Electronic Appendix B. Description of the analytical methods

Methodology for the geochemical analyses

The whole-rock analyses were conducted by ALS in their laboratories in Outokumpu (Finland) and Loughrea (Ireland). Samples were analysed for oxide contents from fused discs with XRF. LOI for XRF was determined at 1000 °C. The majority of the trace elements were analysed from lithium borate fusion with ICP-MS. Some base metals (Li, Sc, Co, Cu, Zn, Mo, Ni, Ag, Cd, Pb) were analysed with ICP-AES after 4-acid dilution. The total carbon and sulphur contents were analysed using IR spectroscopy with LECO.

Methodology for U–Pb zircon analyses

Rock samples were washed and dried. They were cut with a guillotine to less than 9 cm pieces. These pieces were then crushed in a jaw crusher. After jaw crushing, pieces without weathering surfaces or visible alteration were chosen and washed in an ultrasonic bath for 15 minutes. Dried pieces were then sequentially milled with a Retch RS200 swing mill with a tungsten carbide head. Operation times were approximately only 10 seconds per batch to avoid breaking individual grains. The milled material was sieved with a 0.4 mm sieve and fine dust was washed out. Dried samples were then separated with a heavy liquid CH_2I_2 (density 3.3 g/cm^3). When the heavy mineral yield was high, samples were further separated by Frantz isodynamic magnetic separator (slope 24°, tilt 12°, current 1.5 A). The selected zircon grains were then mounted in epoxy resin, sectioned approximately in half and polished. Back-scattered electron (BSE) and cathodoluminescence (CL) images were taken from zircons using SEM.

The samples were analysed using an LA–SC–ICP–MS (laser ablation single collector inductively coupled plasma mass spectrometry) instrument composed of a Nu Plasma AttoM single collector ICP-MS connected to a Photon Machine Excite 193nM ArF laser ablation system.

Samples were ablated in He gas (gas flows = 0.4 and 0.1 l/min) within a HelEx ablation cell (Müller et al. 2009). The He aerosol was mixed with Ar prior to entry into the plasma. For samples A2568-A2570, the Ar flow was 0.94 l/min, and for samples A2572-A2577 it was 0.93 l/min. Ablation conditions were: beam diameter: 25 µm, pulse frequency: 5 Hz, beam energy density: 2.54 J/cm^2 for samples A2568-A2570 and 2.90 J/cm^2 for samples A2572-A2577. A single U–Pb measurement included a short pre-ablation with a 35 µm laser beam, 20 s of He flushing, 15 s of on-mass background measurement, followed by 40 s of ablation with a stationary beam. ^{235}U was calculated from the signal at mass 238 using a natural ^{238}U/^{235}U=137.88. Mass number 204 was used as a monitor for common ^{204}Pb. In an ICPMS analysis, ^{204}Hg mainly originates from the He supply. The observed background counting-rate on mass 204 was 150-200 cps, and has been stable at that level over the last several years. The contribution of ^{204}Hg from the plasma was eliminated by on-mass background measurement prior to each analysis. Age related common lead (Stacey and Kramers 1975) correction was used when the analysis showed common lead contents significantly above the detection limit. Signal strengths on mass 206 were typically ~200000–300000 cps, depending on the uranium content and age of the zircon.

Zircon GJ-1 (609 ± 1 Ma; Horstwood et al., 2016) was used as a calibration standard, and an in-house reference zircon A1772 (2712 ±2 Ma, Huhma et al. 2012) was used as a secondary standard. In-house reference sample A382 (1877±2 Ma, Patchett & Kouvo 1986, Huhma et al. 2012) and Plesoviče standard zircon (338 Ma; Sláma et al. 2008) were run as unknowns for quality control. Raw data were corrected for the background, laser induced elemental fractionation, mass discrimination and drift in ion counter gains and reduced to U–Pb isotope ratios by calibration to concordant reference zircons, using the program Saturn (Silva et al. 2023). To minimize the effects of laser-induced elemental fractionation, the depth-to-diameter ratio of the ablation pit was kept low, and isotopically homogeneous segments of the time-resolved traces were calibrated against the corresponding time interval for each mass in the reference zircon. The $^{206}Pb_c$ percentages were calculated based on $^{206}Pb/^{204}Pb$ ratios, the respective isotope masses and the modelled isotope composition of common Pb according to Stacey and Kramers (1975). The discordances were calculated with IsoplotR (Vermeesch 2018), using concordia distance method recommended by Vermeesch (2021), as it results in the least biased datasets. In notation used by IsoplotR, the analyses below the concordia line of a Wetherill plot (normal discordance) yield positive discordance values, while the analyses above that concordia line (reverse discordance) yield negative values.

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