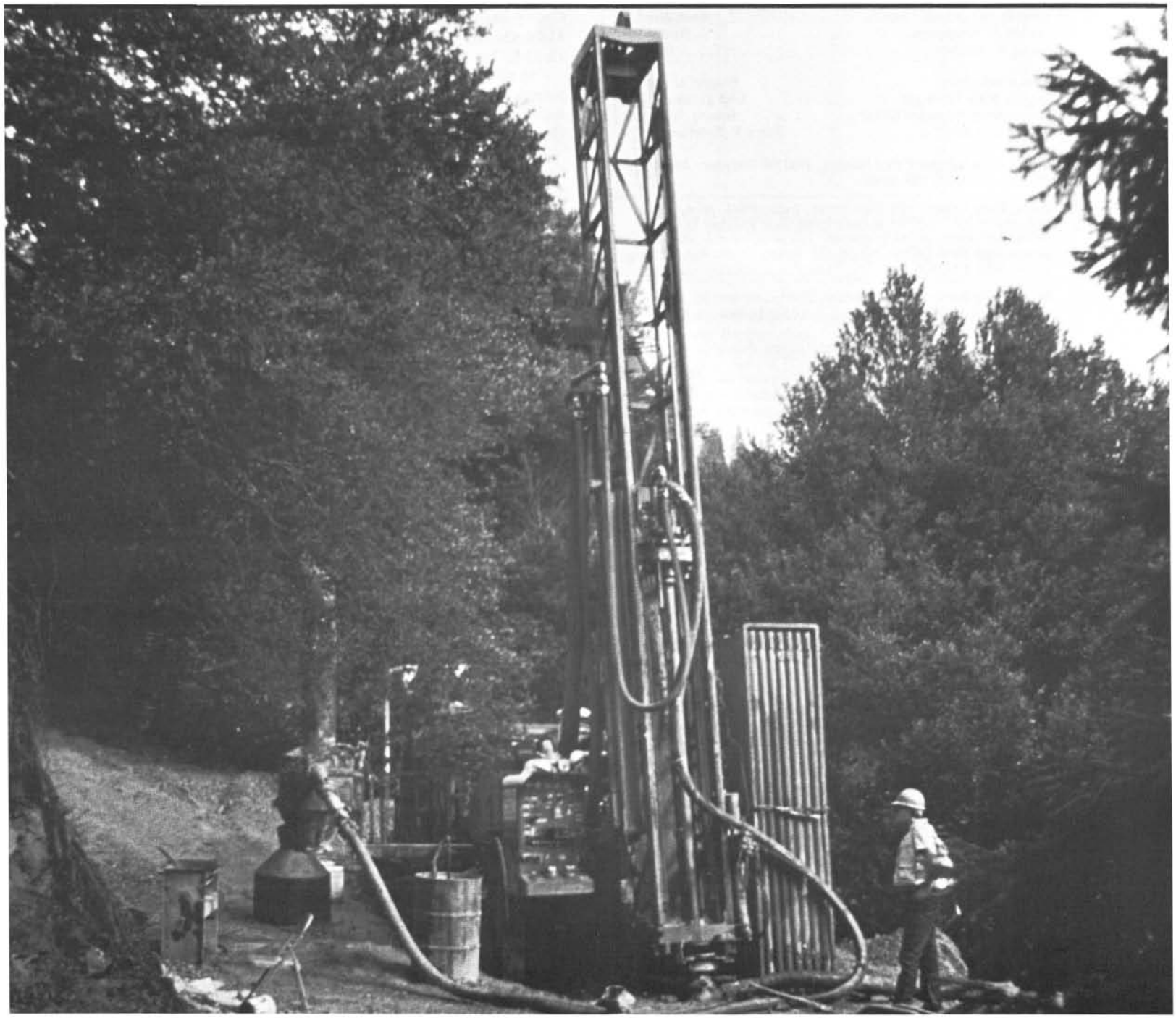
OREGON GEOLOGY

published by the

Oregon Department of Geology and Mineral Industries

VOLUME 49, NUMBER 4 APRIL 1987



THIS MONTH:

Mineral industry in Oregon, 1986

and

Trace fossil *Gyrolithes* from the Astoria Formation

OREGON GEOLOGY
(ISSN 0164-3304)

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Published monthly by the Oregon Department of Geology and Mineral Industries (Volumes 1 through 40 were entitled *The Ore Bin*).

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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 the bibligraphic 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

One of several exploration holes drilled by Kennecott Exploration on the old Almeda Mine property in Josephine County. Kennecott is evaluating a massive sulfide occurrence containing gold, silver, copper, lead, and zinc, from which there was production between 1911 and 1916. See related article beginning on next page.

OIL AND GAS NEWS

ARCO applications permitted

Permits to drill have been issued on nine of the ten applications received from ARCO during February. These are all located in T. 6 N., R. 5 W., Columbia County, and are the Columbia County 11-7-65, Columbia County 11-34-65, Columbia County 23-18-65, Columbia County 32-26-65, Columbia County 32-9-65, Columbia County 24-26-65, Columbia County 22-27-65, Columbia County 41-34-65, and Columbia County 31-27-65. The Longview Fibre 23-33-65 has not yet been permitted at this time.

In addition, a one-year extension was granted on two ARCO permits. The Cavenham Forest Industrics 31-22, sec. 22, T. 6 N., R. 5 W., was extended to July 18, 1988, and the Columbia County 13-21, sec. 21, T. 6 N., R. 5 W, was extended to March 28, 1988.

Gas storage project started

Oregon Natural Gas Development has started preliminary injection tests at the two pools now tapped for gas storage. The pools will be repressured to 75 percent of their original pressures in 1987, or about 800 psi for the Flora Pool and 725 psi for the Bruer Pool. Gas for the repressuring is 60 percent Mist gas from other pools and 40 percent pipeline gas. A tracer is used in the injected gas to detect any leakage to other pools. The first withdrawal will occur in the fall of this year.

Mist Gas Field map updated

The Mist Gas Field map showing well locations, status, and depths has been updated as of March 1, 1987, and is available as Open-File Report O-84-2, *Mist Gas Field Map (revision of 3-87)*. Copies of this report may be purchased for $5 from the Portland office of the Oregon Department of Geology and Mineral Industries.

