

Paleodepositional Environment and Source Rock Potential of the Upper Cretaceous Succession, North Western Desert, Egypt: A Comprehensive Geochemical and Palynological Study

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ABSTRACT

The Abu Gharadig Basin in the north Western Desert is one of the major producing petroleum basins in Egypt. The study aims to investigate the depositional environments and source rock potential of Cenomanian to Santonian sediments of Bahariya and Abu Roash formations from the GPT-3 well. The samples were analyzed for organic and inorganic carbon, sulfur and major element contents and Rock-Eval 6 parameter. Selected samples were extracted and analyzed by Gas Chromatography-Mass Spectrometry. Moreover, some samples were analyzed by Curie-point-pyrolysis-Gas-chromatography mass-spectrometry as well as organic petrological and palynological methods. The data suggest that the Bahariya and Abu Roash formations excluding the Abu Roash "F" Member were deposited in variable oxic shelf environments with poor TOC and hydrogen index values and high Pr/Ph indicating poor organic matter richness and preservation. On the other hand, an excellent richness and preservation is found in the Abu Roash "F" Member represented by two organofacies separated by an organic-poor interval. The lower part of this member has high TOC of greater than 6%, high HI up to 700 mgHC/gRock and liptinite dominated organic matter. It is depleted in iron which led to sulfur incorporation into organic matter and consequently reflects high thiophene/benzene ratios. This indicates anoxic, carbonate-rich depositional conditions and oil prone source rocks with kerogen type-II. The upper part of the Abu Roash "F" Member has TOC and HI values lower than 4 % and 600 mgHC/gTOC, respectively. It is characterized by a fair abundance of palynomorphs, phytoclasts and terrestrial elements. This TOC-Fe-S relationship indicates that the majority of the sulfur was consumed to form pyrite during early diagenesis and inhibits kerogen sulfurization. The previous discussion suggests suboxic conditions and oil prone source rocks with kerogen type-II. Sea level fluctuations which affected the oxygen contents and terrestrial contribution are the main causes of the source rock heterogeneity found in the Abu Roash "F" Member. The source rock section demonstrates lower thermal maturity compared to the above and below intervals as suggested by microscopic, pyrolysis and biomarker data. This denotes retardation/suppression of thermal maturity as a result of high sulphur contents affecting early diagenesis. Two reservoir compartments are found in the Abu Roash "D" and "C" members as indicated by molecular geochemical data.