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The Uranium Isotopic Composition of the Solar System

Goldmann*, A., Brenneka, G., Noordmann, J., Weyer, S., Wadhwa, M., Zipfel, J. *Leibniz Universität Hannover, Institut für Mineralogie, Callinstr. 3, DE-30167 Hannover a.goldmann@mineralogie.uni-hannover.de.

The $^{238}\text{U}/^{235}\text{U}$ ratio was assumed to be constant (137.88) until recent studies found significant variations in terrestrial samples and meteorites (e.g. [1], [2]). Knowing the precise $^{238}\text{U}/^{235}\text{U}$ ratio is an essential factor for accurate U-Pb dating [3].

In this study, we report high precision MC-ICPMS analyses of 40 bulk meteorites including H-, L-/LL-, C-chondrites and several achondrites.

Our results show an overall homogeneous distribution of $^{238}\text{U}/^{235}\text{U}$ among solar system reservoirs, identical with that of the bulk Earth. However, some individual samples display significant U isotope variations. These are generated by (1) decay of live ^{247}Cm in CAIs (observed only for Allende samples[2]). (2) evaporation-related or (3) low temperature alteration-related U isotope fractionation. We suggest a revised $^{238}\text{U}/^{235}\text{U}$ ratio of 137.80 for the solar system, resulting in an average age correction for U-Pb dating of ~1 Ma.

[1] Weyer, S. et al. (2008) GCA 72, 345-359 [2]

Brenneka, G. et al. (2010) Science 327, 449-451. [3]

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