

Combined petrological, U-Pb zircon geochronology, and zircon Hf and whole-rock Nd isotopes studies in Permian granitoids as monitor of sources, Frontal Cordillera of Argentina

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The Frontal Cordillera is composed of mountain ranges identified as 'cordones', which exceed an altitude of 5,000 m.a.s.l., encompassing the provinces of La Rioja, San Juan, and Mendoza in the western of Argentina. The Cordón del Portillo (CP), located in the central part of the province of Mendoza, displays different Permian granitic rocks (1) mostly emplaced in metamorphic rocks assigned to the Guarguaráz Complex (GC), which represent a Neoproterozoic-Early Cambrian metasedimentary assemblage associated with mafic and ultramafic rocks affected by Middle Devonian metamorphism (see (2) and references therein). A Sm-Nd isochron age of 655 ± 70 Ma (2σ) was reported by (3) for the mafic rocks of the GC. Using Sm-Nd data reported by (3), we calculated ϵNd_t ($t = 655$ Ma) values, which yield positive values (average = +5.5, $n = 7$) indicating a Neoproterozoic juvenile source.

In the CP, a granodiorite sample (PBL-109) from the Cerro Punta Blanca pluton (CPBP) was analyzed to obtain U-Pb and Hf zircon and whole-rock Nd isotopes data. The CPBP mostly ranges from granodiorite to monzogranite in the chemical classification diagrams, are metaluminous, and define a high-K calc-alkaline *suite* (1). The representative sample PBL-109, a medium-grained mostly equigranular (1-4 mm) granodiorite, is formed by plagioclase, quartz, and alkali feldspar in order of abundance, with amphibole and biotite as mafic minerals. Accessory minerals are titanite, zircon, allanite, apatite, and opaque minerals. In the geochemical classification diagrams the sample PBL-109 is classified as granodiorite, with $\text{SiO}_2 = 65.3$ wt.%.

Thirteen data selected from eighteen U-Pb zircon SHRIMP analyses yield a Tera-Wasserburg Concordia (TWC) age of 282 ± 2 Ma. However, a detailed analysis based on weighted mean diagram and probability linear plot using *Isoplot* (4) strongly suggest the presence of three ages. Thus, three TWC ages of 278 ± 2 Ma ($n = 7$), 284 ± 2 Ma ($n = 5$), and 290 ± 3 Ma ($n = 4$) can be calculated. These ages are taken as three major crystallization event during the magmatic activity that led to the formation of the CPBP. Although the outer zones of zircon grains were mostly targeted in order to obtain crystallization ages an individual concordant inherited age of 722 ± 7 Ma was obtained.

ϵHf_t ($t = 282$ Ma) values ($n = 17$) mostly range from +0.55 to -2.2 (excepting three values of -3.0, -4.5, and -8.5). The inherited zircon ($t = 722$ Ma) yield a ϵHf_t value of +9.0, but when the ϵHf_t is recalculated to the crystallization age of 282 Ma yield a ϵHf_t value of +0.21 that is within the range obtained for the magmatic Permian zircons. ϵNd_t ($t = 282$ Ma) value is -2 for the sample PBL-109. Hf and Nd T_{DM} (two stages) values yield similar values ranging from 1.2 to 1.4 Ga, and 1.2 Ga, respectively.

The ϵHf_t values calculated from magmatic zircon of the sample PBL-109 would suggest participation of juvenile material or subcontinental mantle lithosphere in the source, but the combination of geological, U-Pb zircon geochronology and zircon Hf isotopes data suggest that a potential source for these rocks would be primitive mafic rocks hosted in the continental crust such as the GC of Neoproterozoic age. In addition, three negative ϵHf_t values (-3.0, -4.5, and -8.5) suggest participation of other source such as older continental lithosphere (ca. 1.3 Ga according to Hf and Nd T_{DM} values) as well as the metasedimentary sequence of the GC. ϵNd_t value of -2 from the sample PBL-109 is consistent with the combined participation of the primitive mafic rocks and the metasedimentary sequence of the GC in the source.

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(3) López de Azarevich et al. 2009. J. South Am. Earth Sci. 28, 333–344.

(4) Ludwig 2008. Isoplot/ex 4.15. Berkeley Geochronological Center. Special Pub. No. 4.

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