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Phlogopite-bearing undersatured basalts and basic andesites from the Ecuadorian rear-arc area

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Ecuadorian rear-arc volcanism is mainly known through previous studies focused on the quaternary Sumaco stratovolcano, which erupted hauyne phenocrysts-bearing undersatured basalts with unusual alkaline affinities (*Colony and Sinclair, 1928*; *Barragan et al., 1998; Eissen et al., 2002*; *Bourdon et al., 2003*). Recently, two new quaternary formations of undersaturated basalts to basic andesites have been identified in the Ecuadorian rear-arc province, near the city of "El Puyo", around 1° South (**fig. 1**). The purpose of this abstract is to present these edifices, as well as the first mineralogical and chemical data already available.

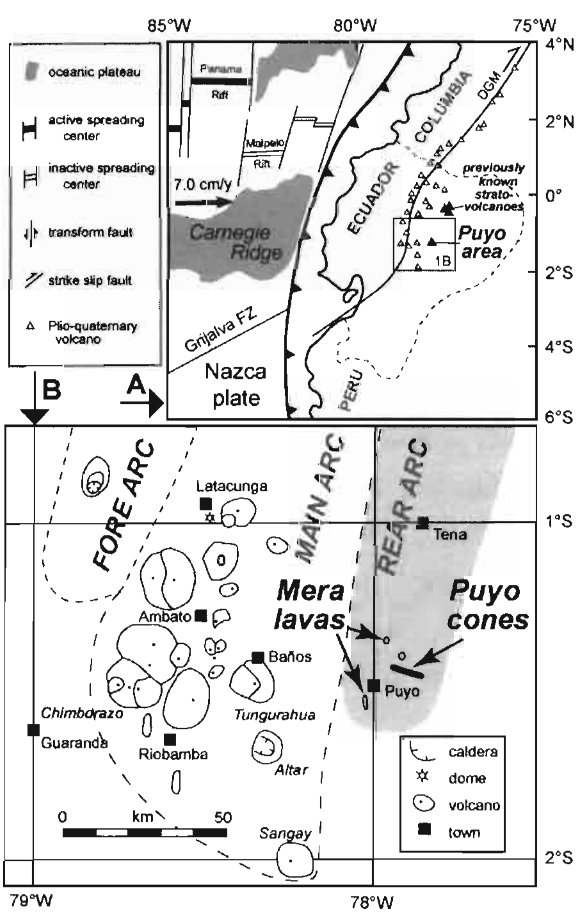

Figure 1

A: Geodynamical simplified map of the Northern Andes (modified from *Gutscher et al., 1999*; relative plate motions according to *Kellog & Vega, 1995*). Grey arrows correspond to the direction of subduction. The Plio-Quaternary Ecuadorian volcanic domain is divided in three sub-parallel rows: the fore arc (Cordillera Occidental), the main arc (Cordillera Real) and the rear-arc area (Oriente). The geochemical characteristics of erupted magmas strongly vary across these three rows. Filled triangles represent the rear-arc edifices.

B: Location map for the studied edifices (Puyo cones and Mera lavas) in the rear-arc area, near the city of "El Puyo".

The Puyo basaltic cones consist of nine aligned scoria cones associated with at least three lava flows, which outcrop nearby the village of "10 de Agosto" (*ca.* 10 km NE of the city of "El Puyo"). They emplaced over the Mera detritic formation, whose erosion surface was dated at about 40 000 yBP (*Bès de Berc, 2003*). These scoriae and lavas consist of olivine + clinopyroxene ± phlogopite phenocrysts-bearing undersaturated basalts exhibiting an ultrapotassic absarokite composition (**fig. 2**) (42 < SiO_2% < 50; 1.4 < K_2O% < 4.1; values from major elements analyses recalculated to 100%, LOI free). Geochemical modelling shows that they could result from very low degrees (1-1.2 %) of partial melting of a mantle previously metasomatized by about 3% of slab-melts, leaving a phlogopite-bearing (but garnet free) harzburgitic residue (**fig. 3**). These scoria cones were probably emplaced during a single fissural eruptive event of upper Pleistocene to possible Holocene age.

