WHITNESSES OF AN ACCRETED OCEANIC TERRANE IN EARLY EOCENE DEPOSITS OF NORTHERN PERU : TECTONIC IMPLICATIONS

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INTRODUCTION - GEOLOGICAL FRAMEWORK

Northwestern South America is made of accreted oceanic terranes, some of which are assumed to have been subsequently displaced along major dextral wrench faults (McCourt et al., 1984; Aspden & Litherland, 1992; Toussaint & Restrepo, 1994; Litherland et al., 1994; Aspden et al., 1995; Cosma et al., 1998; Jaillard et al., 1999). However, such movements are difficult to demonstrate and quantify.

Western Ecuador comprises oceanic and continental terranes accreted to the south-american margin (Litherland et al., 1994; Cosma et al., 1998). These terranes include oceanic plateaus overlain by island arc series of Cretaceous age (Goossens & Rose, 1973; Kehrer & Van der Kaaden, 1979; Lebrat et al., 1987; Cosma et al., 1998, Reynaud et al., 1999). They were accreted in the Late Cretaceous (Faucher & Savoyat, 1973; Kehrer & Van der Kaaden, 1979; Lebrat et al., 1987) and in the Late Paleocene (~ 57 Ma; Jaillard et al., 1997; Cosma et al., 1998). In southern Ecuador (Guayaquil area), the latter event is locally marked by strong deformations which affect early Late Paleocene cherts and are concealed by unconformable, coarse-grained quartz-rich turbidites of latest Paleocene age (Jaillard et al., 1997).

In the Paita area (northern Peru, fig. 1), unconformable transgressive forearc deposits of latest Cretaceous age rework the metamorphic and sedimentary Paleozoic basement (Fig. 2; Jaillard et al., 1999). The unconformably overlaying coarse-grained conglomerates (Mogollón Fm), of latest Paleocene-earliest Eocene age (~ 56-52 Ma, Morales, 1993), contain boulders of mafic magmatic rocks, whereas such boulders are lacking in the underlying deposits. The petrographic and geochemical study of five of these boulders indicates that some of them are of oceanic origin, thus indicating that an accretion occurred in Northwestern Peru by the Paleocene-Eocene boundary.

PETROGRAPHY AND GEOCHEMISTRY OF MAGMATIC ROCK BOULDERS FROM THE MOGOLLON FORMATION (PAITA BASIN)

Petrography and mineralogy

All the samples are affected by a low grade metamorphism. Plagioclase is sometimes altered in sericite while clinopyroxene is entirely replaced by pale green actinolitic hornblende and actinolite. Amphibole is replaced by chlorite and epidote.

Microdiorites are highly phyric with plagioclase and clinopyroxene phenocrysts enclosed in a matrix entirely crystallised into actinolite and chlorite. The plagioclase clusters in glomeroporphyritic aggregates. When preserved, it shows andesine to labradorite compositions. Fe-Ti oxides (5 %) are enclosed in the phenocrysts or present in the groundmass. The gabbro exhibits a cumulate texture with plagioclase (labradorite) as cumulus and clinopyroxene as intercumulus. The crystallization of the abundant Ti-rich magnetite begins after the plagioclase and continues while the clinopyroxene precipitates. Finally, the granophyre is characterized by a pegmatitic texture with plagioclase laths embedded by quartz. Amphibole and epidote are in accessory.

On the basis of the Fe-Ti oxides in the sequence of crystallisation, microdiorites show calc-alkaline affinities while the gabbro is tholeiitic.

