

## INSIGHTS ON THE PRE-CARBONIFEROUS TECTONIC EVOLUTION OF THE SAN RAFAEL BLOCK, MENDOZA, ARGENTINA.

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The San Rafael Block (SRB) lies in the west-central part of Mendoza province, Argentina (35°S-68°30'W), and displays a NNW structural Cenozoic trend in the pre-Andean region. Geological and paleontological evidence suggest that the SRB is an extension of the Cuyania terrane. Diverse igneous-metamorphic and sedimentary events known as 'pre-Carboniferous units' (Dessanti, 1956) crop out at the SRB. New insights (stratigraphy, petrography, geochemistry and isotopic data) allow constraining the evolution of the pre-Carboniferous history of the SRB as follows.

**MESOPROTEROZOIC BASEMENT:** known as **Cerro La Ventana Fm** is composed of mafic to intermediate gneisses, foliated quartz-diorites, diorites and tonalites, partially graded to amphibolites and migmatites. The low K contents and high Mg# number, as well as the low Sr IR allow interpreting as primitive-type rocks. They are similar to the 'Grenvillian-age' Las Matras tonalite-trondhjemites suite from La Pampa (Sato *et al.*, 2000). Whole-rock samples analyzed by the Sm-Nd method define an age of 1228±63 Ma, confirming the Rb-Sr ages (Cingolani and Varela, 1999; Cingolani *et al.*, 2005). The 1.3 Ga model ages ( $T_{DM}$ ) and the  $\epsilon Nd$  are indicative of a 'depleted' source, less evolved than CHUR for the time of crystallization. Euhedral zircon fractions analyzed by U-Pb (ID-TIMS) method indicate an age of 1215±6.5 Ma, interpreted as a Mesoproterozoic zircon crystallization age. The El Nihuil mafic unit comprises meter-scale deformed gabbroic and orthogneissic rocks of intermediate compositions bearing a foliation similar to the one found in Cerro La Ventana type area suggesting a common origin.

**MIDDLE-UPPER ORDOVICIAN SEDIMENTARY UNITS:** The **Ponón-Trehué Fm** is the only early Palaeozoic (Darriwilian-Sandbian) fossiliferous sedimentary sequence (Heredia, 2006) known to record a primary contact with the Grenvillian-age basement of the Cuyania terrane. Petrographical data and geochemical proxies such as Th/U, Zr/Sc, Th/Sc, Cr/V and Y/Ni ratios along with REE patterns indicate contributions from dominantly upper continental crustal and subordinated depleted components, similarly to the Pavón Fm.  $\epsilon Nd(t)$ ,  $fSm/Nd$  and  $T_{DM}$  values are also similar to those from the Pavón Fm. U-Pb detrital zircon ages from the Ponón Trehué Formation cluster around values of 1.2 Ga, indicating a main derivation from a local basement source (Cingolani *et al.*, 2003; Abre *et al.*, 2010).

The early Upper Ordovician (Sandbian) **Pavón Fm** crops out in the central area of the SRB in isolated outcrops dismembered by Tertiary tectonism. It is neither in contact with the Grenvillian-age basement nor with the Ponón Trehué Formation and it is covered by Upper Palaeozoic volcanoclastic rocks. It is a sandy marine turbiditic sequence composed of sandstones and shales bearing graptolites (Cuerda and Cingolani, 1998; Cingolani *et al.*, 2003). Noteworthy is the presence of detrital chromian spinels derived from host rocks emplaced within mid-ocean ridge and intraplate environments (Abre *et al.*, 2009; 2010). Th and U concentrations and Th/U and Zr/Sc ratios are similarly variable compared with the Ponón Trehué Formation, whereas the Th/Sc ratios include also lower values. Cr/V and Y/Ni ratios suggest the influence of a mafic source. REE patterns of the Pavón Fm are also similar to those from the Ponón Trehué Fm. Both units show similar  $\epsilon Nd(t)$ ,  $fSm/Nd$  and  $T_{DM}$  values (Cingolani *et al.*, 2003; Abre *et al.*, 2010). The Pavón Fm records a more complex detrital zircon age populations with main peaks at 1.1 and 1.4 Ga.

