OREGON GEOLOGY

published by the

Oregon Department of Geology and Mineral Industries

VOLUME 46, NUMBER 7 JULY 1984

OREGON GEOLOGY

(ISSN 0164-3304)

VOLUME 46, NUMBER 7 JULY 1984

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

Main Office: 1005 State Office Building, Portland 97201, phone (503) 229-5580.

Baker Field Office: 2033 First Street, Baker 97814, phone (503) 523-3133.
Howard C. Brooks, Resident Geologist

Grants Pass Field Office: 312 S.E. "H" Street, Grants Pass 97526, phone (503) 476-2496.
Len Ramp, Resident Geologist

Mined Land Reclamation Program: 1129 S.E. Santiam Road, Albany 97321, phone (503) 967-2039.
Paul F. Lawson, Supervisor

Subscription rates: 1 year, $6.00; 3 years, $15.00. Single issues, $.75 at counter, $1.00 mailed.
Available back issues of *The Ore Bin*: $.50 at counter, $1.00 mailed.

Address subscription orders, renewals, and changes of address to *Oregon Geology*, 1005 State Office Building, Portland, OR 97201.

Send news, notices, meeting announcements, articles for publication, and editorial correspondence to the editor, Portland office. The Department encourages author-initiated peer review for technical articles prior to submission. Any review should be noted in the acknowledgments.

Second class postage paid at Portland, Oregon.
Postmaster: Send address changes to *Oregon Geology*, 1005 State Office Building, Portland, OR 97201.

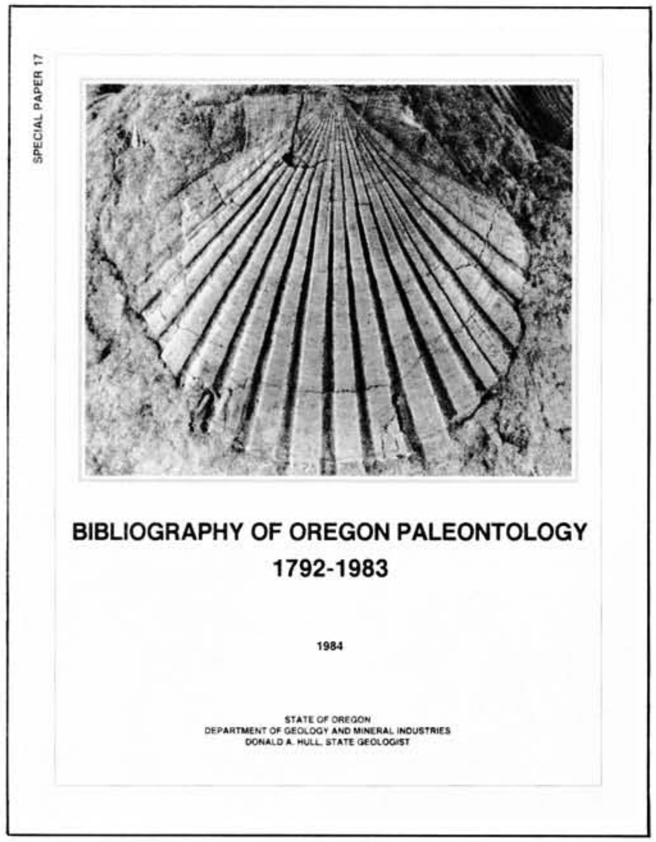
COVER PHOTO

Sandstone pinnacle in Otter Point terrane, upper Sixes River, Curry County, near the Dement Ranch. Article beginning on next page discusses nature of such exotic blocks.

Bibliography of Oregon paleontology released

The Oregon Department of Geology and Mineral Industries (DOGAMI) has released the first comprehensive bibliography of the paleontological literature on Oregon.

Bibliography of Oregon Paleontology, 1792-1983, DOGAMI Special Paper 17, was compiled by Elizabeth L. Orr, Research Librarian in Eugene, Oregon, and William N. Orr, Associate Professor, Department of Geology, University of Oregon. The 82-page publication is the result of six years of research and compilation. It contains approximately 1,200 individual references, including articles from about 160 different serial publications.



Special Paper 17, Bibliography of Oregon Paleontology, by Elizabeth L. and William N. Orr.

The bibliography has two parts: an author index and a subject index. The author entries are annotated, providing information on subject area, location, geologic formation, and similar matters that might not be evident in the title of the entry. The subject index is arranged by formation, county, subject (e.g., Vertebrates), or by a specific name (e.g., Cedar), whenever such a name was used in the title of a reference. Geographic subject terms include broader divisions (e.g., Blue Mountains) as well as smaller subdivisions under the county headings (e.g., Douglas County, Bohemia area). References under individual subject headings also include such geographic subdivisions, so that the literature is accessible through both paleontologic/geologic and geographic subject terms.

The new bibliography, DOGAMI Special Paper 17, 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 $6. Orders under $50 require prepayment. □

The origin of olistostromes in the Roseburg Formation in southwestern Oregon

by Ewart M. Baldwin, Department of Geology, University of Oregon, Eugene, Oregon 97403

OLISTOSTROMES AND OLISTOLITHS

Olistostromes, as defined in the American Geological Institute (AGI) geologic dictionary (Bates and Jackson, 1980), are sedimentary deposits consisting of a chaotic mass of intimately mixed heterogeneous material (such as blocks and muds) that accumulated as a semifluid body by submarine gravity sliding and slumping of unconsolidated sediments. An olistolith is an exotic block or other rock in an olistostrome. The terms "megabreccia" and "wildflysch" are sometimes used for exotic blocks of unusually large size. A seismoturbidite is an olistostrome produced by an earthquake, and the slide involved would presumably have taken place along a broad front all at one time, in contrast to more random sliding of individual blocks.

There are many exotic blocks of schists, greenstone, chert, basalt, and sandstone within the Roseburg Formation in the Coquille and Sitkum (15-minute) quadrangles east of Myrtle Point and along the Middle, North, and East Forks of the Coquille River near the communities of Gravelford and Bridge.

The writer's attention was first directed to these blocks when he was mapping the Coos Bay 30-minute quadrangle (Allen and Baldwin, 1944). Diller (1901) had located several of these blocks on his geologic folio. Magoon (1966) discovered others in the area he mapped along the edge of the Coquille and Sitkum quadrangles. When compiling the geologic map of Coos County (Baldwin and others, 1973), the writer noted these and other exotic rocks that had been discovered during the extension of many logging roads.

The Otter Point Formation (Koch, 1966; Dott, 1971) of southwestern Oregon is largely a mélange of Upper Jurassic and Lower Cretaceous sedimentary rocks, submarine flows, and less abundant pods of chert and blueschists. According to the AGI dictionary, a mélange is a mappable body of rock characterized by the inclusion of fragments and blocks of all sizes, both exotic and native, embedded in a fragmental and generally sheared matrix of more tractable material. The definition goes on to speak of a sedimentary mélange that is about the same as an olistostrome. The writer uses the term "mélange" only to refer to tectonically mixed material. The blocks within the mélange are usually more resistant to erosion, so that they stand out as stacks and pinnacles.

Upfaulted blocks of Otter Point terrane are present in the Powers 15-minute quadrangle (Baldwin and Hess, 1971), a short distance south of the Middle Fork of the Coquille River. This terrane contains rocks similar to those now interspersed within the Roseburg Formation and may have provided the source rock for the olistoliths in it.

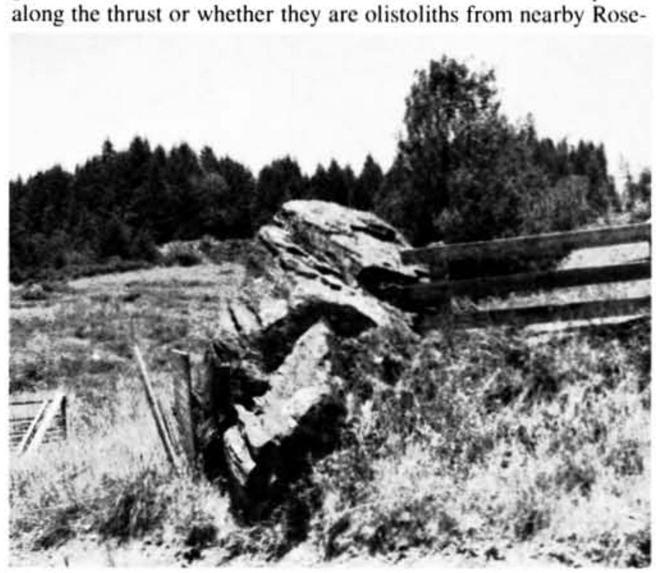
ORIGIN OF EXOTIC ROCKS

The exotic rocks are common to both the Otter Point and Roseburg terranes, and thus there is a problem in determining which is an Otter Point mélange and which is sheared Roseburg along a fault. Such an indeterminate area lies between Powers Junction south of Myrtle Point, Sugarloaf Mountain to the east, and the North Fork of the Coquille River to the north.

The writer mapped a thrust-fault zone extending from the northwest face of Sugarloaf Mountain along the East Fork of the Coquille River to a point just east of the Pleasant Hill School, where it goes under younger and noninvolved Lookingglass sedimentary rocks (Baldwin and others, 1973). Some of the most obvious exotic blocks lie along this zone, and they may be positioned there from thrust Otter Point material or exhumed from nearby Roseburg rock.

