UNITED STATES DEPARTMENT OF THE INTERIOR
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CORRELATION OF TERTIARY ROCKS PENETRATED IN WELLS DRILLED ON THE SOUTHERN OREGON CONTINENTAL MARGIN

By

P. D. Snavely, Jr., H. C. Wagner, W. W. Rau,
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Introduction

Geologic interpretation of seismic reflection profiles on the continental shelves of Oregon and Washington is measurably enhanced through the knowledge of the Tertiary subsurface stratigraphy penetrated in 10 deep exploration wells drilled in the mid-1960's (Braislin and others, 1971; Snavely and others, 1977). These subsurface data make it possible to relate the acoustical units differentiated on seismic-reflection profiles to time-stratigraphic units as determined from micropaleontological studies of samples collected from these wells. These biostratigraphic data also permit correlations between time-stratigraphic units in the offshore test wells and between those units and formations penetrated in onshore test wells as well as strata that crop out in coastal Oregon and Washington.

The purpose of this report is to present information on the stratigraphy and micropaleontology of the Tertiary sequence penetrated in five offshore test wells drilled on the southern part of the Oregon continental shelf (fig. 1) and to show time-stratigraphic correlations between these offshore wells and two deep test wells drilled on the west flank of the Oregon Coast Range (plate 1).

The biostratigraphic and petrographic data that form the framework for correlations between the offshore wells is based upon the studies of sidewall cores and ditch samples generously made available to the U.S. Geological Survey by the oil companies who were operators for those exploratory wells. These operators include: Pan American Petroleum Corporation (now AMOCO Production Corporation), Shell Oil Company, Standard Oil Company of California, and Union Oil Company of California. We also gratefully acknowledge their permission to publish the results of our studies of the subsurface samples.

The writers wish particularly to thank Diane Lander for her thoughtful assistance in the preparation of this report and James Pearl for petrographic studies of the samples. The constructive technical review by Paula Quinterno measurably improved the report.

Previous studies

The Tertiary geology of the southern part of the Oregon continental margin is best understood from detailed geologic mapping in the Coast Range where more than 7000 m of Paleocene to Pliocene sedimentary and volcanic rocks crop out. However, until the 1960's little was known about the Tertiary sequence on the continental shelf because Holocene and Pleistocene sediments mantle most of the older strata except for seafloor exposures of

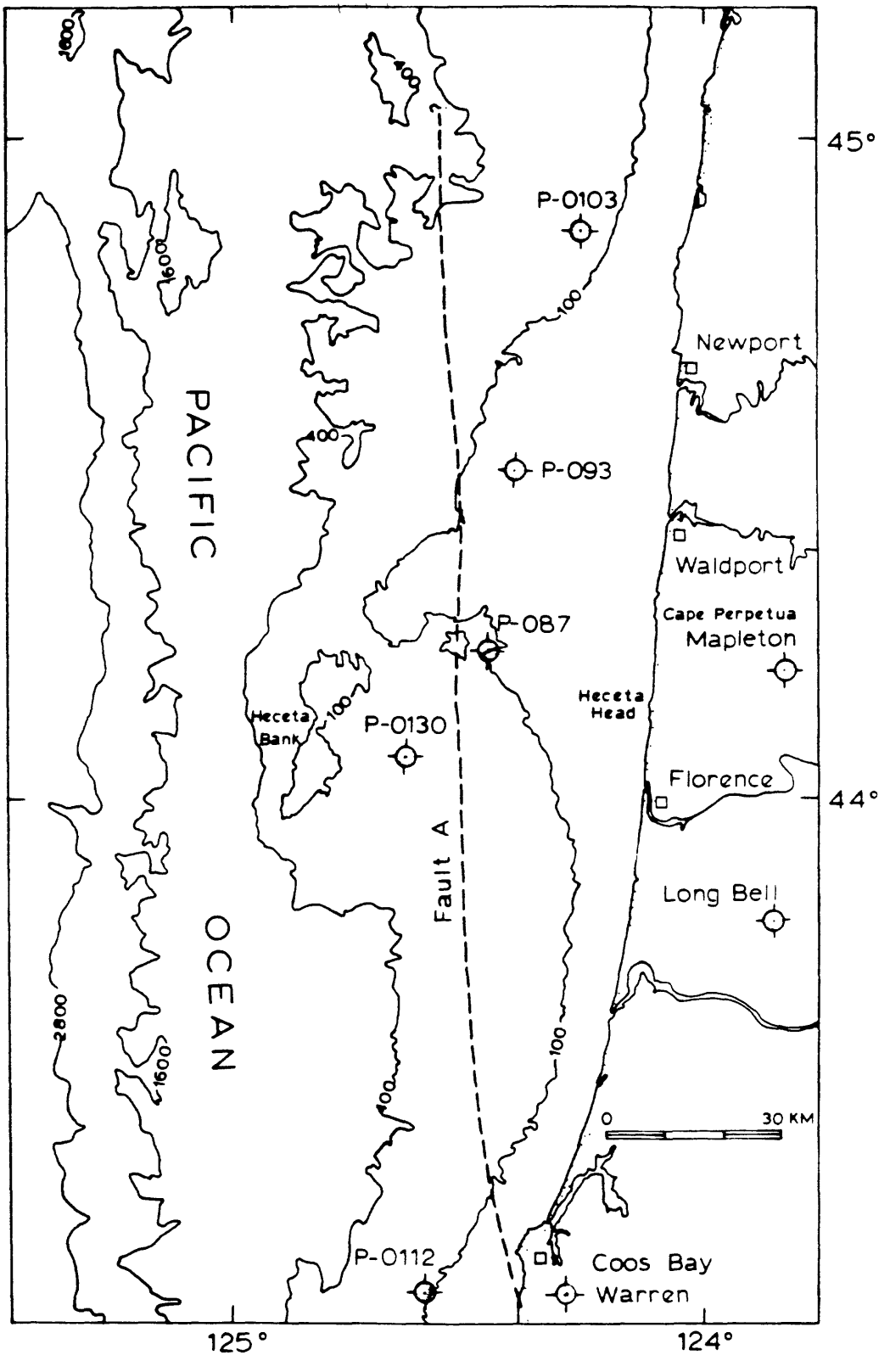

Figure 1.--Index map of southern Oregon continental margin showing the locations of exploratory wells referred to in this report and the approximate location of fault A. Bathymetric contours (in meters) from C&GS Bathymetric Maps 1308N-17 and 22.

Pliocene and less commonly late Miocene strata on Coquille, Heceta, and Stonewall Banks (Kulm and Fowler, 1974; Kulm, 1980). The shallow structure on the shelf is broadly understood from single-channel seismic reflection surveys by members of Oregon State University, Department of Oceanography, principally Kulm (1969), Kulm and Fowler (1970, 1974), Fowler and Kulm (1971), and recent studies by the U.S. Geological Survey (Clarke and others, 1981).

