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Serpentinization and deserpentinization of the mantle wedge at forearc and subarc depths at a convergent plate boundary: evidence from orogenic peridotites from a composite oceanic-continental subduction zone

ZHUANGZHUANG YIN[1] AND REN-XU CHEN[2]

[1]University of Science and Technology of China
[2]CAS Key Laboratory of Crust-Mantle Materials and Environments, School of Earth and Space Sciences, University of Science and Technology of China

Presenting Author: zzyin@mail.ustc.edu.cn

A combined study of whole-rock major and trace elements, mineral major and trace elements, whole-rock and olivine O isotopes and phase equilibrium modelling as well as zirconology were carried out for serpentinite in the Hong'an orogen to provide insights into the crust-mantle interaction in the continental subduction channel. Petrology and geochemistry analyses demonstrate that the serpentinite originated from refractory mantle wedge dunite or harzburgite. The extremely high Fo values (96.7 ~ 97.6) of secondary olivine indicate that they formed by partial decomposition of antigorite. Serpentinite is slightly enriched LILE and LREE, and has low $\delta^{18}O$ of whole rock and mantle-like or slightly higher $\delta^{18}O$ of olivine. It appears that the serpentinite underwent multiple stages of metasomatism by different fluids during subduction and exhumation. The presence of olivine inclusions in zircon domains from serpentinite indicates the growth of metasomatic zircons in subduction channel. ~220 Ma zircon domains exhibit weak zoning or no zoning, type I of these zircon domains show low Th/U ratio and heavy rare earth element (HREE) contents, flat HREE patterns with lack of negative Eu anomalies. Type II of these zircon domains exhibit high Th/U ratios and HREE contents, steep HREE patterns with negative Eu anomalies. Considering the Hf-O isotope composition of these zircon domains, we infer that they were formed through metasomatic reaction by addition of different source of fluids derived from deeply subducted continental crust. ~310 Ma zircon domains show no zoning, high Th/U ratios and HREE contents, with negative Eu anomalies, and contain olivine and calcite inclusions. Combining with the Hf-O isotope compositions, these zircon domains have grown from metasomatic fluids derived from subducted oceanic crust. ~430Ma and 632~2730Ma zircon domains exhibit magmatic zircon characteristics. Their U-Pb age and trace elements and Hf-O isotope compositions are similar to those for protolith zircons from ultrahigh/high-pressure metamorphic rocks in Hong'an orogen. Therefore, these relict zircons would be physically transported into the serpentinite by metasomatic fluids originated from the subducted crust. The serpentinites thus record metasomatic reactions with fluids derived from subducted oceanic crust and subsequent subducted continental crust.