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Shale gas characteristics of the Lower Toarcian Posidonia Shale in Germany: from basin to nanometre scale

Hans-Martin Schulz (1), Sylvain Bernard (2), Brian Horsfield (1), Martin Krüger (3), Ralf Littke (4), and Rolando di primio (1)

(1) GFZ Potsdam, Dep. 4.3 Organic Geochemistry, Potsdam, Germany (schulzhm@gfz-potsdam.de), (2) Laboratoire de Minéralogie et de Cosmochimie du Muséum (LMCM), MNHN CNRS UMR 7202, 57 rue Cuvier 75231 Paris Cedex 5, France, (3) Federal Institute for Geosciences and Natural Resources, Stilleweg 2, D-30655 Hannover, Germany, (4) Lehrstuhl für Geologie, Geochemie und Lagerstätten des Erdöls und der Kohle (LEK), RWTH Aachen University, Lochnerstr. 4-20, Haus B, D-52056 Aachen, Germany

The Early Toarcian Posidonia Shale is a proven hydrocarbon source rock which was deposited in a shallow epicontinental basin. In southern Germany, Tethyan warm-water influences from the south led to carbonate sedimentation, whereas cold-water influxes from the north controlled siliciclastic sedimentation in the north-western parts of Germany and the Netherlands. Restricted sea-floor circulation and organic matter preservation are considered to be the consequence of an oceanic anoxic event. In contrast, non-marine conditions led to sedimentation of coarser grained sediments under progressively terrestrial conditions in northeastern Germany
The present-day distribution of Posidonia Shale in northern Germany is restricted to the centres of rift basins that formed in the Late Jurassic (e.g., Lower Saxony Basin and Dogger Troughs like the West and East Holstein Troughs) as a result of erosion on the basin margins and bounding highs.
The source rock characteristics are in part dependent on grain size as the Posidonia Shale in eastern Germany is referred to as a mixed to non-source rock facies. In the study area, the TOC content and the organic matter quality vary vertically and laterally, likely as a consequence of a rising sea level during the Toarcian. Here we present and compare data of whole Posidonia Shale sections, investigating these variations and highlighting the variability of Posidonia Shale depositional system.
During all phases of burial, gas was generated in the Posidonia Shale. Low sedimentation rates led to diffusion of early diagenetically formed biogenic methane. Isochronously formed diagenetic carbonates tightened the matrix and increased brittleness. Thermogenic gas generation occurred in wide areas of Lower Saxony as well as in Schleswig Holstein. Biogenic methane gas can still be formed today in Posidonia Shale at shallow depth in areas which were covered by Pleistocene glaciers.
Submicrometric interparticle pores predominate in immature samples. At thermal maturities beyond the oil window, intra-mineral and intra-organic pores develop. In such overmature samples, nanopores occur within pyro-bitumen masses. Important for gas storage and transport, they likely result from exsolution of gaseous hydrocarbon.

References

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