The Paleozoic-Mesozoic geodynamic transition along the Western Gondwana*n margin* – Geochemical and chronometric constraints from the Eastern Peruvian Cordillera

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The Eastern Cordillera of Peru represents a major, yet relatively unstudied part of the proto-Andean continental margin. Paleozoic to early Mesozoic batholiths that span its length exhibit profound and systematic variations in the chemistry and timing of emplacement from north to south (Mégard, 1978; Soler, 1991; Vidal et al., 1995; Jacay et al., 1999). As products of long-lived magmatic episodes, these plutonic belts mark loci of active lithospheric boundaries between the western Amazonian Craton and variable Neoproterozoic to Paleozoic crustal domains during the final assembly and ultimate break-up of Pangea. Recognizing variations in their geochemical signature through time and space places constraints on the type of tectonism along the paleo-margin, the composition and provenance of crustal members involved, as well as the nature of the underlying lithospheric mantle.
Here, a new data set from plutonic rocks of the Eastern Cordillera is integrated with the existing geochemical, chronometric and isotopic characterizations of the Peruvian landmass and a provisional geodynamic model is proposed for the Late Devonian - Early Jurassic evolution of this segment of the western Gondwana.

A striking relationship exists between the three principal plutonic belts of eastern Peruvian Cordillera:

(1) Mississippian to Pennsylvanian I-type metaluminous to peraluminous, hornblende-dominated granitoids are restricted to the segment north of 11°S (dominantly north of 9°S), and display calc-alkaline evolutionary trends with elevated LILE/HFSE ratios characteristic of continental subduction zones;
(2) Mid-Permian to Early Triassic peraluminous, S to I-type, mica-rich granitoids of the (south) central Peru, are comagmatic with the compositionally bimodal, calc-alkaline to tholeiitic lavas of the Mitu Group and are characterized by restricted bimodal compositional range (66-72 wt. % SiO_2), Fe enrichment, lack of Nb anomalies, Ba depletions relative to Th and Rb and higher Ga/Al ratios, all of which are associated with the transitional post-orogenic to within-plate granitoid suites;
(3) Late Triassic-Early Jurassic peralkaline, A-type plutons of the southern Cordillera de Carabaya intrude alkaline Mitu Gr. basalts. They are nepheline normative, and characterized by highly elevated HFS elements (ZR, Ti, and P).

Combined $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$ isotopic ratios as well as various Pb isotope systematics from the three intrusive provinces however lack systematic variations, and suggest uniformly large degrees of assimilation of the Proterozoic Amazonian basement throughout, thus constraining their paleo-geographic position proximal to or within the Gondwana craton.

Interestingly, high precision U/Pb (zircon) and 39Ar/40Ar (mica, hbd.) geochronometry reveal a general younging-southward trend. A ~ 20 Ma long magmatism associated with the formation of a Mississippian continental arc in the north-central Cordillera Oriental culminated between 336-325 Ma, and was followed by c.a. 40 Ma hiatus, briefly punctuated during a 314-312 Ma episode of orogenic Au-Ag mineralization and a 307-305 Ma, S-type magmatic pulse, both interpreted to reflect an episode of tectonic uplift of the convergent margin (Haeberlin et al., 2002).
Resumption of Permo-Triassic magmatism (279-230 Ma) initially saw deposition of the bimodal calc-alkaline to tholeiitic volcanics of the Mitu Group contemporaneously with the emplacement of the post-collisional S-type plutons in the south-central Eastern Cordillera (Soler, 1991). The magmatic activity throughout Triassic was marked by eruption of progressively more mafic and alkalic Mitu lavas and initiation of the A-type plutonism (*sensu stricto*) that peaked between 216-205 Ma in the southernmost Carabaya Batholith (Kontak et al., 1990).

Complementarity of the arc and rift-related plutonic belts in the eastern Peruvian Andes points to a major tectono-magmatic change that took place along this segment of the proto-Andean margin of Gondwana during the late Paleozoic.

Any self-consistent tectonic model for the region must take into account the following:

(1) an apparent absence of the cratonic crust under most of the Western Peruvian Cordillera north of ^{13o} S as inferred from isotopic (Mukasa and Tilton, 1984) and gravimetric surveys (Polliand et al, 2005);
(2) Existence of a constructive continental margin as inferred from the subduction-related plutonism restricted to the northern Eastern Cordillera of Peru during mid-to-late Mississippian. The activity resumed 25 Ma later along the Chilean Frontal Cordillera (Mpodozis and Kay, 1992);
(3) Purely Gondwanan Pb isotopic signature of both the Carboniferous and Permo-Triassic plutonic rocks (Macfarlane, 1999);
(4) A north-to-south transition from subduction-related I-type through the S-type, post-orogenic leucogranitoids into the rift-associated A-type plutons, and
(5) A diachronous onset of the Permo-Triassic rift-related magmatism in the central and southern Peru with a younging-southward trend (Sempere et al., 2002).

The aforementioned geochemical and tectonic evidence can be integrated in a geodynamic model in which an originally orthogonal eastward subduction of the paleo-Pacific crust below the western Gondwana during the Late Devonian to Early Carboniferous became strongly oblique towards south-east thus imposing a sinistral strike-slip stress regime on the Gondwanan margin and induced a counter-clockwise rotation of the northern edge of the Arequipa terrane (Figure 4).
The proposed change in strike of the subduction could have resulted in transport of a buoyant segment of oceanic crust (island arc root / plateau), which plugged the subduction zone and resulted in an oceanward trench migration coupled with an initial margin uplift and subsequent fore-arc extension. This scenario explains the “craton- free” basement underlying the Western Cordillera of northern Peru as well as development of ubiquitous ensialic basins filled with the Mitu Gr. Molasses and bimodal volcanics, following the termination of arc-related magmatism in Pennsylvanian.
Continued oblique subduction of oceanic crust in Permian generated incipient S-type melts within the thickened crust of the cent-

ral Peru, while progressive strike-slip duplexing resulted in formation of transtensional basins filled with the Permian rift-related magmas further south during Triassic. We exclude the possibility of extending the Arequipa terrane north of its present isotopic borders during this time and consider it either non-existent, or reserve its removal from the Peruvian segment of the Gondwanan margin before Carboniferous.

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