**Supplementary Material**

**Whole-rock geochemistry**

Samples of approximately 5–10 kg were collected and *c.* 3–5 kg of material was crushed and analysed for major and trace elements at the Central Analytical Facility, University of Stellenbosch, South Africa. Loss on ignition was calculated by placing powdered samples in an oven at 1000°C for 1 hour. Major element compositions were analysed by X-ray fluorescence spectrometry (XRF) on glass beads prepared with La-free flux. Internal standards were basalt BHVO-1 and granite NIM-G. For the granite, calculated uncertainties (twice the measured deviations for the granite standard expressed in wt.%) are: 0.35 for SiO2, 0.02 for TiO2, 0.12 for Al2O3, 0.15 for FeOT, 0.01 for MnO, 0.02 for MgO, 0.07 for CaO, 0.10 for Na2O, 0.02 for K2O and 0.01 for P2O5. Results are plotted after normalization to 100 wt.% volatile-free. Trace element compositions have been obtained from the same fused beads used for major element determination using an Agilent 7500 ICP-MS coupled with a Nd-YAG 223 nm New Wave LASER ablation (LA) system operating at a 12 Hz frequency with a mixed He-Ar carrier gas. Three analyses (each comprising a 30 s blank followed by data collection for 60 s) on each whole rock fused disc were obtained using a 100 μm diameter aperture, and the results averaged. After every three samples (i.e. every 10th analysis) NIST612 glass bead was analysed as a calibration standard, in addition to fused discs of NIM-G (granite) and BHVO-1 (basalt) that were analysed as secondary standards. Data were collected in time-resolved mode and were reduced using the SiO2 content measured by XRF as the internal standard. For each element, the reproducibility of replicate analyses of the samples, and deviation from the certified values of the secondary standards are less than 10%, and mostly less than 5 % relative. Whole-rock major and trace element compositions are presented in table SM1.

**LA-ICP-MS U–Th–Pb dating**

Zircon grains were separated from *c.* 2 kg rock samples by means of standard crushing techniques (Jaw crusher, Disc mill), manual panning and magnetic separation. Approximately 100 grains from each sample were hand-picked under a binocular microscope mounted in epoxy resins ground down and polished to expose their interior. Prior to analytical work, all grains were characterised by cathodoluminescence (CL) imaging using a scanning electron microscope JEOL JSM-6490 at Stellenbosch University. Zircon U–Pb isotope analyses were undertaken at GEUS in Copenhagen (Denmark) using an Element 2 sector field (SF) ICP–MS coupled to a New Wave Research UP-213 ultraviolet laser system and following the method described in Gerdes & Zeh (2006, 2009) and Frei & Gerdes (2009). The following masses were measured: 202Hg, 204(Hg + Pb), 206Pb, 207Pb, 208Pb, 232Th, 235U, 238U in time-resolved, peak-jumping, pulse-counting mode during 30 s background measurement followed by 30 s sample ablation. The laser was operated at a repetition rate of 10 Hz and a nominal energy output of 30%, corresponding to a laser energy of ∼0.025 mJ/pulse and a laser fluence of ∼3.5 J cm−2. Laser spot-size was 20-30 µm with a typical penetration depth of ∼15–20 µm. Signal was tuned for maximum sensitivity for Pb and U while keeping oxide production, monitored as 254UO/238U, well below 1%. With a depth penetration of ∼0.6 µms−1 and a 0.9 s integration time (=15 mass scans = 1 ratio) any significant variation of the Pb/Pb and U/Pb in the µm scale is detectable. Raw data were corrected offline for background signal, common Pb, laser-induced elemental fractionation, instrumental mass discrimination, and time-dependent elemental fractionation of Pb/U using in-house excel spreadsheets (Gerdes & Zeh 2006). The Isoplot software (Ludwig 2003) has been used for final age calculations and plotting of the results.

Laser-induced elemental fractionation and instrumental mass discrimination were corrected by normalization to the reference zircon GJ-1 (Jackson *et al.* 2004). The total offset of the measured 206Pb/238U ratio from the “true” ID TIMS value of the analysed GJ-1 grain was typically around 3–15%. Reported uncertainties (2σ) of the 206Pb/238U were propagated by quadratic addition of the external reproducibility (2SD) obtained from the standard zircon GJ-1 during the analytical session and the within-run precision of each analysis (2SE; standard error). To test the validity of the applied method and the reproducibility of the obtained age data, multiple analyses of the Plešovice reference zircons (Sláma *et al*. 2008) were performed during each analytical session. The results of the LA-SF-ICP-MS analyses for samples and secondary standards are presented in the Supplementary Material, Table SM2.

