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CONTENTS OF DISK

Sm-Nd, Rb-Sr AND K-Ar AGE CONSTRAINTS OF THE EL MOLLE AND BARROSO PLUTONS, WESTERN SIERRA DE SAN LUIS, ARGENTINA

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INTRODUCTION

Within the Early Paleozoic Famatinian orogeny of Southern Sierras Pampeanas (Sierra de San Luis and Sierra de Córdoba), the post-orogenic granitoids are characterized by circular intrusions. The published Rb-Sr and K-Ar ages from plutons in the Sierra de San Luis range between 408 and 320 Ma (see synthesis in Llambías et al., 1998).

The El Molle and Barroso plutons (Sims et al., 1997; González and Sato, 2000) are the two main exposures of a post-orogenic intrusive complex located in the western area of the Sierra de San Luis basement. They also exhibit an overall circular map view of almost 8 km in diameter, and are emplaced in a metamorphic complex developed through pre-Famatinian (Proterozoic? to Early Paleozoic) to Famatinian (Early Paleozoic) orogenies (González and Llambías, 1998; von Gosen and Prozzi, 1998).

We are carrying out isotopic datings of the El Molle and Barroso plutons in order to contribute to the understanding of the magmatic and metamorphic evolution of the final stages of the Famatinian orogenic cycle in the Sierra de San Luis. The first results of the Sm-Nd, Rb-Sr and K-Ar dates are here presented.

GEOLOGY AND PETROGRAPHY

The plutons can be interpreted as the two halves of a circular intrusion, separated by a narrow belt of country rock, and slightly displaced by shear zones of the Río Chico mylonitic belt (Fig. 1). Ring and radial dikes are also associated with the plutons. Although in a few parts the outer margin of the plutons cuts the NNE-SSW foliation trend of the country rock, the general case is a steep inward pluton margin with concentric magmatic foliation in the border zones accompanied by parallel aureole foliation in the close vicinity. These features suggest an emplacement model based on diapirism or ballooning. Chilled margins and contact metamorphism are locally developed.

The field mapping together with petrographic and chemical studies indicate a mingling-mixing of two rock series: (a) monzonitic series (gabbro-diorites, monzogabbro-monzodiorites, monzonites, sienites and monzogranitic dikes) and (b) granitic series (granodiorites and granites), in minor proportion. These rocks appear as strips parallel to magmatic foliations, and also intercalating wall rock strips at marginal areas.

Within the monzonitic series, the more basic rocks are dark green to black colored fine to medium grained rocks that grade to coarser rocks. They consist of plagioclase, clinopyroxene, amphibole, biotite, quartz and microcline. Cumulus pyroxene and intercumulus plagioclase are also recognized. Accessory minerals are sphene, apatite, allanite partially surrounded by magmatic epidote, zircon, monacite, calcite and opaque minerals. The monzonite and sienites are pink to greysh pink, with coarse to very coarse grained and porphyritic textures. Perthitic microcline phenocrysts are up to 3cm long, and surrounded by medium grained microcline and plagioclase. The amphibole, biotite and quartz are of the El Molle pluton. They are fresh rocks, and vary from gabbros to monzogranites.

