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Abstract of PhD dissertation

„Geochemical characteristic of palaeoenvironment and reconstruction of thermal maturity processes development of Middle Jurassic organic matter in Szczecin-Miechów Synclinorium and Mid-Polish Anticlinorium”

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Jurassic rocks rich in organic matter from the North Sea region are source rocks for hydrocarbon deposits on the North Sea shelf. Equivalent sediments, rich in organic matter are also found in the Polish basin. The growing interest in unconventional hydrocarbon deposits, encourages better recognition of the Mesozoic oil system in the Polish basin.

The aim of this dissertation is to characterize source rock potential with the definition of organic carbon content, the genetic type of organic matter, definition the environment of its deposition and the degree of kerogene transformation. These characteristics were made for the Middle Jurassic strata in the Szczecin-Miechów synclorium, in its Mogilno-Łódź segment and the Mid-Polish anti-clinorium, in the Kuyavian Segment. The results of the geochemical characteristic of organic matter in the study area, allowed for one-dimensional numerical modeling (1-D). The modeling results have made it possible to clarify the history of the development of organic matter maturity and to place its individual maturity phases in time and to determine the amount of hydrocarbons present in the Middle Jurassic levels.

The Middle Jurassic deposits in the analyzed area showed good quantitative properties of organic carbon. Despite the high content of organic carbon, the hydrocarbon potential of Middle Jurassic strata is weak. The weak hydrocarbon potential is effect of the predominance of type III and IV kerogene. In addition, an admixture of type IV inert organic matter was noticed. This type of organic matter was created in wildfires, and its presence in the sediments of the Polish basin is proof of the land transport of wildfire products. Charred organic matter has a low hydrogen index, and hence a lower ability to produce hydrocarbons.

Biomarker analysis showed that conifer trees lived on the land adjacent to the Middle Jurassic Sea. Diagenesis, and sometimes biodegradation, prevented accurate identification of species and most families. It was only established that in more humid climatic periods, trees from Podocarpaceae family marked their presence more strongly. During periods of drier climate, trees from Pinaceae family probably dominated. Next to conifers, a traces of fungi and non-vascular plants were found. Traces of oleanans are also found in most of samples from Upper Bajocian and younger. This may indicate the presence of angiosperms.

The considerable amount and variety of pyrogenic polycyclic aromatic hydrocarbons suggests that vegetation was often digested by wildfires. High concentrations and distribution of pyrogenic polycyclic aromatic hydrocarbons indicate that fires were frequent and reached high temperatures reaching a maximum of over 950 ° C. In addition to high-temperature wildfires, there were also low- and medium-temperature wildfires. The high oxygen content in the atmosphere, in a dry and hot climate, led to easy maintenance of fires arising, e.g. from lightning. Organic matter burnt in wildfires was fluvially and aeolically transported to the Polish Basin.

The thermal maturity of the entire Middle Jurassic strata is at a similar level. The northern ends of the Kuyavian and Mogilno-Łódź segments generally contain immature organic matter. Organic matter in the rest of the research area is in its early-mature stage. Such a slight variation in profiles is evidence of hydrothermal solutions that have reheated organic matter.

Deposition of sediments in the studied area of the Polish basin took place in conditions of oxygen deficiency. A greater oxygen deficiency occurred in the Kuyavian segment. This was conducive to preserving more organic carbon compared to the Mogilno-Łódź segment. The smallest oxygen deficiency was in the western part of the Mogilno-Łódź segment. The redox conditions in the entire reservoir were suboxic with a tendency to increase anoxicity in the Kuyavian segment.

In the analyzed part of the Polish basin, mainly type III and IV organic matter deposited in suboxic / anoxic conditions. Within some intervals the presence of marine type II is more pronounced. Organic matter is at an insufficient level of maturity to begin the main phase of kerogen transformation. The result of it is low hydrocarbon potential and an insufficient amount of hydrocarbons which generated from Middle Jurassic rocks to generate accumulation. The Middle Jurassic strata in the study area is not prospective for the search for unconventional hydrocarbons deposits.

Key words: Middle Jurassic, geochemical characteristic, 1-D modeling, wildfires