**LA-MC-ICP-MS Lu-Hf isotope analysis**

Lutetium–hafnium–ytterbium isotopes were measured at the Goethe University of Frankfurt with a Thermo-Finnigan Neptune multicollector ICP–MS coupled to a M-50 Resonetics 193 nm ArF Excimer laser system (CompexPro 102, Coherent) equipped with two-volume ablation cell (Laurin Technic, Australia), following the procedure described by Gerdes & Zeh (2006, 2009). Data were collected in static mode (172Yb, 173Yb, 175Lu, 176Hf–Yb–Lu, 177Hf, 178Hf, 179Hf, 180Hf) during 55 s of laser ablation.

When Lu-Yb-Hf isotopes were measured on previously dated crystals, the Lu-Hf 40 μm laser spot was either drilled «on top» of the 20-30 μm U-Pb laser spot or within the same zircon domain previously dated. Given the relative low number of inherited cores in the Buddusò pluton, *c.* 50% of the Lu-Hf analyses were performed on crystals which were not previously dated. In these cases, the analyses were performed on rims of oscillatory zoned crystals previously imaged by CL.

As for the U-Th-Pb analyses, the integration window was processed offline to verify the homogeneity of the ablated zircons. The isotopes 172Yb, 173Yb and 175Lu were measured during each analysis to allow corrections of isobaric interferences of Lu and Yb isotopes on mass 176. 176Lu and 176Yb were calculated using a 176Lu/175Lu ratio of 0.02656 and a 176Yb/173Yb ratio of 0.795015 (both JWG in-house values). Instrumental biases were corrected using an exponential law and 172Yb/173Yb and 179Hf/177Hf ratios of 1.35351 (mean of Chu *et al*. 2002 and Segal *et al*. 2003) and 0.7325 (Patchett *et al*., 1981) respectively. Following Fisher *et al.* (2014), the bias correction for Hf isotopes was preferentially calculated by calibration to the low-Yb/Hf reference zircons (e.g. GJ-1 and Plešovice) instead of a reference solution (i.e. JMC 475). The mass bias of Yb (βYb) isotopes typically differs from that of the Hf (βHf) with an offset of βHf/βYb, calculated for each analytical session by averaging the βHf/βYb of multiple analyses of the Temora reference material. The mass bias behaviour of Lu was assumed to follow that of Yb. For Yb-rich zircons, the βHf/βYb offset factor was determined from the mean βYb of each analysis. For Yb-poor zircon crystals, the applied correction was calculated using the βHf of each integration step divided by the average βHf/βYb offset factor of the whole analytical session. It is important to note that any under- or over-correction for Yb and Lu interference on mass 176 would result in an apparent correlation of the 176Hf/177Hf and 176Yb/177Yb ratios. The dataset presented in this study has been examined by plotting 176Hf/177Hf against 176Yb/177Yb and the results show insignificant interference by Yb, testifying of the good quality of the data. Quoted uncertainties are quadratic additions of the within-run precision and the reproducibility of the reference zircons GJ-1 (Morel *et al*. 2008), Plešovice (Sláma *et al*. 2008), Temora (Wu *et al*. 2006). Multiple analyses of the reference zircon GJ-1 yielded a 176Hf/177Hf = 0.281999 ± 19 (2SD, n = 38). Temora yielded an average 176Hf/177Hf = 0.282679 ± 27 (2SD, n = 17). Plešovice gave an average of 176Hf/177Hf = 0.282469 ± 20 (2SD, n = 20). These values agree within error with the recommended values for GJ-1 (176Hf/177Hf = 0.282000 ± 5 (2σ), Morel *et al*. 2008), Temora (176Hf/177Hf = 0.282680 ± 31 (2σ), Wu *et al*. 2006), Plešovice (176Hf/177Hf = 0.282482 ± 13 (2σ), Sláma *et al*. 2008).

