**Table S1 – Analytical protocol for LA-ICP-MS U-(Th)-Pb analyses (Farrant et al., 2018)**

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| --- | --- |
| **Laboratory & Sample Preparation** |  |
| Laboratory name | NERC Isotope Geosciences Laboratory |
| Sample type/mineral | Zircon |
| Sample preparation | Conventional mineral separation, 1 inch resin mount, 1um polish to finish |
| Imaging | CL, 10nA, 15 mm working distance |
| **Laser ablation system** |  |
| Make, Model & type | ESI/New Wave Research, UP193FX  |
| Ablation cell & volume | NIGL low volume cell with low effective volume (ca. 3-4cm3), washout time ca.1sec |
| Laser wavelength (nm) | 193 nm |
| Pulse width (ns) | 3-4 ns |
| Fluence (J.cm-2) | 2.0-2.5 J.cm-2 |
| Repetition rate (Hz) | 5 Hz |
| Ablation duration (secs) | 30 secs |
| Ablation pit depth / ablation rate | 16um pit depth, measured using an optical microscope and by SEM, equivalent to 0.08 μm/pulse |
| Spot size (m) | 25-35 μm |
| 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) | 0.8l/min |
| **ICP-MS Instrument** |  |
| Make, Model & type | Nu Instruments, Nu Plasma HR, MC-ICP-MS & Nu Instruments Attom SC-SF-ICP-MS |
| Sample introduction | Ablation aerosol combined with co-aspiration of desolvated Tl-235U tracer (Nu Plasma), free air aspiration of desolvator (Attom) |
| RF power (W) | 1300W |
| Make-up gas flow (l/min) | 0.7l/min Ar |
| Detection system | mixed Faraday-multiple ion counting array (Nu Plasma), discrete dynode MassCom ion counter (Attom) |
| Masses measured | 202-207, 235, 238 (Nu Plasma), 202, 204, 206, 207, (+/- 208), (+/- 232), 235 (Attom) |
| Integration time per peak (ms) | Ca.200ms  |
| Total integration time per reading (secs) | Ca.1 sec  |
| Sensitivity / Efficiency (%, element) | 0.4% U (Nu Plasma), 0.15% (Attom) |
| IC Dead time (ns) | 6, 9 & 7ns IC0, IC1 & IC2 resp. (Nu Plasma), 15ns (Attom) |
| **Data Processing** |  |
| Gas blank | 30 second on-peak zero subtracted |
| Calibration strategy | GJ-1 used as primary reference material.Plešovice & 91500 used for validation. |
| Reference Material info | 91500 (Wiedenbeck et al 1995 ; Horstwood et al., 2016)Plešovice (Sláma et al 2008 ; Horstwood et al., 2016)GJ1 (Jackson et al., 2004; Horstwood et al., 2016) |
| Data processing package used / Correction for LIEF | Nu Instruments TRA acquisition software, in-house spreadsheet data processing |
| Mass discrimination | Tl-U tracer solution used for initial mass bias correction (on Nu Plasma) with 207Pb/206Pb and 206Pb/238U additionally normalised to reference material |
| Common-Pb correction, composition and uncertainty | No common-Pb correction applied to the data |
| Uncertainty level & propagation | Ages in the data table are quoted at 2σ absolute, propagation is by quadratic addition. Reproducibility of reference material is propagated as excess variance following Horstwood et al. 2016. |
| Quality control / Validation | *Nu Attom SC-ICP-MS*206Pb/238U Plešovice = 338.4 ± 1.2 Ma (2σ, n=26/26)207Pb206Pb Plešovice = 344.7 ± 5.0 Ma (2σ, n=25/26)206Pb/238U 91500 = 1069.3 ± 5.5 Ma (2σ, n=30/30)207Pb206Pb 91500 = 1059.5 ± 4.5 Ma (2σ, n=30/30)*Nu Plasma MC-ICP-MS*206Pb/238U Plešovice = 336.3 ± 0.7 Ma (2σ, n=143/143)207Pb206Pb Plešovice = 348.7 ± 1.8 Ma (2σ, n=131/143)206Pb/238U 91500 = 1054.5 ± 2.5 (2σ, n=78/84)207Pb206Pb 91500 = 1064.6 ± 3.8 Ma (2σ, n=75/84) |
| **Other information** | *References:*Horstwood, M.S., Košler, J., Gehrels, G., Jackson, S.E., McLean, N.M., Paton, C., Pearson, N.J., Sircombe, K., Sylvester, P., Vermeesch, P. and Bowring, J.F., 2016. Community‐Derived Standards for LA‐ICP‐MS U‐(Th‐) Pb Geochronology–Uncertainty Propagation, Age Interpretation and Data Reporting. *Geostandards and Geoanalytical Research*, *40*, 311-332.Jackson, S.E., Pearson, N.J., Griffin, W.L. and Belousova, E.A., 2004. The application of laser ablation-inductively coupled plasma-mass spectrometry to in situ U–Pb zircon geochronology. *Chemical Geology*, *211*, 47-69.Sláma, J., Košler, J., Condon, D.J., Crowley, J.L., Gerdes, A., Hanchar, J.M., Horstwood, M.S., Morris, G.A., Nasdala, L., Norberg, N. and Schaltegger, U., 2008. Plešovice zircon—a new natural reference material for U–Pb and Hf isotopic microanalysis. *Chemical Geology*, *249*, 1-35.Wiedenbeck, M.A.P.C., Alle, P., Corfu, F., Griffin, W.L., Meier, M., Oberli, F., Quadt, A.V., Roddick, J.C. and Spiegel, W., 1995. Three natural zircon standards for U‐Th‐Pb, Lu‐Hf, trace element and REE analyses. *Geostandards newsletter*, *19*, 1-23. |