TECTONOSTRATIGRAPHIC DEVELOPMENT AND HISTORY OF AN ALLOCHTHONOUS TERRANE IN THE PREANDEAN GONDWANA MARGIN: THE ARGENTINE PRECORDILLERA

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INTRODUCTION

There seems to be a general consensus that the Argentine Precordillera represents a continental fragment that was rifted from the Ouachita embayment in Laurentia and subsequently accreted to Western Gondwana, present western South America (Astini *et al.*, 1995a). Its origin from the Ouachita embayment is documented by several lines of evidence, including similar ages and geochemistry of the basement rocks, similarities in the faunas and stratigraphy, and similar sizes of the Ouachita embayment and the Precordillera terrane (in the order of 800-1000 km length). Several new aspects on the rifting, drifting and docking of the exotic block, as well as on the postcollisional history of the Precordillera are considered in this contribution.

TECTONOSTRATIGRAPHIC DEVELOPMENT

Three main evolutionary stages can be differentiated in the history of the Precordillera: a) passive margin, b) foreland basin I and c) foreland basin II.

The passive margin stage involves the complete carbonate bank which starts in the Lower Cambrian evolving from synrift to a mature stage platform. Rifting of the Precordillera from the Ouachita embayment is recorded in its stratigraphy, and the geometry of the three-dimensional rift system should have had critical implications in the later contractional histories of both margins. In the context of low-angle extension models for continental rifting (*e.g.* Lister *et al.*, 1986), Astini (1986) and Thomas & Astini (1986) have suggested that the western margin of the Precordillera is the conjugate of the Ouachita rift and its northern margin was defined originally by the Alabama-Oklahoma transform. The model suggests that the Ouachita rift margin is an upper-plate setting, whereas the Precordillera is considered to be the lower-plate margin, and hence, show complementary asymmetry. Thermal doming under the upper-plate Ouachita margin prevent development of synrift rocks, and as predicted by the model, retarded the passive margin sedimentation in almost 20 m.y. In contrast, "samples" of the initial rift stage were found in western Precordillera, and a thick carbonate bank overlying locally important graben-fills (red clastics and evaporites) developed since the late Early to early Middle Cambrian, as a result of a lower-plate configuration. The Early Cambrian graben-fill in the northern region of the Precordillera could represent an intracratonic graben developed in the Precordillera, similar to those of the Birmingham and Mississippi Valley grabens, orthogonally related to the Alabama-Oklahoma transform. The onset of the passive-margin stage is recorded in an upward transition to a thick carbonate bank deposit, that apparently was controlled by thermotectonic subsidence and eustatic sea-level fluctuations. The subsidence history of the Precordilleran platform was already closely compared to the Appalachian curve by Bond *et al.* (1984).

The foreland I stage (FI) starts with the inception of anoxic depocenters which reflects the progressive migration of a foredeep related with the incipient peripheral foreland developed during the transformation from a passive to an active margin. This stage includes the clastic Ordovician units which prograde westward as a clastic wedge over a complex paleogeography with predominance of tectonism over sea-level as the major accommodation control. Carbonate remnants persist into the Middle Ordovician in the Central Precordillera, where the peripheral forebulge was active. As a consequence of the collision, east-vergent deformation and metamorphism in the basement rocks to the east was developed. Associated magmatism in Pampeanas yields ages of ~465 m.y. (Ramos *et al.*, 1996).

The third stage comprises from the latest Ordovician and Early Silurian through the Devonian, time when the Lower Paleozoic dominantly marine Famatinian cycle gives place to the Upper Paleozoic Gondwanic cycle. This rocks are included in the second foreland stage (FII). This foreland basin was developed on top of the former passive margin of the Precordillera terrane and partly overlapped the first foreland as well. It developed as a response of contractional tectonics driven by the approach and collision of the Chilenia terrane to the present west. However, several relaxation episodes are present in between, shortly after each episode of shortening. Relaxation features include the generation of peripheral bulges, which cyclically affected the central Precordillera, generating erosive unconformities and local block faulting with associated clastic wedges. The FII was bounded by the west by an incipient thrust front yielding low-grade metamorphosed Ordovician rocks of the accretional prism and to the east by a thrust front affecting Grenville basement rocks (present day Pampeanas Occidentales Ranges), originated in the old reactivated suture between Precordillera and Gondwana. The eastern thrust front also affected the Eastern Precordillera (~400 m.y. according to Ramos *et al.*, 1996) and subsequently serve as the fundamental source of the Devonian clatic sediments which developed an oversupplied shelf-deltaic complex, opposite to the accommodation regime which predominate during the Silurian.

