

Organic geochemical and petrological investigations on Jurassic, Cretaceous and Eocene organic-matter rich sediments from Morocco

¹V.F. Sachse, R. Littke, ²H. Jabour, ³O. Kluth, T. Schümann

¹Institute of Geology and Geochemistry of Petroleum and Coal, RWTH Aachen University, Lochnerstr. 4-20, 52056 Aachen; sachse@lek.rwth-aachen.de

² ONHYM, Rabat, Morocco

³ RWE Dea AG, Hamburg, Germany

Organic geochemical and petrological data has been compiled for the Tarfaya Basin, southern Morocco and for a Pliensbachian (Lower Jurassic) source rock from the Middle Atlas, due to missing Jurassic outcrops in the Tarfaya Basin. In order to obtain more information about their source rock potential, outcrop samples covering a large area (locations in Tarfaya Basin; locality Ait Moussa, Middle Atlas) were collected. A newly drilled well, Tarfaya Sondage No.2, provided further sample material of Santonian, Coniacian and Late Turonian sediments. Total organic and inorganic carbon contents as well as total sulphur measurements, Rock-Eval pyrolysis, vitrinite reflectance measurements and organic-geochemical analyses (GC/GC-MS) were carried out for these samples in order to determine thermal maturity, hydrocarbon generation potential, and the depositional environment of these rocks.

High C_{org} contents were measured for Eocene sediments in the southern part of the Tarfaya Basin (up to 7 %). Santonian, Coniacian and Campanian C_{org} values range between 1 and 13 % with increasing values towards the recent coast line. Similar C_{org} values were also measured for the Pliensbachian sample set (5 %). Cenomanian/Turonian black shales revealed values up to 18 %. It is remarkable that Late Cretaceous sediments sampled close to the recent coast represent type I kerogen, whereas samples from the hinterland show a more dominant contribution of kerogen types II and III. Kerogen type I was also characteristic for the Eocene, and Cenomanian samples, whereas Pliensbachian contains a mixture of kerogen types I and II. All of these sediments were deposited under marine, oxygen-depleted bottom waters, with favourable conditions for preservations of the organic matter (algae/phytoplankton). Eocene sediments revealed a higher influence of terrestrial organic matter mixed to the plankton-derived material. Thermal maturity of all samples from the Tarfaya Basin is low. Despite their immature range, especially the samples of the Late Cretaceous can be regarded as unconventional petroleum source due to their thickness, quality and quality of organic matter. In contrast to the immature sediments of Tarfaya Basin, the Pliensbachian sediments can be regarded as effective petroleum source. Oil seeping to the surface was observed. Thermal maturity data and bulk kinetic parameters, included into a numerical 1D model (PetroMod) provided information on timing and of petroleum generation within this unit. A burial depth of 2.5 to 2.8 km for the Pliensbachian is likely, leading to two phases of petroleum expulsion in the Late Jurassic and Late Eocene. Taking into account the hydrocarbon potential of this Lower Jurassic unit and adopting the bulk kinetic parameters, a similar Jurassic source rock is regarded as possible source for the oil shows in well Cap Juby in the offshore area of the Tarfaya Basin.