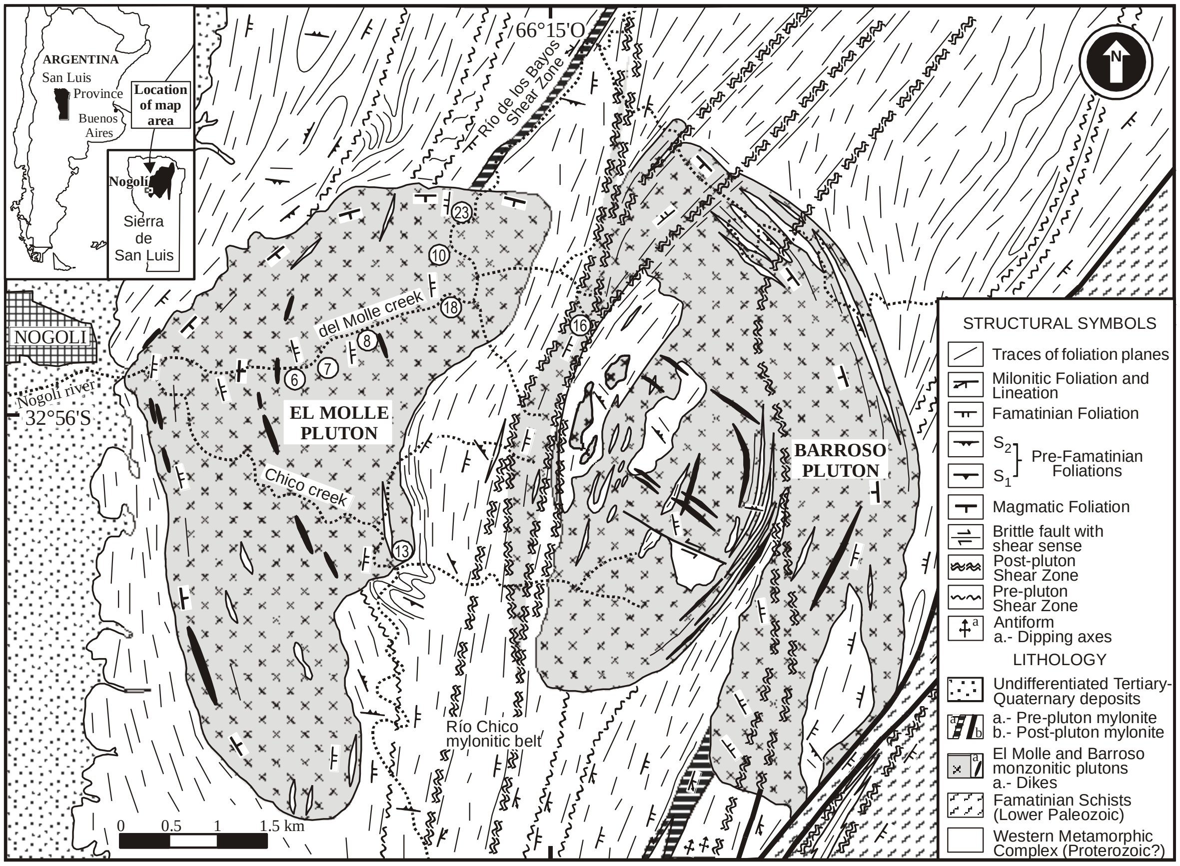

Figure 1. Geological map of the post-orogenic El Molle and Barroso plutons, western basement of the Sierra de San Luis, Argentina. The numbers indicate the location of the analyzed samples.

late-stage crystallization, showing an agpaitic texture. Magmatic epidote, allanite, sphene, apatite and zircon are the accessory minerals.

The rocks from the granitic series are pink to greysh pink, with medium grained granodiorites and granites. They consist of perthitic microcline, plagioclase and quartz, with biotite-muscovite flakes. Accessory minerals are allanite surrounded by magmatic epidote, apatite, zircon, monazite and calcite.

Post-emplacement shear zones (NNE-SSW) affect specially the western margin of the Barroso pluton, and also produce some heterogeneous low-grade metamorphic overprint upon the magmatically foliated rocks.

Sm-Nd, Rb-Sr AND K-Ar RESULTS

The analiyzed samples are rocks belonging only to the monzonite series, and were mainly collected from the El Molle pluton. They are fresh rocks, and vary from gabbros to monzogranites.

The Rb and Sr separations were carried out at Centro de Investigaciones Geológicas, and the Sm and Nd separation as well as the K determinations and isotopic analyses were carried out at Centro de Pesquisas Geocronológicas.

A Sm-Nd isochron was obtained using five whole rock samples and the following mineral separates from one of them (sample NG-18): apatite, amphibole, and two different magnetic fractions of sphene (Fig. 2, Table 1). The age obtained is 348 ± 35 Ma (2σ), with MSWD 0.3 and initial $^{143}Nd/^{144}Nd$ of 0.51199 ± 0.00001. Calculated T_{DM} model ages after DePaolo (1981) are between 958 and 1137 Ma.

