Slope-Centered Processes in Santa Barbara Basin, California Borderland

Three basic types of slope-centered processes are responsible for the infilling of Santa Barbara basin: low-concentration suspenate transport, large-scale glides, and small-scale processes which consist of a continuum of slumps to debris flows. Suspensate transport is concentrated on the northeast part of the basin and is perhaps channeled by the Montalvo trough. Large-scale glides extend across the entire northern slope and are most spectacular in the Montalvo trough where higher sedimentation rates due to suspensate transport seem to speed the process. Small-scale slump to debris-flow deposits can be found at six specific sites. These deposits exhibit fluid escape structures, dish structures, a swirled x-radiograph signature, and in some deposits dramatic, matrix-supported, random fabrics with clasts as large as 4 cm. Laminations provide key markers necessary to discern distortion of sediment in areas of mass movement. The deep basin-floor laminated zone is laminated due to low oxygen content of the water column and deposition of gray layers due to suspensate transport during exceptionally rainy winters. Even parts of this laminated zone appear to be involved in gradual glides. In shallow parts of the basin on the northeast side, laminations are of a different type and are produced by years of suspensate transport. This laminated zone is centered along the axis of the Montalvo trough. High sedimentation rates apparently prevented destruction of the laminations due to bioturbation. Only a relatively small part of the deep basin floor, a flat area which slopes very gradually to the south, is somewhat immune to mass movement. However, fluidal flows generated by mass flows upslope could conceivably reach this area and result in unusually thick laminations.

TILLMAN, RODERICK W., Cities Service Research, Tulsa, OK, and R. S. MARTINSEN, Cities Service Co., Denver, CO

Shannon Sandstone (Upper Cretaceous) Offshore Bar Facies Distribution, Salt Creek Area, Wyoming

Four major facies are identified in the Upper Cretaceous Shannon Sandstone Member submarine bar complex where it crops out in the Salt Creek anticline area of Wyoming. The Central Bar (trough and laminated) Facies forms the backbone of the bars. This facies is quartzitic and glauconitic, fine to medium grained and is composed of stacked sequences of predominantly trough-bedded sandstones up to 35 ft (10.7 m) thick. A normal vertical (bottom to top) and lateral sequence of facies is Shelf Siltstone, Interbar, Bar Margin, Central Bar, Shelf Siltstone (burrowed). Shelf Silty Shales (bedded and burrowed) surround the bar complex. In general, the outcrop section is sandier than several of the bar complexes that produce in the subsurface about 35 mi (56.3 km) northeast of the outcrop. Two new subfacies are introduced, the Interbar (sandy) Facies and the Bar Margin (interbedded trough and ripple) Facies.

The mean direction of transport in the trough-bedded Central Bar and Bar Margin Facies in south-southwest, except locally in the top foot or two of the bar where westerly transport directions are observed. If the upper few feet are excluded, the spread of transport directions is commonly less than 45° for individual outcrops and for the area as a whole.

Foraminifera control indicates that the bar sands were deposited at middle-shelf depth. Ammonite zonation by Gill and Cobban provides detailed time stratigraphy and documents that the shoreline, at the time these bar complexes were deposited, was as far as 80 mi (129 km) to the west.

The Eagle sandstone delta complex of south-central Montana is a possible initial source for the sands. Nearly unidirectional currents, in part intensified by storms, are inferred to be the main process involved in deposition of the linear bar complexes.

TIPNIS, R. S., and M. P. CECILE, Inst. Sedimentary and Petroleum Geology, Calgary, Alta.

Early Paleozoic Conodont Biostratigraphy and Paleogeography of Northwestern Canada

Early Paleozoic rocks in northwestern Canada were deposited on a broad Atlantic type shelf and include platform carbonate rocks and transitional and basinal facies that range in composition from calcilutites to cherts. The Paleozoic history of northwestern Canada began with widespread deposition of Lower Cambrian quartzite and carbonate. In the Middle and early Late Cambrian, shales were deposited in deep troughs and continental areas separated by tectonic arches. During the latest Cambrian and Early Ordovician, platform carbonates were deposited on a broad shelf adjacent to a belt of deep water limestone. Middle Ordovician time was characterized by uplift to the north; carbonate deposition changed abruptly basinward into graptolite shales to the south. Late Ordovician-Early Silurian carbonate deposition on the platform graded basinward into shales and limestones.

The phosphatic microfossil *Mellopegma* occurs in Lower to Middle Cambrian basinal strata while conodonts of the Late Cambrian *Proconodontus* Zone are common to both the platform and the basinal strata. A nearly continuous sequence of Early to Middle Ordovician conodont faunas is found in the platform carbonate rocks. These Mid-Continent type faunas include the Early Ordovician faunas A to E of Ethington and Clark and the Middle Ordovician faunas 1 to 9 of Sweet, Ethington, and Barnes. Coeval basinal and transitional facies of Early and Middle Ordovician age are characterized by North Atlantic type conodonts and a few Mid-Continent forms that sharply decline numerically toward the basin. Late Ordovician conodonts are poorly represented in the platform facies; spot samples from transitional and basinal facies yield predominantly North Atlantic taxa.

Lateral and temporal distribution of conodont faunas from northwestern Canada closely resemble those of coeval faunas reported from the Ibex area of western Utah.

TODD, R. G., and P. R. VAIL, Exxon Production Research Co., Houston, TX