

LINKING IRON OXIDE MINERALOGY AND ORGANIC MATTER PRESERVATION IN MARINE SEDIMENTS

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Recent studies have shown that the interactions between organic matter (OM) and reactive iron oxides (Fe_R) may play an important role in OM preservation in marine sediments. The association here of OM with Fe_R may occur in a number of ways, although these interactions must be largely irreversible to result in long-term OM preservation.

In these studies Fe_R is generally defined by a sediment extraction technique that reduces and solubilizes poorly crystalline, highly reactive iron oxides such as lepidocrocite and ferrihydrite, and crystalline, less reactive iron oxides such as goethite and hematite. At the same time, iron redox cycling in sediments appears to affect these two sub-groups of Fe_R in different ways, which may also have implications for understanding Fe-OM interactions and OM preservation in sediments. Specifically, iron redox cycling in sediments generally results in the initial production of highly reactive oxides such as lepidocrocite and ferrihydrite (termed here Fe_{ox1}) in surficial sediments through upward diffusion of pore water Fe^{2+} and oxidation by either nitrate or O_2 . This then suggests that Fe-OM interactions in the surface sediments should largely involve Fe_{ox1} phases.

With enough time, Fe_{ox1} phases can slowly transform into more crystalline, less reactive iron oxides such as goethite (termed here Fe_{ox2}). However in most sediments, before this transformation can occur to any significant extent sediment burial below the oxygen penetration depth results in preferential dissolution of the more highly reactive Fe_{ox1} phases relative to dissolution of the Fe_{ox2} phases. This then suggests that long-term OM preservation through Fe-OM interactions should largely involve Fe_{ox2} phases.

In this talk I will discuss this potential Fe-OM “sink switching” and its role in sediment OM preservation from two perspectives. First, from the iron “side” I will examine this problem using recent work we have done in contrasting continental margin sediments. This work involves using a sediment extraction scheme that allows us to separate these two-sub-classes of Fe_R (Fe_{ox1} and Fe_{ox2} as described above). I will also examine this problem from the OM side using recent FTICR-MS studies examining the chemical characteristics of pore water DOM.