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lower oligocene organic-rich sediments in the alpine foreland basin (upper austria): a model for syn- and postdepositional source rock features in the paratethys

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Lower Oligocene organic-rich sediments in the Alpine Foreland Basin (Upper Austria): a model for syn- and postdepositional source rock features in the Paratethys

Oligocene rocks are one of the most important sources of hydrocarbons within the Paratethyan realm. In the Alpine Foreland Basin (Central Paratethys) the main Oligocene source rock is the Schöneck Fm. The sediments of the Schöneck Fm.are characterized by lateral continuity, but exhibit vertical variability. The latter reflects major palaeoceanographic changes in the Central Paratethys like the closure of seaways, basinwide changes of salinity and of redox conditions. The upper shaly part of the Schöneck Formation has the highest source potential (>5% TOC, initial HI: 500-600 mgHC/gTOC) and reaches its maximum thickness (c. 5 m) in a narrow belt parallel to the palaeo-shoreline. The present-day distribution of Lower Oligocene rocks is controlled by submarine erosion which affected the northern passive slope of the foreland basin. Erosion climaxed during the late Early Oligocene. The eroded material was re-deposited along the lower basin slope (Oberhofen Facies). The source rock potential of the re-deposited sediments is relatively low. The oil kitchen (4-7 km burial depth) is located beneath the Alpine nappes where the Lower Oligocene succession was locally removed by the advancing nappes. Both submarine erosion at the northern basin slope and tectonic erosion beneath the Alps have to be considered in the evaluation of the prospectivity of the basin.

The original factors controlling the source rock formation are result of the paleoceanographic development. As a result, sediments of the incipient Paratethys during the early Oligocene in the Upper Austrian sector resemble those of the Holocene Black Sea since 7500 yr bp: organic matter-rich black shales (Schöneck Fm.) are overlain by coccolith-bearing marlstones (Dynow Marlstone). Framboid pyrite size, biomarker and C-N-isotope data additionally indicate that isolation of the Paratethys resulted in Black Sea-type characteristics during nannoplankton zone NP 23. In contrast to the estuarine circulation across the Bosphorus since 7500 yr bp, marine conditions prevailed in the incipient Paratethys during NP 21/22. Nitrogen was fixed and low organic carbon accumulation rates prevailed. In both settings a vertical density water-column stratification was accompanied by photic zone anoxia, and by anaerobic methane oxidation in the Paratethys. In the Paratethys increased run off, starting in NP 22, led to estuarine circulation during NP 23. During this period cyclic blooms of calcareous nannoplankton resulted in high calcite accumulation rates which diluted the coeval clay sedimentation. Similar sedimentary features in the young Black Sea and the Paratethys during the earliest Oligocene are result from opposite paleoceanographic developments, both leading to estuarine circulation patterns. In the Black Sea, permanent photic zone anoxic conditions were established 7500 yr bp in response to the first invasion of saline Mediterranean waters into the former freshwater lake. In contrast, brackish surface water in the Paratethys resulted from nutrient-rich freshwater diluting the marine water body.