Geophysical Research Abstracts, Vol. 7, 06264, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06264

Origin of Mud Volcano Fluids in the Gulf of Cadiz (E-Atlantic)

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The Gulf of Cadiz, located west of the Strait of Gibraltar, lies at the boundary between the Mediterranean and Atlantic domains. It also encloses a poorly characterized segment of the African and Eurasian plate boundary. Submarine mud volcanism occurs throughout the Gulf and here we report organic and inorganic geochemical results from gravity core sampling of gas-saturated mud breccias from Bonjardim (deep water, SW Gulf), Captain Arutyunov (shallow water, W of Gibraltar) and Ginsburg (shallow water, SE Gulf) mud volcanoes that were collected during December 2003 (*RV Sonne* Leg 175). A comparative analysis of the organic and inorganic geochemistry of fluids and gases from these mud volcanoes may provide distinct clues about relationships between local geological features and the wider structural geology of the Gulf of Cadiz.

The composition of sediments, pore waters and light hydrocarbon gases (methane to hexane) differ in each of the three submarine edifices. The variations appear to reflect distinctive fluid-generating environments in different sectors of the Gulf. For instance, mud volcano fluids change from the Ginsburg MV (situated close to the Moroccan coast) to the Bonjardim MV (located in the west near the toe of the accretionary wedge), with compositions ranging from sulphate-enriched brines to low-salinity fluids. In the eastern part of the Gulf, gas and fluid generation may be influenced by the past development of a local anoxic evaporitic basin in a shallow platform environment. In contrast, fluid production and expulsion from the Bonjardim MV appear to be related to clay dewatering. The molecular (C_1/C_{2+}) and stable isotope (δ^{13}C-CH_4 and δ^{13}C-C_2H_6) compositions of gases suggest that either different source materials

or processes respond for light hydrocarbon production in different parts of the Gulf and/or that gases have been subjected to different secondary processes during transport (e.g., deep hydrocarbon oxidation and mixing with brines in the Ginsburg MV). Nonetheless, all sites have several characteristics in common, including a low abundance of organic matter of the sediments, a pore-water enrichment in certain elements (e.g., Li, B, Sr), and a predominantly thermogenic origin for hydrocarbon gases. A tentative interpretation of the geochemical data in the context of the Mediterranean-Atlantic gateway and plate boundary evolution is proposed.