

OREGON GEOLOGY

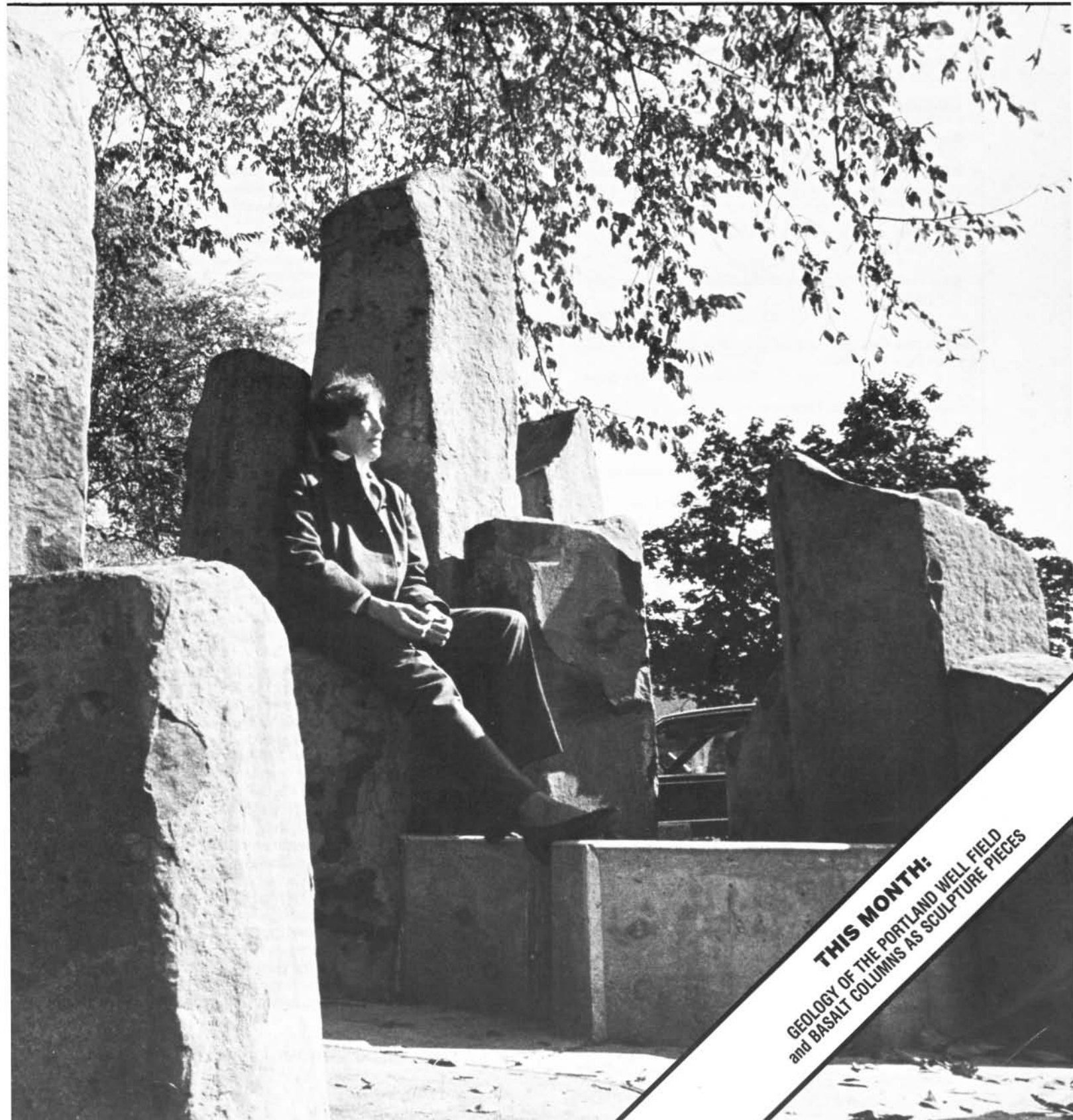
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THIS MONTH:
GEOLOGY OF THE PORTLAND WELL FIELD
and BASALT COLUMNS AS SCULPTURE PIECES

OREGON GEOLOGY

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COVER PHOTO

Basalt columns from the Eugene, Oregon, area compose this sculpture in a Corvallis, Oregon, park. The intended practical use of the sculpture is demonstrated here by Corvallis art historian Marie Louise Martignoni. See related article beginning on page 68. (Photo courtesy John Bragg, *Corvallis Gazette-Times*)

To our readers

Many thanks to the over 300 of you who responded to the questionnaire in the April issue of *Oregon Geology*. Your willingness to spend your time and a 20¢ stamp to share your ideas about *Oregon Geology* with us warmed our hearts.

When the questionnaires have been completely tabulated, we will share the results with you. We are about a third of the way through the tabulation, and we have already learned that you are an interesting group filled with all sorts of good ideas. One theme runs through all your comments—you want to learn as much as you can about some or all aspects of the geology of Oregon. We appreciate that desire, and we will try to pack as much as we can into each issue of *Oregon Geology*.

Many of you indicated your understanding of the problem of satisfying both technical and nontechnical audiences in one magazine. You had some good suggestions on ways to do that, and we will try to implement those ideas as the months go by. We try to maintain a balance of technical and nontechnical material in *Oregon Geology*, and as many of our feature articles and announcements come from you, our readers, we invite authors of both types of articles to submit their work to us.

As always, we invite letters, comments, papers, phone calls—any type of communication from you. *Oregon Geology* is your magazine, and we want it to meet your needs. We want it to be a clearing house of geologic information about the state of Oregon, and we need your help for that. □

New geologic map of eastern Oregon gold-mining country released

A new geologic map of the northwest portion of the Bates 15-minute quadrangle in eastern Oregon has just been published by the Oregon Department of Geology and Mineral Industries (DOGAMI). The new map, *Geology and Gold Deposits Map of the Northwest Quarter of the Bates Quadrangle, Baker and Grant Counties, Oregon*, by Mark L. Ferns, Howard C. Brooks, and Greg R. Wheeler, has been released as Map GMS-31 in DOGAMI's Geological Map Series.

