

volcanic rocks. At the south end of San Diego Bay, a gravity anomaly of -36 mgals. and well data indicate the presence of a sedimentary basin $\pm 6,000$ feet deep. A $+4$ mgal. anomaly at Point Loma and near-zero anomalies at La Jolla reflect a positive westerly gradient.

At the surface, Santiago Peak volcanic rocks, a discontinuously exposed belt of Upper Jurassic and Lower Cretaceous(?) meta-volcanic and meta-volcaniclastic rocks, roughly separate mid-Cretaceous batholithic rocks at the northeast from Upper Cretaceous, Eocene, and Pliocene clastic sedimentary rocks at the southwest. The Campanian-Maestrichtian Rosario Formation crops out at La Jolla and Point Loma. Most surface exposures of undifferentiated Eocene rocks are north of Mission Valley. At the south, the Pliocene San Diego Formation overlaps the Eocene.

An irregular basement surface (batholith and older) dips west; it is elevated slightly under Point Loma and flattened under La Jolla. The Rosario Formation reaches a maximum thickness of $\pm 4,000$ feet at La Jolla and Point Loma. Undifferentiated Eocene sedimentary rocks attain a maximum thickness of $\pm 2,500$ feet south of San Diego Bay where they are overlain by more than 2,000 feet of the San Diego Formation.

Four distinct post-batholith structural blocks are delimited by an east-west Mission Valley hinge line and the north-south-trending Rose Canyon fault. The northeast stable block (Kearny mesa) received mostly Eocene sediments. The northwest block (La Jolla) and southwest block (Point Loma), separated by synclinal Mission Bay, received mostly Upper Cretaceous and Eocene sediments, and later were uplifted, faulted, and tilted. The southeast block (San Diego mesa) probably subsided continuously, receiving more than 2,000 feet of Upper Cretaceous, Eocene, and Pliocene sediments.

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AUTHIGENIC SILICATES IN MARINE SPENCER FORMATION AT CORVALLIS, OREGON

Segments of the petroleum industry are actively exploring the Tertiary rocks of offshore Oregon and Washington; several wells are being drilled and others are projected. It is noteworthy (1) that amphibole and pyroxene occur in sandstone beds of one of the potential reservoir formations under conditions that require an authigenic origin and (2) that the rocks have not been metamorphosed. These minerals, which usually are presumed to have formed in conditions of much higher temperatures than those of diagenesis, are found in the Spencer Formation of late Eocene age at Corvallis, Oregon. The best-preserved examples of these minerals are found in a graded sedimentation unit rich in molluscan fossil fragments, basic volcanic glass, and zeolitic concretions. The marine shell fragments are replaced by thomsonite which contains many idiomorphic crystals and tangled needles of actinolite and clinopyroxene.

Reconstruction of the diagenetic environment suggests a formation temperature near 140°F. , solutions somewhat less saline than sea water, a pH of slightly less than 7.0, and an Eh near -0.2 .

Formation of thomsonite, actinolite, clinopyroxene, and rare analcime, rather than a suite such as clinoptilolite or heulandite, orthoclase, and abundant analcime, is thought to have been caused by a supply of

basic volcanic glass and molluscan calcite rather than acid glass and soda-rich brines.

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DIVING GEOLOGY

A remarkably large amount of "surface geology" has been done in the California offshore areas using both "Hard Hat" and "SCUBA" divers. Considerable oil has been found as a result of this work, but there have been some notable failures.

In the areas where the diving method is applicable, it is a very effective and relatively inexpensive way to explore for oil. In areas of steep dip and in shallow water, it has some distinct advantages over conventional seismic techniques.

Future use will be dependent on the choice of suitable areas for exploration and on improvements in the technique. Suggested improvements include the use of (1) sonar bottom-scanning devices and (2) submersibles to extend the depth of observation.

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STRATIGRAPHY OF MONTESANO FORMATION, WASHINGTON

The Montesano Formation is known to occur over about 250 square miles of Grays Harbor basin. Eight stratigraphic sections were measured along the branches of the Wishkah and Satsop Rivers, the Wynoochee River, and the Canyon River. Exposures of the Montesano Formation along the Middle Fork of the Wishkah River are designated the type section. There it is 2,500 feet thick and is composed of 1,500 feet of fine-grained sandstone, with small amounts of pebble conglomerate and mudstone, overlain by 1,000 feet of tuffaceous mudstone and sandy siltstone. Toward the east the thickness of the formation averages only 1,800 feet, and it is composed principally of fine- to medium-grained sandstone, pebbly sandstone, and conglomerate. Along the West Fork of the Satsop River, an abnormally thick sequence of thin-bedded to laminated, tuffaceous mudstone and very fine-grained sandstone at least 1,100 feet thick contributes to a formation thickness that may exceed 3,000 feet.

Deposition took place in a sea which was transgressing eastward across a broad, east-west-trending embayment. Estimated water depths ranged from sea-level to more than 3,000 feet. The upper parts of the eastern sections apparently represent a regressive phase. Turbidite deposition in a partly closed basin was the principal cause of the abnormally thick accumulation of the thin-bedded sequence mentioned previously.

Foraminiferal evidence places the Montesano Formation mainly in the upper Miocene. It is unconformable on the lower Miocene Astoria and Oligocene Lincoln Formations. A unit sometimes referred to as the Satsop Formation, and questionably considered to be Plio-Pleistocene, overlies the Montesano unconformably.

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AN UPPER CRETACEOUS FAULT-LINE COAST

From northern San Diego County, California, to