Exogenic Forcing Encoded in the Lithostratigraphy of Sand-Quarry Deltas

We analyze sediment texture, rock-magnetic, and depth-rank time series of meso-scale deltas and interpret the results in terms of autogenic depositional processes and exogenic forcings. As an analogue for natural deltas, this study leverages a semi-controlled environment where the deltas prograde rapidly into quarry settling ponds over decadal time spans and have compensation times on the order of ~2.4 months. The distal parts of two deltas were cored with a Geoprobe to a depth of 8.4 m. Recovery ranged from 30% to 70%, that we model as either sediment compaction or missing section (unconformities). The compaction model allows us to generate a complete time series of a decompacted section whereas the unconformity model allows us to consider the impact of significant periods of missing time. The cores were analyzed every 2 cm for magnetic susceptibility as well as grain size, texture, color, pebble content, and organic content, all of which contribute to an overall relative depth and textural ranking. Multi-taper method red-noise modeling of the time series using Astrochron identifies frequencies which rise above a 99% confidence level. The power spectra show a range of peaks, many of which fall below the compensation time and are disregarded. A significant periodicity of 2.6 months emerges in the compaction model. In the unconformity model, a peridocity of 2.6 months and also longer periodicities of 3.5 and 6 months emerge. These seasonal-scale periodicities are similar to those in regional precipitation data (4.4, 3.1, and 2.6 months) and suggest that exogenic forcing, in this case from precipitation that impacts both discharge in the source and water depth of the settling pond, are strong enough to be encoded in the sediments. Meso-scale studies of depositional systems such as these quarry deltas provide a bridge between small-scale analogue models and natural source to sink systems that we are in the process of sampling to further test our approach.

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