Diagram of block movement from the Otter Point terrane to modern sediments.

One large block of greenstone is situated at the south end of the North Fork bridge 2 mi east of Myrtle Point, but it has been largely removed by quarrying. Along the north bank road from this bridge westward to Oregon Highway 42, one soon comes to an outcrop of red chert in the NE¼ sec. 10, T. 29 S., R. 12 W., and, a short distance north of this, an outcrop of yellow sandstone with quartzite-bearing conglomerate which is very close to auger holes that yielded Late Cretaceous microfossils. The other areas between the bridge and the highway are underlain by sheared rock that tends to slide. The writer considered the area to be Roseburg and the exotic rocks to have been introduced by sliding at the time of deposition or by faulting (Baldwin and others, 1973). A greenstone body was present at Kasper's quarry a few miles east of Gravelford, in line with the thrust fault that passes by Sugarloaf Mountain. It is located in the NE¼ sec. 29, T. 28 S., R. 11 W. A few yards down the hill from the quarry are two blocks of schist. Whether both the greenstone and the schist blocks are in Otter Point terrane exposed along the thrust or whether they are olistoliths from nearby Rose-

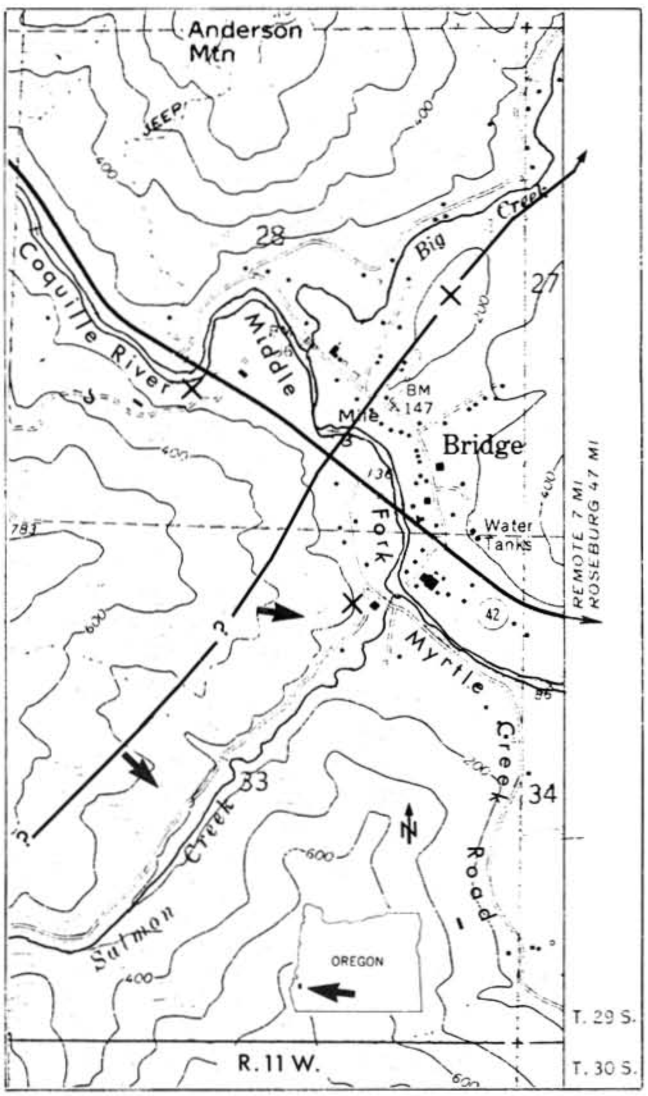


Block of blueschist near Kasper's quarry along the East Fork of the Coquille River.

burg sediments is difficult to determine. Magoon (1966) mapped the area including Kasper's quarry and suggested the possibilities that the rocks were positioned by faulting or by sliding in, during Roseburg deposition, from a nearby Otter Point highland.

OLISTOSTROME AT BRIDGE, OREGON

One of the small exotic blocks mapped by Diller (1901) proved to be a block of schist no more than 8 ft in maximum dimension, on a small ridge just north of the business section in the small community of Bridge. Bridge evidently derived its name from the large covered bridge over the Middle Fork of the Coquille River by the school on the Myrtle Creek road. This bridge was not designed for large logging trucks, so when the State Highway Department straightened Highway 42 at this point, creating two bridges over the Middle Fork of the Coquille, the County extended the Myrtle Creek road across the mouth of Salmon Creek to join the highway farther west, thus eliminating the need for the old covered bridge by the schoolhouse. As the Myrtle Creek road was being relocated, most of the material in a cluster of mica-sheet blocks that had been situated on the west bank of Salmon Creek was removed. Another large block of greenstone, 15 ft or more in diameter and almost



Segment of the Bridge 7½-minute quadrangle showing the olistostrome at Bridge and olistolith locations in the vicinity. Black line=olistostrome. X=olistolith location. Arrows=suggested direction of movement of olistoliths.

metamorphosed to a low-grade blueschist, is situated in the Coquille River just south of the westernmost of the new highway bridges.

The schist block on the small ridge north of the Bridge business section proved to be but one of the exotic rocks in a bed of olistoliths that can be traced to the north across Big Creek and also south to the river bank, then may be projected beneath the alluvial flat and on up the hill southward, paralleling Salmon Creek to the west. There seems to be no doubt as to this bed's being a part of the Roseburg Formation. The bed, which is approximately 4 ft thick, may be seen dipping steeply eastward along the north bank of the river. It contains subrounded to angular blocks of poorly sorted exotic rocks in a sandstone matrix. When projected southward, it goes between the schist blocks at the mouth of Salmon Creek and the large one beneath the highway bridge to the west, but these blocks may have slid from their original positions to where they are now. Other blocks along Salmon Creek probably came from this bed, although some of them may be olistoliths randomly placed in the Roseburg Formation. The writer favors the hypothesis that the olistostrome at Bridge is a seismoturbidite, that is, an olistostrome triggered by an earthquake which caused the olistostrome to form all at one time, in contrast to those singly situated, randomly spaced olistoliths that may have slid into the Roseburg sediments in other parts of the area.

Tor H. Nilsen of the U.S. Geological Survey described the Hilt Bed of the Hornbrook Formation at the Geological Society of America meeting in Indianapolis, November 3, 1983. He traced this bed from Hilt, California, past Ashland, Oregon, and, by projection and intermittent outcrop, to Grave Creek. He considered the Hilt Bed to be a seismoturbidite triggered by an earthquake in Late Cretaceous time. There is a similarity between the Hilt Bed and the one at Bridge, although the latter is not as extensive.

For a modern example of olistostrome formation, we might consider the coastal area south of Humbug Mountain which is underlain by sheared Otter Point terrane (Koch, 1966; Dott, 1971).

Sliding terrane with exotic blocks south of Humbug Mountain, Curry County coast.

Here, the unstable sheared material is sliding seaward, with large exotic blocks reaching the shoreline to beome stacks and eventually migrating seaward by sliding. Studies of sedimentation in other parts of the world indicate that material may slide for a considerable distance on sea bottoms of only a few degrees slope. As the sea erodes inland, the stacks become situated farther from the shore and surrounded by bedded sediments. In both the modern sediments and the Roseburg Formation the exotic blocks almost surely came from such an unstable Otter Point terrane.

(Continued on page 82, **Olistostromes***)*

Petroleum source rock evaluations of outcrop samples from Oregon and northern California

by B.E. Law, D.E. Anders, T.D. Fouch, M.J. Pawlewicz, M.R. Lickus, and C.M. Molenaar,
U.S. Geological Survey, Denver Federal Center, Box 25046, MS 971, Denver, Colorado 80225

ABSTRACT

Petroleum source rock evaluations of carbonaceous sandstone, siltstone, shale, mudstone, and coal samples of various ages collected from surface exposures in Oregon and northern California indicate that the organic matter is predominantly type III kerogen. Most samples contain less than 1.0 weight percent organic carbon; the average organic carbon content is 0.91 weight percent. The thermal maturities of the samples with respect to hydrocarbon generation range from immature in the younger rocks to post-mature in the older rocks. Most of the samples are immature to marginally mature. Based on our evaluation of the type of organic matter contained in these samples, indications are the source rock is capable of generating gas and little or no oil.