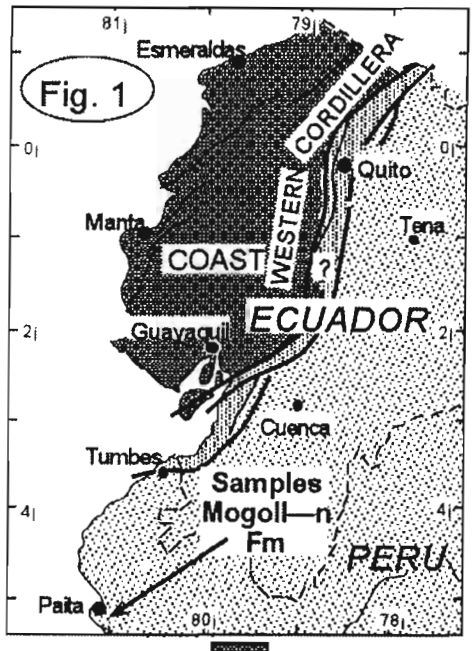
Geochemistry

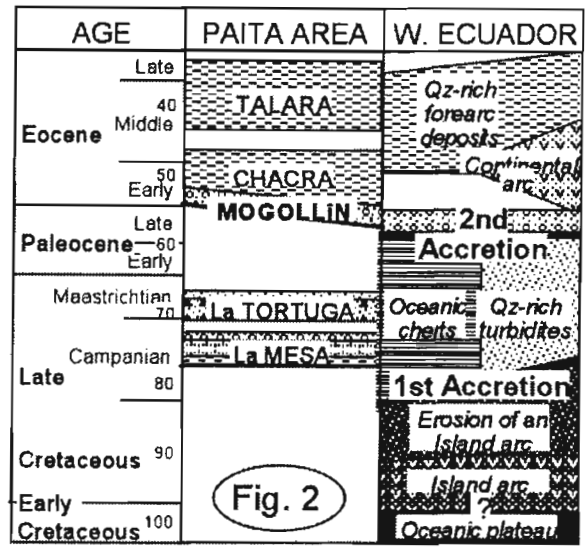
Gabbro and microdiorites have low TiO_2 contents (< 1.5 %). Microdiorites are markedly depleted in Light Rare Earth Elements (LREE) relative to Heavy (H) REE [$0.13 < (La/Yb)_{cn} < 0.76$], whereas the gabbro is slightly enriched in LREE relative to HREE [$(La/Yb)_{cn} = 2.21$] (fig. 4A). The granophyre has the highest $(La/Yb)_{cn}$ ratio (4.3) (fig. 3).

The microdiorites, the gabbro and the granophyre show features of subduction-related rocks because they exhibit the classic Nb and Ta negative anomalies, relative to N-MORB. Both rocks are depleted in Zr and Hf relative to N-MORB. However, the gabbro differs from the microdiorites by the absence of the Ti negative anomaly (relative to N-MORB; Fig. 4B). The granophyre differs from the gabbro and microdiorites by higher contents in large ion lithophile elements (LILE), Th, Zr and Hf (fig. 4B). Finally, the gabbro and microdiorites cluster in the oceanic arc tholeiite field defined by Pearce et al. (1984) while the granophyre falls in the shoshonitic domain (fig. 3).

CONCLUSIONS, TECTONIC IMPLICATIONS

Petrographic and geochemical studies indicate that the microdiorites derived from a calc-alkaline magma depleted in incompatible elements. The gabbro differs from the diorites only by its tholeiitic composition. Therefore, these rocks emplaced most probably in an intra-oceanic island arc setting. The





