Seismic attributes, well correlation and geostatistical analysis for sequence variability prediction in the Sleipner area.

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Abstract

The Upper Cenozoic stratigraphy in the northern North Sea (Sleipner area) has been investigated, using high quality 3D seismic and five exploration wells. Interpretation of the seismic data indicate six distinct sequences (S1-S6). These sequences are classified according to reflection configuration and well log characteristics. A simple model has been constructed using these sequences. The model represents a spatial domain for the co-kriging interpolation method, which is used to interpolate the petrophysical data from the well logs. This gives the possibility to predicate how petrophysical properties change laterally within the study area. Hypothetical wells placed within the model, provide the possibility to extract interpolated well logs and test the co-kriging interpolation method.

The uppermost sequences (S1 – S3) are deposited from Pliocene to Holocene. These sequences have continuous reflections, with a parallel to subparallel reflection geometry. This configuration is often seen in sediments derived from glacio-marine processes. The well logs indicate a shale dominated lithology, and the co-kriging results might indicate that this lithology is dominant for the uppermost sequences in the study area.

Sequence S4 corresponds to the Utsira Formation, which is currently used as a CO_2 storage. The Utsira Formation consist of well-sorted sands from Late Miocene to Early Pliocene. The seismic response is characterized by low amplitude, discontinuous reflections. This reflection configuration could be related to the shale dominated, shallow marine environment the sequence was deposited in. The well

logs clearly indicate a sand interval, which can be strongly correlated between the five wells. The co-kriging results suggest that the Utsira Formation is sand dominated in the whole study area.

Sequence S5 was deposited during Middle Miocene. The sequence comprises several discontinuous reflections, with a disrupted configuration. Numerous anticlinal features have been observed at the base of the sequence, possibly caused by mobilized sediments, injecting into the sequence. The well logs indicate shale, with a few thin-layers of sand. The co-kriging results indicate that this lithology is dominant for S5 in the study area.

Sequence S6 was deposited during Lower Miocene, and show a shale dominated lithology. The seismic response comprise several high amplitude, discontinuous reflections. This configuration is related to extensive polygonal faulting. The co-kriging results, suggest that S6 consist of shale in major parts of the study area.