This new map is the latest eastern Oregon gold-country geologic map produced by DOGAMI in cooperation with and funded in part by the U.S. Forest Service. Earlier maps of this series, which are also available from DOGAMI, include the Bullrun Rock, Rastus Mountain, Bourne, Mount Ireland, Granite, and Greenhorn 7½-minute quadrangles and the Mineral, Huntington, Olds Ferry, and the northeast portion of the Bates 15-minute quadrangles.

The four-color geologic map of the Bates NW quadrangle is at a scale of 1:24,000. It shows sedimentary, volcanic, and metamorphic geologic units that were deposited or formed over a period of time extending from the present day back to the pre-Permian (more than 280 million years ago). The geology of this area is very complex, and two cross sections are included to show the relationships of the 14 geologic units presented on the map.

Parts of this area have been mineralized, and the map area includes the former New Eldorado mining district. The map shows the locations of numerous mines, prospects, and quartz veins. Also included on the map sheet are one data table of mines and prospects, one table with chemical analyses of rock samples, a discussion of the mineral deposits in this portion of the quadrangle, and a list of references about the area.

The new map, GMS-31, is now available at the Oregon Department of Geology and Mineral Industries, 1005 State Office Building, 1400 SW Fifth Avenue, Portland, OR 97201. The purchase price is \$5. Orders under \$50 require pre-payment. □

Geology of the Portland Well Field

by W.H. Hoffstetter, Portland Water Bureau, 1120 SW 5th Ave., Portland, OR 97204

INTRODUCTION

The Portland Well Field (Figure 1) is one of the nation's largest ground-water development programs. It is designed to provide emergency water in case something happens to the Bull Run Watershed, the current major source of water, and to meet peak demand for water during periods of heavy usage. Water-right applications have been filed for over forty production wells with a combined yield of over 150 million gallons per day. Twenty production wells have been constructed with capacities ranging from 1,000 to 10,000 gpm (gallons per minute), producing from fluvial-lacustrine aquifers 100 to 600 ft below ground level. The water rights are being obtained by several municipal suppliers including the Portland Water Bureau, the Parkrose Water District, and the Rockwood Water District. The water will be used for both residential and industrial purposes.

The well field is located in east Portland along the ancestral Columbia River flood plain between the Portland Airport and Blue Lake Park. The area is generally below 30 ft in elevation and contains several sloughs and lakes. Aquifers being developed consist of alluvium with particle sizes of fine sand to coarse gravel with boulders. The ages of the deposits range from Miocene to Recent. Transmissivities range from 20,000 to over 1 million gpd/ft (gallons per day per foot).

The water quality has proven to be good for the intended use. Specific conductivities are mostly from 150 to 400 μ ohms/cm, with calcium, silica, sodium, magnesium, and potassium as the dominant ions. The ground water reportedly has a very good taste.

Geologic and geophysical logging, combined with hydraulic testing, have allowed delineation of the sedimentary deposits. Prior

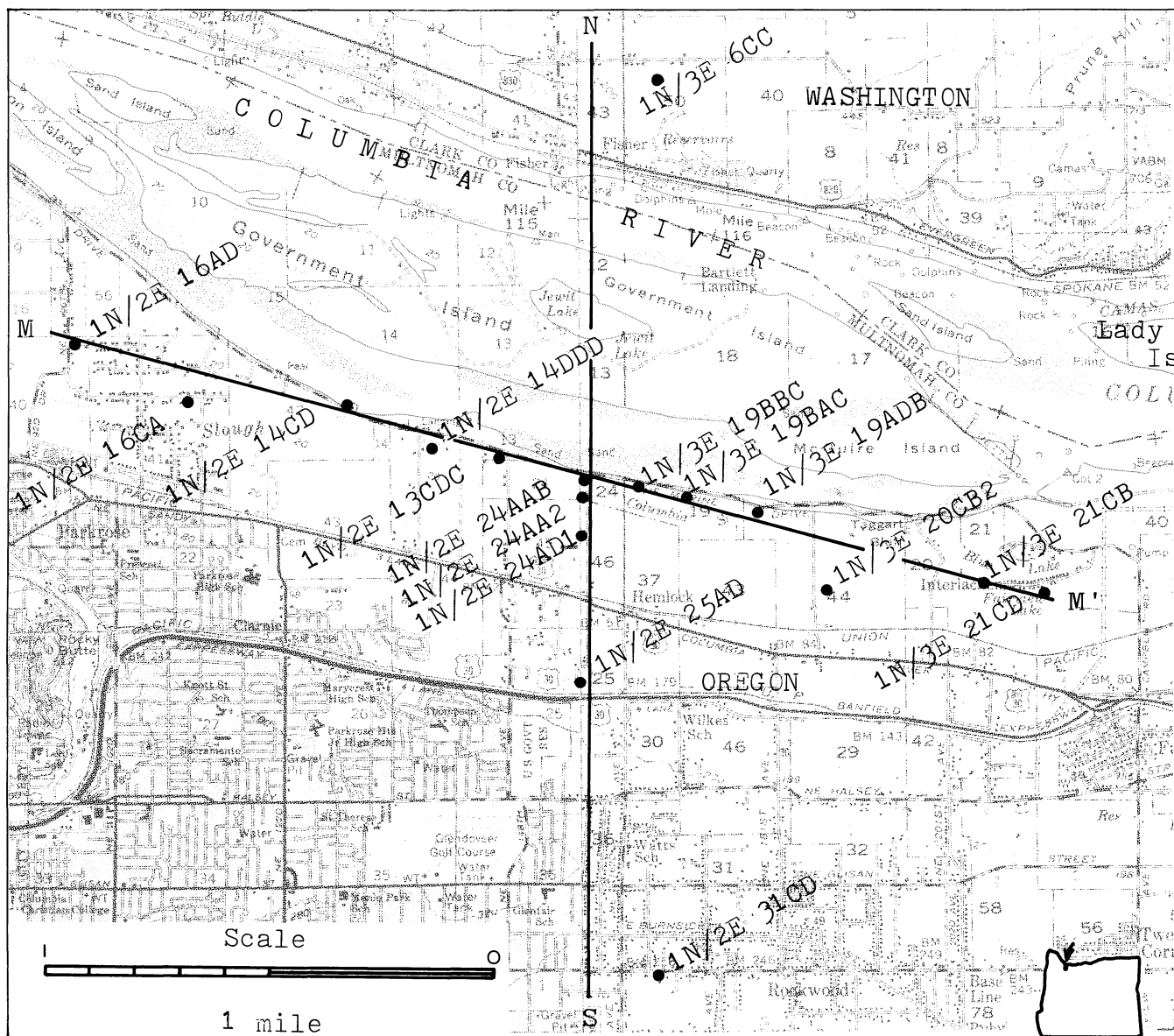


Figure 1. Map showing well locations in the Portland Well Field. Cross sections M-M' and N-S are shown in Figure 3.

