THE FAMATINIAN GRANITOIDS OF SOUTHWESTERN SIERRA DE SAN LUIS, ARGENTINA

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INTRODUCTION

The Sierra de San Luis is located in the southern part of the Eastern Sierras Pampeanas. The most conspicuous orogenic events (arc magmatism, deformation and metamorphism) took place during the Lower Paleozoic Famatinian orogeny, overprinting the metamorphic and sedimentary rocks already delineated by the previous Pampean orogeny (Proterozoic? to Early Cambrian).

The granitoids were classified into pre-, syn- and post-orogenic plutons on the basis of their structural relationship with the penetrative NNE-SSW trending Ordovician structures, attributed to the main Famatinian phase (Ortiz Suarez et al., 1992; Llambías et al., 1998). Available data constrain the low- to high-grade regional metamorphism associated with the deformation mainly within the Early to Middle Ordovician (see synthesis in Sato et al., 2002).

In this contribution we offer new U-Pb ages obtained from granitoid plutons of the southwestern part of the Sierra de San Luis. The new ages together with the already existing data, allow us to understand the magmatic evolution of the Famatinian orogen in relation to the structural and metamorphic events.

GEOLOGICAL OUTLINE OF THE SOUTHWESTERN SIERRA DE SAN LUIS

The southwestern part of the Sierra de San Luis (Fig. 1) is dominated by the Nogoli Metamorphic Complex (Sims et al., 1998). It comprises micaschists, metaquartzites, paragneisses and migmatites, with minor orthoamphibolites, komatiites to high-Fe tholeiitic basalts, marbles, calcsilicates and banded iron formation (Ortiz Suárez, 1999; González, 2000; González et al., 2002). Although the conspicuous NNE-SSW trending structures are related to the Ordovician deformation and metamorphism, remnant NW-SE trending foliations, attributed to pre-Famatinian deformations, are preserved in a few places. The Early Mesoproterozoic Sm-Nd isochron age of *c.*1500 Ma (Sato et al., 2001a) obtained from amphibolites and komatiites might represent either the age of their original crystallization or that of the crust-mantle differentiation, but it has not been confirmed by other isotopic methods. The high-grade metamorphism associated with the penetrative deformation of this region was constrained by Ar-Ar plateau ages (476 and 457 Ma) and a Sm-Nd isochron (445 ± 21 Ma) for amphibolites, as well as conventional U-Pb age (458 ± 3 Ma) and electron microprobe age (470 ± 15 Ma) on monazites from a sillimanite paragneiss (González et al., 2002). This Ordovician regional metamorphism was followed by ductile shear zone deformations that acted until Early Carboniferous times. Broad mylonite zones are particularly conspicuous in this western part of the Sierra (e.g. Rio de los Bayos and Funes shear zones).

The newly dated Famatinian granitoids (Fig. 1) show different structural relationships. The Pantanos Negros Granodiorite is an elongated pluton that intruded cutting the old NW-SE structures of the Nogolí Metamorphic Complex. It is heterogeneously affected by the NNE-SSW foliation and by parallel shear zones. The composition is mainly leucogranodioritic, with minor tonalitic facies. For this pre-orogenic pluton we have no previous dating.

The El Molle pluton forms a circular post-orogenic intrusion together with the Barroso pluton (González & Sato, 2000). They cut the NNE-SSW foliation of the country rock, and produce a concentric aureole foliation parallel to the magmatic foliation of the border zones. Monzonitic series dominate over granitic series in their composition. Although their emplacement postdates the Ordovician penetrative deformation and metamorphism, the plutons affect and are also affected by the ductile shear zones developed in the late stages of the Famatinian orogeny. Previous isotopic dating for these plutons include Rb-Sr whole rock isochron (378 ± 48 Ma), Sm-Nd mineral and whole rock isochron (348 ± 35 Ma), and K-Ar date on biotite (380 ± 7 Ma) (Sato et al., 2001b).

U-Pb RESULTS AND MAGMATIC EVOLUTION

Four zircon fractions (elongated prisms) from the Pantanos Negros Granodiorite align on a discordia line with an upper intercept at 477 ± 3 (± 5) Ma (MSWD = 3.2) (Fig. 2). This date is interpreted as representing the magmatic crystallization age of the pluton.

Five prismatic zircon fractions from the El Molle Monzonite define another discordia line with upper intercept at 417 ± 6 (±7) Ma (MSWD = 3.3). The two most concordant fractions were subjected to air ablation. We consider this age as that of the crystallization of the pluton.

