Analytical procedures for zircon, rutile, and monazite dating

In situ isotope analyses were performed using an inductively coupled plasma mass spectrometer connected to a laser ablation device in Clermont-Ferrand (France) and Pavia (Italy).

In Pavia, U–Th–Pb analyses on zircon were carried out at the Istituto di Geoscienze e Georisorse (CNR, Unità di Pavia). Analytical procedures are reported in detail in Tiepolo (2003) and Paquette and Tiepolo (2007). The LA-ICPMS instrument couples an Argon Fluoride 193 nm excimer laser (type GeoLas 102 from MicroLas) with a sector field ICP-MS (type Element I from ThermoFinnigan). The spot size was 30 μm in diameter with an energy density of 12 J/cm^2 and a repetition rate of 3 Hz.

In Clermont-Ferrand, U–Th–Pb analyses on zircon, rutile, and monazite were carried out at the Laboratoire Magmas et Volcans. The LA-ICPMS instrument couples a 193 nm excimer laser (Resonetics/M-50E) with a Q-ICP-MS (Agilent 7500cs). The spot size was 20 or 25 μm for zircon, 25 μm for rutile, with an energy density of 6 J/cm^2 and a repetition rate of 3 Hz. For monazite, the spot size was 11 μm with an energy density of 15 J/cm^2 and a repetition rate of 1 Hz.

In both laboratories, time resolved signals were carefully inspected to verify the presence of perturbations related to inclusions, fractures, mixing of different age domains or common Pb. Laser induced elemental fractionation and mass bias were corrected using a matrix matched external standard: Zircon 91500 (Wiedenbeck et al. 1995), Moacir monazite (Seydoux-Guillaume et al. 2002a, 2002b), and, for rutile, Zircon GJ-1 (Jackson et al. 2004). To ensure the efficient correction of fractionation effects, external standards and unknowns were integrated over the same time intervals. Data reduction was carried out with the GLITTER software developed by van Achterbergh et al. (2001). In order to better estimate the uncertainty affecting the $^{206}Pb/^{238}U$, $^{207}Pb/^{235}U$, and $^{208}Pb/^{232}Th$ ratios, the individual uncertainties given by GLITTER® for the isotope ratios were propagated relative to the respective external reproducibility of the standard.

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