Allogenic and Autogenic Signals in Quaternary Alluvial Successions of the Northern Gulf of Mexico Passive Margin

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This paper examines the concepts of allogenic forcing and autogenic self-organization in Quaternary alluvial successions of the Gulf of Mexico (GOM). Quaternary records offer advantages over the ancient because deposits can be dated independent of forcing mechanisms. Moreover, GOM rivers are known to have experienced differential climate forcing, but similar glacio-eustasy: the Mississippi was a proglacial system during the last glacial period, whereas drainage basins for other rivers were not glaciated.

In GOM river systems, glacial to interglacial transformations in channel pattern and depositional style have been identified upstream from the influence of sea-level change, and traced downstream to reaches where sea-level change has been important. Such changes are regional, persist for >104 yrs, are significantly different than what has been suggested by experimental studies, and likely reflect system reorganization in response to glacial vs. interglacial climate states. However, within either the glacial or interglacial records, numerous changes cannot be directly attributed to either allogenic forcing or autogenic behavior, but are similar to effects produced in experiments with steady water and sediment discharge, and occur over time scales that overlap with inferred time scales of autogenic behavior. This includes episodes of incision and terrace formation during sea-level fall, and avulsions that characterize alluvial valleys during sea-level rise.

Even in Late Quaternary records, the unambiguous delineation of allogenic forcing and autogenic self-organization remains difficult at best. Attribution of allogenic forcing is grounded in process-based reasoning, but relies on changes in fluvial behavior that are coincident with independently-identified changes in forcing mechanisms. However, error terms on existing dating methods make it impossible to determine if fluvial changes lead or follow changes in forcing, and the number of fluvial system changes never corresponds with the number of independently-identified climate changes. By contrast, autogenic behavior occurs in experimental studies that do not vary water and sediment discharge, but it is unclear if the same styles and time-steps of change would occur with unsteady water and sediment discharge. It is also not clear how to test whether specific geologic records are truly autogenic, and, at present, it is only possible to say that similar signatures have been produced autogenically.