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Relative Role of Stream Discharge, Sediment Flux, and Baselevel Change in Stratal Architecture of Continental and Nearshore Sequences: Results From Forward Numerical Modeling

The climatically-mediated variables of stream discharge and sediment flux, in conjunction with ultimate base level, control aggradation and degradation rates of fluvial systems and the stratigraphic architecture they produce. Simple forward numerical models were used to predict the effect of climatic cyclicity on fluvial stratigraphic architecture. Discharge and sediment flux values for a suite of similar-sized modern fluvial systems, from a variety of climatic settings, were integrated with projected effects such as sediment storage in mountain belts, and used as inputs to the models. Base level fluctuations were also incorporated, and models were run to simulate 4th-order stratigraphic cyclicity (100Ky cycles) along a profile from the sediment source area to the shelf.

These finite difference pseudo-2D models demonstrate several concepts applicable to sequence stratigraphic interpretations. 1) Updip migration of incision related to base level fall extends a maximum of 100-150 km, and this limit is dependent upon the magnitude of base level fall and the discharge/sediment load relationship in the fluvial system. 2) Sequence boundary formation in down-dip areas is dependent upon both base level fall and available stream power. If climatic cyclicity, that largely controls stream power is non-synchronous with eustatic cyclicity, then periods of maximum incision will not be coincident with maximum base-level lowstand. 3) Sequence boundaries that form updip of areas effected by base level can be spatially and temporally unrelated to down-dip sequence boundaries. 4) "Forced regression" deposits are common features formed during base level drop, but are included within the late highstand systems tract because they are overlain by the subsequent erosional surface. New 3-D dynamic grid models are being developed to improve existing models, and to test against modern basin fills and ancient deposits.