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Deepening events and sediment routing systems in migrating rifts. Insights from the Corinth rift

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This study provides new insights into the problems associated with the recognition of major tectonic events in the stratigraphic record of rifts. We discuss in particular the relevance of deepening events across a rift, the evolution of sediment routing systems and the importance of rates of rifting and surface processes. Rifting evolves by initiation and slow growth of isolated normal faults that rapidly link to form master faults onto which extension focuses. An early phase of slow subsidence with continental conditions is thus followed by acceleration in subsidence and abrupt deepening of the basin. This transition from rift initiation to rift climax forms an integral part of the standard model for single phase 'static' rifting. However, what is the stratigraphic pattern in a rift that migrates across strike and/or propagates along strike? In addition, what is the impact of high or low sediment supply on these tectonic signatures in rift stratigraphy? How does rift stratigrapy record rift multiple deepening events? How do we distinguish such a signature from those of migrating/propagating rifting? We address these questions through a case study in the Corinth Rift, Greece.

The Corinth Rift is one of the fastest opening rifts in the world with geodetic N-S extension rates of 11-16 mm/a. It initiated in the Late Pliocene (around 4 Ma) as part of the western Aegean extension system. The older parts of the rift are now relatively inactive and have been uplifted and exposed in a 25-30 km swathe of the northern Peloponnesus. Excellent exposures of the early syn-rift succession in the northern Pelopponesus provide the opportunity to investigate the evolution of the rift sedimentary succession, in particular the sediment routing systems, facies distributions and depocentre. A N-S extension direction, recorded since the beginning of rifting, was accommodated on a dominantly north-dipping, closely spaced system of faults that are now mainly inactive and located to the south of the Gulf. Present-day extension and seismic activity is focused below the Gulf of Corinth itself, indicating very clearly that the locus of deformation has migrated northward. Rift

migration was also associated with acceleration in extension rate. Sediment routing and volumes supplied into the rift were strongly influenced by inherited relief and associated drainage network.

The rift displays a strong lateral asymmetry in the volume of incoming sediment. The eastern Corinth rift is a ‘classic’ rift showing footwall uplift, consequent drainage and distinct depocentres. The rift appears to be older in the east and to have had low supply of relatively fine sediment throughout its history. Stratigraphy and facies record a deepening event in the Late Pliocene. In contrast, in the west the rift was superimposed on high relief inherited from the Hellenide orogen. A strong antecedent drainage supplied high volumes of coarse sediment from the onset of rifting. The erosional power of antecedent rivers allowed northward drainage into the rift to persist throughout rift migration and associated uplift of the southern rift shoulder. We argue that basin deepening was diachronous from east to west, due to rift migration and lateral propagation. High sediment supply can mask deepening events. This study shows that the concepts of rift initiation and rift climax should be used with caution when interpreting the stratigraphic record of rifts.