THE PETROLEUM GEOCHEMISTRY OF THE JOHAN SVERDRUP FIELD, SOUTHERN UTSIRA HIGH, NORWEGIAN NORTH SEA

F. Wesenlund[1], D. A. Karlsen[1]

[1]University of Oslo, Norway

Crude oils in Middle to Late Jurassic reservoirs have been studied in wells from the Johan Sverdrup Field located on the Utsira High, Norwegian North Sea. In addition, core samples of basement rocks and Middle to Late Jurassic sandstones from the Johan Sverdrup Field, the Edvard Grieg Field located 13 km further west, and the "dry well" 17/3-1 (Bark Prospect) situated 65 km further east towards the mainland have been analyzed for geochemical signatures. Organic geochemical data have been created using Iatroscan TLC-FID (bulk saturated, aromatic and polar fractions), GC-FID (*n*-alkanes and isoprenoids), and GC-MS (terpanes, steranes, aromatic steroids, phenanthrenes and methyl dibenzothiophenes). The core samples were subjected to SOXTEC extraction prior to analysis. The compounds listed have been used to interpret the thermal maturity, source rock organofacies, migration from source rock to reservoir, and biodegradation of the oils and core extracts.

The Johan Sverdrup crudes from each well analyzed in this study are geochemically similar in composition, despite a distance up to 24 km between the farthest wells (16/2-9S and 16/5-4). Biomarker parameters indicate the crudes to be early – peak mature, incipient biodegraded, and sourced from the prolific Draupne Fm source rock (Anoxic/dysoxic, algal marine, kerogen type II/III). Intra-Draupne and Hugin Fm sandstone core extracts contain abundant biodegraded allochtonous hydrocarbons of less thermal maturity, but similar source rock organofacies. Sandstone extracts from well 17/3-1 (Sandnes Fm, Bryne Fm) are dominant in polar compounds with only minimal hydrocarbon content, and show little affinity with samples from Johan Sverdrup. Analysis from the Johan Sverdrup Field basement core extract display traces of allochtonous organic hydrocarbons, indicating secondary migration through basement.

Molecular interpretation parameters in the crudes analyzed display no clear lateral or vertical trend in the reservoir. The bulk saturated-to-aromatic ratio of the crudes suggests a southeastern migration direction from the Vana sub-basin area in the northwest to the Johan Sverdrup reservoirs. The results in this study compared with oil family data from Justwan et al (2006) coupled with differential post-glacial isostatic rebound data from Stoddart and Fjeldskaar (2014) may also indicate a northeastern migration route from the southwest. The present study has determined both migration routes as possible candidates based on the geochemical data from the sample set, although more wells from the Utsira High should be analyzed to give an interpretation of higher confidence. The less-biodegraded Johan Sverdrup crudes may indicate a less shallow reservoir than previous reservoir depths, argued by biodegraded Johan Sverdrup core extracts of less maturity. A concept model of reservoir depth evolution due to isostatic influence as a result of glacial activity is presented.

References

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