Allogenic and Autogenic Forcings Within the Context of Sediment-Routing Systems: Examples from Southern California

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Millennial-scale allogenic forcings are seldom interpreted from basinal stratigraphy; rather, records of high-frequency perturbations are commonly attributed to autogenic forcings. This bias is a result of a lack of contextual information about the sediment-routing system as a whole and, more specifically, a lack of adequate age control. Here, we utilize 11 radiocarbon samples from a 12 m thick turbidite succession (ODP Site 1015) tied to high-resolution seismic-reflection data to evaluate controls on stratigraphic patterns over the past 7,000 years for Santa Monica Basin, offshore California. Comparing this basinal record to paleoclimate proxies and with information from other segments of the sediment-routing system indicates that variability in sedimentation rates are largely controlled by: (1) increased discharge of Santa Clara River as a result of increased magnitude and frequency of El Niño-Southern Oscillation (ENSO) events from ~2 ka to present and (2), a change in routing of coarse-grained sediment within the staging area at ~3 ka (i.e., from direct river input to littoral cell input into submarine canyon).

These results demonstrate that signals of millennial-scale climatic (allogenic) forcings are recorded in the basinal stratigraphy. The efficiency of allogenic signal propagation through the entire system over short time scales is, in part, a function of the scale of this relatively small sediment-routing system. In contrast, much larger source-to-sink systems are typically characterized by deposition along intermediary segments between source and terminal sink, which buffers signal propagation and precludes recognition of high-frequency forcings in the stratigraphic record downsystem. Staging-area processes such as river avulsion have been characterized as autogenic; however, the effect on process-response behavior downsystem can be significant and interpreted as allogenic. Therefore, potential transformations of forcing signals along the pathway as a result of interactions and feedbacks with other forcings can complicate interpretation of controls and the simplified allogenic-autogenic dichotomy breaks down. This study demonstrates the importance of a systems-scale approach for evaluating controls on stratigraphy by considering: (1) the type of the sediment-routing system regarding efficiency of transfer from source-to-sink, and (2) position within that system and 'transformation' and/or interaction of forcing types between segments.