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Impact of depositional regimes on biogeochemical cycling of iron and stable Fe signatures in sediments from the Argentina Continental Margin

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The Argentina Continental Margin represents a unique geologic setting where fundamental interactions between bottom currents and sediment deposition as well as their impact on biogeochemical processes and element cycling, in particular iron, can be studied. The aims of this study were to investigate 1) the consequences of different depositional conditions on biogeochemical processes and 2) diagenetic cycling of Fe mineral phases in surface sediments. Furthermore, it was 3) studied how sedimentary stable Fe isotope signatures ($\delta^{56}Fe$) are affected during early diagenesis and finally 4) evaluated, under which conditions $\delta^{56}Fe$ might be used as proxy for microbial Fe reduction in methanic sediments. During RV SONNE expedition SO260, carried out in the framework of the DFG-funded Cluster of Excellence "The Ocean in the Earth System", surface sediments from two depositional environments were sampled each using gravity corer and multi corer. One study site is located on the lower continental slope at 3605 m water depth (Biogeochemistry Site), while the other site is situated in a contourite system on the Northern Ewing Terrace at 1078 m water depth (Contourite Terrace Site). Sequential Fe extractions were performed on the collected sediments to determine four operationally defined reactive Fe phases targeting Fe carbonates, (easily) reducible Fe (oxyhydr)oxides and hardly reducible Fe oxides [1]. Purification of extracts for $\delta^{56}Fe$ analysis of the Fe carbonates and easily reducible Fe (oxyhydr)oxide fractions followed [2]. The dataset was combined with pore-water data obtained during the cruise and complemented by concentrations and stable carbon isotope signatures of dissolved methane determined post-cruise. The extent of the redox zonation and depth of the sulfate-methane-transition (SMT) differ between the two sites. It is suggested that sedimentation rates at the Biogeochemistry Site are low and that steady state conditions prevail, leading to a strong diagenetic overprint of sedimentary Fe phases. In contrast the Contourite Terrace Site is characterized by high sedimentation rates and a lack of pronounced diagenetic overprint [3]. Reactive Fe phases are subject to reductive dissolution at the SMT. Nevertheless, significant amounts of reactive Fe phases are preserved below the SMT as evidenced by the presence of dissolved Fe in the methanic sediments, and are available for deep Fe reduction possibly through

Fe-mediated anaerobic oxidation of methane [4]. In this study, $\delta^{56}Fe$ signatures of reactive Fe phases in methanic sediments were determined for the first time. These data suggest significant microbial fractionation of Fe isotopes during deep Fe reduction at the Biogeochemistry Site, whereas at the Contourite Terrace Site the $\delta^{56}Fe$ signatures do not indicate remarkable microbial Fe isotope fractionation. It is concluded that the applicability of $\delta^{56}Fe$ signatures as tracer for microbial Fe reduction might be sensitive to the depositional regime, and thus may be limited in high sedimentation areas.

References:

Poulton, SW. and Canfield, DE., 2005. *Chemical Geology* 214: 209-221.
Henkel, S. et al., 2016. *Chemical Geology* 421: 93-102.
Riedinger, N. et al., 2005. *Geochimica et Cosmochimica Acta* 69: 4117-4126.
Riedinger, N. et al., 2014. *Geobiology* 12: 172-181.