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FIRST ANNOUNCEMENT

GEOS4 partnership with GFZ on Retention and Transport

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PROJECT OPEN FOR SPONSORSHIP IN 2018

We are very proud to offer this highly topical project for co-sponsorship in 2018:

Polars on the Move (P'move)

- *2-years duration*
- *To be co-sponsored at 35k€ per year*
- *Discounted at 99k€ per year when co-sponsoring* ***all three projects new in 2018***
- *Minimum participant quota will apply*

Kick-off March 1, 2018

Please let me know if this project could be of major interest and you are giving serious consideration for 2018 funding. Email: horsfield@geos4.com Tel: +49 331 288 1780.

Best wishes,

Polars on the Move (P'move)

Key Words: primary migration, secondary migration, rock-fluid reactions in reservoir

Background:

The NSO-containing fractions of petroleum are compositionally complex. NSO-compounds vary in polarity, and are partitioned between aqueous and organic phases and mineral surfaces. Alkylcarbazoles and alkylphenols, and to a lesser degree xanthones, have been tested as potential migration tracers, using GC-MS to compare the relative abundances of shielded versus non-shielded stereoisomers (Newcastle, followed by Jülich, Kiel, Saudi Aramco, Adelaide). All of that work has shown where and how the methodology appears to work or not work for tracing migration. Coming from a totally different and complementary angle, Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR-MS) offers the huge advantage of extending the molecular weight range up to >750 Da, and differentiating between the multitudes of N-, S- and O-compounds in complex mixtures, but cannot assess isomer stereochemistry. The combined array of data from its three operating modes – atmospheric pressure photo ionization, electrospray positive and electrospray negative - allows the full inventory of acidic, neutral and basic hetero-habitats to be evaluated. Fig. 3-1 provides an example from ESI-neg, where the influence of maturity on N1 neutral nitrogen components in source extracts are compared to produced oils. The strategy of combining the respective strengths of these approaches is set to deliver big advances in our understanding of the heteroelement cycle in general, and rock-fluid interactions in particular.

Goal:

The proposed project aims to significantly improve our understanding of NSO-compound geochemistry along the pathway from source to carrier to reservoir to production line. Tracing structural moieties from macromolecules in kerogen and heavy bitumen to asphaltene and resin fractions to hydrocarbons is planned. Rock-fluid interactions and resulting induced fractionations are the primary focus, though the full range of facies and maturity influences and interdependencies are anticipated. We have already undertaken many regional studies to act as foundation for the work.

Area(s) of study:

We wish to focus initially on the Tampen Spur, Viking Graben, Norway, because there the source kitchen and fill-spill pathway is well known, and samples are readily available from the Norwegian Petroleum Directorate. The main study area is expected to be augmented using additional samples from lacustrine petroleum systems, or both vertically and laterally charged traps in marine-carbonate basins, as provided by the sponsors.

Approach:

Unaltered produced oils, reservoir core extracts, source rock extracts and source rock pyrolysates will be analysed, thus inversely tracing the genetic pathway back from products to precursors, sinks to sources. Samples will be selected in close collaboration with sponsors.

The analytical approach will be integrated. Solvent extraction and preparative pyrolysis followed by GC-MS and FT-ICR MS will be the main investigative tools. A summary and synthesis of published and archived data will be made.

Experience and manpower:

Nick Mahlstedt
Steffi Pötz
Mareike Noah
Volker Ziegs
Brian Horsfield
The team has worked on NSO-compounds in shale plays (Niobrara, Barnett, Vaca Muerta), and conventional plays in the North Sea, Western Canada, Sonda de Campeche, Western Europe.
1 full-time postdoc with 3+ years experience in North Sea Petroleum Systems geochemistry will be assigned to the project.

Deliverables

A petroleum geochemical state-of-the-art summary for NSO-compounds
Collation of GC-MS results for hydrocarbon biomarkers and pyrrolic nitrogen.
Synthesised FT-ICR MS results for the full spectrum of NSO-species: ESI-negative, ESI-positive, APPI into a petroleum system framework.

