Nevertheless, large volumes of Franciscan debris must have been removed from the Santa Lucia Range before the Miocene transgression. This debris probably was transported west and deposited as thick early Tertiary clastic sequences in offshore basins.

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INFLUENCE OF CASCADIA CHANNEL ON ABYSSAL SEDIMENTATION

Cascadia channel is the most prominent and extensive deep-sea channel known in the northeastern Pacific Ocean. Preliminary results from a survey of this channel in the part of Cascadia abyssal plain off the Oregon coast and in the seamount province west of the plain are presented.

The bottom of the channel has a depth range of 1,565–1,830 fathoms and a slope of about 1:1,000. Relief ranges from 20 fathoms off northern Oregon to more than 400 fathoms in an abyssal gap in the seamount province. The width of the channel ranges from 1 to 4 nautical miles at the top and from less than ¼ to about 3 miles at the bottom.

Piston cores taken along a 6-mile profile extending from the western side (abyssal plain) to the eastern side (Astoria fan) of Cascadia channel exhibit a marked diversity in sediment texture and composition. On the western side the sediments are composed chiefly of gray clay interbedded with thin laminations of sandy silt. Planktonic Foraminifera predominate in the sandy material. Sediments in the axis of the channel consist of several cyclic depositional units. Each unit is made up of a basal fine sand grading upward into olive-brown silt and clay and overlain by gray clay. The sand and silt contain detrital minerals and organic debris derived from continental sources. On the eastern side the sediments are similar to terrigenous material found elsewhere on Astoria fan.

Sedimentation on Cascadia abyssal plain is controlled, to a large extent, by Cascadia channel. The channel apparently acts as a sediment trap and as an avenue of dispersal for terrigenous material transported along the sea floor.

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RECENT DEVELOPMENT IN WILMINGTON-LONG BEACH UNIT OIL FIELD

The Wilmington oil field is a broad, asymmetrical, anticlinal structure broken by a series of transverse normal faults which divide the producing zones into more than 50 separate pools. The seven producing zones in the field range in age from middle Miocene (Topanga) to early Pliocene (Repetto). Since the discovery of the field in 1936, cumulative production of the Wilmington oil field reached an estimated 1.049 billion barrels of oil at the end of 1965. Current daily production (exclusive of the Long Beach Unit) is approximately 102,000 BOPD, of which 65,000 barrels is estimated to result from salt-water injection. As of December 31, 1965, total cumulative salt-water injection in the Wilmington oil field was 1.2 billion barrels. Land subsidence has been arrested in most of the field except for a 4-square-mile area at the center of the bowl, where maximum subsidence has been reduced to approximately 0.2 feet per year.

Development of the Long Beach Unit (East Wilmington) started on July 16, 1965, when Thums Long Beach Company, under the terms of its contract with the City of Long Beach, spudded its first well, J-146, on the City's newly built Pier J site. By the end of 1965, Thums completed 24 wells (5 are water injectors) from Pier J and was producing approximately 11,000 BOPD. Geologic information from the recently completed wells confirms in general the structural interpretation based on the 1954 seismic survey and core holes drilled in 1962. Some horizontal lithologic changes are evident. It is estimated that 1,000 production and injection wells ultimately may be required to develop the estimated 1.2 billion barrels of oil reserves under a water-injection pressure-maintenance program during a 35-year period. These wells will be drilled from the harbor's Pier J locations and from four drill-site islands. The Long Beach Unit may reach a peak production of nearly 200,000 BOPD by 1970.

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HUNTINGTON BEACH OFFSHORE—PARCEL 14

Union Oil Company of California has developed on California State Tidelands, PRC #3053, Parcel 14, an extension to the Huntington Beach offshore oil field. Union was awarded Parcel 14 by the State of California in 1962 for a bonus of $6,110,000.

Parcel 14 is located down the west plunge of a large east-west-trending asymmetrical anticlinal structure. This offshore structure extends from the shore westward approximately 3 miles. The south flank of the anticline is steep-dipping with known dips up to 65°. The north flank has an average dip of 10°. An axial hade of approximately 70° to the north is present.

Faulting is minor on Parcel 14 with only two 50-foot normal faults mapped. Oil is produced from the Upper Main division "C" sandstone reservoirs, defined as Upper Main and Main zones.

The maximum net oil-sand column penetrated to date is 510 feet. The Upper Main is composed of several sandstone bodies that are lenticular in nature, whereas the Main zone is more of a massive blanket sandstone body and holds the major part of the oil column.

California Division of Oil and Gas, "Summary of Operations," Volume 46, No. 2, contains a description of the Main-zone shale section located shoreward in Parcel 14. This main-zone shale section thickens seaward and new sandstone bodies appear, partly as a result of facies changes, and partly because of lensing. As a result, additional oil-productive zones are developed across Parcel 14 in both the Main and Upper Main intervals. Thirty wells on 10-acre spacing have been drilled directionally and completed from Union's Platform Eva. The wells are positioned on a five-spot waterflood pattern for future secondary operations.

Primary reserves of 23 million barrels and secondary reserves of 10 million barrels, a total of 33 million barrels, have been estimated for Parcel 14. Average daily production from Parcel 14 is 8,000 BOPD. All wells are pumped by hydraulic lift.