The Rb-Sr isotope dilution method was applied using seven whole rock samples (Table 2). The resulting isochron is shown in Fig. 3, where the alignment of the best 5 samples yields an age of 378 ± 48 Ma, with MSWD 2.0 and initial $^{87}Sr/^{86}Sr$ 0.7071 ± 0.0002. If we include the less scattered sample (NG-18) in the isochron, the age will increase to 437 ± 41

Ma, with MSWD 2.6 and initial $^{87}Sr/^{86}Sr$ 0.70695 ± 0.00012. If all the seven samples are included, both the age and MSWD will further increase.

For K-Ar analysis a biotite fraction separated from sample NG-18 was used, and the date obtained was 380 ± 7 Ma (Table 3). Another biotite fraction (NG-75-1) separated from a mylonite of a shear zone cutting the Barroso pluton yielded 364 ± 7 Ma. This latter sample is located to the south of the area represented in Fig.1.

All these isotopic results are not totally consistent, and therefore should be considered with caution. The K-Ar biotite age (380 ± 7 Ma) obtained for the pluton is consistent with the Rb-Sr whole rock isochron age (378 ± 48 Ma) obtained from the five best fitting samples, and is also within the time range of the post-orogenic granitoids of Sierra de San Luis. The Rb-Sr alternative of 437 ± 41 Ma (six samples) is older than and out of the range of the other post-orogenic granitoids. For these reasons we consider that up to now an age of about 380 Ma is the best approximation to the crystallization age. For this age, the $>Nd_{(380)}$ values of –3.1 to –3.5 and the initial $^{87}Sr/^{86}Sr$ ratio of 0.7071 indicate a crustal component for the magma.

The slope of the Sm-Nd isochron is mainly governed by the whole rock sample NG-18 with the lowest $^{147}Sm/^{144}Nd$ and their mineral separates with the highest $^{147}Sm/^{144}Nd$ values. And although the comparatively lower isochron age (348 ± 35 Ma) could represent some later thermal event, this does not agree with the K-Ar biotite age of 380 ± 7 Ma obtained from the same sample NG-18. With respect to the deformation that affects this rock, it is not strong, according to the following features: slightly curved twins and scarce tapered twin edges in feldspars, some myrmekite growth between feldspar crystals, only scarce curved biotite, little recrystallization of quartz-feldspar grains forming 120° junctions, recrystallized and subgrained quartz.

In any case, we consider the K-Ar age of 364 ± 7 Ma obtained from a shear zone that cuts the pluton as an upper limit for the pluton age. Therefore, the Sm-Nd age of 348 ± 35 Ma could be related to another equivalent local shear zone metamorphism, developed after the pluton emplacement. Similar shear zones characterizing the last stages of the Famatinian orogeny have been constrained between 351 and 375 Ma through Ar-Ar datings (Sims et al., 1998) in the Sierra de San Luis.

In summary, we present here the isotopic data that constraint the emplacement and subsequent thermal history of the El Molle and Barroso post-orogenic plutons within the time interval 380 to 348 Ma. We expect that a better constraint will be provided with the results of the U-Pb analyses currently in process.

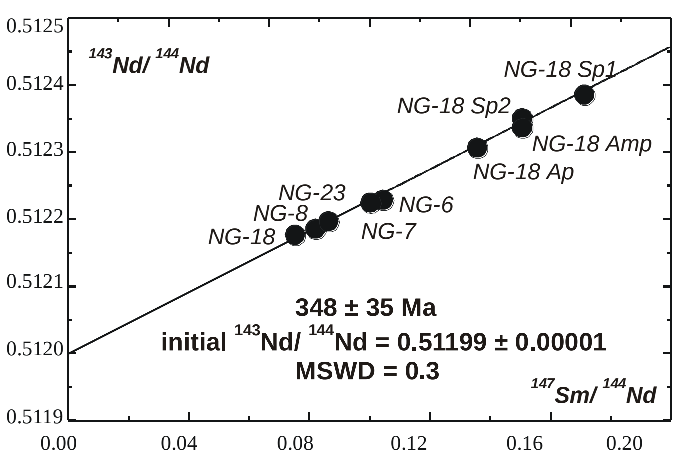

Figure 2. Sm-Nd whole rock and mineral isochron diagram. Ap: apatite, Amp: amphibole, Sp1: sphene 1, Sp2: sphene 2.