to the construction of the well field, a geologic study of the north-east Portland area was completed by Robert Willis and Diane Parth for the Portland Water Bureau exploratory well study (Willis, 1977). Results of this study indicated that the best potential for production wells existed along the ancestral flood plain of the Columbia River. Eleven pilot wells were drilled and test-pumped by the Portland Water Bureau. Detailed cross sections and a geologic study were made by this writer and included in the Portland Water Bureau's pilot well study (Willis, 1979). The cross sections and geology contained in this report include results of more recent well-drilling and test-pumping programs.

WELL-FIELD GEOLOGY

Older bedrock units in the east Portland area consist of Miocene Columbia River Basalt Group flows and Eocene Skamania Volcanics (Figure 2). The Skamania Volcanics crop out on Lady Island to the east of the well field. Although Columbia River basalt has been interpreted to underlie the well field at depth, drilling has reached a depth of over 1,100 ft below mean sea level (MSL) in the well field without encountering any of the flows. The basalt probably underlies the area at a greater depth, unless it is not present due to erosion or initial exclusion from this area. During the deposition of the basalt, a topographic high of Skamania Volcanics which may have existed in the north part of the well-field area could have caused the flood basalts to flow around it to the south. By the end of Columbia River basalt deposition in the Portland area (about 14 million years ago), the topography of the east Portland area probably consisted of a small range of Skamania Volcanics to the north surrounded by a plain of Columbia River basalt. Because of the lack of deep drilling in the Portland Basin, the actual contact between the Skamania Volcanics and the Columbia River basalt has not been located. The contact could be as far north as the Columbia River or slightly farther to the south. The Ladd well (circa 1885, located several miles to the west of the well field) encountered a unit at 1,100 ft below MSL that was originally logged as solid granite. This unit has been interpreted subsequently to be Columbia River basalt and is the basis for Trimble's (1963) cross section of the Portland Basin.

During or after the deposition of the Columbia River basalt, a basin was formed in the Portland area. The basin is structural in origin but could have been locally deepened by erosion along the contact between the basalt and the less competent Skamania Volcanics. The depth of the basin is unknown but is at least 1,100 ft, based on the Ladd well located near SE 39th and Glisan (Hodge, 1938) and on the Portland Water Bureau exploratory well near NE 185th and Marine Drive.

The Portland Basin was filled by fluvial-lacustrine deposits and local lava flows during the Miocene and Pliocene. These deposits, in order of deposition, are the Sandy River Mudstone, the Troutdale Formation, and the Boring Lavas. The sedimentary deposition filled the basin to an elevation of about 700 ft, based on erosional remnants including Mount Tabor, Rocky Butte, and Powell Butte (Allen, 1975).

Erosional forces took control once again in the late Pliocene or early Pleistocene. Much of the Troutdale Formation deposits was removed to an elevation of roughly 100 to 200 ft above present sea level (Mundorff, 1959). Erosion and deposition alternated in the basin as the base level rose and fell during the Pleistocene.

Boring Lava eruptions continued into the Pleistocene, producing numerous volcanic vents and lava flows in the eastern portion of the Portland Basin (Allen, 1975). The lava flows also contributed hyaloclastic material that formed the numerous vitric sand beds in the well field. The Boring Lava flows resisted later erosion and contributed to the formation of the buttes and hills in the eastern portion of the basin. Boring intrusions are associated with these buttes in east Portland. Beeson and Nelson (1979) suggested that geothermal convection within the Troutdale Formation around

these vents caused solution and precipitation of silica in the Troutdale Formation, making the vent areas more resistant to erosion.

The most recent episode of erosion and deposition is illustrated by logs of several wells located near the east end of the Portland Airport. These wells encountered a Fraser Glaciation river valley that had been eroded to 300 ft below MSL approximately 15,000 years ago and then had been filled with sand as the sea level rose during the Holocene.

Alluvium	Recent to upper Pleistocene
Boring Lava	Pleistocene to Pliocene
Troutdale Formation.	Pleistocene to Miocene
Sandy River Mudstone	Pliocene to Miocene
Columbia River Basalt Grp.	Miocene
Skamania Volcanics	Eocene

Figure 2. Major geologic units found in the Portland Well Field and vicinity. Several of these units are subdivided in the text.

The present river geography is similar to that found by the Lewis and Clark expedition and other early explorers. The main channel of the river is controlled to some extent by bed rock in the area to the east of NE 185th Avenue. Resistant beds of the Troutdale Formation and coarse gravel and boulders of the Blue Lake aquifer force the main channel of the river to the northwest near Blue Lake Park. The river is entrenched between outcrops of the Skamania Volcanics near Washougal, Washington. In the study area, the Columbia River is presently an aggrading stream, and tidal fluctuations are measurable in the river adjacent to the well field.

Cross sections and outcrops in the well-field area (Figure 3) indicate a general southwest dip to the older units. It should be noted, however, that part of the apparent structural deformation on the cross sections may be due to normal fluvial processes such as nesting of fills. Outcrops of the Troutdale Formation which occur from Blue Lake to NE 185th Avenue show only poorly developed, wide-spaced jointing without displacement. The jointing is probably from stress release and is not of the magnitude that would indicate faulting in this locality.

GEOLOGIC UNITS

Introduction

The following geologic units were delineated in the well field on the basis of lithology, geophysical logging, and hydraulic testing. Gamma-ray logs were especially useful for differentiating units (Figure 4) and for correlating between wells.

Recent and upper Pleistocene alluvium

Younger alluvium: This unit is represented by (1) flood-plain deposits, (2) a late Pleistocene river valley that was backfilled during the Holocene, and (3) a deposit of coarse-grained fluvial deposits located to the north and east of Blue Lake.

