# DESCRIMINATION OF EUSTATIC AND TECTONIC INFLUENCES IN THE ECUADORIAN ORIENTE BASIN FROM APTIAN TO OLIGOCENE TIMES

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## INTRODUCTION

The Ecuadorian Oriente Basin (Dashwood and Abbots, 1990) evolved from the peripheral eastern part of an old extensive back arc basin to a retroforeland basin system (DeCelles et Giles 1996). It is deformed by major compressive NNE-SSW wrench fault zones (Fig. 1), known from west to east as Subandean Zone, Sacha – Shushufindi Corridor and Capirón–Tiputini Inverted System (Baby et al., 1999). The filling of the Oriente Basin corresponds to 4 tectonosedimentary cycles ranging from Lower Cretaceous to Upper Oligocene (Fig. 2): Hollín Fm./ Lower Napo Fm. (Aptian to Turonian); Upper Napo Fm./ Tena Fm. (Turonian to Maastrichtian); Lower Tiyuyacu Mb. (Lower Eocene); Upper Tiyuyacu Mb./ Orteguaza Fm./ Chalcana Fm (Middle Eocene to Upper Oligocene). This study, realized as part of the research convention between I. R.D. and PETROPRODUCCION, is based on seismic, well logs and field data. It shows the main influence of each tectonosedimentary cycle in the Oriente Basin evolution.

## CRETACEOUS CYCLES

The Hollín Fm./ Lower Napo Fm. tectonosedimentary cycle (Fig. 2) is characterized by a weak tectonic activity. Sedimentation is driven by eustatic variation, illustrated by the Hollín, 'T' and 'U' sedimentary cycles. These three cycles show the same evolution from the base to the top : valley incision, transgression traduced by estuarine deposits filling the incised valley (Hollín, 'T' and 'U' sandstones) and relative highstand by carbonated sedimentation (Lower Napo, 'B' and 'A' limestones). The effect of tectonism is recorded by extensive deformation between 'T' and 'U' cycles, identified at petroleum trap scale by sediment provenance modification and variations in 'U' cycle sediment thickness.

Upper Napo Fm./ Lower Tena Fm. cycle is characterized by a major compressive tectonic event (Fig. 3). Seismic sections show onlaps of 'M-2' sediments over the 'A' limestone in compressive structures. The 'M-2' sandstones correspond to a tectonically enhanced incised valley system which developed in eastern part of the basin. Tectonic uplift can also explain the erosion or non-deposition of 'M-1' sediments in the central part of the basin. This tectonic crisis is contemporaneous with an important continental hotspot volcanic activity (Barragan et al., 1999). Eustatic signature is still present but dominated by local compressive structures deformation. Laterally, equivalent slope facies known as 'Limón flysch', outcropping in the Subandean Zone and in the Ecuadorian Eastern Cordillera (Jaillard, 1997), show a deepening of the basin toward the west.

## CENOZOIC CYCLES

The Lower Tena to Upper Tena transition is characterized by the basin emersion as show sedimentological evidences. Upper Tena Fm. shows an inversion in the basin polarity (sediments provenance from the East). It can be related with the onset of the Colombian Llanos foreland basin (Cooper et al., 1995), due to the subduction rate increasing (Pardo Casas and Molnar, 1987). This event can be interpreted as the retroforeland basin emersion.

