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Fluid flow associated ecosystems of the Nile deep-sea fan, Eastern Mediterranean (MEDIFLUX)

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The Nile deep-sea fan has been investigated during the last four years in the interdisciplinary EUROCORES EUROMARGIN project MEDIFLUX. Building up on geophysical, geochemical and biological data collected from various mud volcanoes and pockmark structures during two earlier MEDIFLUX cruises “NAUTINIL” and “MIMES”, the expedition BIONIL was dedicated to quantitative investigations of the distribution and functions of the Nile fan ecosystems. The objectives were to understand the controls and mechanisms of subsurface and surface chemical element transport and consequent breakdown by seep biota at different types of fluid seeps in the Mediterranean. We combined near-field mapping of selected habitats using the AUV ASTERX (IFREMER) equipped with a Multibeam system (Geosciences-Azur), followed by detailed geochemical in-situ measurements and specific sampling of mud, fluids, carbonates and biota along geochemical gradients performed with the ROV QUEST (MARUM). Three main working areas have been selected: The mud volcanoes “Amon” and “Isis” of the eastern Nile fan province, and the central area characterized by a high density of pockmarks harboring carbonate chimneys and pavements as well as patchy colonies of chemosynthetic organisms. At all sites we found indications of substantial methane and sulfide seepage, indicated by gas ebullition, and fluid and mud advection. By using a combination of in situ technologies including

temperature measurements, gradients of chemical elements and transport processes as well as microbial activity assays, we investigated the relation between seep community diversity, activity and the geological/geochemical structure of the different seep systems. A surprising finding is the multitude of small-scale habitats at the investigated mud volcanoes and pockmark systems, possibly explaining the high microbial and animal diversity of the Nile deep sea fan. Active gas and sulfide seepage was not only detected in the center of mud volcanoes and pockmarks but also at the rise of mud volcanoes and the flat, cemented seafloor between pockmark structures. The Nile deep-sea fan is a fascinating natural laboratory to study geosphere-biosphere coupling and the relation between biodiversity and habitat structure in the deep ocean.