COMPOSITION OF HYDROCARBON GAS VENTING AT EASTERN MEDITERRANEAN MUD EXPULSION STRUCTURES AND THEIR DEEP ORIGIN

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Abstract
Mud volcanoes (MV's) are structures that can be found on land and on the seafloor at passive and continental margins. Eruptions are triggered by overpressure occurring at depth and resulting from decomposition of organic matter. Gas, fluids, and sediments are then mobilized and migrate along the sedimentary column, building mud domes [1,2]. Here, we present results of gas, carbon and hydrogen isotopic composition of migrating hydrocarbons as well as some essential elemental and isotope pore water data in order to highlight the processes involved, and to assess the origin of gases and water. Results will be presented from water and sediment samples collected at N.Alex and ISIS mud volcanoes during the NAUTINIL (Sept. 2003), and the MIMES cruise (May 2004) to the Nile deep-sea fan.
Keywords : Eastern Mediterranean, Geochemistry, Nile, Mud Volcanoes, Passive Margins.

At all mud structures investigated, enhanced concentrations of hydrocarbon gases, namely methane, ethane, and propane, have been observed in the water column. These gas plumes can extend up to several hundreds meter above the seafloor and at shallow sites such as at North Alex MV, in the central part of the Nile fan (Fig. 1) [3,4]. Moreover, these gas plumes are associated with enhanced light scattering, which can be associated to the release of gas bubbles and/or sedimentary particles.
The original signature of the gases can be found in the deepest core samples. The gas content presents various wetness ratio [$\Sigma(C_2\text{-}C_6/(\Sigma(C_1\text{-}C_6)$], a parameter giving indications on the origin of the methane (bacterial vs. thermogenic). In association with the carbon and hydrogen isotopic composition of the hydrocarbons, these ratios indicate that at all mud volcanoes, methane is a mixture of bacterial and thermogenic origin, with a thermogenic contribution up to 65% in the eastern part of the Nile fan.

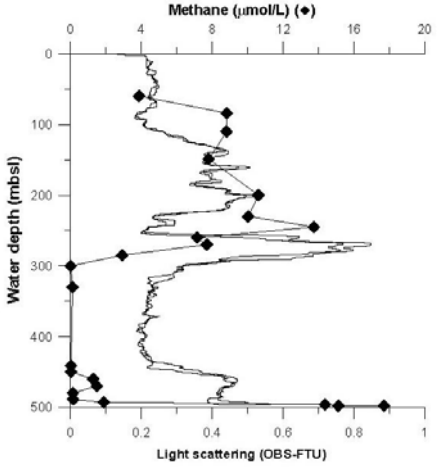

Fig. 1. Methane concentration and light scattering at North Alex mud volcano, central Nile fan.

At Isis MV, a camembert-like mud structure in the eastern Nile fan, large quantities of hydrocarbons appear to be recently released into the overlying water column. Commonly, the methane flux into the water column is controlled by anaerobic oxidation of methane (AOM) occurring in the sediment. During AOM, the anoxic methane oxidation and sulphate reduction, light methane is preferentially oxidized, leading to residual methane enriched in ^{13}C and ^{2}H.methane. This process is clearly visible at Isis MV at about 50 cm below the seafloor, where methane is enriched in ^{13}C and ^{2}H, and sulfate is depleted. But interestingly, beside AOM, oxidation of heavier hydrocarbons also occurs. Indeed, propane and *n*-butane are also enriched in ^{13}C and this enrichment occurs at the same depth as for AOM. Those hydrocarbons seem therefore to be efficient electron donors for sulfate reducing bacteria. Moreover, relatively to methane, propane and *n*-butane seems also to be preferentially oxidized, as suggested by the larger ^{13}C enrichment observed in the AOM zone. Further analysis and investigations are needed to better assess the processes occurring at gas seep related sites and will be one of the aims of the Bionil expedition in November 2006.

Acknowledgements: We wish to thank all captains and crew-members of aboard the R/V's Atalante and Pelagia, This work is supported in part by the EUROMARGINS Programme of the European Science Foundation (NWO 855.01.032, MEDIFLUX project) and the EU ANAXIMANDER project (EVK-2001-00123).

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