The rusty carbon sink: Mechanism of iron and organic matter association in marine sediments

KARINE LALONDE, ANDREW BARBER, ALFONSO MUCCI AND YVES GÉLLINAS

[1]k_lalonde@hotmail.com

From respiration and DNA synthesis to superparamagnetic nanoparticles, magnetotactic bacteria and old rusty cars, iron is everywhere. Our understanding of iron geochemistry is central to the study of carbon and vice versa as it is nearly impossible to find an environment where these two elements are not conjoined. Iron has a profound effect on the carbon that cycles on geological time scales—in sedimentary rocks, in coal and petroleum deposits, the balance between carbon preservation and remineralization is in part modulated by iron. Approximately 20% of the organic carbon buried sediments is protected by reducible iron phases, well below the oxic-anoxic limit of the sediment where they are no longer thermodynamically stable. Iron represents a globally important sink for sedimentary organic matter (OM), contributing to maintaining the delicate balance of O_2 and CO_2 in the atmosphere. In spite of its importance, the exact mechanism of association between iron and OM is not yet known. We postulate that iron and OM form inner-sphere complexes or coagulates with reactive iron oxide at oxic-anoxic interfaces, preferentially sheltering organic molecules with low C:N atomic ratios and enriched isotopic signatures ($\delta^{13}C$).