Recent flood-plain deposits: These deposits consist of unconsolidated layers of silt, clayey silt, and sand. The thickness of these deposits is variable, but the unit generally thickens to the north from Sandy Boulevard to the Columbia River. The maximum recorded thickness is 70 ft at well 1N/3E 19BAC. The lower portion of the flood-plain deposits is probably related to the Columbia River sands group as described by Willis (1979).

Columbia River sands aquifer (CRSA): This unit that fills a Pleistocene Columbia River valley is composed of late Pleistocene and Holocene sand. The aquifer was previously considered to be

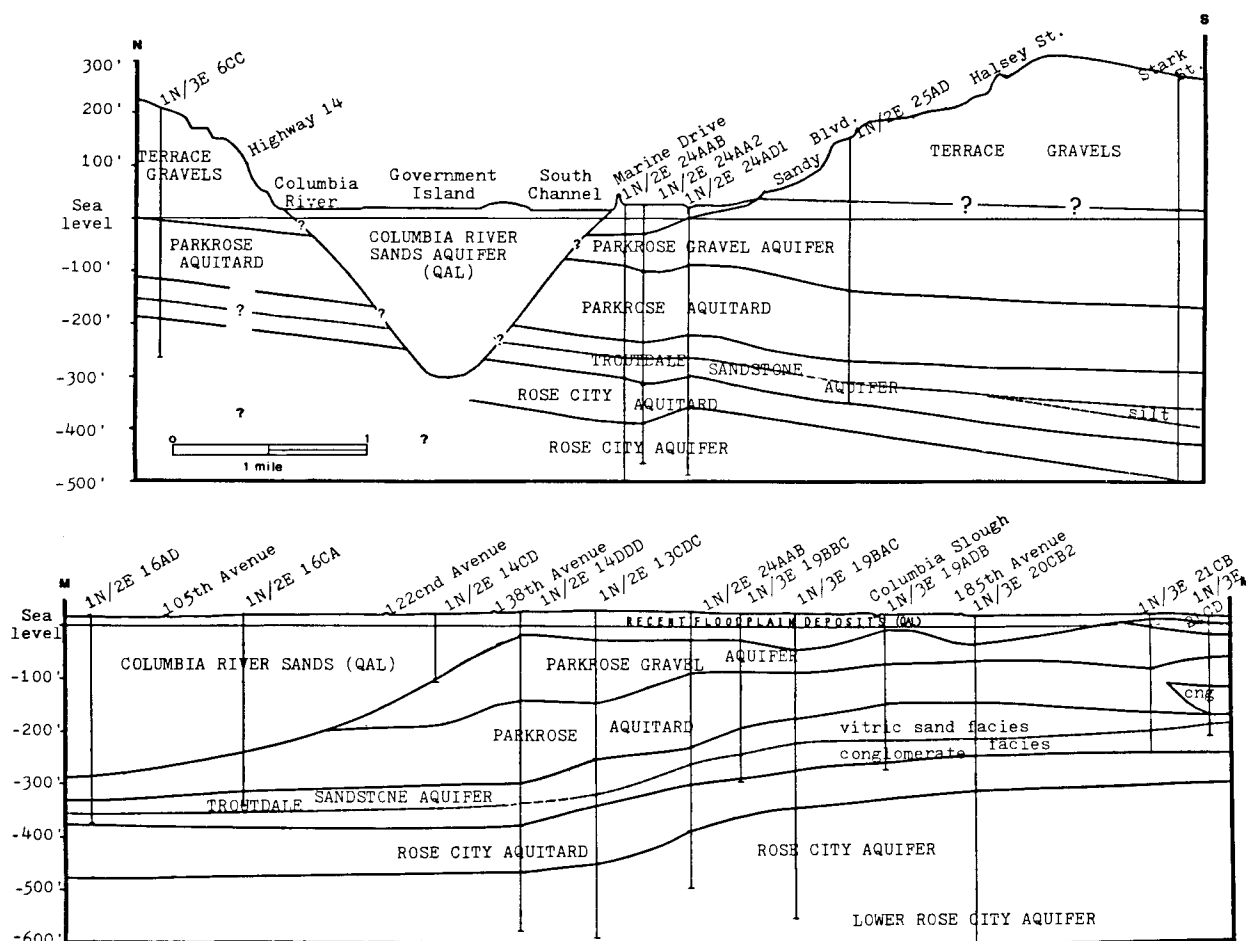


Figure 3. Cross sections N-S and M-M' of the Portland Well Field. Locations of cross-section lines are shown in Figure 1. The unmarked well on the right side of N-S line is well 1N/2E 31CD.

approximately 200 ft thick (Hogenson and Foxworthy, 1965). However, a Portland Water Bureau pilot well (1N/2E 15BC) encountered a thickness of approximately 300 ft. The elevation of the bottom of the CRSA in this well is about 300 ft below MSL, which correlates well with the elevations of Fraser Glaciation erosional valleys along coastlines in other areas (Milliman and Emery, 1968). The CRSA consists of medium sand, with occasional layers of silt, clay, and gravelly zones. The sand is quartzose in composition, and the gravel is basalt, andesite, dacite, and quartzite. A carbon-14 age for a wood sample from Portland Water Bureau well 1N/2E 15BC, depth 200-300 ft, was $8,910 \pm 115$ years (Willis, 1979).

Blue Lake aquifer: This coarse-grained fluvial deposit contains mostly coarse gravel with some cobbles and boulders. The large grain sizes in the aquifer, combined with the lack of cementing and matrix material, provide a very high permeability, and several wells with yields of up to 10,000 gpm are planned. The thickness of the aquifer increases to the north from Blue Lake to the Columbia River, with a maximum recorded thickness of about 200 ft. The Blue Lake aquifer deposits are distinguishable from older deposits by higher percentages of clasts from the High Cascades, the lack of cementation, and the absence of the thin secondary mineralization present on older clasts. An aquifer of similar composition to the Blue Lake aquifer is used extensively by the Crown Zellerbach paper mill in the Camas-Washougal, Washington, area (Hoffstetter, 1981).