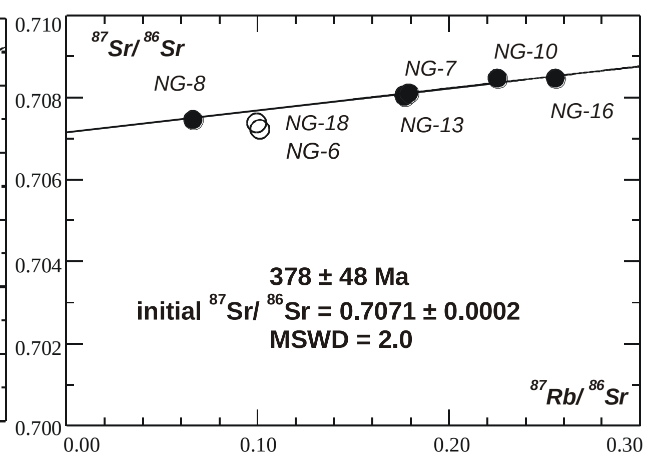

Figure 3. Rb-Sr whole rock isochron diagram. Samples NG-18 and NG-6 not included in the isochron.

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Sample	Material	Sm (ppm)	Nd (ppm)	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$	TDM (Ma)
NG-6	monzogabbro	12.750	73.862	0.1044 ± 0.0007	0.512229 ± 0.000001	1136.7
NG-7	gabbro	18.504	111.639	0.1002 ± 0.0003	0.512225 ± 0.000008	1101.2
NG-8	monzogabbro	19.148	141.182	0.0820 ± 0.0003	0.512186 ± 0.000009	996.1
NG-18	monzonite	16.667	133.945	0.0752 ± 0.0003	0.512177 ± 0.000009	958.0
NG-23	monzonite	20.093	140.726	0.0863 ± 0.0004	0.512197 ± 0.000007	1016.0
NG-18 Ap	apatite	317.475	1415.319	0.1356 ± 0.0005	0.512307 ± 0.000010	
NG-18 Amp	amphibole	36.242	145.599	0.1505 ± 0.0006	0.512337 ± 0.000014	
NG-18 Sp1	sphene-1	418.388	1478.033	0.1712 ± 0.0007	0.512386 ± 0.000028	
Ng-18 Sp2	sphene-2	1658.548	6660.929	0.1506 ± 0.0012	0.512351 ± 0.000009	

Table 1. Sm-Nd analytical data.

Sample	Material	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
NG-06	monzogabbro	66.9	1914.1	0.10121 ± 0.00202	0.70722 ± 0.00008
NG-07	gabbro	108.8	1775.6	0.17726 ± 0.00355	0.70805 ± 0.00009
NG-08	monzogabbro	77.3	3387.4	0.06607 ± 0.00132	0.70746 ± 0.00013
NG-10	monzogabbro	196.3	2523.4	0.22515 ± 0.00450	0.70847 ± 0.00005
NG-13	quartz monzonite	103.0	1671.3	0.17837 ± 0.00357	0.70811 ± 0.00009
NG-16	monzogranite	94.4	1069.9	0.25548 ± 0.00511	0.70847 ± 0.00020
NG-18	monzonite	95.9	2791.6	0.09945 ± 0.00199	0.70738 ± 0.00011

Table 2. Rb-Sr analytical data. Rb and Sr contents analysed by isotope dilution method.

Sample	Material	Rock	% K	$^{40}ArRd\ 10^{-6}$ ccSTP/g	$^{40}ArAtm$ (%)	Age (Ma)
NG-18	biotite	monzogabbro	7.2511	119.27	4.58	380.4 ± 7.4
NG-75-1	biotite	mylonite	7.6375	119.64	7.46	364.0 ± 7.3

Table 3. K- Ar analytical data.