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Effect of crater depth on data precision in SIMS isotopic analyses

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Secondary Ion Mass Spectrometry (SIMS) is known to be sensitive to surface conditions (such as polishing quality, surface relief, and coatings) primarily resulting from the preparation stage, and to the depth of the crater generated during analysis, a factor that significantly influences the quality of the data. The depth of the crater is closely tied to the sputtering ("digging") rate, which varies across different minerals under the same primary beam density. As the crater deepens, it can affect the secondary ion signal intensities during analysis, leading to variations in both inter-elemental and isotopic ratios, commonly in a consistent direction, thereby increasing the size of their associated uncertainties. This effect is more pronounced with the recent development of high brightness (high beam density) ion sources, which typically produces narrower but deeper pits.

In this study, we present a series of examples illustrating the effect of crater depth (measured using a White Light Interferometer) on various isotopic systems. These include U-Pb (zircon, apatite, monazite, baddeleyite), oxygen (zircon, apatite, olivine, barite, anhydrite, glasses, carbonates), and sulfur (pyrite, chalcopyrite, pyrrhotite, pentlandite, barite, anhydrite) isotopes, analyzed under routine conditions using the Cameca IMS-1280.