LATEST CRETACEOUS TO PALEOGENE RED BEDS OF PERU, AND THE EARLY STAGES OF THE ANDEAN DEFORMATION.

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INTRODUCTION

The Peruvian Andes are considered an orogenesis related to the subduction of the Pacific oceanic plate beneath the continental margin of South America. During late Cretaceous and Paleogene times, the Peruvian margin can be divided into several palaeogeographic zones, trending parallel to the trench. These are, from West to East :

- The volcanic arc (Soler 1991) was active mainly during the Albian and was the site of repeated batholith intrusions during late Cretaceous times. This zone seems to have been deformed and partly or episodically emergent since the late Albian-Cenomanian.
- The Western Trough is mobile and subsident basin filled by a thick shallow-marine series (Benavides 1956, Mégard 1978). Compressional tectonics occurred since the Senonian and led to the progressive emergence of this zone, which became the late Cretaceous-Paleogene paleo-Andes.
- A positive threshold ("Marañon Geanticline") received a reduced sedimentation (Wilson 1963, Mégard 1978), and was deformed mainly during Paleogene and Neogene times.
- The Eastern Basin, with moderate subsidence, is characterized by a mixed, marine-continental sedimentation, and was deformed mainly during the Neogene.

The Red Beds of Central and Northern Peru were deposited on the eastern edge of the Western Trough. Their stratigraphy was established by Benavides (1956), Wilson (1963) and Mégard (1978). For the Paleogene succession, Noble et al. (1990), Naeser et al. (1991) and Jacay (1994) specified the stratigraphy and proposed tectonic interpretations.

STRATIGRAPHY OF THE LATE CRETACEOUS-PALEOGENE SUCCESSION IN PERU.

In Central and Northern Peru, the late Cretaceous - Paleogene succession can be subdivided into three main sedimentary cycles (Jaillard 1994) : Coniacian - Campanian (Celendín Fm) ; Late Campanian - Paleocene (Casapalca and Fundo el Triunfo Fms) ; and latest Paleocene - Eocene (Chota and Rentema Fms, upper Mb of the Sacapalca Fm = El Carmen Conglomerate).

Coniacian - Middle (?) Campanian

During early Senonian times, Central Peru was the site of deposition of marls and evaporite (Celendín Fm), the top of which has been dated as Coniacian (Romani 1982) or Santonian (Wilson 1963). Farther North, marine fossiliferous marls and limestones of the Celendín Fm were dated as Santonian in the Cajamarca area (Benavides 1956) and as middle Campanian in the Bagua syncline (Mourier et al. 1988). The end of the marine sedimentation in Peru is, therefore, diachronous from South to North. However, a

major sedimentary hiatus occurred between the Santonian and Middle Campanian marine transgressions, which can be due to mild tectonic uplift or eustatic regression.

Late Campanian - Paleocene

This period is marked by predominantly fine- to medium-grained, continental red deposits of alluvial plain environment. Short-lived marine incursions are indicated by the occurrence of marine foraminiferas and brackish algae at the base of the Sacapalca Fm of Central Peru (Mabire 1961, Bizon et al. 1975, Jacay 1994), and by selachians and mesohaline ostracods at the base of the Fundo el Triunfo Fm of Northern Peru (Mourier et al. 1988). In the latter area (Bagua), selachians, dinosaur bones and charophytes indicate a Late Campanian-Maastrichtian age for the red beds (Mourier et al. 1988). In the Sacapalca Fm, Mégard (1978) quoted Maastrichtian charophytes (Jaillard et al. 1994).

Late Paleocene - Eocene

This period began with unconformable coarse-grained deposits. The El Carmen Conglomerate of Central Peru overlies the lower part of the Sacapalca Fm with local angular unconformity (Mégard written comm. 1996). It is interpreted as deposited on a proximal alluvian fan with local and/or episodic lakes, whereas the coarse-grained sandstones and microconglomerates of the Rentema Fm of Northern Peru were deposited by braided streams in a middle alluvial fan environment (Jacay 1994). In Northern Peru, tuffs associated with the Rentema Fm yielded 54.2 ± 6.4 Ma F/T ages (Naeser et al. 1991). Farther west, the unconformable volcanic Llama and conglomeratic Chota Fms were dated by K/Ar as 54.8 ± 1.8 and 49.5 ± 2 Ma, respectively (Noble et al. 1990). Thus, the age of the basal unconformity nay be considered as close to the Paleocene-Eocene boundary. In Central Peru, the El Carmen Conglomerate is unconformably overlain by the "Carlos Fransisco volcanics", which yielded late Middle Eocene K/Ar ages of 39 ± 1.9 Ma (Noble et al. 1979) and 39.8 Ma (Mégard, written comm. 1996). Vertebrates remains are currently under study.

TECTONIC INTERPRETATIONS

In the Western Trough of Central and Northern Peru, the marine sedimentation ceased between Late Coniacian and Middle Campanian times (Celendín Fm) and gave way to continental red bed deposits of late Campanian - Maastrichtian age (Fundo el Triunfo and Casapalca Fms). The fine-grained clastic supply recorded from the Coniacian onwards and the progressive emergence of the Western Trough result from Senonian contractional deformations and crustal thickening of the westernmost areas of the margin (Peruvian phase; Steimann 1929, Jaillard 1994). However, the eustatic sea-level drop of Late Santonian-Early Campanian age (Haq et al. 1987) can account for a substantial part of the marine regression.

In the studied areas, the basal unconformity of the Chota and Rentema Fms, and El Carmen Conglomerate evidences an erosional hiatus of most of the Paleocene, which is also recorded on the western edge of the Eastern Basin of Southern Peru (Jaillard et al. 1993) and Ecuador (Faucher et al. 1971). This indicates that uplift and, therefore, shortening occurred in the former Western Trough during part of the Paleocene.

The deposition of unconformable coarse-grained conglomerates and sandstones of latest Paleocene and/or Early Eocene age can be ascribed to the compressional early Incaic phase of late Paleocene - Early Eocene age (Noble et al. 1990). Since these deposits are widespread in the Eastern Basin, the early Incaic phase affected the whole western areas.

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