Braislin, Hastings, and Snavely (1971) made the first attempt to tie the geology of the Coast Ranges with that on the continental shelf using subsurface data in the Standard-Union Nautilus No. 1 (P-0103) test well (fig. 1) and seismic reflection profiles collected by industry in the early 1960's. Snavely and others (1977) published general stratigraphic information on the 10 test wells drilled on the Oregon-Washington continental shelf and presented a west-trending 160 kJ single-channel profile through the Nautilus (P-0103) well. Seely and others (1974) published a geologic interpretation of a 12-channel seismic profile across the Oregon continental margin near latitude 44°N but did not tie this profile to the onland geology. Couch and Braman (1980) and Couch and Pitts (1980) prepared generalized crustal geologic cross sections near latitudes 43°15'N and 44°N. These sections were based upon a geologic interpretation of gravity, magnetic, and subsurface stratigraphic data in the Union Fulmar No. 1 (P-0130) and Sinclair Oil and Gas Corporation Federal-Mapleton No. 1 wells for the northern cross section and the Pan American Coos Bay No. 1 (P-0112) and Warren Coos County 1-7 well for the southern cross section (fig. 1). Biostratigraphic interpretations based upon a study of Foraminifera found in strata penetrated in these wells were made by Rau (1973a) and McKeel (1980). The first attempt to prepare a geologic cross section from the Oregon Coast Range westward to the abyssal plain utilizing onshore detailed geologic mapping, 24-channel and single-channel seismic-reflection profiles and subsurface stratigraphic information in the Nautilus (P-0103) well was published by Snavely and others (1980b). A geologic interpretation of a 24-channel seismic-reflection profile on the continental shelf through Shell Oil Company's P-087 well was extended onto the west flank of the Oregon Coast Range and tied to Sinclair's Federal-Mapleton well (Snavely and others, 1981).

Regional geologic setting

The structural, depositional, and magmatic history of Cenozoic sedimentary and volcanic rocks on the continental margin of Oregon is interpreted as resulting from episodic periods of underthrusting, transcurrent faulting, and extension between the Pacific (Farallon) and North American plates (Snavely and MacLeod, 1977; Snavely and others, 1980a, b). This interpretation of the Tertiary evolution is based in part upon the stratigraphic and structural relationships discerned from a study of subsurface data from the five deep test wells drilled on the continental shelf of central and southern Oregon (fig. 1). These data were integrated with a study of 24-channel seismic profiles collected by the U.S. Geological Survey across these wells.

Stratigraphy

A thorough discussion of the formations that crop out in the central and southern parts of the Oregon Coast Range is not presented in this report

as the geology of this area has recently been summarized by Snavely and others (1980a) and Clarke and others (1981). In addition, current knowledge of the stratigraphy of the adjacent continental shelf has been summarized by Snavely and others (1977, 1980b), Newton (1980), and Clarke and others (1981). The rock sequence penetrated in the five offshore wells is presented in a time-stratigraphic framework, as strata in the wells cannot be correlated directly with those that crop out in the Coast Range. Also, many of the formations that crop out in the Coast Range lose their onshore lithologic characteristics seaward due to lateral facies changes that generally reflect deeper water depositional environments.

The time-stratigraphic correlations between the offshore test wells (plate 1) are based principally on a study of foraminifers by Weldon Rau (tables 1-5) and nannofossils by David Bukry (tables 7, 8); the biostratigraphy for the onshore wells was reported on by Rau (1973b) for the General Petroleum Corporation Long Bell No. 1 well and by McKeel (1980) for the Mapleton well. In several wells precise stage boundaries could not be established because of missing sidewall cores or barren samples. The positions of stage boundaries in places do not agree precisely with those shown on the microfossil checklists because ditch samples of older strata were contaminated by cuttings from younger strata. Where a thick interval occurs between well samples that contain microfossils, the stage boundaries are placed at changes of interval velocity or where electric logs indicate a major lithologic change. The inferred correlations between offshore time-stratigraphic units (benthonic foraminiferal stages) and onland formations are shown in figure 2.

Two test wells, Union Oil Company Fulmar (P-0130) and Pan American Petroleum Corporation Coos Bay (P-0112) lie west of inferred transform fault A (fig. 1) which is interpreted to have had major dextral movement during middle to early late Eocene time (Snavely and others, 1980b). Therefore, pre-upper Eocene strata in these two wells cannot be correlated with strata of pre-late Eocene age penetrated in the wells drilled east of the fault (fig. 1). Consequently, on the correlation chart (plate 1) time-stratigraphic correlations are made between wells east of fault A and those west of fault A, but not across fault A.

Lithologic descriptions of the time-stratigraphic units penetrated in the five offshore wells and descriptions of the formations penetrated in the two onshore wells are shown in table 9. The lithologies of rocks encountered in these wells are generalized from descriptions of sidewall cores made by company geologists supplemented by our studies of many of these core and ditch samples.

Table 1.--Checklist of Foraminifera in Standard-Union, Nautilus No. 1, P-0103 well. Identifications by W. W. Rau. Symbols of frequency of occurrence used in tables 1 to 6 are: C, common; F, few; R, rare; and ?, questionable identification.

