THE APTIAN-LATE ALBIAN MARINE TRANSGRESSION IN THE ORIENTE BASIN OF ECUADOR.

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INTRODUCTION

In the Oriente Basin of Ecuador, the early Cretaceous marine transgression begins with the deposition of poorly dated continental to marine sandstones (Hollin Fm), which disconformably overly Paleozoic to earliest Cretaceous rocks (Tschopp 1953, Bristow & Hoffstetter 1977, White et al. 1995). The overlying Basal Napo Formation of Albian age comprises from base to top (Faucher et al. 1971, Bristow & Hoffstetter 1977, Jaillard et al. 1995, fig. 1) : marine, glauconitic shales and sandstones ("Basal Sandstones"), locally capped by thin massive limestones ("C Limestones"); marine black shales ("Basal Napo Shales"); open shelf limestones ("T Limestones"), and marine to deltaic sandstones ("T Sandstones").

Recent biostratigraphic data demonstrate that this succession is strongly diachronous through the basin (Villagómez 1995). It express the progressive backstepping of continental to marine strata onto the border of the basin, the facies sequence reflecting the large-scale Cretaceous transgression in the Andean Basin.

VERTICAL FACIES SUCCESSION

According to most authors (Kummert & Casal 1986, Souza Cruz 1988, White et al. 1995), the lower part of the Hollin Formation, is characterized by coarse-grained, cross-bedded sandstones, conglomeratic beds and plant remains (amber, coal measures), deposited by braided stream in a continental environment. The upper part of the formation, made up of medium-grained sandstones with gentle trough cross-bedding was deposited by meandering fluvial systems, or in estuarine to shoreline environments (fig. 1). The Guianese shield is believed to have been the source-area (Villagómez 1995).

The Basal Napo Sandstones (Upper Hollin of some authors) begin with massive cross-bedded sandstones, fine-grained rippled sandstones and shales of shoreline environment (Souza Cruz 1988, White et al. 1995, fig. 1). The upper part of the unit is made of glauconitic sandstones, shales, marls and sandy limestones with thick shelled bivalves, interpreted as deposited in an open marine shallow clastic shelf environment, in a transgressive context (White et al. 1995, Jaillard et al. 1995). They are capped by the glauconitic "C Limestones", which contain echinoderms, algae and bivalves, of open marine shelf environment. The latter often present thin layers of ammonite-bearing limestone separated by erosional surfaces, expressing stacked flooding events separated by emergence periods (Jaillard et al. 1995, fig. 1).

The Basal Napo Shales are unbioturbated, black laminated shales. They contain abundant inoceramids, ammonites and foraminifers (few Ticinella, some Hedbergella) at the base, and restricted planctonic (Hedbergella, few fish remains) and benthic associations (Cibicides, Praebulimina) in the upper part. The base of the unit represents a major maximum flooding, whereas its upper part express a progradation in a low energy, disaerobic marine environment (Jaillard et al. 1995, fig. 1).

This vertical facies succession evidence a large-scale marine transgression.

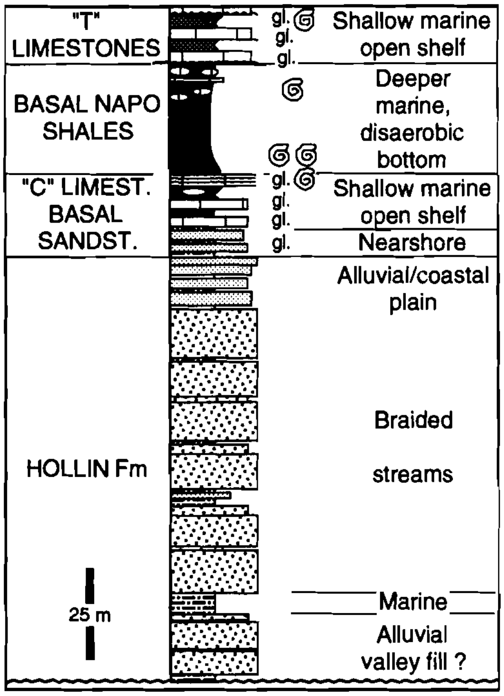


Fig. 1 : Lithostratigraphy of the Aptian-Albian transgression in the northern part of the Oriente Basin of Ecuador (adapted from White et al. 1995).

BIOSTRATIGRAPHY

Biostratigraphic data available from wells and field sections allow to define three chronostratigraphic units.

