Intra-grain plastic deformation in zircons of the Himalayan eclogites: revealed from EBSD and Nano-SIMS U-Pb isotope analysis

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Zircon, a common accessory mineral in igneous and metamorphic rocks, highly resistant to alteration, preserves records of its magmatic crystallization or growth and recrystallization during metamorphic events. Backscattered electron (BSE) and cathodoluminescence (CL) imaging are generally adopted to detect pristine domains in zircons that are used for geochemical analysis and age-dating. However, existence of invisible micro- to nano-scale deformed domains in zircons are sometimes impossible to identify through the commonly investigated methods. A number of studies have reported crystal plastic deformation in zircon (*e.g.*, Reddy *et al.*, 2007; Kusiak *et al.*, 2013; Kovaleva *et al.*, 2018). Such deformations reset or affect geochemical (redistribution of trace elements and their isotopes) and geochronological records in the studied zircons. Investigating zircons through the electron backscattered diffraction (EBSD) method is non-destructive and powerful tool to visualize the plastically deformed (strained) domains. The above-mentioned authors have used EBSD analysis to determine elastic anisotropy of zircons found in the sheared zones. However, little information has been documented on the strain regime of plastically deformed zircons in non-sheared high-grade metamorphic rocks such as eclogites. In this study, we present EBSD analysis on zircons, within thin sections with available textural information, from the Himalayan HP/UHP eclogites. We then conducted multiple U-Pb isotope spot analysis on target domains using the Nano-SIMS. The age-data combined with the EBSD analysis revealed several plastically deformed domains, with reset or disturbed age values. Such plastic deformation in zircons possibly caused to reset the primary geochemical and geochronological records of protolith-related magmatic events and disturbed metamorphic records. Based on these observations, we interpret that not only regional shearing/mylonitization in metamorphic rocks affect the geochemical and geochronological records but zircons in non-sheared high-grade metamorphic rocks can also plastically deform under higher stain conditions that can be identified through the EBSD analysis. Prior to age-dating, identification of undisturbed domains in zircons is necessary to obtain geologically meaningful ages.

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