Species	Stage		Saucesian								Zemorrian to Refugian		
	Epoch	Pleistocene	Pliocene	middle to early Miocene							Oligocene to late Eocene		
	Interval (ft.)	1480-1930	2200-2980	3100-3190	3200-3250	3280-3580	3670-4670	4850-5000	5210-5660	5930-8090	8190-10190	10310-10790	10940-11985	12020-12627
Uvigerina yabei Asano		C	F	-	-	-	-	-	-	-	-	-	-	-
Elphidium clavatum Cushman.		F	R	-	-	-	-	-	-	-	-	-	-	-
Cassidulina californica Cushman and Hughes.		F	F	F	-	-	-	-	-	-	-	-	-	-
Epistominella pacifica (Cushman).		F	C	C	-	-	-	-	-	-	-	-	-	-
Pullenia salisburyi R. E. and K. C. Stewart		F	R	R	-	-	-	-	-	-	-	-	-	-
Quinqueloculina seminulum (Linne)		R	R	R	-	-	-	-	-	-	-	-	-	-
Buccella frigida (Cushman).		R	R	R	-	-	-	-	-	-	-	-	-	-
Florilus labradoricus (Dawson).		R	R	-	-	-	-	-	-	-	-	-	-	-
Cassidulina tortuosa Cushman and Hughes		C	C	F	-	-	-	-	-	-	-	-	-	-
Cassidulina islandica Nørvang		R	R	-	-	-	-	-	-	-	-	-	-	-
Uvigerina peregrina Cushman		F	C	C	-	-	-	-	-	-	-	-	-	-
Cibicides mckannai Galloway and Wissler		F	R	R	-	-	-	-	-	-	-	-	-	-
Elphidiella cf. *E. groenlandica* (Cushman)		F	R	F	-	-	-	-	-	-	-	-	-	-
Uvigerina cf. *U. hootsi* Rankin.		-	F	-	-	-	-	-	-	-	-	-	-	-
Quinqueloculina akneriana d'Orbigny		-	R	R	-	-	-	-	-	-	-	-	-	-
Nonionella miocenica Cushman.		-	R	R	-	R	-	R	R	F	R	R	R	-
Cassidulina pulchella d'Orbigny		-	R	F	-	-	-	-	-	-	-	-	-	-
Globobulimina auriculata (Bailey)		-	F	F	-	-	-	-	-	-	-	-	-	-
Pullenia cf. *P. malkinae* Coryell and Mossman.		-	R	F	R	-	-	-	-	-	-	-	-	-
Epistominella parva (Cushman and Laiming)		-	-	-	R	F	-	-	-	-	F	-	-	-
Epistominella cf. *E. subperuviana minuta* (Cushman and Laiming.		-	-	R	-	-	-	F	-	F	-	-	-	-
Globorotalia cf. *G. scitula* (Brady)		-	-	R	-	-	-	-	-	-	-	-	-	-
Sphaeroidina bulloides d'Orbigny.		-	-	F	R	-	-	-	R	R	-	R	-	R
Siphogenerina kleinpelli Cushman.		-	-	-	F	F	R	R	C	F	C	R	R	-
Florilus costiferum (Cushman)		-	-	-	F	F	F	C	C	F	C	-	F	-
Buccella mansfieldi oregonensis (Cushman, Stewart and Stewart)		-	-	-	F	F	F	R	R	R	F	R	R	R
Bolivina advena Cushman		-	-	-	R	C	C	C	F	C	C	R	R	-
Cassidulina crassipunctata Cushman and Hobson		-	-	-	R	C	F	R	R	C	C	R	F	-
Buliminella subfusiformis Cushman		-	-	-	-	F	C	F	F	C	C	F	R	F
Siphogenerina branneri (Bagg)		-	-	-	-	R	-	-	R	R	-	-	-	-
Fursenkoina (Virgulina) californiensis (Cushman).		-	-	-	-	F	R	F	-	F	R	-	-	-
Uvigerinella californica Cushman.		-	-	-	-	-	R	C	-	F	R	-	-	-
Bulimina ovata d'Orbigny.		-	-	-	-	-	R	F	F	F	F	-	R	-
Valvulineria araucana (d'Orbigny)		-	-	-	-	-	-	F	F	R	R	-	-	-
Uvigerinella obesa impolita Cushman and Laiming		-	-	-	-	-	-	R	F	F	F	-	-	-
Lenticulina cf. *L. mayi* Cushman and Parker.		-	-	-	-	-	-	R	R	R	R	-	-	-
Planulina astoriensis Cushman, Stewart and Stewart.		-	-	-	-	-	-	-	F	-	R	-	-	-
Bolivina marginata adelaidana Cushman and Kleinpell		-	-	-	-	-	-	-	R	R	F	R	-	-
Bulimina alligata Cushman and Laiming		-	-	-	-	-	-	-	F	F	R	-	-	-
Gyroidina orbicularis planata Cushman		-	-	-	-	-	-	-	R	-	F	F	F	F
Cibicides pseudoungerianus evolutus Cushman and Hobson		-	-	-	-	-	-	-	-	R	R	-	-	-
Pseudoglandulina inflata (Borneman)		-	-	-	-	-	-	-	-	R	R	F	F	F
Cassidulina cf. *C. laevigata carinata* Cushman		-	-	-	-	-	-	-	-	R	R	R	R	R
Elphidium cf. *E. minutum* Cushman.		-	-	-	-	-	-	-	-	-	F	R	R	R
Bulimina cf. *B. alsatica* Cushman and Parker		-	-	-	-	-	-	-	-	-	-	R	-	R
Uvigerina gallowayi Cushman		-	-	-	-	-	-	-	-	-	C	F	F	F
Uvigerina garzaensis Cushman and Siegfus		-	-	-	-	-	-	-	-	-	R	F	C	F
Elphidium cf. *E. californicum* Cook.		-	-	-	-	-	-	-	-	-	-	R	R	R
Florilus incisum (Cushman).		-	-	-	-	-	-	-	-	-	-	R	R	R
Anomalina californiensis Cushman and Hobson		-	-	-	-	-	-	-	-	-	-	R	F	F
Siphogenerina cf. *S. nodifera* Cushman and Kleinpell		-	-	-	-	-	-	-	-	-	-	R	-	-
Epistomina eocenica Cushman and M. A. Hanna		-	-	-	-	-	-	-	-	-	-	-	-	R
Pullenia bulloides (d'Orbigny).		-	-	-	-	-	-	-	-	-	-	-	-	F
Karreriella washingtonensis Rau		-	-	-	-	-	-	-	-	-	-	-	-	F
Eponides duprei Cushman and Schenck		-	-	-	-	-	-	-	-	-	-	-	-	R
Dentalina quadrulata Cushman and Laiming.		-	-	-	-	-	-	-	-	-	-	-	-	R
Spiroplectammina cf. *S. tejonensis* Mallory.		-	-	-	-	-	-	-	-	-	-	-	-	R

Table 2.--Checklist of Foraminifera in Union Oil Company of California, Grebe No. 1, P-093 well. Identifications by W. W. Rau.

Species	Interval (ft.)	740-2360	2420-4295	4400-6470	6590-8270	9172-10010
	Epoch	Oligocene		Late Eocene	Late Eocene	Middle Eocene
	Stage	Zemorrian		Refugian	Narizian(?)	Ulatisian(?)
Cassidulina crassipunctata Cushman and Hobson. . . .		C	C	R	-	-
Cibicides elmaensis Rau.		F	-	C	F	-
Elphidium cf. *E. minutum* Cushman		C	-	-	-	-
Cassidulinoides sp.		C	R	-	-	-
Gyroidina orbicularis planata Cushman.		C	C	C	R	-
Florilus incisum (Cushman)		C	-	-	-	-
Uvigerina cf. *U. garzaensis* Cushman and Siegfus. . .		?	C	F	F	-
Uvigerinella obesa impolita Cushman and Laiming. . .		R	R	?	-	-
Cibicides elmaensis var. A. Rau.		F	F	-	-	-
Anomalina californiensis Cushman and Hobson.		?	F	F	R	-
Quinqueloculina weaveri Rau.		?	R	R	-	-
Martinottiella cf. *M. nodulosa* Cushman		-	C	F	-	-
Uvigerina galloxayi U. cocoaensis Cushman (undif.) .		-	R	F	R	-
Lenticulina calcar (Linne)		-	R	-	-	-
Quinqueloculina imperialis Hanna and Hanna		-	?	F	R	-
Sigmomorphina schencki Cushman and Ozawa		-	-	F	R	-
Guttulina irregularis d'Orbigny.		-	-	R	-	-
Guttulina frankei Cushman and Ozawa.		-	-	R	-	-
Eponides umbonatus (Reuss)		-	-	F	R	-
Karreriella washingtonensis Rau.		-	-	R	-	-
Cassidulina cf. *C. galvinensis* Cushman and Frizzell.		-	-	R	R	-
Ceratobulimina washburni Cushman and Schenck		-	-	R	-	-
Angulogerina cf. *A. hannai* Beck.		-	-	?	?	-
Sigmomorphina cf. *S. pseudoschencki* Rau.		-	-	R	-	-
Cibicides natlandi Beck.		-	-	-	?	-
Lenticulina chiranus (Cushman and Stone)		-	-	-	-	X
Amphimorphina californiensis Cushman and McMasters .		-	-	-	-	X

Table 3.--Checklist of Foraminifera from Shell Oil Company, P-087 well. Identifications by W. W. Rau; for checklist of phytoplankton in this well see table 7.

