

U-Pb AND K-Ar AGES OF PICHÍ MAHUIDA GROUP, CRYSTALLINE BASEMENT OF SOUTH-EASTERN LA PAMPA PROVINCE, ARGENTINA

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INTRODUCTION

The crystalline basement of south-eastern La Pampa province consists of Upper Cambrian (?) - Ordovician, very low to medium-grade metamorphic rocks (Las Piedras Metamorphic Complex) and Upper Cambrian - Lower Devonian, non-deformed, post-orogenic granitoids (Pichí Mahuida Group), which are considered to belong to the Famatinian orogenic cycle. In addition to the former rocks, granitic orthogneisses metamorphosed during the Late Paleozoic times (Cerro de Los Viejos Complex) represent the Gondwanic orogenic cycle (Tickyj, 1999; Tickyj *et al.*, 1999).

In this contribution we present new U-Pb and K-Ar ages obtained for Río Colorado Granodiorite and Salto Andersen Granodiorite that belong to Pichí Mahuida Group. These granitoids are located at 38°52'S-65°00'W on the border area between La Pampa and Río Negro provinces, República Argentina. The sample preparation, chemical analyses and mass spectrometry for U-Pb and K-Ar methods were carried out at Centro de Pesquisas Geocronológicas, São Paulo (Brasil).

Previous geochronological data in this area comprise a Rb-Sr date of 500 ± 35 Ma (whole rock, assumed $R_i = 0.707$) reported by Halpern *et al.* (1970) and three Rb-Sr isochrones of 530 ± 30 Ma, 430 ± 15 Ma and 365 ± 15 Ma (whole rock, assumed $R_i = 0.707$), obtained by Linares *et al.* (1980). Besides, a detailed geological study on these granitoids was performed by Sato *et al.* (1996) who obtained for Curaco Granite a Rb-Sr age of 397 ± 25 Ma (whole rock, calculated $R_i = 0.724$).

GEOLOGY

The Pichí Mahuida Group is a post-orogenic unit composed of porphyritic muscovite-biotite granites and granodiorites. It has a minimal deformation and in this aspect it is different from deformed granites of Cerro de Los Viejos Complex.

The main outcrops are located at the riversides of Curacó and Colorado rivers near the locality of Pichí Mahuida (Fig. 1). In this area four plutonic units were identified: 1) Río Colorado Granodiorite, 2) Salto Andersen Granodiorite, 3) Curaco Granite and 4) Puesto Sainges Granodiorite-Granite.

The relationship with the country rocks are poorly known due to the small and discontinuous outcrop situation. The best exposures are in Salto Andersen, where a granodiorite intrudes metasedimentary rocks that belong to Las Piedras Complex.

All studied units are characterized by subalkaline, potassic and peraluminous features. The granodiorites display a calcalkaline trend, although it is not possible to extend this trend to the granites due to compositional gap between them. Moreover, the obtained ages suggest that granites and granodiorites could have independent evolutions.

The Río Colorado pluton is of granodioritic composition. It has a porphyritic texture, with K-feldspar megacrysts up to 11 cm long oriented by magmatic flow. Zoned plagioclase, quartz, K-feldspar, biotite and muscovite are the main minerals. Micaceous enclaves are abundant, while mafic microgranular enclaves are scarce. This unit shows a SiO_2 range of 64-68%, a weak peraluminous character