The crystallization age obtained for the Pantanos Negros Granodiorite is well within the range of the remaining pre-orogenic granitoids of the Sierra de San Luis, and it shares the same structural and compositional

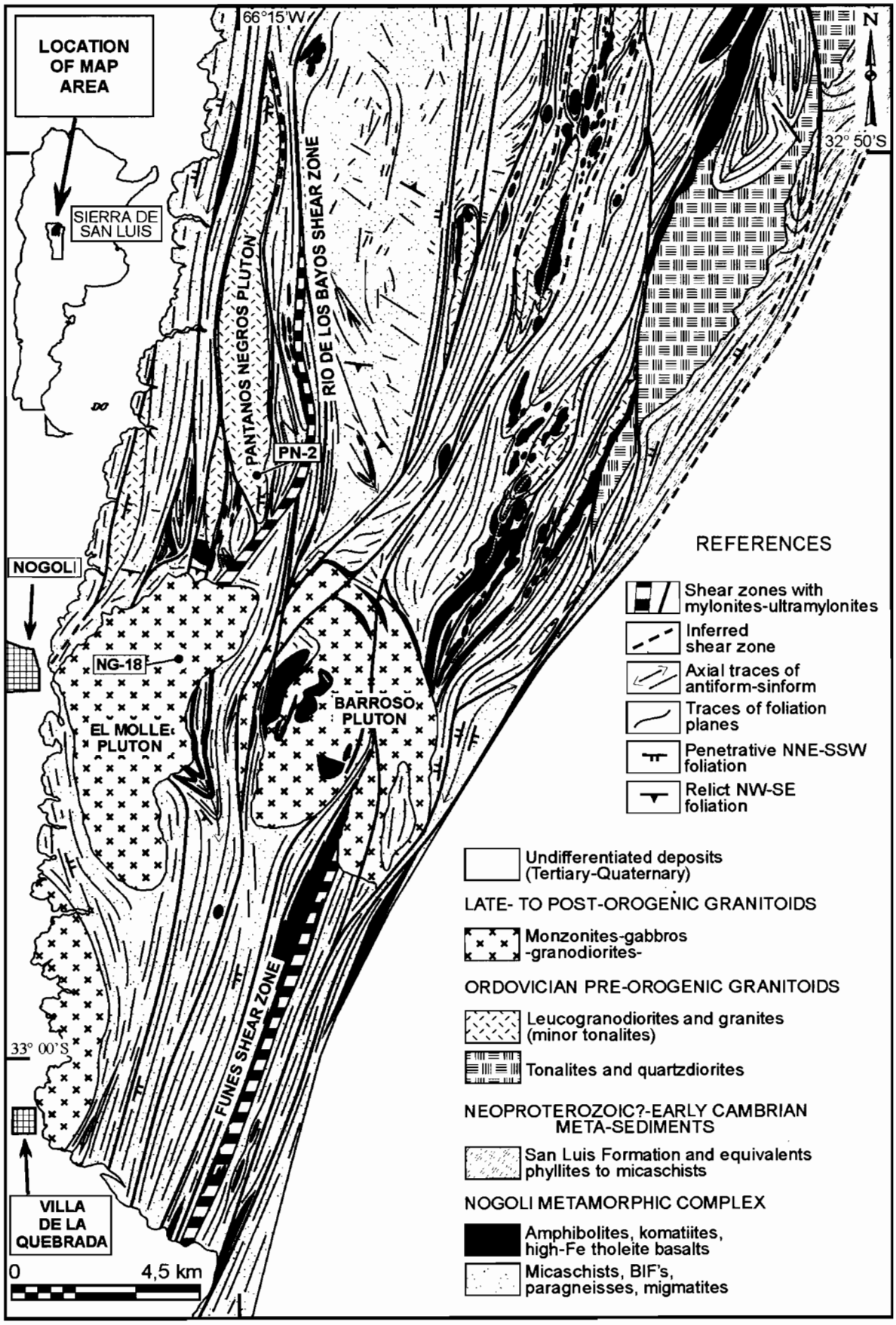

Figure 1. Geological map of the Southwestern Sierra de San Luis, with location of the Pantanos Negros Granodiorite and El Molle Monzonite.

