The crystalline basement in the north of Patagonia: isotopic ages and regional characteristics

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Igneous and metamorphic rocks, mainly covered by large Mesozoic acidic-intermediate volcanic rocks and Cenozoic basaltic plateaux, constitute isolated remnants of the north Patagonian basement. Three different geological regions are distinguished: i) the Atlantic North Patagonian Massif, east of 66º 30', ii) the central-west North Patagonian Massif, south of the Río Limay; and iii) the Andes foothills.

i) This has the most ancient north Patagonian rocks, with high-grade metamorphic rocks (Mina Gonzalito complex) and low-grade schists intruded by post-tectonic granite stocks (Nahuel Niyeu Formation–Ectinita El Jagüelito and Arroyo Salado granodiorite–Punta Sierra granite, respectively) covered by folded shelf Silurian fossiliferous sediments. In the Mina Gonzalito area four zircon fractions from a tonalite gneiss present a $^{206}Pb/^{238}U$ weighted average age of 605 ± 7 Ma (MSWD= 2). One fraction of the same rock suggested a tectono-thermal Permian overprint not yet documented by further analysis. An additional age of 469 ± 4 Ma was obtained on a quartz-feldspar-garnet gneiss from Mina Gonzalito by SHRIMP analysis of zircon metamorphic rims (Pankhurst et al., 2001). In the same region five zircon fractions of the Arroyo Salado Granodiorite defined an U–Pb age of 486 ± 6 Ma. In Devonian and Permian times, minor stocks were emplaced (Varela et al., 1997; Grecco et al., 1994). The main metamorphism and magmatism is related to the Ocloyic orogeny of the early Famatinian cycle. Around 459 ± 9 Ma the area suffered faster cooling episode (muscovite K–Ar ages).

ii) Deformed metasedimentary and plutonic rocks, together with undeformed granites and lesser amounts of volcanic rocks comprise in this basement. They are pre-Upper Triassic according to stratigraphic relationships and include a volcano-sedimentary sequence with *Dicroidium* flora. U–Pb zircon ages of the deformed granitoids around 300–280 Ma and K–Ar cooling ages 260–250 Ma have been obtained for several units (Yaminué Complex, Mamil Choique Formation, Varela et al., 2005a and references therein). The undeformed granitic set is slightly younger and has Rb–Sr ages of 259–239 Ma (Somuncura batholith). The tectonic environment is related to the evolution of a magmatic arc developed during the Gondwanan cycle (Varela et al., 2005 a, b).

iii) In the Cordilleran region north of the Río Limay, relics of metasedimentary sequence (Colohuincul Formation) outcrops among plutonic rocks (Huechulafquén Formation; San Martín de los Andes tonalite). The plutonic rocks have U–Pb zircon ages between 420 and 380 Ma, U–Pb titanite age of ca. 360 Ma and K–Ar mica ages in the 375–310 Ma time interval (Varela et al., 2005a). The tectonic environment is also related to the evolution of a magmatic arc associated with the Chanic orogeny of the late Famatinian cycle.

In Permian times, the crust of region (ii) south of Nahuel Niyeu town was thrust towards the SE (collisional episode) over region (i) (Chernicoff and Caminos, 1996), but no field relationships has yet been identified between regions (ii) and (iii). Moreover, the Sm–Nd T_{DM} ages of plutonic rocks in all three regions are in the 1390–1160 Ma interval, with $\varepsilon Nd_{(t)}$ ranging between –3.0 and –8.4.

The North Patagonian Atlantic region is interpreted as possibly the most austral fragment with South American platform affinities. It is covered by Silurian quartzitic shelf sediments, and in Middle and Late Palaeozoic times was little affected by late Famatinian and Gondwanan events. On the other hand, west of the town of Nahuel Niyeu, the arc-related plutonic rocks and syn-collisional granitoids show strong Gondwanan orogenic effects. Finally, the Cordilleran region north of the Río Limay has geological characteristics of a Chanic Devonian domain. Two orogenies involving Devonian and Late Palaeozoic subduction are envisaged.

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