THE GEOTECTONIC EVOLUTION OF ECUADOR IN THE PHANEROZOIC

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RESUMEN: Durante el Cretacico se acrecionaron terrenos continentales paleozoicos y terrenos oceanicos jurasicos y cretacicos. Estructuras mas tardes, relacionados al levantiamento de los Andes, puede relacionarse a la reactivacion de las fallas de acrecion.

KEY WORDS: Ecuador, terrane, accretion

INTRODUCTION

Studies of the metamorphic rocks of the Ecuadorian Andes by the British Geological Mission and CODIGEM (ex-INEMIN) (Aspden and Litherland, 1982), and the subsequent preparation of national geologic and tectono-metallogenic maps in collaboration with Quito Polytechnic, has led to a new interpretation of the geotectonic evolution of Ecuador involving terrane accretion followed by normal "Andean" subduction.

TERRANES (Fig. 1)

1 *The Amazonic craton,* underlying the eastern lowlands of Ecuador, comprises Precambrian metamorphic rocks overlain or intruded by essentially unmetamorphosed Phanerozoic units. Whilst the Precambrian rocks may have resulted from Proterozoic collisions, during the Phanerozoic the craton acted as a stable block at the margin of Gondwana.

2 *The Loja terrane* occurs as two Andean-trending tectonic units within the Cordillera Real. Rocks comprise low- to medium-grade semipelitic schists and paragneisses, all of presumed Palaeozoic depositional age, associated with amphibolites and foliated, migmatitic and mylonitic S-type granites of the Tres Lagunas

suite dated by U-Pb at 228 + 3 Ma: regarded as the metamorphic age.

3 *The Amotape and Chaucha terranes* contain semipelitic metamorphic rocks, of Palaeozoic depositional age, amphibolites, and foliated S-type granites dated by U-Pb at 228 + 1 (the metamorphic age): a lithological association practically identical to the Loja terrane (above). The rocks of the Amatope terrane trend E-W in Ecuador; those of the Chaucha terrane are largely buried, but small windows and float indications in the south around Chaucha and tectonic lenses in the Pujili ophiolite further north suggest its extension as basement to the Inter-Andean valley.

4 *The Salado and Alao terranes* of the Cordillera Real comprise Jurassic greenstones of basalt to andesite in composition, with associated greenschists, pelitic schists and metagreywackes. Geochemistry indicates the Alao volcanics to be typical of oceanic island arc basalts, but those of Salado show more crustal contamination. The latter are also associated with Jurassic calc-alkaline plutons, the Abitagua-Zamora chain, parallel to a similar, but undeformed, magmatic arc along the adjacent western margin of the Amazonic craton.

5 *The Pinon terrane* comprises Cretaceous oceanic crust overlain by Cenozoic forearc basins. *The Pinon-Macuchi terrane* is overlain by the Palaeocene-Eocene Macuchi island arc of calc-alkaline affinity (Bourgois et al, 1990).

TERRANE BOUNDARIES (Fig. 1)

1 *The Cosanga fault* separates undeformed rocks of the stable Amazonic craton in the east from deformed and metamorphosed Triassic-to-Cretaceous rocks in the west. In particular it separates the undeformed Late-Triassic Piuntza volcano-sedimentary unit from S-type granites and migmatites of the same age in the Cordillera Real.

2 *The Banos fault zone* is a regional, Andean-trending, dextral shear zone affecting the Jurassic rocks of the Alao terrane.

3 *The Peltetec fault zone* is marked by an ophiolitic melange with Middle/Upper Jurassic palynoflora in the sedimentary phase.

4 *The Raspas fault zone* comprises serpentinites, eclogites, blueschists, greenschists and pelitic schists. It is parallel with the dextral shearing event associated with the production of the 228 Ma S-type granites in the adjacent Amotape and Chaucha terranes. A K-Ar date gave a Lower Cretaceous age (Feininger and Silberman, 1982).

5 *Both the Pujili and Guayaquil fault zones* contain ultramafic and mafic rocks regarded as derived from the lower portions of the Cretaceous Pinon oceanic crust.

TERRANE ACCRETION

1 The Palaeozoic sediments of the Loja, Amotape and Chaucha

terranes were sheared, metamorphosed and intruded by S-type granites at around 228 Ma, possibly related to proto-Tethyian rifting or collision.

2 In the early Cretaceous the Amatope and Chaucha terranes were accreted from the SW along with the Jurassic Alao island arc; the Loja terrane may be para-autochthonous. Over the Cordillera Real, this collision resulted in strike-slip and nappe tectonics and regional metamorphism.

3 The Pinon-Macuchi terrane may have been juxtaposed in Late Cretaceous times, but was finally accreted towards the end of the Eocene judging from the presence of reworked continental material in Eocene formations.

