Geophysical Research Abstracts
Vol. 13, EGU2011-12667, 2011
EGU General Assembly 2011

Evaluating 238U/235U in U-bearing accessory minerals: implications for U-Pb geochronology

Joe Hiess (1), Daniel J. Condon (1), Stephen R. Noble (1), Noah McLean (2), Samuel A. Bowring (2), and James M. Mattinson (3)

(1) NERC Isotope Geoscience Laboratory, British Geological Survey, Keyworth, UK (jies@bgs.ac.uk), (2) Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA, USA, (3) Department of Earth Science, University of California, Santa Barbara, CA, USA

U-daughter (U-Pb, Pb-Pb, and U-series) geochronology and cosmochronology utilise the absolute value of the present day $^{238}U/^{235}U$ ratio to determine U/Pb and Pb/Pb isotope ratios and compare derived 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 $^{238}U/^{235}U$ 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 $^{238}U/^{235}U$ data for U-bearing accessory minerals commonly used for U-Pb geochronology.

We present accurate and precise $^{238}U/^{235}U$ determinations (absolute uncertainties of $\sim$200 ppm) 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 multi-collector thermal ionization mass spectrometry and multi-collector inductively coupled plasma mass spectrometry, accurately correcting for mass fractionation using the IRMM 3636 ^{233}U-^{236}U double spike. These results indicate that accessory mineral $^{238}U/^{235}U$ ratios are generally lower than the 'consensus' value of 137.88 and record limited but resolvable variation.

Systematic discordance has been observed in ^{238}U-^{206}Pb and ^{235}U-^{207}Pb dates obtained for closed-system minerals, and has been used to reassess the relative decay constants of ^{238}U and ^{235}U (Mattinson, 2000, 2010; Schoene et al., 2006). These studies derive $\lambda^{235}U$ relative to $\lambda^{238}U$ by assuming equivalence between ^{238}U-^{206}Pb and ^{235}U-^{207}Pb dates and using assumed values (i.e., 137.88 or 137.80) for the present-day $^{238}U/^{235}U$ ratio. Our new determination of coupled $^{238}U/^{206}Pb$, $^{235}U/^{207}Pb$ and $^{238}U/^{235}U$ measurements on the same closed system zircons permits further refinement of $\lambda^{238}U/\lambda^{235}U$ estimates using parameters whose values and uncertainties are all traceable to SI units.

Mattinson J.M. 2000. Revising the "gold standard" - the Uranium decay constants of Jaffey et al., 1971. EOS, AGU Fall meeting Supplement Abstract V61A-02.

Mattinson J.M. 2010. Analysis of the relative decay constants of ^{235}U and ^{238}U by multi-step CA-TIMS measurements of closed-system natural zircon samples. Chemical Geology 275: 186-198.

Schoene B., Crowley J.L., Condon D.C., Schmitz M.D. and Bowring S.A. 2006. Reassessing the uranium decay constants for geochronology using ID-TIMS U-Pb data. Geochimica et Cosmochimica Acta 70: 426-445.

Research funded by the European Community's 7th Framework Programme grant agreement n° 215458.