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3-D Seismic Images of Mud Volcano North Alex, West-Nile Delta, Egypt

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Mud volcanoes within shelf areas are the bathymetric expression of mobilized overpressured sediments causing a feature of possible instability within the slope. Such a scene is given in the West-Nile Delta offshore Alexandria, Egypt at 700 m water depth, ,which was studied during a RWE Dea funded research project.

The West Nile Delta forms part of the source of the large turbiditic Nile Deep Sea Fan. Since the late Miocene sediments have formed an up to 10 km thick pile, which includes about 1 – 3 km of Messinian evaporates. The sediment load of the overburden implies strong overpressures and salt-related tectonic deformation. Both are favourable for fluid migration towards the seafloor guided by the fractured margin. Deep-cutting channel systems like the Rosetta channel characterize the continental slope. Bathymetric expressions of slides and numerous mud volcanoes in the area are expressions of active processes, which contribute to the ongoing modification of the slope. The western deltaic system, Rosetta branch, has formed an 80 km wide continental shelf. Here at 700 m water depth the mud volcano North Alex developed his circular bathymetric feature, which proved to be an active gas and mud-expelling structure.

A grid of 2-D seismic profiles did reveal a large set of faults located within the main mud volcano as well as surrounding the structure. Internal faults are mainly related to episodic mud expulsion processes and continuous gas and fluid production. Deep cutting external faults surround the structure in a half circle shape. They can be tracked up to the seafloor indicating ongoing tectonic activity of the slope area.

A recently build 3-D acquisition system (funded by RWE Dea) suitable for mid-size research vessels was applied to collect an active seismic cube of the mud volcano. Based on the P-Cable design 11 parallel streamers (each 12.5 m long with 1.5 m group interval) were used to record shots of a single 210 cinch GI airgun. Based on GPS positions of the trawl doors precise positions of each streamer were computed by approximation of the first arrival time. Due to the good S/N ratio minor gaps within the data cube could be filled with sophisticated trace interpolation. A 3D time migration provided a 3-D data cube at 5 m grid spacing. Due to the high gas content of the innermost centre of the mud volcano acoustic blanking does hide the internal structure at depth. Nevertheless the high resolution gridding of the cube highlights small scale dipping reflections surrounding the area saturated with gas. The interpretation assumes an oval lens shape body saturated with gas at the top of the mud volcano. It provides the upper termination of the mud chimney.

Further structural information is deduced from a seismology network build by Ocean-Bottom-Seismometers. See Lefeldt et al. for details.

http://www.ifm-geomar.de/index.php?id=wnd&L=1.