Undetermined dwarf ammonites, inoceramids and *Hedbergella* cf. *delrioensis* obtained from marine shales at the base of the Hollin Formation indicate a post-Early Aptian age (Tiguino-1, Mills 1971). A comparable, though undated, marine shale has been mentioned within the Hollin Formation (Zorro-1, Lammons 1975). In other places, micropaleontological associations of probable Late Aptian age have been obtained from part of the Hollin Formation (río Misahualli, Faucher et al. 1971; Villano-3, Stratigraphic Service 1995). Thus, the base of the Hollin Formation appears to be of «middle» or Late Aptian age. Yet, Robertson Research (1988) ascribed to the Early Aptian the association of *Hedbergella delrioensis*, *H.* cf. *gorbachikae*, *H.* cf. *sigali*, *Nannoconus globulus*, *Rhagodiscus achlyostaurion*, *Rh. angustus*, *Callialasporites trilobatus* and *Inaperturopollenites curvimuratus* found at the top of the formation in Cowi-1 (fig. 2). This would imply an Early Aptian or older age for the Hollin Formation at this place. However, the results of recent biostratigraphic studies suggest that this association can be younger.

Early to Middle Albian micropaleontological assemblages have been identified in the upper part of the Hollin Formation in the northern and central part of the basin (Pungarayacu-30, Ordoñez et al. 1994; Tiwae-1, Arai et al. 1990; Villano-3, Stratigraphic Service 1995, fig. 2). They include *Prediscosphaera columnata*, *Callialasporites trilobatus*, *Classopolis echinatus*, *Elaterosporites klaszi*, *Perotriletes pannuceus*, *Sofrepites legouxae* and tricolpate pollens of angiosperms. In the Southwest, however, an ammonite assemblage of earliest Middle Albian age with *Mirapelia* sp., *Brancoceras aegoceratoides* and *Lyelliceras* gr. *ulrichi* occurs at the top of the massive "C Limestones" and at the base of the Basal Napo Shales (Chinimbimi, Bulot & Jaillard 1995, Jaillard et al. 1995, fig. 2).

Late Albian palynomorph markers (*Elaterosporites protensus*, *E. verrucatus*) are common in the

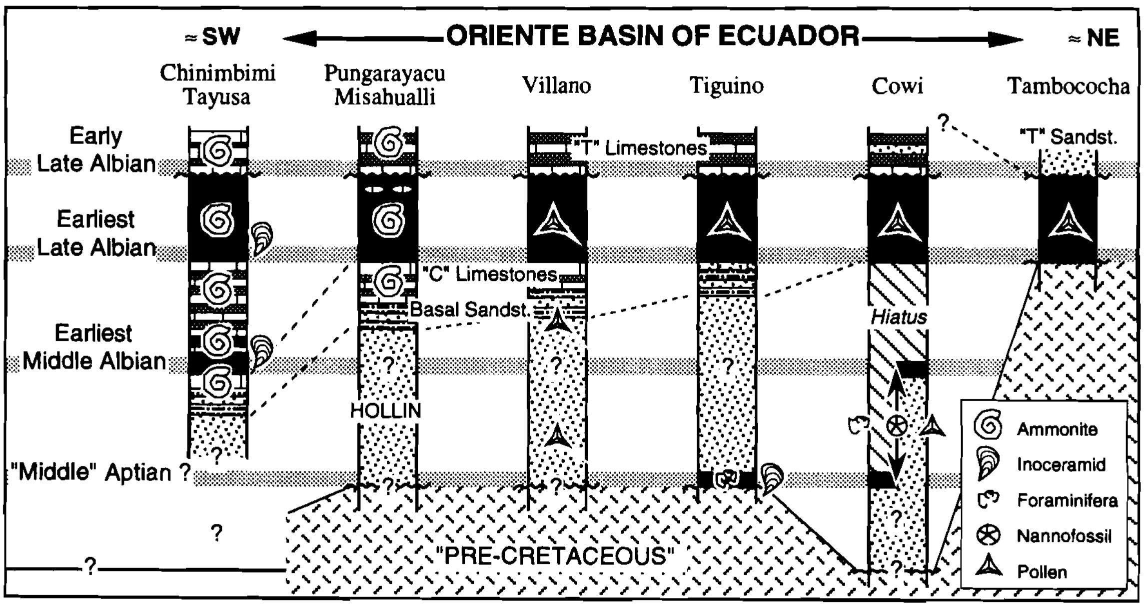


Fig. 2 : Biostratigraphic data for the Aptian-Albian transgression from selected wells and field sections.

