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U/Pb dating of CA /non-CA treated zircons obtained by LA-ICP-MS and CA-TIMS techniques: impact for their geological interpretation

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Chemical Abrasion Isotope-Dilution Thermal Ionization Mass Spectrometry (CA-ID-TIMS) is known as a high precision technique for resolving lead loss and improving the interpretation of U/Pb zircon age data. Here, we argue that combining CA with the widely applied Laser Ablation – Inductively Coupled Plasma – Mass Spectrometry (LA-ICP-MS) improves the precision and accuracy of zircon dates, while removing the substantial parts with lead loss, reducing data scatter, providing meaningful geological interpretations.. The samples are magmatic rocks chosen from different geological time periods (one Paleozoic, one Mesozoic and three Cenozoic). All zircon separates are analysed by LA-ICP-MS before and after CA, and age data are compared with CA-ID-TIMS $^{206}Pb/^{238}U$ dates that are considered as the most accurately obtainable age. All CA-treated zircon crystals show up to 50% less data scatter compared to the non-CA treated zircon grains and thus a reduction of the calculated uncertainties is apparent. The obtained wtd average LA-ICP-MS $^{206}Pb/^{238}U$ ages of the CA-treated zircon grains are up to 4-6 % higher than those for the non-CA treated crystals, exceeding the analytical uncertainties of the LA-ICP-MS dating technique of 1-2 %. The damaged crystal parts, caused by U-decay, with lead loss are removed, so we can exclude younging from the possible geological scenarios. CA-LA-ICP-MS age data are in good agreement with the CA-ID-TIMS dates and suggest advantages of using CA-LA-ICP-MS in order to define accurate ages. The use of the CA technique for very young zircons (~0.2 Ma, Kos rhyolitic tuff, Greece) seems optional; as the obtained mean $^{206}Pb/^{238}U$ ages of non-CA and CA treated zircons coincide within the uncertainty. The negligible time to produce the lattice damage (based on alpha decay or spontaneous fission) makes lead loss less important for age dating and data interpretation of very young zircons (< 1 Ma).

Introduction

Isotope dilution thermal ionization mass spectrometry (ID-TIMS) is the method that yields the most accurate and precise U-Pb dates for accessory minerals, e.g. zircon, monazite, rutile, sphene, and apatite. This is because the TIMS technique escapes "matrix effects" suffered by SIMS and ICP-MS "spot" techniques in which minerals with an array of chemical compositions and physical states are ablated/sputtered. For TIMS, the host mineral is dissolved, and the U, Th and Pb are concentrated, purified and loaded as a consistent compound on a filament in the mass spectrometer. Further, improvements on what parts of the mineral are dissolved and loaded onto the filament can be improved by the chemical abrasion (CA) technique[1, 2]. It is thought that the CA technique heals somewhat damaged mineral regions during annealing, and that the chemical abrasion through the use of HF and HCl removes relatively easy to dissolve parts of the mineral, either badly damaged parts where Pb loss has taken place, or potentially where common Pb is stored[3, 4]. Further the CA method seems not to affect the isotopic systematics of the remaining "healthy" material[4]. Scanning electron microscopy (SEM) images (see Fig. 1)[4] of annealed and "chemically abraded" zircon crystals show the domains affected during the partial HF-attack phase[3]. A second important approach for reducing the U/Pb errors of ID-TIMS data is linked to the Earth Time Project (www.earth-time.org) and the implementation of new U/Pb spike solutions. Since the availability of the $^{202-205}Pb/^{233-235}U$ spike the error of $^{206}Pb/^{238}U$ zircon ages can be reduced by 30 % by the internally Pb and U fractionation correction. Recently, the potential of using new spikes to provide radiometric age constraints or geological samples approaching, and potentially exceeding the 0.1% level of precision and accuracy has been demonstrated[5, 6]. Despite these important advantages of ID-TIMS, another analytical techniques – Laser ablation ICP-MS, has become one of the favored techniques in geochronology and produces accurate data if matrix-matched calibration is used[7-9] and downhole fractionation is carefully corrected. Since the first publication of $^{206}Pb/^{238}U$ ages obtained by an Excimer Laser coupled with an ICP-MS several hardware parameters have been introduced (e.g. the use of He gas through the chamber or sectorfield ICP-MS) and made this technique a routine isotope analysis method[10].