Species	Interval (ft.)	2835-2965	3145-3270	3400-3640	3950-4170	4260	4325	4510-4610	5370-5575	5765-5910	5960-6090	7150-7265	7590-7910
	Epoch	Middle to early Miocene						Oligocene	late Eocene		?	?	middle Eocene
	Stage	Saucesian						Zemorrian	Refugian		?	?	Ulatisian
Buliminella subfusiformis Cushman		R	-	F	C	F	-	-	-	-	-	-	-
Florilus costiferum (Cushman)		-	F	R	F	F	R	-	-	-	-	-	-
Epistominella parva (Cushman and Laiming)		-	F	-	R	R	R	-	-	-	-	-	-
Cassidulina crassipunctata Cushman and Hobson		-	?	-	-	C	F	F	-	-	-	?	-
Uvigerinella sparsicostata Cushman and Laiming		-	F	-	F	R	-	-	-	-	-	-	-
Siphogenerina kleinpelli Cushman		-	C	F	R	F	-	-	-	-	-	-	-
Lagena sp.		-	R	-	-	-	-	-	-	-	-	-	-
Plectofrondicularia cf. *miocenica* Cushman		-	R	-	-	-	-	-	-	-	-	-	-
Baggina washingtonensis Rau		-	F	-	-	-	-	-	-	-	-	-	-
Lenticulina cf. *L. inornatus* d'Orbigny		-	-	R	R	F	F	-	F	-	R	F	-
Nodogenerina advena Cushman and Laiming		-	-	-	R	-	-	-	-	-	-	-	-
Lenticulina mayi Cushman and Parker		-	-	-	-	?	-	R	-	-	-	-	-
Lenticulina sp. [large, rounded periphery]		-	-	-	-	R	-	-	-	-	-	-	-
Buccella mansfieldi oregonensis (Cushman, Stewart and Stewart)		-	-	-	-	F	?	-	-	-	(?)	-	-
Bulimina ovata d'Orbigny		-	-	-	-	F	-	-	-	-	-	-	-
Planulina astoriensis Cushman, Stewart and Stewart		-	-	-	-	R	R	-	-	-	-	-	-
Globigerina sp.		-	-	-	-	R	R	-	-	-	-	-	-
Uvigerinella obesa impolita Cushman and Laiming		-	-	-	-	F	-	-	-	-	-	-	-
Nonionella miocenica Cushman		-	-	-	-	R	-	-	-	-	-	-	-
Fursenkoina cf. *F. californiensis* Cushman		-	-	-	-	R	-	-	-	-	-	-	-
Plectofrondicularia californica Cushman and Stewart		-	-	-	-	R	-	-	-	-	-	-	-
Bolivina marginata adelaidana Cushman and Kleinpell		-	-	-	-	R	F	-	-	-	-	-	-
Epistomina eocenica (Cushman and Hanna)		-	-	-	-	-	-	-	R	-	-	-	-
Dentalina cf. *D. consobrina* d'Orbigny		-	-	-	-	-	-	-	-	R	-	-	R
Cibicides elamensis Rau		-	-	-	-	-	-	-	R	-	-	-	-
Gyroidina condoni Cushman and Schenck		-	-	-	-	-	-	-	-	R	-	-	-
Gyroidina cf. *G. soldanii* d'Orbigny		-	-	-	-	-	-	-	F	R	-	?	-
Uvigerina atwilli Cushman and Simonson		-	-	-	-	-	-	-	-	?	-	-	-
Globocassidulina globosa (Hantken)		-	-	-	-	-	-	-	-	F	-	-	-
Bulimina corrugata Cushman and Siegfus		-	-	-	-	-	-	-	-	-	-	-	R
Nodosaria latejugata Gumbel		-	-	-	-	-	-	-	-	-	-	-	?
Eponides umbonatus (Reuss)		-	-	-	-	-	-	-	-	-	-	-	R
Cibicides martinezensis Cushman and Barksdale		-	-	-	-	-	-	-	-	-	-	-	?

Table 4.--Checklist of Foraminifera in General Petroleum Corporation, Long Bell No. 1 well. Identifications by W. W. Rau (1973b).

Species	Interval (ft.)	4500-5080	5100-5600	5600-6440	6440-7280	7280-7880	7920-8582
	Epoch	middle Eocene	early Eocene				early Eocene
	Stage	Ulatisian	Penutian				lower Penutian
Buccella eocenica (Cushman and Hanna)		R	-	-	R	-	-
Tritaxilina colei Cushman and Siegfus		R	R	R	-	R	R
Alabamina vilcozensis californica Mallory		R	R	-	-	R	-
Valvulineria childsi (Martin)		F	-	F	F	-	R
Discorbis baintoni Mallory		R	-	-	R	-	-
Bifarina nuttalli Cushman and Siegfus		R	-	-	-	-	-
Cibicides pachyderma (Rzehak)		R	R	R	R	R	-
Asterigerina crassaformis Cushman and Siegfus		F	R	F	F	F	F
Eponides umbonatus (Reuss)		R	R	-	R	-	R
Gyroidina orbicularis planata Cushman		F	F	R	R	R	R
Globigerina cf. *G. linaperta* Finlay		F	F	R	F	F	F
Globorotalia cf. *G. nicoli* Martin		R	R	F	R	R	F
Lenticulina alto-limbatus (Gumbel)		R	-	R	R	R	R
Dorothia principiensis Cushman and Bermudez		R	R	R	-	-	-
Vulvulina curta Cushman and Siegfus		R	-	-	-	-	-
Cibicides martinezensis Cushman and Barksdale		F	R	R	R	F	R
Eponides minima Cushman		R	-	R	R	R	R
Cibicides whitei Martin		R	R	R	R	R	F
Spiroplectammina directa Cushman and Siegfus		R	-	-	-	-	R
Globigerina primativa (Finlay)		-	F	R	R	R	F
Globorotalia cf. *G. subbotinae* Morozova		-	R	R	-	R	R
Silicosigmoilina californica Cushman and Church		-	R	-	R	-	-
Chilostomella cf. *C. cylindroides* Reuss		-	R	R	F	R	R
Ceratobulimina cf. *C. perplexa* (Plummer)		-	R	-	-	R	R
Uvigerina lodoensis miriamae Mallory		-	R	R	R	-	-
Anomalina dorri aragonensis Nuttall		-	R	R	R	R	R
Nodosaria latejugata Gumbel		-	R	R	-	-	R
Lenticulina convergens (Bornemann)		-	R	R	R	R	R
Gaudryina coalingensis (Cushman and G. D. Hanna)		-	R	R	-	-	-
Bulimina lirata Cushman and Parker		-	R	R	R	-	-
Globorotalia cf. *G. planoconica* Subbotina		-	-	R	R	R	-
Catapsydrax cf. *C. unicavus* Bolli, Loeblich, and Tappan		-	-	R	R	-	R
Bolivina explicata lodoensis Mallory		-	-	R	F	R	R
Bulimina corrugata Cushman and Siegfus		-	-	R	R	R	R
Pleurostomella acuta Hantken		-	-	R	R	R	R
Globigerina nitida Martin		-	-	-	F	-	R
Eponides cf. *F. dorfi* Toulmin		-	-	-	R	R	R
Gyroidina simiensis Cushman and McMasters		-	-	-	R	-	-
Amphistegina cf. *A. californica* Cushman and M. A. Hanna		-	-	-	R	-	-
Pseudohastigerina micra (Cole)		-	-	-	R	R	F
Anomalina cf. *A. regina* Martin		-	-	-	-	R	R
Pullenia eocenica Cushman and Siegfus		-	-	-	-	R	R
Globorotalia aragonensis Nuttall		-	-	-	-	R	R
Glomospira charoides (Jones and Parker)		-	-	-	-	R	R
Globorotalia cf. *G. aequa* Cushman and Renz		-	-	-	-	-	F
Globigerina mckannai White		-	-	-	-	-	R
Globigerina cf. *G. corpulenta* Subbotina		-	-	-	-	-	R
Lenticulina ulatisensis (Boyd)		-	-	-	-	-	R
Allomorphina conica Cushman and Todd		-	-	-	-	-	R
Globigerina cf. *G. pseudomenardii* Bolli		-	-	-	-	-	R
Bulliminella cf. *B. devlivis* (Reuss)		-	-	-	-	-	R

Table 5.--Checklist of Foraminifera in Union Oil Company of California, Fulmar No. 1, P-0130 well. Identifications by W. W. Rau; for checklist of phytoplankton in this well see table 7.

