Petroleum migration controls mineral reactions in Permian red beds, Central European Basin System

R. SCHÖNER AND R. GAUPP

Friedrich-Schiller-Univ., 07749 Jena, Germany
(*correspondence: robert.schoener@uni-jena.de)

Deeply buried Rotliegend (Permian) reservoir sandstones of the Central European Basin System that were affected by petroleum migration show distinctly different diagenetic evolution compared to reservoir sandstones without hydraulic contact to potential petroleum source rocks. The spatial relationship of source and reservoir rocks, the timing of organic maturation and migration, and the timing and distribution of diagenesis suggest that a specific combination of diagenetic mineral reactions allows to trace former petroleum migration pathways.

Early diagenetic iron oxide grain coatings were removed prior to oil migration. Pre-oil feldspar dissolution caused intragranular porosity, which is significantly higher in zones affected by bleaching. On a local scale, especially around fault zones displacing source against reservoir rocks, distribution of authigenic minerals implies Al import into and probably Fe export from the Rotliegend during deep burial diagenesis. On the scale of basin compartments, however, there is no evidence for major export or import of both Al and Fe according to geochemical data. Fe mobilized during bleaching was incorporated into authigenic ankerite, siderite and Fe-rich chlorite. Al released during feldspar dissolution has been consumed by growth of clay minerals. On the other hand, the bulk K content decreases with increasing percentage of feldspar dissolution and illite authigenesis. This implies that K was exported from the sandstone.

Local dissolution of feldspar and carbonate or sulphate cements took place contemporaneously or after petroleum migration and formation of solid bitumen in the reservoirs. One possible explanation is that oxidation of oil compounds along migration paths and in reservoirs have generated organic acids and/or CO_2 that created late stage porosity enhancement, but the processes are still ambiguous.

We conclude that (1) a specific sequence of diagenetic mineral reactions in Rotiegend red beds can be used to trace migration pathways of petroleum fluids and (2) petroleum migration significantly affects porosity and permeability evolution during burial of sandstone reservoirs. The understanding of these processes can help to improve the prediction of reservoir potential of deep basinal settings.

Evolution of sea surface temperatures in the Eocene and Oligocene reconstructed using organic proxies

S. SCHOUTEN[1], S.M. BOHATY[2], A.J.P. HOUBEN[3], P.K. BIJL[3], A. SLUIJS[3], J.S. ELDRETT[4], I.C. HARDING[2], J.S. SINNINGHE DAMSTÉ[1] AND H. BRINKHUIS[3]

[1]NIOZ Royal Netherlands Institute for Sea Research, Department of Marine Biogeochemistry & Toxicology, PO Box 59, 1790 AB, Den Burg, Texel, The Netherlands
[2]School of Ocean and Earth Science, National Oceanography Centre, University of Southampton, European Way, Southampton, SO14 3ZH, United Kingdom
[3]Palaeoecology, Institute of Environmental Biology, Utrecht University, Laboratory of Palaeobotany and Palynology, Budapestlaan 4, 3584 CD Utrecht, The Netherlands
[4]Shell UK Exploration and Production, 1 Altens Farm Road, Nigg, Aberdeen, AB12 3FY, United Kingdom

The interval spanning the Eocene and early Oligocene represents an important period in Cenozoic climate development marking the transition from a warm greenhouse world to the colder icehouse world [1]. The most likely explanation for this cooling is a lowering of atmospheric CO_2 levels in combination with orbital modulation [e.g. 2]. However, uncertainty exists about the magnitude and timing of the cooling, primarily due to a lack of suitable temperature proxies. Recent approaches have used the Mg/Ca ratios of foraminifera, however, issues regarding preservation, carbonate ion concentration effects and uncertainties regarding the Mg/Ca of sea water make temperature estimates derived from this proxy relatively uncertain. Furthermore, most studies have utilized deep sea benthic foraminifera, and thus record deep water temperatures, while studies on planktonic foraminifera and thus providing sea surface temperatures (SSTs) are rare.

We used a recently developed organic proxy, the TetraEther indeX of 86 carbon atoms or TEX_{86} [3] to estimate SSTs during the early Eocene to early Oligocene. Comparison of these estimates with alkenone-based paleothermometry show in general a good correspondence between absolute SST estimates between the two proxies. However, for several climatic events discrepancies occur between the two proxies. The results are used to constrain the impact of temperature on several oxygen isotope events occuring during the Eocene.

[1] Zachos *et al*. (2001) *Science* **292**, 686-693. [2] DeConto and Pollard (2003) *Nature* **421**, 245-249. [3] Schouten *et al*. (2002) *Earth Plan. Sci. Lett*. **204**, 265-274.