EVALUATION OF THE ^{232}TH DECAY CONSTANT BY EMPIRICAL CROSS-CALIBRATION OF ^{208}PB/^{232}TH AND ^{207}PB/^{235}U SYSTEMATICS IN MONAZITES. W.J. Davis[1] and M.E. Villeneuve[1], [1]Geological Survey of Canada, 601 Booth St. Ottawa, ON. Canada. K1A 0E8. Email: bidavis@nrcan.gc.ca

The ^{232}Th decay constant is imprecise (±0.5%) relative to those of ^{235}U or ^{238}U (<0.07%) and may produce systematic age differences of up to 20 m.y. (95%) at 2 Ga between the U-Pb and Th-Pb systems. Furthermore, no consensus exists between the values accepted by the geological and nuclear communities. Uncertainty in the Th decay constant is particularly problematic for monazite dating by electron microprobe methods as ^{232}Th decay is the main contributor to the Pb determined by this method. Two recent studies focussed on the Th-Pb systematics of monazite, one involving the intercalibration of U-Pb and Ar-Ar ages [1], and the other an evaluation of ion probe mineral standards, provide a comparative data base with which to assess the ^{232}Th decay value relative to the ^{235}U value.

Thirty Th-U-Pb analyses of monazites ranging in age from 24 to 2600 Ma have been determined and the $^{232}\lambda$ value calculated by inverting and solving the traditional age equation assuming concordance between the ^{208}Pb/^{232}Th and ^{207}Pb/^{235}U ages. Analytical uncertainties in the spike calibration, measured ^{208}Pb/^{232}Th value and the ^{207}Pb/^{235}U age are propagated, but not the uncertainty in $^{235}\lambda$. The calculated $^{232}\lambda$ is therefore relative to the accepted $^{235}\lambda$ value. Our preliminary weighted mean value calculated by this approach is 4.940×10^{-11} ± 0.21% (1 sigma) and lies between and within error of the accepted values in the geological 4.948×10^{-11} ± 0.51% [2] and nuclear 4.933×10^{-11} ± 0.4 % [3] literature.

Uncertainties in this approach include geological variability, and the accuracy and precision of the spike calibration. Geological uncertainties are difficult to quantify as there is no robust method to evaluate the comparative behavior of the Th-Pb relative to the U-Pb systems. The data were screened for concordance within the U-Pb system with disequilibrium effects presumed to be minimal in those samples over 1000 Ma. Significant differences between ^{208}Pb/^{232}Th and ^{207}Pb/^{235}U ages are evident in analyses that are more than 0.5% discordant in the U-Pb system, and are most evident in the two Archean samples in the study. Analyses demonstrating this behavior were screened out. The calculated $^{232}\lambda$ values define a normally distributed population that does not indicate a systematic disturbance in the ^{208}Pb/^{232}Th relative to the U-Pb system. The spike was calibrated against a mixed Th-U-Pb reference solution prepared from metals and has an uncertainty in the Th/U ratio estimated to be 0.2%. The standard error of the mean of 30 determinations of $^{232}\lambda$ is 0.05% and contributes little to the overall uncertainty which is dominated by the spike calibration error. As this approach is entirely based on the accepted ^{235}U decay constant any changes in its value will translate directly to the value calculated here. The uncertainties in $^{235}\lambda$ are not propagated into the $^{232}\lambda$ error and the calculated value should not be considered in absolute terms but relative to accepted ^{235}U. Further work targeted at refining the calibration of our spike composition will reduce uncertainties in the decay constant calculated by this method.

[1] Villeneuve, M.E. et al. (2000), GCA. 64, 4017-4030.
[2] Le Roux, L.J. and Glendenin, L.E. (1963) Nucl. Energy Appl. Isotop. Radiat. Proc. 77-88.
[3] Audi, G. et al. (1997) Nucl. Phys. 624, 1-124.