

A novel laser melting sampler for discrete, sub-centimeter depth-resolved analyses of stable water isotopes in ice cores

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We developed a novel laser melting sampler (LMS) for ice cores to measure the stable water isotope ratios ($\delta^{18}\text{O}$ and δD) as temperature proxies at sub-centimeter depth resolutions. In this LMS system, a 2 mm diameter movable evacuation nozzle holds an optical fiber through which a laser beam irradiates the ice core. The movable nozzle intrudes into the ice core, the laser radiation meanwhile melts the ice cylindrically, and the meltwater is pumped away simultaneously through the same nozzle and transferred to a vial for analysis. To avoid isotopic fractionation of the ice through vaporization, the laser power is adjusted to ensure that the temperature of the meltwater is always kept well below its boiling point. A segment of a Dome Fuji shallow ice core (Antarctica), using the LMS, was then demonstrated to have been discretely sampled with a depth resolution as small as 3 mm: subsequent analysis of $\delta^{18}\text{O}$, δD , and deuterium excess (d) was consistent with results obtained by hand segmentation within measurement uncertainties. With system software to control sampling resolution, the LMS will enable us to identify temperature variations that may be detectable only at sub-centimeter resolutions in ice cores.

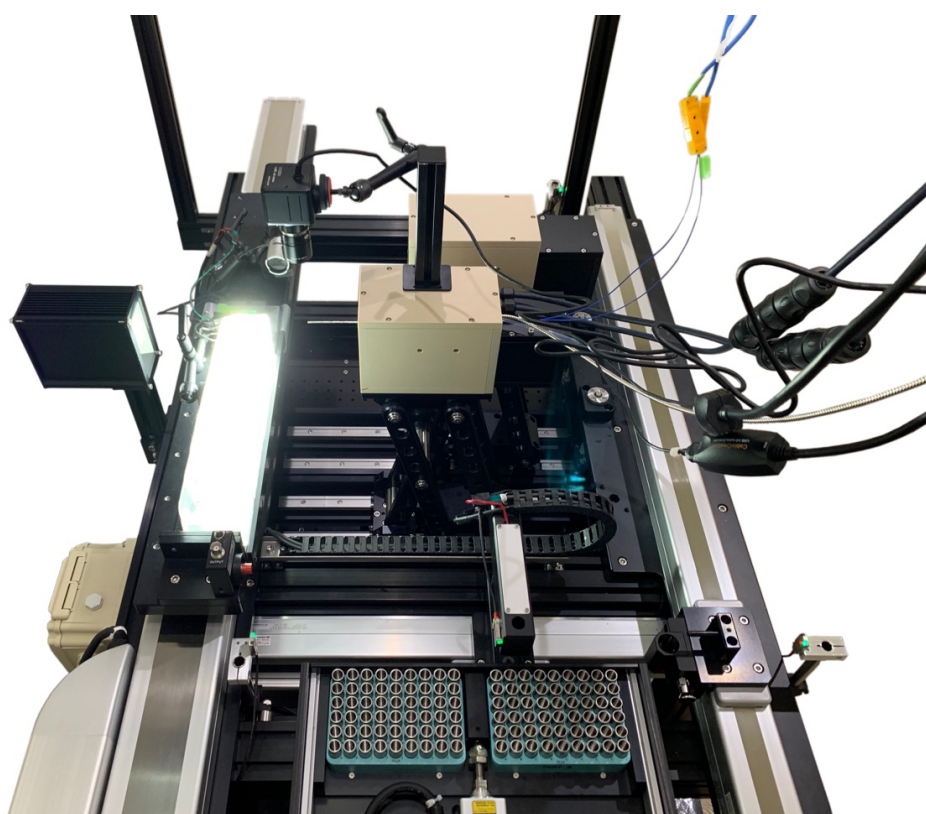


Figure 1. Photograph of the RIKEN-LMS (Laser Melting Sampler) for ice cores.

References

Motizuki, Y., Y. Nakai, K. Takahashi, J. Hirose, Y.V. Sahoo, M. Yumoto, M. Maruyama, M. Sakashita, K. Kase, S. Wada, H. Motoyama and Y. Yano, A novel laser melting sampler for discrete, sub-centimeter depth-resolved analyses of stable water isotopes in ice cores, *Journal of Glaciology*, in press.