NWPA to hold annual symposium

The Northwest Petroleum Association has scheduled its annual symposium for May 18 and 19, at the Riverhouse Motor Inn in Bend, Oregon. The meeting and field trip will concentrate on the Columbia Basin and Plateau geology and hydrocarbon prospects and will include a talk on current geothermal exploration. The field trip, led by Lewis Kleinhans, will be to the Mitchell area. Topics of discussion at the meeting include leasing activity, tectonic overview, structural evolution, Cretaceous stratigraphy, geophysical techniques, and hydrocarbon prospects. For further information contact Phil Brogan, (503) 382-0560, or the NWPA, P.O. Box 6679, Portland, OR 97228. □

Geologic maps trace ancient coast in Clackamas and Marion Counties

The Oregon Department of Geology and Mineral Industries (DOGAMI) has released two geologic maps to complete a block of five 7½-minute quadrangle maps showing ancient sea-shore environments in the foothills of the central Western Cascades just east of Salem.

The new maps are *Geologic Map of the Drake Crossing Quadrangle, Marion County, Oregon*, DOGAMI Geological Map Series GMS-50; and *Geologic Map of the Elk Prairie Quadrangle, Marion and Clackamas Counties, Oregon*, DOGAMI Geological Map Series GMS-51. They were produced by William N. Orr and Paul R. Miller of the University of Oregon. Both maps are at the scale of 1:24,000 and in two colors.

Together with three previously published maps—Wilhoit quadrangle (DOGAMI map GMS-32), Scotts Mills quadrangle

*(Continued on page 48, **Maps**)*

Mineral industry in Oregon, 1986

by Ronald P. Geitgey, Industrial Minerals Geologist, Oregon Department of Geology and Mineral Industries

INTRODUCTION

Preliminary estimates by the U.S. Bureau of Mines place the value of 1986 nonfuel mineral production in Oregon at $131 million, slightly above the 1985 value. Of this total, $92 million was from construction sand, gravel, and crushed stone. Most of the remaining value was contributed by nickel and various industrial minerals.

MINING ACTIVITY

Metals

Placer operations were active in Baker County on Burnt River (5)*, Pine Creek (3), Clarks Creek (2), and Deer Creek (4). Several small-scale seasonal operations continued in Josephine County on Josephine Creek and its tributaries (19), Sucker Creek (20), Althouse Creek (21), Illinois River tributaries (17), and in the Galice area (16) and in Douglas County on Coffee Creek (13).

A small amount of precious metal was produced from the Irish Girl vein of the Greenback Mine (15) in Josephine County. The 900-ft level was rehabilitated, and some drifting was done on the western extension of the Greenback vein.

Hanna Nickel Mining and Smelting Company completed installation of its new wet-screening plant at Nickel Mountain (14) in Douglas County; however, the mill was shut down after only two months of operation. Depressed nickel prices have made the operation uneconomic, and in January 1987 the company announced closure of the mine and mill.

Industrial minerals

Bentonite clay was produced by Central Oregon Bentonite and Oregon Sun Ranch from adjacent properties on Camp Creek (9) in Crook County and by Teague Mineral Products (7) near Adrian in Malheur County. The bentonite is used for drilling muds, pet litter, binder for hay pelletizing, and as sealant for ponds, ditches, and solid-waste disposal sites.

Teague Mineral Products produced the zeolite mineral clinoptilolite from its mine on Succor Creek (8) in Malheur County. Most of the zeolite was packaged and sold as pet litter, with smaller amounts sold as odor-control products, fungicide carriers, and ammonia absorbent in aquarium systems. Clinoptilolite readily absorbs the element cesium, including its radioactive isotope produced by nuclear fission. A one-ton sample was sent by Teague to Bikini Atoll in the South Pacific to evaluate its absorbent characteristics in preventing cesium uptake by food crops grown in soils contaminated by nuclear testing.

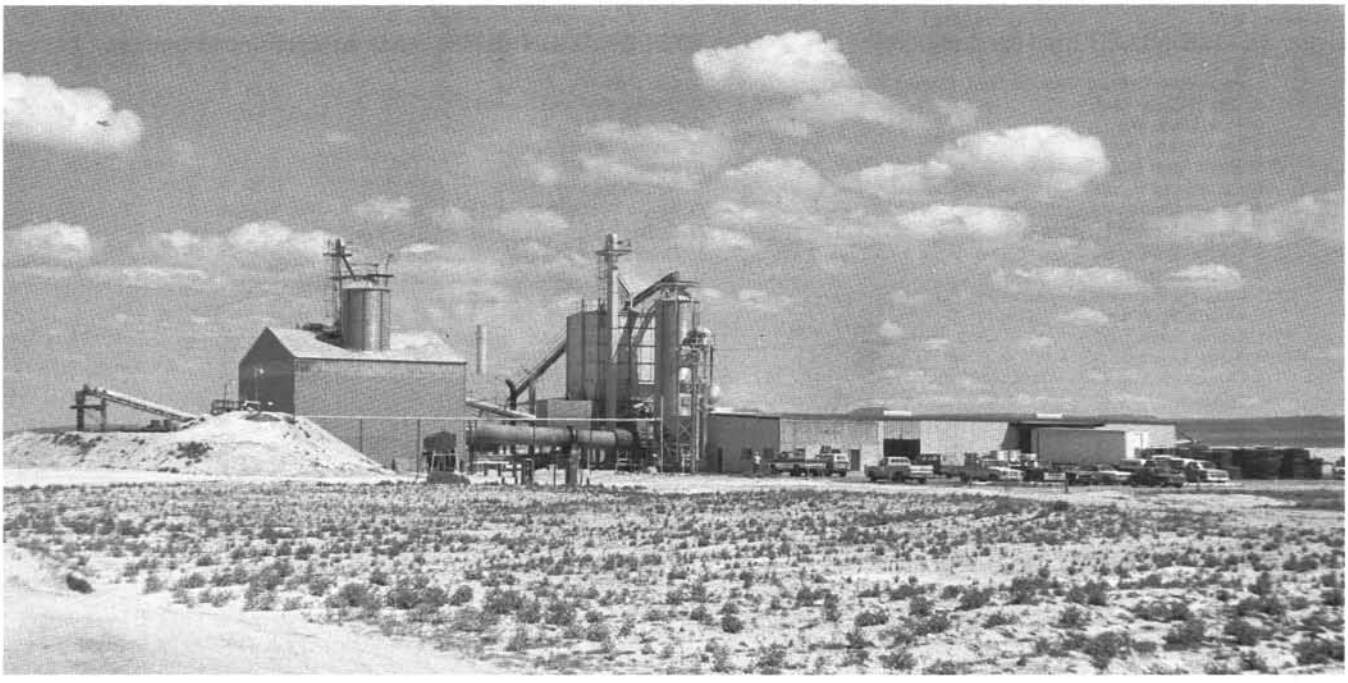
Diatomite production continued by Oil-Dri Production Company in Christmas Valley (10), Lake County. The diatomite is pack-

