

Source rock potential and organic matter characterization of the Messinian evaporitic sequence on Zakynthos Island, Ionian Sea

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In this study, we investigate the hydrocarbon potential as well as the type and thermal maturity of the organic matter in the evaporitic sequence of Kalamaki and Agios Sostis sections (Zakynthos Island, Greece). Detailed sampling of the two sections was followed by analyses for the total organic carbon (TOC) content and the petroleum potential. In Kalamaki, the TOC values range is 0.03-1.31 wt%, 0.15-1.31 wt% in the pre-evaporitic sediments and 0.03-0.95 wt% in the evaporitic sequence, partially indicating fair to good hydrocarbon potential. Overall, our samples are classified principally as non-source rocks. The total of free and pyrolizable hydrocarbons range from 0.03 to 3.41 mg HC/g rock, corresponding to little or no source rock potential. The hydrocarbon index (HI)-TOC cross-plot suggests that the studied samples represent diverse source types ranging from gas-prone to oil-prone. This plot reveals that the most promising rock units are in the evaporitic sequence of Kalamaki. Nevertheless, the HI values of the samples range from 12.46 to 271.14 mg HC/g TOC, whereas the ratio of pyrolizable to free hydrocarbons ranges from 0.02 to 9.12. Therefore, the type of organic material in the studied sediments is classified as gas prone, with the exception of one sample that is classified as gas and oil prone. Based on the HI-oxygen index (OI) plot, most of the samples are type III kerogen derived from terrestrial plant debris deposited in oxidized environments capable of producing gas. A few samples only from the evaporitic sequence are type II (oil prone), and a few from the pre- and the evaporitic sequence are type IV. The cross-plot of free hydrocarbons against TOC indicates indigenous hydrocarbon production for all sediments. Furthermore, based on the production index (PI) and Tmax values, most samples from Kalamaki are immature. However, several samples from the evaporitic sequence have reached the mature oil stage. In addition, these organic-rich evaporitic horizons may be mature in the offshore Ionian areas, where the overburden sediments are very thick. Therefore, they are potential source rock formations. Considering that the main source rock formations of the Preapulian zone are Tortonian sediments (type III, gas prone organic matter), which are also covered by sediments of greater thickness in the offshore areas, the produced hydrocarbons may be trapped below the Messinian evaporitic unit cap rock.