Tectonothermal evolution of Olkhonskaya collision system: Constraints from $^{40}Ar/^{39}Ar$ data on granite veins sealed inside ultramafic bodies

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A mobility of K/Ar system depends on deformations and presence of fluids. When a rock is protected from access of deformations and fluids micas can retain radiogenic argon during superimposed metamorphic events. Such protection can often be observed inside rigid bodies of magmatic origin. We present results of $^{40}Ar/^{39}Ar$ dating of granitic veins which are sealed inside ultramafic-mafic massifs of the Olkhonskaya collision system. Metamorphic framing of massifs was also investigated.

Phflogopite of granitic vein sealed inside dunite body (Shidinskaya zone of Olkhonsky region) yielded $^{40}Ar/^{39}Ar$ age of 497.1±1.2 Ma. It is concordant with U/Pb zircon data on age of metamorphism of granulite facies [Bibikova et al., 1990; Letnikov et al., 1990; Gladkochub, 2004; Khromyh et al., 2004]. At the same time biotites from metamorphic framing of dunite bodies yielded age of 432 Ma. Thus metamorphic event characterized by intense strike slip deformations and amphibolitic PT-conditions is shown to be noticeably (about 70 Ma) distant from granulitic metamorphic stage. It is remarkable that K/Ar of phlogopite of granite vein sealed inside dunite body preserved information about the age of early granulitic stage. Using numerical modeling of phlogopite K/Ar system behavior essential constraints on duration of late metamorphic event have been obtained. If we assume that volume diffusion mechanism promoted argon loss, digital modeling results show that duration of event should be noticeably shorter than 1 Ma. This limitation should be taken into account in regional tectonic reconstructions.

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$^{40}Ar/^{39}Ar$ cooling ages from a vertical transect through the Patagonian batholith 46° S, Chile

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Mesozoic-Cenozoic granitoids of the North Patagonian Batholith in southern Chile have been key to understanding magmatism associated with subduction processes and tectonic uplift of the Southern Andes. Although Rb-Sr and Sm-Nd and fission track (FT) results have revealed the origin and timing of emplacement of several intrusions, and the denudation history of the Andes, thermochronology of the ~ 500–200°C history of this mountain range has not been explored. To better resolve the cooling history, particularly prior to the closure of zircon and apatite fission-track chronometers, we performed $^{40}Ar/^{39}Ar$ incremental heating analyses, using a defocused CO_2 laser beam, on amphibole, biotite, plagioclase and K-feldspar from granodioritic/ tonalitic plutons exposed on the south flank of 1924 m high Cerro Blanco, north of Lago General Carrera at 46° S. Six rocks were collected every 200 m along a vertical transect of 1.2 km through the intrusions between 200 and 1300 masl.

Concordant spectra from 1-3 crystal aliquots (1-2 mg) yield plateau ages as follows: (1) orthoclase correlates with elevation; ages at 410 and 1345 masl are 76 and 82 Ma, respectively, (2) biotite varies from 149 to 152 Ma and amphibole from 144 to 160 Ma; there is no correlation with the elevation. Discordant saddle-shaped spectra are common for plagiclase, and to a lesser degree, amphibole.

We interpret these plateau ages as the result of cooling following the intrusion. Age variations among individual biotite and horblende crystals in each sample are ascribed to disturbances imposed by the growth of minor secondary mineral phases and sub-solidus modifications during cooling. Using a simple linear T-t path and widely adopted closure temperatures for these minerals, the calculated cooling rate prior to 82 Ma was ~2-3°/myr, but this increased to ~4-5°/myr between 76 and 82 Ma. Combining with Rb-Sr ages (<160 Ma) indicates an early history of rapid cooling, followed by remarkably slow cooling for ~80 myr. Orthoclase ages overlap regional zircon FT closure between 73 and 96 Ma and predate apatite FT closure by up to ~70 myr, suggesting an average cooling rate of ~1°/myr from the Late Cretaceous to Miocene. Structural and tectonic evidence, however, led Thomson et al. (2001, *Tectonics*) to propose a non-monotonic cooling path that can only be fully evaluated via further vertically-controlled thermochronology in the #150° C range.