Evaluation of Processes that Control the Hydrocarbon Potential on the Mid North Sea High

Oliver Schenk[1], Alex Karvelas[2], Olga Shtukert[2], and Katharine Broadbent[1]

[1]WesternGeco, Aachen, Germany.
[2]WesternGeco, Gatwick, United Kingdom.

ABSTRACT

The Mid North Sea High (MNSH) is one of the last remaining underexplored regions on the UK continental shelf. Exploration efforts have been restarted with a renewed focus on the Paleozoic basins benefitting from released 2015 government-funded seismic acquisition. The results of this seismic project have allowed improved imaging of sub-Zechstein intervals, essential for delineation of individual Paleozoic play and trap types. Key elements of the Paleozoic petroleum system are Dinantian/Namurian source rocks, likely to have contributed to the recent charge of the Breagh gas discovery in the southern portion of the MNSH. Besides the presence and properties of such source rocks, one key exploration risk is their thermal maturity and timing of hydrocarbon generation relative to trap formation. We present petroleum system modeling results from four 2D composite sections across the MNSH extending into the UK Central Graben. The sections are composed of 2015 government-funded and Multiclient legacy seismic data. Thermally calibrated models test several hydrocarbon plays with structural, stratigraphic, and combination traps. A key aspect is the assessment of the interplay of multiple processes that control thermal maturity of the Paleozoic source rocks and the related timing (e.g. paleo-heat flow, amount of erosion, and impact of Caledonian plutonism). We discuss the impact of Tertiary tilting across the MNSH with erosion in the west and deep burial towards the Central Graben. Our modeling results provide important insight into the Paleozoic petroleum system on the MNSH. The thermal history of the MNSH is very sensitive to subsidence, erosion, and rift-related heat flow peaks; understanding their interplay is key to assessing the Paleozoic petroleum system. Although hydrocarbon losses are predicted for the southern part of the MNSH during Variscan orogeny, discoveries such as Breagh and Crosgan point to late hydrocarbon charge. Towards the central part of the MNSH, the models predict a late phase of hydrocarbon generation from Carboniferous source rocks, taking place after trap formation and with mudstones reaching enhanced sealing efficiencies. The MNSH represents an opportunity for future exploration activities. The presence, extent, continuity, and properties of Carboniferous source, reservoir, and intraformational seal rocks remain uncertain; but reprocessing current seismic data sets will provide a more accurate delineation of the Paleozoic petroleum system.