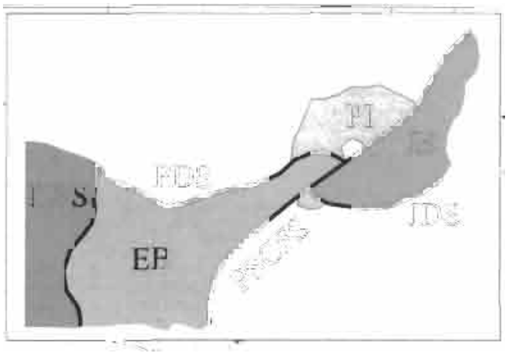
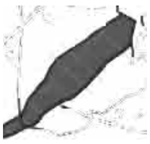
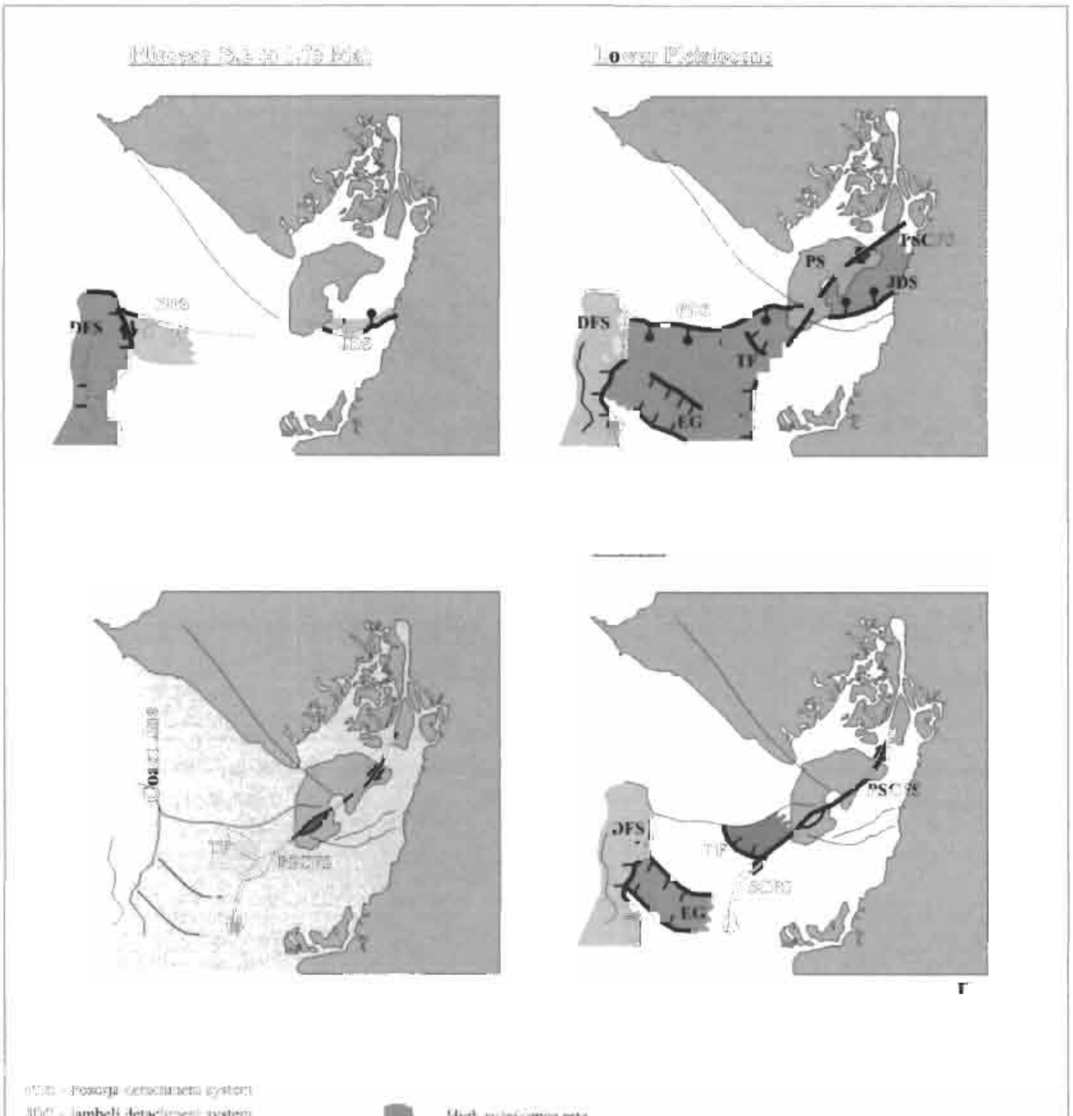

FI
FDS
S
EP
JDS




Pliocene 5.3 to 1.78 Ma
Lower Pleistocene
PDS
DFS
JDS
PS
PSCFS
TF
EG
DFS
TF
EG
SCFS
PSCFS
PDS - Posorja detachment system
JDS - Jambeli detachment system
DFS - Domito fault system
PSCFS - Puná - Santa Clara fault system
PS - Puná segment
EG - Esperanza graben
TF - Tenguel fault
High subsidence rate
Low subsidence rate
Tectonic inversion - uplifted series
Diapir
Detachment
Normal fault
Strike slip fault, transfert fault
Reverse fault

CONCLUSIONS

The PSCFS commonly associated to the southern tip of the DGM (Dolores-Guayaquil megashear) acts as a transfer zone since the Lower Pleistocene time. It accommodated the opposite verging directions between the southward dipping Posorja and the northward dipping Jambeli detachments. The PSCFS shows no landward prolongation to the north and no seaward prolongation to the south toward the trench, it ends at sites where no transfer motion is required.

