Disturbance of U-Pb and trace-element systems in hydrothermally altered zircon revealed by sensitive high-resolution ion microprobe (SHRIMP)

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U–Pb zircon geochronology is a common dating method enabled by the high U content, typically hundreds of ppm, the negligible amount of initial Pb, and the good retention of radiogenic Pb (up to 1000 °C; e.g., Kooijman et al., 2011) in zircons. The paired decay scheme of ^{238}U and ^{235}U also allows us to verify the determined U–Pb zircon age, using two geochronometers. The discordant U-Pb data in zircons are commonly found despite its high durability and high closure temperature, so it is necessary to verify whether the U-Pb data is 'concordant' or not.

On the other hand, some workers reported that radiogenic Pb was released from zircon crystal structure at lower temperature (~200 °C) via both of laboratory experiments and nature (e.g., Geisler et al., 2003; Horie et al., 2006), which indicates that interaction between zircon and hydrothermal fluids is one of important processes for disturbance of the U–Pb system. The Pb-loss occurred with decrease of major elements, increase of non-formula elements (Ca, Mn, Fe, and Al), and rare earth element (REE) through low temperature hydrothermal alteration process. Darker domains of zircon observed in the backscattered electron images are interpreted altered domain of zircon because zircon matrix are depleted by hydrothermal alteration (Hay & Dempster, 2009).

In the last decade, zircon has been more widely used as not only U–Pb geochronometer, but also the target of multiple analytical methods (e.g., Amelin et al. 1999; Watson et al., 2006; Trail et al., 2016; Valley et al., 2003). It should be carefully dealt with that these multiple analyses reflect same geological event, namely concordant information, but the redistribution and/or retention behavior of each element during the interaction with the hydrothermal fluids is questionable. Therefore, it becomes more important to understand the redistribution behaviors during the hydrothermal alteration of zircon. In this presentation, examples of the hydrothermally altered zircon, especially the result of zircons from the Duluth gabbro, U.S.A. obtained by microscopic observation and a sensitive high resolution ion microprobe (SHRIMP) analysis (Takehara et al., 2018), were introduced.

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