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Integrated interpretation to improve subsalt imaging: a case study from the Nordkapp Basin, Norwegian Barents Sea

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Seismic imaging of subsalt structures is still a difficult task and remaining uncertanties in the salt geometries makes exploration in the vicinity of such complex structures challenging. Gravity and magnetic data have proofed in the past their potential in combination with seismics to better delineate the shape of such salt structures. The current work deals with the improvement of subsalt imaging by combined interpretation of seismic and potential field data examined at a case study from the southern Nordkapp Basin. The Nordkapp Basin is a deep, narrow saliferous basin located in the southwestern Barents Sea. It comprises more than 30 salt diapirs, which are likely to create traps for hydrocarbons at their flanks and overhangs. Consequently exploration of the Nordkapp Basin with seismic methods started already in the 1980s, but until today solely seismics was not sufficient to reveal the nature and geometry for large parts of the basin.

Therefore 2D and 3D seismic data were interpreted and used as stratigraphic constraints for the potential field modeling. For this purpose high resolution gravity and full tensor gravity gradient (FTG) data as well as a regional magnetic dataset were available. After processing the potential field data the 3D modeling was conducted by means of the interactive gravity and magnetic modeling software IGMAS+. Furthermore constraints for the rock properties, provided by well logs and susceptibility measurements of adjacent sedimentary well cores, were integrated.

The favoured models indicate for both major salt structures a bulky base and a small root. The depth of the base of salt can vary in a range of about $\pm$ 300 m. Remaining mother salt is found in the northern part of the survey area and has no connection to the diapiric salt. Due to its higher sensibility to shallower sources the FTG data was used to model the flanks of the salt diapirs. In agreement with adjacent diapirs and encountered sequences a cap rock coverage was detected. Additionally, the gravity data and strong seismic reflections suggest a large impedance contrast and a high density body, consisting of dolomite-dominated carbonates and evaporites at the basin slope in the most southeastern corner of the Nordkapp Basin. In combination with the magnetic data the top of basement is located in 15 to 18 km depth. Furthermore a branch of an intrusion below Norsel High and intrusives in the centre of rift were detected.

Our results proof the potential of integrated interpretation of seismic and potential field data. The modeling approach helps to overcome difficulties in seismic imaging of salt structures. Due to the sensibility to sources in different depths, especially FTG data and high resolution magnetic data increase the reliability of subsalt modelling. The resulting model provides additional information to improve seismic velocity models especially in the subsalt area. This study was carried out in the frame of a research project about joint inversion in cooperation with SINTEF, funded by the Norwegian research council, Det norske oljeselskap, Gaz de France and Eon Norge.