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A novel method for analyzing $\delta^{18}O$ by laser ablation IRMS

Elina Sahlstedt[1], Neil Loader[2], and **Katja Rinne-Garmston**[1]
[1]Stable Isotope Laboratory of Luke (SILL), Natural Resources Institute Finland, Helsinki, Finland (katja.rinne-garmston@luke.fi, elina.sahlstedt@luke.fi)
[2]Department of Geography, College of Science, Swansea University, Swansea SA2 8PP, UK (n.j.loader@swansea.ac.uk)

Fine-scale variations in the oxygen isotope composition ($\delta^{18}O$) of organic matrices, such as tree rings, provide an important proxy for past environmental conditions. In practice, however, sampling at high resolution is resource intensive and time consuming, requiring the precise cutting, processing, and weighing of sequential samples prior to mass spectrometry. These factors have limited the production of high-resolution $\delta^{18}O$ data for research purposes. We have developed a novel method for analyzing $\delta^{18}O$ in organic matrices using laser ablation mass spectrometry. This “online” method directly couples a UV laser ablation unit with an isotope ratio mass spectrometer (IRMS). Measurements are conducted on carbon monoxide (CO) gas produced during the laser ablation process. Thus, we sidestep the requirement for separate sample cutting and weighing steps and can take advantage of the high resolution and accurate positioning capabilities of the laser with significantly increased sample throughput and effectively non-destructive sampling. Preliminary results, conducted by analyzing woody materials, indicate a typical measurement precision of ≤0.5 ‰ at spatial resolution of 100µm (spot size). Running a single analysis with the new method takes approximately 15 minutes, which is comparable to a $\delta^{18}O$ analysis run by conventional, thermal conversion IRMS. In the future, the new method is expected to provide a valuable tool for investigating fine-scale variation in $\delta^{18}O$ in organic matrices.