6th International Symposium on Andean Geodynamics (ISAG 2005, Barcelona), Extended Abstracts: 461-463

Cretaceous rotations of the coastal blocks of Ecuador (1°N-3°S): Paleomagnetic evidence and implications for the origin and accretion of the blocks

Léonard D. A. Luzieux [1], Friedrich Heller [2], Richard Spikings [3], Wilfried Winkler [1], & Cristian F. Vallejo [1]

1 ETHZ, Geologisches Institut, Sonnegggstrasse 5, CH-8092 Zürich, Switzerland; leonard.luzieux@erdw.ethz.ch, cristian.vallejo@erdw.ethz.ch, wilfried.winkler@erdw.ethz.ch
2 ETHZ, Institut für Geophysik, CH-8093 Zürich, Switzerland; heller@mag.ig.erdw.ethz.ch
3 Minéralogie, UNIGE, 13 Rue des Maraichers, CH-1211 Genève 4, Switzerland; richard.spikings@terre.unige.ch

KEYWORDS : Ecuadorian forearc, Paleomagnetism, $^{40}Ar/^{39}Ar$, Plateau, Accretion

Introduction

The coastal lowlands of Ecuador, constituting the Andean forearc between 1°N and 3°S, are composed of distinct structural blocks separated by major N-NE and W-NW oriented faults (Fig.1: the Puerto Cayo, Canande and Chongòn-Colonche faults). Although their allochthonous origin has been proven [1], the origin and timing of accretion of the individual oceanic remnants is a matter of debate. We present new paleomagnetic and $^{40}Ar/^{39}Ar$ data derived from Cretaceous basaltic lavas and their early Tertiary sedimentary cover rocks, which constrains the origins of individual, fault-bounded blocks within the Ecuadorian forearc.

Preliminary results and discussion

Mafic, oceanic plateau derived rocks of the Piñon Block (PB) are exposed in the southwest although their eastern contact with basaltic and andesitic hyaloclastites of the Paleocene(?)-Eocene Macuchi island arc is not exposed. The highly altered nature of the basalts has so far precluded radiometric age determination. $^{40}Ar/^{39}Ar$ analyses of low-K phases and whole rocks, however, are currently in progress. Paleontological analysis of the overlying sedimentary rocks constrain the mafic basement to be of pre-Turonian age [3]. Continent-derived turbidites in the juxtaposed Santa-Elena Block to the south suggest that the PB was proximal to the continental margin and possibly collided with it during the Paleocene-Eocene [4]. Our paleomagnetic results indicate that a 50-60° clockwise rotation [1, 5] was achieved mainly prior to the Maastrichtian, suggesting that the PB experienced a major tectonic event during the middle to late Cretaceous. The start of the rotation has been constrained by a $^{40}Ar/^{39}Ar$ hornblende (gabbro) plateau age, which indicates a cooling age of 87±2 Ma. Paleomagnetic data from the same site show that rotation hadn't started at the time of cooling. Thus the tectonic event must have taken place between 87-71 Ma.

The San Lorenzo Block (SLB), which has faulted contact with the PB (Fig. 1), is composed of a mafic oceanic plateau basement sequence, which is overlain by Santonian-Campanian volcanoclastic deposits (Cayo Fm.), and Maastrichtian-Paleocene island arc lavas. Measured declinations within the arc lavas show a clockwise rotation of 40-90°. Their paleomagnetic inclination shows little variation and strongly supports an equatorial position during the crystallisation of the basalts.

