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Eocene to present-day latitudinal variations in the retroforeland basin system of the Peruvian Andes

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INTRODUCTION

From north to south, the Central Andes present significant variations in morphology, deformation and stratigraphic units. They have been ascribed to Palaeozoic and Jurassic paleogeographies (Gil et al., 2001) and geometry of the Nazca plate subduction (Pilger, 1984 ; Pardo-Casas & Molnar, 1987 ; Allmendinger & Gubbels, 1996 ; Norabuena et al., 1999). The retroforeland basin system of the Central Andes orogen constitutes a favoured area to study the tectonic-sedimentation coupling.

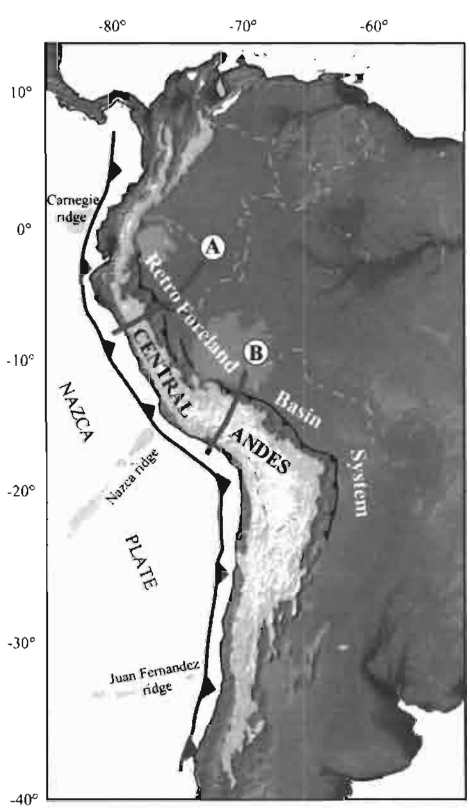

Figure 1: The morphological/structural configuration in Andean Cordillera, showing the retroforeland basin system of the Central Andes orogen. The A and B represent the schematic regional cross-sections location.

The purpose of this study is to present two regional cross-sections, in northern and southern Peru, and their sequential restorations (Figs 1 and 2) illustrating mean latitudinal variations of the Central Andean retroforeland basin system from Eocene to Present day. This study has been carried out from a multi disciplinary approach integrating cross-sections balancing, sedimentary facies analysis and thermochronometry (burial modelling, timing of cooling age).

PRESENT-DAY VARIATIONS

In northern Peru, the Central Andes are ~250 km wide and consist of two cordilleras: the Western Cordillera and the Eastern Cordillera. In the cross-section A (Fig. 2), the associated retroforeland basin system is ~550 km wide and corresponds to the Huallaga Subandean wedge-top basin and the Marañon foredeep and the Iquitos forebulge (Roddaz et al., in press). The Huallaga basin is deformed by thrust-related folds. The thick tertiary infill (10 km) consists of successive foredeep and wedge-top deposits. The foredeep Marañón basin is locally deformed by tectonic inversions of Triassic and Jurassic grabens (Baby et al., 1999; Gil 2001). The Contaya Arch corresponds to the most important inverted structure of the Marañon basin and is active from Cretaceous times.

