

Calcareous nannofossil assemblages and geochemical analysis of Eocene Oil Shales from Wadi Ashajara, Northern Jordan, and their implications for depositional environment

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Eocene oil shale deposits have a special concern among organic-rich deposits in Jordan due to its precipitation in the last stage of Neo-Tethys closure. Twenty-one oil shale samples from Wadi Ashajara section were analyzed for calcareous nannofossil biostratigraphy and paleoecology, isotopic components, and inorganic geochemistry. Using those proxies offer some important insights into the depositional environment of the organic rich sedimentation during the Eocene time. Based on the first occurrences of the marker calcareous nannofossil species: *Discoaster subloensis*, *Nannotetrina quadrata*, and *Discoaster bifax*; Ashajara section was assigned to the Middle Eocene age. Ecological points of view, many genera have been thrived in the Middle Eocene during the Middle Eocene Climate Optimum event. The significant increase in numbers of the *Reticulofenestra* spp. and *Coccolithus* spp. during the calcareous biozone NP 16 is revealing a period of eutrophic environment dominated the ocean in the Middle Eocene. This clear shift in the ecological strategy correlated to periods of nutrient supply (Fe, P, Al, and Si) suggesting that climate has played a major role in enrichment of the primary producers and therefore precipitation of organic-rich environment in north of Jordan. Ecological shifts of calcareous nannofossils were associated also with shifts in oxygen, carbon, uranium and potassium isotopes. The presence of the Redox Sensitive Elements (Fe, Ni, and Cr) suggests that oil shale in study area was deposited generally under anoxic environment. Whereas in some parts of oil shale, the strong euxinic affinities elements (Mo, Zn and V) tend to exhibit the strongest enrichment which in turn indicating deposition of oil shales under euxinic to sub-euxinic environment.