

IDENTIFICATION AND ZIRCON U-PB SHRIMP DATING OF THE GREEN QUARRY SCHISTS, SOUTHERN SAN LUIS PROVINCE, ARGENTINA

Carlos J. Chernicoff¹, João O. S. Santos², Eduardo O. Zappettini³ and Neal J. MsNaughton²

¹ Council for Scientific and Technical Research (CONICET), Geological and Mining Survey of Argentina (SEGEMAR), Julio A. Roca 651, 1067 Buenos Aires, Argentina - jchern@secind.mecon.gov.ar

² University of Western Australia, 35 Stirling Highway, Crawley, Perth, 6009 Australia - orestes1@tpg.com.au

³ Geological and Mining Survey of Argentina (SEGEMAR), Julio A. Roca 651, 1067 Buenos Aires, Argentina - ezappe@secind.mecon.gov.ar

Keywords: Lower Ordovician schists, Green quarry, San Luis province, Argentina, zircon U-Pb SHRIMP.

INTRODUCTION

The southern San Luis province of Argentina is mostly covered by Quaternary sediments. The scarce exposures of schists at the Green quarry have not been described previously. Gravimetric data would suggest that the Green quarry schists underly the Permian red beds recently identified in this region (Chernicoff and Zappettini, 2005a, 2005b). Geological interpretation and modeling of both gravimetric and aeromagnetic data indicate that the Green quarry schists are bounded to the east by a major N-S trending fault that bisects the Pampia terrane; the latter fault would have been originated during the Lower Paleozoic, later reactivated during the Cenozoic (Chernicoff and Zappettini, 2004).

Figure 1 shows the locality and geotectonic setting of the exposures of the Green quarry schists, i.e. they are located within the Pampia block, regarded as one the terranes amalgamated to the western margin of Gondwana during the Paleozoic (e.g. Ramos, 1988). The relationship between these newly described outcrops and the scarce basement exposures of the central-eastern La Pampa province is still under study.

The main rock type at the Green quarry comprises medium grained quartz-plagioclase-biotite (muscovite-zircon-apatite) schists of sedimentary origin. They present a protomylonitic texture characterized by S-C relationships between schistosity and shear planes, plagioclase porphyroclasts and pressure shadows of recrystallized quartz. Scarce clasts of recrystallized acidic volcanics are preserved. Quartz-feldspar injections are frequent, and were affected by the same deformation. Small granitoids intruded the sequence during the late shearing stage.

ZIRCON U-Pb SHRIMP DATING

The studied rock type is restricted to the schists, from which 42 detrital zircons have been analysed up to now. Most of grains are Neoproterozoic (n=20) and Cambrian (n=13) in age, followed by scarce Archean (n=2), Paleoproterozoic (n=3) and Mesoproterozoic (n=4) grains. The Cambrian zircons are composed of three