Species	Stage				Relizian to Saucesian		Saucesian or Zemorrian	Zemorrian		Refugian	Penutian
	Epoch	Pliocene		late Miocene	middle to early Miocene		early Miocene or Oligocene	Oligocene		late Eocene	early Eocene
	Interval (ft.)	1250	1460-1850	1970-2770	2800-3120	3220-3460	3520-3865	4000-4100	4360-4570	4600-4900	4940-5047
Globobulimina auriculata (Bailey)		R	-	-	-	-	-	-	-	-	-
Elphidium hughesi Cushman and Grant		F	-	-	-	-	-	-	-	-	-
Elphidiella cf. *E.* hannai (Cushman and Grant)		R	-	-	-	-	-	-	-	-	-
Cassidulina islandica Nørvang		C	-	-	-	-	-	-	-	-	-
Nonionella miocenica Cushman		F	-	-	-	R	-	-	-	-	-
Globorotalia crassaformis (Galloway and Wissler)		R	-	-	-	-	-	-	-	-	-
Epistominella pacifica (Cushman)		C	R	F	-	-	-	-	-	-	-
Quinqueloculina cf. *Q. akneriana* d'Orbigny		F	R	-	-	-	-	-	-	-	-
Uvigerina juncea Cushman and Todd		C	R	-	-	-	-	-	-	-	-
Bulimina subacuminata Cushman and R. E. Stewart		-	R	-	-	-	-	-	-	-	-
Cassidulina translucens Cushman and Hughes		-	F	R	-	-	-	-	-	-	-
Cibicides mckannai Galloway and Wissler		-	F	R	-	-	-	-	-	-	-
Uvigerina peregrina Cushman		-	F	R	R	-	-	-	-	-	-
Gyroidina soldanii multilocula Coryell and Mossman		-	R	R	R	-	-	-	-	-	-
Plectofrondicularia californica Cushman and R. E. Stewart		-	F	R	R	R	R	-	R	-	-
Sphaeroidina bulloides d'Orbigny		-	F	-	R	R	R	-	R	R	-
Pullenia salisburyi R. E. and K. C. Stewart		-	R	-	-	-	-	-	-	-	-
Glandulina laevigata d'Orbigny		-	F	-	-	-	-	-	-	-	-
Dentalina baggi Galloway and Wissler		-	F	-	-	-	-	-	-	-	-
Orbulina universa d'Orbigny		-	R	-	-	-	-	-	-	-	-
Buliminella brevior Cushman		-	C	R	R	-	-	-	-	-	-
Bolivina cf. *B. torqueata* Cushman and McCulloch		-	R	R	-	-	-	-	-	-	-
Bolivina quadrata Cushman and McCulloch		-	R	R	-	-	-	-	-	-	-
Bolivina spissa Cushman		-	-	F	R	-	-	-	-	-	-
Buccella sp.		-	F	-	-	-	-	-	-	-	-
Uvigerina cf. *U. hootsi* Rankin		-	C	C	-	-	-	-	-	-	-
Bolivina sinuata Galloway and Wissler		-	-	R	-	-	-	-	-	-	-
Suggrunda eckisi Natland		-	-	R	-	-	-	-	-	-	-
Bolivina spissa Cushman		-	-	F	F	-	-	-	-	-	-
Buliminella curta Cushman		-	-	R	-	R	-	-	-	-	-
Fursenkoina cf. *F. bramlettei* (Galloway and Wissler)		-	-	R	R	-	-	-	-	-	-
Uvigerina hispidocostata Cushman and Todd		-	-	R	R	-	-	-	-	-	-
Epistominella cf. *E. gyroidinaformis* (Cushman and Goudkoff)		-	-	R	-	-	-	-	-	-	-
Bulimina uvigerinaformis Cushman and Kleinpell		-	-	R	-	-	-	-	-	-	-
Cassidulina limbata Cushman and Hughes		-	-	-	C	-	-	-	-	-	-
Planulina astoriensis Cushman, Stewart and Stewart		-	-	-	C	-	R	-	R	R	-
Eponides umbonatus (Reuss)		-	-	-	F	R	R	-	R	-	-
Gyroidina soldanii octocamerata Cushman and Siegfus		-	-	-	R	-	-	-	-	-	-
Epistominella subperuviana (Cushman)		-	-	-	C	-	-	-	-	-	-
Siphogenerina kleinpelli Cushman		-	-	-	F	F	R	-	R	-	-
Valvulineria araucana (d'Orbigny)		-	-	-	F	F	R	-	R	-	-
Urigerinella obesa impolita Cushman and Laiming		-	-	-	F	C	F	F	F	F	-
Bulimina alligata Cushman and Laiming		-	-	-	-	C	C	F	R	R	-
Florilus incisum (Cushman)		-	-	-	-	R	-	-	R	R	-
Bolivina marginata adelaidana Cushman and Kleinpell		-	-	-	-	C	-	R	R	-	-
Buliminella subfusiformis Cushman		-	-	-	-	R	R	-	R	-	-
Lenticulina cf. *L. mayi* (Cushman and Parker)		-	-	-	-	F	-	-	-	-	-
Florilus costiferum (Cushman)		-	-	-	-	F	R	-	-	R	-
Nodosaria cf. *N. pioneerensis* Kleinpell		-	-	-	-	F	R	-	R	-	-
Gyroidina orbicularis planata Cushman		-	-	-	-	F	F	F	F	F	-
Cibicides elmaensis var. A Rau		-	-	-	-	R	F	R	R	R	-
Fursenkoina californiensis Cushman		-	-	-	-	R	R	-	R	-	-