TERRANE BOUNDARY REACTIVATION

In the Oligocene the formation and consequent subduction of the Nazca plate produced a continental volcanic arc, with intermontane basins, bounded by a coastal forearc and an Amazonic backarc basin. Major Andean uplift occurred in the Pliocene and many of the accompanying compressive and extensional faults can be identified as reactivated terrane boundaries, in particular the Cosanga, Peltetec, Pujili and Guayaquil faults. Opening up of the Pujili and Peltetec faults to form the Inter-Andean "graben" may have produced the conduits for the double chain of Plio-quaternary volcanoes (Litherland and Aspden, 1992).

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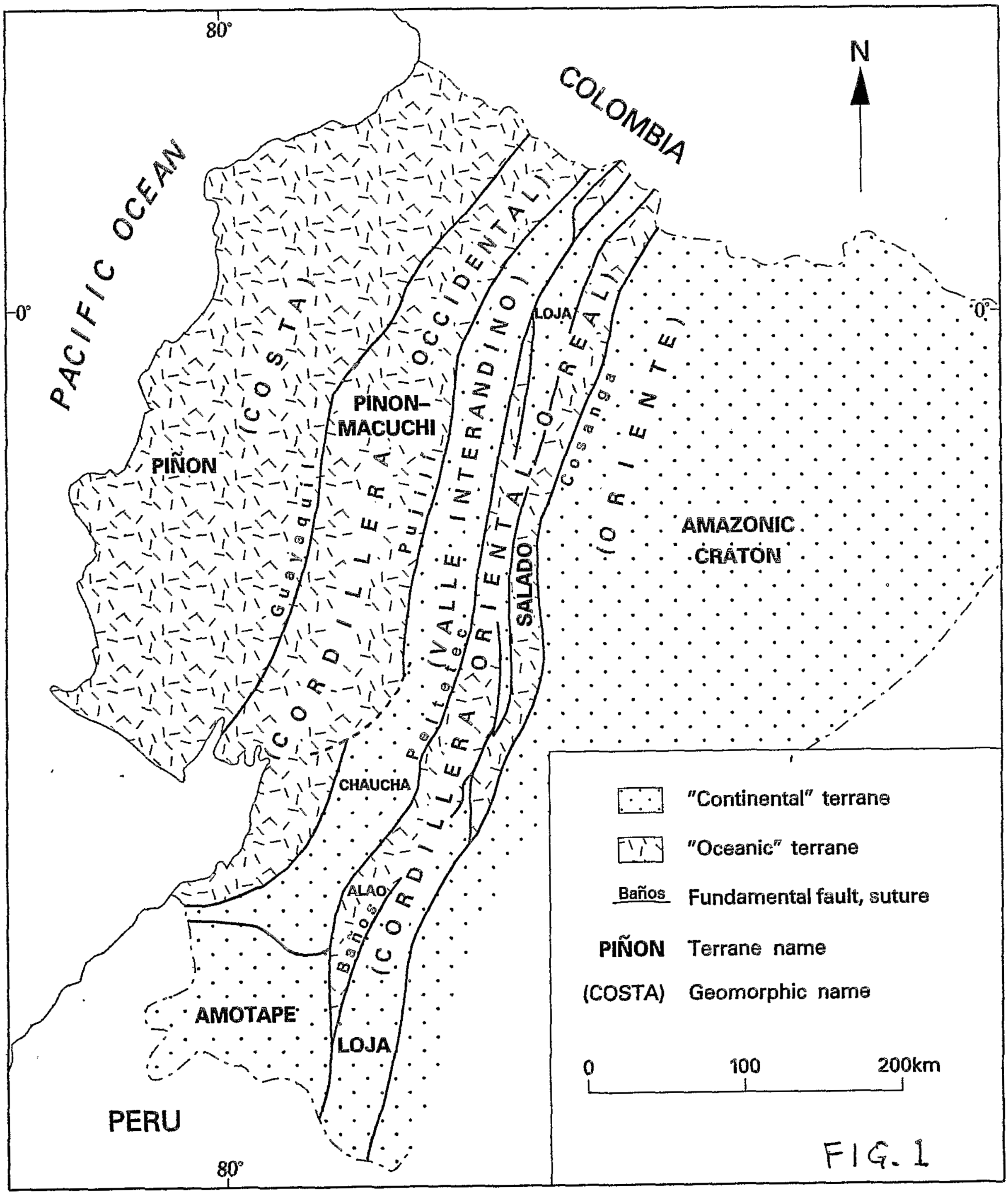
80°
N
COLOMBIA
PACIFIC OCEAN
0°
0°
(COSTA)
CORDILLERA OCCIDENTAL
(VALLE INTERANDINO)
CORDILLERA ORIENTAL O REAL
(ORIENTE)
LOJA
PINON-
MACUCHI
PIÑON
Guayaquil
Pujili
Peltetec
Cosanga
SALADO
AMAZONIC
CRATON
CHAUCHA
ALAO
Baños
(CORDILLERA)
AMOTAPE
LOJA
PERU
80°
"Continental" terrane
"Oceanic" terrane
Baños
Fundamental fault, suture
PIÑON
Terrane name
(COSTA)
Geomorphic name
0
100
200km

FIG. 1