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Active fluid emission systems imaged by high resolution geophysics on the Nile Deep Sea Fan

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The Nile deep sea fan system presents a rich variety of fluid escape structures varying according to the activity, size, morphology, and geological and sedimentary characteristics. Gas chimneys, pockmarks, and several types of mud volcanoes characterize parts of the seafloor there. These seep related structures were first identified on the basis of multibeam echosounder and seismic data and limited sampling (Loncke & Mascle, 2004; Sardou & Mascle, 2003). In the framework of the Mediflux project, these datasets were used to identify the best targets for more detailed studies, direct observations of the seafloor and high-resolution geophysics. Zones of high backscatter in multibeam acoustic imagery are generally associated with active seepage areas. Fluid escape structures were explored for the first time using the Nautile submersible during the Nautinil expedition in 2003 and are characterized by high thermal gradients and highly gas-saturated sediments. Some of these seeping structures are associated with erupted mud flows and/or carbonate crust edifices. More recently, high resolution side scan sonar data acquired during the Mimes expedition (summer 2004) brings more detail to the geophysical imagery for better characterization of fluid related systems in the Nile area. The EdgeTech DTS-1 deep tow sonar was deployed around 100 m above the seafloor and operated at a frequency of 75 kHz, giving the possibility to generate 1m pixel acoustic mosaics. In addition to the sidescan sonar sensors, the DTS-1 contains a 2-16 kHz, chirp subbottom penetrator allowing us to distinguish vertically two seismic reflections within a few tens of cm. The DTS-1 survey targets lie at depths to 2000 m and cover ˜600 km2 of the Nile deep sea fan. The large mud volcanoes over gas chimneys in the East Delta and the pockmarks in the Centre Nile were both investigated. Several gas plumes were detected acoustically in the water

column of the side scan record when the towed fish was above Isis and Amon mud volcanoes and the pockmarks located in the Centre Nile. These observations confirm the intensity of the present-day activity of the Nile deep sea fan in terms of seepage associated with gas emissions and its continuity through time. High-backscatter patches related to these seeps have been observed in all of the explored sites. Structures associated with mud flows, such as concentric ridges and gullies, and subsurface carbonate crust structures were identified on numerous lines. High variability in the backscattering observed at most of the sites greatly assists post-processing interpretation, e.g. seafloor geological mapping. The high-resolution DTS-1 data provide the possibility to identify and map fluid emission areas associated with different types of lithology, mud flows, carbonate crust and gas plumes when the backscatter signal is calibrated with in-situ observations. This surface information is then be integrated with very high-resolution subbottom information of the uppermost sedimentary layer, therefore allowing volume estimates of sedimentary units at the seafloor, mud breccia layers and carbonate crust thickness.

References:

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