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MEDIFLUX surveys reveal fluid seepage through the Nile Deep Sea Fan seabed offshore Egypt

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Fluid-escape structures on the Nile Deep Sea Fan, including large mud volcanoes located above gas chimneys, pockmarks and carbonate crust structures, were investigated during the NAUTINIL (2003), MIMES (2004) and BIONIL (2006) expeditions (EUROMARGINS-MEDIFLUX project). Firstly identified from multibeam bathymetry and backscatter data (Loncke et *al.*, 2004), recent *in-situ* geological observations, geochemical sampling and analyses, and new high resolution geophysical records provide further constraints on the type, distribution, intensity and functioning of these structures.

Explored and surveyed with the *Nautile* submersible (Dupré et *al.*, 2004) and the *EdgeTech DTS-1* high resolution deep towed side scan sonar (Dupré et *al.*, 2005) (operated at a frequency of 75 kHz and coupled with a 2-8 kHz chirp sediment sounder), these structures were found to be characterized by an intense seepage activity, principally dominated by hydrocarbon gas emissions (mostly methane) (Mastalerz et *al.*, 2005). Several gas plumes were detected in the water column from side scan data above Isis and Amon mud volcanoes, as well as above pockmark fields. These active sites were recently surveyed during the Bionil expedition with the *Aster*^{X} AUV (Autonomous Underwater Vehicle) operating 1) a high resolution multibeam (200 kHz) providing detailed seafloor imagery of the seafloor (e.g. $<$ 1m pixel bathymetry map),

and 2) a fishery echosounder (70 kHz) to detect gas in the water column.

Seafloor mapping analysis combining multibeam data at different frequencies, high resolution backscatter imagery and detailed geological maps based on in situ observations provide accurate information on the distribution and activity of seep-related structures (Dupré et *al.*, 2006). Shallow depth subbottom sediment profiler records reveal wipe out and disturbed areas explained by ascending fluids. Acoustic mosaics and geological observations point to broad seafloor areas covered with carbonate crusts. The amplitude of the acoustic backscatter presents spatial variability, which we relate to the type and intensity of present or past seepage activity, e.g. the presence of a variable distribution and thickness of carbonate crust pavements. The feeder channels of the mud volcanoes do not exceed a few tens of metres in diameter near the seabed. Lateral extent of ascending fluid channels in carbonate covered areas, as shown by wipe out dimensions, may reach a maximum of several tens of meters. The full set of collected surface geophysical data indicate that the distribution and functioning of seep-related structures is controlled by the local and regional tectonics in connection with a complex fault network including deep crust-rooted faults and shallower ones associated with salt tectonics and slope instabilities.

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