Molybdenum sequestration in saltmarsh sediments: Role of sulfate reduction, reactive iron and vegetation

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Molybdenum (Mo) is considered an effective proxy for palaeo-redox status of ancient marine deposition as it is systematically enriched compared to other redox-sensitive sulfide forming elements. However, such a proxy can successfully be used only if effective sequestration of the element takes place over geologic time scale. At two adjacent sites (30 m apart) in a saltmarsh in Sapelo Island, USA, Mo profiles showed starkly different characteristics. At the tidal levee site, Mo concentrations do not change with depth whereas at the Ponded Marsh site, depending on the season, a significant peak is observed between 6 and 10 cm below the sediment-water interface. It has been suggested that a switch operates above a threshold concentration of sulfide which leads to the Mo-sulfide bond formation and capture of Mo on the surface of major metal sulfide minerals such as pyrite (Helz et al., 1996). Depth-integrated sulfate reduction rates and hence sulfide production rates are higher at the Tidal Levee site compared to the Ponded Marsh site, yet Mo enrichment was relatively more at the Ponded Marsh site. At the Ponded Marsh site, the lack of reactive iron in the sediment allows accumulation of porewater sulfide in the range of 3 – 8 mM. Compared to this, at the tidal levee site, reactive iron captures any sulfide produced by the sulfate reducers. This would support Mo enrichment via the triggering mechanism suggested by Helz et al., (1996). However, at the studied site, no correlation between Mo profiles and pyrite profiles was observed. Rather, the Mo profiles follow the organic carbon profiles. Capture and retention of Mo by sulfurized organic matter has been proposed by Tribovillard et al., (2004). At Sapelo Island saltmarsh site, it is proposed that sulfide produced during sulfate reduction is responsible for sulurization of organic matter and hence retention of Mo within the organic fraction. The decline in Mo concentration with depth at the Ponded Marsh site, however, suggests that Mo trapped with the organic fraction is not stable over geologic time and is a cause of concern for application of Mo as a palaeoproxy.

References

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