Table 5.--Continued

Species	Interval (ft.)	1250	1460-1850	1970-2770	2800-3120	3220-3460	3520-3865	4000-4100	4360-4570	4600-4900	4940-5047
	Epoch	Pliocene		late Miocene	middle to early Miocene		early Miocene or Oligocene		Oligocene	late Eocene	early Eocene
	Stage				Relizian to Saucesian		Saucesian or Zemorrian		Zemorrian	Refugian	Penutian
Epistominella parva Cushman and Laiming.		-	-	-	-	R	R	-	-	-	-
Cassidulina crassipunctata Cushman and Hobson.		-	-	-	-	R	R	R	F	F	-
Anomalina californiensis Cushman and Hobson.		-	-	-	-	-	R	-	R	F	-
Plectofrondicularia packardi multilineata Cushman and Simonson.		-	-	-	-	-	R	-	R	-	-
Uvigerina garzaensis Cushman and Siegfus		-	-	-	-	-	F	-	C	C	-
Quinqueloculina weaveri Rau.		-	-	-	-	-	-	R	-	R	-
Cassidulinoides sp.		-	-	-	-	-	-	R	R	R	-
Cassidulina cf. *C. kernensis* Smith		-	-	-	-	-	-	-	F	-	-
Elphidium cf. *E. minutum* Cushman		-	-	-	-	-	-	-	R	R	-
Pseudoglandulina cf. *P. inflata* (Bornemann).		-	-	-	-	-	-	-	R	R	-
Anomalina glabrata Cushman		-	-	-	-	-	-	-	F	R	-
Alabamina kernensis Smith.		-	-	-	-	-	-	-	F	-	-
Karreriella washingtonensis Rau.		-	-	-	-	-	-	-	R	R	-
Cibicides cf. *C. spiropunctatus* Galloway and Morrey.		-	-	-	-	-	-	-	R	R	-
Siphogenerina nodifera Cushman and Kleinpell		-	-	-	-	-	-	-	R	-	-
Amphistegina sp. [reworked above 4900 feet].		-	-	-	-	-	-	-	R	R	R
Quinqueloculina imperialis Hanna and Hanna		-	-	-	-	-	-	-	R	-	-
Amphimorphina californica Cushman and McMasters [reworked]		-	-	-	-	-	-	-	R	-	-
Globocassidulina globosa (Hantken)		-	-	-	-	-	-	-	-	R	R
Cibicides elmaensis Rau.		-	-	-	-	-	-	-	-	R	-
Bulimina corrugata Cushman and Siegfus [reworked].		-	-	-	-	-	-	-	-	R	-
Bulimina sculptilis laciniata Cushman and Parker		-	-	-	-	-	-	-	-	C	-
Gyroidina condoni Cushman and Schenck)		-	-	-	-	-	-	-	-	R	-
Cibicides hodgei Cushman and Schenck		-	-	-	-	-	-	-	-	R	-
Plectofrondicularia cf. *P. packardi packardi* Cushman and Schenck		-	-	-	-	-	-	-	-	R	-
Epistomina eocenica (Cushman and Hanna).		-	-	-	-	-	-	-	-	R	-
Vaginulinopsis cf. *V.* vacavillensis (G. D. Hanna) [reworked].		-	-	-	-	-	-	-	-	R	-
Tritaxilina colei Cushman and Siegfus [reworked]		-	-	-	-	-	-	-	-	R	-
Siphonina wilcoxensis Cushman.		-	-	-	-	-	-	-	-	-	R
Cibicides cf. *C. laimingi* Mallory.		-	-	-	-	-	-	-	-	-	R
Bolivina aragonensis (Nuttall)		-	-	-	-	-	-	-	-	-	R
Trifarina advena californica Mallory		-	-	-	-	-	-	-	-	-	R
Eponides primus Martin		-	-	-	-	-	-	-	-	-	R
Valvulineria childsi (Martin).		-	-	-	-	-	-	-	-	-	R
Eponides lodoensis Martin.		-	-	-	-	-	-	-	-	-	R
Bolivina cf. *B. explicata lodoensis* Mallory.		-	-	-	-	-	-	-	-	-	R
Asterigerina crassaformis Cushman and Siegfus.		-	-	-	-	-	-	-	-	-	F
Cibicides pseudowuellerstorffi Cole.		-	-	-	-	-	-	-	-	-	R
Cibicides cf. *C. felix* Martin.		-	-	-	-	-	-	-	-	-	R
Alabamina wilcoxensis californica Mallory.		-	-	-	-	-	-	-	-	-	R
Globigerina linaperta Finlay		-	-	-	-	-	-	-	-	-	F
Globigerina cf. *G. eocaena* Gumbel.		-	-	-	-	-	-	-	-	-	F
Globigerina cf. *G. officinalis* Subbotina		-	-	-	-	-	-	-	-	-	R
Globigerina primitiva (Finaly)		-	-	-	-	-	-	-	-	-	C
Globigerina cf. *G. velascoensis* Cushman.		-	-	-	-	-	-	-	-	-	R
Globorotalia cg. *G. nicoli* Martin.		-	-	-	-	-	-	-	-	-	R
Globorotalia cf. *G. planoconica* Subbotina.		-	-	-	-	-	-	-	-	-	R
Globorotalia aequa Cushman and Renz.		-	-	-	-	-	-	-	-	-	F
Globorotalia cf. *G. pseudomenardii* Bolli		-	-	-	-	-	-	-	-	-	F
Pseudohastigerina wilcoxensis (Cushman and Ponton)		-	-	-	-	-	-	-	-	-	R

Species	Interval (ft.)	Epoch	Stage
Cassidulina translucens Cushman and Hughes	950-980	Pliocene	
Uvigerina peregrina Cushman	1040-1070		
Buccella cf. *B. inusitata* Andersen	1140-1170		
Globigerina cf. *G. bulloides* d'Orbigny	1580-1610		
Cibicides cf. *C. concoideus* Galloway and Wissler			
Epistominella pacifica (Cushman)	2090-2150	? — late Miocene — ?	
Elphidium hughesi Cushman and Grant	2210-2240		
Uvigerina juncea Cushman and Todd	2270-2300		
Globobulimina cf. *G. auriculata* (Bailey)	2540-2570	early Miocene	Saucesian
Uvigerina cf. *V. senticosa* Cushman	2660-2690		
Fissurina sp.	2750-2780		
Florilus sp.	2840-2870	? — Oligocene — ?	? — Zemorrian — ?
Martinottiella communis (d'Orbigny)	2900		
Rotalia garveyensis Natland	3020-3080	late Eocene	Refugian to Narizian
Bulimina cg. *B. inflata* Seguenza	3140-4170		
Karreriella sp.	3170-3200		
Spiroloculina cg. *S. lampsa* Hussey	3350-3380		
Pseudoglandulina sp.	3890-3920	early Eocene	Penutian
Quinqueloculina sp.	3918		
Epistominella parva (Cushman and Laiming)	4490-4850		
Cassidulina cf. *C. cassipunctata* Cushman and Hobson	4852		
Virgulina californiensis Cushman			
Bulimina subfusiformis Cushman			
Guttulina cf. *G. problema* d'Orbigny			
Cibicides cf. *C. elmaensis* Rau var. A			
Buccella mansfieldi oregonensis (Cushman, Stewart and Stewart			
Lenticulina? sp.			
Sphaeroidina bulloides d'Orbigny			
Elphidium cf. *E. minutum* (Reuss)			
Epistominella umbonatus (Reuss)			
Cibicides cf. *C. elmaensis* Rau			
Pleurostomella packardi packardi Cushman and Schenck			
Valvulineria tumeyensis Cushman and Simonson			
Uvigerina garzaensis Cushman and Siegfus			
Uvigerina cf. *U. cocoaensis* Cushman			
Cancris cf. *C. joaquinensis* Smith			
Lenticulina inornatus d'Orbigny			
Eponides yeguaensis weinzierl and Applin			
Quinqueloculina weaveri Rau			
Cassidulina cf. *C. galvinensis* Cushman and Grizzell			
Cibicides cf. *C. pseudowuellerstorffi* Cole			
Globigerina cf. *G. linaperta* Finley			
Globorotalia cf. *G. planoconica* Subbotina			
Anomalina dorri aragonensis Nuttall			
Uvigerina lodoensis miniamae Mallory			
Cibicides cf. *C. venezuelanus* Nuttall			
Bolivina cf. *B. explicata lodoensis* Mallory			
Trifarina advena californica Mallory			
Globorotalia cf. *G. pseudotopilensis* (Subbotina)			
Bulimina cf. *B. whitei* Martin			
Cibicides cf. *C. cushmani* Nuttall			
Siphonina cf. *S. wilcoxensis* Cushman			
Nodosaria lateyugata Gumbell			
Cibicides cf. *C. fortunatus* Martin			
Tritaxilina colei Cushman and Siegfus			
Globorotalia aragonensis Nuttall			
Caudryina coatingensis (Cushman and G. D. Hanna)			
Asterigerina crassaformis Cushman and Siegfus			
Pseudohastigerina micra (Cole)			
Bolivina cf. *B. aragonensis* (Nuttall)			
Cibicides cf. *C. martinezensis* Cushman and Barksdale			
Cibicides cf. *C. felix* Martin			
Buliminella cf. *B. grata convoluta* Mallory			
Siphonina charoides (Jones and Parker)			
Alabamina wilcoxensis Toulmin			
Eponides cf. *E. minima* Cushman			

Table 6.--Checklist of Foraminifera in Pan American Petroleum Corporation, Coos Bay No. 1, P-0112 well.
Identifications by W. W. Rau; for checklist of phytoplankton in this well see table 8.

