dynamical Geology," include aqueous, organic, and igneous agencies. As luck would have it, Le Conte missed including one of the biggest volcanic eruptions of modern times when Krakatau erupted in August 1883. His manuscript was completed in September 1882 and was undoubtedly being set by hand at the time (Ottmar Mergenthaler's Linotype was not patented until 1885).

Le Conte entitles his last chapter "Psychozoic Era – Age of

Man." He starts with the following statement: "In all previous ages there ruled brute force and ferocity. In this (age) alone appears Reason as ruler. The order of Nature must be adjusted to this keynote. Therefore, the great ruling mammals of the previous age must become extinct, and the mammalian class become subordinate; noxious animals and plants must diminish, and useful ones be preserved." Obviously some of those undesirable elements never got around to reading Le Conte.

In light of the great effort currently being expended in the determination of the origins of man, it is interesting to note that Le Conte gives little space to this subject and in the closing paragraphs of his book has this to say: "The amount of time that has elapsed since man first appeared is still doubtful. The question should not be regarded as of any importance, except as a question of science." It should be noted that the first fossil remains of man were yet to be discovered when Le Conte wrote those words.

Le Conte published both *Elements* and *Compend* during a period of rapid flowering of geological interest by such early-day giants as Hutton, Lemarck, Cuvier, William Smith, Agassiz, and the Danas. The main branches of the science were already established, and considerable knowledge had been assembled on the fossil record (nearly 40 percent of *Compend* is given over to historical geology). Le Conte was able to assemble geologic information contained in relatively inaccessible technical papers and to translate it into a language readily understandable by the nonprofessional. A modern version of Le Conte's type of book, *Principles of Physical Geology*, by Arthur Holmes, was published in 1944. Holmes, however, tends to cite a preponderance of British examples in his 1,250-page text, while Le Conte resolutely uses as many American examples of geology as possible. Perhaps Le Conte's greatest contribution was to alert the American public to its great geological heritage.

In summary, *Compend* provides not only a revealing view of the state of the art of physical and historical geology a century ago but also an eloquent plea for all who would study geology to simply look about them and to observe – most carefully. □

EEZ contains large amounts of valuable mineral and energy resources

The Exclusive Economic Zone (EEZ) off U.S. and territorial coasts contains extensive deposits of valuable mineral and energy resources, such as cobalt, manganese, titanium, phosphorus, copper, zinc, gold, silver, oil, and gas, scientists for the U.S. Geological Survey (USGS), said in Washington, D.C.

The Pacific EEZ contains a variety of hard mineral resources, with sand and gravel and associated placer deposits of heavy minerals being the most likely to be developed in the near future. Deposits of phosphorite and sulfides, ferromanganese crusts enriched in cobalt, and deep-ocean manganese nodules are likely to be developed later, according to David Howell, a USGS geologist in Menlo Park, California.

Howell and two other USGS scientists outlined potential mineral resources of the offshore zone in papers presented to a special EEZ symposium being held at the Oceans 84 conference and exposition in September in Washington, D.C. The EEZ proclaimed in March 1983 by President Reagan provides U.S. jurisdiction for living and non-living resources in the EEZ, which extends to 200 nautical miles (230 mi) off the coasts.

Howell, who spoke on mineral resources of the Pacific EEZ, reported that manganese nodules are most promising off Hawaii and Pacific Island territories and that the recent discovery of high cobalt concentrations in ferromanganese crusts on top of several mid-Pacific seamounts suggests that extensive resources of cobalt may lie within the central Pacific EEZ.

The West Coast continental shelf alone contains an estimated 2.7 billion cubic yards of heavy mineral sand of various composition and grade, but this is less than 1 percent of the heavy mineral resources of the Pacific EEZ. There are indications that heavy mineral deposits off Alaska may far exceed those of the other areas.

Sand and gravel production from onshore areas is a $3 billion a year industry, but deposits are becoming progressively more difficult to use because of land-use restrictions, especially near large metropolitan areas where demand by the construction industry is greatest. This means that offshore production will become more attractive. Furthermore, cost of transportation is a significant factor in sand and gravel prices, and barge transportation for offshore production would be cheaper than trucking used for onshore production of sand and gravel, especially for coastal cities. Los Angeles, San Francisco, and San Diego are already experiencing shortages of sand and gravel. Promising deposits are located off Imperial Beach, Calif., in close proximity to the Los Angeles and San Diego markets, and near Grays Harbor off central Washington, close to the Seattle and Portland markets.

