Lower Maastrichtian syntectonic sedimentation along the Subandean Zone and its relationship with an accretionary event of an oceanic terrane registered in the Cordillera Occidental of Ecuador

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INTRODUCTION

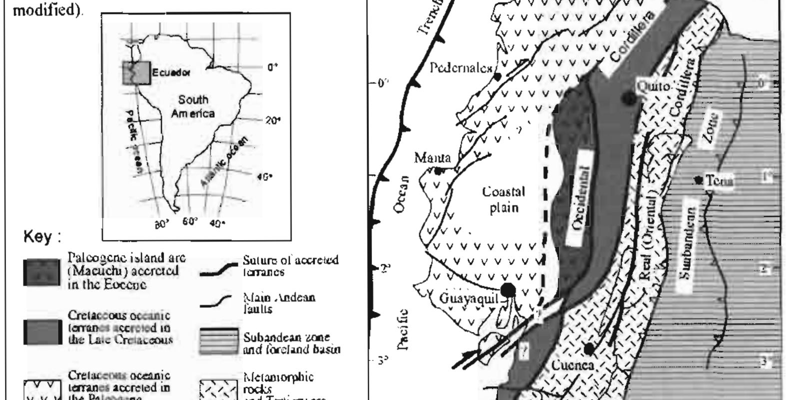
Sedimentary basin fills provide the most continuous records of continental deformation. In this regard, the upper most Cretaceous sediments of the Upper Napo and Basal Tena formations offer a unique opportunity to examine the dynamics of an early deformation in the Ecuadorian Oriente Basin and the relationship with the acretionary events occurred to the west along the Cordillera Occidental of Ecuador (COE).

By employing integrated studies of sedimentology, stratigraphy, and sequence and well log analysis, this paper focuses on the timing of a major accretionary event identified along the COE during the Campanian to lower Maastrichtian period and the consequent delayed (lag time) clastic sedimentation history registered in the Northern and Central Subandean Zone of Ecuador (SAZ).

GEOLOGICAL FRAMEWORK

The Upper Cretaceous sedimentary infill of the Oriente Basin (OB, Fig. 1) and the SAZ of Ecuador is represented by the Upper Napo Fm. (Jaillard et al., 1997) and the basal and lower members of the Tena Formation. They demonstrate a geodynamic evolution whose deposition and distribution along the basin were significantly controlled by the combined effects of global eustatism (White et al., 1995; Toro, 1997; Barragán et al., 1999) and active tectonism (Turonian-Maastrichtian) (Baby et al., 1999).

Figure 1. Simplified geology of Ecuador showing the the Occidental Cordillera and the Subandean Zone (After Jaillard et al., 2002, modified).



The basement of the COE (Fig. 1) is composed of two oceanic terranes, the San Juan (SJT) and the Guaranda terranes, accreted to the Andean margin since late Santonian to latest Maastrichtian (Reynaud et al., 1999; Lapierre et al., 2000; Mamberti et al., 2003; Jaillard et al., 2004). These two terranes represent the former Pallatanga terrane of Hughes & Pilatasig (2002) and are covered by quartz-bearing clastic sediments that sealed these accretions (Toro & Jaillard, 2005 in press).

By using stratigraphic tools and syntectonic markers, Toro and Jaillard (2005, this volume) identified several lag times between the sedimentary record preserved in the SAZ and the accretionary processes registered in the COE. One of these events corresponds to the SJT accretion to the Ecuadorian margin during the late Santonian to late Campanian time span (~ 85-75 Ma, Lebrat et al., 1987; Aspden et al., 1992; Reynaud et al., 1999; Kerr et al., 2002; Jaillard et al., 2004).

In the central part of the COE this event is clearly recorded by the quartz-bearing fine-grained turbidites of the Late Campanian-Early Maastrichtian Yunguilla formation, resting unconformable in the eastern side of the COE on the SJT, and in its western side on the deformed pelagic radiolarians and cherty sediments that overlie the Guaranda allochthonous terrane (Jaillard et al., 2004). In particular, in the Cuenca area, southern Ecuador, the conglomerates of the Quimas Fm. (latest Campanian to earliest Maastrichtian ~ 75 Ma), of the proposed Yunguilla Group of Jaillard et al. (2005, in progress), are interpreted as reflecting the accretion of the SJT (Jaillard et al., 2005) to the margin.

In the Oriente Basin the SJT accretionary event is reflected by the uplifting (unroofing) of the SAZ (Fig. 2), the creation of a regional well marked unconformity and the sedimentary hiatus between the quartz-bearing Basal Tena (lower Maastritchtian ~71 Ma, Jaillard et al., 1997) and the M1 Shales of the Upper Napo Fm. (Santonian to Campanian), and the halted of the alkaline intra-plate magmatism (80-84 Ma, Barragan et al., 2005).