* *All mine numbers in this section refer to "Active Mines" on the location map and in Table 1.*

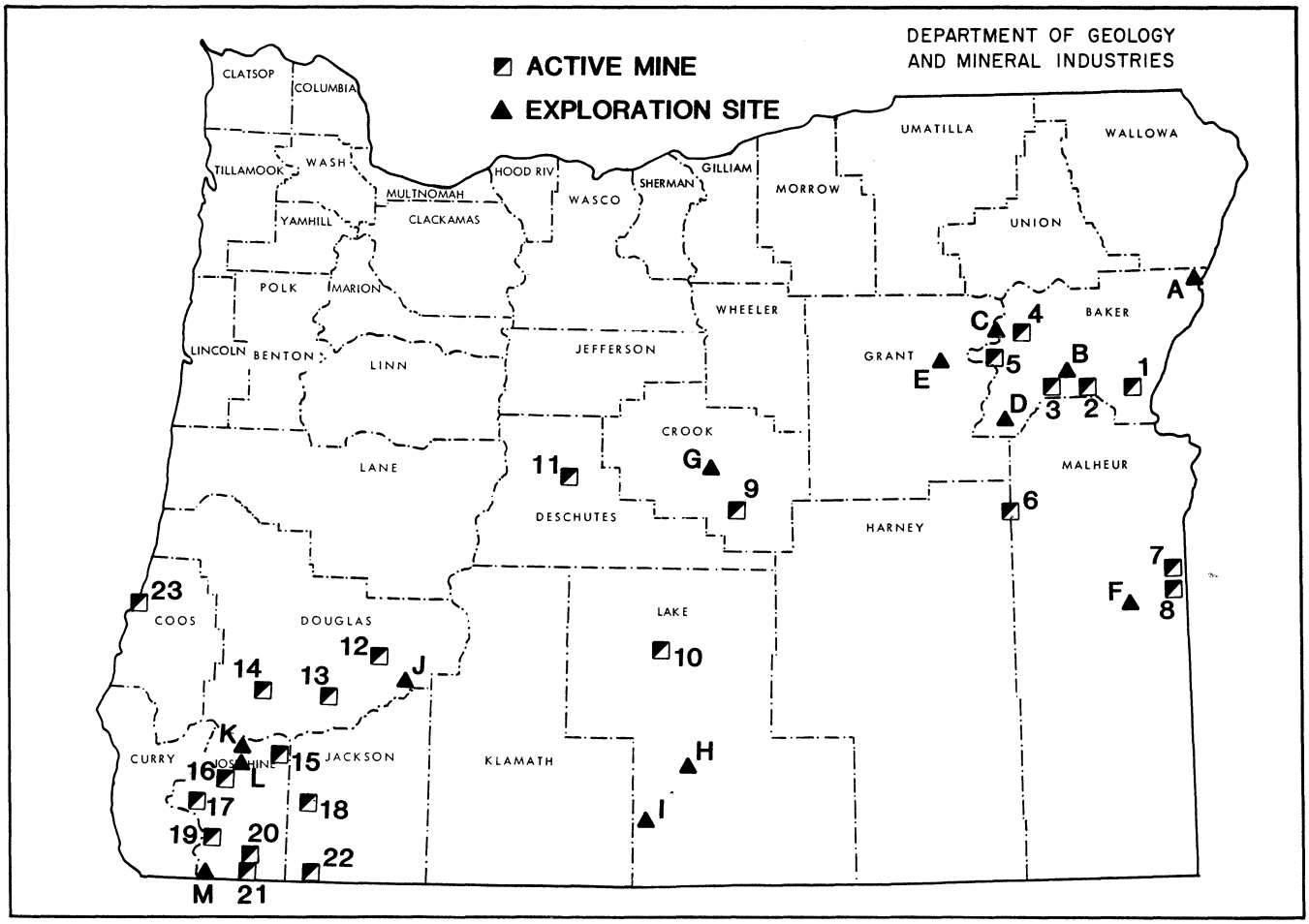
OREGON'S MINERAL PRODUCTION
MILLIONS OF DOLLARS

	ROCK MATERIALS	METALS & INDUSTRIAL MINERALS	NATURAL GAS	TOTAL
	Sand & Gravel, Stone	Cement, Nickel, Pumice, etc.		
1972	54	22	0	76
1973	55	26	0	81
1974	75	29	0	104
1975	73	33	0	106
1976	77	35	0	112
1977	74	35	0	109
1978	84	44	0	128
1979	111	54	+	165
1980	95	65	12	172
1981	85	65	13	163
1982	73	37	10	120
1983	82	41	10	133
1984	75	46	8	129
1985	91	39	10	140
1986	92	39	9	140

Summary of mineral production in Oregon for the last 15 years. Data for 1986 derived from U.S. Bureau of Mines annual preliminary mineral industry survey and Oregon Department of Geology and Mineral Industries natural gas production statistics.



Oil-Dri Production Company diatomite mill near Christmas Valley in northern Lake County.



EXPLANATION

ACTIVE MINES (half-filled square)

1. Ash Grove Cement West (cement, limestone)
2. Clarks Creek (Au)
3. Pine Creek (Au)
4. Deer Creek (Au)
5. Burnt River (Au)
6. Celatom (diatomite)
7. Teague Mineral Products (bentonite)
8. Teague Mineral Products (zeolite)
9. Camp Creek (bentonite)
10. Oil-Dri (diatomite)
11. Cascade Pumice, Central Oregon Pumice (pumice)
12. Ouartz Mountain Silica (silica)
13. Coffee Creek (Au)
14. Nickel Mountain (Ni)
15. Greenback (Au)
16. Galice area (Au)
17. Illinois River area (Au)
18. Bristol Silica (silica)
19. Josephine Creek (Au)
20. Sucker Creek (Au)
21. Althouse Creek (Au)
22. Steatite of Southern Oregon (soapstone)
23. CooSand (silica sand)

EXPLORATION SITES AND AREAS (solid triangle)

A. Iron Dyke (Au, Ag, Cu)
B. Dooley Mountain (perlite)
C. Ibex (Au, Ag)
D. Grouse Spring (Cu, Mo)
E. Susanville (Au, Ag)
F. Red Butte (Au)
G. Alaska Pacific Oregon, Ltd. (bentonite)
H. Tucker Hill (perlite)
I. Quartz Mountain (Au)
J. Foster Creek area (soil amendment rock)
K. Goff (Au, Ag, Cu, Pb, Zn)
L. Almeda (Au, Cu, Zn)
M. Turner-Albright (Au, Ag, Zn, Cu, Co)

Mining and mineral exploration in Oregon in 1986 (excluding sand and gravel and stone). Active mines are keyed to Table 1; exploration sites are keyed to Table 2.

aged as pet litter for several companies under various brand names.

