EVIDENCE FOR PRE-CRETACEOUS COLLISION IN THE ECUADORIAN ANDES

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Resume

Studies of the metamorphic and plutonic rocks of the Eastern Cordillera of Ecuador indicate the presence of ophiolitic rocks, island arc terranes, S-type granites and major nappe complexes. The final accretion was Mid-Jurassic in age but this may have followed an older collision.

Key words: Ecuador, Eastern Cordillera, Jurassic, collision, nappes, S-type.

Introduction

An Anglo-Ecuatorian technical co-operation project involving personnel from the British Geological Survey, funded by the Overseas Development Administration, London, and personnel/funding from the Ecuadorian Institute of Mines (INEMIN), has been studying the geology and mineral potential of the Eastern Cordillera (Cordillera Real) of Ecuador since 1986. Specifically, the project is devoted to the study of the metamorphic and older plutonic rocks, the bulk of which are considered as pre-Cretaceous in age, rather than as equivalents of easterly and westerly unmetamorphosed Cretaceous formations as suggested by Feininger (1975) and Bristow (1973) respectively.
Evidence for pre-Cretaceous collision can be summarised within a description of a general west-to-east geotraverse across the cordillera, which is divided into the Western, Central and Eastern tectonic belts and individual lithotectonic divisions (Aspden et al, 1987; 1988).

The Western belt

This comprises the low-grade metamorphic rocks of certain inliers within the Inter-Andean graben, and the western slopes of the Eastern Cordillera eastwards to the Baños Front. The west-to-east lithotectonic divisions are as follows:
The Guamote division is composed of a continental quartzite/phyllite association of shallow water, molassic affinity, with a shallow-dipping tectonic regime indicating westward thrusting.
The Peltetec division comprises a steeply-dipping tectonic "melange" of ophiolitic affinity containing basalt, gabbro, picrite, serpentinite, cherts and sediments; with slices of Tres Lagunas-type granite. The

eastern Inter-Andean graben fault marks the Cenozoic rejuvination of the Peltetec fault.
The Maguazo division is of steeply-dipping graded turbidites, cherts and andesitic volcanics of forearc affinity. Chert samples have yielded Callovian-Oxfordian palynoflora and reworked Ordovician acritarchs.
The Alao-Paute division is of steeply-dipping meta-andesitic greenstones, agglomerates, tuffs and graphitic and pelitic phyllites of island arc affinity. The Tampanchi mafic-ultramafic complex intrudes this sequence but is probably an Early Tertiary Alaskan pipe.

The Central belt

This lies between the Baños and sub-Andean tectonic fronts and forms the main mass of the high cordillera.
The Baños front everywhere marks a lithological change from Alao-Paute greenstones to semipelites or Tres Lagunas granite. In the north this is also marked by a metamorphic change to medium grade schists and para-gneisses. In the south the front is marked by a 5km wide mylonite zone and a major gold belt related to Cenozoic volcanic activity.
The Tres Lagunas granite is found almost throughout the cordillera east of the Baños front. It is essentially a two-mica granite with S-type affinites, associated in places with weak Sn-W indications. Blue quartz and smoky K-feldspar are characteristic; garnet and cordierite may be present. In the north the granite is essentially gneissic and may be found in zones with incipient migmatisation. In the south the granite intrudes low-grade rocks and is marked by shear zones with augen gneiss separating belts with little or no deformation. Rb-Sr plots for Tres Lagunas indicate an Early Jurassic age.
Nappe complexes may be found east of the Tres Lagunas granite. The best example is east of Quito in the north of the cordillera where a major "flat belt" extends for 20 km across the strike to the sub-Andean front. The nappes comprise individual thrust slices of thin serpentinite, semipelites, graphite and pelitic schists and a calcic magnetite skarn packet which forms a row of isolated high level klippes. These thrusts ride eastwards over a belt of subvertically imbricated rocks comprising the **Azafran calc-alkaline** plutons and envelope greenstones, turbidites and calcareous flysch: possibly another island arc terrane.

The Eastern belt

This occupies the Andean foothill zone between the sub-Andean front in the west and the limit of Andean (Late Miocene) thrusting in the east. Rocks of the Central belt along with Cretaceous formations of the Amazonic cratonic cover are thrust steeply over the essentially undeformed **Abitagua-Zamora plutonic-volcanic continental arc** which Rb-Sr and K-Ar studies indicate as Early/Mid-Jurassic in age.
This narrow Cenozoic thrust belt (presumably Late-Miocene) is believed to represent a rejuvination of the major pre-Cretaceous sole thrusts which essentially marked the eastern limit of the pre-Cretaceous orogeny.

Interpretation

Previously the Western Cordillera and coastal plain of Ecuador have been interpreted as of accretionary origin (Lebrat et al, 1986) of Late Cretaceous/Cenozoic age, rather than related to the simple "Andean" model. The discovery of ophiolitic rocks, S-type granites and nappe complexes in the Eastern Cordillera indicates even older accretionary/collisional events.

The west-to-east lithotectonic sequence of the Western belt has been interpreted as the Mid-Jurassic accretion of the Alao-Paute (island arc) division between the S American plate to the east and the Chaucha-Arenillas plate to the west, across the Peltetec ophiolitic suture (Aspden et al, 1987; 1988). On this basis the Abitagua-Zamora plutonic chain could be interpreted as a continental arc related to this accretion.
A major problem, however, is the interpretation of the S-type Tres Lagunas granite, nappe complexes and serpentinites the Central belt. These could either relate to the same Mid-Jurassic Alao-Paute collision, or to an older (Late Triassic/Early Jurassic) collision which would then define the Baños front as a Mid-Jurassic continental margin. The eastward tectonic transport of the nappe complexes might indicate the overriding of the South America plate by the colliding terrane, in contrast to the Cenozoic subduction pattern.
Work will shortly begin on the El Oro metamorphic basement block of the Huancabamba Deflection and it is hoped that these studies will shed further light on the pre-Cretaceous history.

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