# Improving accuracy on ancient zircon crystallization ages using LA-ICP-MS traverses: example from the Acasta gneisses

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Zircon U-Pb geochronology is arguably the most developed and most reliable dating technique in Earth Sciences [1]. Technical, analytical, and methodological breakthrough made over the last decades enabled outstanding improvements in precision, accuracy, and spatial resolution on the dating of zircon by the U-Pb isotope system [1]. Zircon has also long been known to be the victim of what makes its success in geochronology, namely its high U and Th content that, over time, damages the zircon lattice and compromises its capacity to retain pristine isotopic and chemical information [2]. One detrimental resulting effect is ancient Pb-loss because it results in a loss of information regarding primary crystallization which is usually preserved in the present-day $^{207}Pb/^{206}Pb$ ratio. This information can, nevertheless, be uncovered by U-Pb Discordia lines. However, in most dating approaches, zircons, or zones within zircons, are only analyzed once because the philosophy is to target the best preserved domain(s) so as to obtain the most reliable dates that supposedly pertain to primary crystallization.

The present work investigates the capability of traverses by LA-ICP-MS to identify zones of well-preserved U-Pb isotope systematics, within single zircon crystals, that can be further used to construct Discordia lines for each crystal. These lines provide age information about the crystallization and disturbance(s) experienced by zircons at the scale of single crystals. To test our approach, we have analyzed numerous zircons from three 3.96-3.98 Ga Acasta gneisses previously analyzed by Guitreau et al. [3]. Our results demonstrate that LA-ICP-MS traverses can effectively unravel crystallization and, in some cases, disturbance histories of single zircons. This method is particularly relevant to complex igneous zircon populations and detrital zircons, notably when Hf isotopes are also investigated as they depend greatly on robust age establishment.

[1] Schoene (2014), Treat. on Geoch., 2nd ed., ch. 4.10, Elsevier, Oxford.; [2] Holland and Gottfried (1955), Acta cryst. 8; [3] Guitreau et al. (2012), EPSL, 337-338.