Paleozoic Black Shale Deposition: A Lithological, Stratigraphical, and Geochemical Analysis of the Upper Devonian Kettle Point Formation in Southwestern Ontario

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Abstract

Despite the recent interest in black shales as alternative hydrocarbon reservoirs, the ancient depoformational environments of these rocks remain enigmatic because of a general lack of modern analogs. This study aims to help elucidate the mechanisms behind the deposition of black shales by using the Upper Devonian Kettle Point Formation as a case study. Detailed core and thin section analyses divulged that the Kettle Point Formation could be subdivided into three lithofacies: interlaminated black shales interbedded with greyish green mudstones and separated by thick intervals of non-interlaminated black shales. Subsurface correlation of the Kettle Point, using gamma ray logs, has revealed thickness variations of these lithofacies that suggest the influence of local tectonic features on their depositional patterns. Major variations in lithology within the succession are attributed to changes in the intensity and vertical extent of anoxia in the marine water column that culminated in the deposition of the thick packages of non-interlaminated black shales during the acme of anoxia. Interbedded interlaminated black shales and greyish green mudstones record lower intensities of oxygen deficiency overall, but fluctuating at a finer level between anoxic and dysoxic conditions respectively. Geochemical analysis based on sulphur isotopes is currently being conducted to further resolve the redox conditions of the paleo-basin. Integration of the lithological, stratigraphical, and geochemical data will result in the determination of the depositional environment of the Kettle Point Formation. This information can then be extrapolated and applied to other syndepositional black shales, contributing to the understanding of possible black shale depositional environments and aiding in the interpretation of ancient global climate change patterns.