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Deformation and fabric of a garnet-bearing peridotite from the Sulu terrane, eastern China

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Garnet-bearing peridotites in continental collisional orogens are crucial to decipher the deformation processes active in the subduction zones. Here I report the deformation features of a garnet-bearing peridotite from Ganyu in the Sulu terrane, eastern China. The studied peridotites display a typical porphyroclastic texture characterized by large, weakly deformed porphyroclasts (1-2 mm across) of orthopyroxene and fewer clinopyroxene enclosed in a fine-grained matrix composed of olivine, orthopyroxene, clinopyroxene, amphibole, garnet, spinel, and chromite. Electron backscattered diffraction (EBSD) measurements revealed that olivine shows a B-type crystallographic preferred orientations (CPOs), featured by a girdle of [010] axes normal to the foliation, and a point maximum of [001] axes nearly parallel to the lineation. Orthopyroxene and clinopyroxene neoblasts both show strong and significant CPOs. For orthopyroxene neoblasts, the [001] axes are concentrated parallel to the lineation, while the [100] axes are spreading in a plane normal to the foliation plane. For clinopyroxene neoblasts, the [001] axes are clustered parallel to the lineation, while the (010) planes form a girdle normal to the foliation plane. Amphibole CPOs resemble those of clinopyroxene neoblasts. Based on the petrographic and microstructural observations, I consider that the olivine CPOs are not caused by slip system transition induced by either water or high pressure because both cases require that dislocation creep dominates the deformation. Petrographic features are inconsistent with several hypotheses previously proposed to interpret the formation of the B-type olivine CPO either (e.g., Holtzman et al., 2003; Sundberg and Cooper, 2008; Nagaya et al., 2014; Precigout and Hirth, 2014). Here I considered that diffusion creep dominated the deformation of the Ganyu peridotites. Olivine CPOs are inherited growth fabrics resulting from ultrahigh-pressure metamorphism under stress. This is consistent with structural studies on many high-/ultra-high pressure rocks from continental subduction zones which demonstrated that these rocks are deformed exclusively by dissolution-precipitation creep and stress magnitude within subduction zones is low ($\sim$ 10 MPa). It also reconciles with the field observations that peridotites usually occur as lens and boudins within gneiss, which suggests that the former is more competent compared to the latter. This study provides direct evidence for low-stress deformation of peridotites in continental subduction zones during their exhumation en route to the surface.

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