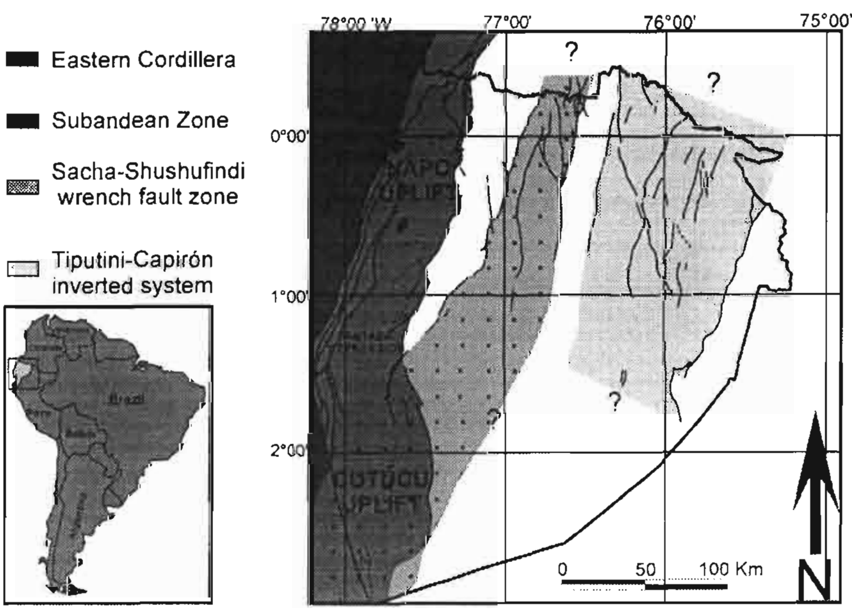


Fig.1 : Simplified structural map of the Oriente Basin. (Modified from Baby et al. 1998)

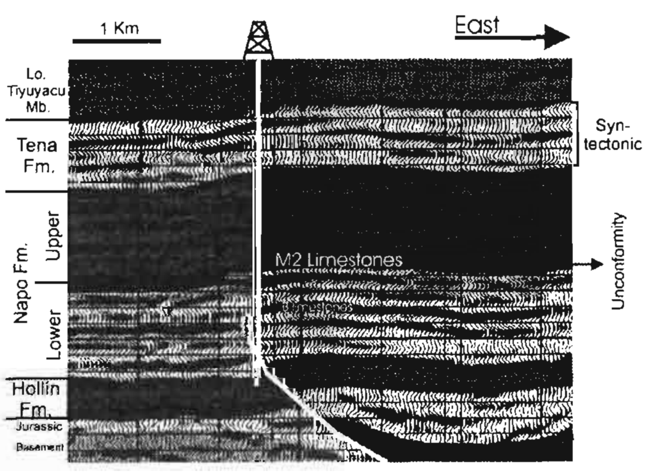


Fig.3 : Tectonic signature of Tena Fm. syntectonic sedimentation and Upper Napo Unconformity

Lower Tiyuyacu Mb. shows a superposition of thinning upward fluvial sediments characterized by a poor maturity of base conglomerates. Seismic sections reveal important thickness variation on compressive structures limbs (Fig. 4). A few progressive unconformities were identified in the basin

