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PALEOREDOX CONDITIONS, PALEOPRODUCTIVITY, AND DEPOSITIONAL ENVIRONMENT OF AN EOCENE BLACK SHALE: MAHOGANY ZONE, GREEN RIVER FORMATION, EASTERN UINTA BASIN, UTAH

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Abstract:

Black Shales are commonly assumed to record anoxic, productive paleoenvironments. The Mahogany zone of the Green River Formation is a world class example of a black shale. It is thought to record a period of high lake level conditions in which algal productivity combined with prolonged anoxia resulted in the preservation of this highly prolific source rock. This research tests the classic anoxic, black shale model, using the Mahogany zone as a case study. The stratigraphic variability of paleoredox conditions, paleoproductivity and mud depositional processes through the Mahogany zone are further investigated using a newly drilled core (PR-15-7C) from the eastern Uinta Basin. High-resolution stratigraphic (5 mm spacing) handheld X-ray fluorescence analysis has been performed on the Mahogany zone (~12.8 m thick) of the core, which provides inorganic major and trace element abundance data. This was combined with quantitative red-green-blue (RGB) analysis of optical core photographs, which provides a proxy for organic richness at high stratigraphic resolution (up to a few hundred microns). Visual core description and standard thin section analysis of mudstone samples were used to determine different sedimentary processes of mud deposition (i.e. suspension settling versus hydrodynamic currents) in the lake system recorded by the Mahogany zone. Paleoproductivity proxies, specifically Ni and Cu content, are positively correlated with Total Organic Carbon (TOC), but are both below the published average marine shale values, suggesting further investigation is needed to accurately apply these proxies to lacustrine systems. Therefore, we interpret TOC as a more reliable indicator of paleoproductivity in this system. Paleoredox proxies, specifically U and Mo content, are in agreement with published average marine shale values. Elevated levels of U and Mo indicate anoxic to euxinic conditions, with Mo displaying periods of euxinia in addition to baseline anoxia. Mo displays stratigraphic cyclicity, with average cycle lengths of about 16 kyr, based on bounding Ar-Ar dates from tuffs and an assumed linear sedimentation rate. This research suggests that the Mahogany zone records anoxic, highly productive conditions, in line with classical interpretations of anoxic black shale successions. The periodic prevalence of euxinic conditions is a new finding and warrants further consideration of the preservation mechanisms in paleolacustrine systems.