Another Look at Fluvial Sequence Stratigraphy

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Vertical changes in fluvial deposit net/gross over 10s to 100s of meters and associated changes in depositional style and channel belt connectivity are widely observed within thick alluvial successions. It is popular to interpret these variations in terms of allogenic accommodation variations defined under a fluvial equilibrium profile of fixed geometry that is coupled to shoreline position. These interpretations generally infer that fluvial gradients steepen during sea-level fall, leading to declining accumulation rates (and eventual channel incision), floodplain narrowing, preferential preservation of channel relative to overbank deposits, and internally sandy channel belts. Sea-level rise is inferred to decrease fluvial gradients and widen floodplains as sediment aggradation accelerates and river incisions fill, leading to greater preservation of floodplain deposits and more internally heterolithic channel belts. Despite their popularity, we suggest current sequence stratigraphic models for fluvial systems based on these ideas are too simplistic and in many cases the underlying assumptions may be wrong. Fluvial stratigraphic interpretations commonly reverse cause and effect on alluvial architecture variables, wrongly predict that most large-scale fluvial successions fine upward, and over-emphasize accommodation controls and the ability of coastlines to buttress fluvial aggradation during relative sea-level rise. As an alternative we interpret fluvial successions as regionally and locally prograding sediment wedges that initially expand as rates of downstream slope decline gradually decay over time and then back-step as sediment aggradation rates locally fall below subsidence rates (c.f., Autoretreat of Muto & Steel, 1997). Progradation can be initiated by allogenic changes or by autocyclic avulsions of sediment supply to areas that have previously undergone gradual subsidence. Sea level is inferred to have little influence on alluvial slopes and rates of sediment progradation, except perhaps in some areas directly adjacent to the coast. The idea that fluvial deposits are composed of prograding and retrograding units (at multiple scales) is used to interpret variations within several thick alluvial successions that gradually coarsen upward as channel belts progressively become larger and more obviously clustered. These successions tend to be capped by a relatively thin, erosionally-based sand-dominated interval, before fairly abruptly fining upsection.