Geophysical Research Abstracts
Vol. 19, EGU2017-4811, 2017
EGU General Assembly 2017

Imaging Seafloor Massive Sulphides at the TAG hydrothermal fields, from the Blue Mining seismic project

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The Trans-Atlantic Geotraverse (TAG) hydrothermal field, located at the Mid-Atlantic Ridge (26ºN), is known for the existence of Seafloor Massive Sulphides (SMS) discovered by the Trans-Atlantic Geotraverse cruise (Rona et al., 1986). The TAG comprises a low-temperature alteration zone, five inactive, high-temperature hydrothermal deposits, and the hydrothermal active TAG mound. TAG is also known for being one of the eight known SMS with a size larger than 2M tones (Hannington et al., 2011). The known SMS deposits do not have the same dimensions as the Massive Sulphides (MS) found on land, covering areas from 10s-100s m2 and their accessibility is more complicated, being located at 800-6000 m water depth. Although they do not seem to be economically exploitable at present, those deep-sea mineral resources could be important targets in the near future.

One of the aims of the European-funded Blue Mining project is to identify the SMS deposit dimensions for the future environmentally sustainable and clean deep-sea mining. The Blue Mining project is focused on the extinct Seafloor Massive Sulphides (eSMS) in the TAG hydrothermal field, in particular Shinkai, Southern and Shimmering mounds. In May/June 2016 the German RV METEOR carried out a seismic refraction/reflection wide-angle (WA) experiment acquiring thirty multichannel seismic (MCS) profiles crossing the TAG hydrothermal field. GEOMAR's 2-unit air-gun array with a total volume of 760 cubic-inches was used, triggering seismic pulses every 12 s along the MCS profiles. Reflected and refracted events from the shallow-towed sources were recorded by 20 Ocean Bottom Seismometers (OBS) and 5 Ocean Bottom Hydrophones (OBH). To obtain the internal velocities and gross geometries of these deposits, 10 of 20 OBS were located on top of the eSMS, Shinaki and Southern mounds, while the other 10 instruments were located in extension of the profiles, covering Shimmering mounds and regional targets.

In this presentation, we present results from controlled-source seismic forward modelling along two 5 km North-South profiles and a 10 km East-West profile. The 10 km profile cross over two eSMS (Shinkai and Southern mounds) deposits, while the other two 5 km profiles, pass through Shimmering and Shinkai mounds, and Southern mound, respectively. Despite the small size of all mounds we have been able to image their dimensions by using forward modelling. From Pg, PcP and PmP arrivals, we could model one $\sim$100 m and two $\sim$120 m thick deposits in 500 m slow thin upper crust layer (2900-5400 m/s), followed by 1500 m lower crust (6400-7200 m/s).