Parkrose gravel aquifer (PGA): This unit consists of a thick layer of coarse-grained fluvial deposits. The unit underlies most of

the well field area to the east of NE 122nd Avenue. In the vicinity of the Portland airport, the PGA has been partially to entirely eroded by the Pleistocene Columbia River. The PGA generally thickens from east to west, with the maximum thickness of 125 ft recorded at Portland Water Bureau well 11(1N/2E 14DDD). The aquifer consists of coarse sand and gravel, with zones containing cobbles and boulders. A silty matrix which is present in some areas severely limits the amount of water obtainable from some wells. In other areas, the gravels are open and yield several thousand gallons per minute. The lower portion of the aquifer is commonly partially cemented, and the clasts are similar to those of the Pleistocene terrace gravels. The upper portion of the aquifer has been reworked locally by the Columbia River, and numerous clasts of High Cascade composition occur in some of the reworked gravels.

Troutdale Formation (Miocene-Pleistocene)

Introduction: The Troutdale Formation in the well field consists of Pleistocene, Pliocene, and upper Miocene fluvial-lacustrine deposits of partially cemented sand, sandstone, and conglomerate, with indurated silts and clays. The formation underlies Recent and upper Pleistocene deposits throughout the study area. Two major aquifers and two major aquitards (semiconfining units of low permeability) have been delineated within the Troutdale Formation. The maximum thickness of this sequence in the well field is over 600 ft.

This sequence is identified as part of the Troutdale Formation because of the presence of basalt and quartzite gravels and clasts of vitric composition, the partial cementation, and the low percentage of High Cascade andesite-dacite clasts. Carbon-14 dates show well-

field samples from the units identified as Troutdale Formation to be over 40,000 years old, which is the age limit for carbon-14 dating. No fossil correlations have been attempted in the well-field area, and there is some controversy about whether or not the sediments may be younger than the Troutdale Formation. This controversy stems from the fact that the well samples appear less weathered and

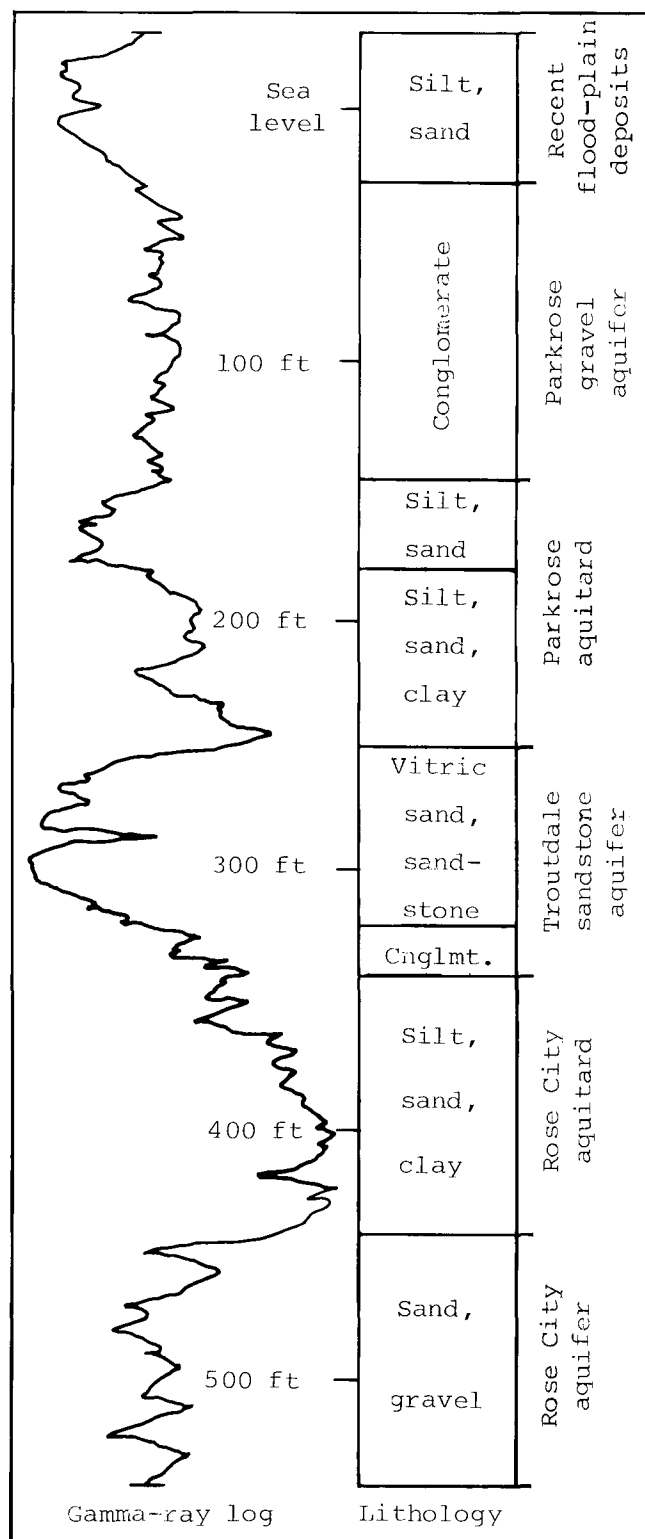


Figure 4. Typical lithologic section located near NE 148th Avenue and Marine Drive.

do not have the yellowish matrix typical of Troutdale Formation outcrops. The absence of the yellowish matrix is possibly caused by the relative reducing environment in the wells as compared to the oxidizing environment at outcrops.

There is some question about the distinction between Troutdale Formation, Sandy River Mudstone, and younger deposits. Hodge (1938) believed that micaceous sands found in the Ladd well near SE 39th Avenue and Glisan Street indicated that the sequence was post-Troutdale because, as he stated, "Micaceous sands are not found in the Troutdale Formation but are characteristic of the present load of the Columbia River." Trimble (1963) determined that the sequence in this well represented Troutdale Formation underlain by Sandy River Mudstone, with the micaceous sand belonging to the Sandy River Mudstone. Tolan and Beeson (1984) reported micaceous arkosic sands in what they termed the lower member of the Troutdale Formation.

