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Active electromagnetic survey of hydrothermal venting area at Saldanha Massif, Mid-Atlantic Ridge

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We have carried out an active source electromagnetic sounding at a ridge offset on the Mid-Atlantic Ridge (36˚33' N, 33˚ 26' W) south of the Azores. This experiment is a joint research project carried out by the Southampton Oceanography Centre and the University of Lisbon. The target area is centred on the Saldanha Seamount, which is an exposed section of upper mantle rocks unexpectedly hosting the site of a hydrothermal venting.

Such circulation systems have been believed to be associated with volcanic ridge sites. An unusual fact is that recent magmatic activity appears to play no direct role in driving this hydrothermal circulation. Thus this combination, while not unique, represents an aspect of sea floor spreading and ocean-lithosphere interaction that has not been well studied in the past.

Our main objective is to investigate the physical properties, and in particular the pore fluid properties in situ, within the upper few km of the seafloor beneath and around the vent site. Recent CSEM exploration of the MAR and other ridges have shown that active EM sounding is a powerful tool for hydrothermal studies, including quantifying sub-sea-floor porosity and pore connectivity. .

During the survey the active source DASI system transmitted a signal for frequency-domain sounding at frequencies of 0.25 and 1 Hz. 8 transmission lines were towed across the survey area. An array of 18 seafloor electric field receivers were deployed in a 10 km x 10 km pattern centred on the Saldanha seamount. This survey geometry

gives us source receiver ranges of up to 10 km and, also, should provide information on resistivity structure to a depth of several km beneath the seafloor. In addition, we made several coring and dragging stations and also collected a set of bathymetry, gravity and magnetic profiles across the ridge.

The experimental data will be interpreted into constraints on geological structure (including distribution of fluid-filled fractures) of the Saldanha Massif by 1D and 2.5D forward modeling and inversion, and geophysical effective medium modeling. By comparison of the results with those from volcanically hosted sites, we shall investigate whether the Saldanha vent site owes its existence to exothermal serpentinization reactions within a deep fracture network, extending downwards through the crust into the underlying mantle rocks.