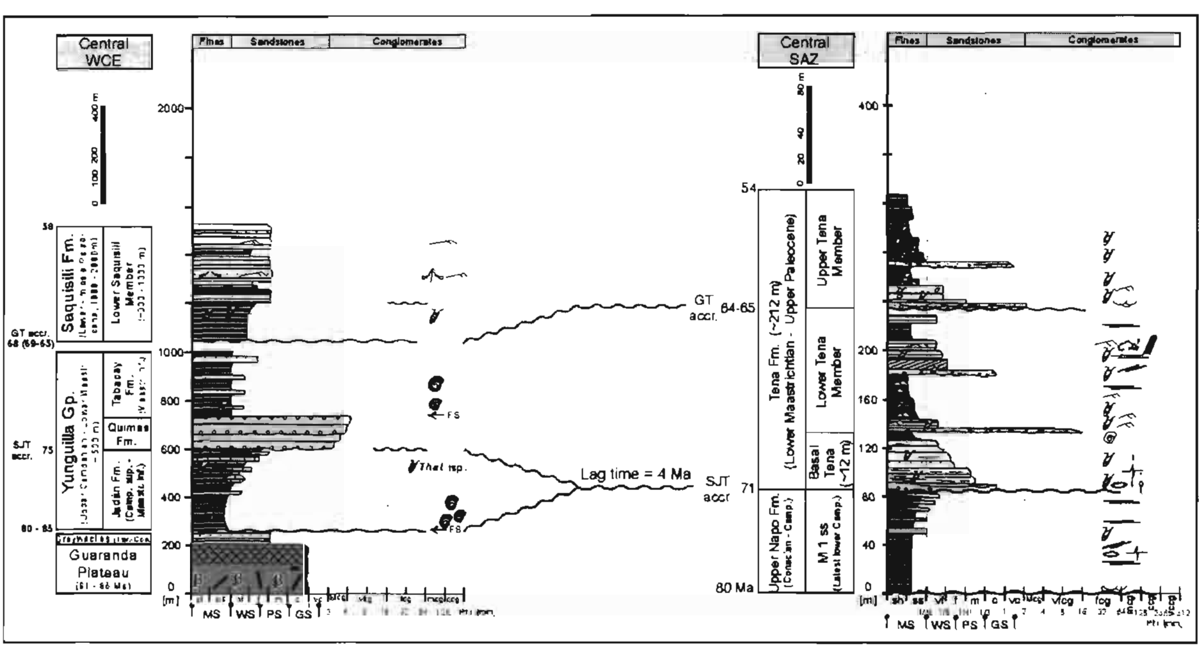


Figure 2. Relationship between the accretionary events registered in the COE during the Santonian to latest Maastrichtian times and the sedimentary response preserved in the SAZ (After Toro and Jaillard 2005, modified). Key: SJT, San Juan terrane; GT, Guaranda terrane; FS, flooding surface; accr., accretion; Phi, grain size diameter; MS, mudstone.

This leads to the conclusion that the lag time between the SJT accretion to the Andean margin (COE) and the sedimentation onset of the sandstones of the Basal Tena Fm. in the SAZ is approximately 4 Ma (Fig. 2).

Well logs analysis and detailed core and outcrop descriptions carried out in the corresponding M1 shales and the overlying Basal Tena sands (*i.e.*, Bermejo Field, Fig. 3) evidence the occurrences of several syntectonic markers (as defined by Jones et al., 2005) associated to the unroofing of the source area (Cordillera Real ?, and the SAZ) such as facies and sedimentary environments dislocation, a clear sequence boundary, and changes in sedimentation rates and lithological compositions. In general, there is an abrupt change of sedimentary facies from marine (lower to medium shoreface facies, M1 Shales) to continental (fluvial facies, Basal Tena Fm), separated by a clear erosive unconformity (SB, Fig. 3). The continental facies grades rapidly upward to marginal marine facies (tidally influenced, Basal Tena Fm) demonstrating a clear transgressive event (TST) which ends towards the occurrence of silty flood plain facies.

CONCLUSIONS

We propose a direct relationship between the SJT accretionary event to the Ecuadorian margin (~ 85-75 Ma), the uplifting of the SAZ (Santonian to Lower Campanian) and Cordillera Real, and the consequent generation of the sedimentary signal in the Basal Tena Fm. (lower Maastrichtian, ~ 71 Ma). The identified syntectonic markers (i.e., facies dislocation) pointed out a major lag time (time span) between the sedimentary signal preserved in the basin and the accretionary process in the COE, estimated of having a duration of around 4 Ma. It appears that towards the eastern side of the basin the lag time will increase.

