Low-Temperature Hydrothermal Alteration of Intra-Caldera Tuffs, Miocene Tejeda Caldera, Gran Canaria, Canary Islands

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The Tejeda caldera erupted ~20 ryholite-trachyte ignimbrites (Mogan Group 14-13.2Ma), followed by ~20 phonolitic lava-flows and ignimbrites (Fataga Group 12.5-7Ma) [1]. Mogan ignimbrites have been severely altered all along the exposed caldera margin, whereas overlying Fataga units are apparently unaltered [2].

We have determined the mineralogy, major and trace element composition, δD and $\delta^{18}O$ ratios of over 100 altered tuff samples from lower, middle, and upper Mogan units. The altered tuffs contain minerals characteristic of secondary fluid-rock interaction (e.g. adularia, zeolites and clays), and relics of the primary mineral assemblage seen in unaltered tuffs. Strong element mobilities are observed for Pb, Sr, Rb, K, and Si, consistent with a system where fluid is a major transporting agent. The available $\delta^{18}O$ values of altered samples are higher than in unaltered tuffs, indicating a low-T alteration environment. The δD values of altered tuffs range from -52 to -96‰. Low-T interaction of ambient meteoric water (δD ca.-25‰) with the tuffs would have resulted in at least partial equilibration. Clay-water ΔD is ca.-30‰ [3], accounting for observed δD values down to -55‰. Those samples with substantially lower δD values suggest interaction with meteoric water with $\delta D \ll -25$‰, which may have been produced in steam fumaroles.

Supported by numerical modelling, our Gran Canaria data reflect the near-surface, epithermal part of a larger, fault-controlled hydrothermal system where fluid temperatures did not exceed 200-250°C. The phenomena on Gran Canaria can thus be used as a dissected analogue for the architecture of inaccessible active hydrothermal systems such as in Indonesia and New Zealand, and for ancient caldera settings associated with poorly exposed hydrothermal ore deposits.

References

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