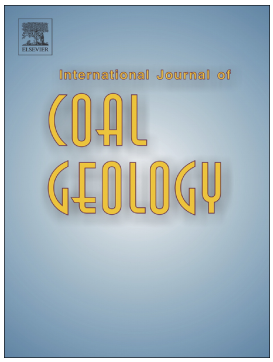

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Redox conditions associated with organic carbon accumulation in the Late Devonian New Albany Shale, west-central Kentucky, Illinois Basin

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ABSTRACT

Factors affecting organic carbon accumulation in marine basins may include surface water productivity, enhanced preservation due to bottom-water anoxia, protection by and adsorption onto clays, and variations in sediment supply. In this study, geochemical proxies for the New Albany Shale of the Illinois Basin were examined for ten cores from the outcrop belt in west-central Kentucky in an attempt to evaluate redox conditions associated with organic carbon enrichment. In these cores, the Late Devonian New Albany Shale is represented by the Clegg Creek, Camp Run, Morgan Trail, and the Blocher members. Specifically, C-S relationships, degree of pyritization (DOP_T), and C-S-Fe relationships along with redox sensitive trace elements (e.g., V and Mo) and ratios (Ni/Co, V/Cr, and V/(V+Ni)) were used to assess redox conditions. In addition, organic carbon to total phosphorus ratios (C_{org}/P_{tot}) were used to assess levels of paleoproductivity that were possibly enhanced by the productivity-anoxia-feedback mechanism.

Results suggest variable bottom-water conditions existed during accumulation of the New Albany Shale of west-central Kentucky, including predominantly anoxic conditions for the Clegg Creek Member, dysoxic conditions for the Camp Run and Morgan Trail members, and dysoxic to oxic conditions for the Blocher Member. However, throughout deposition, all members exhibited some variability in redox conditions. Thus, overall, lowest oxygen levels were likely experienced during deposition of the Clegg Creek, followed by the Camp Run and Morgan Trail members. The Blocher Member was probably deposited under conditions closer to normal marine, yet still dysoxic at most times. High C/P ratios observed in these members suggest regeneration of P, enhanced productivity, and sequestration of organic carbon (as described by the productivity-anoxia feedback (PAF) mechanism) during anoxic periods.

Variations in redox indications obtained from different proxies suggest that multiple parameters should be utilized rather than relying on a single proxy. Reasonably good agreement is seen between C-S, DOP_T, C-S-Fe, and Mo levels; Ni/Co and V/Cr tend to agree well with each other, but suggest higher oxygen levels than the other proxies. Values for V/(V+Ni) tend to be an outlier, suggesting more anoxic (to euxinic) conditions compared to other proxies.

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KEY WORDS: Black shale; C-Fe-S relationships; trace elements; preservation; productivity.