Cretaceous block rotations in the coastal forearc of Ecuador: paleomagnetic, chronstratigraphic evidences, and implications for the origin and accretion of the blocks.

Léonard D.A. Luzieux, Friedrich Heller*, Richard Spikings**, Wilfried Winkler, Cristian F. Vallejo.

Geologisches Institut, ETHZ, Zürich, Switzerland

**Institut für Geophysik, ETHZ, Zürich, Switzerland*

***Institut de Minéralogie, University of Geneva 4, Geneva, Switzerland*

The coastal lowlands of Ecuador, representing the outer Andean forearc between 1°N and 3°S, are composed of distinct structural blocks separated by major NNE and WNW oriented faults (Puerto Cayo, Canande and Chongòn-Colonche faults; Fig.1). Although their allochthonous derivation has been proven (Roperch et al. 1987, Luzieux et al. 2005), the origin and the timing of accretion of the individual oceanic remnants is still badly known. We present new paleomagnetic and $^{40}Ar/^{39}Ar$ data derived from Cretaceous basaltic lavas and their Late Cretaceous sedimentary cover rocks, which define the origin of the individual, fault-bounded blocks within the Ecuadorian forearc.

Mafic, oceanic plateau derived rocks of the Piñon Block (PB) are exposed in the southwestern part of the forearc (Fig. 1). Gabbros from volcanic basement were sampled and separated. Hornblendes were dated by the $^{40}Ar/^{39}Ar$ step heating method at 88±1.6 Ma, corresponding to the cooling of the plateau material. This in not in accordance with earlier stratigraphic correlations of a pre-Turonian age (Benitez 1995, Jaillard et al. 1995). Our paleomagnetic investigation, additionally supported by new micropaleontological results from the overlying Calentura and (?) Cayo fms. indicate that a first 30-40° clockwise rotation has taken place between 70 and 75 Ma, suggesting that the PB experienced a major tectonic event during the Middle Campanian. The remaining 10-20° rotation into the present position was probably achieved during the Eocene final accretion of the blocks. The shallow paleomagnetic inclination values measured in basement and sediments point to an equatorial latitude origin of the plateau sequence.

The San Lorenzo Block (SLB), which is in faulted contact with the PB (Fig. 1), is composed of a mafic oceanic plateau basement sequence, which is overlain by Campanian (on biostratigraphic control) island arc lavas and volcanoclastic deposits of Campanian-Maastrichtian age (Cayo Fm.). Measured declinations within the basement and arc lavas show a clockwise rotation of 60-65° since cooling, and a mean value of about 25° clockwise rotation since the deposition of the Cayo Fm. Paleomagnetic inclinations show little variation and again strongly support an equatorial position during the crystallisation of the basalts. The very similar values and timing of rotations in comparison with the PB strongly suggest a common origin and evolution of both blocks.

The paleomagnetic data acquired from the coastal blocks prove an equatorial latitude during the formation of the magmatic basement. Both basement sequences yield similar geochemical oceanic plateau signatures (Kerr et al. 2002). Stratigraphic differences in their sedimentary cover may be accounted for by their different locations on the single plateau. The present investigation also constrains in both blocks a major tectonic rotation taking place between 70-75 Ma.

The blocks in all probability have their common origin in the Caribbean large igneous province (also referred to as the Caribbean Colombian Oceanic Plateau, CCOP), which extruded from the Galapagos Hotspot (Spikings et al. 2001). We suggest that all oceanic basement blocks present in the Ecuadorian forearc originally occupied marginal parts of the CCOP that fragmented during collision with the South American margin during the Late Cretaceous. The first, Late Creaceous clockwise rotation in both

blocks occurred during the contemporaneous accretion of the Pallatanga Block against the South American margin at 75-70 Ma (Vallejo et al. 2005).

ACKNOWDEDGEMENTS

This work was supported by Swiss Science Foundation Grants no. 2-77193-02 and 2-77504-04

REFERENCES

Roperch, P., Megard, ,F., Laj, C., Mourier, T., Noblet, C., 1987. Rotated oceanic blocs in western Ecuador. Geophysical Re search Letters, 14, 558-561.

Luzieux, L., Heller, F., Winkler, W., Vallejo, C., Spikings, R., 2005. Cretaceous rotations of the coastal blocks of Ecuador 1°N-3°S: Paleomagnetic evidence and implications for the origin and accretion of the blocks. 6th ISAG Meeting, Barcelona.

Benitez, S., 1995. Evolution géodynamique de la côte équatorienne pendant le Tertiaire. Geol. Alpine, 71, 3-163.