Eagle-Picher Industries began a diatomite operation with mines in northern Harney and Malheur Counties (6) and a mill near Vale. The diatomite is processed by air classification and flux calcining (heating to produce partial fusion and agglomeration) and sold under the brand name of Celatom. The principal application of the Celatom line of products is as filter aids for filtering water, beverages, syrups, juices, edible oils, fuels, and pharmaceuticals.

Pumice was produced in the Bend area (11), Deschutes County, by Cascade Pumice and Central Oregon Pumice, primarily for a lightweight aggregate in concrete-block manufacturing.

CooSand Corporation continued to produce silica sand from its property on Coos Bay (23), Coos County. The sand is shipped by rail to a plant near Portland. Part of the sand is sold as air-blast sand and railroad traction sand, and part is cleaned magnetically and used in the production of colored glass containers such as beverage bottles.

Bristol Silica and Limestone Company (18) in Jackson County produced crushed quartz for decorative granules, abrasives, poultry grit, and filtration media. Production of metallurgical silica for silicon metal was discontinued. Hanna Nickel Mining and Smelting Company produced silica from its Quartz Mountain property (12) in Douglas County for use in its nickel smelter, but with the closure of that operation, silica production has also ceased.

Soapstone for art carving was produced by Steatite of Southern Oregon (22) in southern Jackson County. The soapstone is valued particularly for its range of colors. It is shipped throughout North America, with much of the production going to Alaska, and an export market is being developed.

Ash Grove Cement West continued to quarry marble and shale near Durkee in Baker County. Shale and marble were used for the production of portland cement, and crushed marble was used in refining beet sugar in eastern Oregon and western Idaho. The total value of production from this one operation has continued to be about $25 million per year for the last five years, making the company a major source of both income and tax revenue in Baker County.

Table 1. *Active mines in Oregon, 1986*

Map no.	Name	Location	Commodity	Comments
1.	Ash Grove Cement West	Sec. 11 T. 12 S., R. 43 E. Baker County	Cement, limestone	Continued production.
2.	Clarks Creek	Tps. 12, 13 S., R. 41 E. Baker County	Au	Several small placer operations.
3.	Pine Creek	T. 12 S., R. 39 E. Baker County	Au	Several small placer operations.
4.	Deer Creek	Secs. 30, 31 T. 9 S., R. 38 E. Baker County	Au	Several small placer operations.
5.	Burnt River	T. 10 S., Rs. 35, 35½ E. Baker County	Au	Several small placer operations.
6.	Celatom	Tps. 19, 20 S., Rs. 35, 36, 37 E. Harney, Malheur Counties	Diatomite	Eagle-Picher Industries dedicated mill in Vale.
7.	Teague Mineral Products	Secs. 8, 29 T. 23 S., R. 46 E. Malheur County	Bentonite	Continued production.

Table 1. *Active mines in Oregon, 1986*—continued

Map no.	Name	Location	Commodity	Comments
8.	Teague Mineral Products	Sec. 28 T. 23 S., R. 46 E. Malheur County	Zeolite	Continued production of clinoptilolite.
9.	Camp Creek area	Sec. 4 T. 19 S., R. 21 E. Crook County	Bentonite	Continued production by Central Oregon Bentonite Co. and Oregon Sun Ranch, Inc.
10.	Oil-Dri Production Company	Secs. 14, 21, 23 T. 27 S., R. 16 E. Lake County	Diatomite	Continued production.
11.	Cascade Pumice, Central Oregon Pumice	Numerous pits in Bend area Deschutes County	Pumice	Continued production.
12.	Quartz Mountain Silica	Sec. 2 T. 28 S., R. 1 E. Douglas County	Silica	Ceased production due to closure of nickel smelter.
13.	Coffee Creek	Sec. 7 T. 30 S., R. 2 W. Douglas County	Au	Small placer operations.
14.	Nickel Mountain	Sec. 17 T. 30 S., R. 6 W. Douglas County	Ni	Closure of mine and smelter.
15.	Greenback Mine	Secs. 32, 33 T. 33 S., R. 5 W. Sec. 5 T. 34 S., R. 5 W. Josephine County	Au	Production from Irish Girl vein.
16.	Galice area	Tps. 34, 35 S., R. 8 W. Josephine County	Au	Several small placer operations.
17.	Illinois River area	T. 37 S., R. 9 W. Josephine County	Au	Several small placer operations on Briggs, Soldier, and Red Dog Creeks.
18.	Bristol Silica	Sec. 30 T. 36 S., R. 3 W. Jackson County	Silica	Continued production.
19.	Josephine Creek and tributaries	Tps. 38, 39 S., Rs. 8, 9 W. Josephine County	Au	Several small placer operations.
20.	Sucker Creek	Sec. 1 T. 40 S., R. 7 W. Josephine County	Au	Several small placer operations.
21.	Althouse Creek	Secs. 11, 12 T. 41 S., R. 7 W. Josephine County	Au	Several small placer operations.
22.	Steatite of Southern Oregon	Secs. 10, 11 T. 41 S., R. 3 W. Jackson County	Soapstone	Increased production.
23.	CooSand Corporation	Sec. 34 T. 24 S., R. 13 W. Coos County	Silica sand	Continued production of glass sand and abrasive sand.

EXPLORATION AND DEVELOPMENT ACTIVITY

Exploration activity in 1986 was generally less than in 1985. There was some exploration for industrial minerals, but most efforts were directed toward precious metals in both massive sulfide and epithermal systems. Many of the precious-metals investigations were preliminary evaluations and regional reconnaissance programs rather than drilling of specific targets.

Metals

Amselco continued exploration of the Goff Mine area (K)** massive sulfide deposit in northern Josephine County. Five holes were drilled with total footage of 3,500 ft, and the results are being evaluated.

