Miocene adakitic intrusions in the Western Cordillera of Ecuador

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Introduction

Ecuador is part of the northern Andes, which comprise accreted oceanic terranes on their western part. In Ecuador, these terranes are underplated, and form the crustal root of the Western Cordillera (Guillier et al. 2001). On the other hand, Recent arc magmatism is marked by abundant volcanic rocks of adakitic affinity (Bourdon et al. 2002, 2003). This led to the hypothesis that the adakitic products derive from the partial melting of the deeply buried accreted oceanic material (Arculus et al. 1999, Beaudon et al. 2005).

The aim of this paper is to present new geochemical results on Miocene intrusions sampled in the Western Cordillera (Fig. 1), in order to check wether adakites occur, and if so, to constrain their origin.

Sampling

11 intrusions have been sampled west of Latacunga, and near Guaranda, *i.e.* south of the Pichincha volcano and East and South of the Chimborazo volcano, where recent adakites are abundant (Kilian et al. 1995, Bourdon et al. 2002). In the Latacunga area, some intrusions yielded 6.3±0.7 Ma, and all studied rocks crosscut the Zumbagua Fm, of Middle to Late Miocene age (Hughes et al. 1998). In the Chimborazo area, some of the studied intrusions crosscut the Zumbagua Fm (≈ 17-8 Ma, McCourt et al. 1998), while others are injected within major Miocene faults that crosscut Oligocene rocks. Additionally, a small granodioritic stock yielded farther East a 10.1±0.2 Ma (McCourt et al. 1998). Therefore, the age of the studied samples are probably of Middle to Late Miocene age.

Petrography

The intrusions are hypovolcanic stocks, which range in composition from microgabbros to tonalites and dacites, through microdiorites. The microgabbros are formed of abundant cpx, opx and amphibole phenocrysts. The microdiorites differ from the microgabbros by the presence of green or brown zoned amphiboles, coexisting in some facies with plagioclase phenocrysts. Among the most differenciated rocks, represented by tonalites and dacites, biotite and quartz *phenocrysts* are observed.

Geochemistry

All these shallow level intrusions are characterized by LREE-enriched patterns ($3.50 \leq La/Yb_N \leq 10.17$), Nb and Ta negative anomalies ($1.70 \leq La/Nb \leq 4.06$). Their Sr/Y ratios range from 30.17 to 107.88. These features are typical of calc-alkaline melts. Among these rocks, some fall in the range of adakites ($Sr/Y \geq 45$, Fig. 3).

Compared with the recent adakites from the Pichincha volcano, the Miocene adakites show similar primitive mantle normalized patterns (Fig. 2).

In the Sr/Y *vs* Y (ppm) diagram, the hypovolcanic Miocene intrusions show a trend between clac-alkaline rocks and adakitic *s.s.* melts (Fig. 3). This trend is often observed in present-day calc-alkaline adakitic suites.

Discussion, conclusions

Among the analyzed rocks, most exhibit adakitic affinities. In spite of the lack of complementary chronological data, this suggests that adakitic magmas do not occur only in Recent times, but also probably in the Late Miocene. Therefore, their genesis is not necessarily related to flat slab subduction induced by the subduction of the Carnegie Ridge (Bourdon et al. 2003), which is considered as no older that 5 Ma. Moreover, flat slab subduction do not occur north of 4° S (Guillier et al. 2001).

As a consequence, we propose an alternative hypothesis for the genesis of adakitic melts. The latter could derive from the partial melting of the deep mafic root of the Western Cordillera, as supported by the high geothermal gradient evidenced by metamorphic assemblages (Amórtegui et al., this volume).

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