

OIL FROM PLANTS IN CHINA? -RESINOUS ORGANIC MATTER IN THE LOWER CRETACEOUS OF THE LAOHEISHAN BASIN

A. Bechtel¹, Y. Song², D. Gross¹, Z. Liu², R.F. Sachsenhofer¹, Q. Meng²

¹ Montanuniversitaet Leoben, Austria, ² Jilin University, China

Coal and organic matter (OM)-rich shales are often associated in fault-controlled sedimentary basins. Sometimes these OM-rich rocks have an oil yield exceeding 3.5 wt%, which classifies them as oil shale according to Chinese definitions, irrespective of the organic matter type. Oil shales in northeastern China have been deposited during Early Cretaceous and Eocene times. Eocene oil shales (e.g. Fushun, Huadian basins) are very rich in algal material. The Laoheishan Basin located in northeastern China is filled with non-marine coal- and “oil shale” bearing sediments of the Lower Cretaceous Muling Formation. Based on petrological, mineralogical and geochemical methods, the depositional environment and organic matter sources are investigated for the first time.

The coal is subbituminous in rank. Petrological and bulk geochemical data indicate sapropelic coal, deposited in low-lying mire under freshwater conditions. High pristane/phytane ratios provide evidence for a land plant origin of OM and oxic conditions during deposition. A neutral to slightly alkaline pH is reflected by the presence of carbonate. High liptinite contents and terpenoid biomarker composition indicate high amounts of resinous OM.

During “oil shale” deposition, a raised water table was favorable for OM preservation under oxic to dysoxic conditions. The “oil shales” are characterized by high hydrogen index values and resinite contents interpreted to reflect deposition at elevated water depths. In contrast to the findings of previous studies on “oil shales” in northeastern China, indicating its origin from algal OM, a predominance of terrigenous OM, rich in waxy and resinous lipids, is implied from biomarker and maceral composition.

From the sesquiterpenoids, diterpenoids and ferenes identified in all samples, a dominant contribution of Pinaceae, Cupressaceae/Taxodiaceae and ferns to OM accumulation can be concluded. The floral assemblage during coal formation can be characterized by slightly higher abundances of ferns, Araucariceae, and Podocarpaceae. The interpretation is supported by the results of recent palynological studies.

The Lower Cretaceous “oil shale” and coal in the Laoheishan basin contain high amounts of land plant derived terpenoid biomarkers, derived from coniferales and ferns. High hydrogen index values and oil yields are mainly due to terrestrial liptinite and resinous OM indicated by high contents of sesquiterpenoids and diterpenoids. The data highlight the potential of resinous and waxy OM to form excellent hydrocarbon source rocks, as already testified by the established relation of South East Asian and Australian crude oils and coaly sediments rich in dammar resins of the family Dipterocarpaceae, a tropical hardwood.