Improved measurement and modeling of fission tracks in apatite.

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Two abiding issues impact the reliability of apatite fission-track (AFT) thermochronology and time-temperature history inversion in particular: reproducibility of length measurements and kinetic variability in annealing. A new analysis that unifies the major annealing data sets by Carlson et al. [1] and Barbarand et al. [2,3] works toward solving both of these issues, enabling more reliable and robust AFT data acquisition and interpretation.

Barbarand et al. [3] documented variation in length measurements that exceeded predictions by standard statistical treatments. We find that normalizing for track angle using *c*-axis projection improves every aspect of length measurement reproducibility examined. It accelerates convergence of mean length in single analyses; increases consistency among replicate measurements by a single analyst; enhances consistency of measurements of the same mounts by different analysts; and improves the match between analyses conducted with and without Cf-irradiation.

C-axis projection also increases the concordance of geological time-scale predictions based on the data of the Carlson et al. [1] and Barbarand et al. [2] analysts. We thus were able to create a single empirical annealing model that encompasses both data sets and accounts for the different etching protocols used. As found previously, a fanning curvilinear form best fits with expectations based on high- and low-temperature geological benchmarks. The combined 26-apatite data set improves our characterization of kinetic variability. Unit cell parameters show superior correlation with annealing kinetics compared to Cl content and D_{par}, although certain compositional varieties (Mn, Sr, Fe) constitute outliers. A multi-compositional model sucessfully characterizes all apatites studied.

References

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