The findings from the well drilling possibly correlate with Tolan and Beeson's (1984) interpretation. That is, the units that are identified as the upper Troutdale Formation contain sand of mostly vitric, basalt-andesite, and quartzite composition, while the lower Troutdale Formation contains mostly micaceous quartzose or arkosic sand. Basalt and quartzite gravels were found in Portland Water Bureau well 1N/3E 20CB2 to a depth of over 1,000 ft below MSL. These findings indicate a possible maximum thickness of over 1,500 ft of Troutdale Formation in the Portland Basin.

The gravels in the well-field samples identified as Troutdale Formation are different from younger gravels in that they have a low percentage of dacite-andesite clasts of the High Cascade composition.

Troutdale sandstone aquifer (TSA): This unit is a relatively uniform deposit of fluvial conglomerate and fluvial-lacustrine vitric sand and sandstone that probably extends throughout a large portion of the basin. The wells proposed for the TSA have yields of 1,000 to 2,000 gpm. Thickness of the TSA varies from 70 to 140 ft, with the lower third of the unit typically consisting of conglomerate and the upper two-thirds consisting of vitric sand and sandstone. Roughly at the midpoint vertically in the aquifer is a thin layer of silt that shows distinctly in gamma-ray logs. This bed separates the aquifer in depositional mode; the vitric sand and sandstone layer above the silt represents a fluvial-lacustrine hyaloclastic deposit, and the lower layer consists of a fluvial conglomerate. The vitric beds interfinger with fine-grained material of the overlying Parkrose aquitard, and it is common for well logs to show several layers of vitric sand or sandstone with silt and clay interbeds in the aquitard. The vitric beds increase in number and thickness in the lower portion of the aquitard.

The vitric beds are composed of clasts of volcanic glass and volcanic crystalline rock ranging in composition from basalt to andesite, with a minor amount of quartz, quartzite, and mica. The glass is usually relatively dense; however, a vesicular, scoriaceous material is occasionally present. Samples of the sand from boreholes typically have a thin, bluish- to greenish-gray coating. The coating is similar to that on the nonvitric basaltic clasts, and beds of over 50 percent vitric material have been passed over in geologic logging in the well field and discovered later by review of gamma logs. Cementing is highly variable. In some boreholes, the vitric material is cemented so tightly that underreaming* must be done to advance casing, while in another zone the sand may be so loose that it heaves up into the casing. The vitric clasts are believed to have originated when lava flowed into water, chilling quickly into glassy fragments that were transported and then deposited by the ancestral Columbia River and its tributaries (Trimble, 1963). An easily seen example of this process is present at an outcrop along

*Underreaming is a drilling operation done when the formation becomes so consolidated that steel casing cannot be driven through it. A special drilling bit that drills an oversize hole is used, thereby allowing the casing to be moved farther down the hole.

Interstate I-84 west of the town of Hood River, where a large volume of lava flowed into the Columbia River, forming a palagonitic tuff that was later partially eroded by the Columbia River (Waters, 1973).

The lava that formed the vitric sand in the well field is probably of early High Cascade and Boring Lava origin; analysis of samples of the vitric sand show that the chemical composition is similar to that of the Boring Lavas (Beeson, personal communication, 1983).

The conglomerate zone of the TSA is composed of basalt and quartzite gravel, with varying amounts of sand. Some cementing is usually visible on the gravel particles, and the same thin, bluish- to greenish-gray coating that occurs on the vitric sand is also present on the gravel clasts.

Although the sand is mostly well sorted and at least partially rounded, both the sorting and rounding vary from one well to another. This is believed to have been caused by variable distances to local volcanic vents contributing material to the sand. This finding is generally in agreement with the conclusions made on the origin of the vitric sand by Trimble (1963).

A wood sample from the TSA was dated by the carbon-14 method at over 40,000 years B.P.

Parkrose and Rose City aquitards: These units are composed of lenticular and interbedded zones of fine-grained, lacustrine deposits of consolidated sand, silt, and clay that act as hydraulic confining layers preventing the rapid movement of water between the Troutdale and Rose City aquifers.

The Parkrose aquitard, which ranges in thickness from about 70 to 150 ft, underlies most of the well field. Consolidation tests were run on samples from the Parkrose aquitard for the Interstate I-205 bridge foundation (CH₂M-Hill, 1979). These tests show that this unit had been previously loaded by at least an additional 700 ft of overburden. The thickness of the ancestral overburden indicates that the Parkrose aquitard was deposited prior to the time the Troutdale Formation reached its maximum thickness in the Portland Basin. The Troutdale Formation is considered to have filled the Portland Basin to a present elevation of approximately 700 ft.

The other major confining layer is the Rose City aquitard, which separates the Troutdale sandstone aquifer and the Rose City aquifer with an average of about 75 ft of consolidated silt, sand, and clay.

Rose City aquifer: This unit consists of discontinuous lenses of sand, gravel, silt, and clay. Pump tests have shown the unit to be continuous throughout the study area, but each well shows a different sequence of materials. Well yields for the Rose City aquifer range from 2,000 to 3,000 gpm.

The unit is several hundred feet thick, and the well samples generally become finer grained with depth. Various mixtures of gravel and sand usually dominate the upper 100 ft of the aquifer, while thick layers of sand with occasional silt and clay beds predominate in the lower portion of the aquifer. This deeper, finer grained portion of the aquifer is referred to as the lower Rose City aquifer.

Most of the sand in the Rose City aquifer is greenish-gray to gray and quartzose, with a minor amount of mica. Vitric sand is found in several wells completed in the Rose City aquifer, but it generally occurs in separate layers rather than being dispersed within the quartzose sand. Two wells (9 1N/3E 19BAC and 16 1N/2E 24CAC) have logs showing a large amount of vitric sand in the Rose City aquifer. Both wells are in the southern portion of the well field, and the presence of more vitric sand in the Rose City aquifer in this location could indicate a nested fill. The distinct difference between the two sands indicates that two separate sources were providing the sand, and the lack of quartzose sand in the Troutdale sandstone aquifer indicates that the source for the quartzose sand may have become unavailable or was highly diluted by vitric sand during the time of deposition of the Troutdale sandstone aquifer.