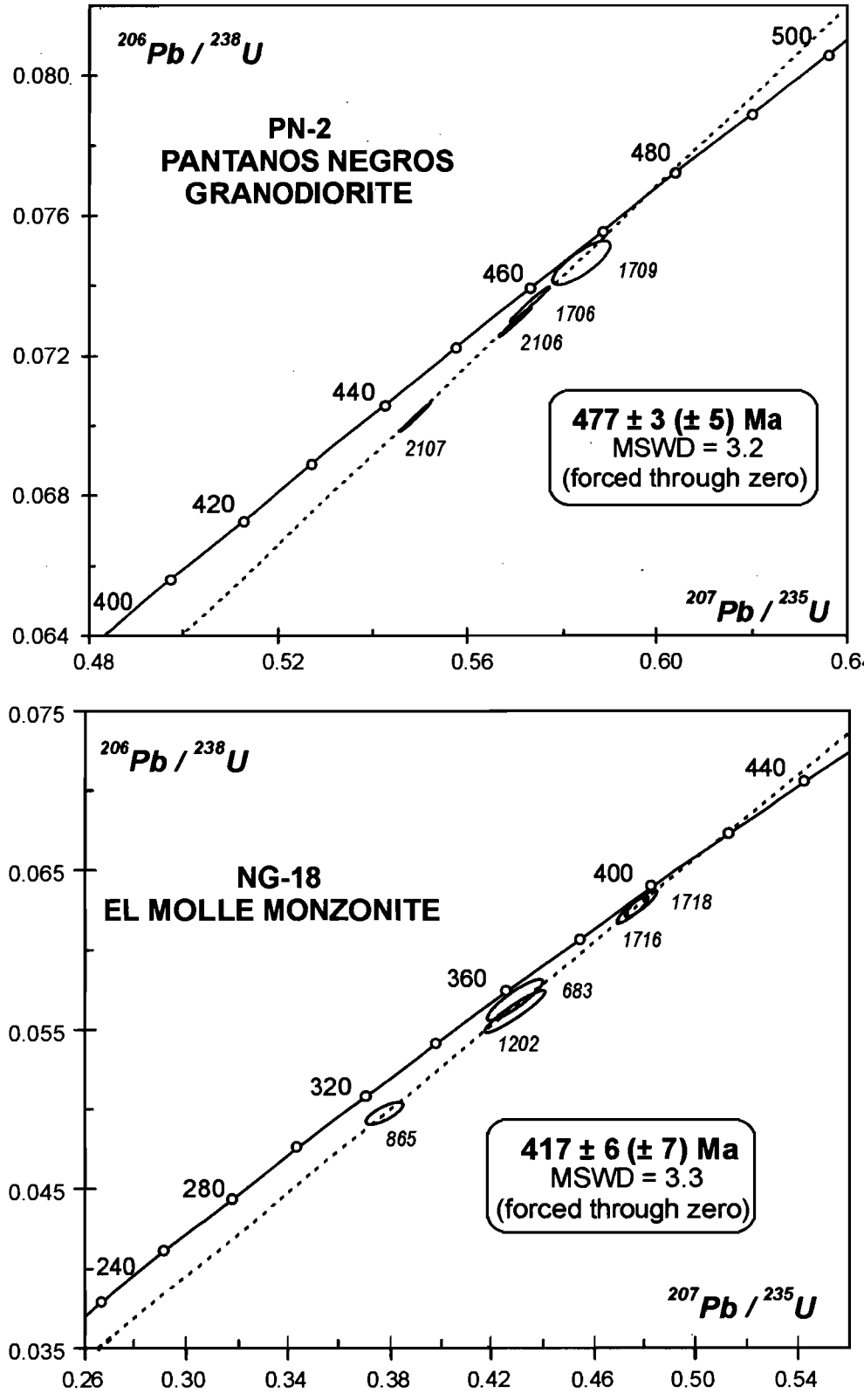

Figure 2. Concordia diagrams (Isoplot/Ex version 2.49)

features. Regionally, the pre-orogenic granitoids are located mainly in the central and western parts of the Sierra and their Rb-Sr and U-Pb dates cover a time span of 512 to 468 Ma, being the Early to Middle Ordovician the most important interval of emplacement. Tonalitic and granitic compositions are the major ones, and when both are exposed together, the granitic plutons intrude the tonalitic ones. They belong to typical calcalkaline series and are affected by the penetrative foliation.

Associated with the Ordovician peak metamorphism, small and numerous anatectic plutons were emplaced following the penetrative structures of the higher grade complexes. They were mostly studied in the central region of the Sierra, and dates around Middle Ordovician predominate for their emplacement (Llambías et al., 1991, 1996, 1998; von Gosen et al., 2002; López de Luchi, 1987; López de Luchi & Cerredo, 2001).

All these peak orogenic processes (arc magmatism, regional metamorphism and penetrative deformation) have been related to a collisional history (collisional Famatinian orogen), in which the Sierra de San Luis is considered as part of the Gondwana autochthon.

Regional metamorphism is no more registered in the post-Ordovician evolution of the Sierra de San Luis, and only ductile shear zones accompany the outlasting compression of the region, producing local metamorphism. The crust thickened in this way favored the production of late to post-orogenic granitoids, which form large anular plutons and batholiths. The monzonitic El Molle pluton is one example of this magmatism, and the crystallization age of 417 ± 6 (± 7) Ma (Late Silurian) places it as one of the earliest late-orogenic plutons of the Sierra de San Luis, whereas the remaining plutons are mainly Devonian to Early Carboniferous. The structural relationship with the shear zones also is in accordance with this early stage emplacement. The Middle to Late Devonian K-Ar, Rb-Sr and Sm-Nd dates of the same pluton suggest the local metamorphism associated with the ductile shear zones. This final stage of the Famatinian orogeny was also referred to as the "Achalian orogeny" (Sims et al., 1998), but based on the lack of regional metamorphism (only local metamorphism related to shear zones) and the lack of arc magmatism (only transitional to anorogenic granitoids), we consider more appropriate to define it as a Famatinian post-orogenic stage.

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