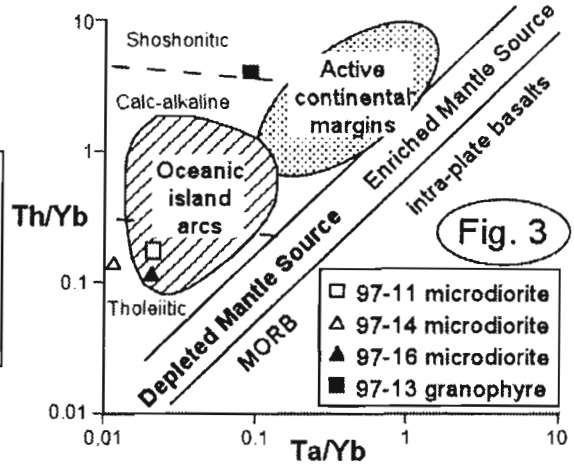
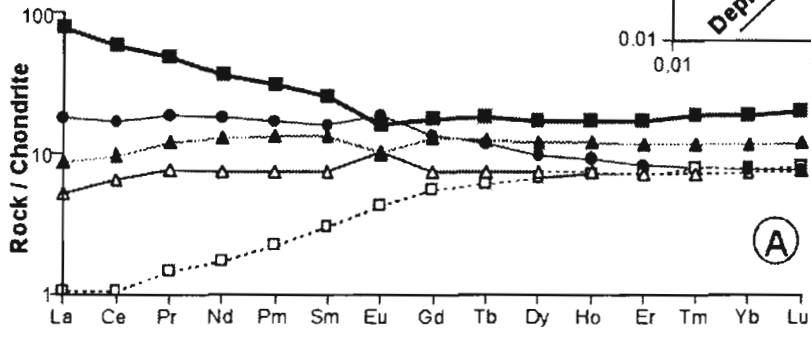


Fig. 1 : Structural sketch of NW Peru and Ecuador.
Fig. 2 : Stratigraphic sketch of NW Peru and Western Ecuador
Fig. 3 : Th/Yb vs Ta/Yb diagram for some boulders of the Mogoll—n Fm



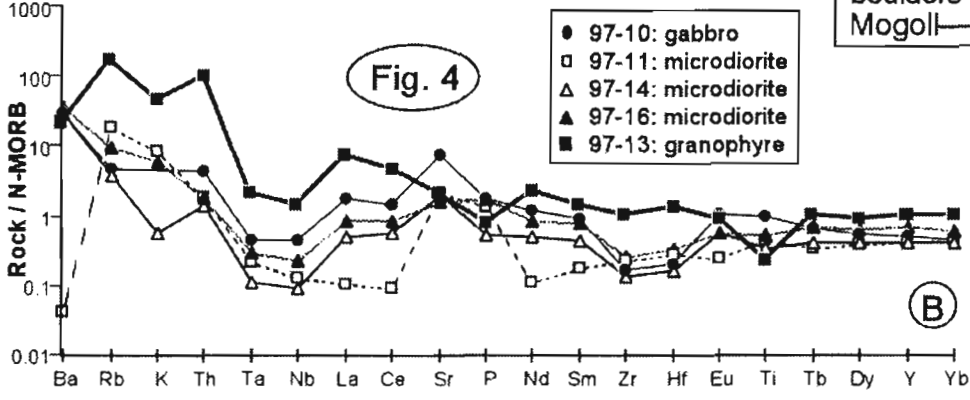


Fig. 4 : Normalized spidergrams of some boulders from the Mogoll—n Fm.

granophyre is significantly enriched in LILE, Th, LREE, Zr and Hf. It may derive either from an evolved island arc, or from an active margin magmatism.

The first appearance of island arc-deriving boulders in the latest Paleocene-earliest Eocene unconformable conglomerates of the Paita area confirms that collision of an oceanic terrane occurred in the Late Paleocene, and indicates that it took place in northern Peru. Since the closest oceanic terrane crops out presently south of Guayaquil, *i.e.*, 250 km north of Paita, it shifted NNE-ward along dextral wrench faults at a minimal average rate of 4.5 mm/year, since the Paleocene-Eocene (~ 55 Ma).

Such dextral wrench movements are documented since the Miocene, and an average rate of 2.5 mm/yr has been estimated for the Quaternary (Lavenu et al., 1994). This rate accounts for only 75 to 200 km since the Paleocene-Eocene boundary. Our data suggest, therefore, that dextral movements began well before the Miocene, and/or that the displacement rate was significantly higher than that calculated for recent times.

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