INTRODUCTION

There has been sporadic interest in the petroleum potential of the Pacific Northwest for several years. Since the 1979 discovery of

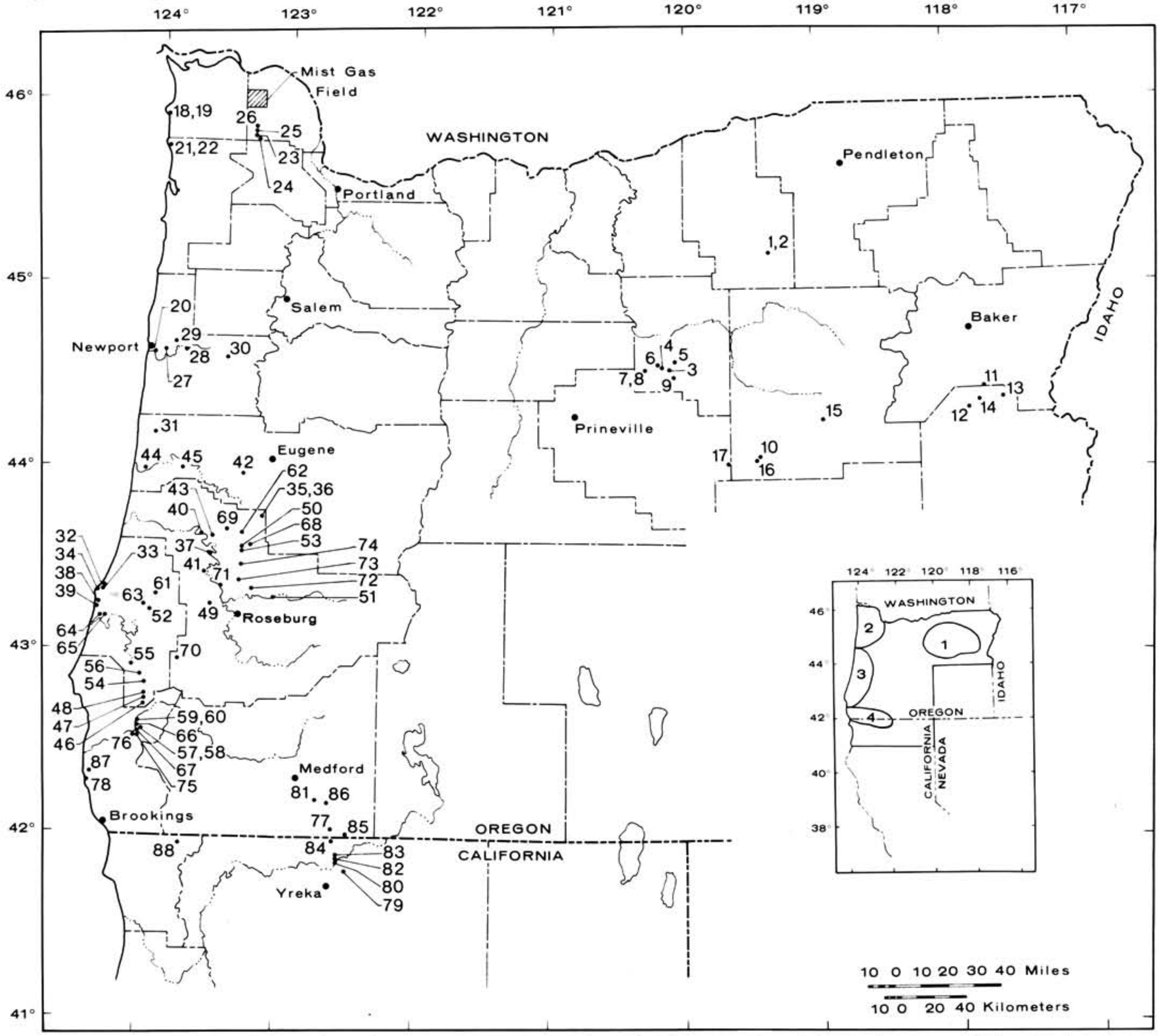


Figure 1. Sample localities and sample areas in Oregon and northern California. Analytical data and more specific locality descriptions for samples are shown in Table 1.

Table 1.--Source-rock analytical data for surface samples from Oregon and northern California

[Tr, Triassic; JTr, Jurassic and Triassic; J, Jurassic; K, Cretaceous; T, Tertiary; argl, argillite; carb, Carbonaceous; clyst, claystone; ms, mudstone; ss, sandstone; sdy, sandy; sh, shale; shy, shaly; sltst, siltstone; slty, silty; -- no data]

Map no. (fig. 1)	Sample no.	Section	Township	Range	County[1]	Age	Stratigraphic unit	Lithology	Vitrinite reflectance, R_o (percent)	Organic carbon (Wt %)	S_1 (mgHC/g)	S_2 (mgHC/g)	S_3 ($mgCO_2$/g)	T_{max} (°C)	Genetic potential (S_1+S_2)	H_2 index (mgHC/gC)	O_2 index ($mgCO_2$/gC)	Transformation ratio, (S_1/S_1+S_2)
Area 1																		
1	082TF-15	SW 34	T. 4 S.	R. 28 E.	Morrow	K	pre-Clarno Fm.	carb sh	--	4.72	.044	3.83	2.04	434	3.87	81	43	.01
2	082TF-14	NW 34	T. 4 S.	R. 28 E.	---do---	K	Sandstone (Pre-Clarno Fm.)	ss	.86	.04	.017	--	.29	--	.017	--	717	1
3	082TF-26	6	T. 12 S.	R. 22 E.	Wheeler	K	Hudspeth Formation	sh	--	1.44	0.013	0.093	0.64	448	0.106	6	44	0.13
4	082TF-27	35	T. 11 S.	R. 21 E.	---do---	K	---do---	ms	0.62	.70	.028	.12	.40	430	.15	17	58	.19
5	082TF-28	18	T. 11 S.	R. 22 E.	---do---	K	---do---	ms	.85	.34	.021	.003	.49	449	.024	1	145	.86
6	082TF-30	28	T. 11 S.	R. 21 E.	---do---	K	---do---	ms	.61	1.19	.017	.123	.76	460	.140	10	64	.12
7	082TF-31	3	T. 12 S.	R. 20 E.	---do---	K	---do---	ms	.63	.21	.017	6.95	.54	438	6.97	3	256	.71
8	082TF-32	3	T. 12 S.	R. 20 E.	Wheeler	K	---do---	ms	--	.47	.022	.09	.28	426	.11	20	59	.19
9	082TF-25	21	T. 12 S.	R. 22 E.	---do---	K	Gable Creek Formation	clyst	.84	.84	.014	.006	.53	434	.020	76	63	.69
10	082TF-22	23	T. 17 S.	R. 27 E.	Grant	J	Sedimentary rocks (Walker, 1977)	sh	1.06	--	--	--	--	--	--	--	--	--
11	082TF-16	7	T. 13 S.	R. 41 E.	Baker	JTr	Sedimentary and volcanic rocks (Walker, 1977)	argl	.49	--	--	--	--	--	--	--	--	--
12	082TF-17	19	T. 14 S.	R. 40 E.	Malheur	JTr	---do---	argl	--	.99	.017	--	.35	--	.017	--	35	1
13	082TF-18	NW 32	T. 3 S.	R. 42 E.	Malheur	JTr	---do---	argl	--	1.22	.010	--	.51	--	.010	--	41	1
14	082TF-19	2	T. 14 S.	R. 40 E.	---do---	JTr	---do---	clyst	.50	.22	.009	--	.49	--	.009	--	222	1
15	082TF-20	NW 11	T. 15 S.	R. 31 E.	Grant	Tr	Graywacke and shale (Thayer, 1956)	sh	3.05	1.00	.016	--	.46	--	.016	--	46	1
16	082TF-23	18	T. 17 S.	R. 27 E.	---do---	Tr	Sedimentary and volcanic rocks (Walker, 1977)	sltst	.34	--	--	--	--	--	--	--	--	--
17	082TF-24	25	T. 17 S.	R. 27 E.	Crook	Tr	Marine sedimentary rocks (Walker, 1977)	sdy sh	.58	--	--	--	--	--	--	--	--	--
Area 2																		
18	082TF-1	18	T. 5 N.	R. 10 W.	Clatsop	T	Astoria Formation	clyst	0.36	1.18	0.043	0.21	1.33	437	0.25	18	112	0.17
19	082TF-2	18	T. 5 N.	R. 10 W.	---do---	T	---do---	sdy clyst	.65	1.61	.061	.77	.46	424	.83	48	28	.07
20	081TF-88	SW 9	T. 11 S.	R. 11 W.	Lincoln	T	Nye Shale (middle part)	sltst	.36	1.34	.091	.99	.97	404	1.08	74	72	.08
21	082TF-3	7	T. 3 N.	R. 10 W.	Tillamook	T	Formation at Oswald West	slty clyst	1.78	.65	.089	.02	.22	446	.11	2	34	.86
22	082TF-4	7	T. 3 N.	R. 10 W.	---do---	T	---do---	sltst	1.86	--	--	--	--	--	--	--	--	--
23	082TF-6	27	T. 4 N.	R. 5 W.	Columbia	T	Keasey Formation (Neim and Van Atta, 1973)	slty clyst	.34	.91	.008	.24	.79	418	.25	27	86	.03
24	082TF-5	35	T. 4 N.	R. 5 W.	Columbia	T	Keasey Formation (lower part)	sltst, coal	--	.18	.017	.03	.36	401	.05	14	203	.40
25	082TF-8	15	T. 4 N.	R. 5 W.	---do---	T	---do---	sdy sltst	.29	--	--	--	--	--	--	--	--	--
26	082TF-7	3	T. 4 N.	R. 5 W.	---do---	T	Cowlitz Formation (upper part) (Niem and Van Atta, 1973)	slty ss	.31	--	--	--	--	--	--	--	--	--
27	081TF-86	SE NE 5	T. 11 S.	R. 10 W.	Lincoln	T	Yamhill Formation (Snavely et al., 1980)	clyst	.32	.50	.021	.17	.51	418	.19	35	103	.11
28	081TF-84	SW SW 3	T. 11 S.	R. 9 W.	---do---	T	Tyee Formation	sh	.53	.53	.012	.16	.39	422	.17	31	73	.07
29	081TF-85	SW 24	T. 10 S.	R. 10 W.	---do---	T	---do---	sh	.46	.95	.034	.21	.48	427	.24	23	51	.14
30	081TF-82	SW SW 18	T. 11 S.	R. 6 W.	Benton	T	Umpqua Formation	clyst	.53	.23	.012	--	.25	--	.012	--	107	1
Area 3																		
31	081TF-87	SW NE 10	T. 16 S.	R. 11 W.	Lane	T	Nye Shale	sltst	0.34	1.75	0.046	1.14	0.91	407	1.19	65	52	0.04
32	081M-13	NE SW 3	T. 26 S.	R. 14 W.	Coos	T	Bastendorff Shale (upper part)	slty sh	.32	.94	.087	.99	1.05	418	1.08	106	111	.08
33	081TF-98	NW 9	T. 26 S.	R. 14 W.	---do---	T	Coaledo Formation (middle part)	sh	.51	1.46	.017	.22	.51	425	.24	15	35	.07
34	081TF-97	NE 8	T. 26 S.	R. 14 W.	---do---	T	Coaledo Formation (lower part)	sh	.49	1.44	.016	.39	.76	417	0.41	27	53	.04
35	081M-4	SE NW 16	T. 21 S.	R. 4 W.	Douglas	T	Spencer Formation	clyst, carb sh	.48	4.48	.030	.99	1.61	409	1.02	22	36	.03
36	081M-5	SW SW 16	T. 21 S.	R. 4 W.	---do---	T	---do---	sltst	.45	1.12	.042	1.02	.35	409	1.06	91	31	.04
37	081M-3	NE NW 30	T. 23 S.	R. 7 W.	---do---	T	Elkton Formation	sltst, slty sh	.59	1.35	.026	1.09	.24	436	1.12	81	18	.02
38	081M-6	C 5	T. 27 S.	R. 14 W.	Coos	T	---do---	slty sh	.45	.86	.029	.37	.66	420	.40	43	77	.07
39	081M-7	NW NW 17	T. 27 S.	R. 14 W.	---do---	T	---do---	slty sh	.52	.58	.022	.25	.48	424	.27	44	83	.08
40	081TF-95	NW NW 22	T. 22 S.	R. 8 W.	Douglas	T	---do---	slty sh	.59	.63	.016	.17	.32	420	.19	27	51	.09
41	081TF-120	NE SE 36	T. 24 S.	R. 8 W.	---do---	T	Elkton Formation (Baldwin, 1974)	sh	.59	.91	.018	.51	.33	431	.53	56	36	.03
42	081TF-91	C W 1/2 29	T. 18 S.	R. 5 W.	Lane	T	Tyee Formation (upper part)	sltst, ss	.49	.62	.051	--	.59	--	.051	--	95	1
43	081TF-94	21	T. 22 S.	R. 7 W.	Douglas	T	---do---	sltst	.60	1.41	.046	.87	.68	436	.92	62	48	.05
44	081TF-89	SE SE 19	T. 18 S.	R. 11 W.	Lane	T	Tyee Formation	sh	.38	.87	.012	.12	.56	427	.13	14	65	.09