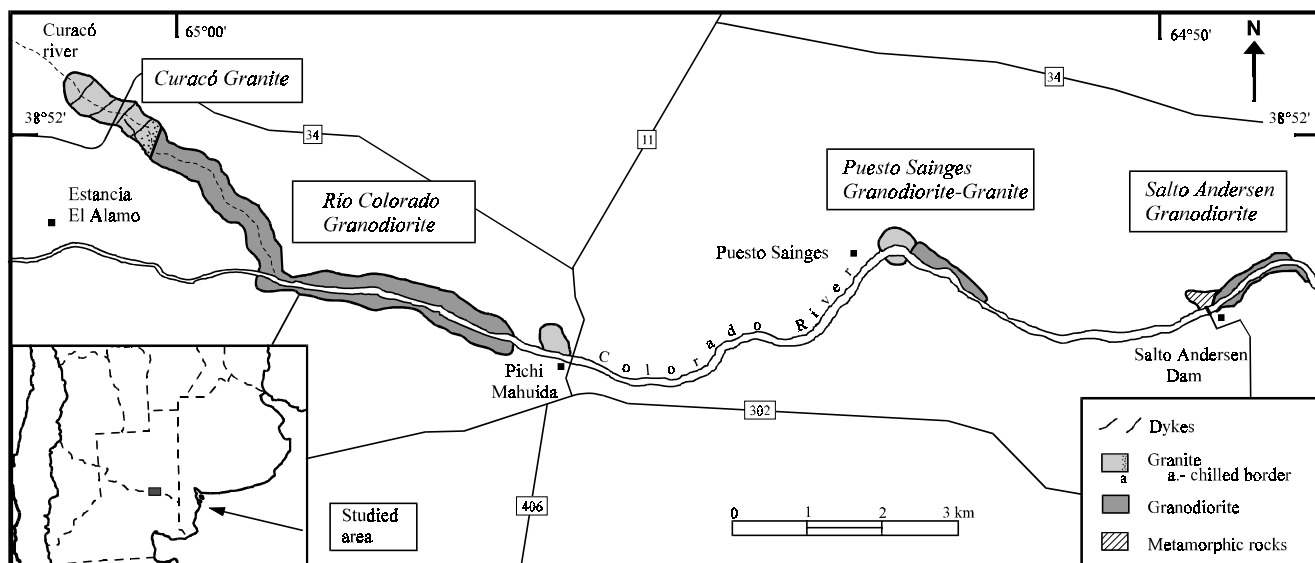


Figure 1. Granitic outcrops of Pichi Mahuida Group at the border area between La Pampa and Río Negro provinces.

($A/CNK=1.04-1.19$) and high K_2O/Na_2O ratios (1.1-1.4).

In the area of Salto Andersen Dam, metasedimentary rocks were intruded by a gray granodiorite. The contact zone displays a metamorphic paragenesis with andalusite and cordierite. The pluton encloses xenoliths of the country rocks and contains abundant joints filled with quartz or calcite. The texture is inequigranular, with few plagioclase phenocrysts up to 1 cm long. Zoned plagioclase, quartz, K-feldspar, biotite and amphibole are the main minerals. Mafic microgranular enclaves are common, while those of micaceous type are scarce. The granodiorite has a SiO_2 content of 65-67%, with a K_2O/Na_2O ratio of 1.2-1.3 and a weak peraluminous character ($A/CNK=1.09-1.17$) (Sato *et al.*, 1996).

The Curacó pluton is a two mica S-type leucogranite intrusive into Río Colorado Granodiorite. It has a porphyritic texture, with K-feldspar phenocrysts up to 3 cm long and contains small micaceous enclaves (<1 cm). It was intruded by abundant aplitic and pegmatitic dikes related to the final stage of the magmatic evolution. This pluton has a SiO_2 range of 73-75%, a peraluminous character ($A/CNK=1.16-1.22$) and high K_2O/Na_2O ratio (1.3-1.6) (Sato *et al.*, 1996).

In Puesto Sainges a small outcrop of metasedimentary rocks was intruded by two granitic bodies. One of them is a biotitic granodiorite, which

has inequigranular texture with plagioclase phenocrysts up to 1.5 cm long. The mineral composition is very similar to Salto Andersen Granodiorite, although without amphibole. Mafic microgranular enclaves are common. The other pluton is a two mica granite, which intruded both the granodiorite and metasediments. Large xenoliths of them are enclosed by the granite.

K-Ar and U-Pb AGES OF RIO COLORADO GRANODIORITE

Separation of biotite and zircon on a sample of Río Colorado Granodiorite was performed for K-Ar dating and U-Pb dating.

The K-Ar analysis on biotite gave an age 437 ± 14.1 Ma (Fig. 2).

Conventional U-Pb analysis were carried out on four fractions of zircons (Figs. 3 and 4a). The discordia line obtained (MSWD=70) has an upper intercept with the Concordia at 500 ± 27 Ma. This result represents the age of crystallization of the granodiorite.

Sample	Location	Rock	Analyzed material	%K	Error (%)	Ar40 rad*10-6 (ccSTP/g)	Ar40 atm (%)	Age (Ma)
GCZ-1	Río Curacó	Granodiorite	Biotite	5.7771	1.8551	110.89	13.25	437.0 ± 14.1

Figure 2. K-Ar analytical data.

Fraction (1)	Weight (g)	U (ppm)	Pb (ppm)	$^{206}\text{Pb}/^{204}\text{Pb}$ Observed (3)	$^{206}\text{Pb}/^{238}\text{U}$ (4)	$^{207}\text{Pb}/^{235}\text{U}$ (4)	$^{207}\text{Pb}/^{206}\text{Pb}$ (4)	Ages (5)		
		(2)	(2)					$^{206}\text{Pb}/^{238}\text{U}$	$^{207}\text{Pb}/^{235}\text{U}$	$^{207}\text{Pb}/^{206}\text{Pb}$
GCZ 01 Río Colorado Granodiorite										
SPU64 M(-2)AA	0.00066	1332.6	99.145	1381.215	0.072362	0.576435	0.057774	460	462	521
SPU65 M(1)AA	0.00051	425.7	29.98	788.2084	0.066441	0.521389	0.056915	415	426	488
SPU66 M(-1)	0.00043	457.84	35.53	1590.837	0.075965	0.601495	0.057427	472	478	508
SPU67 NM(-2)	0.00012	599.0	55.57	547.3753	0.085998	0.674335	0.056870	532	523	486
SAZ 0 Salto Andersen Granodiorite										
SPU251 M(-6)	0.00085	110.2	8.99	542.4758	0.072174	0.60659	0.060955	449	481	638
SPU253 M(-4)	0.00090	188.0	14.27	1024.8	0.070173	0.57059	0.058973	437	458	566
SPU254 M(-3)	0.00110	223.2	18.84	344.887	0.069769	0.54314	0.056461	435	440	470
SPU293 M(-5)	0.00032	213.3	18.69	357.7946	0.073992	0.663601	0.065046	460	517	776
SPU294 M(-6)	0.00036	453.5	41.82	258.0645	0.072075	0.59332	0.059704	449	473	593

