Intraslab remobilization of nitrogen during early subduction facilitates deep nitrogen recycling: insights from the blueschists in the Heilongjiang Complex in NE China

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Nitrogen (N) in subducting slab resides in both sediments and altered oceanic crust (AOC). The extent of subduction-zone metamorphic devolatilization of N in these reservoirs determines the amount of remaining N for deep recycling. However, N behavior inside the subduction zone, particularly below the forearc region, remains poorly understood so far. Here, we studied the pillow-shaped epidote-blueschist facies meta-basalts (hereafter refer to as blueschists) in the Heilongjiang Complex in Northeast China, aiming to understand the N behavior during the early subduction stage. Results show that these blueschists contain N (13.9 to 122.6 ppm; average: 51.0 ppm) up to seven times higher than the altered igneous oceanic crust (including pillow lavas) entering global trenches (N < 19 ppm; average 7 ppm). The N concentrations of the blueschists correlate with the Ba and Th concentrations, indicating that significant N enrichment of the blueschists took place inside the subduction zone in addition to small N enrichment on seafloor. The N concentrations and $\delta^{15}N$ values of the blueschists show two distinct mixing trends, indicating that two types of ammonium (NH_4^+) were added into the blueschists. One is characterized by relatively high abundance and positive $\delta^{15}N$ value (~ +3‰), which can be attributed to the direct assimilation of NH_4^+ in metamorphic fluids derived from the sedimentary components in the mélange. The other is characterized by relatively low abundance and extremely low $\delta^{15}N$ values (~ −16‰). This NH_4^+ is consistent with a product of abiotic reduction of sediment-derived N_2. This study demonstrates that the labile N in sediments released during early subduction can be at least partially (if not all) re-fixed into the more refractory meta-igneous part of the subducting slab, which facilitates the retention of N for deep subduction and recycling.

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