TRIPLE-OXYGEN ISOTOPE COMPOSITION OF MOLDAVITES AND IRGHIZITES: CLUES FOR SOURCE MATERIALS OF TEKTITES AND OTHER IMPACT-RELATED GLASSES

T. Magna[1], K. Žák[2], A. Pack[3], L. Ackerman[2], R. Skála[2], Š. Jonášová[2], J. Ďurišová[2], Z. Řanda[4], J. Mizera[4]
[1]Czech Geological Survey, Prague, Czech Republic. E-mail: tomas.magna@geology.cz. [2]Institute of Geology AS CR, Prague, Czech Republic. [3]University of Göttingen, Germany. [4]Nuclear Physics Institute AS CR, Řež, Czech Republic.

Introduction: Tektites are distal ejecta formed by melting of the uppermost surface layers of the target area and usually lack any trace of the impactor (see [1] for a review). Moldavites are tektites from the Central European strewn field, genetically related to ~14.7 Ma Ries impact structure in Germany. Irghizites, usually ~0.5 to ~2 cm large glassy tektite-like objects, are genetically linked with ~1 Ma Zhamanshin impact structure in Kazakhstan, Central Asia. Two morphological and chemical types of irghizites have been recognized [2, 3], more acidic (up to 72–75 % SiO_2), typically formed by coalescence of small (<1 mm) glass droplets, and more basic (down to 53–56 % SiO_2), where the droplets are not apparent. The former irghizite type shows elevated contents of Ni, Cr and other elements, in particular in surface layers of the glass droplets, while the latter type is not Ni-enriched. To test the applicability of high-precision triple-oxygen isotope analysis in determining the extra-terrestrial component [4], selected moldavites and irghizites were investigated in order to elucidate their origin. The samples have further been characterized by INAA, EMPA and LA-ICPMS.

Results and conclusions: Considering a wide range in moldavite chemical types analyzed here, the obtained $\delta^{18}O_{V\text{-}SMOW}$ variability from 9.4 to 12.6‰ is larger than that found earlier [5] (11.1–11.9‰). The $\delta^{18}O$ values correlate positively with Ca and Mg contents, supporting a mixture of a traditionally considered quartz sand, clay and carbonate components. The $\Delta^{17}O$ values between –0.120 and –0.146‰ fall into the field of terrestrial upper crustal field [4] and do not imply detectable meteoritic component in moldavites. This is in agreement with extremely low abundances of highly siderophile elements. On the contrary, oxygen isotope data of acidic and basic irghizites vary significantly, forming a clear linear trend in the $\delta^{18}O$ vs. $\Delta^{17}O$ plot. The basic irghizite specimen ($\delta^{18}O_{V\text{-}SMOW}$ = 8.0‰, $\Delta^{17}O$ = –0.118‰) differs from the acidic irghizites ($\delta^{18}O_{V\text{-}SMOW}$ from 11.9 to 14.4‰, $\Delta^{17}O$ between –0.195 and –0.248‰). The acidic irghizites with low $\Delta^{17}O$ values have high Ni contents exceeding in some cases 2,000 ppm Ni. This indicates a presence of a meteoritic component in acidic irghizites but the identification and exact quantification of projectile [e.g. 3] requires further oxygen isotope data, paralleled by analyses of other tracers of extra-terrestrial contributions.

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