The individuality of ascent paths in small volcanic systems: Small eruptive centres near Villarrica volcano, Chile

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Stratovolcanoes in arc settings often have complicated magmatic histories. These can include assimilation of slab-derived material and/or wall rock and sometimes multiple phases of fractional crystallisation in reservoirs at varying depths. However, when magma volumes are small and melting and eruption events are too short-lived to develop complicated histories, an opportunity is provided whereby source-to-surface processes in arcs can be investigated.

In Southern Chile there are several examples of stratovolcanoes that are adjacent to small volume basaltic volcanic fields. One such example is the coexistence of the stratovolcano Villarrica and the Caburgua-Huelemolle small eruptive centres (SECs). The latter is composed of eight Holocene basaltic complexes. Three of these are aligned with a major tectonic structure NNE-SSW (the Liquine Ofqui Fault Zone), three form a secondary alignment NEE-SWW, and two are not related to structural features. The nearby stratovolcanoes Villarrica, Quetrupillan and Lanin are aligned NW-SE. Whole rock major and trace element data and U-Th isotopes were obtained for eruptive material from the majority of the SECs. Significant variation is observed in composition, between and within eruption sequences. Individual centres display distinct signatures in U-Th space despite erupting only a few kilometres apart. The chemical dissection of a case study centre suggests that ascent is fast at the beginning of the melting event, and slows with the progression into a more stable magmatic system, as seen in whole rock data and more in-depth crystal studies. It is suggested that rather than differences in the mantle source, it is the ascent processes which vary and create the real difference to the neighbouring stratovolcanoes. Such studies may provide the 'missing link' between single event (monogenetic) and stratovolcanoes helping us to understand why one volcanic style is preferred over another in such settings, and how they can co-exist.