Warren et al, Supplementary Information

NIGL analytical details

Laboratory & Sample Preparation	
Laboratory name	NERC Isotope Geosciences Laboratory
Sample type/mineral	Monazite
Sample preparation	In-situ on polished thin sections
Imaging	X-ray mapping using Electron-Probe MicroAnalysis (EPMA)-Open University, U.K.
Laser ablation system	
Make, Model & type	ESI/New Wave Research, UP193SS
Ablation cell & volume	NWR two-volume 'large format cell' with low effective volume (ca. 3-4cm^3), washout time ca.<1sec
Laser wavelength (nm)	193nm
Pulse width (ns)	3-4ns
Fluence (J.cm^{-2})	~2.5 J.cm^{-2}
Repetition rate (Hz)	5Hz
Ablation duration (secs)	30secs
Ablation pit depth / ablation rate	~15µm pit depth, measured using an optical microscope
Spot size (mm)	15 – 20µm
Sampling mode / pattern	Static spot ablation
Carrier gas	100% He, Ar make-up gas combined ca.50% along sample line.
Cell carrier gas flow (l/min)	0.7l/min
ICP-MS Instrument	
Make, Model & type	Nu Instruments Attom SC-SF-ICP-MS
Sample introduction	Free air aspiration of desolvator
RF power (W)	1300W
Make-up gas flow (l/min)	0.8l/min Ar
Detection system	Discrete dynode MassCom ion counter
Masses measured	202, 204, 206, 207, 208, 232, 235
Integration time per peak	200µs (202, 204, 206), 300µs (232, 208), 3000µs (207, 235) 40 sweeps per integration
Total integration time per reading (secs)	0.30 seconds
Sensitivity / Efficiency (%, element)	~0.27% for Uranium
IC Dead time (ns)	15ns
Data Processing	

Gas blank	60 second on-peak zero subtracted
Calibration strategy	Manangotry, Moacyr (Palin et al. 2013). Manangotry used as primary reference material for normalization, and others used as check on accuracy.
Reference Material info	Stern 512.1±1.9 Ma (2σ) ID-TIMS ^{238}U-^{206}Pb age (Palin et al. 2013) Manangotry 559±1 Ma (2σ) ID-TIMS ^{238}U-^{206}Pb age (Palin et al. 2013) Moacyr 515.6±1.4 Ma ID-TIMS ^{238}U-^{206}Pb age (Palin et al. 2013)
Data processing package used / Correction for LIEF	Nu Instruments TRA acquisition software, in-house spreadsheet data processing
Mass discrimination	$^{207}Pb/^{206}Pb$, $^{206}Pb/^{238}U$ and $^{208}Pb/^{232}Th$ normalised to reference material
Common-Pb correction, composition and uncertainty	Stacey & Kramers (1975) model composition, based on f206c, using estimated age derived from $^{206}Pb/^{238}U$ and f208c using measured $^{208}Pb/^{206}Pb$.
Uncertainty level & propagation	Ages in the data table are quoted at 2sigma absolute, propagation is by quadratic addition. Excess variance of reference material is propagated.
Quality control / Validation	*206Pb/238U ages:* Stern – 514.0±1.4 Ma (MSWD = 1.15; n=117) Moacyr – 516.0±1.7 Ma (MSWD = 1.07; n=68) *208Pb/232Th ages:* Stern – 507.1±1.5 Ma (MSWD = 1.04; n=117) Moacyr – 512.2±2.1 Ma (MSWD = 1.14; n=68)
Other information	