Rift-Climax Deposition and Reservoir Architecture on the Hangingwall Dipslope of a Large Half-Graben; South Viking Graben, Northern North Sea

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The stratigraphic development of hangingwall depositional systems in rifts is poorly understood due to low preservation potential of associated deposits on low subsidence hangingwall dipslopes. In addition, boreholes tend to be located towards the footwall crests, updip of syn-rift hangingwall deposits. Existing tectono-stratigraphic models for rifts imply that; (i) hangingwall dipslopes are structurally simple during the late syn-rift (rift-climax) when activity focused on basin-bounding structures; and (ii) hangingwall depositional systems are characterised by shallow marine shorefaces fringing rotated fault blocks. In this study, subsurface data are used to investigate the controls on rift-climax turbidite systems on the hangingwall dipslope of a salt-influenced half-graben. During rifting, two normal faults developed on the hangingwall due to westwards tilting and gliding of cover strata above an underlying evaporite-rich detachment. Isochron mapping indicates; (i) initiation of activity along the central part of the easternmost fault, (ii) lengthening of the easternmost fault by lateral tip propagation and initiation of activity along the northern segment of the central fault, (iii) southwards propagation of the central fault and initiation of activity on the easternmost fault, and (iv) cessation of activity on all faults. Although seismic data is not of sufficient resolution to map individual depositional elements, well, core and biostratigraphic data are used to determine the control of gravity-driven normal faulting on syn-rift turbidite systems. Based on these data three main stratal units are identified, the oldest of which comprises thick, amalgamated turbidites, which are restricted to the hangingwall of the earliest, most basinward growth fault. The middle unit is more areally extensive than the underlying system, sealing the non-inactive basinward growth fault and extending upslope into the hangingwall of a now-active growth fault. The youngest unit is more sheet-like and was deposited when all growth faults were largely inactive and slope topography had been almost fully healed. This study demonstrates that changes in accommodation impact the distribution and architecture of syn-rift turbidite reservoirs. In addition, existing tectono-stratigraphic models of rift basin should be refined to recognise the importance of ductile detachment units at-depth and the impact these may have on hangingwall depositional systems.