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Dissolution-reprecipitation of zircon at low-temperature, high-pressure conditions (Lanzo Massif, Italy)

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Abstract

An eclogite facies meta-plagiogranite from the Lanzo massif (western Alps, Italy) contains crystals of zircon intimately associated with allanite. Zircon displays different microtextures ranging from pristine, euhedral, and magmatic to fractured, porous varieties with mosaic zoning, and pervasive recrystallization into euhedral microcrystals. Fractures and voids in the recrystallized zircon microcrystals are mainly filled by high-pressure Na-rich pyroxene. Electron backscattered diffraction analysis revealed a similar crystallographic orientation for primary magmatic zircon crystals and microcrystals, with less than 2° misorientation among neighboring microdomains. The textural change is coupled with chemical and isotopic modifications: recrystallized zircon domains contain significantly less Th and light- to mid-REE, but are richer in Sr than magmatic zircon crystals. Magmatic zircon preserves the protolith U-Pb age of 163.5 ± 1.7 Ma, whereas zircon microcrystals have a mean age of 55 ± 1 Ma. The coexisting allanite also contains inclusions of Na-rich pyroxene and has chemical features (elevated Sr and Ni contents and lack of Eu anomaly) indicating formation at high pressure. Despite being associated texturally with zircon, allanite yields a younger Th-Pb age of 46.5 ± 3.0 Ma, suggesting that the Lanzo unit remained at relatively high pressure conditions for ~8 m.y.

Zircon recrystallization proceeded with volume reduction and loss of material to an alkaline metamorphic fluid that acted as the agent for a coupled dissolution-reprecipitation process. Recrystallization occurred with minimum transport, in a low-strain environment, and was not significantly enhanced by metamictization. The source of the fluid for zircon recrystallization is most probably related to prograde devolatilization reactions in the surrounding serpentinite.

Keywords: U-Th-Pb geochronology, allanite, EBSD, plagiogranite, Lanzo peridotite