Stable iron isotopes: A tool to study cycling of Fe-OC aggregates in the boreal landscape

JOHAN INGRI[1] AND SARAH CONRAD[1]

[1]Applied Geology, Luleå Univeesity of Technology, SE 97187, Luleå, Sweden (correspondence: Johan.Ingri@ltu.se/ Sarah.Conrad@ltu.se

Sediment burial of organic matter is the primary sink by which carbon is removed from the atmosphere-biogeosphere and stored over geological times, yet the mechanism of sediment carbon sequestration is still poorly understood. The recent recognition of a 'rusty sink' for organic carbon in marine sediments represents a major advance in our understanding of the carbon cycle. The sequestration of a large portion of organic carbon (OC) in margin sediments appears to be associated with Fe oxyhydroxide phases. In turn, organic matter appears to affect the oxidation, hydrolysis and aggregation of Fe.

We propose that the rusty sink in boreal areas is established already on land, acting as a key factor in the long-term storage of organic carbon and thus contributing to the global cycles of carbon, oxygen and sulfur. In soils, the formation of complexes of iron and organic matter has been identified as one mechanism for stabilizing organic carbon. This relationship has not previously been explored as a mechanism for preserving organic matter in aquatic environments. We show that stable Fe isotopes can be used to trace cycling and the origin of particulate and colloidal Fe-OC(organic carbon) species in brown waters. Two types of Fe aggregates are formed in boreal-subarctic landscape, Fe-oxyhydroxide and Fe-OC aggregates. Iron aggregates with high concentrations of organic carbon show an overall negative isotope signature, and they settle early close to the coast during estuarine mixing. The Fe-oxyhydroxide group is enriched in the heavy isotope, and is found further out in open water. It is important to characterise these two groups because they probably regulate not only carbon but also trace metal, and P cycling in the coastal zone.