Laboratory & Sample Preparation	
Laboratory name	Geochronology & Tracers Facility, NERC Isotope Geosciences
	Laboratory
Sample type/mineral	Zircon, titanite, allanite
Sample preparation	Conventional mineral separation, 1 inch resin mount, 1 µm polish
	to finish
Imaging	CL and BSE, FEI Quanta 600
Laser ablation system	
Make, Model & type	ESI/New Wave Research, UP193FX
Ablation cell &	low-volume teardrop cell
volume	
Laser wavelength	193nm
(nm)	
Pulse width (ns)	4ns
Fluence (J.cm <sup>-2</sup> )	2 J/cm <sup>-2</sup>
Repetition rate (Hz)	5 Hz
Spot size (µm)	Variable – e.g. 25 µm (zircon), 35 µm (titanite and allanite)
Sampling mode /	Static spot
pattern	
Carrier gas	100% He, Ar make-up gas from DSN-100 combined using a Y-
	piece 50% along sample line.
Ablation duration	30secs
(secs)	
Cell carrier gas flow	0.51/min
(l/min)	
× /	
<b>ICP-MS Instrument</b>	
ICP-MS Instrument Make, Model & type	Nu Instruments, Attom, SC-ICP-MS
<b>ICP-MS Instrument</b> Make, Model & type Sample introduction	Nu Instruments, Attom, SC-ICP-MS Ablation aerosol
<b>ICP-MS Instrument</b> Make, Model & type Sample introduction RF power (W)	Nu Instruments, Attom, SC-ICP-MS Ablation aerosol 1300W
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min)	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar   Single Mascom SEM
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 µs to 800 µs per peak
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms)	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 µs to 800 µs per peak
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 µs to 800 µs per peak0.35 sec
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 µs to 800 µs per peak0.35 sec(should represent the time resolution of the data)
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs)	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 µs to 800 µs per peak0.35 sec (should represent the time resolution of the data)
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity /	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 µs to 800 µs per peak0.35 sec(should represent the time resolution of the data)~0.2% U
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%,	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 µs to 800 µs per peak0.35 sec(should represent the time resolution of the data)~0.2% U
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element)	Nu Instruments, Attom, SC-ICP-MS Ablation aerosol 1300W 0.71/min Ar Single Mascom SEM 202, 204, 206, 207, 208, 232, 235 Dwell times of 200 µs to 800 µs per peak 0.35 sec (should represent the time resolution of the data) ~0.2% U
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element) IC Dead time (ns)	Nu Instruments, Attom, SC-ICP-MSAblation aerosol1300W0.71/min ArSingle Mascom SEM202, 204, 206, 207, 208, 232, 235Dwell times of 200 μs to 800 μs per peak0.35 sec(should represent the time resolution of the data)~0.2% U15 ns
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element) IC Dead time (ns) Data Processing	Nu Instruments, Attom, SC-ICP-MS Ablation aerosol 1300W 0.7l/min Ar Single Mascom SEM 202, 204, 206, 207, 208, 232, 235 Dwell times of 200 µs to 800 µs per peak 0.35 sec (should represent the time resolution of the data) ~0.2% U 15 ns
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element) IC Dead time (ns) Data Processing Gas blank	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar   Single Mascom SEM   202, 204, 206, 207, 208, 232, 235   Dwell times of 200 µs to 800 µs per peak   0.35 sec   (should represent the time resolution of the data)   ~0.2% U   15 ns   30 second on-peak zero subtracted
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element) IC Dead time (ns) Data Processing Gas blank Calibration strategy	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar   Single Mascom SEM   202, 204, 206, 207, 208, 232, 235   Dwell times of 200 µs to 800 µs per peak   0.35 sec   (should represent the time resolution of the data)   ~0.2% U   15 ns   30 second on-peak zero subtracted   Primary reference material: 91500 (zircon), Ont-2 (titanite), 40010
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element) IC Dead time (ns) Data Processing Gas blank Calibration strategy	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar   Single Mascom SEM   202, 204, 206, 207, 208, 232, 235   Dwell times of 200 µs to 800 µs per peak   0.35 sec   (should represent the time resolution of the data)   ~0.2% U   15 ns   30 second on-peak zero subtracted   Primary reference material: 91500 (zircon), Ont-2 (titanite), 40010 (allanite)
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element) IC Dead time (ns) Data Processing Gas blank Calibration strategy	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar   Single Mascom SEM   202, 204, 206, 207, 208, 232, 235   Dwell times of 200 µs to 800 µs per peak   0.35 sec   (should represent the time resolution of the data)   ~0.2% U   15 ns   30 second on-peak zero subtracted   Primary reference material: 91500 (zircon), Ont-2 (titanite), 40010 (allanite)   See manuscript.
ICP-MS Instrument Make, Model & type Sample introduction RF power (W) Make-up gas flow (l/min) Detection system Masses measured Integration time per peak (ms) Total integration time per reading (secs) Sensitvity / Efficiency (%, element) IC Dead time (ns) Data Processing Gas blank Calibration strategy Reference Material info	Nu Instruments, Attom, SC-ICP-MS   Ablation aerosol   1300W   0.71/min Ar   Single Mascom SEM   202, 204, 206, 207, 208, 232, 235   Dwell times of 200 µs to 800 µs per peak   0.35 sec   (should represent the time resolution of the data)   ~0.2% U   15 ns   30 second on-peak zero subtracted   Primary reference material: 91500 (zircon), Ont-2 (titanite), 40010 (allanite)   See manuscript.

package used /	using Nu Instruments TRA software
Correction for LIEF	
Mass discrimination	Standard sample bracketing
Common-Pb	None applied to zircon.
correction,	Regression for allanite and titanite. <sup>207</sup> Pb based correction
composition and	assuming concordance for allanite and titanite <sup>206</sup> Pb/ <sup>238</sup> U ages.
uncertainty	
Uncertainty level &	Ages are quoted at 2sigma absolute, propagation is by quadratic
propagation	addition. Excess variance of reference material propagated into
	sample data. Systematic uncertainties include age uncertainty of
	reference material.
Quality control /	See supplementary data.
Validation	
Other information	