Deepwater Tidalites in the Cretaceous Wheeler Gorge, Southern California

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Tidally driven currents in deepwater settings are well known from modern measurements, especially within submarine canyons. These currents are present as internal waves (internal tides) within the oceans due to the action of tidal forces on layers of different densities within the water column. Internal tides have been documented at velocities up to 80 cm/sec, with common diurnal or semidiurnal up and downcanyon velocities between 15 and 40 cm/sec, putting common, once or twice-daily currents in the ripple and dune fields for bedform development in fine and medium sand, movement in coarse sand and fine gravel, and for the highest velocities development of coarse sand and fine gravel dunes. While internal tides are well know from modern environments, very few papers have dealt with internal tidal deposits in deep marine environments. Data collected from the lower part of a channel-levee complex in the Upper Cretaceous of Wheeler Gorge, California, are interpreted as the deposits of internal tides due to a very regular cyclicity of relative thicknesses of laminae. The laminae are organized in thick/thin pairs. The thicker laminae tend to be slightly coarser, but both laminae tend to be silt to very fine sand in grain size. Small ripple cross-laminations are common, some of which are mud-draped. Minor amounts of erosion are common, although less than the thickness of an individual lamina is removed by this erosion.

On the larger stratigraphic scale, each thick and thin pair tend to increase in thickness for 25-30 laminae, then decrease in thickness for 25-30 laminae, meaning that a complete wavelength for a thickening then thinning cycle is 50-60 laminae total. This order of cyclicity is probably associated with tidal cycles, in which perhaps the weaker monthly tides (neap tides) are not always represented, and the strongest montly tides (spring tides) are represented by the thickest thick/thin pairs, and may cause some of the erosion. The arrangement of the laminae in thick/thin pairs may be indicative of a semidiurnal tidal regime. Whether this is a synodically-driven or equatorial-driven system is as yet unclear. Nearer to the top of the succession the record becomes more chaotic and less cyclic in nature, probably due to increasing turbidity current influx presaging the overlying conglomeratic channel complex.