Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37319

# The thermal history of Haughton impact structure, Canada: constrains from clumped isotope thermometry

**XIANYE ZHAO**[1], INIGO ANDREAS MÜLLER[1], SWAGATA CHAUDHURI[1], GORDON R. OSINSKI[2] AND PHILIPPE CLAEYS[1,3]

[1]Archaeology, Environmental Changes and Geo-Chemistry (AMGC), Vrije Universiteit Brussel
[2]University of Western Ontario
[3]University of British Columbia

Impact cratering is a ubiquitous process in the Solar System with implications for planetary evolution and the origin of life. Therefore, it is important to understand cratering process. Synthesizing crater post-impact cooling behavior across a range of sizes, settings (terrestrial versus marine), and target rock lithologies is essential. The use of carbonate clumped isotopes provides a new approach to constrain crater thermal history and to validate widely used numerical simulations, yet some fundamental uncertainty remains: (1) kinetic fractionation effect on $\Delta_{47}$ based temperature and (2) intensity difference of the post-impact fluid activity between contrasting impact settings (e.g., marine versus terrestrial, and diameter of the impact craters). Here, clumped isotope is applied to impactites from the Haughton impact structure on Devon Island, Canada. The target rock of the Haughton structure mainly consists of carbonate minerals (Paleozoic marine sediments), providing material well-suited for $\Delta_{47}$ analyses. Moreover, the terrestrial Haughton structure provides a complementary endmember and a useful basis for comparing the intensity of post-impact fluid activity across contrasting impact settings (marine versus terrestrial). In this study, multiple impactite lithologies are examined. Calcite- and dolomite minerals are first micro-sampled separately based on X-Ray Fluorescence results. Novel dual clumped isotopes data ($\Delta_{47}$–$\Delta_{48}$) suggest that the impactites preserve equilibrated clumped isotope signatures with no significant kinetic bias. The highest apparent equilibrium temperature 334.9 (+81.4/-58.0) °C is identified in calcite clast preserved within the impact melt rock. The lowest value -0.4 (+11.9/-10.5) °C is observed in the impact melt rock, which points to a near-freezing temperature, consistent with the low-temperature characteristics of Devon Island in the Arctic region. Combining $\delta^{13}C$ and $\delta^{18}O$ data, further constrains the impact-related thermal history and the intensity of fluid activity at the Haughton impact structure. It seems that the clumped isotope signatures of the studied samples show limited evidence of hydrothermal activity at Haughton.