Baretta Mines, Ltd., and Rayrock Mines, Inc., continued work on the Turner-Albright massive sulfide deposit (M) in southwestern Josephine County. The deposit was described by M.D. Strickler in the October 1986 issue of *Oregon Geology*. Uncertainties remain over the extent of post-mineralization faulting, but reserve estimates range between 2 and 4 million tons averaging approximately 0.12 oz/ton of gold, 0.60 oz/ton of silver, 1.55 percent copper, 3.70 percent zinc, and 0.50 percent cobalt.

The Almeda Mine massive sulfide deposit (L) in northern Josephine County was drilled by Kennecott, and evaluation is in progress.

Silver King Mines produced 4,000 tons of gold ore from its Iron Dyke property (A) in northeastern Baker County. The deposit is a series of massive sulfide boulders, some as large as 80 ft in diameter, entrained in a lahar. The last defined boulder is being mined out, and exploration is now directed toward locating more boulders and their in-situ massive sulfide source in areas covered by flows of the Columbia River Basalt Group.

American Copper and Nickel Company maintained its Susanville (E) precious-metal vein deposit in Grant County and is attempting to acquire a joint-venture partner to continue exploration. NERCO's Ibex property (C), part of the Bald Mountain Batholith vein system in Grant and Baker Counties, was drilled by American Copper and Nickel Company. Four diamond core holes, each about 1,000 ft deep, were drilled on the Ibex vein.

Manville International Group continued drilling and geophysical work on its Grouse Spring (D) copper-silver-zinc skarn deposit in Baker County. Manville also continued work on its Red Butte (F) sediment-hosted, epithermal, precious-metal prospect in Malheur County. The company has completed geophysical surveys and an extensive sampling program and is now in the permitting process for several drill sites.

The most intensively prospected area in Oregon has been in the volcanic-hosted, epithermal systems associated with the Quartz Mountain (I) intrusive belt in southwestern Lake County. Quartz Mountain Gold Corporation controls about 10,000 acres of this former Anaconda property and has completed over 75,000 ft of drilling, primarily on one of five rhyolite intrusives in the area. Earlier Anaconda estimates of 10-15 million tons containing 0.04 oz of gold per ton have been confirmed on this intrusive, and preliminary drilling results on a second are reported as equally encouraging. Reserve calculations, metallurgical testing, and feasibility studies for a heap leach operation are in progress.

Several other companies were active in precious-metal exploration in the state, with programs ranging through regional reconnaissance, property acquisition, sampling, and drilling. In many loca-

*(Continued on page 50, **Mineral Industry**)*

*** All letters in this section refer to "Exploration Sites" on the location map and in Table 2.*

Exploration trench for precious metals on the Quartz Mountain Gold Corporation property in southwestern Lake County.

Table 2. *Exploration sites and areas in Oregon, 1986*

Map letter	Name	Location	Commodity	Comments
A.	Iron Dyke	Sec. 21 T. 13 S., R. 45 E. Baker County	Au, Ag, Cu	Continued exploration and limited production by Silver King Mines.
B.	Dooley Mountain	Tps. 11, 12 S., R. 40 E. Baker County	Perlite	Continued evaluation by Supreme Perlite.
C.	Ibex	Sec. 4 T. 9 S., R. 36 E. Baker, Grant Counties	Au, Ag	Continued diamond drill program by American Copper and Nickel.
D.	Grouse Spring	Secs. 24, 25 T. 14 S., R. 36 E. Baker County	Cu, Ag, Zn	Continued drilling by Manville.
E.	Susanville	T. 10 S., R. 33 E. Grant County	Au, Ag	Continued evaluation by American Copper and Nickel.
F.	Red Butte	Secs. 26, 27, 34, 35 T. 25 S., R. 43 E. Malheur County	Au	Continued sampling by Manville.
G.	Alaska Pacific Oregon, Ltd.	Tps. 16, 17 S., Rs. 19, 20 E. Crook County	Bentonite	Sampling and drilling on company land east of Prineville.
H.	Tucker Hill	Sec. 35 T. 34 S., R. 19 E. Lake County	Perlite	Continued evaluation by Tenneco Minerals and Western States Minerals.
I.	Quartz Mountain	T. 37 S., R. 11 E. Lake County	Au	Drilling and trenching by Quartz Mountain Gold Corporation.
J.	Foster Creek area	Sec. 15 T. 29 S., R. 3 E. Douglas County	Soil amendment	Continued evaluation, bagging plant under construction.
K.	Goff	Secs. 20, 29 T. 33 S., R. 7 W. Josephine County	Au, Ag, Cu, Pb, Zn	Continued drilling program.
L.	Almeda	Sec. 13 T. 34 S., R. 8 W. Josephine County	Au, Cu, Zn	Drilling program by Kennecott.
M.	Turner-Albright	Secs. 3, 15, 16 T. 41 S., R. 9 W. Josephine County	Au, Ag, Zn, Cu, Co	Continued evaluation by Baretta Mines and Rayrock Mines.

Miocene *Gyrolithes* (lebensspur) from the Astoria Formation, Lincoln County, Oregon

by Guy H. Rooth, Western Oregon State College, Monmouth, Oregon 97361

INTRODUCTION

Two specimens of small (6 by 17 cm), spiral, biogenic structures were found on the beach 5 mi north of Newport, Lincoln County, Oregon. The structures consist of filled burrows within surrounding sedimentary rock. The structures are considered to be lebensspuren (traces of life), as classified by Seilacher (1953).

This paper describes these structures, compares them with similar structures from other localities, examines evidence as to the probable organism that caused them, and discusses the environmental significance of the structures.

PREVIOUS INVESTIGATIONS

Coiled marine structures similar to those from Oregon were first described and given the name *Gyrolithes* by Saporta in 1884 from Cretaceous rocks in Belgium. Since that time, similar structures ranging in age from Jurassic to Miocene have been described from several other localities throughout the world. The only other occurrence from the West Coast of the United States is from Miocene rocks of the Monterey Group, as reported by Mansfield (1930). The structures are common in some Miocene rocks of the U.S. Atlantic Coastal Plain. Miocene occurrences in North America are listed in Table 1.

The most detailed paleoenvironmental interpretation of *Gyrolithes* lebensspuren is by Gernant (1972) in a study of more than 400 samples from Miocene rocks of Maryland.

Powell (1977) has described a living polychaete worm with a similar burrow in the intertidal muds of North Carolina.

DESCRIPTION OF STRUCTURES

The two *Gyrolithes* structures from Oregon are very similar in size and geometry. They are loosely coiled, with about two coils per 10 cm of length. The coil diameter of the entire structure is approximately 6 cm, while the diameter of the burrow varies from 1.8 to 2.0 cm. The specimens are not complete, but each is approximately 17 cm long. The burrow diameters are constant throughout the structure (Figure 1).

