ORGANIC GEOCHEMISTRY OF PETROLEUM IN THE CAMBRO-ORDOVICIAN SUCCESSION OF NY FRIESLAND, SPITSBERGEN, SVALBARD

T. B. Abay[1], D. A. Karlsen[1], S. Olaussen[2], J. H. Pedersen[3].

[1] University of Oslo, Oslo, Norway, [2] University Centre in Svalbard, Longyearbyen, Norway, [3] Lundin Norway AS, Norway

Rocks of Early Palaeozoic are well exposed in Ny Friesland, Spitsbergen and have been known since the 1960s, with studies focusing on stratigraphy, sedimentological and fossil assemblages. The Cambrian to Ordovician sedimentary succession in Ny Friesland include shallow marine carbonate platform and clastic plus deep marine facies deposited in varying settings. The carbonate rocks probably represent source rocks and potential reservoir rocks. In this study we show the first-ever organic geochemical data from bituminous carbonates and shales representing the Cambrian Tokammane and the Ordovician Valhallfonna formations. The purpose is to describe the petroleum in terms of kerogen type, depositional environment, thermal maturation, source rock and age.

The data reveal that the Valhallfonna Formation rock extracts are geochemically distinct from extracts of the Tokammane Formation. Thus, the Valhallfonna extracts have higher ratios of dibenzothiophene/phenanthrene, C29/C30 hopane, and C35/C34 hopane, C24 tetracyclic terpane/C26 tricyclic terpane, but lower ratios of Ts/(Ts + Tm), Pr/Ph, 29Ts/(29Ts + norhopane), C29 steranes, also lower relative amounts of diasteranes than the Tokammane Formation extracts. All samples contain moderate amounts of gammacerane, but the gammacerane index is higher in the Tokammane, than in the Valhallfonna extracts. These biomarker features of the Valhallfonna Formation are consistent with petroleum derived from carbonate and/or organic-rich marly source rocks deposited under highly reducing depositional environment, while that of the Tokammane Formation is consistent with a more siliciclastic source rock depositional environment.

Based on biomarker data, it is suggested that organic material originating from aquatic organic life forms was deposited under marine to transitional conditions with oxygen-depleted bottom waters. The C29 steranes in the investigated samples are dominant among regular steranes, making 42 – 57% of the total. Sterane distributions with such occurrences of C29 found in pre-Devonian sediments suggest a marine cyanobacterial contribution, without higher plant input.

Parameters used to assess the maturity of the extracts including C29ααα sterane 20S/(20S+20R), C31 homohopane 22S/(22S+22R) and C29 ββ sterane ratios suggest maturity levels ranging from the onset, to the middle of the oil generation window.

From numerous data it could be inferred that the bitumen occurring within the Cambrian-Ordovician succession is – to a large extent migrated, with some samples containing possible contribution from *in situ* generated bitumen.
Comparison of several age specific biomarkers from the Ny Friesland samples with known Mesozoic and Palaeozoic derived oils and source rocks reveal that the source rock for this petroleum is Palaeozoic in age. Geochemical similarities with the Timan-Pechora system,

Russia are numerous, and similarities concerning the paleo-depositional system are also obvious.

This is the first study revealing the existence of a carbonate type Palaeozoic petroleum systems this far north on Spitzbergen, and it is speculated if this petroleum system could also exist on the continental shelf to the north and NE.

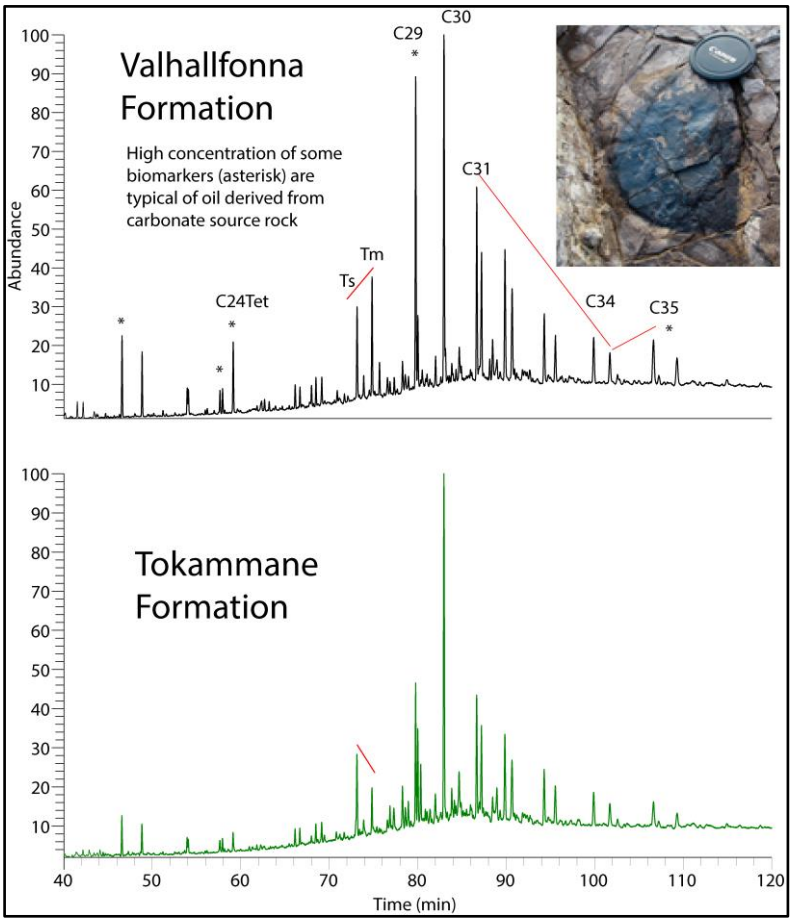

Figure 1 *m/z=191 GC-MS chromatograms showing distribution of terpanes for Valhallfonna and Tokammane Formation samples. Inset at upper right is example of bitumen stained rock sample analysed in this study from the Valhallfonna Formation in Ny Friesland, Spitsbergen.*

References

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