Neutron calibration for fission track dating

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Fission track dating, as other radiometric dating methods, requires that some of the assumptions be met. Some of the parameters to be checked and calibrated are neutron energy, neutron flux, and the composition of standard glasses. An essential part of the calculation of a fission track age is the induction of ^{235}U fission tracks in a well thermalized neutron flux. The fission cross-sections of ^{238}U and ^{232}Th will increase at higher flux energies, which may contribute significantly to reduced track density. In order to determine the thermalization of our irradiation site at McMaster reactor, we have irradiated (a) several standard glasses of different U and Th contents, and (b) a Th standard glass (CN3, 40 ppm Th), with the following results.

(1) The greater the U content of the glass, the higher the induced track density (independently variations in Th content).

(2) The track density as high as 6.50×10^4 track/cm^2 was induced from glass CN3, though it is reported to be essentially free of U. This track density corresponds to about 1 ppm U. Because Th has little or no effect on the glass when well thermalized (see (1)), we conclude that there must be at least 0.5 ppm U in glass CN3.

(3) The track density from glasses in one irradiation package was obviously lower than those of the other packages, though the

same irradiation conditions were specified, including that either the actual irradiation time (900 sec), or actual flux (5×10^{15} n/cm^2) were lower for this package.

We are confident that our internal calibration using the zeta factor in fission-track dating compensates for these minor deviations from the ideal conditions, but we conclude that watchful calibration and standardization are essential because no externally obtained data can be taken at face value.