Geochemistry and tectonic setting of upper Carboniferous granitoids in Umango Range, La Rioja Province, Argentina

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Abstract. En la presente contribución se muestran los resultados del análisis petrográfico y geoquímico del granito La Troya, de edad Carbonífera, ubicado en el extremo sur de la Sierra de Umango (La Rioja, Argentina). Dicho análisis tiene por objeto su caracterización a fin de establecer su ambiente tectónico y su posible relación con el cinturón magmático Carbonífero Superior-Pérmico Inferior que aflora principalmente en Cordillera Frontal.

Su asociación con dicho magmatismo podría implicar que los granitoides en estudio representan un cuerpo plutónico menor aislado, producto de la expansión del arco Carbonífero hacia el límite oeste de las Sierras Pampeanas, en contacto con Precordillera, el cual probablemente aprovechó el límite entre los distintos terrenos para emplazarse.

Keywords: Carboniferous, Magmatism, Umango, Veladero.

1 Introduction - Section Headings are 11 pt

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The Neopaleozoic magmatism study in the central Andes is complex, because it comprises a large area that extends from about 28° to 33°SL. In addition, there are no detailed geochemical comparisons between the plutons from the volcanic front and those located to the back-arc. Therefore, present work purpose is the petrographic and geochemical characterization of the La Troya granite to establish its tectonic setting and a possible relationship with a Late Carboniferous to upper Permian magmatic belt that crops out principally in Frontal Cordillera and then discuss a possible model to explain the characteristics of neopaleozoic magmatism in the region.

The studied granitoids are located on the Veladero Hill that is part of the southern extreme of the Umango range (La Rioja province, Argentina). It consists of a stock that intrude into the Neoprotérozoico Tambio Unit (Varela et. al. 2003), a medium to low grade metavolcanosedimentary rock, assigned to the crystalline basement of western Pampean Ranges. The emplacement of the granites coincides with the Valle Fértil lineament (Cingolani et. al., 1993) and they are unconformable overlay by sedimentary rocks of the Paganzo Group of Upper Carboniferous to Permian age.

Early studies of the area were realized by Hausen (1921) and Furque (1972). More recently, Scalabrini Ortiz and Arrondo (1973) in a detailed cross section of Paleozoic rocks named the stock as “La Troya” granite. Cingolani et. al. (1993) made a petrographic study and dated the granitoids, obtaining a Rb/Sr age of 311 ± 15 Ma.

2 Characterization of the stock of the Veladero Hill

The La Troya granite is an elipsoidal body which extends along about 2.5 km with an average width of 1 km. The contact with the country rock is sharp and discordant with respect to their metamorphic foliation. Five representative samples were selected and analyzed petrographic and geochemically to the study of the pluton. The principal rock types are porphyritic and coarse to medium-grained hornblende and biotite-bearing quartzitic monzonites and granites. Mineral constituents are peritic potassium feldspar which show frequently micrographic texture, plagioclase (andesine - oligoclase) with a slight zonation, quartz, biotite commonly altered to muscovite, titanite and opaques and hornblende. Accessory minerals are sphe ne, apatite, zircon and opaques.

Most samples range between 68% and 69% SiO₂, have high K₂O content (3.82 - 6.37 % wt) and are metaluminous to peraluminous, with A/CNK values that range from 0.96 to 1.11, consistent with the corundum normative character (2 - 4.5 %) of three of the samples analyzed.

Spider diagrams normalized to primordial mantle (Fig. 2.a) show a relative enrichment in LIL elements, Th and U and negative anomalies in Sr, Ti, Ta and Nb. The La Troya granite has strong Nb and Ta depletion as well as Th, U, alkaline earth enrichment, both characteristic typical of an arc signature.

The REE condrite-normalized patterns (Fig. 2.b) maintain a small dispersion and are characterized by an enrichment in LREE over HREE, which is reflected in the relatively high La/Sr ratios (2 - 4.5 %) of three of the samples analyzed. Another notable feature is the lack of Eu anomaly. The slight concave-up REE patterns suggests amphibole fractionation and the relatively flat HREE patterns consistent with fractionation in a garnet-free, normal thickness crust.

Given the petrographic and geochemical characteristics described above, the granitoids of the Veladero Hill shows a high K calc-alkaline affinity and metaluminous to peraluminous character, which were formed from a garnet-free source, all characteristics that suggest a relationship between these rocks and the activity of a magmatic arc.
Regional extension of Carboniferous magmatism

Cingolani et al., (1993) have suggested that the stock of the Veladero Hill could be associated with Devonian-Carboniferous granitoids of Pampean Ranges or with the Carboniferous-Permian magmatism that crops out mainly in Frontal Cordillera and Precordillera (FCP), generated by Pacific subduction. The former were described by several authors as post-orogenic A-types granites (Fogliata et al., 2008; Grosse et al., 2009; Dahlquist et al., 2010) and most of them present an alkaline footprint, so their association with the magmatism that originated the stock of Veladero Hill is discarded, due to its calcalkaline character and I and S type affinities.

In order to establish the regional and tectonic context of the studied granitoids, they were compared with Carboniferous magmatic rocks of Frontal Cordillera and Precordillera (FCP) to evaluate their possible link. Figure 1 shows the location, names and ages of the samples with which they were compared.

On the spider diagram (Fig. 2.a) is represented the compositional fields of the FCP samples. They are characterized by a pronounced troughs in Ta, Nb and Ti and an enrichment in LIL, U and Th, showing a good correlation with the rocks of the Veladero Hill. The REE patterns (Fig. 2.b) of the FCP samples shows an important enrichment of LREE over HREE without (or with a very slight) Eu anomaly, similar to those of the La Troya granite.

In the tectonic classification diagram (Fig. 3.a) after Pearce et al. (1984) all the samples of the La Troya granite plot on the field of the magmatic arc granites and the Y versus 10,000 Ga/Al diagram (Whalen et al., 1987) show that they corresponds to the I and S Type granites (I&S). On the same diagrams are the fields corresponding to the FCP samples, showing the overlap and relative low dispersion between them. This geochemical evidence suggests an association of high K calc-alkaline affinity probably originated during an orogenic regime.

4 Discussion and conclusions

Most authors (Nasi et al., 1985; Kay et al., 1989; Llambías & Sato, 1990) agree with the concept that those Carboniferous rocks such as Tabaquito (High Lower Carboniferous) or Elqui Complex (Upper Carboniferous) are part of a magmatic arc related to the Pacific subduction along the western margin of Gondwana. (Llambías & Sato, 1995). The close similarity of the chemical characteristics and related age from La Troya granitoids with the samples from FCP (and hence their genetic relationship) suggests an association between the stock of the Veladero Hill and Carboniferous magmatism developed in the Western margin of Gondwana as a result of Pacific subduction, which crops out extensively in Frontal Cordillera and to a lesser extent in Precordillera (Mpodozis and Kay, 1992).

The relative large distance to the Cordillera Frontal batholiths where magmatic arc was located (Hervé, 1987) can be explained as a product of a strong eastward shifting and expansion from Late Carboniferous to Early Permian (Rodríguez Blanco, 2004). This expansion was explained by Ramos and Folguera (2009) with a possible flat slab subduction. The Veladero stock could then relate to an isolated minor plutonic body, as a product of such magmatic expansion located on the western edge of the Pampean Ranges in contact with Precordillera. Moreover it is possible that the boundary between these different terranes was probably used by the magma to rise, thus proving the tectonic nature of the contact between them (Llambías, 1999).

References


