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Ecological and Post-Depositional Changes across the Cretaceous-Palaeocene succession Inferred from Molecular Fossils in Black Shales, Egypt

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Abstract:

The upper Cretaceous-lower Palaeocene black shales of Egypt are part of a giant worldwide belt of organic-rich shales. Black shales are particularly developed in North Africa and the Middle East. In Egypt, these shales are hosted mainly in the Duwi and Dakhla formations in ascending order. Studying the bulk organic geochemical characteristics, molecular source-specific biomarkers and the isotopic composition of organic-rich sediments of central Egypt, we estimate the structure of the water column and the post-depositional changes. The study was conducted on core samples collected from two shallow bore holes in Western (OSN-1) and Eastern (OSR-1) Deserts of Egypt. High quantities of desmethyl steranes with relative preponderance of rearranged steranes (diasterenes) in OSN-1 samples suggest that marine algae were the main primary producers. The presence of different isomers of hopanes (C_{27}, C_{29}-C_{31}) and hopanoic acids (C_{31}-C_{33}), in addition to aryl isoprenoids (including isorenieratane) reveal the contributions from bacteria and green sulfur bacteria, respectively. The observed variable abundance of biomarkers corresponds to changes in planktonic assemblages associated with sea level change and episodic Photic Zone Anoxia (PZA) in particular, which is indicated by the occurrence of aryl isoprenoids in some strata. The dominance of 17β (H), 21β (H) hopanes and hopanoic acids over 17α (H), 21β (H) homologues indicates the immaturity of the preserved organic material. The preponderance of diasterenes over the regular steranes in section OSN-1 indicates enhanced clay catalysis rather than increased thermal maturity. Negative carbon isotope excursions of -1 to -1.3‰ and -2‰ for OSN-1 and OSR-1, respectively, along with high organic carbon content are detected at the Duwi-Dakhla transition. The causes of these excursions are not yet understood.

Keywords: Molecular fossils, isotope, Cretaceous-Palaeocene, black shales, Egypt.