EASTERN MEDITERRANEAN ANAXIMANDER AND NILE MUD EXPULSION STRUCTURES: DEEP ORIGIN FOR FLUIDS AND GASES.

Gert J. De Lange [1]*, Vincent Mastalerz [1] and Anke Daehlmann [1]
[1] Geosciences, Utrecht University, 3584CD, Netherlands - gdelange@geo.uu.nl

Abstract
Mud expulsion structures occur in eastern Mediterranean Passive and Active Margin settings. Active structures have major fluxes of methane and also higher hydrocarbons. The porefluid and hydrocarbon isitopic composition idicate a deep source for the water and for the gases. Variable salinities of the porefluids are encoutered as related to the presence or absence of underlying Messinian evaporites.
Keywords: Active Margins, Passive Margins, Eastern Mediterranean, Mud Volcanoes

In the Eastern Mediterranean not only the Mediterranean Ridge (Äctive Margin") but also the Nile Fan area ("Passive Margin") are characterized by active mud expulsion structures. These structures at Anaximander area and Nile fan have been sampled for the integrated study of fluid and gas systematic, including the potential occurrence of Gas Hydrate (GH). At Anaximander, the active top part of mud volcanoes is usually characterized by fluids of reduced salinities (~10 ‰), whereas in the Nile area, these structures have fluids of near-normal salinity to brine composition (> 300 ‰). The low salinity waters are related to deep dewatering during smectite-illite transition, whereas the high salinities result from dissolution of underlying Messinian evaporites [1]. It seems therefore, that the salinity of the advecting fluids is dramatically different between the two areas, whereas the measured methane concentrations are similar, ranging from 1 to 3 mM for Anaximander and from 1.5 to 3.5 mM for the Nile area. In addition, in both areas but in particular that of the Nile, major expulsions of gas occur into the water column [2,3]. In the Anaximander area low sub-bottomwater temperatures occur associated to GH decomposing during recovery, whereas in particular the Cheops and Chefren mud volcanoes in the Nile area have enhanced salinities & temperatures being 150 ‰ & 57^{o}C at Chefren and > 300 ‰ & 37 / 25^{o}C at Cheops. The latter two mud volcanoes situated inside the large Menes Caldera, 8 km diameter, have a distinct chimney-like brine/mud pit. Inside these muddy brine structures, the liquid mud has been sampled for gas, and for porewater. At both sites, the profiles are rather constant with depth and do not differ between cores and accompanying brine-CTD's. The depth of the brine is approximately 300 meters at Chefren and 10 meters at Cheops, which needs to be compared to a 80 m depth of the Menes Caldera itself. Concurring with the enhanced temperatures, the Si concentration in the cores has higher values at Chefren (500-600 µM) and lower values at Cheops (300 µM). Hydrogensulfide was found in higher concentrations in the central cores of Chefren MV (up to 1.5 mM), and only in minor amount at Cheops. Two camembert-like more shallow structures have also been studied in detail: Isis and Amon mud volcano (MV). IN the central part of both MV's methane has similarly high concentrations af for the earlier mentioned sites, but salinity is below normal for Isis and slightlyl above normal for Amon. It is in particular the high sulphate that is remarkable for the latter, pointing to a gypsym evaporate contribution. This results in the peculiar co-occurrence of high methane and sulphate within these sediments, where only in the topmost interval methane is noticeably being degraded [3] . 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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