Cause and Effect of Supra-Salt Decoupling on Mesozoic Graben Formation in the United Kingdom Southern North Sea

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ABSTRACT

It has long been recognized that Upper Permian (Zechstein Group) evaporites have a major control on structural styles and prospectivity in the UK Southern North Sea. Their occurrence creates a regional super-seal beneath which the main Rotliegend Group (Leman Sandstone Formation) reservoir play fairway is prospective. However, the evaporites have a highly variable thickness due to the effects of syn-depositional basin architecture and halokinesis. The latter takes the form of diapirism and salt withdrawal, which can lead to touchdown (welding) of the supra-salt section on the prospective pre-salt section and the development of local graben systems. The interpretation and depth conversion of well-calibrated, high-fidelity, 3D post-stack time-migrated (PSTM) seismic data in strategic areas along the southwestern margin of the basin, in UKCS Quadrants 47 and 48, has permitted a detailed analysis of the relationship between underlying basement structure, Zechstein Group sedimentary facies architecture, and its impact on overburden deformation. The results show a c. 15 km (9 miles) wide NW-SE striking elongate extensional graben system to transect the area, defined by a series of large, overlapping, en-echelon listric growth faults, with oblique secondary planar faults that sole on detachments in the Zechstein Group and the Middle Triassic Röt Halite Member. Detailed well-calibrated mapping of the Lower Zechstein has revealed the evolution of the extensional system to be influenced by a bisecting, up to 300 m-thick ESE-WNW striking anhydrite-carbonate shelf margin. Whilst the initial formation of the narrow graben systems was related to Mesozoic extension, they also display a significant contractional overprint as a result of regional compression and basement inversion during the Tertiary. Importantly, the occurrence of thick, low velocity sediments within the narrow graben have profound effects on depth conversion and seismic imaging of prospective Rotliegend structures beneath, not only in this area, but elsewhere in the Southern North Sea where similar Mesozoic structures are known to transect.