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Formative process of fracture in granite on the basis of geological history at the Toki Granite, central Japan

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Fractures in the crystalline rock (e.g. granite) can act as groundwater pathways. Therefore, understanding of the fracture characteristics (e.g. frequency distribution and infilling minerals) is an important subject for the disposal of high-level nuclear waste. Geological setting and formation process of the granite can influence the fracture characteristics. Thus, this study discuss the relation between 'the formation of fracture and infilling mineral' and geological history from the emplacement to present in the Toki granite, Tono district, central Japan.

The thermochronology for the Toki granite (Suzuki and Adachi, 1998; Shibata and Ishihara, 1979; Yuguchi et al., 2011) and the age determination for the basal layer of the Mizunami Group overlaying unconformably the Toki granite (Sasao et al., 2006) gave the geological history (especially, cooling history) of the granitic pluton. The Toki granite cooled rapidly during about 20 million years after the emplacement to about 250 ^{o}C, and then the granite underwent exhumation with slowly cooling during about 50-30 million years until the subaerial exposure.

Brittle fractures occurred below the temperature of about 300 to 400 ^{o}C in the cooling granite, and thus the fracture filling minerals also occurred below such temperature. The fracture fillings collected from the Toki granite are hydrothermal minerals such as chlorite and mica clay mineral, hydrothermal and meteoric water-derived calcite. The hydrothermal calcite occurs in accompany with plagioclase sericitization in the country rock, that is, such calcite was produced by supplement of anorthite (Ca) component form plagioclase through the hydrothermal fluid (Ishibashi et al., 2014). Chloritization temperature in the Toki granite ranges from about 200 to 300 ^{o}C (Yuguchi et al., in press), which is indicator of formation temperature of the hydrothermal fracture fillings. The meteoric water-derived calcite was produced during the process in which the meteoric water seeped underground through the fractures in the granite. This phenomenon occurred in a period between the sedimentation of the Mizunami Group (20Ma) and present.

Reference

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