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A potentially considerable geochemical sink during rodingitisation: Implications for the geochemical cycle in the subduction zone and mantle heterogeneity

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Rodingite is a Ca-rich and Si-poor metasomatized mafic rock that commonly occurs as a dyke in serpentinized peridotite. The source of fluids invoked during rodingitisation and the mechanism responsible for its origin remain unresolved. Rodingitisation in the subduction zone and its role in mantle and crustal geochemical heterogeneities are largely ignored. We report, for the first time, numerous rodingite dykes of centimetre–metre scale from the Shargole ophiolite, Trans-Himalaya, NW India. Ca-Sr-Nd isotopic and elemental data for the rodingite and its mineral phases, along with a thermodynamic model, are presented to address these issues. The rodingites have relatively higher contents of U, Th, Li, and radiogenic Sr isotope, and their pressure-temperature conditions (12.5-14.3 kbar; 450-465 °C) are comparable to forearc depths, indicating that they likely originated in the subduction zone. The pressure-temperature conditions in the rodingite increase with the degree of rodingitisation. High field strength elements (HFSE) and REE concentrations increase with the degree of rodingitisation and with higher pressure, suggesting HFSE and REE mobilisation during rodingitisation in the subduction zone. This mobilisation of HFSE and REE in the subduction zone is driven by F^{-}-PO_4^{-3}-CO_3^{-2}-rich fluids. This is supported by a) the presence of calcite and fluorapatite in the rodingite and b) HFSE and REE in the rodingite are notably higher than those of their protoliths. These hybrid fluids could have been sourced from the subducted slabs. Chlorite, garnet, and apatite in the rodingite could sequester Li, Ca, HFSE, and REE during rodingitisation. The $\delta^{44/40}$Ca value in the studied rodingite is heavier than that from the bulk silicate Earth. We propose that rodingitisation in the subduction zone acts as a sink for Ca, Li, HFSE, and REE. This study highlights that a) rodingitisation in the subduction zone could be attributed to mantle heterogeneities and b) the application of elemental and isotopic ratios to identify and quantify the subduction components should take into account the elemental and isotopic fractionation effect in the subducted slab components, including “rodingite”.