The gravel in the Rose City aquifer is similar to other gravels in the Troutdale Formation. It consists almost entirely of basalt and quartzite clasts. Some cementing is usually evident on the gravel clasts, and the thin, bluish- to greenish-gray coating is visible. A minor amount of pyrite has been found in samples from the deeper portions of the aquifer. The cementing is apparently less tight than in the Troutdale sandstone aquifer, and the zones that are predominantly sand have caused problems for the drillers because of sand heaving up into the well casing when the hydraulic head is reduced during drilling. The quartzose sand is subrounded to rounded and very well sorted. The sorting is better and more consistent than that of the vitric sand.

CONCLUSIONS

The drilling of over 40 wells in the East Portland area has provided new data on the geology of the Portland Basin and has allowed the definition of several major units. Further work defining the ages and characteristics of the Troutdale Formation, the Sandy River Mudstone, and younger units in light of these new findings will enhance our understanding of the geology of the Portland area.

ACKNOWLEDGMENTS

The writer would like to thank J.E. Allen, M.H. Beeson, L.A. Palmer, and T.L. Tolan for reviewing this paper and making many valuable comments.

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Facts your geology professor never taught you

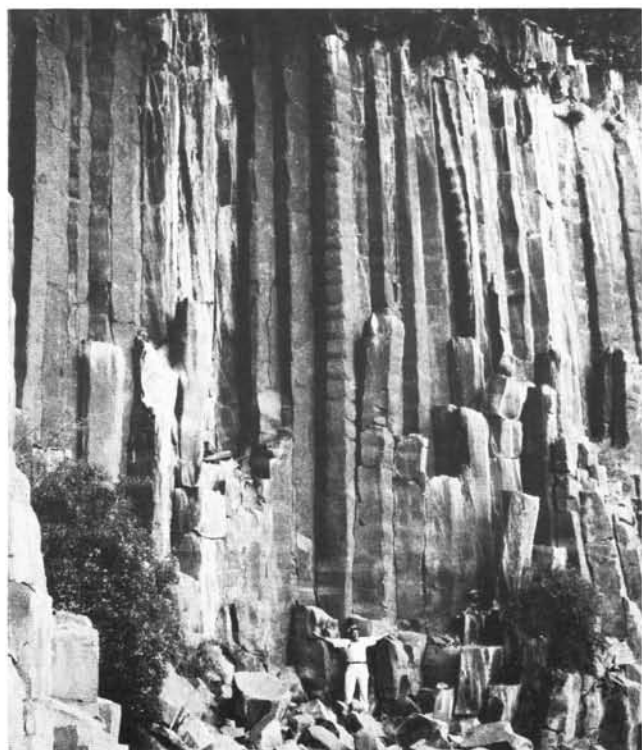
In "The Geologic Column" (*Geotimes*, August 1982), Robert L. Bates quotes a report by Edwards and Anderson of a recent industrial-minerals Congress: "Unobtainium trioxide is a 'derivative of the ore mineral bewilderite, an accessory mineral in many enigmatite bodies. It is a by-product of enigmatite mining in central Erewhon, and from the new deep-sea mining venture in the republic of Atlantis. It is, withal, a compound of rare provenance.'" □

Basalt columns as sculpture pieces

by Jim Howland, Senior Consultant, CH₂M Hill, Corvallis, Oregon



Ceremonial structure made of basalt columns, Nan Madal, Ponape Island, Micronesia.



Basalt columns in the Crooked River canyon above Prineville, Crook County.

It is a long way, both geographically and culturally, from a prehistoric ceremonial structure on the island of Ponape (Micronesia), far out in the western Pacific, to a park sculpture on Madison Avenue in Corvallis, Oregon. Yet, there is a connection: they are both made of long, narrow basalt columns that form when basaltic magma cools undisturbed and under just the right conditions. And from the Ponape structures came the idea for the Oregon application.

The prehistoric natives on Ponape built islands in a large



Basalt columns beside the North Umpqua River at the Soda Springs Powerhouse, Douglas County.



Basalt column arrangement at SW 8th and Madison, Corvallis, Oregon, under construction.

lagoon formed by coral reefs. First, they filled protective rings of basalt columns with coral and dirt. On top of the fill, they created massive walls by laying up crisscrossed stacks of columns. Legend has it that the stones were transported from the main island to the construction sites by a great chief who flew there with a column under each arm.

My wife and I, with the help of former State Geologist Ralph S. Mason, searched Oregon for suitable columns that could be obtained reasonably and transported to Corvallis. We found beautiful specimens along the North Umpqua River, near the Soda Springs powerhouse, also in the Crooked River canyon above Prineville, and at Skinner Butte Park in Eugene. The columns we found ranged in thickness from a few inches in a roadside quarry above Hills Creek Dam (near Oakridge in Lane County) to several feet in the Crooked River canyon. However, these stones were not available for a variety of reasons. At Hills Creek, the columns were cemented together with quartz and thus could not be removed as columns. Many of the columns found in various locations were



Designers and builders pose on the finished basalt column sculpture in Corvallis, Oregon.

fractured every few feet.

Finally, in the spring of 1983, easily available stones were located practically in our backyard, in the S.J. Quam quarry on West 11th Street in Eugene. With a source of columns located, Corvallis landscape architect John Stewart designed and supervised the construction of a small plaza featuring groupings of columns.

The columns are set in a concrete base, with a concrete seat formed in among them. On nice days, there is generally at least one person sitting by the columns. During events in the park, the stones provide elevated seating for numerous spectators.

In the Eugene area, short sections of basalt columns were used as slope paving for an early water reservoir that is still in use on Skinner Butte. Entrance stones to the rhododendron garden in Hendricks Park are basalt columns, as are a number of sign supports and building number displays in Eugene. Basalt columns were used to form water falls at the Spokane World's Fair in 1974. Perhaps the time has come when we will see more use of these distinctive natural shapes in construction and art pieces. □

Summer geology to be presented at the OSU Marine Science Center in Newport, Oregon

Oregon State University's Hatfield Marine Science Center at Newport is offering the following geology presentations and courses in its summer program this year.

Workshops—On July 20 and 21, Guy Rooth, geologist, Western Oregon State College, will conduct a class on coastal fossils. On July 23, 24, and 25, Clara Jarman, Corvallis geologist, will hold a workshop on rock identification.

Van trips—Don Giles, OSU Extension marine education specialist, will lead six one-day tours to survey the natural history and geology of the central Oregon coast. The dates are July 5, 17, and 26 and August 2, 14, and 21.

