Structural evolution and Cenozoic erosion of the western Barents Sea margin

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In preparation for the 22nd licensing round Noreco focused on the western margin of Barents Sea. A key challenge here is to identify areas that are both oil prone and where reservoir properties have not been destroyed by excessive burial.

Regional mapping of key horizons and faults was done utilizing a comprehensive seismic database. This was integrated with data and models from publications, acquired studies and ongoing research projects. The outcome was an improved tectonic model with identification of individual structural elements, and structural development history for the area.

From Devonian to mid-Cretaceous times the area was characterized by a series of rotated mega-scale NNE-SSW trending half-grabens with their primary boundary fault to the SSE, formed along weakness zones that presumably were guided by orientations linked to a Caledonian structural fabric. It is thought that during rifting events, continuous rotation of these major fault blocks occurred. A complex tectonic regime existed during Late Cretaceous to Oligocene with both compressive and extensive movements taking place related to the opening of the North Atlantic. During the Neogene the area was tectonically rather quiet and most of the area experienced uplift and erosion.

An oil maturity map for the Hekkingen Formation source indicated potentially oil prone areas along the western margin of the Loppa High along the rim of Bjørnøya Basin onto the Stappen High. Further studies here aimed both at detailed structural mapping, prospect maturation, and at quantifying the maximum burial and the subsequent Paleogene and Neogene uplift and erosion.

Estimating maximum burial depth was done by using both well data such as vitrinite reflectance and porosity depth trends, and combining these with stacking velocities in areas away from well control. The revised erosion map shows dramatic amounts of erosion, particularly on Stappen high where as much as 4 km may have been removed.

The consequences of high amounts of uplift are significant with regards to prospectivity. In the Stappen High area, 'economic' basement rose to well above the main Mesozoic reservoir section, and areas previously viewed as oil-prone should now be viewed as gas-prone. Kilometer scale uplift furthermore jeopardizes the volumes of already trapped oil as gas dissolution, gas expansion, fault rejuvenation, tilting, and thermal shrinking all leads either to a reduction or a complete escape.