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C-Type Olivine Fabric in the Zhimafang Garnet Peridotite from the Sulu Ultrahigh-Pressure Metamorphic Terrane, Eastern China: Implications for Water in Continental Subduction Zone

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A 432.08-m-deep pre-pilot drillhole (CCSD-PP1) of the Chinese Continental Scientific Drilling project penetrated the Zhimafang garnet peridotite body in the southern Sulu ultrahigh-pressure (UHP) metamorphic terrane, eastern China. The lattice-preferred orientations (LPO) of olivine in garnet lherzolite, garnet harzburgite and garnet-free dunite from the CCSD-PP1 are measured by using the electron backscatter diffraction (EBSD) technique. Despite of different strain regime (simple shear or uniaxial compression) and alteration degree, all peridotites display water-induced C-type olivine fabric in which the olivine [001] axis is subparallel to the stretching lineation and the (100) plane is subparallel to the foliation, suggesting that the olivine LPO were formed under high water fugacity and modest stress. Compared with the exhumation-induced LPO of quartz in the Sulu terrane, the olivine LPO of the Zhimafang peridotites developed at UHP metamorphic conditions and preserved during exhumation. Because subduction of cold, dry, old supracrustal rocks of the Yangtze Plate provided a fluid-deficient environment and the subsequent fluid-rock interaction during exhumation was very limited, the structural hydroxyl should be incorporated in olivine when the Zhimafang garnet peridotite was in a hydrous mantle wedge prior to the Triassic continental collision. In addition, the water contents in olivine are determined by the infrared spectroscopy method. The varying water contents of olivine (21 to 410 ppm wt. H2O) indicate that at least some olivine grains have released most water during rapid decompression, and water dissolved in the nominally anhydrous minerals such as olivine can be recycled into the crust by exhumation of mantle peridotites. The results suggest that during subduction of the Yangtze Plate, the Zhimafang garnet peridotite was captured from the overlying mantle wedge and then experienced coeval UHP metamorphism, deformation and exhumation with supracrustal rocks. The continental subduction zone may contain more water than expected.