Talks—On July 11, Bob Bailey, Oregon Land Conservation and Development will speak on "Gorda Ridge—Mining Off Oregon's Coast?". On July 18, Don Hunter, Eugene audiovisual specialist, will present a multimedia show, "The Volcanic Cascades." On August 29, Paul Komar, OSU oceanographer, will present a talk entitled "Coastal Erosion—What to Look For". The talks are free and are presented at 7:00 p.m. on Wednesday evenings in the Hatfield Marine Science Center Auditorium.

The workshops and trips are available for a fee, and space must be reserved. For additional course descriptions, registrations, and further information on the Marine Science Center's summer program, call (503) 867-3011. □

British research ship to visit Coos Bay

The British research ship *Farnella* is due to dock in Coos Bay, Oregon, Monday, July 9, and leave again Wednesday, July 11, for the last leg of its cruise along the West Coast in a joint British-U.S. project called EEZ-SCAN.

EEZ-SCAN is the name of a three-month project of the U.S. Geological Survey (USGS) and the British Institute of Oceanographic Sciences (IOS). It involves sonar scanning of offshore West Coast parts of the Exclusive Economic Zone (EEZ) established last year by presidential proclamation (see related report in this year's February issue of *Oregon Geology*). EEZ-SCAN is the first step in the systematic and comprehensive study and exploration of the EEZ.

The EEZ-SCAN trip by the *Farnella* will involve about 21,000 nautical miles of scanning and cover nearly one million square miles of ocean bottom. It began in San Diego, California, at the end of April, with subsequent stops scheduled for Los Angeles (late May) and San Francisco (mid-June). After the final cruise from Coos Bay to the Canadian border, the ship will return to San Diego in early August.

The scanning system and equipment, named GLORIA for Geological Long-Range Inclined Asdic (sonar), was designed, developed, and operated by the IOS and is the only system of its kind in the world. The images it creates will reveal in broad outlines
(Continued on page 70, *EEZ-SCAN*)

OIL AND GAS NEWS

Mist Gas Field: Remedial Work

Repair work has been completed on the Reichhold Energy well Paul 34-32. This has eliminated the water-production problem but reduced gas production to about 0.25 to 0.5 MMcfd (million cubic feet per day).

Mist Gas Field: One new producer on line

Since December of last year, Reichhold Energy has completed two new wells in the Mist field, Columbia County 23-22 and Columbia County 43-22. A gathering line has been installed to the new wells, which lie 1.5 mi south of the nearest production, and gas started flowing from Columbia County 23-22 on April 15 at a rate of about 2 MMcfd. Additional treatment equipment is needed to put Columbia County 43-22 on line.

Mist Gas Field: Gas well on compressor

The gathering lines from the two new wells (item above) join the line from the producer Columbia County 4. To bring the output pressure of the older producer up to the level of the new producers, a compressor was installed in April.



Installation of compressor on Reichhold Energy well Columbia County 4, Mist Gas Field.

Mist gas production

Month	Total Mcf	Field avg. Btu	Total therms
January 1984	185,602	970	1,799,901
February 1984	185,281	970	1,795,891
March 1984	185,882	972	1,803,542
Cumulative field production through March 1984	16,984,167		

Recent permits

Permit no.	Operator, well, API number	Location	Status, proposed total depth (ft)
260	Amoco Production Co. Weyerhaeuser 1-26 019-00024	SW ¼ sec. 26 T. 25 S., R. 9 W. Douglas County	Application. 15,000
261	Amoco Production Co. Weyerhaeuser 1-34 019-00025	NW ¼ sec. 34 T. 25 S., R. 9 W. Douglas County	Application. 15,000
262	Amoco Production Co. Weyerhaeuser 1-1 011-00020	SE ¼ sec. 1 T. 25 S., R. 11 W. Coos County	Application. 14,800

Stinchfield reappointed to Governing Board

Governor Victor Atiyeh has reappointed Allen P. Stinchfield of North Bend to the Governing Board of the Department of Geology and Mineral Industries (DOGAMI). Stinchfield's new term will begin July 1, 1984, and end June 30, 1988. The term is subject to Senate confirmation.

The three-member DOGAMI Governing Board makes policy for the Department, whose mission it is to develop needed information about the geology and mineral resources of Oregon and to effectively store and disseminate this information so that it can serve as a basis for correct decisionmaking in resource development and land management.

Stinchfield is the retired vice-president of the Menasha Corporation, Land and Timber Division, North Bend. He is also chairman of the board, Posey Manufacturing Company, Hoquiam, Washington, and currently serves on the board of directors, Bay Hospital, Coos Bay.

He is a graduate of the University of Washington (1940) and Grays Harbor College, Aberdeen, Washington. □

Malheur Field Station offers summer courses

Malheur Field Station, one of Oregon's unusual research outposts at Malheur Lake in the Malheur National Wildlife Refuge, Harney County, will offer a great variety of summer courses during a 12-week period from mid-June through August.

The classes offer optional and easily transferable college credit through Pacific University and are taught by instructors from a variety of colleges across the nation. Room and board are, of course, provided.

One-week workshops will be held at the beginning and end of the session. Subjects will include environmental assessment, ecology, natural history, experimental anthropology, aquatic biology, insect studies, bird identification, nature drawing, and watercolor painting. The period in between will offer three sequences of three-week courses on such subjects as animal behavior, marshlands ecology, field botany, flint knapping, fossil excavation, regional geology, natural history, ornithology, solar heating systems, and poetry.

All class sizes will be limited. For a course brochure or other information, write to Malheur Field Station, P.O. Box 260E, Princeton, OR 97721, or call (503) 493-2629. □

(EEZ-SCAN, continued from page 69)

the bathymetry (underwater topography) of the ocean floor. One of the first products of the approximately \$2-million program will be an atlas of a mosaic of images of the entire West Coast EEZ, at a scale of 1:500,000.

The public is invited to visit aboard the *Farnella* while the ship is in port. A summary report on proposals and recommendations for developing the offshore mineral and energy resources of the EEZ has been published by the USGS as Circular 929 and is available at the USGS Public Inquiries Office, 678 U.S. Courthouse, West 920 Riverside Avenue, Spokane, WA 99201, phone (509) 456-2524, and at many other USGS offices. □

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