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Tectonostratigraphy of Sedimentary Basins Subjected to Multiphase Rifting - Learnings from the Middle-Upper Jurassic of Northern North Sea

The tectonostratigraphic evolution of the northern North Sea and Norwegian Sea rift basins spans several temporal scales. Large-scale rift evolution comprises multiple rift episodes, each lasting 10's of my. Rift episodes can be subdivided into intervals representing distinct phases of rifting, separated by periods of tectonic quiescence. Individual rift phases span periods of 2 to 10+ my, recorded by second-order sequences or "megasequences". Smaller scale, syn-rift successions represent packages related to distinct deformation events (e.g. rotational tilting or faulting) occurring over .2 to 2+ my, corresponding in duration to third-order sequences. Discrete, large-magnitude faulting events often exert a fundamental control on high-frequency cyclicity and development of higher-order sequences.

The fundamental tectonic controls on sequence development and stratigraphic architecture in rift basins include topography generation, sediment supply, accommodation creation, basinal energy regime and inherited depositional physiography. During the rift initiation phase, sediment yield to subbasins from adjacent highs is dependent on basin bathymetry. Syn-rift stratigraphic architecture typically varies from a threefold sandstone-mudstone-sandstone succession, to a twofold sandstone-mudstone or singlefold mudstone lithology motif, associated with sediment overfilled/sediment balanced, sediment underfilled and sediment starved rift basin conditions, respectively. Spatial and temporal variations in syn-rift stratigraphic architecture reflect relative hinterland-to-basin transport distances and changes in rift topography during basin evolution.

The record of sequence development, linkage of depositional systems and stratigraphic signatures of early syn-rift, rift-climax, and late syn-rift to early post-rift stages of basin evolution vary significantly between the different rift basin infill types, as do the sedimentary responses to tectonic processes. Recognition of the inherent characteristics and variability of the different syn-rift infill types and their relationship to external controls can substantially increase the predictability of the interaction between structural and stratigraphic processes in rift settings.