Contribution of oceanic gabbros to the N recycling in subduction zones

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Nitrogen content and isotopic composition together with major and trace element concentrations were determined in a sequence of metagabbros from the western Alps (Europe). These samples experienced (i) hydrothermal alteration on oceanic seafloor, followed by (ii) subduction to different depths (0 to ~70 km) along low geothermal gradient (~9°C/km) representative of a cold slab environment. A comparison of hydrothermally-altered metagabbros with their blueschist and eclogitic facies equivalent provides constraint on the evolution and behavior of N during progressive dehydration attending subduction zone metamorphism. Non-subducted and blueshists facies metagabbros are low-strain rocks from the Chenaillet massif and Queyras Valley, respectively. Eclogitic facies rocks include low-strain rocks, mylonites and veins collected in a major shear zones from the Monviso massif. Whole rock N content (between 2.6 and 28 ppm) and $\delta^{15}N$ (between +0.8 to +8.1 ‰) do not show any specific evolution with increasing metamorphic conditions. Low-strain rocks show a striking inverse linear correlation between Cu concentration and $\delta^{15}N$. It is argued that this correlation is most likely inherited from a pre-subduction stage such as magmatic differenciation or oceanic hydrothermalism. The preservation of this correlation implies that N remained in low-strain rocks during metamorphism although eclogitization was accompanied by ~90 % fluid loss. In contrast, Cu concentration estimates and $\delta^{15}N$ values obtained in veins and mylonites are not correlated. This indicates that dynamic re-crystallisation induced a release of N from the host rock to the fluid phase. Accordingly, deformation rather than metamorphism alone should be considered as a key factor for the preservation or loss of N in subducting metagabbros.

Metagabbros are a major component of the subducted oceanic crust. They represent mass flux of ~ 4×10^{16} g/yr (Peacock, 1990), being twice higher than basaltic crust flux. Considering the mean N content of mylonitic and low-strain metagabbros from this study (9.4 ± 7.0 ppm), the flux of subducted N associated with metagabbros is estimated at 3.8 (± 2.8) × 10^{11} g/yr. This value is half of the sedimentary N flux input in subduction zones, showing that gabbros may represent up to 30 % of the whole budget of recycled N.

Reference

Peacock S.M. (1990) *Science* **248**, 329-336.

Partial dehydration of blueschist: Insights into the slab-wedge transfer

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The mafic high-pressure rocks of the Tianshan (NW China) display an interconnected network of eclogite-facies veins derived by prograde blueschist dehydration. They provide unique insights into fluid-rock interaction and element load during dehydration and long-distance fluid flow occurring during the major fluid release of subducting oceanic crust. The transition from blueschist- to eclogite-facies paragenesis is displayed as dehydration haloes around some veins. The vein-network consists of the dehydration veins – derived by dehydration of the immediate blueschist host– and veins which cross the blueschist host foliation and display sharp interfaces towards its wall rock. The latter ones show no evidence of dehydration reactions in the immediate blueschist host. In these cases the fluid source is regarded as being of external origin. These veins may represent high-pressure transport veins, thus potential channelways of fluid escape. This study focuses on such a transport-vein, its blueschist host and an eclogitized reaction zone (blueschist alteration zone), located in the central part of the vein. Textural evidence and the almost twice as high Li-concentration of the vein and the blueschist alteration zone in comparison to the blueschist host indicate the external origin of the vein forming fluid. This fluid triggered eclogitization and the associated devolatilization of the blueschist alteration zone. The low in trace element fluid caused a strong leaching of LILE, REE, and HFSE in those parts of the host rock with which the passing fluid reacted. The main difference between the blueschist host and the blueschist alteration zone is the replacement of glaucophane, dolomite and titanite by omphacite and rutile respectively, while garnet, rutile, phengite and clinozoisite occur in both parts of the rock. Therefore we regard the fluid-flow regime rather than the mineral assemblages and equilibrium partition coefficients as the main control of the trace element mobility. The mobilized trace elements reflecting those needed to create the ‘slab signature’ of arc magmas.