A Three Dimensional Geometric Analysis of Bank-attached Bar-forms in Sinuous Submarine Channels: A Tool for Inferring the Relative Importance of Bedload and Suspended Load Sedimentation

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Sinuous submarine channels often show bank-attached bar-forms, which are interpreted as the preserved deposits associated with lateral or downstream migration of channel bends. Processes responsible for the formation of these deposits have recently been a subject of enthusiastic debate. Bar accretion surfaces were mapped at a high level of detail, from nine channel bends of a buried sinuous channel imaged by high resolution seismic data from offshore West Africa. A 3-D geometric analysis of these surfaces was undertaken to determine whether these bars were constructed from bedload or suspended load.

This channel has an average depth of 44m, average width of 430m and sinuosity of 2.36. Channel bends have maximum curvatures of 0.15-0.35 degree/m and are separated by straight channel segments with lengths 1.5-3 times average channel width.

Packages of inclined strata defining bar growth are 1.0-1.5 times the associated channel width, indicating limited channel migration. Systematic spatial changes in the heights of accretion surfaces indicate that bar and bend growth occurred during phases of weak channel incision. The majority of the mapped bar surfaces initiate at the inner bank at maximum channel curvature and extend to the point of minimum channel curvature. We have identified concave benches positioned immediately downstream from strongly accreting bars. These observations suggest that sedimentation in low velocity zones occurred in these areas, analogous to concave-bank accretion in fluvial

channels caused by flow separation from the inner bank down-stream of high-curvature bends.

The median bar slope is 11 degrees, with values as high as 18 degrees. Median bar height is 40% of channel depth, with values up to 80% channel depth. A geometric approximation using slope and height of bars indicates that the bars occupied 25-30% of cross-channel width. In contrast, bedload-dominated bank-attached bars in rivers have slopes ranging from 4-7 degrees and cross-channel widths equal to 70-90% of the total channel width.

We will discuss how the small amount of observed lateral motion for this submarine channel together with the observed bar slopes and widths are consistent with bar construction by a suspension dominated depositional style rather than construction from bedload transport. This study has important implications for the reservoir properties of these deposits, which are common architectural elements in sinuous turbidite channel reservoirs.