

SOURCE ROCK HETEROGENEITY AND OIL-SOURCE ROCK CORRELATION IN THE LOWER PALAEOZOIC PETROLEUM SYSTEM, BALTIC BASIN

S. Yang¹, H.-M. Schulz¹, N. H. Schovsbo², J. Bojesen-Koefoed²

1. Helmholtz Centre Potsdam–GFZ German Research Centre for Geosciences, Germany
2. Geological Survey of Denmark and Greenland (GEUS), Denmark

The Lower Palaeozoic petroleum system has the biggest potential for conventional and unconventional petroleum resources in the Baltic area. Up to now, the lateral and vertical heterogeneity of the source rocks was not well evaluated and the oil-source correlation is still a matter of debate.

23 source rocks were investigated for their uranium contents, by pyrolysis-GC and analysed for their bulk kinetic characteristics to qualitatively and quantitatively determine the petroleum potential. Additionally, ten source rock samples and 15 oil samples from five north European countries bordering the Baltic Sea Basin were analysed by GC-FID, GC-MS, and GC-MS/MS to detect acyclic isoprenoids, and aliphatic, aromatic, and NSO biomarkers. Chemometric tools were applied to screen source- and age-significant biomarkers and to highlight genetic relationships.

A great heterogeneity exists among source rocks from different ages with varying uranium contents according to the pyrolysis results and kinetic features. The uranium-rich Alum Shale produces mainly gaseous hydrocarbons. Extended tricyclic terpane ratios, C₂₄ tetracyclic terpane/C₂₆ tricyclic terpane ratios, and relative C₂₉ sterane concentrations are considered the most promising biomarker information in differentiating Silurian shales from the Cambrian to Ordovician Alum Shale and in correlating with its expelled oil. The uranium irradiation-induced C₂₆-C₂₈ triaromatic steroid concentrations allow distinguishing the source potential of the different Alum Shale units.

The Alum Shale is thus considered the main source rock for oil accumulations in Lower Palaeozoic reservoirs of the Baltic basin. Oil seepage occurring in Middle Ordovician limestones were mainly generated by the Middle Cambrian Alum Shale, whereas Middle Cambrian sandstone reservoirs were mainly sourced by Furongian (Upper Cambrian) and Lower Ordovician Alum Shale both with higher maturity. Considerations about the assessment of migration distances are based on carbazole concentrations and C₂₉ sterane isomerization.

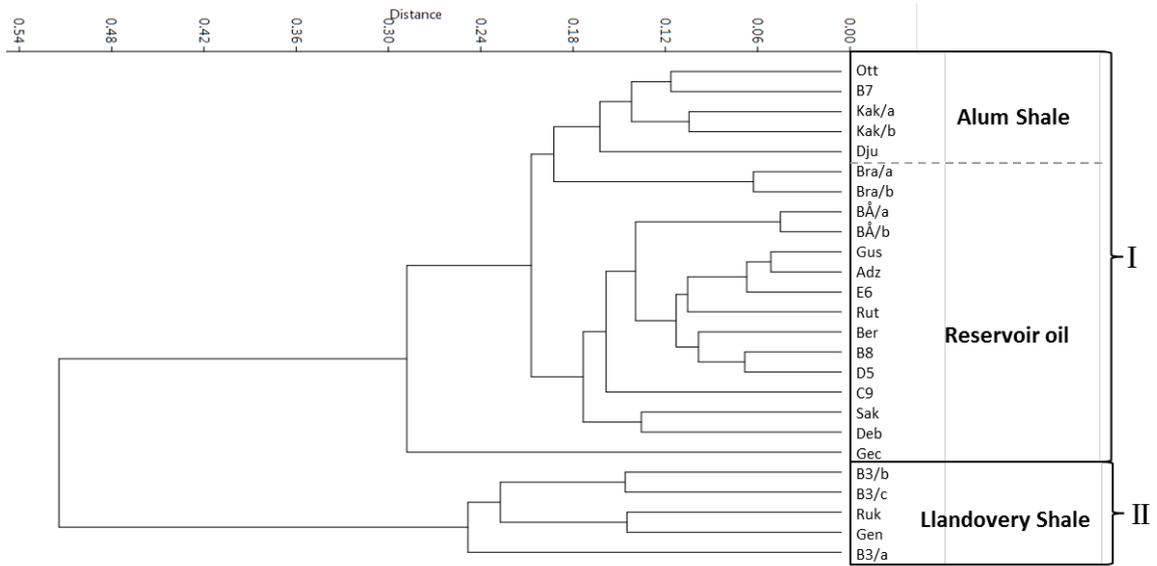


Figure 1 Hierarchical cluster analysis highlighting that the Lower Palaeozoic source rocks fall into two groups, and the Alum Shale-oil correlation.