The burrows are preserved as internal fillings of tan sandy mud that is more resistant to erosion than are the surrounding sediments. Both specimens were found on the wave-cut platform in the Moolack Beach area 5 mi north of Newport in Lincoln County, Oregon. No specimens were found in place, but Gernant (1972), after studying several hundred burrows in Maryland, reports that they are oriented upright, varying no more than 3° or 4° from bedding surfaces.

The Oregon structures agree closely with published reports. However, a few specimens reported in the literature have lengths of 30 to 40 cm (Table 1).

INTERPRETATION OF SEDIMENTOLOGICAL FEATURES

The animal that produced the *Gyrolithes* structure is not known with certainty. No remains have been found in the burrows. Nevertheless, some characteristics of the Oregon specimens, the detailed study by Gernant (1972) of the Miocene forms of Maryland, and the description by Powell (1977) of burrows made in present-day intertidal muds of North Carolina allow a probable paleoenvironmental interpretation.

The absence of several features is important. No traces of a tubelike sheath of calcium carbonate or organic matter have been found associated with any of the structures. Gernant (1972) reports that the surrounding sediments were not deformed, as would be the case with an animal forcibly displacing sediment as it burrows. The animal appears to have burrowed by excavation.

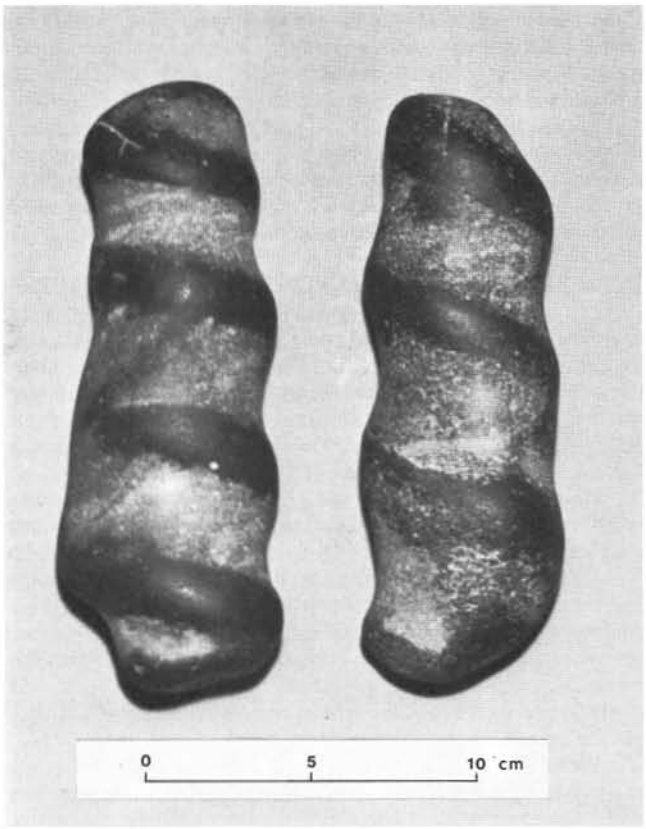


Figure 1. Fossil Miocene burrows (Gyrolithes) *from the Astoria Formation, Moolack Beach, north of Newport, Lincoln County, Oregon. Approximate size 6 by 17 cm.*

Gernant (1972) also describes and illustrates several grooves and ridges that parallel the spirally sloping burrow, suggesting that the animal that occupied the structure possessed a hard carapace or exoskeleton capable of producing continuous grooves on the outer wall of the burrow. He concludes that the evidence suggests that a burrowing crustacean occupied the burrow, rather than a softbodied wormlike animal or a symmetrical animal such as a bivalve.

Gernant notes that Schmitt (1965) described the burrowing behavior of *Myctris longicarpus* (soldier crab) as digging downward with the legs on one side of the body while rotating at the same time, so that a downward-spiraled pattern is produced. In 1972, Gernant concluded that *Gyrolithes* was made by the spiral excavations of a scavenging crustacean that repeatedly used the burrow as a "retreat." He now accepts the interpretation of Powell (1977), described in a later section of this paper, that the organism making the burrow was a polychaete worm (personal communication, 1986).

The Oregon specimens are sediment filled, whereas those studied by Gernant (1972) were not. In an attempt to obtain more information on the nature of the Oregon organism, one of the specimens was cut lengthwise to yield a cross section through the structure. It was

found that the structure contained no calcareous or organic lining and that the burrow cross section is elliptical rather than circular. No trace of the actual animal was found.

The outer portion of the burrow is smooth and contains a lens of fine, tan mud. The inner wall of the burrow, which is irregular and highly disturbed, contains pieces of the surrounding sediment. No grooves could be found on the outside of the Oregon specimens due to abrasion after erosion from the bed rock.

In his paleoecologic study, Gernant (1972) indicates that the sediments and associated biofacies of the St. Leonard Member of the Choptank Formation and the St. Marys Formation suggest that the animal lived in a very shallow marine or marginal marine environment. Gernant (personal communication, 1986) has indicated, however, that some examples of *Gyrolithes* may reflect deeper water.

Because neither of the Oregon specimens was found in place, it is not possible to make interpretations based upon associated sediments or faunas. The specimens weigh 0.5 kg and were probably eroded directly from the nearby sea cliffs of the Astoria Formation somewhere in the Beverly Beach-Moolack Beach area.

INTERPRETATION BASED UPON LIVING POLYCHAETES

In the more than 90 years since the original description of *Gyrolithes* by Saporta in 1884, no one had documented a living organism with a similar burrow, until Powell (1977) attributed the structure to a polychaete worm of the family Capitellidae. He reports that two living species, *Notomastus latericeus* Sars and *Notomastus lobatus* Hartman, build spiral burrows. The spiral burrow of *Notomastus lobatus* is very similar to the fossil form *Gyrolithes*.

Powell (1977) describes the spiral burrows of *Notomastus lobatus* in intertidal muds on Banks Channel near Wrightsville Beach, North Carolina, and Sebastian Inlet, Florida, which were studied by C.E. Jenner of the University of North Carolina at Chapel Hill. The range in dimensions, based upon 27 burrows, was (1) burrow diameter, 0.5-1.1 cm, averaging 0.8 cm; and (2) diameter across the spiral, 1.9-4.0 cm, averaging 2.7 cm. The length occasionally exceeded 25 cm. The dimensions of the shaft and coil are slightly smaller than in the case of the Oregon specimens and the Miocene specimens from Maryland, but the overall geometry is nearly identical.

