Microbial Organic Matter Diagenesis and Carbon Cycling within Deep-sea Antarctica Sediments

S. CARR[1]*, K. MANDERNACK[2], C. MILLS[3], F. SCHUBOTZ[4], R. DIAS[3], R. DUNBAR[5], R. SUMMONS[4], C. ESCUTIA[6] AND H. BRINKHUIS[7]

[1]Colorado School of Mines, Golden, USA
scarr@mymail.mines.edu
[2]IndianaUniversity, Purdu University –Indianapolis, Indianapolis, USA
kevinman@iupui.edu (*presenting),
[3]U.S. Geological Survey, Denver Federal Center, Denver, USA
cmills@USGS.gov, rfdias@usgs.gov
[4]Massachusetts Institute of Technology, Cambridge, USA
schubotz@mit.edu; rsummons@mit.edu
[5]Stanford University, Stanford, USA
dunbar@standford.edu
[6]Instituto Andaluz de Ciencias de la Tierra, Granada, Spain
cescutia@gur.es
[7]Utecht University, Utrecht, The Netherlands
H.Brinkhuis@uul.nl

We investigated the sedimentary microbial communities at two Antarctic sites with very different rates of organic matter (OM) deposition: an offshore continental margin (sed. rate ~20m/Myr) and a near shore basin rich in diatoms (sed. rate ~ 2cm/yr). Structural and $\delta^{13}C$ analyses of lipids, SSU rRNA gene sequencing, measurements of total hydrolysable amino acids (THAA), porewater and sedimentary geochemistry were used to characterize the interactive relationship between OM quality and resident microbial communities. Sediments of the continental margin are suggestive of refractory OM, as indicated by low THAA abundances (2% of total organic carbon (OC)), and large proportions of non-protein amino acids β -alanine and γ -aminobutyric (40% THAA). In contrast, labile OM of the basin sediments is characterized by large THAA concentrations (40% of total OC) and relatively low amounts of non-protein amino acids (5% THAA). Sediments of the basin have higher bacterial cell numbers (~10^9 cells g^{-1}) than sediments from the margin (10^6-10^7 cells g^{-1}). Both sites appear to support heterotrophic communities evidenced by $\delta^{13}C_{lipid}$ values, sequencing results, and interstitial and sedimentary geochemistry. Autotrophic activity in deeper sediments of the basin is evident from increasing $\delta^{13}C_{DIC}$ values, CH_4 concentrations (12.8 mM at 21.6 meters below sea floor) and depleted $\delta^{13}C$ values of dialkyl glycerol tetraethers. We hypothesized that autotrophic methanogens are utilizing CO_2 derived from heterotrophic co-inhabitants to produce CH_4. Ultimately these observations imply that when increased primary production and phytodetritus fluxes create anoxic environments, preservation of labile OM occurs even when large heterotrophic microbial communities are present.