Sr-isotope diffusion profiles from Alpine marbles: what do they mean?

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We have measured Sr-isotope profiles in calcite across phlogopite-bearing bands in marbles from the Central Swiss Alps (e.g. Figure 1).

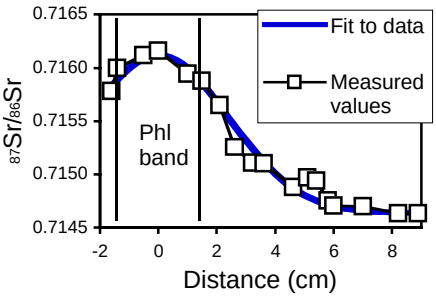

Figure 1. HT15, Lago del Naret, Ticino, measured by laser ablation multi-collector ICP. Most errors are within the size of the plotting symbols.

The integrated area beneath the profiles, coupled with the Rb/Sr of the mica bands, suggests that they contain ^{87}Sr built up since deposition of the limestones in the Triassic. However, the flat background to the profiles is higher than would be expected for Triassic seawater, indicating early diagenetic homogenisation.

The symmetry of the profiles, with inflection points at the edges of the mica bands, suggests fluid advection was negligible and exchange took place by diffusion alone. The data fit well to diffusion profiles that assume all the ^{87}Sr in the profile was originally contained in the high Rb/Sr mica bands. The *Dt* product for the exchange is 2.5-0.15 x 10^{-4} m^2. Assuming exchange takes place by combined volume diffusion and grain boundary diffusion only, then the calculated time for exchange exceeds the age of the rock, and is unfeasible. Therefore exchange must have taken place *via* a faster process such as diffusion through a fluid phase on the grain boundaries. However, assuming an interconnected fluid, even with a low porosity, gives high *D* values, with consequently short exchange times of ~10^{-2} Ma. This is very short compared with times envisaged for Alpine metamorphism (5-10 Ma?). Such discrepancies are also apparent from a limited number of similar studies elsewhere.

Either 10^{-2} Ma *is* the duration of fluid connection along the grain boundaries, or exchange took place over a longer duration due to a variety of causes. Sr-isotopic profiles across individual calcite grains are flat within error. Do these allow us to choose between these possibilities?

Late Archean komatiites and BIFs, Woodburn Lake Group, Churchill Province, Nunavut

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Komatiites and banded iron formations (BIFs) of the Woodburn Lake Group (WLG) comprise a metallogenically important component of a so-called platformal greenstone belt, an assemblage of komatiite, iron formation, intermediate to felsic volcanics, and volcaniclastic-epiclastic sedimentary rocks, which formed in a subaqeous to shallow marine paleodepositional environment. WLG komatiites include texturally well-preserved lava flows (thin/distal) with massive, fine-grained B zone cumulates (MgO >40 wt%) overlain by coarse, random, olivine spinifex-textured A zone flow units (MgO >27 wt%). Locally B1 zones are also present. The BIFs occur in oxide, silicate and sulphide facies intimately associated with the komatiites, felsic volcanics and silicified tuffs and mudstones. A Re-Os isotopic and geochemical study of these late-Archean komatiites and BIF has as its goals the magmatic age and source characteristics of the komatiites and the relationship of komatiite to BIF/BIF-hosted gold mineralization, as typified by the possibly world-class Meadowbank and Meliadine occurrences.

Komatiites analyzed for Re-Os have high MgO (>30 wt%) in both spinifex and cumulate portions. Re and Os contents of some of the spinifex-textured komatiites are typical of komatiitic magmas, whereas; the cumulates have exceptionally low Re (0.05 ppb) and high Os (3.2-6.7 ppb) contents leading to exceptionally low $^{187}Re/^{188}Os$ (0.04 to 0.1) for komatiitic whole-rocks.

Re-Os isochron systematics are complex. Four cumulate B zone komatiites and a subset of the BIFs form a 2690+/-41 Ma isochron in good agreement with a U-Pb zircon age on a interlayered rhyolite. The initial $^{187}Os/^{188}Os$ of this isochron is 0.1074 +/- 0.0091 and establishes the BIFs as Archean and the WLG mantle source as having a slightly subchondritic time-averaged Re/Os typical of depleted Archean upper mantle. Spinifex-textured komatiites, some cumulates and mineralized BIFs fall on secondary subparallel arrays with 2450 Ma age and an elevated initial Os. This suggests that some spinifex textured rocks may have been preferentially reset by by crustal fluids 200-300 Ma after crystallization.