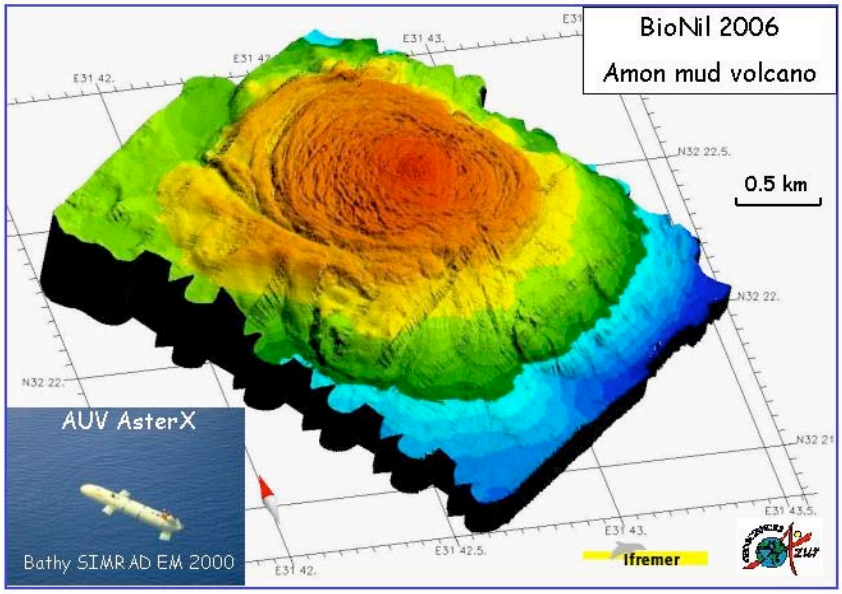
Expedition M70/2a — Antje Boetius

1. Weekly report (21.10.-29.10.06) — RV METEOR

The expedition BIONIL (leg M70/2a) investigates recently discovered seep systems of the deep Nile fan. These consist of numerous fluid-escape structures at water depths between 1000 and 3000 m including pockmarks, mud volcanoes and brine pools. Many of these systems emit hydrocarbons (mostly methane), as well as sulfide. These chemical energy sources build the basis for rich and abundant microbial life and diverse chemosynthetic organisms. Our research combines activities of the ESF EUROCORES EUROMARGIN project MEDIFLUX, the German "Geotechnologien" project MUMM II (funded by BMBF/DFG), and the EU project HERMES. On the basis of geophysical, geochemical and biological data from various seep structures collected during two earlier MEDIFLUX cruises, M 70/2 aims at gaining better understanding of the distribution and functions of the novel seep ecosystems. The objectives are to understand the controls and mechanisms of chemical element transport and breakdown by seep biota, and to obtain insight in the biodiversity and functioning of life at different types of fluid seeps in the Eastern Mediterranean. These goals will be achieved by detailed mapping of selected habitats using the French autonomous underwater vehicle (AUV) AsterX (IFREMER) followed by detailed geochemical in-situ measurements and specific sampling of mud, fluids, carbonates and biota along geochemical gradients. Sampling and in-situ measurements are performed with ROV QUEST of MARUM (University Bremen, Germany).

We used the 19 October to install our equipment on METEOR's deck and labs making sure that every possible place is used well ☺. On the 20 October we had a very nice visit by the scientific steering committee of the Census of Marine Life Program CeDaMar as well as the agency and port authorities of Crete wishing us luck for our mission. We left Heraklion on the 21 October with excellent weather for the first week of work at the East Delta of the Deep Nile fan. Within 4 days we could accomplish 2 ROV and 2 AUV dives, focusing on the highly gassy mud volcanoes "Amon" and "Isis". The "Amon" mud volcano has a very unusual morphology, with a pointed center instead of the typical crater. We could visualize details of "Amon"'s structure with the AUV AsterX carrying the multibeam echosounder Simrad EM2000 (CNRS Geosciences-Azur). AsterX was navigated at a fixed altitude of 70 m above the seafloor, allowing for Digital Terrain Models to be computed with data gridded at a space interval of 1 m, achieving a much higher resolution than allowed by conventional ship-borne bathymetric echosounders. Maps were produced after each AsterX run in less than two hours after the recovery of the AUV on deck and represent an invaluable help to plan the ROV dives.



Our strategy is to use bathymetric maps, gas flare imaging and visual inspection of the seafloor to select representative habitats for detailed analyses including in situ chemical and biological measurements. For the geochemical and microbiological analyses of the different seep structures of the deep East Mediterranean, the ROV QUEST is packed with an array of sampling tools.

Our first analysis of “Amon” mud volcano shows that the tip of “Amon” has a very rough morphology indicating recent gas and mud eruptions. The sediments are laden with gas and emit gas bubbles when touched with sampling tools. We detected diverse patches of giant sulfur oxidizing microorganisms as the main inhabitants of the central area. The central zone is surrounded by a vast area of large biogenic mounds produced by a yet unknown animal. Other unexpected findings with regard to the morpho-structures of the two volcanoes of the East Delta include the presence of three active centres of mud emission on “Isis”, and of old mudflows covered with densely populated carbonate crusts to the south-west of “Amon”.

The beauty of ecosystem research in deep waters is that every dive results in unexpected findings questioning our understanding of geosphere-biosphere interactions. At the moment on of our favourite discoveries at “Amon” is a fresh mudflow forming a riverbed between the inner mud volcano and its southern rim (shown above). This highly sulfidic mud flow shows a succession of microbial mats from uncovered black sediments with first small spots of Arcobacter mats, then filamentous giant sulfide oxidizers, and finally a dense carpet of an unknown type of bacterium looking like the small sister of the famous “sulfur pearl” Thiomargarita. Currently we have moved to the Central Delta and are investigating a flat area of the margin with numerous small pockmarks, large carbonate crusts and spots of highly reduced gassy sediments. Unfortunately, the wind is sometimes too strong to allow AUV and ROV operations, but we are hoping to have a few more dives in this area before moving on to the Caldera in the West of the Nile Fan.

With best greetings to all colleagues, friends and families on land
– the BIONIL team