Source-to-Sink in Rift Basins - Predicting Reservoir Distribution in Ancient, Subsurface Systems

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Exploration in rift basins is associated with many uncertainties, and one of the most crucial is the determination of lateral distribution and aerial extent of potential reservoir units. The distribution of sandy depositional environments varies greatly throughout the lifetime of a rift basin, primarily due to changes in local and regional tectonics and relative base level, but also in response to climatic fluctuations. Many of these parameters are difficult to constrain for ancient, subsurface systems. At any given time during the filling of a basin, the main factor controlling the spatial distribution of sandy depositional units on the scale of individual subbasins to the scale of the entire rift system, is the location of river mouths and sediment input points. Area and thickness of shallow- and deep-marine/lacustrine depositional units are determined by the size of the rivers and by the temporal stability of the outlet location.

Analysis of catchment morphology and outlet spacing in six modern, underfilled rift basins characterized by deep marine/lacustrine basins suggest that the outlet position of transverse drainages can be predicted from the width of the rift-flank escarpment relative to the shoreline. Range-scale basins (the catchments which define the water divide) show a common simple relationship between outlet spacing and rift-flank escarpment width, which appears to be independent of both size and structural characteristics of the rift (e.g. escarpment vs. hinged margin). In general, wide rift flanks are occupied by large catchments forming large depositional units which are spaced farther apart compared to narrower rift flanks. In addition, accommodation zones separating individual subbasins are often associated with pre-rift basement structures intersecting the rift, and represent areas of weakened basement commonly exploited by pre-rift drainage. Combined with low uplift rates, these areas are typically characterized by large catchments and stable outlet positions. Using this relationship together with input on structural characteristics from seismic mapping, the location of potential shallow- and deep-marine/lacustrine reservoir units can be predicted semi-quantitatively in ancient, subsurface systems.