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THE TECTONIC FRAMEWORK OF PERU AS A SETTING FOR BATHOLITHIC EMPLACEMENT

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The main elements of the Andes in Peru are the Paleozoic and Mesozoic fold belts. Both are contained within catogenic elements–the Brazilian shield to the east and the Arequipa massif to the west. The Brazilian shield is totally concealed in Peru but is thought to underlie conformable sequences of Lower Paleozoic to Tertiary sediments exposed in block-faulted structures on the east side of the Andes (HAM and HERRERA, 1963).

The Arequipa massif is well exposed in the coastal Cordillera of southern Peru and consists of gneisses of granulite facies metamorphism cut by granitic migmatites and overlain by well-differentiated schists of the amphibolite facies. All the structures strike inland at right angles to the Andean trend and are cut both by the deep sea trench and by Andean folding. A K-Ar date of 642 ± 16 m.y. was obtained by STEWART and SNELLING(1970), from gneisses in the Arequipa area and it is conjectured (COBBING, 1972), that a metamorphic basement underlies the broad continental shelf from Ica in the south to Amotape in the north.

There are two discrete Paleozoic fold belts in Peru; the main one forms the Eastern Cordillera which terminates in northern Peru at the Huamcabamba deflection where the strike of the Andes changes abruptly from N.W. to N.E. Here schists and phyllites of Paleozoic age form the coastal Amotape hills which continue into Ecuador.

The main fold belt of the Eastern Cordillera is divided into two parts; a thick black shale-quartzite flysch of Ordovician to Devonian age south of Huancayo contrasts with pre-Ordovician green-schist facies pelites to the north. The schists are locally associated with gneisses which may represent reworked Precambrian basement (WILSON, 1964, 1967). The entire fold belt was considered to be intracratonic by MEGARD, *et al.* (1971).

Thin platform sequences on the shield abruptly change to thick flysch deposits in the trough, located at the present sub-Andean Fault zone. This zone represents Pliocene reactivation of a Paleozoic hinge line. It is the oldest recognizable feature to follow a truly Andean trend, and indicates that the Andean mobile belt was first formed during the late Precambrian or lower Paleozoic (MARTINEZ, *et al.*, 1971, and COBBING, 1972).

Mid-Devonian tectonism was followed by Carboniferous to Permian plutonism, while final stabilization of the belt was marked by Upper Permian andesites and red beds of the Mitu Formation. This typical post-tectonic molasse was laid down unconformably upon the folded schists and sediments and also formed the first structural stage of the Mesozoic fold belt which subsequently developed immediately to the west.

The Mesozoic fold belt forms the Western Cordillera and is separated from the Eastern Cordillera in southern Peru by a molasse-filled Tertiary graben, the Altiplano. The fold belt is divided into an eastern miogeosynclinal belt of folded clastics and carbonates which forms the crest of the Sierra, and a western eugeosynclinal belt of relatively undeformed marine volcaniclastics. The well-marked polarity of the Mesozoic fold belt from eastern sediments to western volcanics is in contrast to the wholly

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sedimentary clastic flysch of the Paleozoic fold belt. This difference in composition may reflect a difference in their mode of origin.

It is clear that the andesitic eugeosynclinal deposits are concentrated in a belt near the present continental margin and are therefore possibly connected with subduction of oceanic crust down a Cretaceous Benioff zone. It is also clear however, that the

