

Nutrient and organic carbon alteration during transit through shallow coastal sediment

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Shallow coastal sediments represent interfacial zones characterized by diverse, complex and rapid biogeochemical transformations. Nowadays throughout much of the world, coastal areas are overdeveloped, overcrowded and overexploited. Alteration of nutrient and organic carbon loading to aquifers and their transformations in groundwater during transit through shallow coastal hydrogeologic systems was investigated using a plug trough reactor approach.

In the first study, basic metabolic processes occurring in sediment subject to antropogenic impact (Dover Bluff a residential community using septic systems to process household waste) under ex situ conditions (artificial groundwater) were determined. In a second study, alteration of autochthonous groundwater nutrient and organic carbon has been quantified as a function of development regime, e.g. if pristine (Moses Hammock, Sapelo Island, which has little human impact) or the anthropogenically impacted site (Dover Bluff). For both sets of experiments, nitrate reduction, sulfate reduction and volatile fatty acids (VFA) generation/consumption rates were quantified as a function of depth and along the upland-marsh-creekbank gradient.

During nitrate reduction and additions of lactate and acetate, both carbon substrates were completely consumed. Acetate is assumed to be a major substrate for sulfate reducing bacteria in various environments [1, 2] however in this study, systematic production of acetate during sulfate reduction was observed with both natural organic matter and when acetate and lactate were provided as electron donor.

[1] Sorensen *et al* (1981) *Appl. Environ. Microbiol.*, **42**, 5-11

[2] Fukui *et al*, (1997) *Ecol. Res.* **12**, 201-209

Mg isotopic analyses of weathering peridotite

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Since the introduction of routine multi-collector ICPMS analyses, studies of magnesium isotopes have implicated weathering as a major source of isotopic fractionation. These include many recent studies on the isotopic values of Mg in water, carbonates, silicate sediments, soils, and igneous source rocks. Mg isotopic studies of soils and weathering products in particular have shown a wide variance in $\delta^{26}\text{Mg}$ from approximately -1.5 to +1.0‰ (DSM3) and are generally assumed to be isotopically heavier than their parent rocks. As multiple processes could be involved in the apparent fractionation of weathering products from parent rocks in these studies, we have begun a program to analyze *in situ* the effect of chemical weathering by meteoric water on exposed rock surfaces. Peridotite both weathers quickly and contains a very high weight percent MgO, making it ideal for this type of study.

A fresh sample of Alpine peridotite was collected from a road cut in southern Spain. The peridotite has an average Mg# of 91, and contains ~41 wt% MgO. The sample has a 3 cm weathering rind from about 30 years of exposure to precipitation. The fresh core and weathered rind were separated and ground to produce two representative bulk sample powders. These were digested and purified for Mg, then analyzed using a ThermoFinnigan Neptune MC-ICPMS at the University of California, Los Angeles. The rind and core record isotopic ratios of $\delta^{26}\text{Mg}_{\text{DSM3}} = -0.635 \pm 0.018\text{‰}$ (2σ , $n=7$) and $-0.268 \pm 0.012\text{‰}$ (2σ , $n=7$), respectively. The weathered rind is isotopically lighter by 0.366‰. Weathering of peridotite therefore fractionates light Mg isotopes in the residue, a behavior similar to that observed in the Li isotopic system.