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Tectono-Sedimentary Analysis of Rift Basins: Insights from the Corinth Rift, Greece

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Existing models for the tectono-sedimentary evolution of rift basins are strongly linked the growth and linkage of normal fault segments and localization of fault activity. Early stages of faulting (rift initiation phase) are characterized by distributed, short, low displacement fault segments, subdued fault-related topography and small depocentres within which sedimentation keeps pace with subsidence. Following linkage and displacement localization (rift climax phase), deformation if focused onto major, crustal-scale fault zones with kilometre-scale displacement. These major faults generate pronounced tilted fault-block topography, with subsidence rates that outpace sedimentation causing a pronounced change to deep-water deposition. Such models have been successful in helping to understand the gross structural and sedimentary evolution of rift basins, but recent work has suggested that pre-existing structures, normal fault interaction with pre-rift salt and antecedent drainage systems significantly alter this initiation-to-climax perspective of rift basin development.

The E-W-striking, Pliocene-Pleistocene Corinth rift, central Greece, is an excellent natural laboratory for studying the tectono-sedimentary evolution of rift basins due to its young age, excellent onshore exposure of syn-rift structure and stratigraphy and extensive offshore seismic data. The rift cuts across the NW-SE-striking Hellenide mountain belt and has migrated northward and westward during its evolution. The Hellenide mountain belt significantly influences topography and drainage in the west of the rift. High topography and large antecedent drainage systems, focused along palaeovalleys, provided high sediment flux to NE-flowing alluvial systems that overfilled early-rift depocentres. Further east, away from the main antecedent drainage networks, contemporaneous deposits comprise deep-lacustrine turbidite channel and lobe complexes and basinal marls. Thus the stratigraphic expression within the Pliocene rift fill is similar to rift initiation in high sediment flux locations in the west and rift climax in low sediment flux locations in the east. Major shifts in the locus of fault activity within the Corinth Rift further complicate tectono-stratigraphy analysis of its basin fill. Pliocene depocentres are largely located onshore, south of the present-day Gulf of Corinth and involved activity that was distributed among north- and south-dipping faults. A northward shift in the southern rift margin in the early Pleistocene, established the present-day Gulf of Corinth as the site of several main depocentres and caused abandonment, uplift and reworking of a large portion of the Pliocene rift. Changes in the locus of fault activity during the Pleistocene record a change from activity on north- and south-dipping faults to mainly north-dipping faults. Such shifts in fault activity have a profound effect on the basin fill, with new footwall areas subject to subaerial exposure and incision while contemporaneous hangingwall depocentres undergo rapid subsidence and drowning. Such local complexity is not surprising, but factors such as major antecedent sediment transport pathways and marked temporal and spatial shifts in fault activity make application of conventional tectono-sedimentary subdivsions of pre-, syn-, and post-rift difficult to apply at the basin-scale.