– USGS news release

USGS publishes data and results of Klamath Falls geothermal study

A study of the geothermal resource at Klamath Falls, Oregon, by the U.S. Geological Survey (USGS), the Oregon Institute of Technology, Lawrence Berkeley Laboratory, and Stanford University has shown that thermal water occurs in an extensive, heterogeneous aquifer beneath an area of nearly 2 mi^2 at depths of a few hundred to nearly 2,000 ft. Highest temperatures measured in wells are more than 130° C. Chemical and isotopic analyses suggest that the aquifer water is a mixture of water derived from rain and snow that has low concentrations of chloride and silica and thermal water from a deep source with a temperature of about 190° C and moderately high concentrations of chloride and silica. The thermal water enters the shallow aquifer through a fault zone on the northeast border of Klamath Falls. The water spreads southwestward in the aquifer, losing heat as it moves, to supply more than 450 wells that tap the aquifer for space heating in homes and businesses.

The results of the study have now been published in USGS Water-Resources Investigation Report 84-4216, *Analysis and Interpretation of Data Obtained in Tests of the Geothermal Aquifer at Klamath Falls, Oregon*, edited by E.A. Sammel. Data collected during the summer of 1983 specifically for the aquifer test have been published in graphical and tabular form in USGS Open-File Report 84-146, *Data from Pumping and Injection Tests and Chemical Sampling in the Geothermal Aquifer at Klamath Falls, Oregon*, by S.M. Benson and others. Both reports are on file at the Oregon Department of Geology and Mineral Industries, 1005 State Office Building, 1400 SW Fifth Avenue, Portland, OR 97201. Copies may be purchased from the Open-File Services Section, U.S. Geological Survey, Western Branch of Distribution, P.O. Box 25425, Federal Center, Denver, CO 80225. Paper copy price for the Water-Resources Investigation Report is $22, for the Open-File Report $14.25. Microfiche copies of both reports are available for $3.50 each. All orders require prepayment.

– USGS news releases

Metals and Minerals Conference announced

The 1985 Pacific Northwest Metals and Minerals Conference will be held April 25-27 at the Davenport Hotel in Spokane, Washington. The theme for the conference is "Recovery '85." More information regarding the program and registration can be obtained from registration chairman Jim Spear, U.S. Bureau of Mines, East 360 Third Street, Spokane, WA 99202. □

In memoriam: Laurie L. Hoagland, 1897–1984

The Oregon Department of Geology and Mineral Industries mourns the death of Laurie L. Hoagland ("Hoagie"), former chemist and assayer of the Department, who passed away shortly before his 87th birthday.

Laurie L. Hoagland

Hoagland had served the Department faithfully and ably for 25 years, before he retired in 1967. He had joined the Department staff when he moved to Portland in 1943, after working for 10 years with the C&H Sugar Company in Crockett, California. He was a member of the American Chemical Society and the American Institute of Mining Engineers.

Surviving are his wife, Winnie, three sons, seven grandchildren, and three great-grandchildren. □

GSOC meetings announced

The Geological Society of the Oregon Country (GSOC) holds noon luncheon meetings in the Standard Plaza Building, 1100 SW Sixth Ave., Portland, Oregon, in Room A adjacent to the third floor cafeteria, and evening lectures (8 p.m.) at Portland State University, Room 371, Cramer Hall. Upcoming meetings, topics, and speakers are:

October 19 (luncheon) – *The 1984 President's Golden Anniversary Campout*. Slide review by Clair Stahl, Virgil Scott, Don Parks, William Kennedy, Dr. Ruth Keen, Phyllis Bonebrake, and Effie Hall. Exhibit of indigenous rocks in campout area of Lewiston, Idaho: Obersons, Bonebrakes, Parks, and others.

October 26 (lecture) – *A Geological and Scenic Look at New Zealand*, Dr. Robert S. Yeats, professor and chairman of geology at Oregon State University.

November 2 (luncheon) – *Trout Creek Mountains: A Proposed BLM Wilderness Area*, by Minda S. Craig, BLM wilderness coordinator for the Portland Audubon Society.

November 9 (lecture) – *Oil and Gas Potential in the Northwest*, by Dr. Tom Benson, professor of geology, Portland State University.

November 16 (luncheon) – *An Elderhostel at Hancock Field Station*, by Donald D. Barr, instructor and naturalist.