Table 1.--Source-rock analytical data for surface samples from Oregon and northern California--continued

Map no. (fig. 1)	Sample no.	Section	Township	Range	County[1]	Age	Stratigraphic unit	Lithology	Vitrinite reflectance, R_o (percent)	Organic carbon (Wt %)	S_1 (mgHC/g)	S_2 (mgHC/g)	S_3 ($mgCO_2$/g)	T_{max} (°C)	Genetic potential (S_1+S_2)	H_2 index (mgHC/gC)	O_2 index ($mgCO_2$/gC)	Transformation ratio, (S_1/S_1+S_2)
Area 3																		
45	081TF-90	NE NE 16	T. 18 S.	R. 9 W.	---do----	T	----do------------------------	slty sh	.54	2.55	.042	.96	.93	435	1.00	37	37	.04
46	081TF-104	NW 21	T. 33 S.	R. 11 W.	Coos-----	T	----do------------------------	sh	.86	.84	.024	.08	.18	435	.10	10	22	.22
47	081TF-106	SW NE 32	T. 32 S.	R. 11 W.	---do----	T	----do------------------------	coal	.55	54.97	.285	147.71	7.03	423	148.00	269	13	.002
48	081TF-109	NE 29	T. 32 S.	R. 11 W.	---do----	T	----do------------------------	coal	.63	36.61	.999	59.69	7.70	416	60.69	163	21	.02
49	081TF-119	SW SW 33	T. 26 S.	R. 7 W.	Douglas--	T	Tyee Formation (lower part)----	sh	.58	1.02	.019	.76	.42	435	.78	75	41	.02
50	081TF-127	SW NW 8	T. 23 S.	R. 5 W.	---do----	T	----do------------------------	sh	.59	.65	.020	.12	.26	430	.14	19	39	.14
51	081TF-117	C N 1/2 17	T. 26 S.	R. 3 W.	---do----	T	Umpqua Formation---------------	clyst	.52	.22	.008	.05	.27	432	.06	22	122	.15
52	081M-16	C W 1/2 15	T. 27 S.	R. 11 W.	Coos-----	T	Umpqua Formation---------------	slty sh	.51	.66	.016	.16	.38	427	.18	24	57	.09
53	081TF-126	C SW 20	T. 23 S.	R. 5 W.	Douglas---	T	----do------------------------	slty sh	.61	.31	.019	.02	.75	440	.04	5	243	.54
54	081TF-102	NW 5	T. 32 S.	R. 11 W.	Coos-----	T	----do------------------------	sh	.58	.66	.025	.18	.23	431	.21	27	35	.12
55	081TF-100	C NE 34	T. 30 S.	R. 12 W.	---do----	T	Umpqua Formation--------------- (=Lookingglass Formation of Baldwin and Beaulieu, 1973)	sh	.46	.89	.019	.11	.47	431	.13	13	52	.14
56	081TF-101	C 19	T. 31 S.	R. 11 W.	---do----	T	----do------------------------	sltst	.61	.61	.017	.13	.33	426	.15	22	54	.12
57	BELO 2082	NE 5	T. 35 S.	R. 11 W.	Curry----	T	Umpqua Formation--------------- (=Lookingglass Formation of Ahmad, 1981)	slty sh	.75	.77	.016	.09	.23	428	.11	12	30	.14
58	BELO 2182	SW 5	T. 35 S.	R. 11 W.	---do----	T	----do------------------------	slty sh	.63	.48	.017	.11	.41	440	.13	23	85	.13
59	BELO 2382	SE SW 19	T. 34 S.	R. 11 W.	---do----	T	----do------------------------	slty sh	.63	.35	.015	.01	.34	439	.03	3	96	.60
60	BELO 2482	NE SW 19	T. 34 S.	R. 11 W.	---do----	T	----do------------------------	shy sltst	.64	.41	.029	.152	.31	439	.181	37	75	.16
61	081TF-116	C 13	T. 26 S.	R. 4 W.	Coos-----	T	Umpqua Formation--------------- (=Lower part of Lookingglass-Formation of Baldwin, 1974)	slty sh	.53	.37	.015	.04	.37	428	.06	12	99	.26
62	081M-2	CN 1/2 17	T. 22 S.	R. 5 W.	Douglas--	T	Umpqua Formation---------------	sh, clyst	.65	.32	.016	.12	.38	422	.14	37	120	.12
63	081M-15	NW SE 5	T. 27 S.	R. 11 W.	Coos-----	T	----do------------------------	slty sh	.53	1.47	.010	.05	.40	428	.06	3	27	.18
64	081M-8	NE 34	T. 27 S.	R. 14 W.	---do----	T	Umpqua Formation--------------- (=Roseburg Formation of Baldwin and Beaulieu, 1973)	slty sh	.52	.37	.024	.094	.28	447	.118	25	75	.20
65	081M-9	NW 35	T. 27 S.	R. 14 W.	---do----	T	----do------------------------	slty sh	.59	.68	.014	.08	.26	424	.09	12	38	.15
66	BELO 2282	SE NW 31	T. 34 S.	R. 11 W.	Curry----	T	Umpqua Fm. (=Roseburg --------- Formation of Ahmad, 1981)	slty sh	.60	.42	.013	.09	.22	441	.10	22	52	.12
67	BELO 2582	NE NE 7	T. 35 S.	R. 11 W.	---do----	T	----do------------------------	carb shy sltst	1.75	.13	.024	--	.23	--	.024	--	57	1
68	081M-1	SW 2	T. 23 S.	R. 5 W.	Douglas--	T	Umpqua Formation---------------	slty sh	.60	.43	.009	.007	.46	426	.016	2	107	.56
69	081TF-92	S 1/2 SW 8	T. 22 S.	R. 6 W.	---do----	T	----do------------------------	sh	.76	.41	.021	.05	.66	422	.07	13	161	.27
70	081TF-113	NW 16	T. 30 S.	R. 9 W.	---do----	T	----do------------------------	carb sltst	.48	19.20	.037	11.05	16.66	425	11.09	58	87	.003
71	081TF-121	SE SE 25	T. 25 S.	R. 7 W.	---do----	T	----do------------------------	slty sh	.59	.63	.028	.24	.24	428	.27	38	38	.10
72	081TF-122	NE SW 36	T. 25 S.	R. 5 W.	---do----	T	----do------------------------	sh	.54	.81	.018	.003	.87	442	.021	33	108	.87
73	081TF-124	18	T. 25 S.	R. 5 W.	---do----	T	----do------------------------	sh	.56	.34	.011	.06	.23	431	.07	16	68	.17
74	081TF-125	SW NW 17	T. 24 S.	R. 5 W.	---do----	T	----do------------------------	sh	.64	.84	.015	.14	.25	426	.16	17	30	1
75	BELO 2682	SW NW 18	T. 35 S.	R. 11 W.	Curry----	K	Unnamed Cretaceous rocks	slty sh	.75	2.42	.067	.79	.24	448	.86	33	10	.08
76	BELO 2782	NE 13	T. 35 S.	R. 12 W.	---do----	K	----do------------------------	slty sh	.72	2.48	.040	.36	.62	454	.40	14	25	.10
Area 4																		
77	BELO 1082	NE 32	T. 40 S.	R. 2 E.	Jackson--	T	Colestin Formation------------- (Elliott, 1971)	carb slty ms	0.52	0.11	0.002	--	0.31	--	0.002	--	277	1
78	BELO 282	SW SE 18	T. 38 S.	R. 14 W.	Curry----	K	Hornbrook Formation------------ (Wells and Peck, 1961)	slty sh	.54	.57	.008	.12	.33	431	.13	21	59	.06
79	BELO 482	SE 23	T. 46 N.	R. 6 W.	Siskiyou (CA)	K	Hornbrook Fm. - Unit b--------- (Nilsen et al.,1983	coaly sh	.59	23.61	.120	44.68	5.50	442	44.80	189	23	.003
80	BELC 582	NE 32	T. 47 N.	R. 6 W.	---do----	K	----do------------------------	carb sltst, ss	.51	.93	.026	.25	.19	437	.28	27	21	.09
81	BELO 1482	NW 5	T. 39 S.	R. 1 E.	Jackson--	K	----do------------------------	shly sltst	.77	.64	.012	.04	.33	431	.05	8	65	.21
82	BELC 682	NE NE 29	T. 47 N.	R. 6 W.	Siskiyou (CA)	K	----do------------------------	slty sh	.58	.37	.007	.01	.46	455	.02	3	123	.4
83	BELC 782	NW 20	T. 47 N.	R. 6 W.	---do----	K	----do------------------------	slty sh	.67	.74	.022	.22	.34	438	.24	30	46	.09
84	BELC 882	SE NW 25	T. 48 N.	R. 7 W.	---do----	K	----do------------------------	slty sh	.64	.90	.013	.17	.20	434	.18	19	22	.07
85	BELC 982	SE 14	T. 48 N.	R. 6 W.	---do----	K	----do------------------------	slty sh	.60	.69	.016	.20	.26	431	.22	30	37	.07
86	BELO 1282	12	T. 39 S.	R. 1 E.	Jackson--	K	----do------------------------	slty sh	.52	.64	.009	.01	.83	434	.02	2	129	.39
87	BELO 182	SW SW 32	T. 37 S.	R. 14 W.	Curry----	K	Days Creek Formation----------- (Wells and Peck, 1961)	ms	.55	1.08	.015	.03	.65	433	.05	2	60	.36
88	BELC 382	NW 15	T. 18 N.	R. 4 E.	Del Norte (CA)	J	Galice Formation---------------	slaty sh	5.33	1.14	0	0	.22	--	0	0	19	0