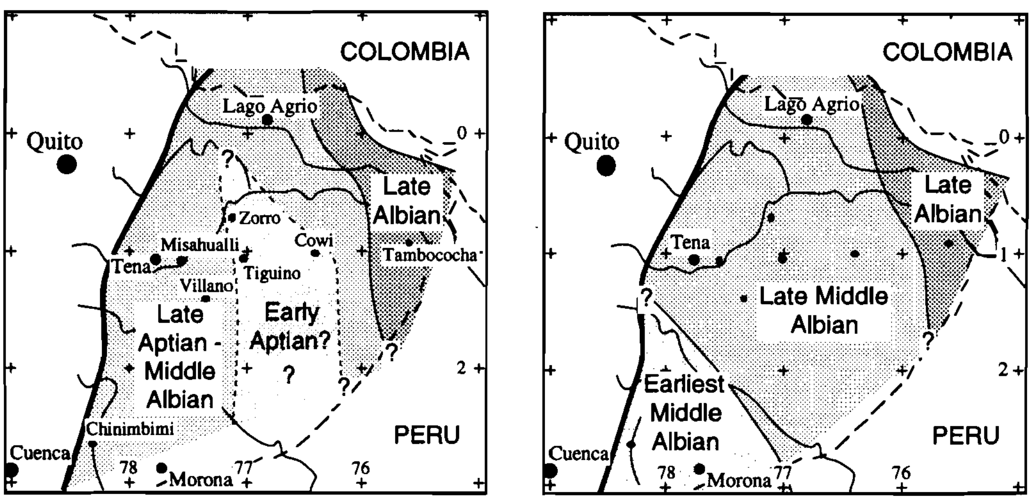
Basal Napo Shales of the northwestern and central parts of the basin (Pungarayacu-30, Ordoñez et al. 1994; río Misahualli, Faucher et al. 1971, Jaillard et al. 1995; Tivacuno-1, Ordoñez et al. 1989; Tiwae-1, Arai et al. 1990; Cowi-1, Robertson Research 1988; Villano-3, Stratigraphic Service 1995; fig. 2). On the eastern border, however, they occur in marine shales overlying directly the pre-Cretaceous basement, below the "T Sandstones" (Tambococha-1, Zambrano et al. 1994), thus indicating the lack of Late Aptian to Middle Albian sandstones (fig. 2). In the northwestern part of the basin, an ammonite assemblage of earliest Late Albian age with *Dipoloceras* gr. *bouchardianum* and *Venezoliceras (Venezoliceras)* cf. *venezolanum* was found at the base of the Basal Napo Shales (Pungarayacu-30, río Misahualli, Bulot & Jaillard 1995, Bulot et al. in press). In the South, a similar association occurs in the upper part of the Basal Napo Shales (Chinimbimi, Bulot & Jaillard 1995, Bulot et al. in press, fig. 2).

INTERPRETATIONS AND CONCLUSIONS

In the Oriente Basin of Ecuador, the Early Cretaceous transgression is marked by at least two important Maximum Floodings representing useful time-lines. "Middle"to Late Aptian marine shales are locally present, and predate the deposition of sandstones of Late Aptian to Albian age. The major Maximum Flooding of early Late Albian age occurs at the base of the Basal Napo Shales in the northern part of the basin, and within its upper part in the South. Other Maximum Floodings of probable Early Albian (Basal Sandstones) and earliest Middle Albian age (Basal Shales) were identified in the southwestern part of the basin (Chinimbimi, fig. 2 and 3). However, additional studies are necessary to correlate them with other sections.

These biostratigraphic data demonstrate that the Aptian-Albian marine transgression resulted in a large-scale backstepping of the facies and thus, in an important diachronism of the lithological units. As an example, the disconformable continental sandstones would be of Late Aptian to Early Albian age in the central-southern part of the basin, of Late Aptian to Middle Albian age in its northern and central parts, and of Late Albian age in its northeastern border of the basin, where they are, therefore, coeval with the "T Sandstones" of the rest of the basin. In this interpretation, the Hollin facies represents the coastal onlap deposits of the "middle" to Late Aptian Maximum Flooding. In the same way, the Basal Napo Shales facies is of earliest Middle Albian age in the Southwest, and of early Late Albian age in most of the basin.

During the Early Cretaceous transgression, the lateral facies succession in the basin comprised (1) continental sandstones deposited by braided streams; (2) glauconitic sandstones and shales of shallow shelf to nearshore environment; (3) fossiliferous limestones of open marine, shallow-shelf environment; and (4) deeper marine, disaerobic black shales (see also White et al. 1995). These lithofacies are strongly diachronous. In the westernmost part of the Andean basin (Lima area, Peru), the transgressive Early Cretaceous sandstones are of probably Early Valanginian age (Rivera et al. 1975, Benavides 1956, Jaillard & Sempéré 1989). As a consequence, the Early Cretaceous transgression displays a diachronism of nearly 30 Ma across the whole Andean Basin. Therefore, chronostratigraphic correlations cannot be established in the transgressive deposits of the Andean basin, without previous careful biostratigraphic studies.



Age of transgressive sandstones

Age of marine shales or limestones

Fig. 3 : Paleogeography of the Aptian-Albian transgression in the Oriente Basin of Ecuador.

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