The DFS marks the limit between a zone controlled by continental margin processes and another one (Esperanza and Jambelí basins) strongly controlled by the tectonic escape of the NAB. During the Lower Pleistocene times the subsidence in the Esperanza and Jambelí basins began, it was triggered by the N-S verging detachment structures related to the tectonic northward escape of the NAB. Taking into account the strong dependence of the subsidence in the GG area with respect to NAB motion, we assume that the Pliocene–Lower Pleistocene limit is associated with a major change in the northward migration rate of the NAB. We assume that the major change of the extensional strain direction from ~E-W (recorded along the DFS) to ~N-S (Posorja and Jambelí detachment systems) is related to the initiation of NAB northward migration. Because no major cinematic reorganization exists along the Nazca-South America plates since the Pliocene (5.2 Ma) that would explain the initiation of the northward tectonic escape of the NAB, we assume that the Carnegie ridge began to collide with the trench at that time. Subsequently the ridge subduction increased plate coupling, producing the northward expulsion of the NAB.

A major emersion of the GG area occurred during glacial sea level fall of isotopic substage 6e (between 180 and 140 ka). This emersion induced the accumulation of marine sediment to stop. Also this major paleogeographic change probably caused local strain changes able to have tectonic signatures. These are the so-called Upper Pleistocene compressional deformations confined to two small segments of the PSCFS and the central segment of the Tenguel fault. We consider that these Upper Pleistocene local compressional tectonic features (inversion) have local causes. Indeed no cinematic reorganization at plate boundaries existed at that time. Therefore, we assume that no major change in the general tectonic regime existed during the Quaternary evolution of the GG area. The GG area remained under extensional strain since the Lower Pleistocene. The GG area is a zone of great sediment input since it corresponds to the end of one of the two major Ecuadorian Andean-coastal drainage basins. The emersion of the GG area allows the sediments to reach the trench axis instead of being trapped in the GG area. It has been shown elsewhere (von Huene and Scholl, 1991; Bourgois et al., 2000) that sediment supply to the trench axis is a major cause of the tectonic regime switching from subduction-erosion to subduction-accretion. This reflects the potential importance of the GG area in controlling the tectonic regime along the southern Ecuadorian margin.

At Present time, the tectonics of the studied zone is dominantly extensional (**Figure 2D**). In the GG area it is concentrated in the Esperanza graben and along the Tenguel fault. The DFS shows a reactivation as a normal fault in recent times while the Posorja and Jambelí detachments are no longer active. The extreme conditions of subsidence triggered by low angle detachment zones not directly related with strike-slip systems suggest that the GG area is not a pull-apart basin in a commonly accepted sense, as previously proposed. The GG area developed in a relation with the northward escape of the NAB, in good agreement with the extensional tectonic features bounding the main depocenters. Moreover, no eastern boundary of NAB was identified in the GG area. At the latitude of the GG area the NAB-South American plate boundary should be located landward, possibly in the Andes.

Acknowledgements. This work was supported by the Institut de Recherche pour le Développement (IRD), the Fundacyt (Ecuador), the Centre National de la Recherche Scientifique (CNRS), and the French Embassy in Quito. Petroproduccion (Ecuadorian Petroleum Company) that provided the seismic and well data used in this work is deeply acknowledge. We thank Galo Montenegro (head of the Centro de Investigaciones Geologicas de Guayaquil) for its widely opened help. We thank also Cesar Ranero, Valenti Sallares and Alcinoe Calahorrano for their helpful suggestions.

References

Aalto, K.R., Miller, W., 1999. Sedimentology of the Pliocene Upper Onzole Formation, an inner-trench slope succession in northwestern Ecuador, Journal of South American Earth Sciences 12, 69-85.

Bourgois, J., Guivel, C., Lagabrielle, Y., Calmus, T., Boulègue, J., Daux, V., 2000. Glacial-interglacial trench supply variation, spreading-ridge subduction, and feedback controls on the Andean margin development at the Chile triple junction area (45-48°S), J. Geophys. Res. 105, 8355-8386.

Cantalamessa, G., Di Celma, C., 2004. Origin and chronology of Pleistocene marine terraces of Isla de la Plata and of flat, gently dipping surfaces of the southern coast of Cabo San Lorenzo (Manabí, Ecuador). Journal of South American Earth Sciences, 16, 633-648

Deniaud, Y., Baby, P., Basile, C., Ordoñez, M., Montentegro, G., Mascle, G., 1999. Ouverture et évolution tectono-sedimentaire du Golfe de Guayaquil: basin d'avant arc néogène et quaternaire du Sud des Andes équatoriennes, C.R. Acad. Sci. Paris 328 (3), 181-187.

Trenkamp, R., Kellogg, J.N., Freymuller, T., Mora, P.H., 2002. Wide plate margin deformation, southern Central America and northwestern South America, CASA GPS observations, Journal of South American Earth Sciences 15, 157-171.

von Huene, R., Scholl, D., 1991. Observations at convergent margins concerning sediment subduction, subduction erosion and the growth of continental crust, Reviews of Geophysics 29 (3), 279-316.

Witt, C., Bourgois, J., Michaud, F., Ordoñez M., Jiménez, N., Sosson, M., submitted. Development of the Golfo de Guayaquil (Ecuador) as an effect of the North Andean block tectonic escape since the Lower Pleistocene.