ABSTRACTS OF TECHNICAL PAPERS

SEDENTARY PROCESSES AND THEIR ROLE IN THE FORMATION OF FUTURE SOURCE AND RESERVOIR ROCKS

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In order to more fully understand the principles of transportation in shallow parts of all marine systems, a series of studies by diving geologists at the University of Southern California are aimed at providing new data on the mechanisms of sediment movement from the surf zone to depths of approximately 100 feet. It is evident from the first results of this program that much of the theoretical information on wave transport based on wave tank observations must be modified.

Measurements have been made of rates of sand movement using dyed sand (Vernon, 1965), magnitude of wave generated surges over the bottom in shallow depths (Vernon, Summers and Gorsline, 1966), changes in energy in the surf zone (Ingle, 1966; Schiffman, 1965), regional changes in beach characteristics (Gorsline, 1966), movement and quantity of suspended sediment over the shelf (Rodolfo, 1964); Wildharber, 1966) and movement of fine sediment in canyons (Gorsline, in progress). These various measurements show that the wave transport of sediments is active to depths of 60 to 80 feet off California during an average year and that the flow of sand along the coast is probably matched in magnitude by the flow of fine suspended material. It is also demonstrated that sand moves around headlands below surf depth and is then moved back into the surf system by onshore wave action. Much of the sand entering submarine canyon heads probably is moved below surf depth by this same ripple transport mechanism.

All of these systems are strongly controlled by bottom or coastal physiography. In addition to the commonly considered physiographic barriers to sedimentation, numerous contemporary examples of water barriers also exist that have effects at all scales on the distribution and character of marine sediments. Since these are also the precursors of most source and reservoir rocks, an understanding of their effects is of basic importance to petroleum geologists.

On a relatively small scale, circulation patterns in Florida Bay, at the southern tip of the Florida peninsula, are slow tidally controlled gyres that create a flow that probably prohibits sediment transport into the central portions of the individual "lakes" of this broad shallow embayment. Thus the sediment accumulation occurs around the periphery of the individual segments and these lines of sedimentation in turn appear to coincide with the locus of points of small or zero tidal amplitude. Current transport of these materials also takes place and thus ultimately come to rest in the deep water of the Florida Straits.

In large coastal bays on the Pacific coast, water circulation also plays a strong part in the distribution of sediment types. Sebastian Viscaino Bay is an open broad north-facing embayment that also forms the southern extremity of the Continental Borderland off California and Baja California. Within this huge embayment the California Current turns back upon itself and forms a large gyre. The patterns of texture, bioclastics and organic content are strongly controlled by this circulation pattern and, in fact, parallel the contours of flow.

Work by K. S. Rodolfo at U. S. C. shows that the shift in the Monsoon and the period of strong river flow combine in the Andaman Sea to restrict Irrawady sedimentation to the confines of the Sea even though no physiographic barrier is present to hinder flow to the adjacent Bay of Bengal. Thus, the sedimentation in the two areas is from two different sources producing lenses of sedimentation of geosynclinal scale side by side from different sources. The development of the entire Andaman margin is effectively controlled by these circumstances.

Off the southern Atlantic coast of the United States, the Gulf stream forms an effective boundary to the detrital terrigenous sediments of the upper shelf and the bioclastic sediments of the outer shelf and Blake Plateau. The combination of broad shelf and strong regional current also influence the form of the coast and apparently also prevents the active formation of submarine canyons.

ORIGIN, GEOMETRY AND PRODUCTION OF A SANDSTONE RESERVOIR

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Oil production from the Robinson sandstone, of Pennsylvanian age, is localized by the LaSalle anticline in an area 25 miles long and up to 10 miles wide. However, within the structurally high area, production is controlled by stratigraphic variations. Original oil in place is estimated as 750 million barrels — approximately 1160 bbls/acre-ft. Primary production was by solution gas drive; supplemental recovery methods include vacuum, gas repressuring, water flooding, and *in situ* combustion.

Detailed core and log studies have led to an interpretation of the depositional environment and an understanding of the rock and reservoir characteristics of the Robinson sandstone. This information has explained the discontinuity of productive areas and has guided supplemental recovery operations.

Sandstone occurs in isolated or coalesced lenses up to two miles long, one-half mile wide, and up to 50 feet thick; these are enclosed in siltstone and shale. Each lens is usually characterized by a sharp erosional basal contact, gradational upper contact, decreasing grain size upward, absence of marine fossils, abundance of carbonized wood fragments, and sedimentary structures that are predominantly high-angle cross stratification and trough-shaped ripple laminations. The direction of sediment transport, measured from sedimentary structures in geographically oriented cores, parallels the long dimension of a sand body. Collectively, these characteristics are interpreted as indicating a fluviatile environment of deposition.

Variation in sandstone texture and in the type and distribution of sedimentary structures controls variation in porosity, permeability (specific, directional, and relative), as well as general reservoir heterogeneity. Internally the sandstone lenses may be uniform vertically, or they may be made up of layers characterized by distinct texture and sedimentary structure. In general, porosity and permeability decrease upward as well as laterally from the center to the edges. Internal variations in texture and sedimentary structure control primary production as well as secondary recovery by water floding and *in situ* combustion.

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