[1]All counties are in Oregon, except as noted.

the Mist Gas Field in northwestern Oregon and encouraging gas shows in wells drilled in central Washington, the region has experienced renewed hydrocarbon exploration activity. However, very little information that might be used to establish the oil and gas source rock potential of the region has been published. The only study in Oregon and northern California is an oil and gas investigation report by Newton (1980) in the Coos Bay, Oregon, area.

The purposes of this study are (1) to report the analytical results of a reconnaissance source rock sampling project in Oregon and northern California and (2) to evaluate the quality, quantity, and thermal maturity of organic matter contained in those samples.

SOURCE ROCK EVALUATION

Eighty-eight samples were collected from outcrops, primarily in road cuts and stream drainages. Sample localities are shown in Figure 1 and are listed in Table 1. Based on the areal distribution of samples, the region was subdivided into four areas (Figure 1). Within each area, the samples are listed in approximate order of increasing age. The age of most samples is Cretaceous or younger. A few pre-Cretaceous rock samples were collected, although rocks older than Cretaceous are commonly metamorphosed. The samples consist of carbonaceous sandstone, siltstone, shale, mudstone, and coal (Table 1) and represent depositional environments ranging from nonmarine to marine. The samples were analyzed for vitrinite reflectance (R_o), total organic carbon (weight percent), and Rock-Eval pyrolysis (Table 1). Vitrinite reflectance and Rock-Eval pyrolysis analyses were conducted by the U.S. Geological Survey (USGS), Denver, Colorado, and organic carbon analyses were conducted by Rinehart Laboratory, Arvada, Colorado.

Rock-Eval pyrolysis includes evaluations of the genetic potential (S_1+S_2), organic matter type (hydrogen index [S_2/organic carbon] versus oxygen index [S_3/organic carbon]), and thermal maturity ($T°S_2$ max. and transformation ratio [S_1/S_1+S_2]). S_1 represents the quantity of volatile hydrocarbons (HC) expelled from rocks held at 250° C for 5 minutes. S_2 measures the quantity of hydrocarbons (HC) released from the rock upon pyrolysis of the kerogen at 250° to 550° C, programmed at 25° C per minute. S_3 is a measure of the amount of pyrolitic carbon dioxide evolved during the heating interval from 250° to 390° C. Detailed explanations of Rock-Eval pyrolysis are given by Espitalié and others (1977) and Tissot and Welte (1978).

The organic matter richness of the samples is generally low. However, the organic matter content of these surface samples may have been significantly reduced by weathering (Leythaeuser, 1973; Clayton and Swetland, 1978). Most samples contain less than 1.0 weight percent organic carbon (Table 1); average organic carbon content, excluding coal, is 0.91 weight percent. According to Dickey and Hunt (1972), a rock must have a minimum organic carbon content of 0.50 weight percent to be an effective hydrocarbon source rock. Organic matter occurs in most samples as disseminated flakes and plant fragments. The more organic-rich rocks are the coals and carbonaceous shales and mudstones.

Hydrogen and oxygen indices from Rock-Eval pyrolysis are plotted in Figure 2. These results show that the organic matter in the analyzed samples is mainly type III kerogen. The three samples that are in proximity to the merged types I and II evolutionary paths are coal and coaly shale (map numbers 47 and 48 from the Eocene Tyee Formation and 79 from the Cretaceous Hornbrook Formation, Figure 1 and Table 1). Some variation in the hydrogen and oxygen indices may result from different proportions of the organic matter types in the rocks. The hydrogen index is also affected by the organic carbon content of the samples; low organic carbon values commonly give artificially low hydrogen index values due to adsorption of the pyrolysis products by mineral matter in the rock. In general, the more hydrogen-rich kerogens (types I and II) are oil and gas source rocks, and the hydrogen-deficient kerogens (type III) are gas source rocks. Thus, nearly all of the samples from this study are gas source rocks with little or no potential for oil.

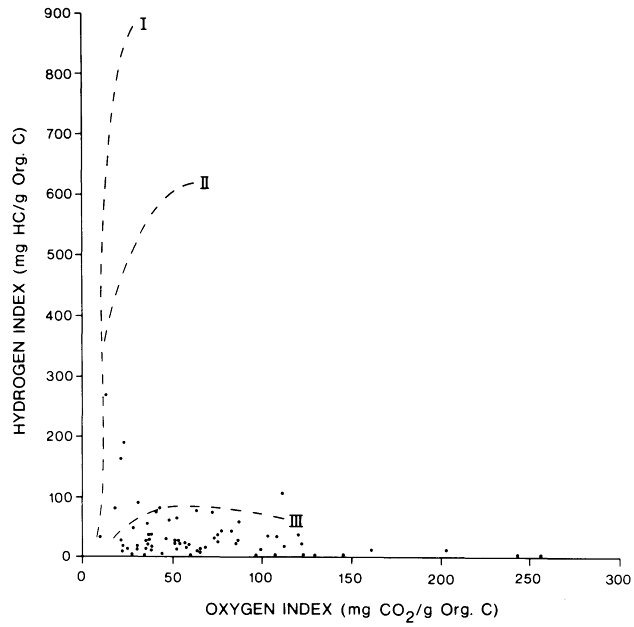


Figure 2. Modified van Krevelen diagram (Tissot and Welte, 1978) of hydrogen and oxygen indices of samples from Oregon and northern California.

