American Mineralogist, Volume 104, pages 569–579, 2019

On growth and form of etched fission tracks in apatite: A kinetic approach

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Abstract

We discuss differences between the bulk etch rate (v_B) and an alternative radial etch rate (v_R) model for fission-track etching in apatite. A skeletal v_R-model, based on the inferred orientations of the v_R minima and maxima, accounts for the main geometrical features of etched fission tracks, including the track-surface intersections, track channels and their terminations, and the outlines of confined tracks. It unifies the diverse appearances of etched tracks as variations of a basic plan, governed by the orientation of the etched surface and that of the track. The v_R-model also embeds fission-track etching in the mainstream theories of crystal growth and dissolution. However, in contrast to the v_B-model, the v_R-model does not provide bottom-up criteria for discriminating between tracks that are counted by an observer or a computer program and those that are not. Moreover, abandoning the v_B-model implies that basic assumptions of fission-track dating must be reconsidered, in particular that track counting efficiencies depend only on a critical dip angle, and are thus independent of the track registration geometry and the length distribution.

Keywords: Apatite, fission track, etching, fission-track dating