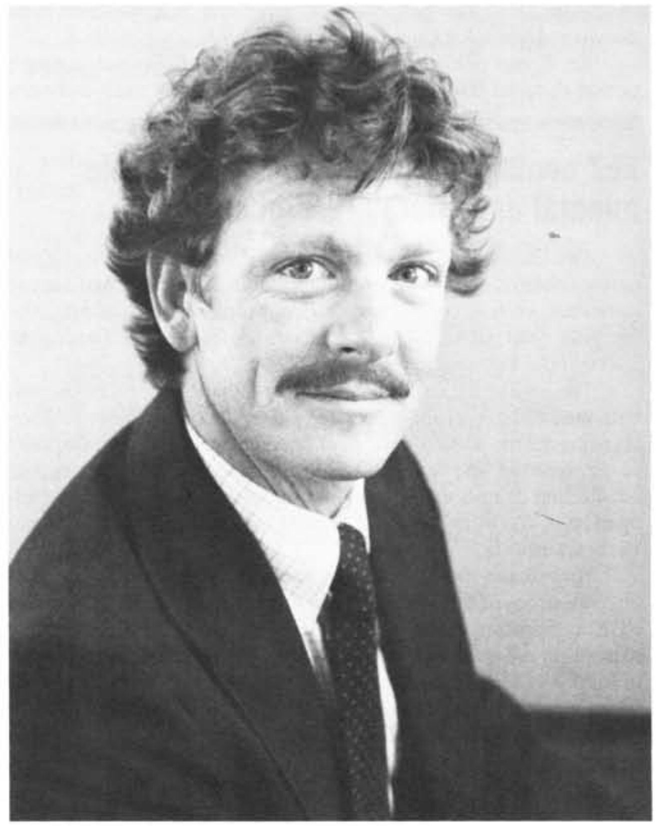
December 7 (luncheon) – *Basic Principles I've Found in Strange Places*, by Dr. John Eliot Allen, professor emeritus of geology, Portland State University.

December 14 (lecture) – *Natural History of Sandy River Gorge*, by Tom McAllister, sports outdoor writer for *The Oregonian*.

For additional information about the lectures or luncheons, contact Viola L. Oberson, GSOC president, phone (503) 282-3685.

McMurray becomes Marine Minerals Program Coordinator

Gregory McMurray joined the staff of the Oregon Department of Geology and Mineral Industries as Marine Minerals Program Coordinator on September 10, 1984. His duties include the coordination of activities of the Oregon members of the Gorda Ridge Working Group, the preparation and management of contracts with non-Department groups that are analyzing the economic and environmental impacts of offshore mineral resource exploration and development, the compilation of scientific information, the monitoring of current marine research, and other related tasks.



Gregory McMurray

A biological oceanographer, McMurray received his bachelor's degree in zoology from Ohio University, his master's degree in biology (limnology) from the University of Akron, and his doctor's degree in oceanography from Oregon State University. He was most recently on the staff of VTN Oregon, Inc., where he was a project manager and principal investigator for physical, chemical, and biological oceanographic studies of the Pacific coast estuaries and fjords. His data collection and analysis included hydrography, water chemistry, and the ecology of phytoplankton, zooplankton, ichthyoplankton, and micronekton. He spent a year with the U.S. Geological Survey, studying the phytoplankton ecology of San Francisco Bay and the lower Sacramento River. He has also served as a consultant for ARAMCO, conducting a study of periphyton community structure related to distance from outfalls near Ras Tanura Refinery in Saudi Arabia.

McMurray is author and coauthor of numerous papers and reports based on his biological studies in Alaska, California, Oregon, and Ohio. He has also been the recipient of a travel grant to New Zealand, where he attended and addressed the Fifteenth Pacific Science Congress in 1983. □

