American Mineralogist, Volume 100, pages 1452–1468, 2015

Inter-laboratory comparison of fission track confined length and etch figure measurements in apatite

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Abstract

Apatite fission-track length and etch figure data are powerful tools for obtaining thermal history information, but both require human analysts making manual measurements and reproducibility is not assured. We report the results of an inter-laboratory study designed to clarify areas of congruence and divergence for these measurements and provide a basis for evaluating best practices to enhance intercompatibility of data sets. Four samples of megacrystic apatite from Durango, Mexico, with induced tracks, one unannealed and three thermally annealed by varying amounts, were distributed internationally. In all, 55 analysts in 30 laboratory groups participated in the experiment. Relative mean track lengths among the samples were consistent across all analysts, but measurements for each sample showed scatter among labs and analysts considerably in excess of statistical expectation. Normalizing measurements of annealed samples using the unannealed sample improved consistency, as did normalizing for track angle using **c**-axis projection. Etch figure data also showed variability beyond statistical expectation, and consistency was improved by normalizing. Based on these data we recommend rigorous analyst training for length and etch figure measurement that includes measurement of standards, and that each analyst's data on unknowns be normalized by that analyst's own measurements on standards when using thermal history inverse modeling as part of the interpretation process.

Keywords: Geochronology, fission-track dating, track length measurement, apatite, inter-laboratory calibration, thermal history analysis