Jaillard, E., Ordenez, M., Benitez, S., Berrones, G., Jimenez, N., Montenegro, G., and Zambrano, I., 1995. Basin development in an accretionary, oceanic-floored fore-arc setting: Southern coastal Ecuador during Late Cretaceous - late Eocene time. Journal of South American Earth Sciences, 9(1-2), 131-140.

Spikings, R.A. Winkler, W. Seward, D. Handler, R. (2001). Along-strike variations in the thermal and tectonic response of the continental Ecuadorian Andes to the collision with heterogeneous oceanic crust. Earth and Planetary Science Letters 5742: 1-17.

Vallejo, C., Spikings, R., Winkler, W., Hochuli, P., Luzieux, L., 2005. Geochronology and provenance analysis of base ment and clastic cover sequences within the northern Western Cordillera, Ecuador. 6th ISAG Meeting, Barcelona.

Kerr, ,A., Aspden, J., Tarney, J., Pilatasig, L., 2002. The nature and provenance of accreted oceanic terranes in western Ecuador; geochemical and tectonic constraints. Journal of the Geological Society, London 159, 577-594.

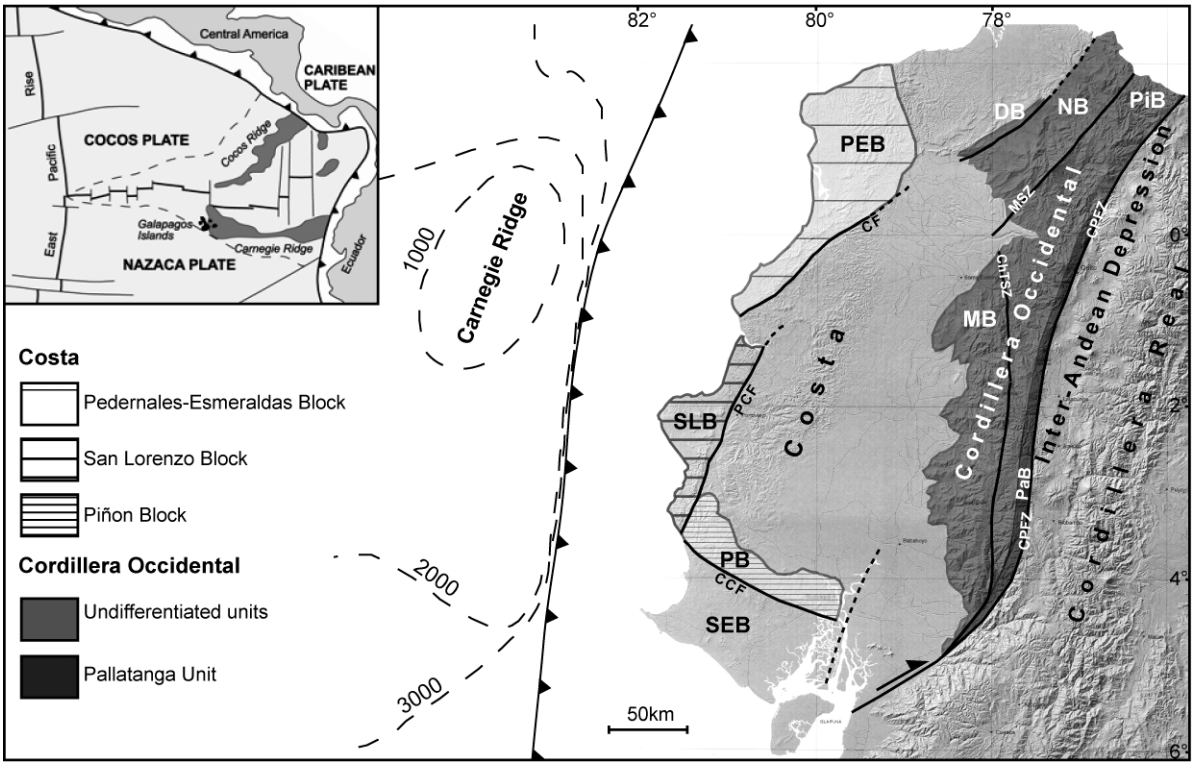

Fig. 1: Position of the blocks in the Ecuatorian forearc in relation with the actual subduction zone. Only the PB and SLB are discussed in the present work. Faults - CCF: Chongòn-Colonche Fault, PCF: Puerto Cayo Fault, CF: Canande Fault, ChTSZ: Chimbo-Toachi Shear Zone, CPF: Calacali-Pallatanga Fault 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) – PaB: Pallatanga Block, MB: Macuchi Block, PiU: Pilaton Unit, NB: Naranjal Block, DB: Rio Desgracia Block.