Oligocene-Miocene Sediment Remobilization in the Northern North Sea: Influence of Diagenesis and Fluid Flow Processes

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The study area is within the offshore North Viking graben, Horda platform and the Troll field area, spanning an area of 11,059 km^2. Our 3D seismic study utilizes the NNS megasurvey, courtesy of PGS Ltd. The dataset shows widespread occurrence of polygonal faulting, a potential opal A/CT diagenetic reflection, jack-up structures, fluid conduits and injectites. The aim of this study is to determine how different seismic facies relate to the distribution of jack-up structures, fluid conduits and injectites and characterize their responses and possible link with diagenetic events. Detailed regional mapping shows the polygonal faults are restricted to the basinal part of the succession with sufficient sedimentary thickness (with the lower thickness limit about 150ms TWT). Their fairly consistent dip direction is altered where there is strong push-up of the basal (potential) opal A/CT reflection boundary. This manifests itself in the arching of the top boundary which deforms the base of the overlying Utsira sands, which are a prime target for CO_2 sequestration in the North Sea. The internal facies of the basal Utsira mounds are characterised by chaotic reflections and bright V-shaped reflections. The mounds have previously been interpreted as mud diapirs. However, the adjacent areas do not show apparent thinning which would have been indicative of substantial mass flow. The remobilization complex could spread as wide as 15 km and extend for as long as 50 km. Downslope its width decreases and develops a meandering trend. The seismic stratigraphic observation leads us to conclude that the mounds represent remobilized sandy deposits surrounded by more compactable muds, which are prone to silica diagenesis and polygonal faulting during shallow burial.

This study shows that the Oligocene - Miocene succession in the Northern North Sea has undergone widespread deformation which has been influenced by and continues to influence fluid migration in the area. The processes affecting these deposits are particularly well documented in the North Sea due to its long history of hydrocarbon exploration and wide availability of high-quality datasets. However, the operation of sediment remobilization and fluid flow processes are by no means limited to this basin and we predict that more frontier basins will yield similar features when more fully explored.