

On the potential strata of oil shale in northeastern China

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In order to identify new stratigraphic units and areas for exploration, this work focuses on the potential strata of the early Jurassic, based on geological survey and related data. Stratigraphic, paleoenvironmental, and geochemical characteristics of the early Jurassic strata were investigated, based on profiles, geologic mapping, and geochemical analysis of samples. Audio frequency magnetotelluric sounding (AMT) survey was used to study the basin and the source rocks. Geochemical and thermal maturity analyses included Leco Total Organic Carbon (TOC), Rock-Eval Pyrolysis, vitrinite reflectance, and bitumen content (determined by a Soxhlet extraction using chloroform). Oil yield potential for the shale was determined using a low temperature retorting method. There are around eleven basins of early Jurassic age distributed throughout NE China. The areas covered by these basins range from 50 to 500,000 km². Statistical data on spores and pollen collected in the basins indicate that the paleoclimate was humid; typical distributions were 51.7% Hygrophyte, 26.73% Mesophyte, 16.44% Helophyte, 4.5% Xerophyte, and 0.63% Hydrophyte. The vegetation was dominated by needle and broad-leaved forest grassland, which consisted of coniferous (49.95%), herbaceous (28.59%), broad-leaved evergreen (16.85%), shrub (4.09%) and deciduous broadleaved (0.52%) plants. The total thickness of the source rocks of the early Jurassic strata was 102 m; the thickest monolayer was 13.78 m thick. AMT profile data suggested that the depth in the inner basin varies from about 500 to 3500 m. Representative geochemical data for the core samples are as follows: TOC 1.09 - 45.87% (average 9.79%); Hydrocarbon generation potential 0.84 to 42.96 mg/g (average 9.875 mg/g); Chloroform-extracted bitumen 0.03 to 0.83% (average 0.264%); and total hydrocarbon 2.7 to 150.6 µg/g (average 62.61 µg/g). Vitrinite reflectance values ranged from 0.94% to 1.17% (average ~1.01%). The oil yield of the shale varied from 0.76% to 8.01% (average 3.337%). The climate of the early Jurassic in NE China was humid and temperate to subtropical, and the sedimentation was gentle and stable. The ideal oil shale source rocks occurred in the early Jurassic basins and were covered by thick volcanic-sedimentary rocks. This discovery will provide new strata and areas for oil shale exploration in NE China.