

The palaeoenvironmental significance of the lower Toarcian Lower Sulphur Band, Cleveland Basin, UK

Connor O'Keeffe^{1*}, Crispin T.S. Little¹, Christian März¹, Fiona Gill¹,

Christopher Vane², Simon Poulton¹

¹ School of Earth and Environment, University of Leeds, UK

² British Geological Survey, Keyworth, UK

In the Cleveland Basin (Yorkshire, UK) a thick unit of organic-rich, laminated black shales ('Jet Rock') occurs from the top of the Tenuicostatum Zone in the Grey Shales Member through the Exaratum Subzone of the overlying Mulgrave Shale Member. These shales were deposited under reduced oxygen (often euxinic) conditions, which excluded most benthic marine fauna. Although most of underlying Grey Shales Member was deposited under oxic conditions, there are three decimetre scale black shale units (the Sulphur Bands) in the Grey Shales that may presage later reduced oxygen events in the basin. Here, we present results from an ongoing, multiproxy, 0.5-centimetre-scale study of the earliest of these events: the Lower Sulphur Band (LSB). The LSB is lithologically heterogeneous, with bituminous, siliciclastic, cross-stratified, and intensely bioturbated fabrics represented. A sequential Fe extraction revealed that the LSB was highly enriched in reactive Fe species, and that pyrite formation was sulphur-limited. A bulk HF digest showed that the LSB was associated with Mn enrichment. This implies that Mn cycling took place along the chemocline of a stratified water column, in a basin subject to a rapid transgression during the lower Toarcian. Episodic enrichments in K/Rb, and the presence of two distinct sources of organic matter (Rock-Eval pyrolysis) suggest that episodes of enhanced fluvial flux from surrounding emergent areas also took place during the deposition of the LSB. Our results demonstrate a strong association between black shale deposition within the Cleveland Basin, and the development of highly ferruginous conditions. The biogeochemistry of the basin is also shown to be dependent on sea level and fluvial flux changes. This study highlights that temporally brief episodes of black shale deposition were sensitive to a wide range of palaeoenvironmental processes, and better constrains the impact of transient anoxia on benthic invertebrate communities (bioturbation).

Mots-Clés : Toarcian, Cleveland Basin, Redox, Lower Sulphur Band, Ferruginous, Mn Enrichment

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Intervenant