Table 7.--Checklist of phytoplankton in Shell Oil Company, P-087 well.
Identifications by David Bukry.

Species	Age	Late middle Miocene	Late late Eocene or early early Oligocene		Late middle Eocene	Early middle Eocene (Discoaster sublodoensis Zone)
	Depth (ft.)	2835	5980	6090	7890	7910
Diatoms-						
Actinocyclus sp. cf. *A. ingens* Rattray		x				
Denticula hustedtii Simonsen & Kanaya		x				
Rhaphoneis amphiceros Ehrenberg; varieties		x				
Silicoflagellates-						
Distephanus longispinus (Schulz)		x				
Mesocena circulus (Ehrenberg)		x				
Calcareous nannoplankton-						
Braarudosphaera bigelowii (Gran & Braarud)			x	x		
Chiasmolithus grandis (Bramlette & Riedel)						x
C. solitus (Bramlette & Sullivan)					x	x
Coccolithus eopelagicus (Bramlette & Riedel)					x	
C. formosus (Kamptner)					x	x
Cyclicargolithus pseudogammation (Bouché)					x	x
C. sp. cf. *C. pseudogammation* (Bouché)				x		
Dictyococcites bisectus (Hay, Monler, & Wade)			x			
Discoaster barbadiensis (Tan)					x	x
D. deflandrei Bramlette & Riedel					x	
D. distinctus Martini						x
D. sp. cf. *D. nodifer* (Bramlette & Riedel)					x	
D. sp. cf. *D. nonaradiatus* Klumpp						x
Discolithina plana (Bramlette & Sullivan)						x
Ellipsolithus lajollaensis Bukry & Percival						x
Helicosphaera lophota Bramlette & Sullivan						x
H. seminulum Bramlette & Sullivan						x
Isthmolithus recurvus Deflandre			x	x		
R. inflata Bramlette & Sullivan						x
Reticulofenestra dictyoda (Deflandre)						x
R. samodurovii (Hay, Monler, & Wade)					x	
R. umbilica (Levin)				x	x	
Rhabdosphaera crebra (Deflandre)						x
Micrantholithus spp.						x
Sphenolithus radians Deflandre						x
Transversopontis pulcher (Deflandre)						x

Table 8.--Checklists of phytoplankton in Pan American Petroleum Corporation, Coos Bay No. 1, P-0112 and in Union Oil Company of California, Fulmar No. 1, P-0130 wells. Identifications by David Bukry.

Species	Well No.	P-0112					P-0130			
	Age	Early Eocene					Early Eocene			
	Coccolith Zone	*Discoaster lodoensis* or *D. sublodoensis* Zone	--		*Tribrachiatus orthostylus* Zone		*Discoaster lodoensis* Zone	--		*Tribrachiatus orthostylus* Zone or *Discoaster lodoensis* Zone
	Depth (ft.)	3170	3411	4245	4350	4550	5430	6600	7500	12180
Braarudosphaera bigelowii (Gran and Braarud)					x					
Campylosphaera dela (Bramlette and Sullivan)						x	x		x	x
Chiasmolithus consuetus (Bramlette and Sullivan)						x	x		x	
C. grandis (Bramlette and Riedel)				x	x		x	x		
C. solitus (Bramlette and Sullivan)							x			
Coccolithus crassus Bramlette and Sullivan		x	cf.							
C. formosus (Kamptner)							x			
C. magnicrassus Bukry							x			
C. pelagicus (Wallich) s. ampl.			x				x		x	
Cyclicargolithus pseudogammation (Bouché)			x				x		x	
Cyclococcolithina? gammation (Bramlette and Sullivan)				x		x				
Discoaster barbadiensis Tan										x
D. distinctus Martini								x		
D. lodoensis Bramlette and Riedel				x		x	x			x
D. sp. (6-rayed)		x								
Discoasteroides kuepperi (Stradner)			x	x	x	x	x	x		x
Discolithina plana (Bramlette and Sullivan)				x			x	x		
D. sp. (bipore)				x	x					
D. sp. (multipore)						x				
Helicosphaera lophota Bramlette and Sullivan				x	x		x			
H. seminulum Bramlette and Sullivan		x	x	x	x		x	x	x	
Lophodolithus nascens Bramlette and Sullivan							x			
Micrantholithus sp.				x	x	x				x
Reticulofenestra? sp. (small)		x								
Rhabdosphaera crebra (Deflandre)		x				x	x			
R. perlonga (Deflandre)							x			
Scyphosphaera tubicena Stradner				x						
S. spp.						x				
Sphenolithus radians Deflandre s. ampl.		x	x	x	x	x	x	x		
Transversopontis pulcher (Deflandre)		x	x	x	x	x	x	x	x	x
Tribrachiatus orthostylus Shamrai					x	x	x			
Zygrhablithus bijugatus (Deflandre)		x				x	x			
Zygolithus dubius Deflandre								x		