LA-ICP-MS studies involving quadrupole, sector-field and multicollector magnetic sector ICP instruments offers several advantages; i) simple sample preparation procedures; ii) measurement of isotopic ratios at high spatial resolution (10 to 100 µm); iii) rapid analysis, typically in the order of few minutes; iv) relatively cheap and easy to use intruments; v) in the case of quadrupoles, the ability to measure a suite of trace elements during the U-Th-Pb dating analysis. The availability of quadrupole and magnetic sector-inductively coupled plasma mass spectrometry (ICP-MS) technology has increased within the last decade, and has led to innovative research studies involving both stable and radiogenic isotope systems[11-14]. Recent advances have also been achieved in U-Pb geochronological studies of accessory minerals by LA-ICP-MS [14, 15] despite the fact that many physical and chemical principles involved in the laser ablation process are still not well understood[16]. Recently, Allen and Campbell (2012)[9], demonstrated that the $^{206}Pb/^{238}U$ age offset between TIMS and LA-ICPMS analyses is strongly correlated to the alpha dose and the physical state of zircon, and the use of the first part of the CA technique (annealing at 850 °C, 48h) resulted in two important effects: 1. Precision is greatly improved and 2, accuracy is within the measured precision of about 1%. It is thought that much of the improvement in the ICPMS ages stems from making the matricies of the standards and unknown similar, ie annealing them to the same physical condition. Although the U–Pb dates obtained by LA-ICP-MS are inherently less precise[9, 14, 17-19] (typical 2 σ error on $^{206}Pb/^{238}U$ age ~2-5% for a quadrupole ICP-MS if the annealing technique is *not* used, 1-2% if it is, and 1-2 % for a sector-field ICP-MS[13, 18, 20, 21]) compared with ID-TIMS analyses, LA-ICP-MS has certain advantages when employed for research projects that require a moderate precision (e.g. regional geological studies).

We examine zircons from 6 rock samples (Table 1) and several quality assessment reference materials (zircons 91500, Plesovice, and Temora, Table 2). We analysed CA-treated zircons of all but one sample by TIMS. We take the $^{206}Pb/^{238}U$ ID-TIMS age as the accepted or target age for the measured non-CA- and CA-treated zircon analyses (LA-ICPMS). The data are then compared to the ICP-MS (Elan 6100, Element-XR) results for untreated zircons as well as different zircon aliquots that were treated by chemical abrasion (the CA technique[3]). Because of its high-precision the ID-TIMS technique has recently played a key role in provoking discussion about the volumes and rates of magma emplacement[22-24] and the life-spans of magmatic-hydrothermal systems[6, 25]. In particular, zircon populations from individual single intrusions have given weighted mean U–Pb zircon dates that differ by 10^5–10^6 yr over many km distance[26, 27]. The instrumentation used for the ICP study (Table 3) was consistent across all samples except for the very youngest (<1 Ma) for which a different ICP set up was used (Table 4). We use an untreated GJ-1 as primary zircon standard for all zircon analyses (non-CA, CA). To exclude an age offset between non-CA and CA treated GJ-1 as primary zircon standard, we make several runs with GJ-1/non-CA and GJ-1/CA and CA-treated secondary zircon standards (Table 2). The weighted mean $^{206}Pb/^{238}U$ ages are summarized in Table 3 and 4, detailed data set are listed in Table 2.

Experimental

Sample preparation

Four selected samples were first fragmented with the SelFrag laboratory equipment. The high voltage pulse fragmentation offers the advantage of liberating morphologically intact minerals and of limiting contamination since no mechanical contact is needed. A 700 µm sieve was used and all materials passed through the sieve mesh. The Carboniferous sample was crushed by conventional method, using a mechanical jaw crusher and disc mill.

After sieving samples, were subjected to heavy liquid mineral separation using methylene iodide (3.3 g/cm^3). If necessary Clerici solution, a mixture of thallous formate and thallous malonate with a density of 4.28 g/cm^3, was used to further enrich the zircon crystal concentrates. Finally, further separation using the Frantz isodynamic separator permitted the isolation of sufficiently small mineral fractions according to their magnetic susceptibility so that zircons became apparent in a few samples. Zircons are usually magnetic at more than 1 Ampere but that can vary according to mineral chemistry. The magnetic separation is therefore performed in small steps, starting at 0.5A and increasing the current up to 1.5A in some cases. Both mineral fractions, the non-magnetic and magnetic are analyzed under a binocular microscope and if needed the operation is repeated.

