Ichnology, Sedimentology, and Dip Variability in Pleistocene Tidal Bars at Willapa Bay, Washington

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Estuaries-and their associated geomorphological components-are common features present on many of the world's coastlines. While the depositional processes and the resultant large-scale facies trends associated with estuaries have been widely discussed, further characterization of estuary subenvironments is still required. Criteria such as detailed sedimentological and ichnological content, geobody morphology and bed-orientation are necessary data for the inference of a depositional setting from sub-surface datasets. In particular, mapping and interpreting the orientation and dip of large-scale laterally and vertically accreting beds from subsurface datasets are inherently difficult tasks. This study focuses on establishing the complex stratal architecture and facies relationships displayed in Pleistocene tidally influenced channel complexes that outcrop at Willapa Bay, WA. The dataset presented includes complete sedimentological and ichnological characterizations that are used to identify discrete channels in an intensely amalgamated "channel-belt" horizon.

The Pleistocene outcrops that surround Willapa Bay have been previously interpreted to represent tidally influenced bay/estuary deposits. Detailed bedding dip and details of channel amalgamation did not form substantive parts of the earlier works. The oldest Pleistocene strata dominantly comprise mud-dominated Inclined Heterolithic Stratification (IHS) beds. The bedding is cm-scale, shallowly dips towards the mid-channel and is dominated by wavy through lenticular bedding with mud flasers preserved in sandstone units. Bioturbation comprises a low-diversity suite of (decreasing order of abundance) Skolithos, Planolites, Psilonichnus, Cylindrichnus, Lockea and Siphonichnus. Bioturbation intensity increases upwards into bioturbated tidal-flat deposits. Individual channels display different sand-mud ratios and ichnological content. This is interpreted to represent landward versus bayward position of the tidal channel (i.e. landward channels are muddier and display a reduced ichnological content). The channels show lateral and vertical accretion. Rose-plots of bedding dip directions show that the discrimination of discrete channels from dip-meter data is not straightforward. In fact, we suggest that bedding dip directions are commonly not sufficient to reveal discrete channel contacts and that sedimentary facies data must be combined with bedding measurements to adequately characterize channel architecture.