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Développement du Sujet : (1 à 2 pages)

1. The Ecuadorian volcanic arc

Based on whole-rock major and trace elements compositions, two contrasting models have been postulated for the Ecuadorian arc. From one side, a group of researchers considers that the metasomatic agent is an aqueous fluid issued from dehydration process of the slab (Barragan et al., 1998; Garrison and Davidson, 2003; Chiaradia et al., 2009). On the other side, the occurrence of adakitic compositions on the Ecuadorian arc suggested that the metasomatic agent is a siliceous melt originated by slab partial melting (Bourdon et al., 2003; Samaniego et al., 2005; 2010; Hidalgo et al., 2012). Recently, Ancellin et al. (2017) studied the regional variability of the whole-rock major, trace elements and Sr-Nd-Pb isotopes of the entire Ecuadorian arc, and conclude that the strong along- and across-arc geochemical variations can be explained by the participation of both slab and crustal sources.

Constraining arc magmatic sources in arcs with thick continental crust is a challenging task because crustal differentiation process (such as fractional crystallization and assimilation) partly conceals the deep geochemical signal associated with the slab and mantle wedge. In order to avoid this crustal imprint, we focus on primitive magmas with little or no crustal geochemical signatures and specifically on olivine-hosted melt inclusions in these primitive magmas. In Ecuador, primitive arc magmas are mostly represented by primitive andesites (Mg# ≥ 60, following the criteria of Kelemen et al., 2014), whereas primitive basalt are absent or are extremely rare. In fact, in the whole NVZ, only one primitive basalt has been described at Sangay volcano (sample SAN20B, Monzier et al., 1999).

In a previous work, Le Voyer et al. (2008) analysed olivine-hosted melt inclusions in two samples from Pichincha and Pan de Azucar volcanoes, which are located in the northern part of the arc (at frontal and back-arc positions), and more recently Narvaez (master's report, 2016) analysed melt inclusions trapped on Fo-rich olivines in several samples from Puñalica and Sangay volcanoes (including SAN20B sample) located in the southern part of the arc, on both sides of the Grijalva Fracture Zone. Both studies show (1) the existence of Ca-rich compositions that suggest the participation of clinopyroxenite-rich lithologies in the mantle wedge; and (2) that two contrasting metasomatic agents (an aqueous fluid and a siliceous melt) co-exist in this part of the Andean NVZ.

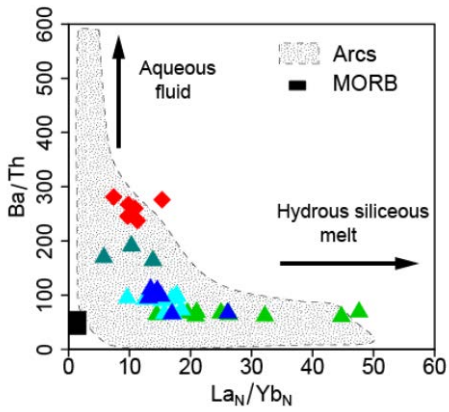

Figure 2. $(La/Yb)_N$ vs. Ba/Th diagram for primitive melt inclusions of Sangay (red diamonds) and Puñalica (green and blue triangles). The contrasting behaviours of the aqueous fluids and the hydrous siliceous melts are also depicted. From Narvaez (2016).

2. Objectives and proposed work

This project deals with the enlargement of Le Voyer et al. (2008) and Narvaez (Master 2, 2016) works by studying 5 new primitive andesites in order to cover the entire arc. The targeted samples come from Cotacachi (Ancellin et al. 2017), La Virgen cone (Cayambe; Samaniego et al., 2005), and Yuyos lava flows (Chacana; Chiaradia et al., 2014) from the northern part of the arc; and the Licto and Calpi cones (Ancellin et al. 2017) from the southern part of the arc. Our goal is to determine the major, trace elements and volatile compositions of primitive melt inclusions. Based on these data we would to:

**** Constrain the mantle source of these magmas.*** In particular, we are looking for potential along-arc major elements variations of primitive melt inclusions with the aim to identify potential changes of mantle lithologies (clinopyroxenite *vs.* peridotite sources) in a continental arc with thick crust. Our target is to estimate the contribution of these clinopyroxenite-rich lithologies to the arc magma generation.

**** Constrain the slab components incorporated into the mantle wedge.*** Based on the trace elements and especially volatile composition of the primitive melt inclusions (H_2O, CO_2, F, Cl and S), we would identify the potential along-arc changes of the components released from the slab. In doing that, we would correlate these slab components with the geodynamical parameters such as slab age and geometry (i.e. the thermal regime of the slab).

**** Experimentally study sulphur diffusion to bring new constrains on sulphur degassing along the Ecuadorian arc.*** The primitive volatile composition of the magma in combination with sulphur diffusion data would provide insights into degassing history of magma. This is because sulfur is one of the earliest volatile element to exsolve in magmas (≈140MPa; e.g. Spilliaert et al., 2006) and sulphur has several isotopes (^{32}S, ^{33}S, ^{34}S and ^{36}S) that can fractionate during degassing. Experiment simulation of sulphur degassing provide critical information to access the extent and the timing of the degassing process.

3. Deliverables

- A comprehensive set of major, trace elements and volatiles concentrations for selected primitive andesites of the Ecuadorian arc.
- Characterisation of the metasomatic components from the north to the south of the Ecuadorian arc and its links with the geodynamics.
- A model for degassing processes via experiments on sulphur.

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