Powell (1977) reports that the living *Notomastus lobatus* grows to a length of 1 m and a diameter of at least 0.8 cm. Since the organism occupies the burrow throughout life, the sediments become compacted, and the burrow persists after the death of the animal.

He states that *Myctris longicarpus* (soldier crab) digs a burrow when the animal is alarmed, and that the burrow is abandoned immediately after the danger has passed. Burrows of this type are probably not stable and stand little chance of being preserved as open shafts.

CONCLUSIONS

The Miocene burrow *Gyrolithes* from the Astoria Formation of Oregon is very similar to the ones reported abundantly from the shallow-water marine rocks of Maryland. The geometry and dimensions of the structures from both localities agree closely.

The organism that produced the burrows was probably a polychaete worm, slightly larger in size but closely related to the living *Notomastus lobatus* as reported by Powell (1977). The paleoenvironmental interpretation of a shallow intertidal to sublittoral organism is supported by the sedimentological evidence of Gernant (1972) and the distribution of the living *Notomastus lobatus* as reported by Powell (1977).

In the absence of reported fossil remains within the burrows, however, the possibility that these structures were formed by asymmetrically burrowing crustaceans cannot be discarded.

The Miocene *Gyrolithes* specimens from the Astoria Formation in Oregon were probably sublittoral in origin. Gernant (personal communication, 1986) indicates that while the majority of occurrences of *Gyrolithes* are from very shallow water, some are reported from deeper water. Additional specimens from Oregon are needed to provide evidence as to the organism responsible and the paleoenvironment in which it lived.

Table 1. *Occurrence and dimensions of Miocene* Gyrolithes*

Stratigraphic unit	Location	Number	Length (cm)	Coil diam. (cm)	Shaft diam. (cm)	Source
St. Marys Fm.	Maryland	1	20.3	4.2	1.8	Mansfield, 1930
Calvert Fm.	Maryland	?	30-60	3.8	---	Dryden, 1933
Braunkohlenfm.	Germany	?	15-40	3-5	1-2	Kilpper, 1962
Choptank Fm., St. Leonard Mbr.	Maryland	100	8-16	4-5	1.5-1.8	Gernant, 1972
St. Marys Fm., Bed 22	Maryland	300	7-30	3.5-4.0	1.5-1.8	Gernant, 1972
Astoria Fm.	Oregon	2	17-18	6	1.8-2.0	This report

* *Data modified from Gernant (1972)*

ACKNOWLEDGMENTS

The author would like to thank Lowell Spring and Ray Brodersen of Western Oregon State College, Richard Thoms of Portland State University, and William Orr of the University of Oregon for reviewing the manuscript. The author is indebted to Bruce A. Spero, student at Western Oregon State College, for his loan of one of the specimens. Personal communication with Robert Gernant was also extremely helpful.

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***(Maps,** continued from page 42)*

(DOGAMI map GMS-33), and Stayton NE quadrangle (DOGAMI map GMS-34)—the new maps cover the area extending approximately from the community of Monitor in the north to Silver Falls State Park in the south and from the community of Pratum in the west to the Molalla River in the east, showing surficial and bedrock geologic units and geologic structure on a topographic base.

In their interpretation, the authors emphasize aspects of sedimentation and paleontology and reconstruct paleoenvironments of the time period approximately 15 to 35 million years ago. At that time, this area was part of the coast along the ancient Pacific Ocean.

The study of the five quadrangles has also led the authors to the identification of a new geologic unit, which they call the Scotts Mills Formation. It is represented and described on the new maps and was presented formally in a recent article in *Oregon Geology* (December 1986 issue).

All five maps, GMS-32, GMS-33, GMS-34, GMS-50, and GMS-51, are now available at the Oregon Department of Geology and Mineral Industries, 910 State Office Building, 1400 SW Fifth Avenue, Portland, OR 97201. The purchase price for each map is $4. Orders under $50 require prepayment. □

Glimpses of DOGAMI history

John Eliot Allen, Professor Emeritus of Portland State University, was among the earliest staff members of the Oregon Department of Geology and Mineral Industries (DOGAMI). Within a year of DOGAMI's inception, he was hired by Director Earl K. Nixon as field geologist for the office in Baker and served on the DOGAMI staff for ten years. The following excerpts are from the manuscript of his autobiography, one of his latest endeavors, and from the DOGAMI Ore Bin, *in reaction to Allen's resignation, one of three that shocked the Department in one year.*

From J.E. Allen's autobiography

"When Nixon first hired me, he said, 'John, I am putting you over in eastern Oregon to compile a "Mines Handbook" of all the mines and prospects in that part of the state. I may get over to see you once every 5 or 6 months. I am paying you for your 8-hour days' work, but all your advancement and promotion will depend upon two things: one, the number of new ideas you come with and two, the amount of overtime you put in.' This is the best simple formula for success I have ever heard, and I have tried to follow it throughout my career.

"The Baker office was located in a small one-story building on Court Street and consisted of a small front office, two cubbyholes for Leslie Motz, the assayer and chemist, and myself, and a slightly larger room for the assay laboratory. Albert Quine, whom I succeeded, had left to take charge of the Cornucopia Mine operations. I spent much of my time in the field, coming in for weekends and a day or so for report-writing. During my 2 years in Baker, I visited and wrote reports on 335 mines and prospects east of the Cascade Range in Oregon. . .

"On one of my very first mine examinations, I visited a small free-gold property on Chicken Creek, northwest of Homestead. It had a drift about 300 feet long on a narrow quartz vein of free-milling gold. But the geology was quite complicated, since the vein cut serpentine, gabbro, porphyritic andesite, and a large granodiorite dike.

"The miner was digging with a pick and shovel, moving the ore and waste with a wheelbarrow, and at the end of the dump he had erected a one-stamp mill operated by a one-lunger gas engine, the fines flowing out over an amalgamated copper plate. He was producing $15-20 per day, and the 2- to 5-inch vein probably ran several hundred dollars a ton in free gold.

"In mapping the mine, I had collected quite a suite of rock specimens and was sitting on the dump with the miner, examining them in the daylight, and telling him all the names of the variety of rocks I was proudly able to identify. I noticed that he was apparently getting more and more restless, and finally his face got red and he burst out: 'There's only two kinds of rock in my mine — bin rock and dump rock!'

"This was a very good initiation for a budding economic geologist, and I have used the story for many years in my classes. I later heard an equivalent story from a construction engineer — who must learn to distinguish between 'clink rock' and 'clunk rock'."

