Evolution of helium signatures from Kermadec arc under water volcanoes

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Method

The isotopic signature R = ^{3}He/^{4}He of primordial helium in hydrothermal fluids and plumes is significantly different from the atmospheric ratio (Ra) and can be identified with high precision in fluid/water samples. During the *RV Sonne* expedition SO253, we sampled noble gas isotopes from four hydrothermal active volcanoes along the Kermadec arc (SW Pacific) with summit depths between 290 to 1200m below the surface. We extend an existing time series of helium isotopes from the 1990s/2000s in this area [1-4] to observe changes in the underlying plumbing of the hydrothermal systems. The samples were analysed in the lab post-cruise using a combined QMS/SMS [5]. Primordial excess ^{3}He is reported as δ^3He, the deviation of R from Ra (in %).

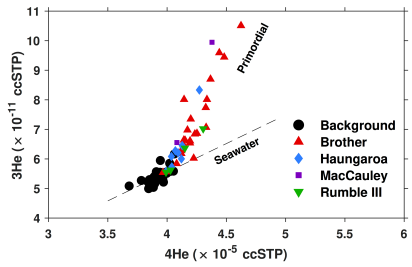

Figure 1: He concentration from Kermadec volcanoes from 2017 (SO253).

Results

The ^{3}He/^{4}He ratios at the volcanoes vary between 5.8 and 6.5 Ra. The maximum δ^3He at the non-buoyant plume level are: Rumble III 90%, Haungaroa 83%, Macauley Cone site 144%, Macauley Caldera site 16%, Brothers Cone site 56%, Brothers NW Caldera site 94%. The sites at Brothers and Macauley Caldera are relatively stable since the late 1990s/early 2000s [3, 5]. δ^3He at Macauley Cone has increased tenfold since 2005 [4], and showed the highest δ^3He of 445% in a weakly diluted sample (pH = 5.0) from the rising plume (< 1m above vent).

[1] de Ronde *et al*. (2001) *EPSL* **193**, 359–369. [2] de Ronde *et al*. (2005) *Econ. Geol*. **100**, 1097–1133. [3] de Ronde *et al*. (2007) *G3*. **8**, Q07007. [4] de Ronde *et al*. (2011) *Miner. Deposita* **46**, 541–584. [5] Sültenfuß *et al*. (2009) *Isotopes Environ. Health Stud*. **45**, 1–13.