

Effect of abiotic environment on biogeochemical response of arctic sediments : a multivariate analysis

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The effects of global changes on Arctic Ocean biogeochemical cycles are difficult to predict given the complex web of physical, biological and chemical interactions that act in this system. It is clear, however, that the flux of organic matter to coastal Arctic sediment will be considerably altered. In this context, understanding how the benthic biogeochemical fluxes of arctic sediment are controlled by organic carbon fluxes is essential.

To examine the effect of abiotic environment on benthic nutrient and metabolite exchanges, we measured fluxes of dissolved oxygen, nitrate, nitrite, ammonia, soluble reactive phosphate and silicate at the sediment-water interface of nine stations located in the southeastern Beaufort Sea in water depth from 45m to 580m. We focussed on abiotic parameters that characterize the quality of the organic matter that reaches the seafloor (e.g. Chla, phaeopigment, $\delta^{13}\text{C}_{\text{org}}$, C/N_{tot}, $\delta^{13}\text{C}$ on lipids, particulate organic carbon fluxes) and others that characterize the surficial sedimentary environment (e.g. overlying dissolved oxygen concentration, salinity, temperature, surficial Fe and Mn concentrations, surficial porosity). In this communication, after a presentation of the spatial distribution of the measured fluxes, we will use a multivariate approach enabling simultaneous evaluation of several variables. The biogeochemical response pattern will be evaluated with ordination by non-metric multidimensional scaling (nMDS) and principal components (PCA). The relationship between multivariate biogeochemical fluxes and abiotic parameters will also examine using distance-based multivariate multiple regression using the DISTLM routine. The model will be built using a forward selection of abiotic parameters tested on individual fluxes using a multiple regression analysis. Most of these tests are still in progress.

We will show that multivariate approach is efficient to reveal hidden relationships between samples and that it can be used to improve our knowledge on coastal environments.

Mass-independent sulfur isotopic fractionation in VUV photodissociation of H₂S: implications for meteorite data

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Introduction

Mass-independent sulfur isotopic compositions have been observed in chondritic chondrules and organics [1-2] and bulk achondritic meteorites [3-4]. Sulfonic acid extracts from Murchison also displayed a significant ³³S anomaly and it was suggested that methanesulfonic acid could have resulted from gas-phase ultraviolet irradiation of a precursor, carbon disulfide [2]. Stellar nucleosynthesis and cosmic ray spallation have been ruled out as the cause of the observed $\Delta^{33}\text{S}$ anomaly [3]. Photochemical reactions in the early solar nebula was inferred to be a leading process to generate mass independent sulfur composition.

UV photolysis of SO₂, H₂S and CS₂ with ≥ 180 nm photons have been carried out in the laboratory to understand the isotope effect in photolysis of sulfur bearing molecules [5-7]. Here we present S-isotope data from VUV photodissociation (using Chemical Dynamics Beamline at the ALS synchrotron) of H₂S.

Results and Discussion

H₂S photolysis was carried out at four different synchrotron bands centred at 90, 121.6, 139.1, and 157.6 nm at various pressures in a differentially pumped chamber. Elemental sulfur produced in all these experiments was collected and converted to SF₆ to measure the isotope ratios (e.g., ³³S/³²S, ³⁴S/³²S, and ³⁶S/³²S). Among four different synchrotron bands used, 121.6 nm photolysis products show significant mass-independent fractionations both in $\Delta^{33}\text{S}$ and $\Delta^{36}\text{S}$ with a $\Delta^{36}\text{S}/\Delta^{33}\text{S}$ ratio of -3 ‰.

H₂S is one of the major sulfur-bearing species in the gas-phase of the solar nebula. Photodissociation of H₂S by Lyman-alpha (121 nm) lines from solar radiation could change the isotopic composition of this major sulfur reservoir. The observed meteoritic sulfur isotopic anomaly, especially those measured in organics may be due to the isotope shift of this precursor sulfur reservoir due to photochemistry. The complete results and a full discussion will be presented at the conference.

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