AVAILABLE DEPARTMENT PUBLICATIONS

GEOLOGICAL MAP SERIES

	Publication	Price	No. copies	Amount
GMS-4:	Oregon gravity maps, onshore and offshore. 1967	$ 3.00		
GMS-5:	Geologic map, Powers 15-minute quadrangle, Coos and Curry Counties. 1971	3.00		
GMS-6:	Preliminary report on geology of part of Snake River canyon. 1974	6.50		
GMS-8:	Complete Bouguer gravity anomaly map, central Cascade Mountain Range, Oregon. 1978	3.00		
GMS-9:	Total-field aeromagnetic anomaly map, central Cascade Mountain Range, Oregon. 1978	3.00		
GMS-10:	Low- to intermediate-temperature thermal springs and wells in Oregon. 1978	3.00		
GMS-12:	Geologic map of the Oregon part of the Mineral 15-minute quadrangle, Baker County. 1978	3.00		
GMS-13:	Geologic map, Huntington and part of Olds Ferry 15-minute quadrangles, Baker and Malheur Counties. 1979	3.00		
GMS-14:	Index to published geologic mapping in Oregon, 1898-1979. 1981	7.00		
GMS-15:	Free-air gravity anomaly map and complete Bouguer gravity anomaly map, north Cascades, Oregon. 1981	3.00		
GMS-16:	Free-air gravity anomaly map and complete Bouguer gravity anomaly map, south Cascades, Oregon. 1981	3.00		
GMS-17:	Total-field aeromagnetic anomaly map, south Cascades, Oregon. 1981	3.00		
GMS-18:	Geology of Rickreall, Salem West, Monmouth, and Sidney 7½-minute quads., Marion/Polk Counties. 1981	5.00		
GMS-19:	Geology and gold deposits map, Bourne 7½-minute quadrangle, Baker County. 1982	5.00		
GMS-20:	Map showing geology and geothermal resources, southern half, Burns 15-minute quad., Harney County. 1982	5.00		
GMS-21:	Geology and geothermal resources map, Vale East 7½-minute quadrangle, Malheur County. 1982	5.00		
GMS-22:	Geology and mineral resources map, Mount Ireland 7½-minute quadrangle, Baker/Grant Counties. 1982	5.00		
GMS-23:	Geologic map, Sheridan 7½-minute quadrangle, Polk/Yamhill Counties. 1982	5.00		
GMS-24:	Geologic map, Grand Ronde 7½-minute quadrangle, Polk/Yamhill Counties. 1982	5.00		
GMS-25:	Geology and gold deposits map, Granite 7½-minute quadrangle, Grant County. 1982	5.00		
GMS-26:	Residual gravity maps, northern, central, and southern Oregon Cascades. 1982	5.00		
GMS-27:	Geologic and neotectonic evaluation of north-central Oregon: The Dalles 1°×2° quadrangle. 1982	6.00		
GMS-28:	Geology and gold deposits map, Greenhorn 7½-minute quadrangle, Baker/Grant Counties. 1983	5.00		
GMS-29:	Geology and gold deposits map, NE¼ Bates 15-minute quadrangle, Baker/Grant Counties. 1983	5.00		
GMS-31:	Geology and gold deposits map, NW¼ Bates 15-minute quadrangle, Grant County. 1984	5.00		
GMS-32:	Geologic map, Wilhoit 7½-minute quadrangle, Clackamas/Marion Counties. 1984	4.00		
NEW! GMS-33:	Geologic map, Scotts Mills 7½-minute quadrangle, Clackamas/Marion Counties. 1984	4.00		

OTHER MAPS

Publication	Price	No. copies	Amount
Reconnaissance geologic map, Lebanon 15-minute quadrangle, Linn/Marion Counties. 1956	3.00		
Geologic map, Bend 30-minute quad., and reconnaissance geologic map, central Oregon High Cascades. 1957	3.00		
Geologic map of Oregon west of 121st meridian (U.S. Geological Survey Map I-325). 1961	5.50		
Geologic map of Oregon east of 121st meridian (U.S. Geological Survey Map I-902). 1977	5.50		
Landforms of Oregon (relief map, 17×12 in.)	1.00		
Oregon Landsat mosaic map (published by ERSAL, OSU). 1983	$8.00 over the counter; $11.00 mailed		
Geothermal resources of Oregon (map published by NOAA). 1982	3.00		
Geological highway map, Pacific Northwest region, Oregon/Washington/part of Idaho (published by AAPG). 1973	5.00		

BULLETINS

	Publication	Price	No. copies	Amount
33.	Bibliography of geology and mineral resources of Oregon (1st supplement, 1937-45). 1947	3.00		
35.	Geology of the Dallas and Valsetz 15-minute quadrangles, Polk County (map only). Revised 1964	3.00		
36.	Papers on foraminifera from the Tertiary (v.2 [parts VI-VIII] only). 1949	3.00		
44.	Bibliography of geology and mineral resources of Oregon (2nd supplement, 1946-50). 1953	3.00		
46.	Ferruginous bauxite deposits, Salem Hills, Marion County. 1956	3.00		
49.	Lode mines, Granite mining district, Grant County. 1959	3.00		
53.	Bibliography of geology and mineral resources of Oregon (3rd supplement, 1951-55). 1962	3.00		
61.	Gold and silver in Oregon. 1968	17.50		
62.	Andesite Conference guidebook. 1968	3.50		
65.	Proceedings of the Andesite Conference. 1969	10.00		
67.	Bibliography of geology and mineral resources of Oregon (4th supplement, 1956-60). 1970	3.00		
71.	Geology of selected lava tubes, Bend area, Deschutes County. 1971	5.00		
77.	Geologic field trips in northern Oregon and southern Washington. 1973	5.00		
78.	Bibliography of geology and mineral resources of Oregon (5th supplement, 1961-70). 1973	3.00		
81.	Environmental geology of Lincoln County. 1973	9.00		
82.	Geologic hazards of Bull Run Watershed, Multnomah and Clackamas Counties. 1974	6.50		
83.	Eocene stratigraphy of southwestern Oregon. 1974	4.00		
84.	Environmental geology of western Linn County. 1974	9.00		
85.	Environmental geology of coastal Lane County. 1974	9.00		
87.	Environmental geology of western Coos and Douglas Counties. 1975	9.00		
88.	Geology and mineral resources, upper Chetco River drainage, Curry and Josephine Counties. 1975	4.00		
89.	Geology and mineral resources of Deschutes County. 1976	6.50		
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