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Basin-Floor Topography and the Scaling of Turbidites

Turbidite bed thickness distributions from deep-water settings result from the interaction of an initial magnitude/frequency of source-derived flow volumes, modified within the receiving basin by (1) variable flow rheologies (2) environmental controls such as channels and lobes, and (3) basin-floor topography. This study attempts to isolate the effects of basin floor topography on turbidite bed thickness distributions using outcrop examples where the ancient sea-floor topography has been reconstructed, and is thought to dominate the signal. The Eocene and Oligocene Taveyannaz and Annot Sandstones of eastern Switzerland and France were deposited in confined intra-slope basin, and base-of-slope settings. The deposits of the confined basin record flow ponding and flow-stripping; the base-of-slope deposits record the amalgamation of turbidite beds. Bed thickness data for both the confined basin and base-of-slope settings, when plotted as cumulative frequencies on log/log axes, exhibit convex upward curves. Statistical experiments presented here demonstrate that these signals can be generated by the modification of an input signal with a power-law distribution. In the case of the confined basin, flow ponding causes dramatic thickening of beds. However, flow-stripping counteracts this, particularly for the thicker beds, and may account for a very large proportion of the input volume of sediment bypassing the basin even before the basin is filled. For the base-of-slope setting, erosion and non-deposition of beds will result in the preferential preservation of thicker beds; the thick-bed population is also enhanced by the unidentified amalgamation of beds.