**ORDOVICIAN IGNEOUS EVENT:** The **El Nihuil mafic unit** is composed mainly of porphyritic dolerite and gabbroic rocks and was considered to as the extension of the "Famatinian ophiolite belt" on the western side of Cuyania terrane. The undeformed dolerites have a tholeiitic ocean floor basalt geochemical signature (Cingolani *et al.*, 2000) and were interpreted as an Ordovician-age igneous event based on K-Ar ages. The REE pattern is similar to N-MORB average. The gabbroic and tonalitic rocks are present in several small outcrops but they are overprinted by ductile deformation and could be considered as roof pendant Mesoproterozoic relicts. The El Nihuil undeformed dolerites was interpreted as an Ordovician-age igneous event based on K-Ar ages. The Nd isotopes and model ages ( $T_{DM}$ ) show characteristics of mantle derivation rocks.

## SILURIAN TO DEVONIAN SEQUENCES

Two units composed the Silurian-Devonian sedimentary events within the SRB the **La Horqueta Fm** and the **Río Seco de los Castaños Fm (RSC)** mapped and described mainly by Dessanti (1956) and González Díaz (1981).

The **La Horqueta unit** initially comprised all 'pre-Carboniferous' sedimentary rocks of the SRB. It is a sandy-dominated metasedimentary marine sequence restricted to the rocks outcropping between Río Seco de las Peñas to the North and the Agua de la Piedra creek to the South. The best section is exposed along the Diamante river sector. This unit has been folded, cleaved and faulted by a main deformational event that was associated with very low to low-grade metamorphism (anchizone and medium P/T conditions). In some outcrops (Punta del Agua area) the Carboniferous rocks overlay the La Horqueta Fm by unconformity (Chanic tectonic phase). The Rb-Sr whole-rock age obtained from two different outcrops yielded  $371\pm 62$  Ma and  $379\pm 15$  Ma (Tickyj and Cingolani, 2000). The U-Pb (LA-ICP-MS) detrital zircon ages show main clusters from Mesoproterozoic, Neoproterozoic-Ordovician and Silurian-Lower Devonian (Cingolani *et al.*, 2008). These data constrain the maximum sedimentation age to the Lower Devonian.

The **Río Seco de los Castaños Fm** (Upper Silurian-Lower Devonian) is a marine-siliciclastic unit (González Díaz, 1981) and is interpreted as a distal to proximal silty platform-deltaic system (Manassero *et al.*, 2009). The dominant sedimentary processes were wave and storm action and the source areas were located to the east. Some acritarchs, lycophyte plants and *Nereites* ichnogenera were registered. The lithofacies are mainly immature arkosic sandstones showing both recycled orogen and continental block provenances. Sedimentological characteristics of conglomerate-filled channels and an organic-matter-rich bed were described. A very low-grade metamorphism acted during the Early Carboniferous ( $336\pm 23$  Ma; Rb-Sr method). Geochemical analyses indicate moderate to strong weathering, and a provenance from a less evolved upper continental crust.  $T_{DM}$  ages and  $\epsilon Nd$  are within the range of the Mesoproterozoic basement and Paleozoic supracrustal rocks from the Cuyania terrane.

### DEVONIAN IGNEOUS EVENT:

The **Rodeo Bordalesa tonalite** is intrusive into the RSC sedimentary rocks (Cingolani *et al.*, 2000). It is characterized by high to medium K contents, with metaluminous composition and I-type calc-alkaline signature. The crystallization age was dated at  $400\pm 3$  Ma by U-Pb on zircon and  $400\pm 17$  by biotite K-Ar method. Nd model ages ( $T_{DM}$ ) range between 1 to 1.6 Ga and the negative  $\epsilon Nd$  is characteristic of crustal sources. The ca. 400 Ma age corresponds of an Early Devonian time and the field relationships suggest a late-orogenic event.

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