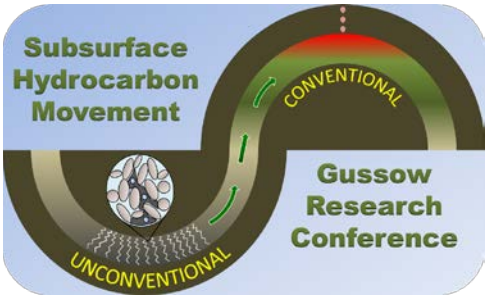

Laboratory simulation of petroleum and gas generation and expulsion via the “Expulsinator”

Lorenz Schwark, Martin Stockhausen
University of Kiel

Summary

A reservoir´s petroleum composition and quality as well as its charge history are controlled by a continuum of reactions including in particular generation, expulsion and migration, all of which are affected by source-rock/reservoir lithology and the nature of source organic matter. Therefore, studying generation, expulsion and migration effects under defined laboratory conditions is essential in obtaining a comprehensive picture, from generation to reservoir charge, and aiming towards calibration and improvement of modelling calculations.

Investigation of these critical processes until now is still hampered by inappropriate methodologies applied in lab-scaled simulation. Addressing this issue, the Organic Geochemistry Unit at Kiel University has developed the “EXPULSINATOR”-device, which facilitates semi-open hydrous pyrolysis of an intact source rock (i.e. with unaltered mineral matrix and kerogen network) under near-natural lithostatic and hydrostatic pressure regimes (Stockhausen, 2013). The technique has been applied to a variety of generation, migration and expulsion studies, proving its applicability for laboratory simulation of oil and gas generation and release upon subsidence or alternatively upon uplift events. Previous EXPULSINATOR studies demonstrated a systematic, though highly variable expulsion behaviour in dependence of source rock character, which controlled the lithological or petrophysical properties and the kerogen type (Stockhausen, 2013).

However, geo- and biomarker maturity ratios in some cases exhibited unexpected behaviour, demonstrating gaps in our knowledge concerning the sensitive interplay of generation, decomposition and conversion affecting these parameters. A key role in the application of EXPULSINATOR based molecular maturity parameters seems to be the short time between release of components from the kerogen network and expulsion from the source rock, i.e. the limited interval available for isomerization reactions. Fast expulsion may lead to incomplete isomerization processes and underestimation of thermal maturity reached in the experiments.

The EXPULSINATOR may facilitate laboratory ground-proofing of the established “geochromatography” concept by spiking an authentic source rock with deuterium-labelled model compounds (n-alkanes, aromatics, thioaromatics, carbazole) and expelling these compounds from an intact source rock exposed to petroleum generation temperature and pressure conditions.

A review of these EXPULSINATOR applications will be given in this presentation.