The genetic potential (S_1+S_2 in Table 1) is a measure of the generation capacity of the rock in milligrams of hydrocarbon per gram (mg/g), which is equivalent to kilograms per metric ton (kg/t). Tissot and Welte (1978) have suggested that samples with values less than 2 kg/t have low hydrocarbon potential, samples from 2 to 6 kg/ton have moderate source rock potential, and samples with more than 6 kg/t have good source rock potential. Based on these generation potential values, most of the analyzed samples are poor source rocks, and only a few could be classified as moderate to good source rocks.

The level of thermal maturity at which thermal generation of hydrocarbons starts is variable. The initiation of thermogenic hydrocarbons is largely dependent on the quality of organic matter. According to Tissot and Welte (1978), the top of the "oil window" is between vitrinite reflectance (R_o) values of 0.5 and 0.7 percent, and the bottom of the "oil window" is 1.3 percent. Less is known about the generation of thermogenic gas from type III kerogen, but it is known that significant gas generation begins at a slightly higher level of organic maturation than in types I and II kerogens (Tissot and Welte, 1978; Hunt, 1979). Source rock studies of type III kerogens from Cretaceous and Tertiary rocks in the Greater Green River Basin of Wyoming, Colorado, and Utah (Law and others, 1979, 1980; Law, 1984) indicate that the generation of thermogenic gas begins at a vitrinite reflectance (R_o) value of about 0.80 percent (range is 0.74-0.86 percent). The vitrinite reflectance values of most analyzed samples in this study are below 0.70 percent, indicating that these samples are immature or marginally mature with respect to gas generation.

Temperature maximum (T_{max} in Table 1) data are in fair agreement with vitrinite reflectance data. According to Espitalié and others (1977), temperature maximums in the range of 400° to 435° C correspond to immature source rocks, and temperatures between 435° and 460° C correspond to mature source rocks. The transformation ratio (S_1/S_1+S_2 in Table 1) is another measure of thermal maturity. The transformation ratio generally increases with increasing thermal maturity. Values in the range of 0.1 to 0.4 are considered to be in the oil generation zone (Tissot and Welte, 1978). Coal rank data reported for several coal fields in Oregon by Brownfield (1981) are also in general agreement with the vitrinite reflectance data.

CONCLUSIONS

A source rock evaluation of surface samples collected in Oregon and northern California indicates that the organic matter is predominantly type III kerogen and therefore has the potential of generating gas and little or no oil. The sampling density is insufficient to evaluate the source rock characteristics of any particular stratigraphic unit, but the analyses provide insight into the hydrocarbon potential of the region.

In general, most samples are organically lean, containing less than 1.0 weight percent organic carbon. Thermal maturities of the samples are highly variable. However, most samples are immature to marginally mature with respect to gas generation.

REFERENCES CITED

Ahmad, R., 1981, Stratigraphy, structure, and petrology of the Lookingglass and Roseburg Formations, Agness-Illahe area, southwest Oregon: Eugene, Oreg., University of Oregon master's thesis, 150 p.

Baldwin, E.M., 1974, Eocene stratigraphy of southwestern Oregon: Oregon Department of Geology and Mineral Industries Bulletin 83, 40 p.

Baldwin, E.M., and Beaulieu, J.D., 1973, Geology of Coos County, Oregon: Oregon Department of Geology and Mineral Industries Bulletin 80, p. 1-40.

Brownfield, M.E., 1981, Oregon's coal and its economic future: Oregon Department of Geology and Mineral Industries, Oregon Geology, v. 43, no. 5, p. 59-67.

Clayton, J.L., and Swetland, P.J., 1978, Subaerial weathering of sedimentary organic matter: Geochimica et Cosmochimica Acta, v. 42, p. 305-312.

Dickey, P.A., and Hunt, J.M., 1972, Geochemical and hydrogeologic methods of prospecting for stratigraphic traps: American Association of Petroleum Geologists Memoir 16, p. 136-167.

Elliott, M.A., 1971, Stratigraphy and petrology of the Late Cretaceous rocks near Hilt and Hornbrook, Siskiyou County, California, and Jackson County, Oregon: Corvallis, Oreg., Oregon State University doctoral dissertation, 171 p.

Espitalié, J., Laporte, J.L., Madec, M., Marquis, F., Leplat, P., Paulet, J., and Boutefeu, A., 1977, Rapid method for source rock characterization and for evaluating their petroleum potential and their degree of evolution (English translation): Institut Français Du Pétrole, v. 32, p. 23-42.

Hunt, J.M., 1979, Petroleum geochemistry and geology: San Francisco, Calif., W.H. Freeman and Co., 617 p.

Law, B.E., 1984, Relationships of source rock, thermal maturity, and overpressuring to gas generation and occurrence in low-permeability Upper Cretaceous and lower Tertiary rocks, Greater Green River basin, Wyoming, Colorado, and Utah, *in* Woodward, J., Clayton, J., and Meissner, F., eds., Symposium on sources for oil and gas in the Rocky Mountain area: Rocky Mountain Association of Geologists [in press].

Law, B.E., Spencer, C.W., and Bostick, N.H., 1979, Preliminary results of organic maturation, temperature, and pressure studies in the Pacific Creek area, Sublette County, Wyoming, *in* 5th DOE Symposium on Enhanced Oil and Gas Recovery and Improved Drilling Methods, vol. 3—Oil and Gas Recovery: Tulsa, Okla., Petroleum Publishing Co., p. K-2/1-K-2/13.

——— 1980, Evaluation of organic matter, subsurface temperature, and pressure with regard to gas generation in low-permeability Upper Cretaceous and lower Tertiary strata in the Pacific Creek area, Sublette and Sweetwater Counties, Wyoming: Mountain Geologist, v. 17, no. 2, p. 23-35.

Leythaeuser, D., 1973, Effects of weathering on organic matter in shales: Geochimica et Cosmochimica Acta, v. 37, p. 113-120.

Newton, V.C., Jr., 1980, Prospects for oil and gas in the Coos Basin, western Coos, Douglas, and Lane Counties, Oregon: Oregon Department of Geology and Mineral Industries Oil and Gas Investigation 6, 74 p.

Niem, A.R., and Van Atta, R.O., 1973, Cenozoic stratigraphy of northwestern Oregon and adjacent southwestern Washington, *in* Beaulieu, J.D., field trip committee chairman, Geologic field trips in northern Oregon and southern Washington: Oregon Department of Geology and Mineral Industries Bulletin 77, p. 75-132.

Nilsen, T.H., Barats, G.M., Elliott, M.A., and Jones, D.L., 1983, Geologic map of the outcrop area of the Hornbook Formation, Oregon and California: U.S. Geological Survey Open-File Report 83-373, scale 1:62,500.

Snavely, P.D., Jr., MacLeod, N.S., Wagner, H.C., and Lander, D.L., 1980, Geology of the west-central part of the Oregon Coast Range, *in* Oles, K.F., Johnson, J.G., Niem, A.R., and Niem, W.A., eds., Geologic field trips in western Oregon and southwestern Washington: Oregon Department of Geology and Mineral Industries Bulletin 101, p. 39-76.

Thayer, T.P., 1956, Preliminary geologic map of the John Day quadrangle, Oregon: U.S. Geological Survey Mineral Investigations Field Studies Map MF-51, scale 1:62,500.

Tissot, B.P., and Welte, D.H., 1978, Petroleum formation and occurrence: Berlin, Springer-Verlag, 527 p.

Walker, G.W., 1977, Geologic map of Oregon east of the 121st meridian: U.S. Geological Survey Miscellaneous Investigations Series Map I-902, scale 1:500,000.

Wells, F.G., and Peck, D.L., 1961, Geologic map of Oregon west of the 121st meridian: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-323, scale 1:500,000. □

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 8 p.m. evening lectures at Portland State University, Room 371, Cramer Hall. Upcoming meetings, topics, and speakers are:

July 6 (lecture)—*Rocks, Minerals, and Scenery of Australia*, by Lew and Mura Birdsall, members OAMS and GSOC.

July 13 (lecture)—*Channeled Scablands*, by John Whitmer, M.D., GSOC member.

July 20 (luncheon)—*1984 President's Campout, August 18-26, Lewiston, Idaho*, by Lloyd Wilcox, chairman.

July 27 (lecture)—*Mount St. Helens*, by Bud Beachwood, Public Affairs producer, KOIN-Television.

August 10 (lecture)—*Same topic as July 20: President's Campout*.

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

State Capitol mineral display provided by Eugene Mineral Club

The Eugene Mineral Club installed a varied and beautiful display in the State Capitol display case of the Oregon Council of Rock and Mineral Clubs on June 1. Dean and Betty Axtell and Louie and Sibyl Redfern arranged the exhibit provided by 19 members of the club. Lyle Riggs, agent for the Council, and Florence Riggs assisted.

Fourteen Oregon counties are represented by the approximately 70 displayed specimens: Baker, Crook, Grant, Harney, Jackson, Jefferson, Lake, Lane, Lincoln, Linn, Malheur, Sherman, Wasco, and Wheeler Counties.

