A new approach to mapping isotopic ratio of hydrogen (D/H) using polyatomic ions with the NanoSIMS ion microprobe

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Ion microprobes, based on the principle of secondary ion mass spectrometry (SIMS), are reference techniques for performing in situ microanalysis of solid samples. The NanoSIMS is an ion microprobe combining efficient collection of secondary ions and a mass spectrometer with parallel detection capabilities aiming to limit the information loss related to the destructive nature of the method. However, for light element as hydrogen, simultaneous recording of D^-/H^- ratio and isotopic compositions of heavier elements is beyond the limit of mass tuning range.

To overcome such limitation, we present a new approach to accessing opportunities expected from polyatomic secondary ions. With an improved mass selectivity of the spectrometer, it is possible to perform D/H ratio measurement using $^{12}CD^-/^{12}CH^-$, $^{16}OD^-/^{16}OH^-$, or $^{12}C_2D^-/^{12}C_2H^-$ ratios while allowing recording of isotopic compositions of heavier elements like $^{15}N/^{14}N$ (via $^{12}C^{15}N^-/^{12}C^{14}N^-$) in parallel thus provides a powerful tool to select the phase of interest (e.g., mineral versus organics). High mass resolution spectra and an example of isotopic imaging where D/H ratios were obtained via the $^{12}C_2D^-/^{12}C_2H^-$ ratio with $^{12}C_2D^-$ free from neighboring mass interferences will be presented. This method used in materials science, geochemistry and cosmo-chemistry, opens up many opportunities for the localization and analysis of biological molecules otherwise complex to be accurately tracked *in cellulo*. Thus, cellular distribution and metabolism of biomolecules, such as structural lipids or steroid hormones, could be studied by molecular labeling by using deuterated metabolic precursors.