Fluid-melt crust interaction beneath the Andean arc : textures, crystal zoning and CO2-inclusions in gabbroic xenoliths from san Pedro volcano (SVZ)

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Crustal sections beneath active continental arcs are 'percolation columns' in which the crust is continuously under modification by pluton emplacement, circulating fluids, and interactions with ascending magmas. Amphibole- and phlogopite-bearing gabbroic xenoliths from a Holocene dacite of V. San Pedro have been interpreted as formed by the reaction of a hydrous silicic melt with a partly solidified cumulate pile (Costa et al. 2002).

Optical microscopy and back-scattered electron images reveal complex textures including partial melt zones, numerous arrays of secondary fluid inclusions, and, in some samples, melt inclusions, mainly in olivine. Three main stages are identified. (1) Metasomatism of original gabbroic cumulates leads to the formation of poikilitic hornblende, micas, orthopyroxene and sodic plagioclase by reaction of olivine, plagioclase and possibly clinopyroxene with hydrous melt. (2) Fluid infiltration along cracks, now preserved as fluid-bearing healed microfractures affects olivine, most orthopyroxene, clinopyroxene, plagioclase and first stage amphibole. (3) Destabilization and melting, mainly of the hydrous minerals, occur during the remobilization in the host lava, associated with new mineral growth. Amphibole, orthopyroxene, olivine, and sodic feldspar produced in stage (3) resemble those from stage (1) but lack fluid inclusions. Fracture and melt migration at this stage is observed as veinlets cross-cutting various minerals.

Inclusions analysed by Raman spectroscopy and microthermometry contain CO2 fluids with a small amount of N2. Their low density, below the critical density, implies equilibration at pressures lower than 2 kbar. Variations between inclusion arrays suggest several generations of fluids under variable conditions. LA ICPMS data of inclusions in olivine show low trace element contents in early, dense inclusions and more trace elements (Th, Sr, Pb) in late, very low-density fluids suggesting possibly aqueous fluid (although not observed) or melt.

Because of the overpressure caused by reheating in the host melt, CO_2 inclusions present in the gabbros before assimilation can modify the melt-crust interactions by facilitating the fracturing of the solid rocks and influence crustal assimilation by the magma.

REFERENCES

Costa F, Dungan MA, Singer BS 2002. Horneblende- and phlogopite-bearing gabbroic xenoliths from Volcán San Pedro (36°S), Chilean Andes: evidence for melt and fluid migration and reactions in subduction related plutons.Journal of Petrology 43, 219-241.