Geochronology and provenance analyses of allochthonous terranes of the Western Cordillera, Ecuador.

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The Western Cordillera of Ecuador consists of allochthonous terranes, which accreted to the South American margin during the Late Cretaceous and Early Tertiary. Each allochthonous terrane is composed of a mafic oceanic basement, overlain by pre-, syn- and post-accretionary Late Cretaceous and Tertiary sedimentary rocks. Transcurrent displacements along major N-S trending faults, resulting in variable clockwise rotations, have produced a complex juxtaposition of tectono-stratigraphic units. We present both, provenance analyses of the sediments, which overlie the mafic basement, as well as U/Pb zircon (SHRIMP) and $^{40}Ar/^{39}Ar$ datings of basement rocks between 0º 20' N to 2º S. Based on this data we propose a tentative geological history of parts of the Western Cordillera.

The Pallatanga Terrane is exposed along the eastern border of the Cordillera (Fig. 1) and is separated from the continental margin by a deformed suture zone (the Pujilí fault zone). Mafic basement rocks (Pallatanga Unit) yield oceanic plateau geochemical signatures and probably form part of the Caribbean Oceanic Plateau, implying a Late Cretaceous age (Spikings et al., 2001; Kerr et al., 2002). The Macuchi Terrane is located along the western border of the cordillera, and is separated from the Pallatanga Terrane by the regional-scale Chimbo-Toachi dextral shear zone. Geochemically, the basaltic-andesitic basement of the Macuchi Terrane (Macuchi Unit) has an island arc affinity (Hughes and Pilatasig, 2002). $^{40}Ar/^{39}Ar$ analyses of plagioclase crystals yield a plateau age of 42.62 ± 1.3 Ma, which is consistent with the Middle Eocene age determined in the sedimentary rocks associated with this unit (Eguez, 1986).

The San Juan Unit hosts ultramafic and gabbroic mafic cumulates, which yield an oceanic plateau geochemical signature, similar to the Pallatanga Unit (Mamberti et al., 2004). U/Pb (SHRIMP) analyses of homogeneous zircons extracted from a gabbro in the San Juan Unit yielded an age of 87.1 ± 0.8. Ma. The U/Pb age is interpreted as the crystalllisation age of the gabbros. Zircons from a fractionated juvenile pegmatite, which forms part of the Pallatanga Unit, yielded a U/Pb (SHRIMP) zircon age of 85.5±0.6, which we interpret to be the time of crystallisation of late, fractionated melts that gave rise to the Pallatanga Unit. The San Juan and Pallatanga units have very similar ages, suggesting that they probably represent a single plateau sequence that hosts both ultramafic cumulates and younger fractionated sequences, similar to what is observed in the Caribbean Colombian Oceanic Plateau sequence in Colombia (Kerr et al., 2002).

Associated with the Pallatanga Terrane is the Rio Cala volcanic arc system, which comprises various volcanic and volcaniclastic units (Natividad, Mulaute, Pilatón units). $^{40}Ar/^{39}Ar$ analyses of plagioclase crystals extracted from basalts of the Natividad Unit yield a plateau age of 64.3±0.4 Ma, interpreted as the time of crystallization subsequent to eruption.

Heavy mineral (HM) assemblages of volcanic rich sandstones overlying the Pallatanga Unit (Mulaute and Pilatón units), are characterized by high percentages (90 - 95%) of volcanic derived minerals, suggesting that they were derived from a volcanic source, distant from the continent. However, a significant quantity of material derived from continental crust occurs in the Saguangal Unit. The latter stratigraphically overlies the Mulaute and Pilaton units. Single grain geochemistry of clinopyroxenes (CPX) extracted from these units indicate that their mafic sources were tholeiitic and formed in a subduction zone, suggesting an oceanic island arc origin. The juxtaposed Campanian - Maastrichtian Natividad Unit is dominated by volcanic derived minerals. The composition of CPX extracted from basalts and sandstones in this unit indicates a tholeiitic island arc setting.

In conclusion, similar U/Pb crystallization ages from the San Juan and Pallatanga units suggest that they represent ultramafic and fractionated components of a single oceanic plateau sequence, which crystallized during 88 – 85 Ma. These ages partly overlap with those determined for the Caribbean plateau (e.g. 91 - 88 Ma; Sinton et al. 1998). Heavy minerals, single grain geochemistry and sedimentary facies indicate that the associated Rio Cala island arc units were derived from an island arc volcanic source, which was separated from continental detrital input until deposition of the Saguangal Unit. $^{40}Ar/^{39}Ar$ dating indicates that the island arc was active during the Maastrichtian-Danian. However, microfossil data suggest it may be as old as the Campanian (Boland et al. 2000). Furtheron, U/Pb zircon dating (LA-ICPMS) in sedimentary rocks of the Saguangal Unit yield a maximum age of 56 Ma for the detrital zircons, which suggests that the Rio Cala island arc system was already accreted to the continent during the Late Paleocene.

The Macuchi Terrane is interpreted as a volcanic arc produced by subduction of oceanic crust below the already accreted Pallatanga oceanic plateau elements. The activity of this arc probably started in the Paleocene and continued till the Late Eocene.

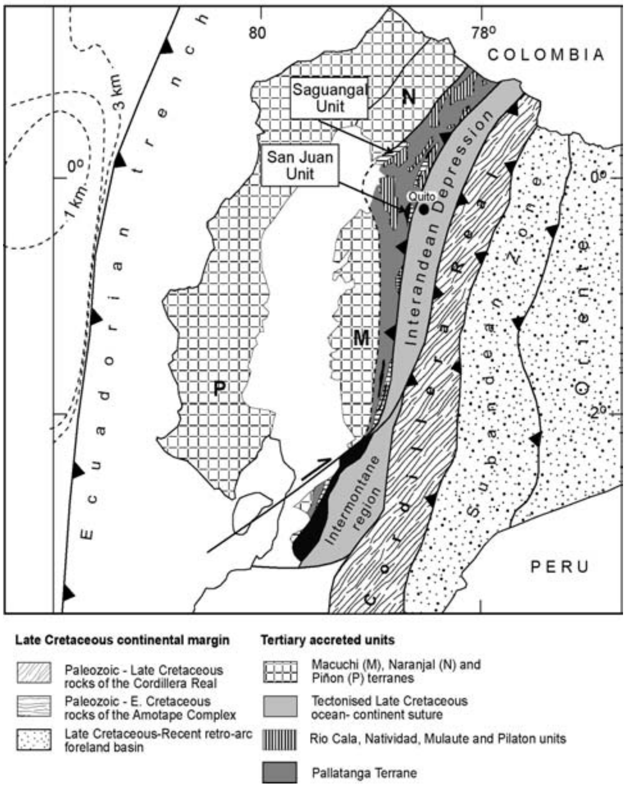

Figure 1. Regional geology of Ecuador, including the allochthonous terranes of the Western Cordillera and coastal region.

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