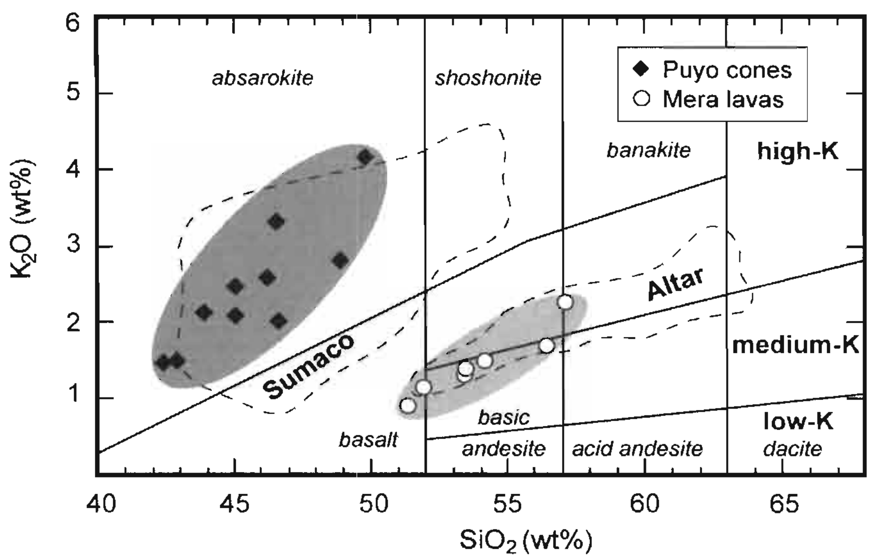

Figure 2:
K_2O *vs.* SiO_2 diagram showing Puyo cones and Mera lavas. Fields for Sumaco (rear-arc stratovolcano: *Bourdon et al., 2003*) and Altar volcano (edifice belonging to the main arc) come from IRD geochemical data base.

The Mera lavas are represented by several isolated thick olivine + clinopyroxene phenocrysts-bearing lava flows. Their emissive center(s) as well as their age (probably upper Pleistocene) still remain unknown. Even if their medium-K basaltic to basic andesitic compositions are similar to those of main arc lavas, they differ by their incompatible element contents, especially their high-Nb contents (*e.g.* 11 < Nb ≤ 14 ppm) which clearly relates them to the Ecuadorian rear-arc province. Geochemical modelling points out that they also result from low degrees (1.4-2%) of partial melting of a slab-melt-metasomatized mantle leaving a harzburgitic residue (**fig. 3**) followed, for the more differentiated terms of this series, by up to 30% of fractional crystallization of an olivine + clinopyroxene + plagioclase + titanomagnetite + apatite cumulate (**fig.4**).

The Sr (~0.7041) and Nd (~0.5128) isotopic ratios of the Mera samples are similar to those of the Ecuadorian main arc lavas, showing that extremely limited continental contamination might have affected these magmas during their ascent towards the surface.

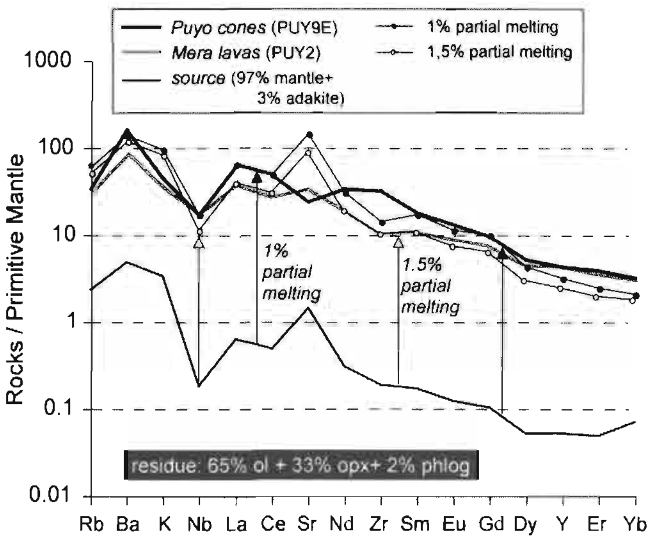

Figure 3:

Extended trace element patterns showing 1% and 1.5% partial melting of a 3% adakite-metasomatized depleted mantle. For comparison, the most pristine lava of each series, namely PUY9E for the Puyo cones and PUY2 for the Mera lavas, is shown. The computed residue contains 65% olivine + 33% orthopyroxene + 2% phlogopite. Normalization to primitive mantle from Sun & McDonough (1989).

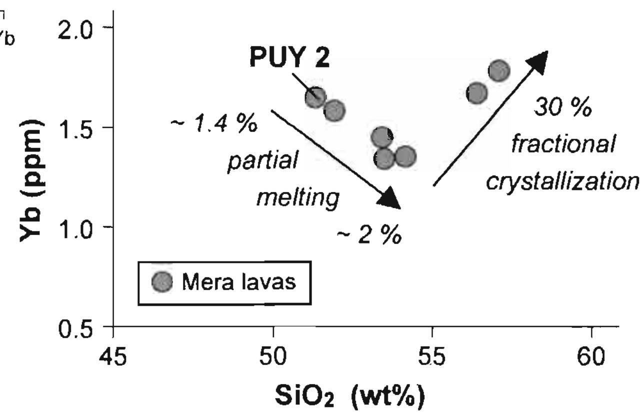

Figure 4:

Yb *vs.* SiO_2 diagram showing the change of Yb behaviour in the Mera lava series at 55% SiO_2. This break is interpreted as due to the change from partial melting to fractional crystallization process

These two new volcanic formations allow to extend the Ecuadorian rear-arc province some 100 km south of the previously known large alcaline stratovolcanoes (*eg.* Sumaco and Pan de Azucar), located around the equator. Their K- and Nb-rich nature, with several other parameters, is similar to the geochemical characteristics of the High-Nb basalts, observed in association with adakitic occurrences in many other volcanic provinces. Their presence in the Ecuadorian rear-arc area supports the petrogenetic model that has been proposed previously by Bourdon et al. (2003). In order to constrain more precisely the petrogenesis of these magmas, melting experiments are carried out in a piston-cylinder apparatus, whose results will be compared with further geochemical modellings.

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