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Geometries of inversion structures and implication for hydrocarbon prospectivity in the Troms-Finnmark Fault Complex, SW Barents Sea

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Several inversion structures have been reported in the Southwestern Barents Sea, however such structures are poorly understood in the Troms-Finnmark Fault Complex (TFFC). This study interpreted three-dimensional (3-D) seismic data mainly in the TFFC and several adjoining structural elements, such as the Harstad and Tromsø Basins, the Finnmark Platform and the Ringvassøy Loppa Fault Complex. The methods used here include detailed seismic interpretation, analysis of structural maps, and fault displacement characterization. Our results show several evidences of localized partial positive inversion, intermittent with rifting events of Middle Jurassic to Early Cretaceous age. The inversion structures are of Middle/Late Triassic to Early Cretaceous age and include snakehead geometries of inverted wedge structures, folds associated with extensional faults, small-scale stratigraphic inversion in a fault network and reverse drag geometries along planar to rotated fault planes. The axial planes of folds associated with extensional faults in the study area revealed two different episodes of contraction linked to either compressional or shearing movements. Causes of inversion may also include far-field stresses related to halokinesis in the Tromsø Basin and uplift of the Loppa High. Inversion structures have had an impact on hydrocarbon prospectivity and accumulation in the TFFC and surrounding basins. Our work shows that localized folds close to extensional faults positively change the geometries of traps within the Stø Fm. (reservoir) and the Hekkingen Fm. (cap rock). In contrast, folding observed in the potential source rock of the Hekkingen Fm. post-dates the timing of petroleum generation and migration. Reactivated faults in the TFFC can act as conduits for hydrocarbons or compromise the sealing integrity of the traps.