The display includes three obsidian carvings (a fish, an eagle, and a bear reclining on a small log), petrified wood and limb casts, Paiute agate, natrolite crystal, sagenite, tempskya fern, thunder eggs, Owyhee picture jasper, beach agates, tumbled and faceted sunstones, an agatized clam, carnelian, sunset agate, and a large slab of Chief Paulina agate.

The Eugene Mineral Club display will remain on exhibit until the end of August. □

OIL AND GAS NEWS

Mist Gas Field

Reichhold Energy has extended its exploration activity to the southeast of production by drilling Crown Zellerbach 34-28 in sec. 28, T. 6 N., R. 4 W. The well was spudded April 30 and drilled to a total depth of 3,654 ft. Plugging took place on May 11, 1984.

Columbia County 43-22, completed on February 29, 1984, was put on line May 14, at a rate of approximately 1 MMcfd (million cubic feet per day).

Amoco to explore southwest Oregon

On May 25, 1984, the Oregon Department of Geology and Mineral Industries granted three permits to drill to Amoco Production Company (table in June issue) for wells in Douglas and Coos Counties. The wells, two in T. 25 S., R. 9 W. and one in T. 25 S., R. 11 W., are proposed for 15,000 ft and 14,800 ft, respectively. The wells will likely encounter lower to middle Eocene rocks such as the Roseburg and Flournoy Formations. The proposed locations are on land leased from Weyerhaeuser Company.

Columbia County

Champlin Petroleum Company of Denver has been issued a permit to drill in Columbia County (table below). Drilling may start this month (July).

Recent permits

Permit no.	Operator, well, API number	Location	Status, proposed total depth (ft)
263	Champlin Petroleum Co. Puckett 13-36 009-00128	SW¼ sec. 36 T. 8 N., R. 5 W. Columbia County	Location; 3,500.

□

OSU geology class holds 50th reunion

The first geology class to be graduated from Oregon State University (OSU) met for its fiftieth alumni reunion on June 7, 1984, in Corvallis. As part of the reunion of the OSU class of 1934, the geology graduates met for a social hour at the Dawes House and dinner at the Black Swan Restaurant. Graduates attending included Wayne Felts, Morris Eisenbrey, Leslie Richards, and Robert Gamer. Also attending were geology faculty members including Ira Allison, who was one of the professors for the Class of 1934. □

(Olistostromes, *continued from page 76***)**

The Curry County coastline gives us a clue as to how the exotic Otter Point blocks slid into the Roseburg Formation, as the early Eocene seas lapped against the Otter Point highlands.

REFERENCES

Allen, J.E., and Baldwin, E.M., 1944, Geology and coal resources of the Coos Bay quadrangle: Oregon Department of Geology and Mineral Industries Bulletin 27, 157 p.

Baldwin, E.M., Beaulieu, J.D., Ramp, L., Gray, J.J., Newton, V.C., Jr., and Mason, R.S., 1973, Geology and mineral resources of Coos County, Oregon: Oregon Department of Geology and Mineral Industries Bulletin 80, 82 p.

Baldwin, E.M., and Hess, P.D., 1971, Geology of the Powers quadrangle: Oregon Department of Geology and Mineral Industries Geologic Map Series GMS-5.

Bates, R.L., and Jackson, J.A., eds., 1980, Glossary of geology, 2nd. ed.: Falls Church, Va., American Geological Institute, 749 p.

Diller, J.S., 1901, Coos Bay folio, Oregon, folio 73 *of* Geologic Atlas of the United States: U.S. Geological Survey.

Dott, R.H., Jr., 1971, Geology of the southwestern Oregon coast west of the 124th meridian: Oregon Department of Geology and Mineral Industries Bulletin 69, 63 p.

Koch, J.G., 1966, Late Mesozoic stratigraphy and tectonic history, Port Orford-Gold Beach area, southwestern Oregon coast: American Association of Petroleum Geologists Bulletin, v. 50, no. 1, p. 25-71.

Magoon, L.B., III, 1966, Geology of T. 28 S., R. 11 W., of the Coquille and Sitkum quadrangles, Oregon: Eugene, Oreg., University of Oregon master's thesis, 73 p. □

Quartzville Corridor saved for recreational mining

Opened officially on May 14, 1984, the Quartzville Recreation Corridor is now reserved for recreational mining and other recreational uses such as camping and fishing. The corridor is a stretch nearly 20 mi along Quartzville Creek in Linn County, beginning at Rocky Top Road on the northeast arm of Green Peter Reservoir and extending upstream to Freezeout Creek Road. It consists mainly of the creek and the land between it and the road which parallels it. Most important for the allowed recreational use of the corridor is the fact that permission for most forms of placering is not needed for the west half of the corridor.

This form of recreational mining in an area that has a rich tradition of mining for gold and silver had been protected in the past by a "mineral withdrawal" provision of the U.S. Bureau of Land Management (BLM) by which the area was kept free of mining claims. As the provision was expiring this year, seven public and private owners and operators of the land involved collaborated to save the corridor for recreation use. The BLM, U.S. Forest Service, Oregon Department of Forestry, City of Sweet Home, and Champion International Corporation, all property owners or managers of the land involved, were brought together with the Linn County Parks Department by the Western Mining Council to work out an arrangement under which Linn County now leases the west half of the corridor and keeps it free of mining claims.

Representatives from several cooperating agencies were on hand for the formal opening of the Quartzville Recreation Corridor. Pictured above, from left to right, are Dave Monson, Public Works Director for the City of Sweet Home; Dave Cooper, Linn County Commissioner; Russell J. Anderson, District Land Manager, Champion International; Jerry Gray (kneeling), resource person for the Western Mining Council; and Merle Marshall, Santiam Area Manager for the Bureau of Land Management. Photo courtesy of The New Era, *Sweet Home.*

At the entrance to the corridor, a large information sign has been put up by the BLM. Near it, a box contains copies of a brochure printed by Champion International describing the corridor, guidelines for its use, and the mining history of the area.

For additional information about the Quartzville Recreation Corridor, contact the Western Mining Council, Gerald Ullman, 122 Chemawa Road N., Keizer, Oregon 97303, phone (503) 390-3497. □

