

# How to Find Buried and Inactive Seafloor Massive Sulfides using Transient Electromagnetics

## A Case Study from the Palinuro Seamount



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### MARTEMIS

At GEOMAR we have built the new marine transient electromagnetic induction system MARTEMIS (→ A), which is specifically designed for the detection and characterization of seafloor massive sulfides (SMS):

- operational depth up to 6000m,
- coincident loop with  $4.3 \times 4.3\text{m}^2$ ,
- transmitter (TX) coil with 1-2 windings,
- TX current of 40A @ 50% duty cycle,
- TX turn-off time  $\sim 120\mu\text{s}$ ,
- TX repetition frequency of 2.5Hz,
- receiver (RX) sampling frequency 10kHz.

### Working Area

The Palinuro Volcanic Complex, located in the Tyrrhenian Sea, has some characteristics, which make it up to date a unique site for testing equipment on inactive and buried SMS:

- little to no hydrothermal activity,
- no surface expressions (e.g. black smokers),
- sedimentary cover,
- SMS verified by drilling (Petersen et al., 2014).

### Experiment

After calibration in the water column (→ B), demonstrating the quantitative functioning of the MARTEMIS system, it was lowered towards the seafloor. Measurements were then carried out at a total of 80 locations along a  $\sim 750\text{m}$  long profile within 1.5h (→ C).

### Interpretation

A qualitative comparison of all measurements shows a subset of processed transients with increased amplitudes (→ D, red lines). These correspond to locations (→ C, red dots) in the vicinity of the area of previous drilling (→ C, black rectangle).

While a 1D inversion of data at station TX12 shows, as expected, background resistivities (→ E), the response at site TX38 requires a highly conductive layer ( $\sim 15\text{S/m}$ ) at a depth between 8–16m (→ F), which is clearly indicative of SMS and may not be solely explained by warm saline fluids.

The display of all 1D models shows that the layer of high conductivity is evident in all measurements in the vicinity of the previous drilling (→ G, marked). In addition, a second unknown conductive anomaly towards the E hints at a hitherto unknown SMS occurrence at greater depth (→ H, marked).

### Outlook

Measurements with the MARTEMIS system will be carried out at the TAG hydrothermal field in summer 2016. For 2017 we have applied for shiptime to continue measurements at the Palinuro Volcanic Complex.

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