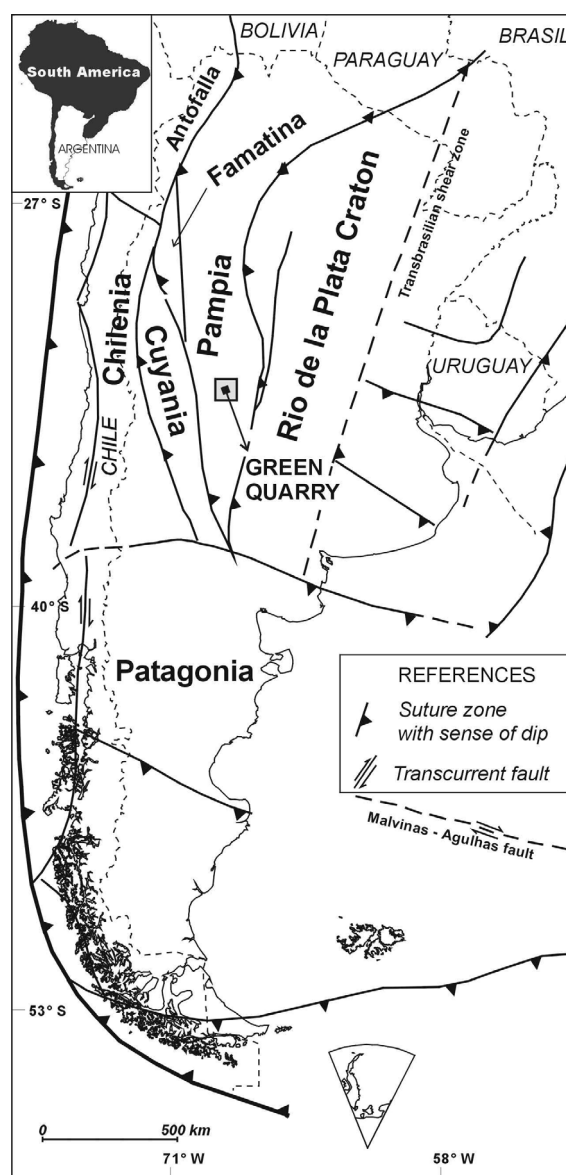


Fig. 1. Locality map and geotectonic setting of the Green quarry schists. (Map of accreted terranes in the southern region of South America, after Chernicoff and Zappettini, 2004).

populations at 500 Ma (6 grains), 518 Ma (5 grains) and 533 Ma (n=2), which corresponds to the Series 3 of Cambrian. Most of the Neoproterozoic zircons group into three populations at 653 Ma (n=5), 753 Ma (n=4) and 965 Ma (n=5). Three Mesoproterozoic (Stenian) ages group at 1052 Ma, which correlates to the Sunsás or Grenvillian Orogen age.

About one third of the grains are metamorphic (i.e. 90% of the Cambrian zircons analysed), which is indicated by their very low Th/U ratios (Vavra et al., 1999) of 0.004 to 0.019, about 8 to 400 times lower than the magmatic grains (0.16-1.58). Metamorphic grains, because in average are richer in U, tend to survive less during transport and during recycling when compared to magmatic grains (Hartmann and Santos, 2004). The presence of one third of metamorphic zircons (dominantly of Cambrian age) indicates that there were abundant metamorphic sources for basin deposition at that time, also pointing to a possibly short transportation of (Cambrian metamorphic) grains, the latter suggesting the immature nature of the sedimentary protolith (metagraywackes/metatubidites ?) of the Green quarry schists.

The age of the youngest detrital zircon is 500 ± 3 Ma (Upper Cambrian), which corresponds to the maximum age for the onset of sedimentation, indicating that deposition probably occurred during the Ordovician.

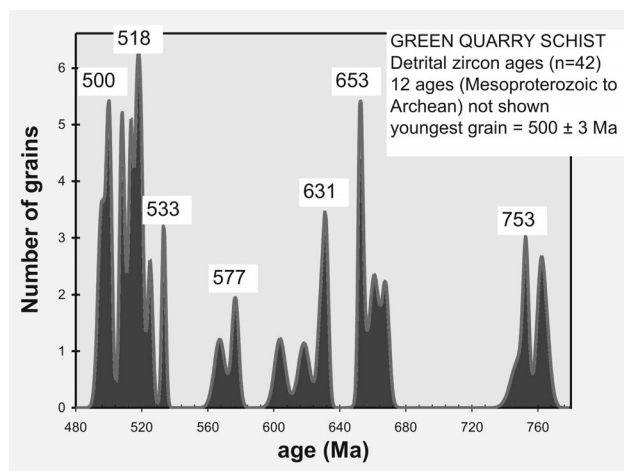


Fig. 2. Detrital zircon ages (n=42) of the Green Quarry schists. Twelve ages (Mesoproterozoic to Archean) not shown. Youngest grain: 500 ± 3 Ma,

DISCUSSION

The Green quarry schists are regarded to pertain to a supracrustal sedimentary sequence originated in a foreland basin during the Lower Ordovician at the southwestern margin of Gondwana. Equivalent sediments were deposited further north in the San Luis province (San Luis Formation), both sharing the same tectonic setting (e.g. Chernicoff and Ramos, 2003). The Lower Ordovician sequence was subject to metamorphism ca. 464 Ma (unpublished data of the present authors,

determined for the nearby Paso del Bote parashists of central-eastern La Pampa) during the Famatinian orogeny related to the docking of the Cuyania terrane.

The provenance of the ca. 500-530 Ma metamorphic zircons would be the metamorphic complexes originated during the Pampean orogeny. The absence of magmatic zircons of this age also points to a sedimentary setting that precedes the development of the Famatinian magmatic arc to the west of the studied area.

The provenance of the older zircons would correspond to the Río de la Plata craton (RPC): e.g. 630-670 Ma Sierra de la Ventana basement (Cingolani and Dalla Salda, 2000), 750 Ma possibly corresponding to magmatic sources of the RPC related to the Cryogenian orogeny, well represented in southwestern Gondwana (da Costa Campos Neto, 2000). In addition to the latter zircon ages, smaller peaks at around 1000 Ma are a common feature around the Gondwana margin and have been previously described from Cambro-Ordovician sediments further north in the Sierras Pampeanas, as well as in Australia, New Zealand and west Antarctica (Camacho and Ireland, 1997).

