Crustal – mantle melt interactions during continental breakup at the Early Paleocene Vøring Plateau, North Atlantic igneous province

R. MEYER[1], J. HERTOGEN[1], R.-B. PEDERSEN[2], L. VIERECK-GÖTTE[3] AND M. ABRATIS[3,]

[1]Geo-Instituut, K.U.Leuven, Celestijnenlaan 200E, B-3001 Leuven, Belgium (romain.meyer@geo.kuleuven.be);
[2]Geological Institute, University of Bergen, Allegaten 41, N-5007 Bergen, Norway (rolf.pedersen@geo.uib.no)
[3]Inst. Geowiss., Friedrich-Schiller Univ., Burgweg 11, D-07749 Jena, B.R.D. (lothar.viereck-goette@uni-jena.de)

Drilling during ODP Leg 104 Hole 642E showed that the Volcanic Rifted Margin (VRM) at the Vøring Plateau is built up of mafic Seaward Dipping Reflector Sequences (SDRS) of Transtional T-MORB character, underlain by silicic volcanic formations (“Lower Series”, LS). The latter are dominantly peraluminous dacites formed by anatexis of crustal material. The core samples not only provide a unique sequence to study the geodynamic processes leading to continental breakup, but they provide the opportunity to investigate in space and time geochemical variations before and during excess magmatism. The samples from the LS allow to identify the crustal components that were potential contaminants of tholeiitic dykes within the LS and the tholeiitic T-MORB Upper Series sequence. These are essential data to determine the intrinsic geochemical characteristics of the mantle sources of the mafic melts. Trace element data, and Sr, Nd and Pb isotopes indicate that a lower crustal component and a upper crustal component contributed to the isotopic signatures, either through melt mixing or through mechanical mixing of pyroclastics. In order to better understand mixing processes we have analyzed a number of selected samples for the element caesium with a low-blank ICP-MS procedure. The Cs signature of the LS rocks (6.13–0.12 ppm) confirms the crustal anatectic contribution of these rocks, and the data of the Upper Series tholeiites (0.14–0.01 ppm) indicate that a minor amount of crustal material might have been involved during the SDRS formation. A systematic investigation of Cs in the Hole 642E core defined a decreasing influence of continental crust during the magma formation. The tholeiitic “Upper Series” of both the Vøring and the SE Greenland VRM are isotopically rather similar. In contrast, the “Lower Series” from the two areas are isotopically fundamentally different, due to a different composition of the crust at the two locations. The LS of the Vøring Plateau interacted with high $^{87}Sr/^{86}Sr$ and moderately negative εNd lower to upper crust. At the SE Greenland margin the isotopic composition of Sr, Nd and Pb point to a crustal contaminant of granulitic to high grade amphibolite nature (relatively low $^{87}Sr/^{86}Sr$ and rather negative εNd). This marked asymmetry of the geochemical signature of the crust at both sides of the nascent North Atlantic should be taken into account into models of the geochemical evolution of the ‘Iceland Plume’ system or alternative models for the formation of the NAIP LIP.

Microbial diversity and SIP investigations of streamer biofilm communities in Yellowstone National Park

D. MEYER-DOMBARD[1], A. DIBBELL[1], A.S. BRADLEY[1], E.L. SHOCK[2] AND R.E. SUMMONS[1]

[1]Dept. of Earth, Atm., and Planetary Sciences, MIT, Cambridge, MA, USA (drmd@mit.edu)
[2]School of Earth and Space Exploration, ASU, Tempe, AZ, USA (Everett.Shock@asu.edu)

Streamer-forming biofilm microbial communities (SBCs) are common in some alkaline-chloride geothermal systems. Examples of SBCs have been reported in a variety of terrestrial thermal habitats [1], including Yellowstone National Park (YNP). 16S rRNA surveys of SBCs in one YNP location (Octopus Spr.) revealed that those communities were largely composed of presumably autotrophic Aquificales-like Bacteria [3]. However, further investigation of in situ metabolic characteristics of those SBCs by SIP (Stable Isotope Probing) techniques have indicated potential heterotrophic activity [4].

The physiochemical parameters of growth of SBCs down a thermal gradient at “Bison Pool” were investigated, in the context of the geochemical environment. While “Bison Pool” is geochemically similar to Octopus Spring, 16S rRNA and total lipid extract analyses have revealed a significant crenarchaeal component to the “Bison Pool” SBCs. At “Bison Pool”, the SBC bacterial component increases in complexity (going from 3 to 11 genera) while the archaeal component varies little (from 3 to 2 genera) in a 14°C gradient down the outflow channel, crossing the chemotrophic-phototrophic fringe.

Octopus Spring and “Bison Pool” SBCs were used as inoculae for SIP investigations of metabolic function. Microcosm experiments using ^{13}C labeled salts of acetate, formate and bicarbonate were conducted over an incubation period of 3-4 days at in situ conditions. Following incubation, cells were extracted by a modified Bligh and Dyer technique in order to isolate various metabolic pools for evaluation of overall carbon uptake and its pathway into cellular metabolism

SBC lipids showed uptake of ^{13}C-labeled acetate and uptake was preferentially seen in archeal lipids after a short incubation (several hours), especially in caldarchaeol and its cyclic counterparts. Non-isoprenoid lipids also showed selective uptake, with the lipids diagnostic of Aquificales showing little or no isotope uptake. Further detailed analyses of these samples should shed light on the uptake of inorganic carbon and its incorporation into cellular metabolism.

References

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