

VisualbetaAge: An Iolite-based data reduction approach for the LA-ICP-MS/MS *in situ* β -decay geochronology

SHITOU WU¹ AND YUE-HENG YANG²

¹Institute of Geology and Geophysics, Chinese Academy of Sciences

²College of Earth and Planetary Science, University of Chinese Academy of Sciences

The advent of inductively coupled plasma tandem mass spectrometry (ICP-MS/MS) has enabled the online separation of isobaric isotopes, such as distinguishing ^{176}Hf from ^{176}Lu and ^{176}Yb . When coupled with a laser ablation (LA) system, ICP-MS/MS facilitates *in situ* β -decay geochronology. This technique is rapidly evolving and has been applied to a variety of mineral phases for Rb-Sr, Lu-Hf, K-Ca, and Re-Os systems, significantly broadening the scope of *in situ* geochronology beyond the traditional U-Pb system. In this study, we introduce "VisualbetaAge," an Iolite-based data reduction approach tailored for LA-ICP-MS/MS β -decay geochronology. It comprises a data reduction scheme (DRS) within Iolite (a general mass spectrometry data analysis tool) as well as visualization routines. Key features of VisualbetaAge include: (1) **Downhole fractionations correction:** The method allows for the monitoring and correction of downhole fractionations (DHF) of parent-to-daughter ratios. For the Rb-Sr system, while internal precision is improved, accuracy remains limited due to varying DHF patterns across different matrices. (2) **Simultaneous multiple system data reduction:** VisualbetaAge can process multiple geochronological systems concurrently, such as Rb-Sr and K-Ca in muscovite ($\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$), as well as Lu-Hf and Pb-Pb in gadolinite ($\text{Y}_2\text{FeBe}_2\text{Si}_2\text{O}_{10}$). (3) **Live isochron visualization:** The tool provides the capability to display one or multiple live (inverse) isochron diagrams, allowing users to visualize data with custom designed integration intervals. Isochron ages are calculated in real-time, either with anchored or unanchored initial values, offering immediate feedback on data accuracy and precision, and the identification of disturbed systems. Meanwhile, it enables the correction of isobaric interferences on targeted isotopes in mass-shift positions, particularly relevant in systems like Re-Os. It also supports online matrix effect correction using matrix-matched reference materials. VisualbetaAge thus represents advancement in the field of *in situ* geochronology, providing a robust and versatile tool for the analysis of β -decay systems.