REFERENCES

- Camacho, C. and Ireland, T.R., 1997. SHRIMP U-Pb geochronology: Final Report. Geoscientific mapping of the Sierras Pampeanas, Argentine-Australia Cooperative Project. Report, 53 p. (Unpublished).
- Chernicoff, C.J. and Ramos, V.A., 2003. El basamento de la sierra de San Luis: nuevas evidencias magnéticas y sus implicancias tectónicas. *Revista de la Asociación Geológica Argentina*, 58 (4): 511-524.
- Chernicoff, C.J. and Zappettini, E., 2004. Geophysical evidence for terrane boundaries in south-central Argentina. *Gondwana Research*, 8 (4): 1105-1116.
- Chernicoff, C.J. and Zappettini, E.O., 2005a. Evidencias de una cuenca de pull apart neopaleozoica en el sudeste de la provincia de San Luis, Argentina: extensión austral de la cuenca de Paganzo. 16 Congreso Geológico Argentino, Actas I: 471-476. La Plata.
- Chernicoff, C.J. and Zappettini, E.O., 2005b. Identification of the southernmost Paganzo basin deposits (Upper Paleozoic red beds) in south-central Argentina. *Gondwana 12 Conference*. Mendoza. Proceedings: p. 102.
- Cingolani, C. and Dalla Salda, L., 2000. Buenos Aires cratonic region. In: Cordani, U.G., Milani, E.J., Thomaz Filho, A. and Campos, D.A., 2000. Tectonic evolution of South America, 139-146. Río de Janeiro.
- da Costa Campos Neto, M., 2000. Orogenic systems from southwestern Gondwana: an approach to Brasiliaano-Pan-African cycle and orogenic collage in southeastern Brasil. In: Cordani, U.G., Milani, E.J., Thomaz Filho, A. and Campos, D.A., 2000. Tectonic evolution of South America, 335-365. Río de Janeiro.
- Hartmann, L.A. and Santos, J.O.S., 2004. Predominance of high Th/U, magmatic zircon in Brazilian Shield sandstones. *Geology*, 32 (1): 73-76.

Ramos, V. A., 1988. Tectonics of the Late Proterozoic-early Paleozoic: a collisional history of southern South America. *Episodes*, v. 11, pp. 168-174.

Vavra, G., Schmid, R., and Gebauer, D., 1999. Internal morphology, habit and U-Th-Pb microanalysis of

amphibolite-to-granulite facies zircons: Geochronology of the Ivrea Zone (Southern Alps): *Contributions to Mineralogy and Petrology*, 134: 380-404.

RESUMEN

Los escasos afloramientos de rocas esquistosas de la cantera Green se estudian por primera vez. Estos comprenden esquistos cuarzo-plagioclásicos-biotíticos (con moscovita-circón-apatita) de grano medio; su origen es sedimentario.

Un total de 42 circones detríticos han sido analizados hasta el momento. La mayoría de los granos son neoproterozoicos y cámbricos, seguidos por escasos granos arqueanos, paleoproterozoicos y mesoproterozoicos.

Aproximadamente un tercio de los granos son metamórficos (90% de los circones cámbricos analizados). La presencia de esta cantidad importante de circones metamórficos (predominantemente cámbricos) indica que hubieron abundantes fuentes metamórficas en ese período, posiblemente indicando también un corto transporte de los detritos (de metamorfitas cámbricas); esta última característica sugiere la naturaleza inmadura del protolito sedimentario.

El circón detrítico más joven es de 500 ± 3 Ma (Cámbrico Superior), correspondiente a la edad máxima para el inicio de la sedimentación, indicando que la depositación probablemente ocurrió en el Ordovícico. La proveniencia de los circones metamórficos de 500-530 Ma correspondería a los complejos metamórficos originados durante la orogenia Pampeana. La ausencia de circones magmáticos de esta edad indica que la sedimentación precede al desarrollo del arco magmático famatiniano al oeste del área de estudio. La proveniencia de los circones más antiguos correspondería al cratón del Río de la Plata.

Se considera que los esquistos de la cantera Green pertenecen a una secuencia sedimentaria supracortical originada en una cuenca de antepaís durante el Ordovícico Inferior, con un metamorfismo ocurrido a los 464 Ma durante la orogenia famatiniana. Los mismos serían equivalentes a la Formación San Luis.