

# MIDDLE CRUST EXHUMED ORTHOGNEISSES IN THE SIERRA DE VELASCO OF LA RIOJA, ARGENTINA

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**ABSTRACT:** The orographic ridge of the Sierra de Velasco, located to the west of the Pampa de la Viuda plateau, is represented by a deformed coarse-grained porphyritic garnet – bearing peraluminous granite to granodiorite orthogneisses known as Antinaco Complex. The unit crop out along the western flank of the Sierra de Velasco towards the type-I granitoids located to the south of the Sierra. Eastwards, the Antinaco Complex is intruded by the Carboniferous aged Sanagasta and Huaco granites.

The Antinaco Complex is part of the Lower Ordovician Magmatic Famatinian belt of the Sierras Pampeanas.

Within the complex, on the upper part of the mountains deformed coarse porphyritic granites are present. These display a limited areal extent and are composed by microcline phenocrysts, oligoclase, quartz, biotite, garnet, cordierite, sillimanite, magnetite and spinel.

The aluminum silicates do not display equilibrium paragenesis: garnet is always unstable, often relict, and is replaced by cordierite rings. In addition, magnetite mostly appears as unstable and surrounded by cordierite. Relictic sillimanite is commonly surrounded by spinel wreaths.

Associated to these granitoids deformed outcrops of inequigranular hiperstenic metatonalites are recognized. These are characterized by medium grained metatonalites composed of acid andesine, quartz, biotite and hypersthene. The hypersthene is found lacking equilibrium with biotite, indicating the replacement of biotite by orthopyroxene.

Geochemical data projections and REE spider diagrams of these rocks indicate an average matching composition as accepted for the Middle Crust.

The crystallization age of SHRIMP U-Pb zircon, obtained earlier in the cordieritic granitoid is  $481.4 \pm 2.4$  Ma while low-U overgrowths observed in the cathode luminescence images display an age distribution centered at  $469.0 \pm 3.9$  Ma indicating a metamorphic process and / or deformation. The current paper presents additional data on monazite ages (microprobe), which display similarly a crystallization age of the oldest and youngest deformation and / or metamorphism.

The interpretation of thermobarometric data combined with the calculation of pseudosections have established a first stage of relatively rapid exhumation from 25 km (isothermal decompression) to approximately 10 km (depth of intrusion of the Carboniferous granites ). This is followed by another stage of slow exhumation, due to a low rate of erosion, while the temperature remained persistently high.

Described geological conditions would be prevalent in a thickened crust, causing a very favorable environment in order to generate temperatures above 900 ° C in the lower crust promoting partial melting.

While there is still no precise agreement about the source of heat, our interpretation is a viable alternative to that of a very thin crust model proposed by other authors for the generation of the Famatinian granites.

**KEYWORDS:** SLOW EXHUMATION – THICKENED CRUST