From magma to mudpool: linking arc volatiles and active geothermal systems

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The Taupo Volcanic Zone (TVZ) offers a perfect location to track the evolution of volatiles and fluid mobile elements from mafic to felsic melts, as well as their fractionation into the hydrothermal fluids and alteration minerals. These can be compared to the fluid chemistry of active surface features.

Recent melt inclusions analyses show that based on content of F, Cl, and B content, as well as Li and Cs, two distinct types of rhyolites are present in the different eruptive centers in the TVZ [1]. CO_2 and S_{tot} are generally depleted or below detection limits in rhyolites in contrast to andesites or basalts. Similarly, TVZ geothermal fluids are divided into two groups, 1) low-gas (i.e., CO_2), high Cl and Li [2], low B and Li/Cs ratio systems, suggested to have chemical affinities with basaltic (and rhyolitic) magmas, and 2) high-gas, low Cl and Li, high B and Li/Cs ratio systems, having chemical affinities with andesitic magmas [3]. Variation in F and total sulfur are also distinct between geothermal field types.

Melt inclusion data and measurements of gas emissions both are indirect estimates of the true magmatic volatile content. They represent the “left over” after degassing or hydrothermal scrubbing. New direct in–situ analyses of trapped fluid inclusions in phenocrysts and hydrothermal veins associated with magmatic degassing and deep meteoric water circulation provide a way to assess the composition of exsolved magmatic fluids and deep dilute near-neutral geothermal waters. Hypersaline fluid inclusions are enriched in B, Cs and Li in fluid trapped in rhyolite skeletal phenocrysts compared to hydrothermal fluids in veins hosted in diorite. Dilute chlorine meteoric-dominated fluids are enriched in Li, Cl, as well as K and Ca, but are depleted in B.

Sulfur in fluid inclusions is generally below detection limits but the isotopic compositon of ubiquitous pyrite suggests that H_2S is the dominant gas and is likely ultimately derived vias deep basalt degassing. However, rare occurences of hypogene sulfate suggest that some gases with relatively high SO_2/H_2S ratios may be produced by degassing of shallow andesitic intrusions episodically in past or presently.

[1] Bégué *et al* accepted GSL [2] Bernal *et al* 2014, *Geo Cosmo Acta*, **126**, 265-283, [3] Giggenbach 1995, JVGR.