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Magmatic volatile influx and fluid boiling in submarine caldera-hosted hydrothermal systems, Niuatahi volcano, Tonga rear-arc

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Submarine caldera volcanoes may host several distinct hydrothermal systems along the caldera wall and related to younger volcanic cones [1]. Magmatic volatile influx and fluid boiling are common processes in shallow subduction zone-related settings leading to spatial variations in the metal endowment of seafloor hydrothermal mineralizations that remain poorly constrained. Four active vent sites are known at Niuatahi caldera discharging high temperature fluids (up to 334°C) with variable salinities (369 to 583 mM Cl) indicating fluid boiling at some of these vent sites. Mineralogical and chemical constraints on the hydrothermal precipitates suggest a transition from magmatic volatile- to host rock-dominated fluid venting along a continuum from the caldera center to the caldera wall. Volatile element enrichment (e.g., Se, Bi, Te) in seafloor mineralizations is typically related to magmatic volatile influx and/or vapour-rich fluid venting induced by boiling processes in the sub-seafloor [2, 3]. However, deciphering the effect of these two processes on the trace element distribution in caldera-hosted submarine hydrothermal mineralizations is still challenging. Here, we combine stable S and radiogenic Pb isotope data with trace element ratios (Te/As, Te/Au) in hydrothermal sulfides and native S that allow, for the first time, to distinguish between a volatile element contribution by magmatic volatiles or boiling-induced vapour-rich fluids. This ultimately leads to the spatially selective trace element enrichment in the seafloor mineralizations at Niuatahi caldera, such as Te, Se, Bi, and Co (± Au, Ag) in the caldera center compared to Au, Ag, Zn, Cd, Tl, and Pb at the caldera wall.

[1] de Ronde et al. (2011), *Mineralium Deposita* 46, 541-584. [2] Keith et al. (2018), *Contributions to Mineralogy and Petrology* 173:40. [3] Falkenberg et al. (2021), *Geochimica et Cosmochimica Acta* 307, 105-132.