

Seepage activity offshore Egypt revealed by high resolution geophysical and ground truth data

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Fluid escape structures on the Nile Deep Sea Fan, large mud volcanoes located above gas chimneys, pockmarks and carbonate structures were investigated during the NAUTINIL and MIMES expeditions (MEDIFLUX project). Explored and surveyed for the first time with the *Nautilie* submersible and the *EdgeTech DTS-1* high resolution deep towed side scan sonar (operated at a frequency of 75 kHz and coupled with a 2-8 kHz chirp sediment sounder), these structures are characterized by an intense seepage activity, principally dominated by gas emissions. Several gas plumes were detected in the water column acoustically from the side scan data in the investigated central delta, above Isis and Amon mud volcanoes (structures of a few km wide) and numerous pockmarks containing carbonate crusts.

Seafloor mapping analysis combining multibeam data, high resolution backscatter imagery and detailed geological maps based on in situ observations provides accurate information on the seep-related structures and associated activity. Acoustic mosaics of the seafloor and shallow depth subbottom profiles reveal subsurface sediments commonly disturbed by ascending fluids throughout the delta and usually marked by seafloor carbonate crust structures. The geophysical signature of these active sites, commonly associated with high backscatter, presents, however some variability in the signal depending on the intensity and the type of seep-related structures, e.g. the presence of relatively young mud breccia or authigenic carbonate crust pavements. The feeder channels below mud volcanoes, similar to the gas conduits below the widespread carbonate crust structures, are relatively narrow and, for the vast majority of them, do not exceed a few tens of metres in diameter. These seep-related structures, gas chimneys and carbonate crust structures are controlled by the local and regional tectonics in connection with a complex fault network, deeply rooted faults, and shallower ones associated with salt tectonics and slope instabilities.