Signatures of anaerobic hydrocabron biodegradation in sulfidic and methanic environments

M.J. FORMOLO[1]*, S.T. PETSCH[2], A.M. MARTINI[3] AND T.G. FERDELMAN[1]

[1]Max Planck Institute for Marine Microbiology, Department of Biogeochemistry, D-28359 Bremen, Germany (*correspondence: mformolo@mpi-bremen.de)
[2]Department of Geosciences, University of Massachusetts, Amherst, MA 01003, USA
[3]Department of Geology, Amherst College, Amherst, MA 01002, USA

Subsurface microbial communities are responsible for the anaerobic degradation of organic matter which can lead to the production of toxic gases or economical gas reserves. In addition, these processes are often responsible for extensively altering the chemical composition of petroleums. Focusing on two of the major fractions of sedimentary organic matter, the saturated and aromatic hydrocarbons and specifically mono- and bi-cyclic aromatic compounds and linear and alicyclic aliphates, we attempt to integrate traditional biodegradation measurements with the measurment of *in situ* metabolites. The chemical composition of the *in situ* metabolites reflect the transformation processes occurring in the sediments and provide valuable information linking the substrate precursors and the products. In this study we compare the observed biodegradation signatures associated with a Devonian black shale-hosted biogenic methane reserve and in organic matter-rich marine sediments off the coast of southwest Africa.

Biodegradation signatures and *in situ* metabolites in the Antrim Shale and in sediments from the Benguela Upwelling Zone are similar to those observed in petroleum reservoirs and hydrocarbon contaminated sites. These degradation products indicate that the microbial communities in sulfate reducing and methanogenic environments are actively accessing and metabolizing ‘inert’ hydrocarbons. Integrating the information provided by these anaerobic metabolites with biodegradation signatures provides information regarding the mechanisms and microbial pathways controlling the biodegradation of hydrocarbons in these two environments. Linking anaerobic metabolites to available hydrocarbons is essential to understanding the subsurface biosphere and remineralization of ancient and modern organic matter

Joint seismic-geodynamic-mineral physical constraints on heat flux across the CMB

A.M. FORTE[1]*, R. MOUCHA[1], N.A. SIMMONS[2] AND S.P. GRAND[3]

[1]GEOTOP, Université du Québec à Montréal, CP 8888, Montréal, Québec, H3C 3P8, Canada (*correspondence: forte60@gmail.com)
[2]Lawrence Livermore National Laboratory, Atmospheric, Earth & Energy Division, Livermore CA 94551, USA (simmons27@llnl.gov)
[3]Jackson School of Geosciences, University of Texas at Austin, Austin TX 78712, USA (steveg@geo.utexas.edu)

Significant progress in mapping the lateral variations in mantle temperature has been achieved by jointly inverting global seismic and geodynamic data sets, in which mineral physical constraints on mantle thermal heterogeneity are also imposed (Simmons *et al.* 2009). These new seismic tomographic inferences of the thermochemical heterogeneity in the mantle provide high quality fits to the global seismic data and the entire suite of convection-related geodynamic observables (free-air gravity anomalies, tectonic plate motions, dynamic surface topography and excess CMB ellipticity) we have employed. We present here new models of the present-day global mantle convective flow predicted on the basis of the thermal and non-thermal (compositional) density perturbations derived from the new tomography model and using the inferences of depth-dependent, horizontally averaged mantle viscosity derived from joint inversions of glacial isostatic adjustment and mantle convection data (Forte & Mitrovica 2004). We employ this tomography-geodynamics based mantle convection model to explore the convective transport of mass (buoyancy flux) and heat (advected heat flux) across the lower and upper mantle. We show that the predictions of advected heat flux at the top of the seismic D″ layer provide direct constraints on the heat flux across the core-mantle boundary (CMB). Our current best estimates of the present-day CMB heat flux are in *excess* of 10 TW. We present a sensitivity analysis showing the degree of robustness of this inference, depending on the inferred variation of mantle viscosity in the lower mantle. We also present new predictions of the present-day distribution of secular heating and cooling at different depths in the mantle.