Carbon cycling at cold seeps: biogeochemical processes and benthic CH_4 fluxes

G. ALOISI[1], K. WALLMANN[2], I. BOULOUBASSI[3], R.D. PANCOST[4], AND R. LUFF[2]

[1] CNRS UMR 5125, Université Claude Bernard Lyon 1; Giovanni.Aloisi@univ-lyon1.fr

[2] IFM-GEOMAR Research Center, Kiel; kwallmann@ifm-geomar.de, rluff@ifm-geomar.de

[3] CNRS UMR 7159, Université Pierre et Marie Curie, Paris; ibou@ccr.jussieu.fr

[4] School of Chemistry, Bristol University; R.D.Pancost@bristol.ac.uk

Cold seeps are of great biogeochemical and geomicrobiological interest because (1) they support diverse microbial communities based on the anaerobic oxidation of methane (AOM), (2) they are the locus of widespread microbial carbonate precipitation and (3) they represent a potential methane source to the ocean-atmosphere system.

During the past few years, efforts have been directed at answering open questions including the nature of the microbial populations involved in AOM, the rate of AOM and carbonate precipitation and the controls on benthic methane fluxes. We present the results of an integrated study of organic matter, authigenic carbonates and pore waters sampled at cold seeps which contributes to answering some of these questions.

Combined lipid biomarker analysis and 16S rRNA gene surveys of modern cold seep carbonate crusts highlight very diversified archaeal and bacterial communities which are responsible for AOM and the precipitation of carbonates and which indirectly control carbonate mineralogy [1]. Pore water geochemical profiles of CH_4, SO_4^{2-} Ca^{2+} and alkalinity are used to constrain numerical models of cold seep biogeochemical processes [2]. At fluid flow rates < 90 cm a^{-1} all of the rising methane is consumed in the sediments by AOM and no benthic methane flux is present. In the absence of bioturbation and with relatively low sedimentation rates (< 50 cm ka^{-1}), a large part of the bicarbonate produced by AOM precipitates as authigenic carbonates which form a dm-thick pavement in a time span of 100 to 500 a. At higher fluid flow rates (> 90 cm a^{-1}), crust formation is inhibited and methane is exported to the water column. If dissolved barium is abundant in the seeping fluids, sulfate is consumed through barite ($BaSO_4$) precipitation, AOM is mitigated and the benthic methane flux increases.

References

[1] Bouloubassi, I., Aloisi, G., Pancost, R.D., Hopmans, E. and Sinninghe Damsté, J.S. (2006) *Org. Geochem.* **37(4),** 484-500.

[2] Luff, R., Wallmann, K., and Aloisi, G. (2004) *EPSL* **221,** 337-353.