Molybdenum drawdown during the Cretaceous OAE 2

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During the Cretaceous greenhouse, globally occurring events of black shale deposition were associated with widespread ocean deoxygenation. Possibly the most pronounced of these oceanic anoxic events (OAE's) was the Cenomanian-Turonian OAE2 (~94 Ma). However, although certain redox sensitive trace metals tend to be preferentially sequestered in sediments deposited under anoxic conditions, with Mo drawdown being specifically prone to euxinic settings, these elements are generally somewhat depleted in sediments deposited during OAE2. To understand the driving factors responsible for this depleted trace metal drawdown, we have studied a low latitude section from the proto-North Atlantic Ocean in high-resolution, where existing biomarker and iron-sulphur data point to a dominantly euxinic water column, with periodic transitions to ferruginous water column conditions.

We utilised a variety of redox proxies (Fe-speciation, redox sensitive trace metals and Mo isotopes), which, in combination, allows us to evaluate the detailed nature of ocean redox conditions and hence controls on trace metal drawdown. Our data suggest that very low Mo/TOC ratios at Tarfaya and elsewhere in the proto-North Atlantic may have been result of partial restriction of deep-water exchange with other ocean basins. However, the low and possibly heterogeneous δ^{98}Mo values inferred for seawater, together with low Mo/TOC ratios, point to a large decrease in the size of the oceanic Mo reservoir during OAE2 due to a major increase in Mo drawdown under euxinic conditions.

Future gas through bioconversion of stranded coals

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The biology of methanogenesis in deep subsurface environments is not well understood, and there has been only limited work on microbial processes in coal seams despite the fact that they may support a large subsurface ecosystem potentially capable of replenishing gas depleted by coal seam gas production. To carry out field scale stimulation of microbial methane production from coal, we need to determine what makes a coal favorable for microbial methane generation, which native microorganisms are essential for the stepwise conversion of coal to methane, what fraction of coal is convertible to microbial methane and whether there are chemical or physical stimulation methods that can enhance the rates of conversion. Many of these questions are best addressed in the laboratory through enrichment experiments using coal bed formation water as the source of microbes and coal as the sole substrate [1]. However, implementation of microbially enhanced coal bed methane will necessarily involve the identification of conceptual exploration targets, which requires not only understanding of the geological history of the coal basin but also the development of ancient analogue models for microbial methane generation.

In eastern Australia, the chemical and stable isotope compositions of coal seam gases and related production waters vary systematically with depth, which reflects mixing between shallow biogenic gas and deeper thermogenic gas in higher rank uplifted coals and variations in openness of the microbial system in low rank coals. In the northern Bowen Basin, methane carbon isotope compositions become less negative with depth and highest gas production occurs at intermediate levels where the gas is of mixed origins [2]. The higher gas production is a function of saturation and permeability. Individual wells in the Surat Basin also commonly show a positively parabolic trend in gas content with depth [3], which is interpreted to reflect enhanced methanogenesis linked to hydrology. Lateral variability in gas content is less well understood and requires further research.

[1] Papendick *et al*. (2011) *Int. J. Coal Geol*. **88**, 123–134. [2] Kinnon *et al*. (2010) *Int. J. Coal Geol*. **82**, 219-231. [3] Hamilton *et al*. (2012) *Int. J. Coal Geol*. **101**, 21-35.

DOI:10.1180/minmag.2013.077.5.7