

Early Cambrian high-grade metamorphism at Sierra de Lonco Vaca: southern extension of the Pampean orogen from the Sierras de Córdoba, Argentina

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The Lonco Vaca Metamorphic Complex (La Pampa Province, 35°08'S, 65°04'W) is mainly composed of biotite-garnet gneisses and clinopyroxene amphibolites, with minor meta-dacites, micaschists and deformed granitic dykes. The complex underwent two distinctive deformation phases and one metamorphic event: (1) D₁ ductile deformation characterized by isoclinal F₁ folds affecting the primary foliation S₀ and penetrative N- to NE-trending, E-dipping S₁ foliation, contemporaneous with M₁ regional high grade amphibolite facies metamorphism. (2) D₂ deformation with gentle crenulations of S₀-S₁ foliations and tight-to-open F₂ folds. Neither S₂ cleavage nor M₂ metamorphic overprint are recognized. Five monazite single crystal fractions from the felsic gneiss define a ²⁰⁶Pb/²³⁸U mean age of 526.4 ± 5.4 Ma, which we interpret as that of the peak M₁ regional metamorphism related to the D₁ deformation phase. This Early Cambrian age suggests the effects of the Pampean orogeny in Sierra de Lonco Vaca. Comparable Pampean high-grade metamorphism appears to the north, in the Sierras Pampeanas de Córdoba (522 Ma, Rapela et al., 1998). However, metamorphic rocks in Lonco Vaca seem to have been formed at shallower crustal levels than in Córdoba, where migmatites and granulite facies rocks are involved. The age obtained confirms the early interpretation of Linares et al. (1980) that the Lonco Vaca area represents the southern extension of the Sierras Pampeanas basement of central Argentina. Zircon fractions from the same gneiss yield a mean ²⁰⁶Pb/²³⁸U age of 718 ± 34 Ma, which can be interpreted as representing either: (1) a crystallization age of a pre-D₁-M₁ igneous protolith or (2) an age related to a sedimentary source. A comparable age of 724 ± 18 Ma (Rb-Sr whole rock, Parica, 1986) was also reported from the area. The deformed granitic dykes (now orthogneisses) cut S₀ and are parallel to S₁, but they are affected by the tight-to-open F₂ folds. This feature suggests that the dykes intruded the Lonco Vaca Metamorphic Complex during or after D₁-M₁ and prior to D₂. Local stratigraphy is followed by a younger granitic pluton and associated granite-pegmatite longitudinal dyke swarm that cut and thermally affect the entire former metamorphic fabric. The pluton and dykes are additionally cut by another near orthogonal E-trending dyke swarm of aplites and porphyritic granites. The structural relationship and the absence of ductile deformation in all these intrusions indicate their post-orogenic character with respect to the Pampean D₁-M₁/D₂ phases. Subsequently, the metamorphic complex and intrusions were affected by the D₃ deformation phase canalized through local N-trending, E- and W-dipping ductile shear zones, with F₃ drag fold and mylonitic fabric. These younger events – post-orogenic magmatism and D₃ deformation – might be ascribed to a late- to post-orogenic stage of the Pampean orogeny, or to the still younger Famatinian orogeny. From a more regional point of view, the Pampean age of 526 Ma in Sierra de Lonco Vaca confirms for these latitudes the same E-W zoning pattern of orogenic belts observed in Sierras Pampeanas of Córdoba, San Luis and San Juan. In La Pampa province, the innermost Pampean proto-Pacific Gondwana border is also located to the east, where high-grade rocks crop out at Lonco Vaca in the north, and low-grade rocks at Las Piedras–Antimán (523 Ma, Tickyj et al., 2002) in the south. The Famatinian belt is a parallel belt to the west along Valle Daza and the Paso del Bote area (467–461 Ma, Tickyj et al., 2002), whereas the Grenvillian basement of allochthonous origin appears further west in Las Matras area. This E-W polarity of orogenic belts along the western Gondwana border has not been recorded to the south of Río Colorado, within the Patagonia region.

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