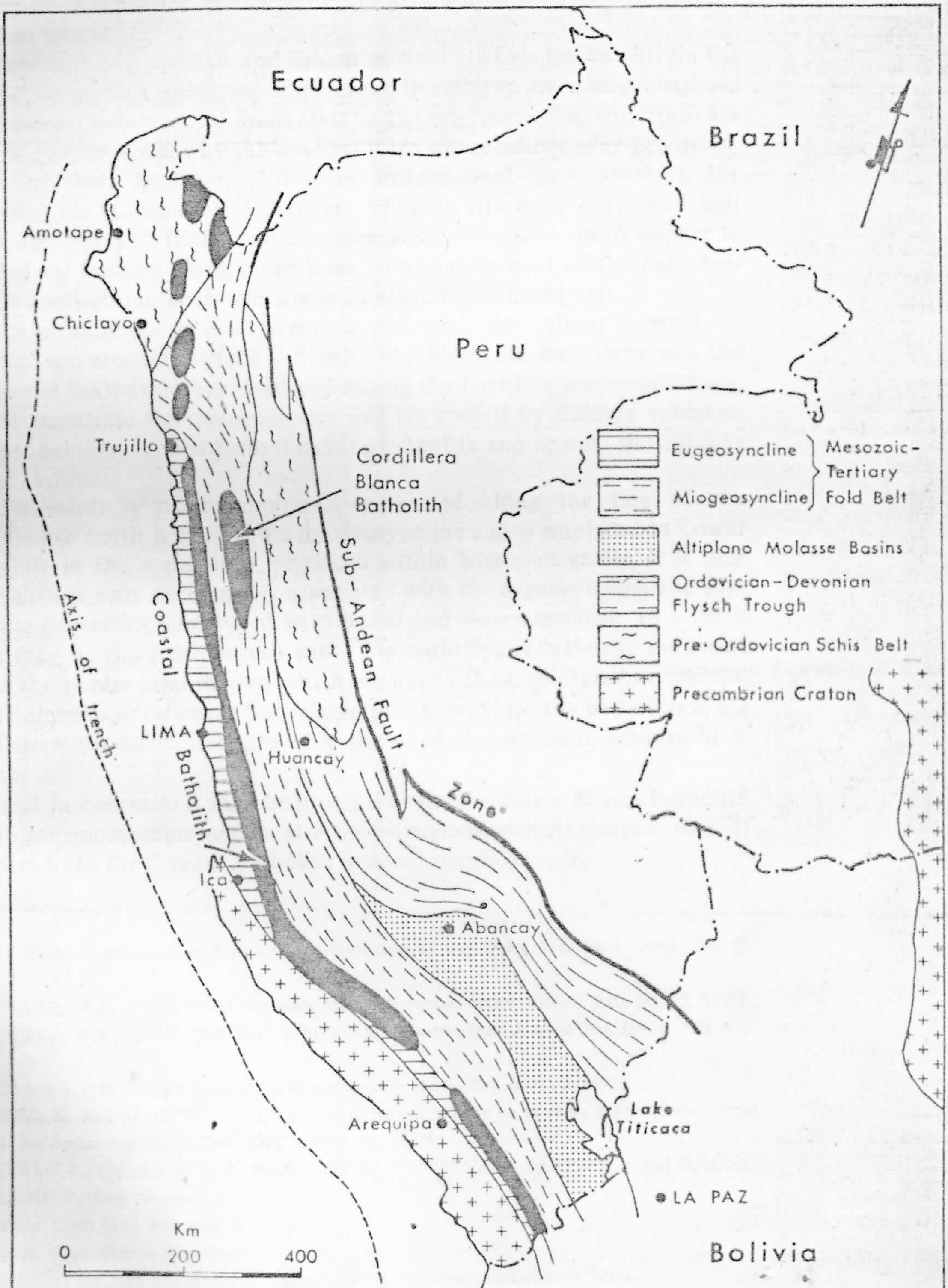

Fig. 1. Main elements of the Peruvian Andes.

volcanic sequence, although thick, was deposited upon sialic crust in shallow water and that therefore continental accretion by deposition of intermediate volcanics on oceanic crust cannot apply in this instance (COBBING and PITCHER, 1972a). Moreover, the presence of normal continental crust at the leading edge of the continental margin shows that continental material is available in the area which could contribute to granitic magmatism or anatexis.

The Mesozoic fold belt was uplifted and folded in the Late Cretaceous. Within the miogeosyncline tight concentric folds are continuous in outcrop over long distances and are closely associated with vertical faults, but in the eugeosyncline, structures are more open except in narrow zones of tight isoclinal folds where schists were produced. Faults are still important, however, and were instrumental in controlling the emplacement of intrusives (COBBING and PITCHER, 1972b). The miogeosynclinal belt was more strongly uplifted and both its deposition and subsequent uplift appear to have been controlled by faulting along hinge lines immediately west of the Paleozoic fold belt, possibly in a structural block which was foreland to that fold belt.

A thick sequence of andesitic to acid terrestrial volcanics, the Calipuy Formation, was laid down upon an erosion surface cut into the Mesozoic structures and the intrusives of the Coastal Batholith were emplaced during the Late Cretaceous and Early Tertiary. These just penetrate the unconformity and are roofed by Calipuy volcanics which were in all probability derived from the rising batholith and formed the cover in which emplacement finished.

The Coastal Batholith is most commonly emplaced along the line of the eugeosyncline but in the north it crosses the miogeosyncline and is emplaced in Lower Paleozoic rocks, while in the south it is emplaced within basement gneiss. It is thus clear that the batholith is only accidentally associated with the eugeosyncline and that the model of granite generation associated with burial and metamorphism, of a thick geosynclinal prism may be discarded in this case. The batholith is evidently the result of some process at the continental margin which produced the eugeosyncline and the Tertiary terrestrial volcanics as different but related products. Since the batholith is the most persistent of these products, it is probably the most characteristic expression of the underlying process.

In conclusion and in contrast, it may be noted that the Cordillera Blanca Batholith is emplaced in the miogeosyncline and is strictly associated with its deepest part. It may be that it differs from the Coastal Batholith in some significant way.

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