Etching behaviour of alpha-recoil tracks in natural dark mica studied via artificial ion tracks

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Alpha-recoil tracks (ARTs) created by the a-decay of U, Th, and their daughter nuclei, are used by a new dating method to determine the formation age of dark mica bearing Quaternary and Neogene volcanic rocks and the cooling age of plutonic and metamorphic rocks [Chem. Geol. 166 (2000) 127, Science 155 (1967) 1103]. The age equation combines the volumetric density of ARTs with the U and Th contents. Etching latent ARTs (diameter 30–100 nm) in the mica mineral phlogopite by HF and measuring the areal density of triangular etch pits by optical and scanning force microscopy (SFM) leads to a linear growth of ART areal density versus etching time. The ART volume density is a function of the slope of the areal density and the etching rate (v_{eff}). Therefore, the determination of v_{eff} is essential for the calculation of an age value.

To determine the etching parameters such as etching efficiency and v_{eff}, phlogopite samples were irradiated with 80 keV Au ions. Irradiated surfaces were etched with 4% HF at 23 ± 2°C during successive time intervals and after each interval studied with SFM. The etching rate v_{eff} was determined by different techniques. To evaluate the threshold of etchability, the energy losses of the Au ions and α-recoil nuclei in phlogopite were calculated with the SRIM00 code. The etching efficiency of the Au ion tracks was then used to predict the corresponding etching efficiency of the natural radioactive nuclei.