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OPTIONS FOR GEOLOGISTS IN SELECTING A PROFESSIONAL STATUS

God helps those who help themselves, but state assemblymen and senators, and even engineers, can be of some assistance. The profession has dallied for years on the primrose path of apathy, except for periodic outraged reaction to intrusion on its preserve by others. As a "program" this mixture of apathy and outrage is reminiscent of the life of a porcupine. Fortunately there are other paths to take. The profession has the capacity for making a rational choice from the overlapping yet conflicting programs offered by registration (equals licensing), certification, and incorporation (equals chartering). If you do not know the precise differences among these terms, this is as good a time as any to find out. If you do know, and have an interest in the profession at which you work, this talk offers a 20-minute interval in which to think about it.

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CHRONOLOGY OF DEFORMATION OF PALEOZOIC AND TERTIARY SUCCESSION NEAR RAILROAD VALLEY, NEVADA

Principal structures occurring in the Paleozoic sedimentary section of the Horse Range are thrust faults (some placing older over younger rocks, but most placing younger over older), north-south-trending, asymmetrical, eastward-overturned folds, and high-angle faults. Pre-Oligocene deformation of these Paleozoic rocks is indicated by Oligocene volcanic rocks lying with angular unconformity on overturned Ordovician strata.

In the dissected pediments west of the Horse Range, a 10,000-foot-thick sedimentary and volcanic succession of Oligocene, Miocene, and Pliocene rocks crops out (Moores, 1965). The Miocene-Pliocene part of the section lies disconformably on Oligocene volcanic rocks and consists of an assemblage of terrestrial strata, including indurated ash beds, lacustrine limestone, and immature detrital deposits which contain angular Paleozoic carbonate and Oligocene volcanic clasts derived from adjacent ranges.

The general parallelism of the Paleozoic and Tertiary successions given as evidence for contemporaneous deformation (Moores, 1965) is expressed only in that they are in contact with one another for a distance of approximately 12 miles. There the parallelism ends. Folds and thrust faults in the Paleozoic rocks trend north-south, whereas folds within the Tertiary succession trend east-west and plunge steeply toward the west. These relations, together with the angular unconformity between the Oligocene volcanic rocks and Paleozoic rocks, temporally separate tectonic deformation of the Paleozoic and Tertiary successions.

Principal deformation of the Paleozoic succession at least preceded the Oligocene volcanic rocks, and may be as old as Pennsylvanian (Ptacek, 1963). Deformation of the Tertiary succession occurred, at least in part, after the Pliocene rocks were deposited, and probably during the Oligocene and Miocene, as is suggested by several unconformities reported in the Tertiary succession (Moores, 1965).

Some occurrences of Paleozoic rocks are in positions that suggest emplacement by gravity sliding during or after deposition of Tertiary rocks. These occurrences can be explained easily as gravity-slide blocks emplaced from adjacent ranges (*e.g.*, Horse and Grant) as the ranges were uplifted along high-angle faults, but in no way imply that the principal deformation of the Paleozoic strata was contemporaneous with deformation of the Tertiary succession.

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CLOSING THE ONSHORE-OFFSHORE GAP

(No abstract submitted.)

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STRATIGRAPHIC FACIES PREDICTION AND RECOGNITION IN YOUNG OFFSHORE BASINS FROM STUDIES OF FOSSIL ENVIRONMENTS

Basic principles of stratigraphy provided by Cambrian paleontology have analogies with Pacific Coast Oligocene, Pliocene, and other rocks. Re-examination of concepts from the time of Hutton (1795) and restudy of the complete fossil record are proposed to interpret the geologic history of new areas of petroleum exploration.

The doctrine of uniformitarianism in sedimentary processes, and uniformitarian biologic laws, provide the key to solution of stratigraphic problems if they are combined with the principle of uniqueness of environments (Nairn, 1965).

Stromatolite reef occurrences from the Precambrian of Glacier National Park (Rezak, 1957) to the Recent of Shark Bay, Australia (Logan, 1961), with oölite, glauconite, and shoal sediment features, illustrate the first principle (unchanging physical geologic processes).

Palmer's biomere concept (1965) for benthonic trilobites and his Upper Cambrian agnostid studies, and the Middle Cambrian agnostid studies of Robison (1964), provide analogy with benthonic and nektoplanktonic fossils of any age under the second principle (uniformitarian biologic laws).

The stratigraphic limitation of the fossil biomere in Cambrian, Oligocene, or Pliocene by historical events, by the migration from eurybathyal to stenobathyal habitats, and by the effect of cyclical climatic events on evolution or extinction shows the third principle (uniqueness of environments).

Analogous examples of the fundamental principles are provided by Foraminifera in benthonic uvigerinid biomeres in the Oligocene of the Pacific Coast. Analogy with cyclothems is found in correlations between cyclical climatic stages of the Pliocene planktonic *Globigerina pachyderma* (Bolli, 1950) in the Los Angeles and Ventura basins, California (Bandy, 1961), and synchronous climatic history in Japan (Kobayashi and Shikama, 1961).

Correlation of cyclical historical events rather than reliance only on syntax of animal or plant fossils is important for regional correlations and sedimentary-facies studies.

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CONTINENTAL MARGIN OF NORTHERN AND CENTRAL CALIFORNIA

The geology of the continental margin offshore from northern and central California, though actively studied in recent years, still is very incompletely known. Much of the available data consists of measurements made at the ocean surface from which deductions have been made regarding the rocks and structures on the sea floor. The nature of the young sediments on the surface of the sea floor is moderately well known from dredge sampling, though not nearly