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Stable carbon and hydrogen isotopic composition of hydrocarbon gases venting at eastern Mediterranean mud volcanoes

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Within the framework of the EU EUROMARGINS MEDIFLUX and ANAXIMANDER projects, mud volcanoes at the Nile deep-sea fan (NDSF, African passive margin) and Anaximander Mountains (Mediterranean ridge) have been the target for the integrated study of fluid systems and related phenomena (NAUTINIL (Sept. 2003), AEGEO (May 2003, Nov.2004) and MIMES (May 2004). During these cruises, seawater and sediment samples have been taken by conventional CTD rosette and coring stations.

All these mud structures are associated with the presence in the sediment column of enhanced hydrocarbon gases. In the overlying seawater, major gas plumes have also been observed, extending up to several hundreds meter above the seafloor. These gas plumes are associated with enhanced light scatter, which we associate to gas bubble releases.

Stable carbon and hydrogen isotopic composition of the hydrocarbons provided insights into the origin of the gases and the processes involved. At all mud volcanoes, the source of the gas is mainly thermogenic, with variable bacterial contributions.

At Isis MV (western NDSF), in the upper sediment section, anaerobic oxidation of methane occurs within the Sulfate-Methane Transition Zone (SMTZ) located at about 1 m below the seafloor. In addition, major shifts in the δ^{13}C of propane and n-butane have been observed within the SMTZ, which indicate that these hydrocarbons are also efficient terminal electron donors for sulfate reducing bacteria. Moreover, propane and

n-butane appear also to be preferentially oxidized compared to methane.

However and despite this oxidizing barrier, major hydrocarbon gas plumes are observed in the overlying seawater and isotopic data suggest a gas bubble transport mechanism. We propose that a subsurface gas reservoir is responsible for the migration of gas bubbles in the sediment entrained by an intense advective upward fluid flow in the central channel and initiating convective downward flow in the peripheral area.