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Early Silurian "Hot Shales" in the Ghadamis Basin, North Africa: palynological and geochemical characterization, and depositional model

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Lower Silurian organic rich shales occur extensively across North Africa and the Middle East, where they constitute the major source rock of the Palaeozoic-sourced hydrocarbons. For their exceptionally high organic content as well as for their typical enrichment in natural radioactive elements (Uranium), the early Silurian shales are well characterized in well logs ("hot shale" spikes in gamma-ray logs), and have been often used as reference horizons for correlation purposes. However, it is now well known that the biostratigraphic age of the "hot shales" can vary considerably along a basin centre to margin transect. Another controversial aspect of the "hot shales" is their origin in the context of climatic changes and sequence stratigraphic development (e.g., Armstong et al., 2005; Luning et al., 2006).

In the present study, we characterized palynologically and geochemically typical "hot shale" horizons in the Ghadamis Basin of northeastern Libya and southern Tunisia. This permitted to map accurately the spatial and temporal distribution of the organic-rich deposits across the basin and to better understand the processes which are responsible for the extreme accumulation and preservation of organic matter in specific stratigraphic intervals.

Causative links between onset of black shale sedimentation, fluctuations in biodiversity of marine microphytoplankton, changes in oceanic productivity, development of anoxia, and organic carbon isotopic excursions have been evidenced. Our data demonstrate that an extended period of black shale deposition occurred regionally over the

entire Ghadamis Basin from Rhuddanian to early Wenlock times, progressively transgressing from basin centre to basin margin. The palynofacies and organic geochemical evidence strongly support an origin by coastal upwelling-promoted productivity increase. A progressive landward shift in location of coastal upwelling following a long-term (second order?) transgression might explain the observed pattern of black shale deposition and is also well in accordance with a previous model of early Silurian black shale deposition on the North African platform, previously proposed by Lüning et al. (2000).

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