PALEOGEOGRAPHY

None of the three stages mentioned before are present in the Western Gondwanic basins with these characteristics, what allows considering the Precordillera as an exotic terrane. Large lithological and faunal contrasts of the Cambrian and Lower Ordovician (passive margin stage) with the surrounding synchronous basins of Gondwana (Astini *et al.*, 1995a; Vaccari, 1995; Sánchez y Waisfeld, 1995), suggest that the Precordillera is an allochthonous terrane to Gondwana (*cf.* Ramos *et al.*, 1986; Astini, 1995; Astini *et al.*, 1995a, Benedetto *et al.*, 1995). By contrary, its strong faunal and stratigraphic similarities with successions in the southern cone of Laurentia point out to an unequivocal provenance from North America (Benedetto, 1993; Benedetto *et al.*, 1995, Astini *et al.*, 1995a y 1995b). Recent studies carried out on basement xenoliths in the Precordillera are summarized in Kay *et al.*, (1996) and conclude on basis of U-Pb zircon ages, whole rock Pb and Nd isotopic data that the affinities of the Precordilleran basement are as those of the North American Grenville basement, and particularly close to that outcropping in Texas. Furthermore, Tosdal (1996) and Kay *et al.*, (1996) suggest an origin as a rifted fragment from Laurentia pointing out the strong differences with other basements present in Western Gondwana. According to this, the Precordillera is considered as a terrane exotic to Gondwana that rifted from Laurentia in the Early-Middle Cambrian and collided with Western Gondwana in the Middle-Late Ordovician (Fig. 1). An intermediate history of drifting and gradual geographic isolation is necessary to explain the faunal differentiation and endemism noted by Benedetto *et al.* (1995). It also explains the gradual cooling that affected the Precordillera since Arenig. The lithological indicators of climatic shift from low-latitude Bahamian-type carbonates in the Cambrian-lowermost Ordovician to glacial tills in the Late Ordovician (Astini, 1995). Faunal links with Gondwana started in Llandeilo-Caradoc times. The conclusive effects of the Hirnantian glaciation together with the typical *Hirnantia* fauna are categorical in favor of its definite connection with Gondwana.

CONCLUSIONS

An up-to-date synthesis of the geologic evolution of the Argentine Precordillera during the Lower Paleozoic considers it as an allochthonous terrane that rifted from the Ouachita embayment in North America and collided with Western Gondwana in the Mid-Late Ordovician. Its Grenville basement has similar geochemical characteristics than the Grenville belt of southeastern North America and its closest match is with that of the Texas Promontory. Its basement outcrops in the present Sierras Pampeanas Occidentales from the Sierra de Pie de Palo in San Juan down to the Ponon Trehué area in Mendoza.

Three main evolutionary stages can be defined in its history: a) a passive-margin stage, characterized by a common history with Laurentia including the asymmetric rifting and drifting stages, b) a first foreland basin stage, characterized by a clastic wedge prograding west, and deformation of the basement to the east due to the accretion of Precordillera to Gondwana (Ocloyic diastrophism), and c) a second foreland basin stage, which characterizes the postcollisional interval and ends with the accretion of the Chilenia terrane in Middle Paleozoic times (Precordilleran distrophism). From a paleobiogeographical viewpoint a pure Laurenitan stage (Cambrian-Tremadoc), a dominantly isolated - with major endemism- drift stage (Arenig-Llandeilo) and a dominantly Gondwanic stage (Caradoc-Ashgill) can be differentiated in the Cambrian-Ordovician history, where the Arenig and the Caradoc represent main turnover moments, hence transitional stages. The Silurian and Devonian faunas and environments of Precordillera are clearly Gondwanic and do not differ, as well as those of the late Ordovician, from those of surrounding South American basins.

On the basis of contrasted basements and passive-margin stage rocks and faunas the Argentine Precordillera in considered a unique exotic terrane which can be differentiated from the rest of the surrounding regions and Lower Paleozoic basins in western Gondwana.

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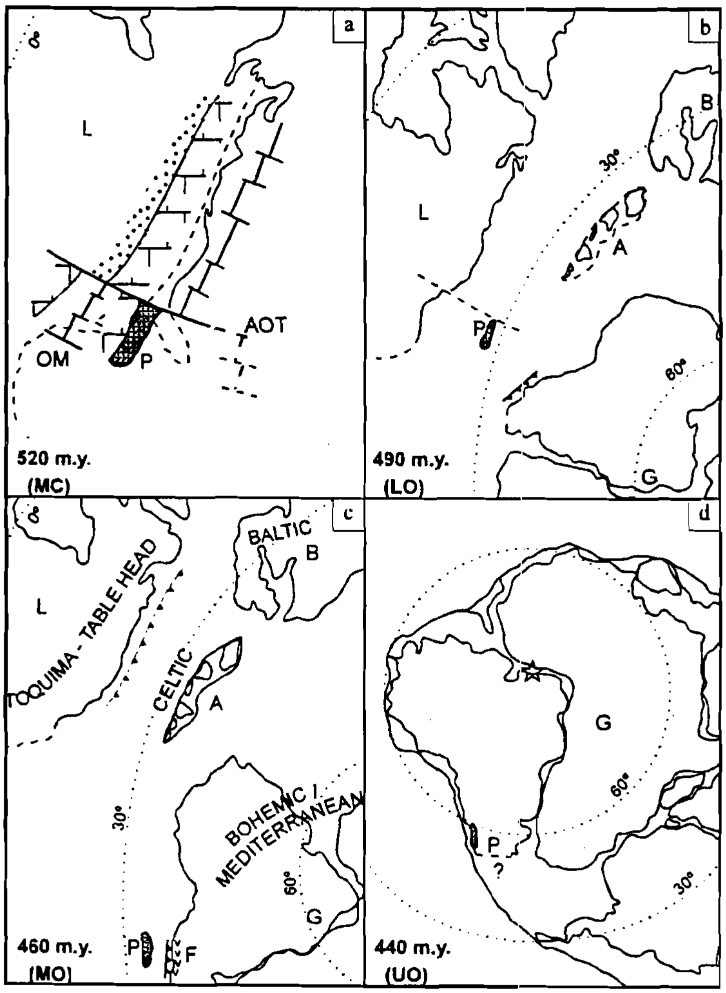

Fig. 1: Series of maps showing the paleogeographic evolution of the Precordillera terrane between the Middle Cambrian (MC) and the Upper Ordovician (UP) (modified from Astini et al., 1995). c) includes the Ordovician brachiopod biogeographic provinces. L:Laurentia, P:Precordillera, B:Baltica, A:Avalon, G:Gondwana, F:Famatina, OM:Ouachita mid-ocean ridge, AOT:Alabama-Oklahoma transform.