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Chronology from rifting to foreland basin in the Paganzo Basin (Argentina), and a reapprisal on the "Eo- and Neohercynian" tectonics along Western Gondwana

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Analysis of the Paganzo Basin (Argentina), incorporating new isotopic and provenance data, provides the basis for an integrated model of the evolution of the southern Central Andes from Early Carboniferous rifting (ca. 360-325 Ma) to commencement of the late Permian Choiyoi granite-rhyolite silicic magmatic province. The rifting that initiated the Paganzo Basin postdates convergent margin docking of the Chilenia terrane during the Early-Mid Devonian (ca. 385 Ma) [1,2] and was followed by renewal of subduction at approximately 325 Ma [3] resulting in inversion to a retroforeland basin, located within the present Argentine foreland (Fig. 1). This two-fold evolution can be extrapolated to other regions along the peri-Gondwana Terra Australis Orogen where two main tectonic events have been inappropriately termed Eo and Neohercynian. Based on our work these two events involve pulses of extension and compression, respectively. The Early Carboniferous rift stage (Fig. 1A) includes an important component of bi-modal volcanism with an intraplate signature and juvenile influence. U/Pb ages on the volcanic activity (both SHRIMP and LA-ICP-MS) fall between 360 and 335 Ma in the western domain of the Paganzo Basin (WDPB) and extend north into southern Puna. This major volcanic episode is interbedded with a marine stratigraphic record in the WDPB indicating a strongly extended lower-plate setting (Fig. 1B), and locally directly onlaps onto Grenville age basement of the Western Sierras Pampeanas [4]. Provenance within the younger Carboniferous units of the WDPB shows a restricted local input from the basement indicating incomplete drainage development during synrift stages. By contrast, analysis of the stratigraphic record from the eastern domain of the Paganzo Basin (EDPB) indicates regional uplift that established a plateau, which triggered development of an ice cap (Fig. 1B) that reached its maximum during the Late Mississippian and influenced sedimentation within the Andean region [5]. Mississippian A-type granites [6,7] (Fig. 1B) and strong exhumation indicating minimum uplift of <4 km within the Eastern Pampeanas Ranges [8,9,10] are consistent with upwarping (epeirogenic tectonics) induced by underplating. The contrasting architectures of the WDPB and EDPB are linked through a model in which they represent the lower plate and upper plate components, respectively of asymmetric simple shear extension (Fig. 1A,B). The orientation of the detachment was likely influenced by the preferential fabric in basement, which is probably inherited from the accretion of Chilenia. Although the overall regime was extensional, it could have been a component of regional transtension, which enhanced volcanic activity [11] associated with pull-apart basins [12]. By the late Carboniferous (325-305 Ma) subduction was reestablished along the Gondwana margin. Coupling between the down-going and over-riding plates generated regional compression, inversion and broad-scale tilting (Fig. 1C). Compression triggered a folded belt within the Cordillera Frontal [13] and broken foreland stage within the retroforeland [14] between ca. 305-290 Ma (Fig. 1D). Blanketing of the EDPB occurred by the early Permian (Fig. 1E) when red beds onlapped basement highs. The only hints of glaciation in the EDPB are given by dissected "U" shaped paleovalleys deeply carved into basement. However, provenance within the glacial valley fills and within the WDPB glacial and postglacial series show recycling from all recorded events within the basement rocks (Pampean, Ocloyic and Achalian) [15]. By Early-Middle Permian, contraction generated by the San Rafael orogeny ("Neohercynian event") had affected the entire Carboniferous-Early Permian series in the WDPB (Fig. 1E), in the Cordillera Frontal, and the northern Precordillera [16]. Supra-subduction magmatism (I-type granites) commenced by the Late Carboniferous (Fig. 1D) and progressed across the Cordillera Frontal during the Permian (Fig. 1E). The developing orogenic arc barrier prevented access of humid air to the foreland and triggered climate change resulting in pervasive development of red beds within the stratigraphic record. West-directed high level ash plumes may have triggered distal tuffs recorded within the distal foreland in the EDPB. Except for the Late Permian onwards the general flow pattern (paleocurrents + provenance) has been from east to west, showing that the main input to the western domain of the Paganzo basin was from the unroofed upper-plate relief within the extensional setting. After complete tectonic inversion (Fig. 1E) the flow pattern reversed and mimiced the present Andean dispersal. By Late Permian-Early Triassic (Fig. 1F) gravitational collapse of the inactive slab [17] or slab rollback may have promoted lithosphere delamination and asthenosphere upwelling.

