FORE-ARC GEODYNAMIC EVOLUTION OF THE ECUADORIAN SUBDUCTION SYSTEM

Stalin BENÍTEZ

Petroproduccion, Casilla 10829, Guayaquil, Ecuador

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REGIONAL GEOLOGY

The Ecuadorian country has a physiography and a geology deeply related to the subduction system affectin uninterruptedly the West South American margin from Colombia to Chile. Consequently, there are recognized in Ecuador three main morphotectonic regions: the Coast or Forearc Region, the Sierra (Highlands) or Volcanic arc (two chains: Western and Eastern or Real) and the Oriente or backarc region which joins to the Amazonian foreland.

The Ecuadorian subduction system is characterized by the oceanic origin cretaceous basement of the forearc region and Cordillera Occidental. The same situation has been postulated for the equivalent colombian regions. Both, the colombian and ecuadorian Andes, compose the so called Northern Andes. The oceanic terranes accretion has been performed during the Palegene provoking a very deep paleographic change.

FOREARC STRATIGRAPHY

Two main paleographic zones has ben distinguished in the forearc region. At present they are separated by the Colonche Fault. To the North of this fault in the Chongon-Colonche Hills outcrops the early cretaceous oceanic origin basement (the Piñon Formation), covered by a thick volcanoclastic sequence (the Cayo Formation) dated as upper Cretaceous. At the top of this sequence it is found a finer marine sequence (the Guayaquil Formation) with sparse intercalations of tuffaceous material dated Maastrichtien in the more cherty base and Paleocene in the slighty more calcareous resto of the formation. The top of the Cayo Formation and the Guayaquil Formation have been laterally replaced in the Manta zone by volcanic series of island arc origin called San Lorenzo Formation (Lebrat, 1985). Over the oceanic-volcanic related series and after a diastrophic event in the Paleocene-Eocene boundary there are turbiditic limestones (San Eduardo Formation) of Early to Middle Eocene age followed by hemipelagic siliceous mudstones (Las Masas and Cerro Formations). The sands and conglomerates (San Mateo Formation) deposited at the end of the Middle Eocene clearly indicates the beginning of the continental feeding just at the time of the collision between the oceanic terrain against the continental southamerican landmass. From the late Eocene until the Oligocene there are found only argilaceous neritic to upper bathyal deposits, Resting unconformably on the previous series we found the mainly Miocene to Quaternay sequences corresponding to the filling of the forarc basins formed after the collision stage.

To the South of the Colonche Fault in the Santa Elena Peninsula oilfield district cretaceous and paleogene rocks also outcrop but much more deformed tha those of the Chongon-Colonche Hills. The basement presumably of the same oceanic origin doesn't crop out, but only tectonized fragments of it are found intercalated with contorted radiolarian shales similar to those of the Guayaquil Formation. They are

dated Campanian to Paleocene. After unconformity of middle Paleocene age the Azucar turbidic sands and conglomerates dated late Paleocene are found. This formation is mainly composed of quartz and matamorphics detrital elements which indicates a contienental basement provenance, corroborated by NNE trend of the paleocurrents; the area souce is certainly the Amotape NW peruvien province. After a new diastrophic event they are deposited in the Early?-Middle Eocene the turbidites and argilaceous beds of the Ancon Group in a paleoenvironment of neritic to bathyal depth. An unconformably neogene filling is found in the subsiding zones of Progreso and Jambeli forearc basins.

VOLCANIC ARC STRATIGRAPHY

In the Cordillera Occidental a similar to the Northern Coast Cretaceous to Paleogene stratigraphic sequence is found, though more deformed and less known at present. Tectonic scales of an oceanic basement, and of late cretaceous volcano-clastic series have been mapped. There are also found arc-island origin series named Macuchi unconformably covered by turbiditic Eocene limestones (Unacota Limestone), followed by the Apagua Formation sandstones and conglomerates (Eguez, 1986; Santos and Ramirez, 1986). The first calcalkaline volcanic arc rocks are the Alausi adn Lower Saraguro Formations recently dated Late Eocene by radiometric methods by Lavenu et al (1982).

In the Cordillera Oriental or Real, buitl-up of metamorphic and igneous rocks of jurasic age reseted in the Late Cretaceous (Aspden, 1992), it is not found a younger sedimentary or volcano-clastic cover but some datings in igneous intrusions seems to indicate a volcanic arc activity during the Paleocene-Eocene, contermporaneously with the Macuchi island arc.

GEODYNAMICS

Three main evolutionary stages are distinguished in the forearc region and Cordillera Occidental. During the first stage (late Aptian-Early Campanian, 108-08 Ma) or pre-collision stage, this region underwent an oceanic type evolution. The early cretaceous oceanic crust (Piñon Formation) was unusually thickened due to the influence of a hot spot. Over this crust it developed an dipping East island-arc system which emerged locally (Cayo Arc). The arc products originated thic grawackes deposits (Cayo Fm.) in the barck-arc marginal basin located between the arc and the Southamerican continent.

The second stage or collision stage does not occur simultaneously in the whole forearc region. The collision is essentially oblique, beginning in the South by the collision of the Amotape Block against the NO peruvian margin during the Early Campanian (E. Jaillard pers. comm.) provoking its rotation and accretion. The collision continues to the North with the accretion of the Santa Elena Peninsula during the Paleocene. The Coastal Block to the North of the Colonche Fault and the Cordillera Occidental were accreted at the end of the Middle Eocene.

The third stage or post-collision stage started in the Late Eocene developing the present forearc basins which underwent a stronger subsidence period during the Miocene and locally during the Pliocene-Pleistocene. The main deformation in this stage is atributed to transcurrent faulting due to the partition phenomena of the Nazca Plate oblique subduction. The collision and subduction of the Nazca (12 Ma) and Carnegie (2 Ma) ridges have locally and temporarily affected the sedimentation buy they have not produced very deep transformations in the forearc region.

The invoked mechanism capable to provoke the collisions is the installation during the Campanian of a second East dipping subduction zone paralell to the ancient cretaceous system subsisting to the West, which followed the marginal basin axis then located between the cretaceous island-arc and the Southamerican continent. Both subduction systems might have funcioned simultaneously until the Middle-Upper Eocene. From the Oligocene it survives only the more ancient and more occidental subduction system which envolves during the Neogene to its present condition.