Predicting Preserved Stratigraphy from Dunebed Topography After Annual Peak Flows in a Modern Large River

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Deposits from large river dunes are indicators of channel scale, flow regime, climate, and hence are important inputs for reservoir characterization. The observation of large sedimentary structures in the fluvial record may be due to the occurence of high dunes itself, sampling bias, or preservation potential. Regarding the latter, the hydrograph effects on the variability in channel-bed/bedform height and scour distributions are still not well known. Here, the Leclair-Bridge model (2001) and the Paola-Borgman theory (1991) are used for embedded modeling, at the dune scale within the channel scale, in order to predict quantitatively the thickness of preserved cross-sets within cosets at the end of a spring peak flow in a large meandering river. Data consists of high-resolution dunebed elevations from five successive surveys along a 15-km reach of the lower Mississippi River. Selected sub-reaches of various flow depth include a 5-km straight reach, the stoss and lee sides of a 3-km-long macro bedform, and a 1-km long bend scour.

Observations made soon after the highest peak flow challenged one of our common assumptions: indeed, small dunes were dominant in deep waters, and large dunes (up to 7-m high) in shallower flows. Results from the embedded models reveal that only few of the high-flow deposits would be preserved in the deepest parts of the channel; large-dune cross-sets would rather be found at bed elevation up to 10 m from the meander bend-scour height. Deposits from dunes migrating during rising discharge have a low preservation potential because the river bed rises at that hydrograph stage, and decreases afterward. Most of the preserved strata at the end of annual peak flows seems to be formed during decreasing discharge, yet again not specifically in the deepest reaches. Although there is a general fining-upward trend, deposits from the selected reaches would be an assemblage of cosets 1.3 to 1.5 m- thick (on average) containing cross-sets with mean thickness ranging 0.5 m - 0.7 m. This narrow range of values suggests that the distributions from various hydrograph stages probably overlap, which would make it difficult to distinguish such deposits in an outcrop or a core.

These results have important implications for our interpretation of sedimentary deposits and the recognition of large rivers the rock record.