On magmatic domains, initial 176Hf/177Hf were calculated using an age of 293 Ma, while initial 176Hf/177Hf for inherited cores were calculated using their individual LA–ICP–MS spot age. Epsilon Hf (εHf) were calculated using Chondritic Uniform Reservoir (CHUR) 176Lu/177Hf and 176Hf/177Hf values of 0.0336 and 0.282785 respectively (Bouvier *et al*. 2008) as well as a 176Lu decay constant of 1.867 × 10−11 year−1 (Scherer *et al*. 2001).

**References**

Bouvier, A., Vervoort, J.D. & Patchett, J.P. 2008. The Lu–Hf and Sm–Nd isotopic composition of CHUR: constraints from unequilibrated chondrites and implications for the bulk composition of terrestrial planets. *Earth and Planetary Science Letters*, **273**, 48–57

Chu, N., Taylor, R.N., Chavagnac, V., Nesbitt, R.W., Boella, R.M., Milton, J.A., German, C.R., Bayon, G. & Burton K. 2002. Hf isotope ratio analysis using multi-collector inductively coupled plasma mass spectrometry: an evaluation of isobaric interference corrections. *Journal of Analytical Atomic Spectrometry*, **17**, 1567–1574.

Fisher, C.M., Vervoort, J.D. & Hanchar J.M. 2014. Guidelines for reporting zircon Hf isotopic data by LA–MC–ICPMS and potential pitfalls in the interpretation of these data. *Chemical Geology* **363**, 125–133.

Frei, D., Gerdes, A. 2009. Precise and accurate in situ U–Pb dating of zircon with high sample throughput by automated LA-SF-ICP-MS. *Chemical Geology* **261**, 261–270

Gerdes, A., Zeh, A. 2006. Combined U–Pb and Hf isotope LA-(MC)-ICP-MS analyses of detrital zircons: comparison with SHRIMP and new constraints for the provenance and age of an Armorican metasediment in Central Germany. *Earth and Planetary Science Letters*, **249**, 47–61

Gerdes, A., Zeh, A. 2009. Zircon formation versus zircon alteration- new insights from combined U-Pb and Lu-Hf in-situ LA-ICP\_MS analyses and consequences for the interpretation of Archean zircons from the Central Zone of the Limpopo Belt. *Chemical Geology*, **261**, 230-243.

Jackson, S.E., Pearson, N.J., Griffin, W.L. & Belousova E.A. 2004. The application of laser ablation-inductively coupled plasma-mass spectrometry to in situ U–Pb zircon geochronology. *Chemical Geology*, **211**, 47–49.

Ludwig, K.R. 2003. Isoplot/Ex Version 3.00: A Geochronological Toolkit for Microsoft Excel. Berkeley Geochronology Center, Berkeley, CA.

Morel, M.L.A., Nebel, O., Nebel-Jacobsen, Y.J., Miller, J.S. & Vroon, P.Z. 2008. Hafnium isotope characterization of the GJ-1 zircon reference material by solution and laser-ablation MC-ICPMS. *Chemical Geology*, **255**, 231–235.

Patchett, P.J., Kouvo, O,. Hedge, C. E. & Tatsumoto, M. 1981. Evolution of continental crust and mantle heterogeneity: evidence from hafnium isotopes. *Contributions to Mineralogy and Petrology,* **78**, 279-297.

Scherer, E., Munker, C. & Mezger K. 2001. Calibration of the Lutetium-Hafnium clock. Science, **293**, 683–687.

Segal, I., Halicz, L. & Platzner, I.T. 2003. Accurate isotope ratio measurements of ytterbium by multiple collection inductively coupled plasma mass spectrometry applying erbium and hafnium in an improved double external normalization procedure. *Journal of Analytical Atomic Spectrometry*, **18**, 1217–1223.

Sláma, J., Košler, J., Condon, D.J., Crowley, J.L., Gerdes, A., Hanchar, J.M., Horstwood, M.S.A., Morris, G.A., Nasdala, L., Norberg, N., Schaltegger, U., Schoene, B., Tubrett, M.N. & Whitehouse M.J. 2008. Plešovice zircon — a new natural reference material for U–Pb and Hf isotopic microanalysis. *Chemical Geology*, **249**, 1-35.

Wu, F.-Y., Yang, Y.-H., Xie, L.-W., Yang, J.-H., Xu, P. 2006. Hf isotopic compositions of the standard zircons and baddeleyites used in U–Pb geochronology. *Chemical Geology*, **234**, 105–126.