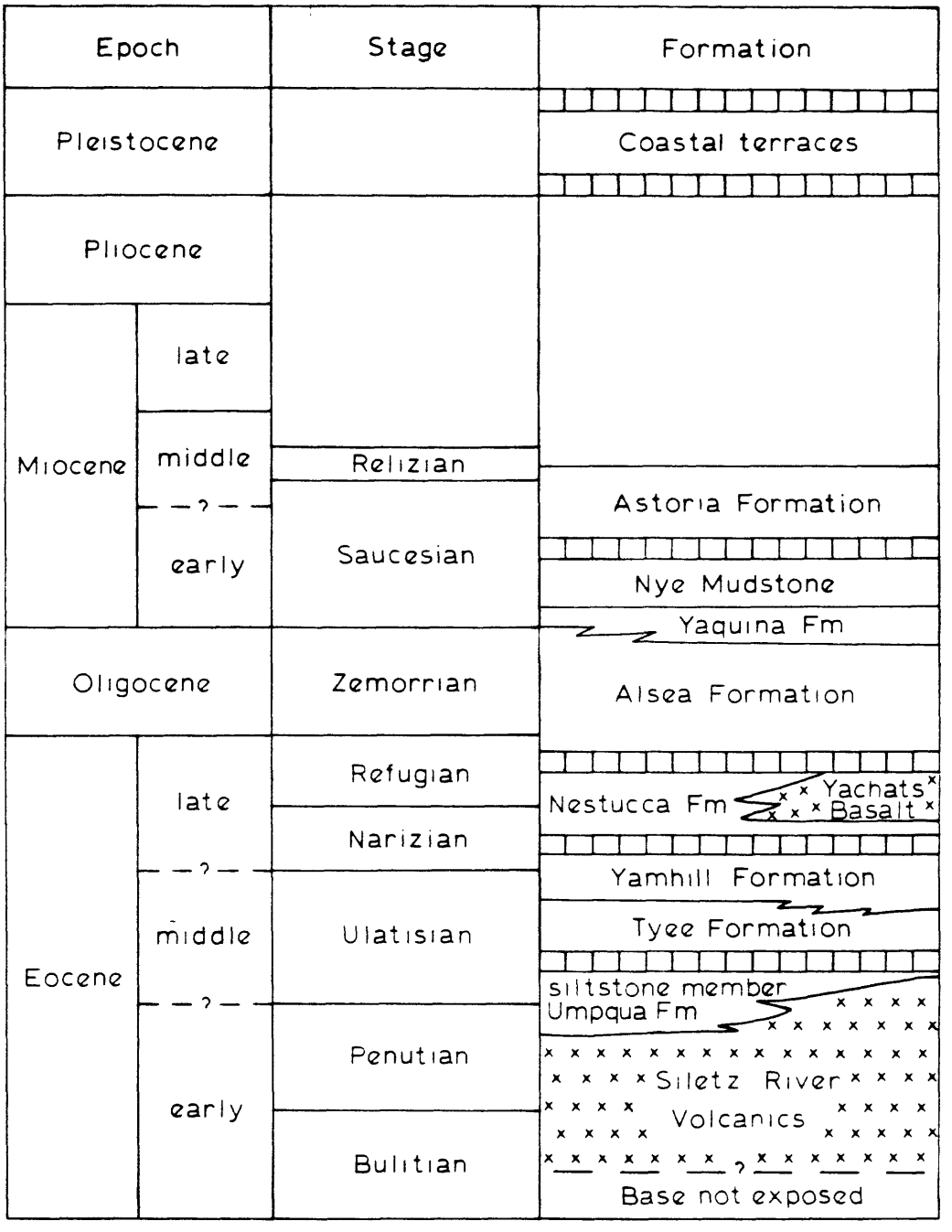

Figure 2.--Inferred correlations between time-stratigraphic units, benthic foraminiferal stages as applied in the Pacific Northwest by Rau (1981), and onshore formations in the central part of the Oregon Coast Range.

Table 9.--Generalized lithologic descriptions of time-stratigraphic units penetrated in offshore and onshore wells

OFFSHORE UNITS

PLEISTOCENE

Olive-gray massive semiconsolidated foraminiferal clayey to sandy silt with occasional interbeds of fine- to very fine-grained micaceous, lithic to quartzose sand.

PLIOCENE

Brownish-gray massive foraminiferal finely micaceous siltstone and claystone with thin interbeds of gray medium- to fine-grained moderately well-sorted glauconitic, quartzose, lithic, sandstone.

LATE MIOCENE

(Delmontian and Mohnian Stages[1/] undifferentiated)

Brown massive to laminated, foraminiferal, generally carbonaceous and glauconitic, tuffaceous, sandy siltstone and silty claystone; fine tuff laminae locally common; few interbeds of light-gray fine-grained glauconitic, micaceous, feldspathic, quartzose, lithic sandstone.

MIDDLE AND EARLY MIOCENE

(Saucesian Stage)

Dark-gray to olive-gray massive, foraminiferal, silty claystone and micaceous sandy siltstone and light-gray medium- to fine-grained silty sandstone; contains a few fine tuff beds; pillow basalt flow and sill in well P-0103.

OLIGOCENE

(Zemorrian Stage)

Light-gray silty claystone and medium-gray foraminiferal, glauconitic, tuffaceous, carbonaceous siltstone. Contains a few gray very fine grained quartzose, lithic sandstone and occasional white tuff beds.

LATE EOCENE

(Refugian Stage)

Light-gray to grayish-brown massive tuffaceous claystone and medium-gray finely micaceous, tuffaceous slightly sandy siltstone. Contains a few gray fine-grained lithic sandstone laminae or interbeds; intruded by basalt sill in well P-093.

[1/] Pacific Northwest benthonic foraminiferal stages as used by Rau (1981).

(Narizian Stage)

Dark- to light-gray fine- to coarse-grained angular to subangular lithic wackes with siltstone and claystone rip-ups. Lower part of unit contains water-laid tuff breccia, basaltic sandstone, and conglomerate. Description mainly from well P-093.

(Narizian Stage)

Varicolored lapilli tuff and tuff breccia interbedded with pebble conglomerate composed of clasts of porphyritic andesite and basalt in a matrix of coarse- to medium-grained basaltic sandstone; few thin tuffaceous claystone beds. Description mainly from well P-087.

LATE MIDDLE EOCENE

(Ulatisian Stage)

Medium-gray to grayish-brown medium- to very fine grained, calcareous, micaceous, quartzose, feldspathic, lithic sandstone and sandy siltstone and medium-gray to dark olive-gray massive tuffaceous or calcareous silty claystone and varicolored well-indurated silty to sand zeolitized tuff breccia.

EARLY MIDDLE EOCENE

Dark-gray or black aphanitic basalt with dark-greenish tint and veined with calcite and zeolite; few interbeds of tuffaceous siltstone. Description from well P-087.

EARLY EOCENE

(Penutian Stage)

Medium-gray coarse- to fine-grained angular to subangular, carbonaceous, slightly micaceous, feldspathic, quartzose, lithic sandstone in wells P-0112 and P-0130; cemented or veined with calcite, laumontite, and quartz; contains thick interbeds of laumontite- and calcite-cemented conglomeratic sandstone with pebbles and fragments of metamorphic, volcanic, schistose and ultrabasic rocks; also has interbeds of olive-gray tuffaceous, carbonaceous, micaceous siltstone and fissile claystone.

ONSHORE FORMATIONS

LATE OLIGOCENE AND LATE EOCENE

Undifferentiated intrusive igneous rocks--includes basalt feeder dikes to the upper Eocene Yachats Basalt (Snavely and MacLeod, 1974) and upper Oligocene granophyric gabbro and diabase sills and dikes (Snavely and Wagner, 1961).

LATE EOCENE

Nestucca Formation--thin-bedded to massive tuffaceous siltstone with very thin tuff interbeds; locally contains massive to thick-bedded arkosic sandstone (Snavely and Vokes, 1949).

MIDDLE EOCENE

Tyee Formation--fine- to medium-grained lithic, feldspathic, or arkosic, carbonaceous, micaceous sandstone; beds 1/2 to 2 m thick (turbidites); finely micaceous siltstone in upper part of graded beds and in thin interbeds (Snavely and others, 1964).

EARLY TO MIDDLE(?) EOCENE

Siltstone member of Umpqua Formation--well-indurated dark-gray finely micaceous siltstone, commonly veined with calcite and intruded by basalt and diabase dikes and sills; basal member consists of a 200-m thick water-laid varicolored vitric and crystal tuff and basaltic sandstone in a calcareous matrix (Diller, 1898; Hoover, 1963; Lookingglass Formation of Baldwin, 1974).

EARLY EOCENE

Siletz River Volcanics--tholeiitic pillow lava and breccia with minor interbeds of basaltic sedimentary rocks; dark-gray porphyritic and amygdaloidal olivine and augite basalt (Snavely and Baldwin, 1948; Snavely and others, 1968).

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