Tectonic switching in the Terra Australis Orogen within the Central Andes segment of the Gondwana margin can be related to the following sequence of events: collision of Chilenia (~385 Ma), post-collisional extension (360-335 Ma), initiation of subduction along the Chilean trench (~325 Ma), strong compression and coupling in an Andean type setting with progressive shallowing of the subducting slab (305-270 Ma), and final slab break-off around 260 Ma enhancing the Choiyoi granite-rhyolite silicic magmatic province.

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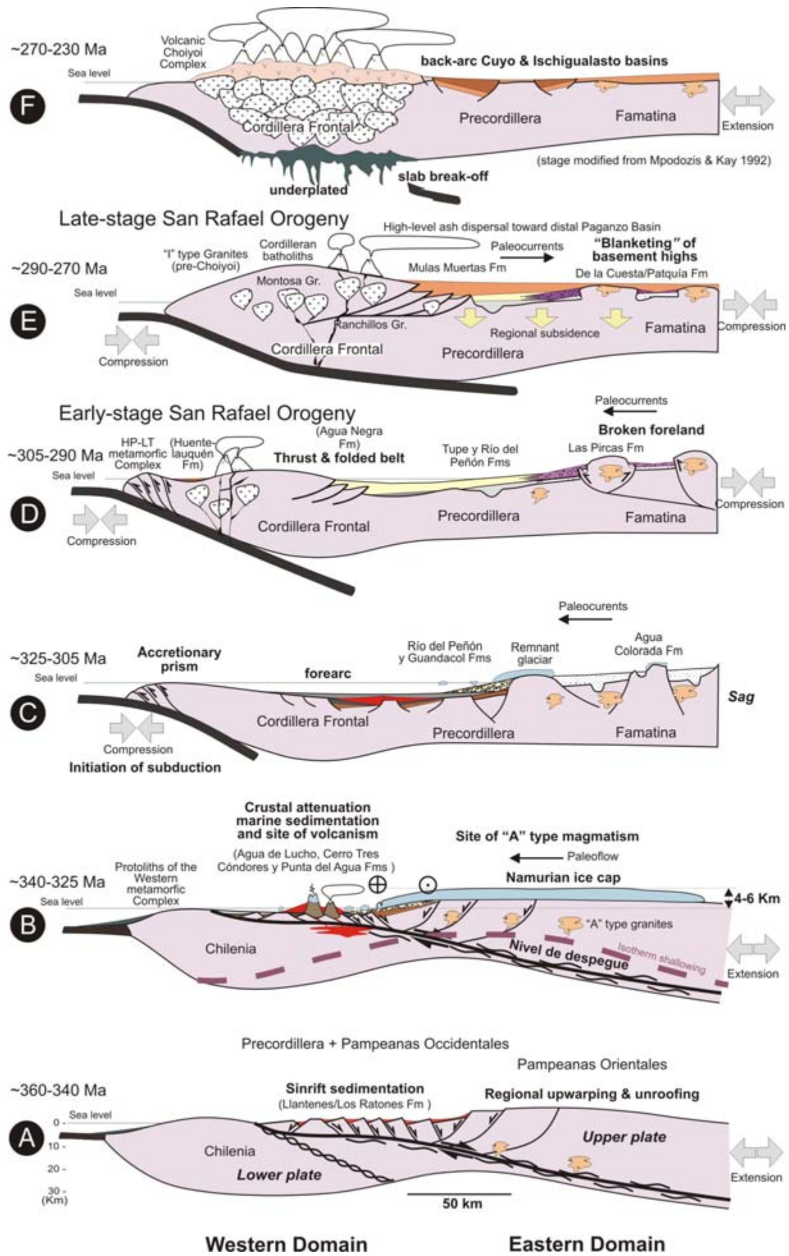

Figure 1: Western Gondwana rifting to foreland Paganzo Basin model for the Andean segment.