Geophysical Evidence for Iron Mineral Transformation in a Petroleum Contaminated Aquifer

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Hydrocarbon-contaminated environments are excellent laboratories for understanding microbial mediated iron reduction. The excess carbon serves as an electron donor, which can stimulate microbial activity if electron acceptors, such as iron, are available. Previous studies have suggested that magnetic susceptibility (MS) measurements are a potential tool to follow microbial Fe mineral transformation. In this study, we investigated the MS and iron content variations that exist at a hydrocarbon contaminated aquifer in order to determine the major magnetic mineral present. Our results show large down hole excursions in the MS at the contaminated location coincident with peak concentrations of Fe(II) and Fe (Total), and the presence of *Geobacter* species. Variability in the down hole MS at the uncontaminated locations are not associated with peaks in Fe(II) or presence of *Geobacter* ; However, Fe(III) dominates the Fe pool. Our results also show high marked increase in the MS values in the vadose zone at the contaminated locations concomitant with higher concentrations of Fe(II) and Fe (Total). This could be evidence for the microbial reduction of Fe(III) minerals, producing magnetic mineral phases. Trace metal data will be used to determine the chemistry of the sediments and identification of the local mineralogy. With this information, we anticipate characterizing the processes that control the biogeochemical cycling of iron and carbon.

Ice age carbon dynamics of the interior Atlantic Ocean inferred from a highly resolved sedimentary depth transect

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Many models show that the relative intensity of stratification must be a primary variable governing sequestration and release of carbon from the ocean over ice ages. The observations necessary to test these model-derived hypotheses are not yet sufficient, but sedimentary depth transects represent a promising approach for making progress. Here we present results from a suite of 24 cores spanning water depths of 1000-3700 meters, collected from the Namibian margin. This is an especially suitable location to collect vertical depth transects over ice age cycles, given that it is sensitive to the intersection of the principal water masses involved in the thermohaline circulation of the Atlantic. In aggregate, these cores allow for depth transects that have roughly 100 meter vertical resolution, and “steady state” benthic foraminiferal proxy profiles can be compiled at various points spanning the last full ice age cycle.

In this presentation, we contrast the “steady state” vertical distribution of benthic foraminiferal tracers from Marine Isotope Stages 5e, 5a, 4, and the LGM, compiled from the full suite of cores, with the transient evolution of these tracers over the last and penultimate deglaciation in a subset of the cores. The comparison between purely physical tracers (e.g. $d^{18}O$) and tracers that are sensitive to the carbon cycle (e.g. $d^{13}C$ and B/Ca) offers critical insight to the relationship between deep/mid-depth stratification and global carbon dynamics. The observation of the nonconservative behavior of mid-depth $d^{13}C$ in the South Atlantic during the so-called 'Mystery Interval,' for example, will be examined in light of the suggested carbon inputs external to the ocean-atmosphere system [1].

[1] Tessin, A.C. and D.C. Lund. (2013) *Paleoceanography* Advance online publication. doi: 10.1002/palo.20026

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