Fluid-rock interaction in Dora-Maira whiteschist as recorded by phengite

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The Dora-Maira Massif (DMM) is a fragment of continental crust which has experienced subduction to sub-arc depths (~4 GPa, 120 km), accompanied by intense fluid-rock interaction. Here we present an *in-situ* study of fluid mobile element (FME) and B isotope data from phengite to investigate the sources of fluids present at sub-arc depths and the extent of element mobilization during prograde subduction.

Dora-Maira whiteschists are the product of extensive Mg-metasomatism of a metagranite protolith. Bulk rock data show that whiteschists are depleted in many FME compared to the metagranite (Schertl & Schreyer, 2008), but Li and Rb much less than Sr and Ba. Phengite is the main host of these elements in the whiteschists, whereas in the metagranite Li and Rb are primarily hosted in biotite and Ti-rich phengite, whilst Ba and Sr are mainly hosted in feldspars. Thus, elements hosted in mica were retained more effectively than those hosted in feldspar, which were lost during metasomatism.

Like Rb and Li, boron is primarily hosted in mica in both metagranite and whiteschist, but it is enriched by a factor 10-20 in the latter. Thus, substantial amounts of B were added to the whiteschist during metasomatism. Whiteschist matrix phengite is B-rich (155-350 µg/g) and has a mean $\delta^{11}B$ = -10.1 ± 2.3‰, which suggests a metasomatic fluid with ca. 600 µg/g B and $\delta^{11}B$ of ca. -8 to -4‰. This rules out subducted oceanic crust or slab-hosted serpentinite as a fluid source, but instead points to a mixed fluid with sediment- and mantle wedge serpentinite-derived components (*cf*. Clarke *et al*. 2020). Such fluids fit a tectonic scenario where the subducted Dora-Maira continental crust was entrained in a serpentinite-rich subduction channel mélange. Published B isotope data from rare tourmaline-bearing whiteschists ($\delta^{11}B$ = -9 to 0‰; Xiong *et al*., 2022) support our scenario, but also recorded a ca. +4‰ shift in $\delta^{11}B$ compared to the metagranite, which is not visible in our dataset probably due to recrystallisation of metagranite mica during prograde metamorphism. Work is currently underway to determine phengite B isotope systematics in tourmaline-bearing samples to allow more detailed comparison.

Whiteschist phengite also preserves a record of distinct metamorphic stages in the form of inclusions in garnet, phengite in the matrix and late phengite on garnet rims. These phengite generations indicate that following the influx of Mg-rich fluids during prograde metamorphism, peak to early retrograde-stage reactions lead only to internal redistribution of FME. Only the last retrograde stage was characterized by influx of nitrogen-rich external fluids, indicative of dominantly sediment-derived fluids.

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