:: Drilling an active hydrothermal system associated with a submarine intraoceanic arc volcano - November 15-17, 2012, Lisbon, Portugal

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Hydrothermal processes associated with intraoceanic arcs play a major role in the exchange budgets of the global oceans and seafloor crust. Investigations of the distribution of sub-seafloor mineralisation and alteration styles are critical in further assessing the potential of intraoceanic arc hydrothermal systems as a tectonic environment for seafloor resources and a supplier of important metals and nutrients to the oceans. Seafloor hydrothermal systems along intraoceanic arcs are also some of the most hostile environments for life, owing to the extraordinary high concentrations of toxic metals and metalloids in very acidic (and gas-rich) fluids. Drilling into an intraoceanic arc volcano with diverse hydrothermal vents would provide critical new insights into **(1)** the mechanisms and extent of fluid-rock interaction and consequences for mass transfer of S and C species, and some metals and metalloids, into the oceans, **(2)** the distribution of metals and associated formation of mineral deposits in the sub-seafloor, and **(3)** the diversity and extent of microbial life in a hostile volcanic environment.

The purpose of the MagellanPlus Workshop was to bring together an international group of geologists, petrologists, geochemists, geophysicsists and microbiologists to discuss and plan an IODP proposal to drill into a hydrothermal system hosted by the submarine Brothers volcano of the Kermadec intraoceanic arc. The group included specialists in volcanic processes, fluid geochemistry, fluid-rock interaction, ore deposit formation, petrology and geochemistry, geophysical exploration, and microbiology of extremophiles. Scientists who have played lead roles in past hydrothermal drilling expeditions were on hand to guide those with less IODP drilling experience and to impart their wisdom gained from previous drilling of seafloor hydrothermal systems.

The meeting was co-funded by ECORD, ICDP and IODP-MI and took place between November 15 and 17 in a building of the Faculty of Sciences, University of Lisbon. A field trip on November 14 to the Neves Corvo mine, one of two large operating mines in Portugal and the western-most extension of the Iberian Pyrite Belt, was attended by most of the 25 workshop participants *(above)*. Lectures in the mornings of days 1 and 2 of the workshop covered various topics, including the global distribution and significance of arc hydrothermal systems, geochemical and microbiological processes within active submarine volcanoes, lessons from past scientific drilling in hydrothermal systems, and the geology and geophysics of Brothers volcano and its hydrothermal systems. In several discussion sessions the present state of knowledge about arc hydrothermal systems and the outstanding science questions that can best be addressed by drilling were defined. The drilling and logging strategies and anticipated technical difficulties with drilling Brothers volcano were also discussed.

It was concluded that within the extreme change in forcing parameters of subduction along the Tonga-Kermadec Trench, Brothers provides the possibility for examining specific structural/magmatic/volcanic co-evolution patterns. A question

central to hydrothermal deposit research over the past several decades, is the role of leaching of metals by circulating external waters, relative to metal input from degassing magmatic fluids. The question of how much metal transport is due to magmatic-degassing flux versus water-rock dominated hydrothermal circulation can be investigated at Brothers volcano as it is host to hydrothermal systems derived by both these mechanisms. Sub-seafloor hydrological patterns at volcanoes like Brothers are closely related to caldera and cone formation. Thus, drilling will aid in our understanding of how volcano architecture influences the distribution of large-scale permeability.

Deep, non-riser drilling will provide access to critical zones dominated by magma degassing and high-temperature hydrothermal circulation. The desired drill cores should contain valuable information on the influence of magmatic degassing on metal transport and allow us to distinguish between two principal sources: **(1)** directly from the magma and **(2)** via acid-promoted dissolution or leaching of rock. The cores will also help in the examination of the upflow zones away from areas of shallow entrainment of seawater.

The drilling technology currently available on the *JOIDES Resolution*, has a poor record of achieving high core recovery for the 10 m immediately below the seafloor. Any *JR*-style drilling expedition should hence be complemented by seabed drillrig sampling, which will provide core from shallow intervals most useful for microbiological studies.

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