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Fission-track etching in apatite: A model and some implications

Raymond Jonckheere[1,*], Carolin Aslanian[1], Bastian Wauschkuhn[1], and Lothar Ratschbacher[1]

[1]Geologie, TU Bergakademie Freiberg, 09599 Freiberg, Germany

Abstract

From their formation, fission tracks are complex structures, onto which their thermal histories come to be imprinted. Track etching leaves elongated voids whose lengths and orientations are used for reconstructing these histories. It is thus important to understand etching for interpreting track data. We revive an existing dissolution model that explains the geometries and dimensions of etched fission tracks in apatite. It implies that on continued etching, the track contours come to reflect the minimum and maximum apatite etch rates, at the same time that all trace of the track structure is erased. We cannot derive valid etch rates from the dimensions of the track openings or from the length increase of step-etched confined tracks. The roundedness of the track tips is not a measure of etching progress. Understanding the contours of confined tracks does permit, in most cases, to calculate their true etch times. We propose to exploit this fact to set an etch-time window and to model the confined-track data in this interval. The excluded measurements will be those of the least-etched and most-etched tracks. This numerical loss is offset by the fact that an etch-time window relaxes the requirement of a fixed immersion time, and a longer immersion multiplies the measurable confined tracks. This calls for no changes to existing procedures if the etch-time windows for different protocols give consistent results. The length data for apatites with different compositions could become comparable if their etch-time windows were linked to a compositional parameter.

Keywords: Apatite, fission track, etching, effective etch time, surface track, confined track