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Anomalous enrichment of redox-sensitive trace elements in the marine black shales from the Duwi Formation, Egypt: Evidence for the late Cretaceous Tethys anoxia

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Abstract

Marine black shale beds in the Duwi Formation of NE Egypt are part of the Late Cretaceous-Palaeogene Middle East to North African phosphogenic province. These black shales were analyzed for their redox-sensitive trace elements (V, Ni, Mo, U, Cu, Cr, Re, Cd, Sb, Tl, and Mn) to examine their depositional conditions. The data shows that the black shales have elevated concentrations of redox-sensitive trace metals, low Mn contents, low Th/U and V/Mo ratios, and high V/Ni, Ni/Co, V/(V+Ni) and V/(V+Cr) ratios as well as a positive correlation of metal Mo to V in concentrations. These geochemical data suggest that the Campanian-Maastrichtian Tethys was stratified and stagnant, with reducing bottom water conditions. The high V/Ni ratios in the studied shales indicate their dominantly marine origin and suggest that the high-productivity upwelling regime that persisted over ~20 m.y. at the southern margins of the Tethys Ocean is the main source of the organic matter. A combination of elevated primary productivity, remineralization and reducing depositional conditions is the main control of enrichment of redox-sensitive trace elements in the black shales of the Duwi Formation.

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