Evaluating $^{238}\text{U}/^{235}\text{U}$ in U-bearing accessory minerals

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U-daughter (U-Pb, Pb-Pb, and U-series) geochronology and cosmochronology utilize the absolute value of the present day $^{238}\text{U}/^{235}\text{U}$ ratio to calculate and compare dates. For decades, this value has been assumed to be invariant and equal to 137.88, but recent experiments indicate that there is potential for ‘per mil level’ variation in $^{238}\text{U}/^{235}\text{U}$ in natural materials, hypothesized to be the result of redox reactions. These studies have largely focused on materials formed in low-temperature environments (e.g. speleothems, corals) and U ore deposits. At present there are no published high-precision high-accuracy $^{238}\text{U}/^{235}\text{U}$ data for U-bearing accessory minerals commonly used for U-Pb geochronology. We present accurate and precise $^{238}\text{U}/^{235}\text{U}$ determinations for a suite of common U-bearing accessory minerals (zircon, monazite etc.), from a variety of geological environments and ages. Measurements have been made by thermal ionization mass spectrometry, accurately correcting for mass fractionation using the IRMM 3636 $^{233}\text{U}/^{236}\text{U}$ double spike. Accessory mineral $^{238}\text{U}/^{235}\text{U}$ ratios are generally lower than the ‘consensus’ value of 137.88.

Systematic discordance has been observed in $^{238}\text{U}/^{206}\text{Pb}$ and $^{235}\text{U}/^{207}\text{Pb}$ dates obtained for closed-system minerals, and has been used to reassess the relative decay constants of $^{238}\text{U}$ and $^{235}\text{U}$ (Mattinson, 2000, 2010; Schoene et al., 2006). However, these attempts assumed values (i.e., 137.88 or 137.80) for all present-day $^{238}\text{U}/^{235}\text{U}$ ratios. Our new determination of coupled $^{238}\text{U}/^{206}\text{Pb}$, $^{235}\text{U}/^{207}\text{Pb}$ and $^{238}\text{U}/^{235}\text{U}$ measurements on the same closed system zircons, all traceable to SI units, permit further refinement of $\lambda_{^{238}\text{U}}/\lambda_{^{235}\text{U}}$ estimates.

Mattinson J.M. 2000. Revising the "gold standard" - the Uranium decay constants of Jaffey et...


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