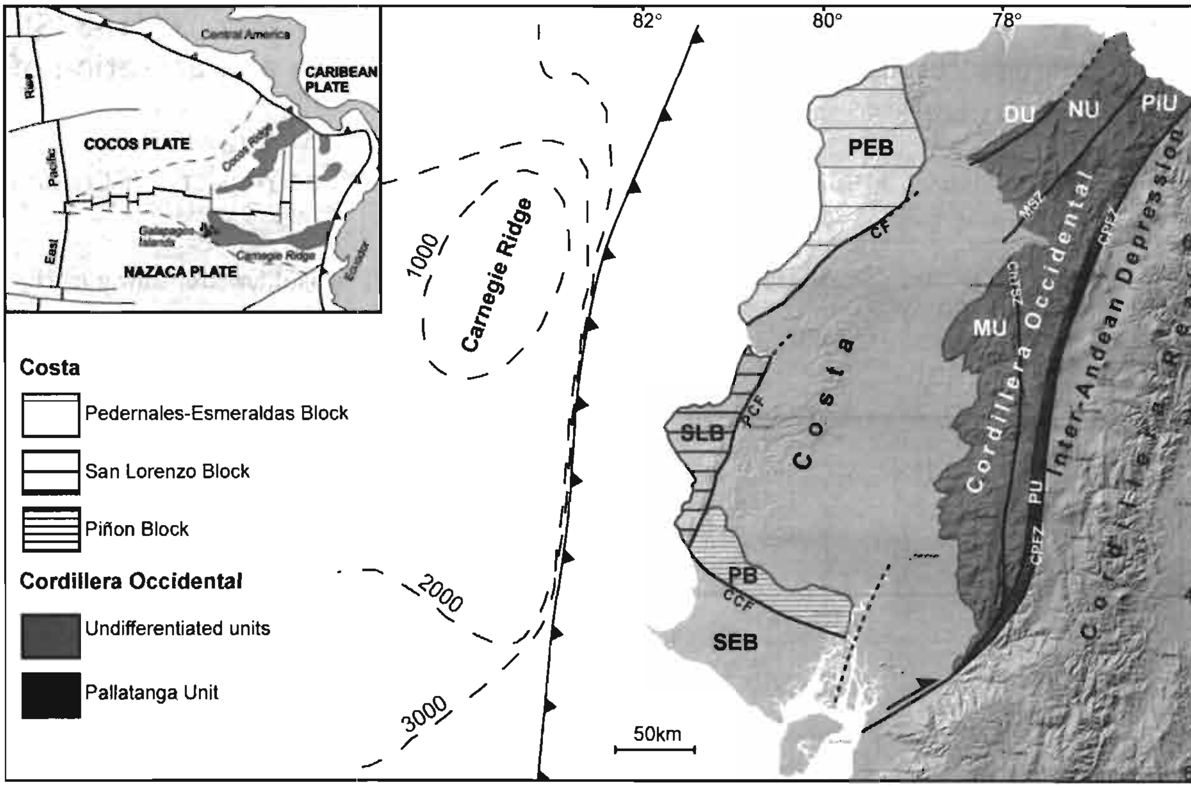

Fig.1 : Faults - CCF: Chongòn-Colonche Fault, PCF: Puerto Cayo Fault, CF: Canande Fault, ChTSZ: Chimbo-Toachi Shear Zone, CPF: Calacali-Pallatanga Fault Zone, MSZ: Mulaute Shear Zone. Blocks (Costa) – SEB: Santa Elena Block, PB: Piñon Block, SLB: San Lorenzo Block. PED: Pedernales-Esmeraldas Block. Units (Cordillera Ocidental) – PU: Pallatanga Unit, MU: Macuchi Unit, PiU: Pilaton Unit, NU: Naranjal Unit, DU: Rio Desgracia Unit.

The Pedernales-Esmeraldas Block (PEB), located in the northwest (Fig. 1), is also underlain by a mafic-extrusive oceanic plateau sequence, which is covered by lavas deposited in a volcanic island arc system [6]. Preliminary paleomagnetic results indicate that this block has rotated 110-130° clockwise since the lavas cooled.

The declination data acquired from the basement units of each block suggest that clockwise rotations increased from the southwest to the northeast. Possible explanations include the hypothesis that all of the faulted basement blocks were originally part of a single plateau that fragmented upon collision with the South American plate during the late Cretaceous. Each fragment was gradually rotated in a clockwise manner until it became locked into position by suturing against the South American Plate. This hypothesis implies that the mid-late Cretaceous tectonic event recorded in the PB is linked to the accretion of the Pallatanga Unit (PU) 85-80 Ma ago [7]. Both basement sequences yield geochemically similar oceanic plateau signatures [8]. Stratigraphic differences in their sedimentary sequences may be accounted for by their different locations within the single plateau. Such a configuration of rotating fragmented blocks would expose each block to subduction related magmatism and continental derived detritus at different times, generating complex spatial variations in the cover sequences. Consequently, the PB and PU may have originated at the same hotspot. Alternatively, the coastal lowlands may be composed of two unrelated remnants, similar to what has been previously proposed [6].

References

[1] Roperch, P., Mégard, ,F., Laj, C., Mourier, T., Noblet, C., 1987. Geophysical Research Letters, 14, 558-561.

[2] Reynaud, C., Jaillard, E., Lapierre, H., Mamberti, M., Mascle, G.H., 1999. Tectonophysics, 307, 235-254.

[3] Benitez, S., 1995. Geol. Alpine, 71, 3-163.

[4] Jaillard, E., Ordenez, M., Benitez, S., Berrones, G., Jimenez, N., Montenegro, G., and Zambrano, I., 1995. Journal of South American Earth Sciences, 9(1-2), 131-140.

[5] Luzieux, L., Heller, F., Winkler, W., Vallejo, C., Spikings, R., Hochuli, P., 2003. Abstract, Swiss Geosciences Meeting, Basel.

[6] Mamberti M., Lapierre H., Bosch D., Jaillard E., Ethien R., Hernandez J., Polve M., 2003. Lithos, 77, 173-199.

[7] Spikings, R., Winkler, T., Hughes, R., Handler, R., 2005. Tectonophysics, in press.

[8] Kerr, ,A., Aspden, J., Tarney, J., Pilatasig, L., 2002. Journal of the Geological Society, London 159, 577-594.