モナザイトのフィッション・トラック年代測定：より低温の熱年代計の開発

Fission-track dating method in monazite: Development of lower-temperature thermochronometer

*宍倉 愛[1]
*Ai SHISHIKURA[1]

1. 京都大学
1. Kyoto University

Fission-track (FT) thermochronometry has been one of the most useful methods to reconstruct the low-temperature thermal history of the rocks [1]. With such data we can estimate the time of geological events accompanied by a change of temperature, such as erosion and denudation of mountains [2] and slips of fault zones. FT analysis is generally applied to apatite and zircons with closure temperatures of 90-120℃ and 330-350℃ respectively [1]. We attempt to establish FT analysis on monazite because monazite FT system is known as a lower-temperature thermochronometer with the estimated closure temperature of 50˚C or lower [3]. Monazite contains substantial amount of rare-earth elements (REE), such as Gd and Sm. These REEs cause neutron self-shielding and nuclear heating during irradiation, which has been a major challenge in practical application of monazite FT dating [4]. For the calculation on the FT ages we need to measure the track density and the uranium concentration. However, uranium concentration is conventionally measured by using the external detector method (EDM) which utilizes irradiation of thermal neutrons. In recent years, application of LA-ICP-MS has made it possible to measure the uranium concentration [5] without the irradiation of the neutrons in the crystal. On the other hand, annealing kinetics of the monazite FT system has not been well determined because laboratory studies using induced tracks are difficult due to the problem of the heat generation during irradiation; annealing kinetics of a FT system is generally studied based on measurements of induced tracks annealed under well-controlled time-temperature conditions. Hence, in this study, we try to estimate the long-term annealing kinetics of the monazite FT system, based on the depth (temp) vs FT length profile by utilizing the boring core samples of Toki granite from Gifu prefecture, central Japan. We collected unaltered intact granitites from ~1,000-m-deep boreholes [6] at ~100 m intervals. In the first step, we are establishing efficient procedures of separation of monazite. In this presentation, we are planning to report the results of the mineral separations, preliminary experiments of monazite FT, and future prospects.

* E-mail: shishikura.ai.74e@st.kyoto-u.ac.jp

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