Biogeochemical cycling in shallow-sea and terrestrial hydrothermal systems

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Mounting evidence indicates that microbial diversity varies substantially between hydrothermal systems of differing provenances. For example, among terrestrial hydrothermal systems, it has been shown that diversity and distribution of microorganisms may be related to geographical location or physical separation [1, 2]. There is, however, minimal evidence concerning differences in the diversity and distribution of genes associated with biogeochemical functions. Of particular interest is the nature of biogeochemical cycles such as nitrogen or carbon cycling in hydrothermal systems. Recent work has revealed snapshots of genetic potential for nitrogen cycling processes in hydrothermal systems such as nitrogen fixation and nitrification, and potential correlation with geography and other physicochemical parameters [for example, 3-6]. As of yet, no comparison of these processes between terrestrial and shallow-sea hydrothermal systems has been made.

We surveyed over 100 locations, representing terrestrial hydrothermal systems in Yellowstone National Park [USA] and Turkey, and shallow-sea hydrothermal systems in Sicily [Italy] and Papua New Guinea. In each area, we have characterized the geochemical environment, energetic potential, and functional genes diagnostic for stages of the nitrogen cycle. Our results show that the distribution of nifH [nitrogen fixation], amoA [nitrification], and narG/nirKS/nosZ [denitrification] genes differs between samples in sediments and biofilms. In addition, the genetic potential for nitrogen cycling is dependent on metabolic zonation within the hydrothermal system; for example, chemosynthetic vs. photosynthetic zones. The diversity of nitrogen cycling genes also varies with the provenace of the sample location, showing evidence for adaptation.

[1] Takacs-Vesbach *et al*. (2008) *Env. Micro*. **10**. [2] Whittaker *et al*. (2003) *Science* **301**. [3] Mehta *et al*. (2005) *Env. Micro*. **7**. [4] Zhang *et al*. (2008) *AEM* **74**. [5] Hamilton *et al*. (2011). [6] Hall *et al*. (2008) *AEM* **74**.

Multi-proxy ($\delta^{18}O$, χ_m , Nd and Pb isotopes) study for paleoclimate and paleoweathering in the Maldives area

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On the MD900963 sediment archive cored on the edge of the Maldives Plateau (Equatorial Indian Ocean), we measured $\delta^{18}O$, $CaCO_3$, Magnetic susceptibility (χ_m), Neodymium and Lead isotopic compositions of both the ancient seawater and the detrital fraction. Our analyses cover the last 250 Ka.

The observed variations show fluctuations, which mimics the glacial-interglacial variations shown by $\partial^{18}O$. The two dominant frequencies are 100 Ka and 23 Ka.

The coherent results of Nd (ε_{Nd}) and Pb isotopes on the detrital fraction and carbonated corrected χ_m on one hand and Nd and Pb isotopes of the ancient seawater on the other hand show without doubt that these variations reflect the regional weathering and regional sedimentation. These data will also be in perspective with ODP Site 758 [1] and additional lead isotopes data from this eastern site.

All together, these results confirm that rain, physical & chemical erosion were larger during warm periods than during cold periods. These variations reflect the fluctuations of the summer monsoon rain intensity. Therefore the study gives strong limitations for the processes driving the relationship between climate, rain and weathering in the equatorial Indian Ocean region over the Glacial/Interglacial alternate.

[1] Gourlan, A. T. L. Meynadier, C. J. Allègre, P. Tapponnier, J.-L. Birck, & J.-L. Joron (2010) *Quaternary Science Reviews,* **29**(19-20) DOI: 10.1016/j.quascirev.2010.05.003.