Analysis of Fluvio-Lacustrine Depositional Environments, East African Rift: Sedimentary Architectures and Relationships to Rift Stage

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ABSTRACT

Continental rifts are important areas of petroleum system generation. Fluvial and lacustrine systems are major depositional environments in these settings. Although many qualitative models describing fluvial and lacustrine system interactions have been proposed, systematic quantitative analysis of sedimentary environments has yet to be undertaken. This study aims to quantify planform area, basin-wide coverage and geometries of depositional environments, and associated landforms present in the East African Rift System (EARS), with two research objectives: (i) assess variations in the prevalence of different sedimentary environments across different extensional phases (initiation, linkage, climax and death); and (ii) determine the importance of different depositional systems in specific basins and the potential impact on reservoir presence. Rift basins were defined in terms of their surface expression on satellite imagery, and sedimentary environments within each were classified (e.g., distributive alluvial fans, delta tops) based on geomorphic characteristics (e.g., meander-scroll pattern). This has allowed for systematic observations, collated in a database of sedimentary-environment distributions. Thirty-three rift basins have been characterised in terms of 5 continental environments (braided fluvial, meandering fluvial, lacustrine, alluvial and deltaic) and defined by their key allogenic controls: tectonics, climate, and sediment supply. Resulting data allow for comparison between depositional processes in different rift settings and yield the following primary findings: (i) lacustrine environments dominate early rift settings forming ~60% of basin area; (ii) alluvial systems occupy ~20% of basin area despite climatic variations during main rift pulse events; (iii) regardless of lake size, deltaic environments (leading to the deposition of delta top facies) only make up 1-3% of modern basin area; (iv) despite climatic and subsidence variations, braided systems are uncommon in the studied rift basins, with transverse and axial meandering systems dominating fluvial deposition. Results presented here add a quantitative value to previous continental rift models. This has implications for reservoir prediction, specifically concerning: (i) the distribution of previously interpreted axial ‘braidplain’ deposits, (ii) the diachronous nature of deltaic sediments and potential reservoir compartmentalization during progradational and retrogradational phases.