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Tectonics and Sedimentation in the Long Beach Unit of Wilmington field, Los Angeles Basin, California

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ABSTRACT

The integrated effect of differential subsidence plus variable sedimentation rate is well documented in two Mio-Pliocene, stratigraphic sequences of the Ranger interval (Pico and Repetto Formations) that subcrop on the west margin of the Los Angeles basin, California. These sequences represent a line-sourced, shore-parallel turbidite system deposited across the offshore part of the 20-mile long Wilmington anticline---a prolific structure (>2 billion bbls of oil produced) that formed along a transform margin during compression between the Palos Verdes thrust, and the Newport-Inglewood fault zone. Sand-rich sections of these sequences on the anticlinal crest contrast with thicker flank sections containing siliceous, in some places diatomaceous, shales. This architecture results from differential subsidence during deposition.

Interestingly, structurally-controlled thickening and thinning of strata is most evident in sand-poor sections at the bases of the Ranger sequences, and least evident in sand-rich sections at the tops, even though the anticline and associated faults likely existed throughout deposition. Instead, the sandy sections show thickening trends parallel to presumed sediment transport directions. Thus, structural controls (e.g., subsidence) are most evident in sand-poor sections, and stratigraphic controls most evident in sand-rich sections.

Most likely, the presence and/or absence of a structural versus stratigraphic signature reflects sedimentation rates. Because sand-rich sections originated as debris flows and high-density turbidity currents, sediment accumulation was rapid, whereas sand-poor sections dominated by suspension settling and dilute remnants of turbid flows, took longer to deposit equivalent sediment thicknesses. Thus, enough time existed during shale deposition for anticlinal growth and fault displacements to affect sediment accumulation. By contrast, only evidence of sediment transport directions was preserved when sand flows overwhelmed the system, despite ongoing tectonic subsidence. Thus, the sequence architecture reflects the integrated effects of both controls, which means sedimentation rates must be considered if using stratal thicknesses to infer the timing of structural events.