3-D Seismic Geomorphological Mapping of Clastic and Carbonate Reservoirs – The Farsund Basin, Offshore Southern Norway

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ABSTRACT

In the subsurface, widely spaced boreholes typically provide constraints on only the 1D-to-quasi-3D distribution of sedimentary facies, thus hampering our ability to map reservoirs at the inter-well scale. In basins where well data is sparse, or even completing lacking, 3D seismic reflection data can provide high-resolution, plan-view images of the Earth's subsurface at multiple stratigraphic levels; this allows us to identify and map reservoirs during the early phase of exploration. The Farsund Basin is an underexplored basin located offshore southern Norway. Only one well has been drilled in the basin, despite it lying within the same broad tectono-stratigraphic domain as the highly prolific North Sea rift. Here, we undertake seismic attribute analysis, including spectral decomposition, of 3D seismic reflection data to constrain the paleo-geomorphological evolution of the Jurassic within the Farsund Basin, and determine the types and distributions of potential reservoirs. We identify a series of east-flowing rivers in the Lower Jurassic, the distribution of which were controlled by syn-depositional salt-detached faults, rather than the basement-involved faults dominating the present basin structure. Subsequently, following Mid-Jurassic flooding, a series of carbonate reefs, expressed as sub-circular amplitude anomalies, developed. Two distinct reef morphologies are identified, which we infer represent growth in differing water depths controlled by differential compaction of sub-reef strata across underlying faults. During the Late Jurassic, water-deepening and basin anoxia shut down the carbonate factory. Within the Upper Jurassic we identify a series of curvilinear features, arranged into discordant sets within a clinoform-bearing interval. We interpret these features as the downlap terminations of southward-prograding deltaic clinoforms. The distribution of these Upper Jurassic clinoforms appears to be controlled by fault-related topography, marking the onset of Late Jurassic-Early Cretaceous rift-related faulting. We show how seismic attribute-driven, seismic geomorphological analysis can be used to identify clastic and carbonate reservoirs in frontier basins. Furthermore, the stratigraphic development of such basins, inferred directly from seismic reflection data, can be related to and can thus help constrain their tectono-stratigraphic development.