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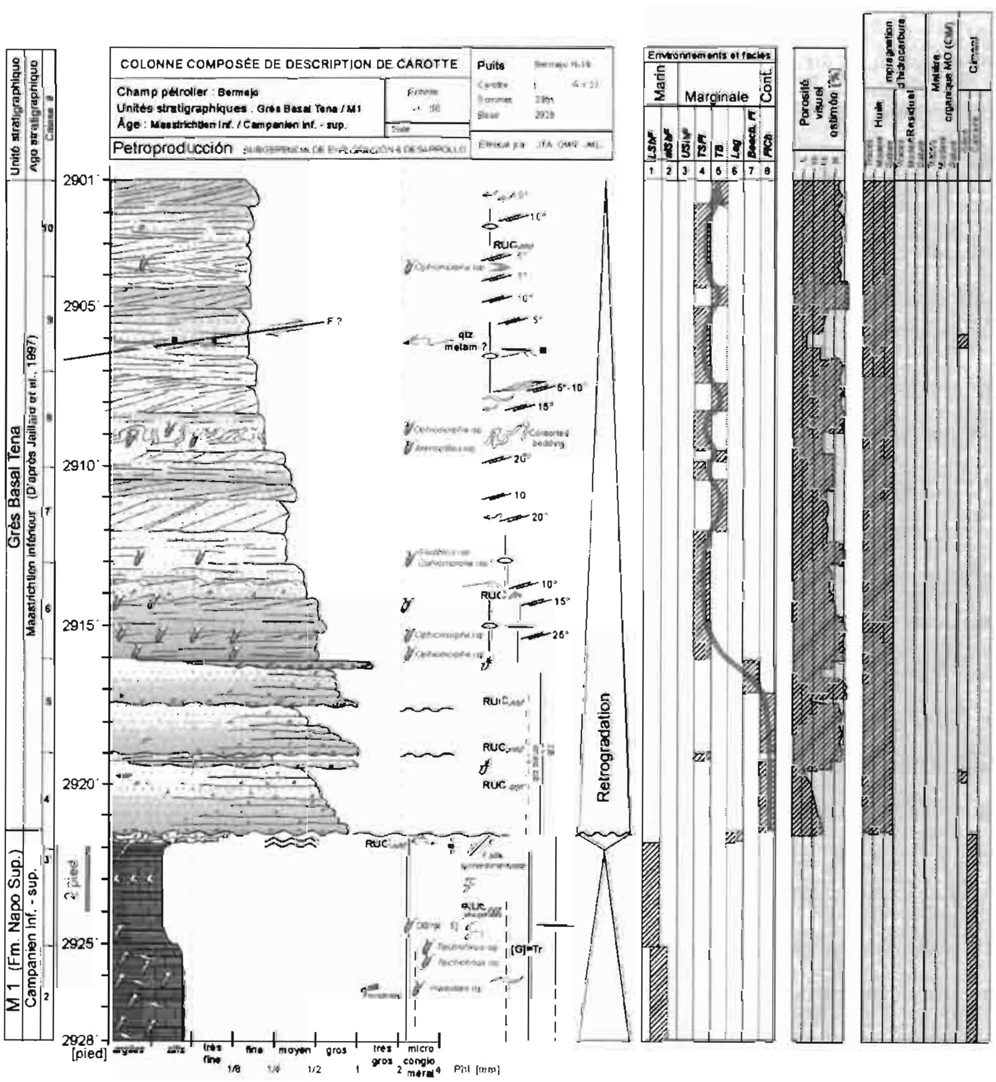

Figure 3

Lithologic, ichnologic, sedimentologic and environmental interpretation of the clastic series of the upper part of the M1 Zone (Campanien, Upper Napo Fm.) and the Basal Tena Fm. (lower Maastrichtian) within the Bermejo N-19 well (2901' - 2928'), Bermejo field, north Subandean Zone, Ecuador. Ages after Jaillard et al., 1997.

Facies and environments :

1, Lower Shoreface (*LShF*) ; 2, Medium Shoreface (*MShF*) ; 3, Upper Shoreface (*UShF*) ; 4, Tidal Sand Flat (*TSFl*) ; 5, Tidal Bar (*TB*) ; 6, Lag ; 7, Beach sands with fluvial influence (*Beach.Fl*) ; 8, Fluvial Channel (*FlCh*)