The Tonga-Kermadec intraoceanic arc: an 8 year odyssey of discovery

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Prior to 1998, nothing was known about hydrothermal venting along the Kermadec-Tonga arc NE of New Zealand. By 2005, six surface ship cruises dedicated largely to plume mapping and two others focused on submersible dives, means that every single volcanic center along the entire ~2,500 km long arc has been surveyed for hydrothermal emissions in one form or another. This has resulted, for the first time, in an inventory of seafloor venting for an entire arc system. Results show that the Kermadec part of the arc has a high incidence of venting and appears more active than both the Tonga part of the arc and intraoceanic arcs elsewhere. Cone type volcanoes dominate the southern parts of the Kermadec arc whereas caldera type volcanoes predominate further north. The style and chemical composition of hydrothemal venting is heterogeneous along the arc. Venting typically occurs near the summit of cone volcanoes or perched on the inside walls of the calderas. Depth plays an important role in the style of venting seen on the seafloor, with diffuse, metal poor but gas-rich venting common to most 'shallow' sites (<500 m), while more focused, high temperature, metal rich systems occur at deeper (>1000 m) sites.

At least five active hydrothermal systems occur on subaerial islands along the Kermadec-Tonga arc, with three associated with active volcanoes. The study of these systems together with those on the seafloor, provides an opportunity to understand the chemical and physical transition between submarine and subaerial hydrothermal systems. Surveys of the Aeolian submarine hydrothermal systems equally provide an opportunity to compare and contrast submarine styles of venting with the better know hydrothermal systems hosted by several of the Aeolian island arc volcanoes.