Palaeoclimatic reconstruction of Maastrichtian oil shale deposition in the southern Tethyan realm, Egypt

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Sedimentary records of climatic conditions and sea-level rise during the Late Cretaceous across the northeast African craton were examined based on integrated elemental geochemistry, clay mineralogy and biostratigraphy of three Maastrichtian oil shale (MOS) horizons from Egypt. The age of these horizons is constrained by nannofossil biostratigraphy. The Cretaceous oil shale beds accumulated in intracratonic sedimentary basins on the stable African shelf and occupied large-scale asymmetric syncline systems in the southern Eastern Desert of Egypt. These basins were formed due to deformation, structural differentiation and subsidence of the rigid cratonic African plate. The evolution of these basins was mainly controlled by a system of NW-trending faults. The Maastrichtian oil shales have slightly elevated Ga/Rb ratios (~ 0.4) that progressively increase upwards in the upper horizon (~ 0.8). Moreover, the average ratios of Rb/Sr are generally low (~ 0.03). The calculated C-value of the lower MOS horizons ranges from 0.05 to 0.79 and fluctuates between 0.07 and 0.16 in the upper MOS horizon. In addition, the average CIW and CIA values of the studied MOS samples are 87 % and 83 %, respectively. The MOS samples are specifically enriched in Sr and P and depleted in Mn. The studied intervals of MOS are characterized by the occurrence of warm water nannofossil taxa such as Lithraphidites quadratus and Micula sp. Mineralogical data proves the abundance of smectite within the lower MOS horizons and the prevalence of kaolinite in the upper MOS horizon. The MOS horizons are distinguished by a northward increasing carbonate/siliciclastic ratio (from 0.43 to 1.43) and an upwards increase in the upper horizon (up to 1.98). The occurrence of MOS beds is mainly assigned to a major Late Cretaceous transgression of the Tethyan Ocean. This marine transgression resulted in continuous deposition of clastics from the exposed Arabian-Nubian Shield basement rocks. We suggest that the deposition of MOS in the Eastern Desert of Egypt exemplifies warm greenhouse climate during a general cooling trend, with a transition from a cooler, seasonal fluctuating phase during the early Maastrichtian, to a warmer period at the early to late Maastrichtian transition, accompanied by a regional sea-level rise.