EGU21-12745, updated on 26 May 2022
https://doi.org/10.5194/egusphere-egu21-12745
EGU General Assembly 2021

In situ measurements of nitrogen contents in formerly subducted rocks reveal variable behaviour of nitrogen during fluid-rock interaction.

Ben Harris[1], Cees-Jan de Hoog[1], and Ralf Halama[2]
[1]School of Geosciences, University of Edinburgh, Edinburgh, United Kingdom (b.j.r.harris@sms.ed.ac.uk)
[2]School of Geography, Geology and the Environment, Keele University, Keele, United Kingdom

Nitrogen recycling from the Earth's surface to the mantle through subduction zones is a key component of the long term global nitrogen cycle. Data on the nitrogen contents of formerly subducted rocks is key to constraining this flux and to understanding nitrogen behaviour during subduction dehydration. Studies have so far been restricted to analyses of whole rocks or mineral separates, which masks textural controls and mineral heterogeneity. Here we present the first *in situ* SIMS analyses of nitrogen contents in white micas and other minerals from a suite of subduction-related crustal rocks. We determine the nitrogen distribution in these rocks and explore the behaviour of nitrogen, compared to other fluid-mobile elements, during subduction and fluid-rock interaction. Samples from three localities were investigated: blueschist and eclogite from the Raspas Complex, Ecuador; blueschist and eclogite from the Franciscan mélange (Jenner, California); eclogite and garnet-phengite quartzite from Lago di Cignana, Italy.

Our data confirm that white mica (phengite, paragonite) is the primary host for nitrogen across all samples. Both phengite and paragonite contain substantial amounts of nitrogen (up to 320 ppm), but the concentrations vary widely across different samples. Chlorite replacing garnet in eclogites and blueschists contains little nitrogen. In contrast, chlorite occurring with garnet, phengite (108 - 270 ppm N), glaucophane and titanite in the matrix of a blueschist from Jenner contains measurable quantities of nitrogen (10 - 83 ppm). Other minerals (clinopyroxene, amphibole, epidote, titanite, garnet) contain little nitrogen (<5 ppm) in all samples.

A blueschist from Raspas contains coexisting phengite and paragonite, in addition to garnet, glaucophane, epidote, and accessory albite and carbonate. Nitrogen preferentially partitions into phengite (117 - 243 ppm) over paragonite (31 - 118 ppm). Albite also contains some nitrogen (15 ppm). Silicon contents of phengite vary from 3.32 – 3.40 a.f.u. Decrease in silicon is correlated with decrease in nitrogen and boron, and increase in lithium. These trends can be explained by growth of paragonite during retrograde fluid-rock interaction and redistribution of these elements between phengite, paragonite and glaucophane.

Variability in nitrogen concentrations in other samples which have undergone peak or retrograde fluid-rock interaction, and contain only phengite as a nitrogen-bearing phase, cannot be explained

by redistribution. Different samples display either no change in nitrogen, or addition of nitrogen during fluid-rock interaction, as recorded by different generations of phengite. No correlation between nitrogen contents of the samples and P-T conditions was observed, but this was likely due to the large range of protoliths in this study.

Our results demonstrate that nitrogen behaviour during fluid-rock interaction is complex and can be variable between samples, and that *in situ* data can inform understanding of the processes controlling N distribution.