The Rusty Sink: Investigating the Importance of Iron to the Long-term Storage of Organic Carbon in Coastal Sediments

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The Fe and OC biogeochemical cycles are closely linked. In marine sediments it has been shown that reactive Fe phases promote the preservation of OC [1]. This resulted in the phrase "Rusty Sink" as Lalonde *et al*. [1]suggested that this connection between Fe and OC is a key factor to the long-term storage of OC. However, they were largely unable to quantify the importance of Fe to the preservation of OC over long-timescales (10^3 yrs). The mineralogy of the reactive Fe phase is also poorly known but is essential to understand what is behind the Fe-OC stabilisation processes.

We have collected a 22.5 m sediment core (MD04-2832) from Loch Sunart, a mid-latitude fjord on the W coast of Scotland. This core covers the period back to 8,000 BP [2], and 9.4 Mt of OC are stored in the postglacial sediment of Loch Sunart [3], yet little is known about what governs the preservation of this significant quantity of OC. Here we present first results investigating selected horizons of this core for the importance of Fe to the long-term storage of OC through the application of Mössbauer spectroscopy combined with elemental and stable isotope analysis with the goal of exploring Fe reactivity and mineralogy in the context of different types of OC (marine vs terrestrial) found in coastal sediments. Mössbauer spectroscopy has the potential to characterise the often nanoparticulate or poorly-crystalline reactive Fe phase in the Rusty Sink and reveal the mutual stabilisation of Fe-organic matter complexes against mineral transformation and decay of organic matter into CO_2 [4].

[1] Lalonde, K. *et al*. (2012) *Nature* **483**, 198-200. [2] Cage and Austin (2010) *Quaternary Sci. Rev.* **29**, 1633-1647. [3] Smeaton *et al.* (2016) *Biogeosciences* **13**, 5771-5787. [4] Schröder, C. *et al*. (2016.) *HyperfineInteractions*, **237,** 85.