From the *Ore Bin*, v. 9, no. 8, August 1947

"Department Loses Geologists. Three geologists occupying key positions in the Department have resigned to accept better jobs. Their leaving brings home a condition in the country which was confidently predicted in educational and scientific circles, but was given little attention by those in authority during the war.

"Young scientists were grabbed by the draft and in many instances put into service bearing little relation to their training and possible future use to the country. As a consequence, they lost three or four years of training work in their professions, causing a present shortage of those qualified to carry on scientific investigations and research. This shortage is accentuated by the large increase in enrollment at institutions of higher learning and the increased need for teachers, especially those qualified to teach science and engineering. The shortage, of course, has resulted in bidding (in which the Federal Government has participated) for qualified men, which leaves relatively small agencies like the Department, whose salary ranges are pretty well fixed by law, out in the cold. Such small departments are not able to fill vacancies immediately by promotion, and must suffer a setback in work on projects which are interrupted by resignations.

"Dr. Wallace D. Lowry left the Department on August lst to take a position in California as geologist with the Texas Company.

"Dr. Ewart M. Baldwin has accepted the position of Assistant Professor of Geology, University of Oregon, at Eugene. He is leaving the Department early in September.

"Dr. John Eliot Allen, department geologist for ten years, is leaving in September to become Associate Professor of Geology at Pennsylvania State College." □

John E. Allen (left) mapping and surveying in the Wallowa Mountains (?) in 1938-1939, together with Leslie Motz, assayer and chemist at the Baker field office. Photo from DOGAMI files.

Metals and Minerals Conference to be held in Portland

The 33rd Annual Pacific Northwest Metals and Minerals Conference will be held in Portland, Oregon, Monday and Tuesday, April 27-28, 1987, at the Red Lion Inn, Lloyd Center. It is jointly sponsored by the local sections of AIME, AWS, ASM, and AIChE.

The 1987 Conference theme will be "Modern Mineral and Metal Technology," emphasizing recent developments and emerging technologies that affect the future direction of the minerals and metals industry.

The conference will begin with a Monday morning Keynote Session in which Robert C. Horton, Director of the U.S. Bureau of Mines, Gerard A. Drummond, President, Nerco Inc., and Karl W. (Bill) Mote, Executive Director, Northwest Mining Association, will address the outlook for metals and minerals industries in the Northwest. At the conference luncheon on Tuesday, Mr. Maynard Miller, Dean, University of Idaho Mines and Resources, will present the academic viewpoint on the future of the metals and minerals industry.

The two-day conference will include 12 technical sessions that address recent technological developments in welding and joining, physical metallurgy, geology, small mining, regional mineral resources potential, pyrometallurgy, hydrometallurgy, and chemical processing. Summaries of the latest results of ongoing research and emerging technologies will be presented in Monday and Tuesday afternoon poster sessions. At one of the Monday afternoon technical sessions, five speakers will address the geological and technical characterization of the sites for a high-level nuclear waste repository. On Tuesday morning one of the technical sessions will highlight four talks addressing nuclear waste disposal technology.

A popular feature of this conference is the "Industrial Trade Exposition" held in conjunction with the regular program. A full slate of social activities, including varied local activities for spouses, will round out the conference. Additional information can be obtained from Charles B. Daellenbach, P.O. Box 70, Albany, OR 97321, phone (503) 967-5833. *—PNMMC news release*

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*(**Mineral Industry,** continued from page 46)*

tions, companies are evaluating their preliminary surveys and are in the process of consolidating their land positions.

Industrial minerals

Relatively little exploration activity for industrial minerals was evident in 1986. Exploration for zeolites was minimal, due in part to continued difficulty in generating large-volume markets for natural zeolites and in part to numerous corporate reorganizations in the mineral exploration business as a whole. Several zeolite deposits have been drilled in recent years, and most are still held by various companies attempting to develop markets.

Supreme Perlite continued exploration of perlite deposits on Dooley Mountain (B) in Baker County. Tenneco Minerals, in a joint venture with Western States Minerals, has completed testing of a perlite deposit on Tucker Hill (H) in Lake County. The deposit is of excellent quality, but its location with respect to transportation and markets is a disadvantage.

Endurance Minerals is evaluating hydrothermally altered volcanic rocks in the Foster Creek area (J) of southeastern Douglas County for use as a soil amendment and micronutrient source. A bagging plant is under construction, and field testing of the product is continuing.

Alaska Pacific Oregon, Ltd. (G), conducted a bentonite sampling and drilling program on its land east of Prineville in Crook County. Teague Mineral Products continued to block out further reserves of bentonite associated with its mining operation in Malheur County. □

WSA evaluations continue in Oregon

U.S. Geological Survey geologists will be conducting geological studies of the following Bureau of Land Management Wilderness Study Areas (WSA) during 1987 as part of the WSA evaluation process. Persons with any questions, comments, or additional information on mineral resources within these areas are urged to contact Floyd Gray, U.S. Geological Survey, MS 901, 345 Middlefield Road, Menlo Park, California 94025, phone (415) 323-8111, extension 4141.

WSA name	Oregon WSA number
Lakeview District	
Devil's Garden Lava Bed	OR-001-002
Squaw Ridge Lava Bed	OR-001-003
Four Craters Lava Bed	OR-001-022
Diablo Mountain	OR-001-058
Orejana Canyon	OR-001-078
Abert Rim	OR-001-101
Fish Creek Rim	OR-001-117
Guano Creek	OR-001-132
Spaulding	OR-001-139
Hawk Mountain	OR-001-146A
Burns District	
Malheur R.-Bluebucket Cr.	OR-002-014
Sheepshead Mountains	OR-002-072
Wildcat Canyon	OR-002-072D
Table Mountain	OR-002-072I
East Alvord	OR-002-073A
Alvord Desert	OR-002-074
Pueblo Mountains	OR-002-081
Rincon	OR-002-082
High Steens	OR-002-085F
Home Creek	OR-002-085H
Blitzen River	OR-002-086E
Little Blitzen Gorge	OR-002-086F
Vale District	
Camp Creek	OR-003-031
Cottonwood Creek	OR-003-032
Dry Creek Buttes	OR-003-056
Upper Leslie Gulch	OR-003-074
Slocum Creek	OR-003-075
Honeycombs	OR-003-077A
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Willow Creek	OR-003-152
Disaster Peak	OR-003-153
Fifteen Mile Creek	OR-003-156
Oregon Canyon	OR-003-157
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Owyhee Canyon	OR-003-195
Prineville District	
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