For each sample, the least-magnetic zircon crystals were selected and mounted in epoxy resin and imaged by cathodoluminescence to assess whether the population contains inherited cores. CL images were made of the studied zircons, which are embedded in an epoxy-resin pellet and then polished to the middle of the grains[28, 29]. The CL images were taken from a split screen on a CamScan CS 4 scanning electron microscope (SEM) at ETH-Zurich. SEM-CL imaging of zircons are used to identify magmatic oscillating internal structures for the U/Pb dating procedure. Most grains from the studied rock samples showed complex but euhedral oscillatory zoning, indicating zircon growth without later resorption or hydrothermal overprint domains[28, 29]. CL images of the Carboniferous and Cretaceous sample of non-CA treated zircons (ESI, Figure 1) have a weak contour and a higher contrast between individual growth rims; CA-treated zircons (ESI, Figure 2) show light grey oscillating bands, open cracks and holes.

The annealing – leaching technique (CA - 'chemical abrasion')

In order to minimize the effects of lead loss, chemical abrasion (CA) was employed involving high-temperature annealing followed by a HF and HCl leaching step[3]. The latter has been shown to be most effective in removing strongly radiation damaged zircon domains that underwent lead-loss during post crystallization fluid processes[4]. A total number of 40–100 zircon grains of each sample were loaded into quartz crucibles and placed in a furnace at 900 °C for approximately 48 h. Subsequently, zircons from each sample were transferred into 3 ml screw-top Savillex vials with concentrated HF. Savillex vials were arranged into a Teflon Parr™ vessel with concentrated HF, and placed in an oven at 180 °C for 12–13 h. After the partial dissolution step, the leachate was completely pipetted out and the remaining zircons were fluxed for 24 hours in 6 N HCl on a hotplate at ~ 85 °C, rinsed in ultrapure H_2O and washed with double-distilled acetone. Single zircons were selected, weighed and loaded for dissolution into pre-cleaned Teflon vessels for ID-TIMS measurements or mounted in epoxy resin for LA-ICP-MS analysis.

Selected sample material

For our study four geological samples with different magmatic ages were selected (Table 1; see Intern. Chronostratigraphic Chart – www.stratigraphy.com): a) 0.2 Ma (Quarternary), b) 24 Ma (Oligocene), c) 76 Ma (Upper Cretaceous), d) 330 Ma (Carboniferous), and the zircons were dated also by the high-precision "conventional" CA-ID-TIMS technique, using the Thermo-Scientific TritonPlus mass spectrometer. All samples are of magmatic origin and represent a geological time range between 0.2 and 330 Ma.

Instrumentation – ICP-MS system

Instrument parameters used during the course of this study are detailed in Tables 3 and 4. Most of the data (sample b, c, d, see Table 1) presented here were acquired using an Elan 6100 ICP-MS (PerkinElmer, Norwalk, CT, USA) coupled to an 193 nm ArF-Excimer laser ablation sysytem similar to a Geolas system (Coherent, USA). The laser was operated at 10 Hz, spot size was 40 micrometer and a fluence of 4 J cm^{-2} was used. All experiments were performed using helium as carrier gas. The carrier gas was mixed with argon as make-up gas before entering the ICP (see Table 3). The second laser system was used for the youngest sample (< 1 Ma). The data was acquired using an Element-XR SF-ICP-MS (Thermo Fisher, Bremen, Germany) coupled with a 193 nm Excimer laser (Resonetics Resolution S155-LR) that was operated at 5 Hz and a fluence of 2.0 J/cm^{-2} [20]. The spot size for obtaining the data for the young zircons was 30 µm.

Analytical protocol: TIMS

All analyses were carried out using the $^{202-205}$Pb/$^{233-235}$U spike of Condon and Members of the Earthtime (ET) Working Group (see www.earth-time.org) which has been internationally intercalibrated and proven to yield ^{206}Pb/^{238}U interlaboratory reproducibility better than 0.1% [30]. After adding the mixed Pb/U spike, zircons were dissolved in concentrated HF with a trace of 7 N HNO_3 at 208 °C for 5-6 days, evaporated and re-dissolved in 3 N HCl. Pb and U were separated by anion exchange chromatography in 50 µl micro-columns. Isotopic analyses were performed on a TritonPlus thermal ionization mass spectrometer (TIMS) equipped with a digital ion counting system of a MasCom multiplier. The linearity of the MasCom multiplier was calibrated using the SRM982 and U500 standard solutions. The mass fractionation of Pb and U were corrected through the double ET $^{202-205}$Pb/$^{233-235}$U spike. Both Pb and U were loaded with 1 µl of silica gel – phosphoric acid mixture[35] on outgassed single Re-filaments. Pb as well as U (as UO_2) isotope ratios were measured sequentially on the electron multiplier. Total procedural Pb blank was estimated at 1.0±0.25 pg and corrected with the following isotopic composition: ^{206}Pb/^{204}Pb = 18.08±0.22, ^{207}Pb/^{204}Pb = 15.62±0.28, ^{208}Pb/^{204}Pb = 38.05±0.59 (all ±2σ). Common lead in excess of this blank was corrected using the model of Stacey and Kramers (1975)[31] for an age of 330 Ma, 76 Ma, 24 Ma and 0.2 Ma, respectively. The model Th/U ratio was calculated from radiogenic ^{208}Pb/^{206}Pb ratio assuming concordance.

