

Measurement of fission-track lengths in zircon and apatite using the step-etch technique

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One of the characteristics of the fission track (FT) method is that the closure temperature is low compared with those of other radioactive dating methods. In addition, under the influence of thermal excitation (annealing), FTs exhibit the feature that their lengths become shorter depending on the heating temperature or time, and finally disappear. In other words, we can investigate the detailed temperature history around the closure temperature by measuring the length of FTs.

Conventionally, measured have been the horizontal confined tracks (HCT), i.e., tracks that are located within a crystal and are etched through a host track or cleavage. In this study, we tried a new approach, the method of Baba(1985), which is to measure the newly etched FTs that are emerged from inside of the grain by the repeating step-etching. Such tracks also have full lengths like HCTs. It was reported that the adaption of this method to apatite (annealed samples) enabled to find more FTs and to measure the FT lengths more precisely than the conventional method (Baba, 1985). However, the validity of this method for zircon is not known well. So, we adopted this new method to the three zircon samples (TRG07, NST03, FCT94), which are different in the track density. In addition, We performed the supplementary examination for the non-annealing apatite samples (DUR01,FCT87).

As a result of this measurement, it was observed that in zircon new FTs appeared on the surface when step-etching was advanced as in the case of apatite. In addition, the length of FTs etched to the full length decreased when the step-etching advanced. This is different from the result of Baba (1985).

As for the number of grains analyzed, we succeeded to reduce the number largely compared to the conventional method, except FCT94 which has the highest FT density. From this result, it suggests that the method of Baba is not suitable for the sample which has high track density.

The average FT length were found to be shorter than the conventional method for all samples, likely because this method is not affected by the overetching in contrast to the conventional method. However, the average FT length of NST03 was shorter than expected, owing to the existence of short FTs of about 5-7 micrometer. In addition, the standard deviations of two samples of apatite and zircon TRG07 were similar or decreased, but that of zircon NST03 was nearly twice.