Common-lead Corrected U-Pb age Dating of Perovskite by Laser Ablation Magnetic Sectorfield ICP-MS

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Perovskite is a very useful mineral for dating the age of emplacement of kimberlites and associated rocks. Conventionally, U-Pb dating of perovskite is achieved using isotope dilution (ID-TIMS) or ion-probe (SHRIMP) techniques, which are time- and cost-intensive. The potential of the rapid and inexpensive laser ablation ICP-MS technique for U-Pb dating of perovskite has been demonstrated recently. The main obstacle for obtaining accurate and precise U-Pb age dates from perovskite by laser ablation techniques based on quadrupole ICP-MS instruments is the large amount of common lead that is incorporated into perovskite and the associated difficulty to perform accurate common lead corrections due to the high mercury blanks of the gases (i.e. Ar and He) used in LA-ICP-MS. We therefore investigated the benefits (very high sensitivity, very low dark noise and a large linear dynamic range) of single collector magnetic sectorfield ICP-MS (SF-ICP-MS) instruments for U-Pb dating of perovskite by laser ablation. To this end perovskites from two kimberlites from Garnet Lake, W Greenland, and Pyramidefjeld, SW Greenland, have been separated. Multigrain aliquots of both perovskite separates were U-Pb dated by ID-TIMS, yielding emplacement ages of 568 $\pm$11 Ma for the Garnet Lake kimberlite and 151$\pm$2 Ma for the Pyramidefjeld kimberlite. After embedding in epoxy, grinding and polishing, multiple perovskite grains from both samples have been dated in-situ with high spatial resolution (spot analyses using a 30 μm beam diameter) by laser ablation employing a ThermoFinnigan Element2 SF-ICP-MS coupled to a NewWave UP 213 laser system. A common lead correction was applied based on the measured ^{204}Pb intensity (after correction for the measured ^{204}(Pb+Hg) gas blank). Perovskite from the Ice River Complex, British Columbia, was used as a secondary standard for quality control purposes. Multiple in-situ measurements of the Ice River perovskite in two different analytical sessions yielded concordia ages of 359$\pm$3 Ma and 357$\pm$3 Ma, in excellent agreement with the age of 356 Ma determined by ID-TIMS (Heaman, *pers. comm.*). Nineteen in-situ analyses of perovskite grains extracted from the Garnet Lake kimberlite yielded a concordia age of 566$\pm$5 Ma, also in excellent agreement with the age obtained by ID-TIMS. Because of the very low Pb contents in perovskites from the Pyramidefjeld (around 1 ppm) and the associated large uncertainties of the common lead correction, no concordia age could be obtained. However, the in-situ laser ablation analysis yielded a common lead corrected weighted average ^{206}Pb/^{238}U age of 152$\pm$3 Ma which is again in excellent agreement with the weighted average ^{206}Pb/^{238}U age of 152$\pm$2 Ma obtained by ID-TIMS. We therefore conclude that laser ablation SF-ICP-MS is a fast and inexpensive method for precise and accurate common lead corrected U-Pb dating of perovskite, and hence diamond exploration.

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