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A global compilation of known-origin keratin hydrogen and oxygen isotope data for wildlife and forensic research

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Variations in stable hydrogen (δ^2H) and oxygen ($\delta^{18}O$) isotope ratios have been used in wildlife and forensic applications to infer the provenance of biological tissues by comparing isotopic measurements for unknown samples to geographically indexed measurements or predictions. Tissues composed of the structural protein keratin have been targeted in many systems, leading to a legacy of published data for known-origin samples. An open synthesis of these data would be useful to support broader analysis of keratin isotope patterns across biological systems and as a reference data collection for future studies.

Significant differences in sample preparation and analysis protocols and calibration and normalization approaches among laboratories have created substantial challenges in the integration of these data, however. Here we identify and assess factors that might be limiting comparability of δ^2H and $\delta^{18}O$ data among laboratories. These include sample type and sampling method, procedure for lipid extraction, whether and how partial exchange of keratin H with atmospheric moisture has been addressed, which laboratory reference materials have been used, drying and handling protocols, analysis method, and quality of chromatography for O isotopic analyses. We compile a list of reference materials (including Utah, USGS, and Saskatoon standards) and their established values, and develop a set of 'rules' and corrections to account for differences in processing methods and standards as well as the associated uncertainty. We apply these corrections to more than 2500 known-origin data from the literature and demonstrate that the comparability of isotopic data among laboratories is greatly improved by linking all measurements to the same scales. We highlight both the potential of the harmonized dataset for use in wildlife and forensic research as well as substantial challenges and limitations that remain.