

underlying ocean plates.

The hydrogeology of continental coasts and islands is usually an extension of continental-type hydrogeology, except that coastal hydrology often is overwhelmingly influenced by the relation between fresh water and sea water in aquifers. Arc-island hydrogeology is dominated by andesitic volcanic rocks, often acting as aquicludes, and in many places by fossil reefs, which are normally suitable as freshwater aquifers if extensive enough. The hydrogeology of ocean islands is characterized by permeable basalts, relatively impermeable sediments, and, occasionally, fossil reefs. Atolls are emerged fossil reefs overlying preexisting arcs or ocean islands.

The hydrogeology of islands is particularly crucial to successful economic development as examples of the importance of hydrogeology to economic growth show.

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SOME SHALE TECTONIC CONSEQUENCES OF POSSIBLE PHENOMENON OF SUBDUCTION AND ITS MEANING TO HYDROCARBON EXPLORATIONIST

No abstract available.

MOODY, J., D. A. HOLMGREN, R. W. ESSER
TECTONIC FRAMEWORK OF PACIFIC REGION

No abstract available.

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HYDROCARBON POTENTIAL OF OFFSHORE CALIFORNIA

Seaward from the tideline of the California coast to the base of the continental slope is an area of 100,000 sq km (38,600 sq mi) containing 16 sedimentary basins covering 60,000 sq km (23,200 sq mi) with a volume of 166,000 cu km (39,800 sq mi).

The shelf is less than 10% explored and the activity has been confined largely to the coastal fringe of the Santa Barbara Channel and near Los Angeles. Nevertheless 1.8 billion bbl of oil and 1,200 billion cu ft of gas have been produced from 4,400 exploration and development wells. Reserves are estimated at 4.5 billion bbl.

The region has three distinct tectonic provinces. Clastic sediments with occasional pyroclastic and extrusive igneous rocks are common to all and cherts are abundant in the Santa Maria basin of the northern province. There are no carbonate rocks.

The southern province of 46,600 sq km (18,000 sq mi) is a region of tectonic extension with northwesterly trending horst and graben development that clearly reflects the bathymetry. Nine sedimentary basins occupy the deep-water areas; islands and shallow banks are underlain by thin or older sediments and basement rocks. Maximum sedimentary thickness is probably about 4,000 m (13,100 ft) with a volume of about 56,700 cu km (13,600 cu mi).

The Santa Barbara Channel province trends east-west. Compressional forces have formed several lines of sharp folds along the northern edge of the basin.

Many large faults on the north and south borders show left-lateral movement. Rocks from Cretaceous to Pleistocene aggregate up to 20,000 m (65,600 ft) in thickness. Basement is estimated at 12,000 m (39,360 ft) at the eastern end rising toward the sea floor at the western end. The basin has an area of 5,200 sq km (2,000 sq mi) and a volume of 41,700 cu km (10,000 cu mi).

The northern province has 6 basins covering 31,000 sq km (12,000 sq mi) with a volume of 67,600 cu km (16,200 cu mi). Structural trends are northwest and compression forces are indicated by marginal thrust faulting and folding. Erosional remnants of Upper Cretaceous and lower Cenozoic rocks are common but prospective sediments are of Miocene and Pliocene age. Five of the basins are 3,000 m (10,000 ft) deep or less. The Eel River basin may be as deep as 4,500 m (14,750 ft).

Future potential reserves are estimated as 23.3 billion bbl of oil and 16,200 billion cu ft of gas.

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MINERAL RESOURCES OF ECUADOR—DEVELOPMENT AND PROSPECTS

Mineral deposits in Ecuador are many but only one metalliferous mine, the Portovelo gold mine, now is operating. It was worked in colonial times but on a systematic basis only since 1904. Gold was the principal product together with silver, copper, lead, and zinc. At present, copper is more important but the ore reserves are virtually exhausted. The Macuchi mine was worked for copper, gold, and silver in the 1940s and prospects containing various combinations of copper, silver, lead, and zinc were discovered at La Plata, Sigchos, Molleturo, and Pilshum.

In 1965 the United Nations in cooperation with the newly established Servicio Nacional de Geologia y Minería began a seven-year mineral resources survey. The principal discovery was the Chaucha porphyry copper-molybdenum deposit where 55 million tons of 0.7-percent copper were proved. Other porphyry copper-molybdenum deposits were discovered at Los Linderos, Rio Playas, and Fierro Urco. At Fierro Urco 50 million tons of ore with low-gold values was indicated. Vein-type mineralization at Angas (copper, lead, zinc, silver, and gold), San Bartolome (silver and lead), and Uritohuaser (zinc, lead, and silver) also were discovered. Anomalies in tin and tungsten minerals were found near Saraguro.

Most surveys have been in the southern Andes where exposed Tertiary and older rocks are intruded by granitic bodies. The flanks of the Andes have not been explored thoroughly because of difficult access and dense forest. Much of the north-central Andes has a cover of Quaternary volcanic rocks mantling the older rocks, but until there are methods to probe through this thick mantle for possible mineralization the potential is unknown. The prospects however must be good because the Ecuadorian Sierra is part of the great mineralized mountain belt extending through the western Americas.

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STRUCTURAL EVOLUTION OF TERTIARY BASINS OF SOUTHEAST ASIA