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HIERARCHIAL AND FRACTAL NATURE OF RIFT FILL SEDIMENTS: AN EXAMPLE FROM KG OFFSHORE BASIN, INDIA

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Abstract

Sequence stratigraphy improves our understanding of the evolution and infill architecture of sedimentary basins, thus providing a methodology for predictive exploration of natural resources. The method of sequence stratigraphy emphasizes changes in depositional trends (i.e. progradation, retrogradation, aggradation, erosion) and the resulting stratal stacking patterns through time, which are controlled by shifts in the balance between accommodation (space available for sediments to fill) and sediment supply (Emery and Myers, 1996; Posamentier and Allen, 1999; Catuneanu, 2002, 2006; Catunneanu et al., 2009).

The balance between rates of accommodation and the rates of sedimentation controls the creation of transgressions (coastal retrogradation) and regressions (coastal progradation) (Catuneanu, 2006). A hierarchy of interpreted eustatic cyclicity in siliciclastic sedimentary rocks has a pattern of superposed cycles with frequencies in the ranges of 9–10 m.y., 1–2 m.y., 0.1–0.2 m.y., and 0.01–0.02 m.y. (second- through fifth-order cyclicity, respectively). Stratigraphic units displaying this cyclicity include composite sequences, sequences, and parasequences. On the Exxon global cycle chart, fundamental third-order cycles (1–2 m.y. average duration) stack into related groups (second-order cycles: 9–10 m.y. duration). A much larger pattern (about 200 m.y.) is interpreted as tectonically controlled eustasy probably related to sea-floor spreading rates (Mitchum and Wagoner, 1991)

A consistent hierarchy of sedimentary strata is observed in a well drilled in KG Offshore basin, India. The gamma ray log and lithology of the well shows high frequency 4th Order and 3th Order sequences formed at 0.1-0.2 m.y cyclicity including constituent parasequences and system tracts and play a dominant role in controlling the reservoir, source and sealing rock distribution. The 3rd and 4th order cycles comprises dominantly shale and sandstone alternations and a fractal nature of these cycles can be observed from 2nd order to 4th order cycles. The gamma ray peaks indicating shale layers are picked up and the interval between them is plotted using Box Counting (Voss 1988; Fedder, 1988). The log-log plot of box versus the number of counts yields the fractal dimension D in the range 0.72 to 0.98 with increasing length section taken for box counting and showing the fractal nature of the rift-fill sediments.

The crux of this poster is to present a hierarchical and fractal distribution of the dominant stratigraphic patterns in the syn-rift sequence that are commonly encountered in the KG Basin and provide a framework for understanding the process-response model between the accommodation space and the resulting stratigraphic stratal patterns.