

Arc-Front Volcanic Centers and Hydrothermal Systems along the Monowai Segment, Tonga-Kermadec Arc, SW Pacific

A. Gray*¹, M.D. Hannington^{1,2}, M.S. Stewart³, A.T. Baxter¹, D. Diekrup¹, S. Petersen², U. Schwarz-Schampera⁴, H.L. Gibson⁵

¹Department of Earth and Environmental Sciences, University of Ottawa, Ottawa, Ontario, Canada

²GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany

³Department of Earth and Environmental Sciences, Mount Royal University, Calgary, Alberta, Canada

⁴Bundesanstalt für Geowissenschaften und Rohstoffe, Ore Deposit Research, Hannover, Germany

⁵Harquail School of Earth Sciences, Laurentian University, Sudbury, Ontario, Canada

*agray090@uottawa.ca

Three significant active hydrothermal systems have been found at arc-front volcanoes along the Monowai Segment of the Tonga-Kermadec arc. Most occur in summit calderas of still active volcanic cones and exhibit different characteristics (e.g., high- vs low-temperature venting, boiling, magmatic contributions to the hydrothermal system) depending on the settings. Volcano 18 at 24°30'S contains a stratovolcano (10 km diameter, rising to 190 mbsl) with >40 small cones cutting the stratovolcano along a SW-NE lineament and another stratovolcano (14 km diameter) dominated by a 6.9 x 6.3 caldera (1520 deep). The eastern wall of the caldera has clusters of chimneys, including two black smokers (260°C), sulphides, and mussels present. Volcano 19 at 24°48'S is a 14 x 12 km stratovolcano rising from 1400 mbsl to 385 mbsl, containing an elongated caldera (1.9 km diameter). It contains two large (800 x 800 m) hydrothermal fields; the summit of the central cone and a swarm of dykes in the southern wall of the caldera. Hydrothermal vents at the summit of the cone include sulphide chimneys venting phase-separated hydrothermal fluids (270°C). Contrasting the arc-front volcanoes occupying the shallowest parts of the volcanic arc, the Monowai volcanic center (25°53'S), occupies a deep depression (Monowai Rift Graben) crossing the arc front. The volcanic complex consists of a large caldera complex (12 km wide, 1600 m deep) and adjacent stratovolcano (Monowai Cone) rising nearly to sea level. Significant hydrothermal activity is located along the southwest caldera wall (Mussel Ridge) with low-temperature (>60°C) hydrothermal venting and inactive sulphides obscured by large mussel beds. A major control on venting along the arc front is water depth (900 m at Volcano 19 to over 1600 m at Monowai caldera), with the highest temperatures inferred for the deep vents and significant volcanic degassing at the shallow vents. We have mapped the volcanic centres to characterize the volcanic stratigraphy associated with the different styles of hydrothermal venting. These comparisons provide important clues for recognizing potential ore-hosting volcanic caldera sequences and structures in ancient submarine volcanic arcs. This is Metal Earth Contribution MERC-ME-2021-018.