SCHWADE, IRVING T., Richfield Oil Corporation, Los Angeles, Calif.

PETROLEUM GEOLOGY OF COASTAL PERU AND ECUADOR

Oil fields of coastal Peru and Ecuador lie within the only significant coastal plain along the western margin of South America. This plain is underlain by chiefly marine lower Tertiary and variably marine to continental upper Tertiary sediments, and is capped by a spectacular, but locally heavily dissected, elevated Quaternary marine terrace, or *Tablazo.* Although evidence is meager, the marine lower Tertiary sediments are considered not to have been deposited as in a basin, but more likely as in a half-basin or marine bank on a narrow continental shelf, facing the open ocean on the west.

The principal producing areas in this belt, from north to south are (Ecuador) Ancon, and (Peru) El Alto, Lobitos, Talara-Negritos, and Portachuelo. Estimated ultimate recovery from established reserves are: Ecuador, possibly in excess of 125 million barrels of 37° gravity oil; and Peru, possibly up to 1 billion barrels of 37° gravity oil. Production comes chiefly from Eocene sandstones and conglomerates, with fracturing commonly playing a major part in reservoir permeability.

The Tertiary coastal belt is one of both common stratigraphic complications and a rather unique structural arrangement. Much of the marine Tertiary sedimentary sequence demonstrates rapid facies change and evidence of large-scale submarine landslides, resulting in common turbidity deposits and recurrent faunal zones. The structural situation is dominated by a myriad of normal faults having no regular pattern, but predominantly following a rule of faulting which favors downward movement of the updip block (in a regional sense), which is interpreted as dislocation resulting from a westerly spreading or creep of the sediments of this ancient marine bank during periodic recurrent elevations of the ancestral Amotape mountains on the east, with no massive basement buttress on the west to contain this semi-plastic mass.

Because of both the restricted remaining undeveloped area and vertical sedimentary column in the onshore, particularly in Peru, development of additional major reserves may be expected to come chiefly from the submerged continental margin adjacent to existing production.

SCULL, BERTON J., Sun Oil Company, Richardson, Tex.

COMPARISON OF PLIO-MIOCENE SEDIMENTATION OF GULF COAST WITH ATOKAN SEDIMENTATION OF ARKOMA BASIN

The Plio-Miocene sediments of the Gulf Coast and the Atoka sediments of the Arkoma basin represent similar stratigraphic sequences deposited in quite different tectonic settings. The Plio-Miocene units are associated with the orogenically placid Gulf Coast geosyncline. The pattern of deposition has been development of load-produced basins (depocenters) during cyclic offlap. The Atokan units are associated with the Ouachita orogeny and represent shelf and trough suites. Certain aspects of these stratigraphic sequences are comparable with the modern sediments of the northwestern Gulf of Mexico.

The depositional patterns of the Plio-Miocene and the Atokan sedimentary prisms reflect structural-sedimentation interrelationships. In each prism, flexure zones demark abrupt thickening of the sedimentary units. The Atokan sediments were deposited on more competent sub-strata than were the Plio-Miocene sediments so that fewer major flexures developed. The depositional axis of the Atoka probably was tectonically controlled (a facies scarp) and the depositional axis of the Plio-Miocene (if properly located) was determined by sedimentary processes.

The Plio-Miocene and the Atoka have other features in common. Each is very predominantly clastic, represents a new area of maximum sediment accumulation in the depositional basin, and displaced a carbonate-shale facies. Prograding deltaic facies dominate the depositional environments but cyclic deposition is a prominent aspect of the sedimentation. Both the Atoka and the Plio-Miocene thicken at comparatively rapid rates and attain greater thicknesses than the associated older and younger sediments.

Kuendig (1959) has suggested that geosynclines should be classified by structural configuration, not sedimentary content. However, the similarities of the Plio-Miocene and the Atoka indicate that sedimentary patterns reflect source areas, transport and depositional processes, and topography. They do not reflect the structure of the catchment basin.

SIEVER, RAYMOND, AND GARRELS, ROBERT M., Harvard University, Cambridge, Mass.

EARLY DIAGENESIS: COMPOSITION OF INTERSTITIAL WATERS OF RECENT MARINE MUDS

The earliest diagenetic changes that may be observable in a Recent marine sediment are those due to chemical reactions between the solid minerals and trapped sea water. The nature and extent of the reactions may be interpreted from the chemical composition of the interstitial water in combination with the mineralogy of the sediment. The water composition may be a more sensitive clue to some reactions than the mineralogy of the solid.

Interstitial waters have been extracted from four different sets of long cores of fine-grained recent marine sediment of the Atlantic Ocean using a modified filter press. Four cores come from an area off Cape Cod, Massachusetts; two cores are from the western side of the Atlantic off the coast of Brazil; three cores are from the Romanche Deep in the equatorial Atlantic; seven samples came from the preliminary test for the Mohole, off Guadalupe Island in the Pacific. More than 150 samples of waters, similar in composition to sea water, have been analyzed for Na, K, Ca, Mg, Cl, and SiO_2. It appears that in the sediment waters, in comparison with the overlying sea water, there is some tendency for sodium and chloride to increase slightly, calcium to decrease, magnesium to remain constant, and silica to increase greatly. Wide variations in water composition are correlative with sediment lithology. Changes in water composition may be due to post-burial reactions between sea water and clay and carbonate minerals as well as to salt-filtering effects of the compacting clay membranes. Calcium concentration may be reduced by precipitation of secondary $CaCO_3$. Sodium and chloride increase as a result of salt-filtering, although some paleosalinity effects may be possible in some nearshore areas where hydrography was strongly affected by Pleistocene events. Silica increases as a consequence of the dissolution of amorphous siliceous organisms and is probably poised at concentrations in equilibrium with montmorillonite. Shipboard determinations of pH on fresh cores compared with pH of