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Thermal History, Ice Loading and Inversion of the SW Barents Sea as revealed by Basin Modelling

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The southwestern Barents Sea is a frontier area for petroleum exploration on the Norwegian Margin. The juxtaposition of the North Atlantic rift system with the borderlands of the Eurasian continental shelf makes for an unusual basin evolution with oil- and gas-prone petroleum systems. The area is home to giant gas fields and one of the largest known ocean floor gas hydrate deposits in the world (Kleshchev 2004). Since exploration began in the early 1980's, some 60 wells and 250,000 km of seismic have helped to define seven distinct plays in the petroleum systems of the region. Prospective drilling has largely concentrated on the three principal plays of the Hammerfest Basin, i.e. the sandstones of the Triassic, Lower to Middle Jurassic and Upper Jurassic to Lower Cretaceous. These have yielded giant gas discoveries, very little oil and evidence of significant inversion during the Late Cenozoic. These findings are typical of peripheral North Atlantic Margin basins that have undergone exhumation during the Cenozoic. At present, there is a consensus on the three principle episodes of Cenozoic exhumation in the region as having occurred during the Paleocene, Oligo-Miocene, and Quaternary respectively (Doré et al. 2002), and the amount of total erosion within the Hammerfest Basin as approximating 1000-1500 metres (Linjordet and Olsen 1990). However, the relative severity of each individual episode and associated impact on fluid dynamics within the basin are poorly constrained. This modelling study aims to establish the sensitivity of the south-western Barents Sea petroleum systems to thermal, ice loading and isostatic changes during the Late Cenozoic. Here we present our initial findings for the Hammerfest Basin. Using a 2D basin modelling approach (PetroMod 2D, IES, Germany) a north-south section extending from the Finnmark Platform to the Loppa High has been tied to well data from the core area of Snohvit-Albatross-Askeladd. Available vitrinite reflectance and temperature data

provide the constraints for calibration of the burial and thermal histories. Calibration studies focussed on the individual effects of erosion timing and magnitude, heat flow history, and timing and thickness of glacial ice coverage. While it is not possible to achieve a good calibration using heat flow variations alone, the effects of erosion and ice coverage seem to result in similar results with respect to calibration to the available data. We are currently testing, and will report, the model response to the combined effects of these three model input variables.

Doré, Corcoran & Scotchman 2002. Prediction of the Hydrocarbon System, London Geological Society.

Kleshchev 2004. Geodynamic analysis of the Barents and Norwegian Seas, AAPG Abstract.

Linjordet & Olsen 1990. The Jurassic Snøhvit Gas Field, Hammerfest Basin, AAPG Memoir.