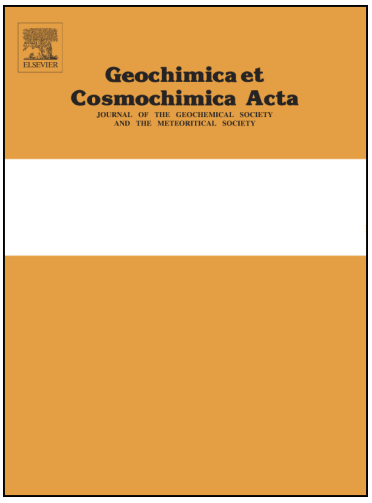

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Evaluating the robustness of a consensus $^{238}U/^{235}U$ value for U-Pb geochronology

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Abstract

U-Pb geochronology requires knowledge of a precise and accurate value for the $^{238}U/^{235}U$ ratio of any mineral or material being dated by this method. It is now well established that the long-accepted value of 137.88 is not representative of most terrestrial materials and that the ratio is variant both between and within samples. As most samples used for chronology have insufficient amounts of U to determine a precise isotopic composition, the U-Pb geochronology community has informally adopted the recommended value of 137.818 ± 0.045 based on a single data set of 44 zircons by Hiess et al. (2012). To evaluate the robustness of this value and the true range of U isotopic compositions in U-bearing minerals, we have measured the U isotopic composition of 28 bulk zircon samples as well as several co-existing accessory minerals from rocks with a wide range of ages and geographical distributions. The $^{238}U/^{235}U$ ratio of 137.817 ± 0.031 represents the mid-point value of our data with an uncertainty that includes all 28 zircon populations analyzed and their respective uncertainties. This value is indistinguishable from the previously recommended value but with a smaller uncertainty that may reflect the refined analytical methods employed in our study. This result provides confidence to the U-Pb geochronology community that the value recommended by Hiess et al. (2012) is appropriate and that their stated uncertainty appears to be conservative. We find variability in the $^{238}U/^{235}U$ ratio of coexisting phases within single samples of up to 2.9 ε-units (parts per 10,000). In addition, our range of U isotopic compositions for zircon is heavier than that reported for bulk continental crust in general and most granitoid intrusive rocks specifically. We attribute these observations to differences in the coordination environment of U in zircon and other U-bearing