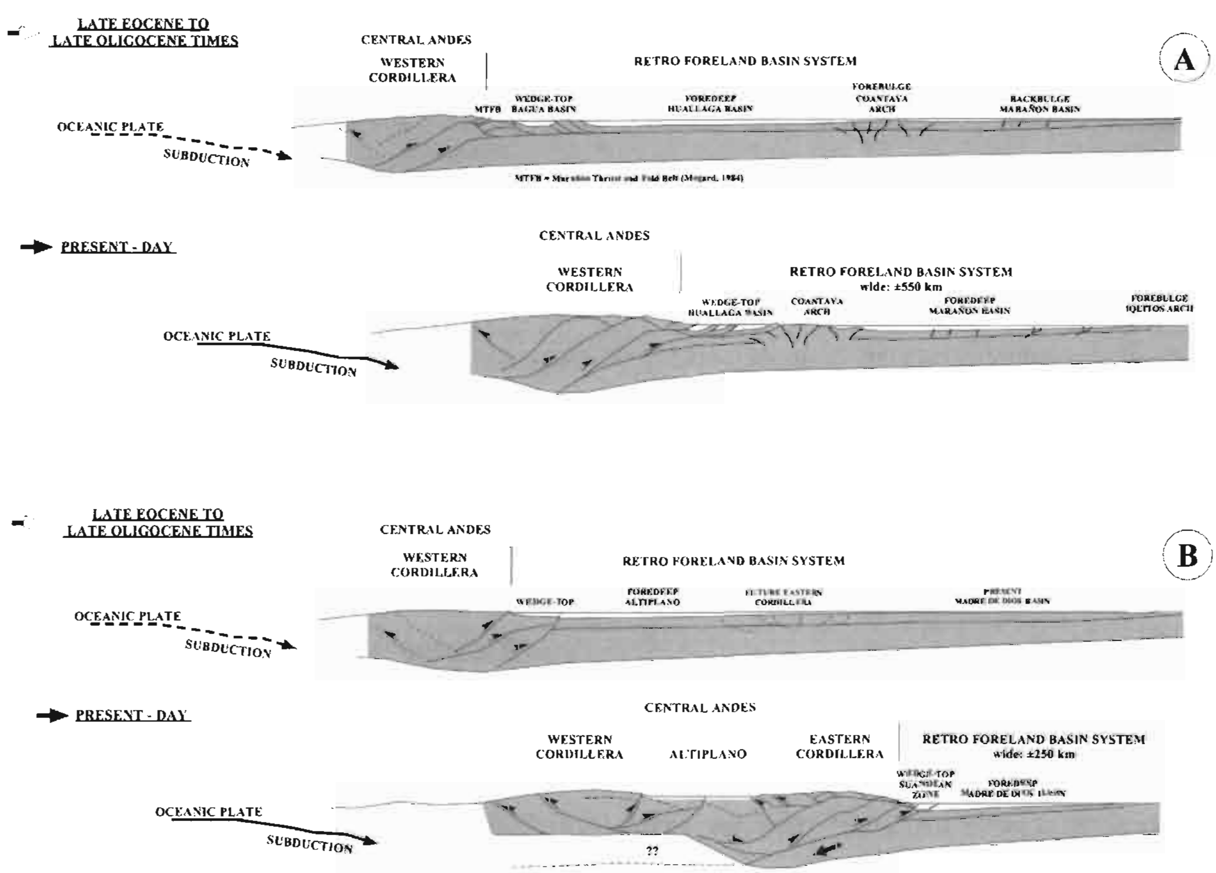

Figure 2 : Schematic regional cross-sections, in northern (A) and southern Peru (B), which illustrate the mean latitudinal variations of the Central Andean retroforeland basin system propagation from Eocene to Present- day times.

In southern Peru, the Central Andes are 400 to 600 km wide. The Western and Eastern Cordillera are separated by the Altiplano, whose width varies between 50 and 100 km (Laubacher & Naeser, 1994). The Andean retroforeland basin is ~250 km wide (cross-section B-Fig. 2), and comprises the Subandean zone and the Madre de Dios foredeep. The Subandean zone is deformed by thin-skinned tectonics and characterized by classical thrust-structures and piggyback basins. The flexural Madre de Dios basin is poorly deformed.

VARIATIONS IN THE RETROFORELAND BASIN PROPAGATION

During the early and middle Eocene, the Western Cordillera of northern Peru between 3 and 8°S experienced large uplift and erosion. This event is interpreted as a stage of tectonic quiescence and erosional unloading also described in the Ecuadorian Andes (Christophoul et al., 2002). South of 11°S, no such event is recorded in the sedimentary fill and the sedimentary architecture indicates the development of a flexural basin related to orogenic loading. Because the North Amazonian foreland basin system is situated at the junction between the Central Andes and the Septentrional Andes, this change in the geodynamic process can be ascribed to the interference with the Septentrional Andes evolution.

From Late Eocene to Late Oligocene times, orogenic loading is generalized in the entire Central Andes and the foreland basin system is controlled by the rapid eastward propagation of the Western Cordillera orogenic wedge. In the North Amazonian basin, orogenic loading is characterized by a rapid base level rise from the Late Eocene to the Oligocene, which results in a large increase in accommodation space and a marine ingression. This marine ingression (Upper Pozo and Pozo Shale Fms) is also well-known in the Northern Andes (Ecuador and Colombia), but did not reach the South Amazonian basin where subsidence was much less.

From the latest Oligocene to Present-day, the deformation of the orogenic wedge and the orogenic load increased in the Central Andes. This is recorded by the rapid eastward propagation of the thrusts front together with a large-scale marine ingression in the whole foreland basin (Pebas sea) followed by complete basin filling and continental sedimentation. However, the North Amazonian (3 and 8°S) and the (11°S) foreland basins have strong structural differences (Fig. 2). In the north, the foreland basin system is very wide and continued to be controlled by the propagation of the Western Cordillera orogenic wedge, whereas, in the south, the foreland basin system is progressively driven by the uplift and the propagation of a newly formed Cordillera-the Eastern Cordillera, which started at ~25 Ma (Allmendiger et al., 1997 ; Jordan et al., 1997 ; Lamb et al., 1997). This Eastern Cordillera resulted from the west-dipping continental subduction of the brazilian shield under the Altiplano. This continental subduction was from then on the driving force of the South Amazonian foreland system.

The North Amazonian foreland basin acquired its modern configuration between 15 and 10 Ma with the development of the wedge-top depozone of the Huallaga basin, where the transition from marine to continental environments was directly controlled by thrusts propagation.

In the southern part of the Central Andes, the present-day configuration was acquired at ~11 Ma. Deformation style is characterized by the development of a series of thrust imbricates involving homogeneous Palaeozoic sedimentary rocks. The north-eastern margin of the present Madre de Dios foredeep basin is eroded as a result of the uplift of the Fitzcarrald arch.

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