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Nitrogen subduction efficiency via metabasic rocks: case study from a tectonic mélange in Central Tibet

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Input of nitrogen in subduction zones via tectonic mélanges needs to be constrained well to determine the fluxes of nitrogen between Earth's atmosphere, crust and mantle. Metamafic mélange rocks may be a significant source of nitrogen input and the behavior of nitrogen in these lithologies during metamorphism needs to be studied. Previous studies have investigated blueschist- and eclogite-facies metabasic rocks that represent metamorphosed altered basalts and gabbros from upper and lower oceanic crust, respectively. Here we constrain nitrogen behavior in metamorphosed mafic intrusions and sills in passive margins and their potential to input nitrogen in subduction settings. We use ten amphibolite and epidote blueschist samples from the Qiantang Metamorphic Belt in Central Tibet where the protoliths represent upper Paleozoic shallow marine strata and magmatism during intracontinental rifting and passive margin development. We find that K_2O, Ba and Rb are correlated with nitrogen in abundance indicating that nitrogen was sourced from fluids in these rocks. The rocks contain 14-147 ppm nitrogen, the highest reported in metabasic rocks thus far. These are much higher abundances than global altered oceanic crust likely indicating that nitrogen was introduced in subduction channels rather than by alteration at passive margins. $\delta^{15}N$ varies from +1.8‰ to +10.0 ‰ indicating sedimentary or continental fluid source in subduction channels. There is an absence of correlation between nitrogen abundance and metamorphic grade indicating that nitrogen abundances likely do not reflect devolatilization during prograde metamorphism. Heterogeneity in nitrogen concentrations from the same location indicate that enrichment is possible at local scales. We calculate nitrogen input fluxes via metabasic rocks across modern-day subduction zones using lower (10 ppm) and upper (100 ppm) limits of nitrogen abundance and compare the fluxes with that of metasedimentary rocks with 500 ppm nitrogen concentration. We find that metabasic rocks can carry equal to or higher nitrogen than metasediments indicating that they are the major carrier of nitrogen in subduction zones. We estimate potentially higher global input of nitrogen than previous studies, however, future studies need to constrain the syn-subduction behavior of nitrogen in mafic-rich mélanges to revise slab output fluxes and recycling efficiency.