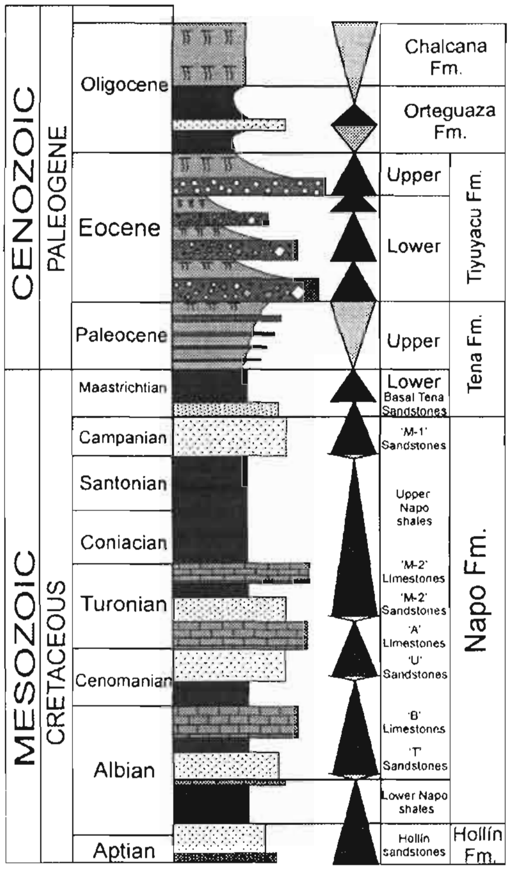


Fig. 2 : Stratigraphy of the Oriente Basin From Aptian to Oligocene

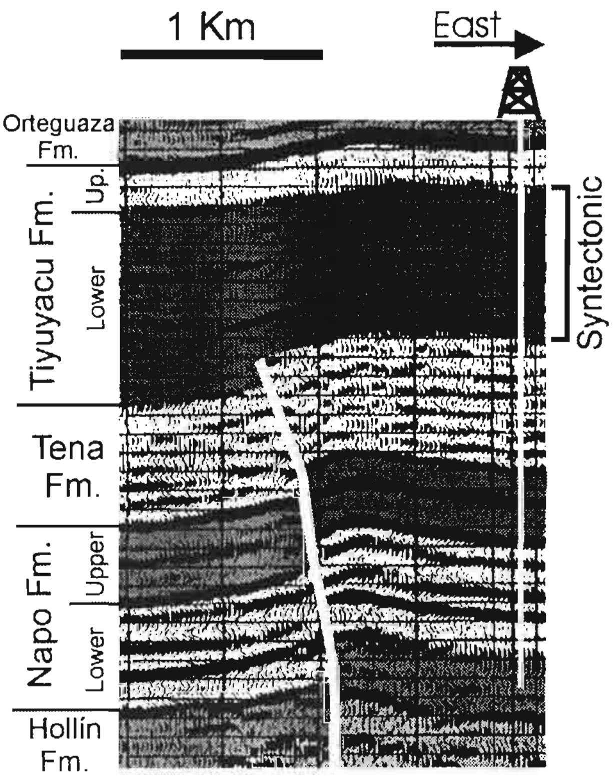


Fig. 4 : Seismic expression of syn-tectonic Tiyuyacu Fm.

western part. This member can be interpreted as syntectonic. Sedimentation is clearly driven by tectonics and each Lower Tiyuyacu Mb. sequence could be related to the growth of the orogenic wedge.

Upper Tiyuyacu Mb. / Orteguaza Fm. / Chalcana Fm. cycle shows no local tectonicdeformation. In seismic sections, no sediments thickness increasing and nor onlap have been identified near the compressive structures. Sedimentation is traducing a huge transgression-regression cycle independent of flower structures growing. Upper Tiyuyacu Mb. is an accumulation of fluvial deposits trapped in the basin by a base level rising with thinning upward stacking pattern. Orteguaza Fm. corresponds to fluvial, estuarine and shelf deposits (Tschopp, 1953) showing 2 transgressive-regressive cycles. The regression at the Orteguaza Fm. top goes on with the alluvial and fluvial Chalcana deposits. Tuffs identified in the Tiyuyacu Upper Mb have recorded a volcanic event related to the Upper Eocene Andean surrection.

Nevertheless, this tectonosedimentary cycle can be considered as syntectonic from stratigraphic and sedimentologic evidences : the Andean surrection increases the topographic load on the continental plate and therefore the subsidence, which produces more accommodation. This stage is expressed by retrogradation in the sediments stacking pattern (Upper Tiyuyacu Mb. and Orteguaza Fm. base). At the end of this stage, subsidence stops its increasing, the created relief is eroded and the accommodation vanishes. Sediments response is characterized by progradation (Orteguaza Fm. upper part and Chalcana Fm.). This transgression-regression evolution can be correlated with the tectonic stage of south Colombia (Casero et al., 1997). The apparent lack of deformation in this part of the basin is interpreted as the consequence of the far cratonward basin location and the subduction rate decreasing.

## CONCLUSION

The Oriente Basin evolution from Aptian to Oligocene shows an Andean retroforeland onset in the Paleocene. Hollín / Lower Napo deposits shows an organization driven by eustacy. The basin inversion and its evolution to the foreland basin start during Upper Napo (Turonian-Maastrichtian). The basin emersion apparently occurred at the transition Lower Tena/Upper Tena (Paleocene). But, the Ecuadorian Oriente forms only one part of this foreland basin. In spite of no local deformation, Upper Eocene to Oligocene sedimentation must be considered as syntectonic. It is not directly related to local compressive structures, but to the Andean surrection. Sediments have an outer foredeep to forebulge depozones origin (DeCelles et Giles, 1999), and are driven by tectonics. This basin evolution is coherent with tectonic stages known northward in Colombia.

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