1: Non magnetic fractions (Frantz separator at 1.5 amp. current); 2: Total U and Pb concentrations corrected for analytical blank; 3: Not corrected for blank or non-radiogenic Pb; 4: Radiogenic Pb corrected for blank and initial Pb; U corrected for blank; 5: Ages given in Ma using Ludwig Isoplot Program (1993), decay constants recommended by Steiger and Jäger (1977).

Figura 3. U-Pb analytical data.

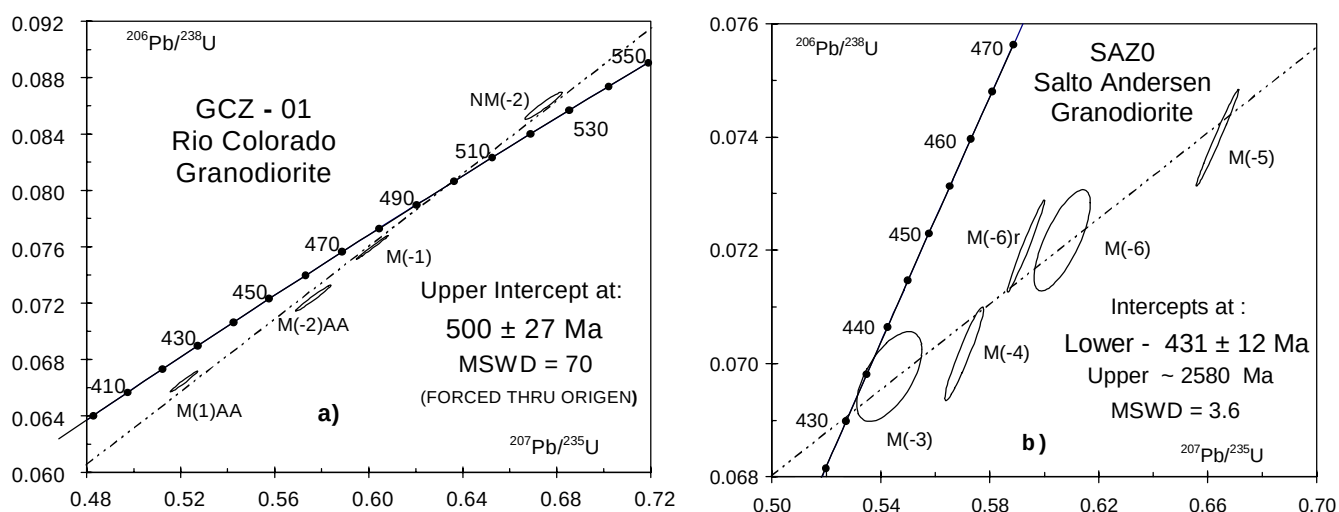


Figure 4. Concordia diagrams: a) Río Colorado Granodiorite, b) Salto Andersen Granodiorite.

The value obtained by the K-Ar method on biotite is probably related to thermal effects caused by later magmatic or metamorphic activities.

U-Pb AGE OF SALTO ANDERSEN GRANODIORITE

For this unit five fractions of zircons were obtained to perform a conventional U-Pb dating (Figs 3 and 4b). The Concordia diagram shows a lower intercepts at 431 ± 12 Ma (MSWD=3.6), which is taken as the age of crystallization.

DISCUSSION

The new U-Pb ages obtained on Rio Colorado Granodiorite (500 ± 27 Ma) and Salto Andersen Granodiorite (431 ± 12 Ma) together with previous geological and geochronological data reported by Sato et al. (1996) constrains the magmatic activity of Pichi Mahuida Group from Late Cambrian to Early Devonian times.

Granitoids with similar ages are found to the north in Sierra de San Luis (Llambías *et al.* 1998) and also to the south in the Atlantic area of North-Patagonian Massif (Varela *et al.*, 1997, 1998).

However, the absence of ductile deformation distinguishes Pichi Mahuida granitoids from those of San Luis. Any studied plutons have not pervasive deformation, although the metasedimentary rocks situate in the south of La Pampa have Late Cambrian(?)–Ordovician metamorphic ages (Tickyj, 1999).

On the other hand, the crystalline basement of southern La Pampa has striking similarities with the Atlantic Area of North-Patagonian Massif (Tickyj *et al.*, 1999), where metasedimentary rocks are intruded by Lower Ordovician - Upper Permian granitic to granodioritic plutons.

More detailed studies on Pichi Mahuida granitoids are required to make more precise correlations.

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