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Karla Kane[1], Sanjeev Gupta[1], Howard Johnson[1], Bruce Trudgill[1], Philip Cox[2] (1) Imperial College, London, United Kingdom (2) Amerada Hess Limited, London, United Kingdom

Progressive Confinement of a Turbidite Lobe System in Response to Intrabasinal Normal Fault Growth: North Halibut Graben, Outer Moray Firth, North Sea

Processes of normal fault segmentation and linkage continuously modify basin-floor topography and thereby exert a significant control on turbidity flows and their deposits. We investigate changes in turbidite distribution and architecture in response to extensional fault growth in sub-basins of the Moray Firth, North Sea.

Depositional patterns of the Claymore Sandstone Member, a syn-rift turbidite lobe system, are reconstructed within the evolving North Halibut Graben sub-basin. Structural analysis indicates that the basin formed through the interaction of NE-SW and E-W fault trends. Seismic cross-sections and isochron maps of the syn-rift succession demonstrate that sedimentation was initially concentrated in the NE-SW trending Theta Graben. Subsequent propagation of the E-W oriented Halibut Horst and Tartan Ridge resulted in a shift of the overall depocentre.

Sedimentological analysis suggests that variations in the turbidite system are directly related to these changes in basin floor geometry. Well correlations reveal initial lobe building in the south of the graben followed by a northward migration around the time of E-W fault propagation. Core interpretations imply that turbidites deposited subsequent to capture of the dispersal system by fault-controlled basin development are thicker, sandier and more amalgamated than their less confined counterparts. Variations in lobe thickness can be linked to rates of fault growth, and slumps become more common as displacement increases.

Our observations indicate that structural evolution of extensional sub-basins can have a significant effect on contemporaneous turbidite sands. The growth and interaction of intra-basinal normal faults in particular can lead to progressive confinement of turbidite dispersal systems.