ORDER FORM — CUT ON DASHED LINE

Available publications

BULLETINS	Price	No. Copies	Amount
33. Bibliography (1st supplement) geology and mineral resources of Oregon, 1947: Allen	$ 3.00		
35. Geology of the Dallas and Valsetz quadrangles, rev. 1964: Baldwin (map only)	3.00		
36. Papers on Tertiary foraminifera: Cushman, Stewart, and Stewart, 1949: v. 2	3.00		
44. Bibliography (2nd supplement) geology and mineral resources of Oregon, 1953: Steere	3.00		
46. Ferruginous bauxite deposits, Salem Hills, 1956: Corcoran and Libbey	3.00		
49. Lode mines, Granite mining district, Grant County, Oregon, 1959: Koch	3.00		
53. Bibliography (3rd supplement) geology and mineral resources of Oregon, 1962: Steere and Owen	3.00		
61. Gold and silver in Oregon, 1968: Brooks and Ramp	17.50		
62. Andesite Conference guidebook, 1968: Dole	3.50		
65. Proceedings of the Andesite Conference, 1969: (copies)	10.00		
67. Bibliography (4th supplement) geology and mineral resources of Oregon, 1970: Roberts	3.00		
71. Geology of selected lava tubes in Bend area, Oregon, 1971: Greeley (copies)	5.00		
NEW! 77. Geologic field trips in northern Oregon and southern Washington, 1973	5.00		
78. Bibliography (5th supplement) geology and mineral resources of Oregon, 1973: Roberts	3.00		
81. Environmental geology of Lincoln County, 1973: Schlicker and others	9.00		
82. Geologic hazards of Bull Run Watershed, Multnomah, Clackamas Counties, 1974: Beaulieu	6.50		
83. Eocene stratigraphy of southwestern Oregon, 1974: Baldwin	4.00		
84. Environmental geology of western Linn County, 1974: Beaulieu and others	9.00		
85. Environmental geology of coastal Lane County, 1974: Schlicker and others	9.00		
87. Environmental geology of western Coos and Douglas Counties, 1975	9.00		
88. Geology and mineral resources of upper Chetco River drainage, 1975: Ramp	4.00		
89. Geology and mineral resources of Deschutes County, 1976: Peterson and others	6.50		
90. Land use geology of western Curry County, 1976: Beaulieu	9.00		
91. Geologic hazards of parts of northern Hood River, Wasco, and Sherman Counties, Oregon, 1977: Beaulieu	8.00		
92. Fossils in Oregon (reprinted from *The Ore Bin*), 1977	4.00		
93. Geology, mineral resources, and rock material of Curry County, Oregon, 1977	7.00		
94. Land use geology of central Jackson County, Oregon, 1977: Beaulieu	9.00		
95. North American ophiolites, 1977	7.00		
96. Magma genesis: AGU Chapman Conference on Partial Melting, 1977	12.50		
97. Bibliography (6th supplement) geology and mineral resources of Oregon, 1971-75, 1978	3.00		
98. Geologic hazards of eastern Benton County, Oregon, 1979: Bela	9.00		
99. Geologic hazards of northwestern Clackamas County, Oregon, 1979: Schlicker and Finlayson	10.00		
100. Geology and mineral resources of Josephine County, Oregon, 1979: Ramp and Peterson	9.00		
101. Geologic field trips in western Oregon and southwestern Washington, 1980	9.00		
102. Bibliography (7th supplement) geology and mineral resources of Oregon, 1976-1979, 1981	4.00		
GEOLOGIC MAPS			
Reconnaissance geologic map of Lebanon quadrangle, 1956	3.00		
Geologic map of Bend quadrangle and portion of High Cascade Mountains, 1957	3.00		
Geologic map of Oregon west of 121st meridian (USGS I-325), 1961	5.50		
Geologic map of Oregon east of 121st meridian (USGS I-902), 1977	5.50		
GMS-4: Oregon gravity maps, onshore and offshore, 1967 (folded)	3.00		
GMS-5: Geologic map of Powers quadrangle, Oregon, 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, Cascade Mountain Range, central Oregon, 1978	3.00		
GMS-9: Total field aeromagnetic anomaly map, Cascade Mountain Range, central 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 quadrangle, 1978	3.00		
GMS-13: Geologic map of the Huntington and part of the Olds Ferry quadrangles, Oregon, 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, Cascade Mountain Range, northern Oregon, 1981	3.00		
GMS-16: Free-air gravity anomaly map and complete Bouguer gravity anomaly map, Cascade Mountain Range, southern Oregon, 1981	3.00		
GMS-17: Total-field aeromagnetic anomaly map, Cascade Mountain Range, southern Oregon, 1981	3.00		
GMS-18: Geology of the Rickreall, Salem West, Monmouth, and Sidney 7½-minute quadrangles, Marion, Polk, and Linn Counties, Oregon, 1981	5.00		
GMS-19: Geology and gold deposits map of the Bourne quadrangle, Baker and Grant Counties, Oregon, 1982	5.00		
GMS-20: Map showing geology and geothermal resources of the southern half of the Burns 15-minute quadrangle, Oregon, 1982	5.00		
GMS-21: Geology and geothermal resources map of the Vale East 7½-minute quadrangle, Oregon, 1982	5.00		
GMS-22: Geology and mineral resources map of the Mt. Ireland quadrangle, Baker and Grant Counties, Oregon, 1982	5.00		
GMS-23: Geologic map of the Sheridan quadrangle, Polk and Yamhill Counties, Oregon, 1982	5.00		
GMS-24: Geologic map of the Grand Ronde quadrangle, Polk and Yamhill Counties, Oregon, 1982	5.00		
GMS-25: Geology and gold deposits map of the Granite quadrangle, Baker and Grant Counties, Oregon, 1982	5.00		
GMS-26: Residual gravity maps of the northern, central, and southern Cascade Range, Oregon, 1982	5.00		
GMS-27: Geologic and neotectonic evaluation of north-central Oregon: The Dalles 1° by 2° quadrangle, 1982	6.00		
GMS-28: Geology and gold deposits map of the Greenhorn quadrangle, Baker and Grant Counties, Oregon, 1983	5.00		
GMS-29: Geology and gold deposits map, NE¼ Bates quadrangle, Baker and Grant Counties, Oregon, 1983	5.00		
NEW! GMS-31: Geology and gold deposits map, NW¼ Bates quadrangle, Baker and Grant Counties, Oregon, 1984	5.00		
OIL AND GAS INVESTIGATIONS			
3. Preliminary identifications of foraminifera, General Petroleum Long Bell #1 well	3.00		
4. Preliminary identifications of foraminifera, E.M. Warren Coos County 1-7 well, 1973	3.00		
5. Prospects for natural gas production or underground storage of pipeline gas, upper Nehalem River Basin, Columbia-Clatsop Counties, Oregon, 1976	5.00		
6. Prospects for oil and gas in the Coos Basin, western Coos, Douglas, and Lane Counties, Oregon, 1980: Newton and others	9.00		
7. Correlation of Cenozoic stratigraphic units of western Oregon and Washington, 1983	8.00		
9. Subsurface biostratigraphy of the east Nehalem Basin, 1983: McKeel	6.00		

Available publications (continued)

SPECIAL PAPERS	Price	No. Copies	Amount
1. Mission, goals, and programs of Oregon Department of Geology and Mineral Industries, 1978	3.00	____	____
2. Field geology of SW Broken Top quadrangle, Oregon, 1978: Taylor	3.50	____	____
3. Rock material resources of Clackamas, Columbia, Multnomah, and Washington Counties, Oregon, 1978: Gray and others	7.00	____	____
4. Heat flow of Oregon, 1978: Blackwell, Hull, Bowen, and Steele	3.00	____	____
5. Analysis and forecasts of the demand for rock materials in Oregon, 1979: Friedman and others	3.00	____	____
6. Geology of the La Grande area, Oregon, 1980: Barrash and others	5.00	____	____
7. Pluvial Fort Rock Lake, Lake County, Oregon, 1979: Allison	4.00	____	____
8. Geology and geochemistry of the Mt. Hood volcano, 1980: White	3.00	____	____
9. Geology of the Breitenbush Hot Springs quadrangle, Oregon, 1980: White	4.00	____	____
10. Tectonic rotation of the Oregon Western Cascades, 1980: Magill and Cox	3.00	____	____
11. Theses and dissertations on the geology of Oregon: Bibliography and index, 1899-1982, 1982: Neuendorf and others	6.00	____	____
12. Geologic linears of the northern part of the Cascade Range, Oregon, 1980: Venkatakrishnan, Bond, and Kauffman	3.00	____	____
13. Faults and lineaments of the southern Cascades, Oregon, 1981: Kienle, Nelson, and Lawrence	4.00	____	____
14. Geology and geothermal resources of the Mount Hood area, Oregon, 1982: Priest and Vogt	7.00	____	____
15. Geology and geothermal resources of the central Oregon Cascade Range, 1983: Priest and Vogt	11.00	____	____
16. Index to the *Ore Bin* (1939-1978) and *Oregon Geology* (1979-1982), 1983: Mahoney and Steere	4.00	____	____
NEW! 17. Bibliography of Oregon Paleontology, 1792-1983, 1984: E.L. and W.L. Orr	6.00	____	____
SHORT PAPERS			
21. Lightweight aggregate industry in Oregon, 1951: Mason	1.00	____	____
24. The Almeda Mine, Josephine County, Oregon, 1967: Libbey	3.00	____	____
25. Petrography, type Rattlesnake Formation, central Oregon, 1976: Enlows	3.00	____	____
27. Rock material resources of Benton County, 1978: Schlicker and others	4.00	____	____
MISCELLANEOUS PAPERS			
1. A description of some Oregon rocks and minerals, 1950: Dole	1.00	____	____
5. Oregon's gold placers (reprints), 1954	1.00	____	____
8. Available well records of oil and gas exploration in Oregon, rev. 1982: King, Olmstead, and Newton	4.00	____	____
11. Collection of articles on meteorites, 1968 (reprints from *The Ore Bin*)	3.00	____	____
15. Quicksilver deposits in Oregon, 1971: Brooks	3.00	____	____
17. Geologic hazards inventory of the Oregon coastal zone, 1974: Beaulieu, Hughes, and Mathiot	5.00	____	____
18. Proceedings of Citizens' Forum on potential future sources of energy, 1975	3.00	____	____
19. Geothermal exploration studies in Oregon – 1976, 1977	3.00	____	____
20. Investigations of nickel in Oregon, 1978: Ramp	5.00	____	____
MISCELLANEOUS PUBLICATIONS			
Landforms of Oregon (17 × 12 inches)	1.00	____	____
Mining claims (State laws governing quartz and placer claims)	1.00	____	____
Geological highway map, Pacific NW region, Oregon-Washington (published by AAPG)	5.00	____	____
Geothermal resources of Oregon map, 1982 (published by NOAA)	3.00	____	____
Back issues of *The Ore Bin*	50¢ over the counter; $1.00 mailed	____	____
Back issues of *Oregon Geology*	75¢ over the counter; $1.00 mailed	____	____
Colored postcard, *Geology of Oregon*	10¢ each; 3 for 25¢; 7 for 50¢; 15 for $1.00	____	____
Oregon Landsat mosaic map, 1983 (published by ERSAL, OSU)	$8.00 over the counter; $11.00 mailed	____	____

Separate price lists for open-file reports, geothermal energy studies, tour guides, recreational gold mining information, and non-Departmental maps and reports will be mailed upon request.

OREGON GEOLOGY

1005 State Office Building, Portland, Oregon 97201

Second Class Matter
POSTMASTER: Form 3579 requested

PUBLICATIONS ORDER

Minimum mail order $1.00. All sales are final. Publications are sent postpaid. Payment must accompany orders of less than $50.00. Foreign orders: please remit in U.S. dollars.

Fill in appropriate blanks and send sheet to Department.

YOUR NAME ____________________

ADDRESS ____________________

____________________ Zip________

Amount enclosed $________

OREGON GEOLOGY

____ Renewal ____ New Subscription ____ Gift

____ 1 Year ($6.00) ____ 3 Years ($15.00)

NAME ____________________

ADDRESS ____________________

____________________ ZIP ________

(If Gift, From: ____________________)