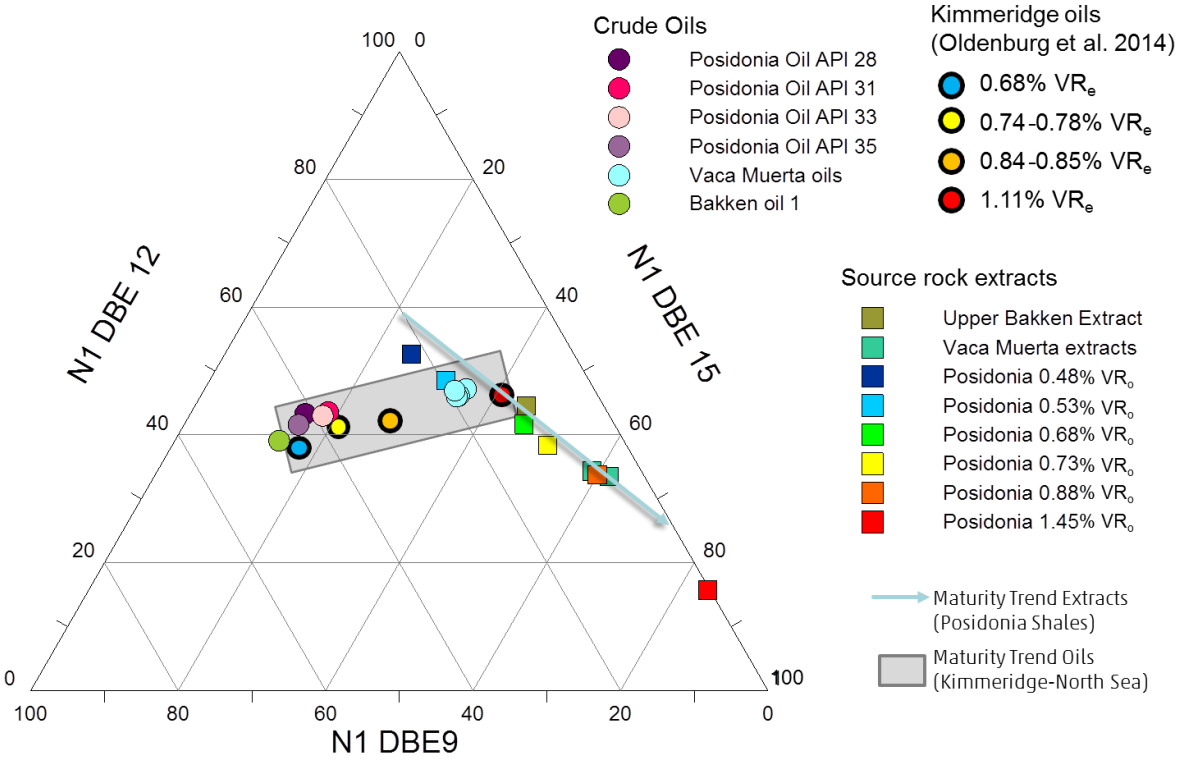

Fig. 3-1 Using ESI-neg, three major DBE classes of the N1 compounds are shown in ternary diagrams for Posidonia Shale extracts and Posidonia Shale sourced-crude oils (Mahlstedt et al., 2016), Kimmeridge Clay-sourced North Sea oils, Bakken Shale extract and oil, and Vaca Muerta extract and oil. Posidonia Shale-sourced oil samples plot in the vicinity of North Sea oils (maturity assignment in Oldenburg et al., 2014) with maturity levels 0.68-0.74% Re. Maturity levels of extracts from the Posidonia Shale, and extracts and oils from the Bakken Shale and Vaca Muerta are verified by further geochemical data (Ro, Tmax, etc...) of the extracted source rocks.

Literature:

Mahlstedt N., Horsfield B., Wilkes H., Pötz S. (2016). Tracing the impact of fluid retention on bulk petroleum properties using nitrogen-containing polar compounds. Energy and Fuels, 2016, 30 (8), pp 6290–6305
DOI: 10.1021/acs.energyfuels.6b00994