

**Paleoenvironmental conditions and hydrocarbon potential assessment on the Late Miocene evaporitic sediments of Zakynthos Island (Greece)**

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In the present study, we investigate the stable oxygen ( $\delta^{18}O$ ) and carbon ( $\delta^{13}C$ ) isotope ratios, the total organic carbon (TOC) content, and the petroleum potential of the pre-evaporitic and evaporitic Messinian deposits (6.46–5.33 Ma) from continuous sections on Zakynthos Island, Greece. The pre-evaporitic sequence mainly consists of alternating massive and laminated marls with rare calcareous marl and calcarenite intercalations. It is conformably followed by the gypsum unit. Particularly, the study is focused on Kalamaki and Agios Sostis sections (Kontakiotis et al., 2016; Karakitsios et al., 2017; Vasiliev et al., 2019; Fig. 1).

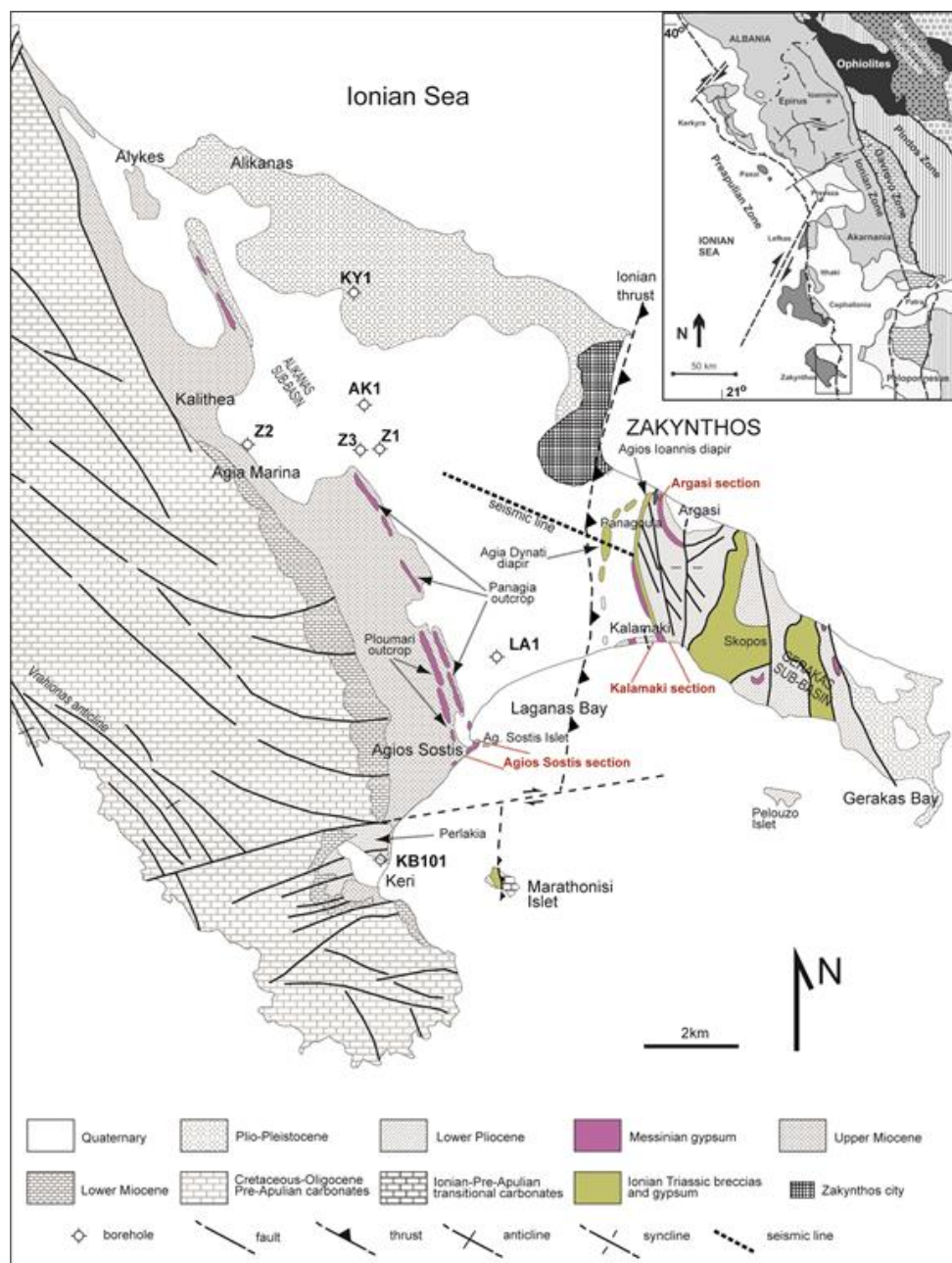


Figure 1 Geological map of Zakynthos Island (Karakitsios et al., 2017). The regional location is indicated in the inset map. Z1, Z2, Z3, LA1, KB101, AK1, KY1 correspond to boreholes.

In Kalamaki section, the gypsum unit corresponds to Primary Lower Gypsum (PLG) deposits, consisting of a 108-m thick succession with eight gypsum-marl cycles and different gypsum facies (Karakitsios et al., 2017). In Agios Sostis section the gypsum unit is more than 16 m thick, consisting of several alternations of primary and clastic gypsum which derived from the re-sedimentation of older PLG deposits (Karakitsios et al., 2017). The isotopic bulk values are greatly variable: in Kalamaki section, -3.75 to +8.8‰ for  $\delta^{18}\text{O}$ , and -9.42 to -0.93‰ for  $\delta^{13}\text{C}$ , whereas in Agios Sostis section, -3.54 to -0.31‰ for  $\delta^{18}\text{O}$  and -7.74 to +0.08‰ for  $\delta^{13}\text{C}$  respectively. Isotope values of the Agios Sostis section clearly show a marine environment, whereas in Kalamaki, the relevant values imply influence of continental fresh water in an environment of highly evaporated solutions. The origin of continental water is also confirmed by the organic matter type (type III kerogen) and the presence of plant remains (leaves) in the samples. Total organic carbon (TOC) values in Kalamaki section range from 0.15 to 1.31 wt% in the pre-evaporitic sequence, and from 0.07 to 0.95 wt% in the shale layers of the Primary Lower Gypsum, whereas in the post-evaporitic from 0.03 to 0.3 wt%. In terms of petroleum potential, many of the samples are immature, whereas some of them correspond to the mature oil stage. Nevertheless, the pre-evaporitic and evaporitic sequence present a fair to good hydrocarbon-generating potential. Although the onshore source rocks are partially immature due to insufficient thickness of the overburden sediments that does not preclude the possibility that the same source rocks are mature for oil generation in the offshore area (between Zakynthos and Peloponnesus) where they are covered by more than 3 km of Pliocene-Pleistocene sediments.

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