

Static phenomena retained by garnet during exhumation of metamorphic rocks

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Electron back scatter diffraction (EBSD) method was employed for the analysis of crystallographic orientations of garnet grains to discuss tectonic behavior of various types of metamorphic rocks during exhumation. Selected metamorphic rocks were coesite-eclogite from the Sulu belt, China, granulite in the Mogok belt, Myanmar, and epidote-amphibolite and quartz schist of eclogite and non-eclogite units, respectively, in the Sanbagawa belt, Japan. The garnet grains are grouped into segmentation and honeycomb types. The segments forming an aggregate, which formed by hydration reaction during the exhumation stage, share similar crystallographic orientations, with misorientations of less than 3–4°. This suggests that the segmentation textures were not formed by deformational crush and the grains recorded a static environment during exhumation. The Sulu and Mogok garnet grains segmented under granulite-upper amphibolite facies conditions have been continually exhumed to the earth's surface without incurring specific deformation and/or rotation. The garnet grains in the epidote-amphibolite from the Sanbagawa eclogite unit were once fragmented by hydration reactions during exhumation and have subsequently become unified by hydration reactions during prograde epidote-amphibolite facies metamorphism. This fact indicates that the Sanbagawa garnet grains in the eclogite unit have recorded static conditions during the hydration and dehydration stages. Honeycomb garnet in a quartz schist from the Sanbagawa non-eclogite unit, which formed during prograde stage under the lower epidote-amphibolite facies, also shows no evidence suggesting deformation processes. This sample might not have undergone significant deformation during exhumation from depths of 25–30 km (0.8–0.9 GPa) to the earth's surface. Such undeformed phenomena recorded in these metamorphic garnet grains during exhumation might have been promoted by episodic exhumation, buoyancy-driven and static exhumation of the metamorphic belt, or local concentration of tectonic stress and heterogeneities of deformation impacts caused by the contrast of lithologic competency and tectonic discontinuity development.

Keywords: EBSD, exhumation, garnet, metamorphic rock