The uncertainty of the concentration of U and Pb in the spike solution (±0.1%) was taken into account and propagated to each individual analysis. The PbMacDAT program was used for age calculation and error propagation[32]. Calculation of concordant ages was done with the Isoplot/Ex v.3 program of Ludwig[33, 34]. Uncertainty ellipses of individual analyses are at 2σ level and include the uncertainty of tracer calibration, decay constant and non-blank common Pb composition.

Analytical protocol: LA-ICP-MS

Samples and standards, mounted together, were ablated in an air-tight sample chamber flushed with He for sample transport. The laser was focused on the sample surface and energy density was kept constant for each analytical run. Data were collected in discrete runs of 20-24 analyses, comprising 11-15 unknowns bracketed before and after by three analyses of the primary standard zircon GJ-1[35] and secondary zircons 91500[36], Plesovice[30] and Temora[37]. Data were collected for up to 70 s per analysis with a gas background taken during the initial ca. 30 s and ablation for 40 seconds. Due to the extremely low ^{204}Pb signal, no common lead correction was applied. Preliminary selection of the background, analysis signal intensities, instrumental drift correction and data calculation was performed using the Glitter[38] and Iolite[39, 40] software packages for the samples 248-2, 059-1, 029-5, DG026 and AvQ244. Data for sample KPT-04 were collected in one discrete run using the same standard zircon material. Raw data was imported into Iolite[39, 40] and with the use of the VizualAge[41] data reduction scheme, reduced to obtain ages and ratios corrected for instrumental drift and downhole fractionation. Downhole fractionation was found to be very similar between primary, secondary zircon standards and zircon samples. The GJ-1 ^{206}Pb/^{238}U ratio of 0.09761[35] was used as reference. The behavivour of CA and non-CA treated GJ-1 zircon is shown in Figure 3 (ESI). The raw ^{206}Pb/^{238}U ratios of CA and non-CA GJ-1 have a similar trend with a small offset, due to instrumental drift, but the obtained final ratios were the same (Table 3). Concordia age calculation, weighted mean averages, intercept ages and plotting of concordia and weighted mean diagrams were performed using the Isoplot/Ex rev. 2.49[34].

For each analysis, all time-resolved signals were collected and carefully studied to ensure that only flat stable signal intervals were included in the age calculations. Given that a selection of consistent signal intervals is critical in obtaining the most accurate and precise ratios, the following features were always avoided: i) inclusions of minerals containing U, Th, Pb_{rad}, Pb_{common} (e.g. rutile, thorite, apatite); ii) U-Th-Pb chemical zoning; iii) fracture zones with high Pb_{common}; iv) core-rim features; v) inconsistent behaviour of U-Pb and Th-Pb system. These features are identifiable by observation of the isotope ratio time-integrated signals. Analyses with all the signals affected by the above features were rejected for the calculation.

U-Th disequilibrium correction

Since the fundamental work of Schärer (1984)[42] it has been accepted that most zircons have a deficit of ^{206}Pb due to initial Th/U disequilibrium caused by the exclusion of ^{230}Th during zircon growth[42, 43]. The relative age correction becomes increasingly higher with younger ages and is significant for zircons <10 Ma, therefore all geological samples of Paleogene age and younger[42] have to undergo an initial ^{230}Th disequilibrium correction. It is especially important to decode complex geochronological sequences for young samples (< 1 Ma). The correction of ^{206}Pb/^{238}U and ^{207}Pb/^{206}Pb dates for the deficit requires an estimate of Th/U of the zircon and Th/U of the magma from which the zircon crystallized. The Th/U ratio in the zircon was modeled based on the amount of ^{208}Pb and ^{206}Pb measured by ID-TIMS, assuming concordance between the ^{208}Pb/^{232}Th (not measured) and ^{206}Pb/^{238}U systems. The Th/U ratio of zircon is measured with LA-ICP-MS directly using the SRM NIST 610 for calibration. The Th/U ratio of the magma is more difficult to estimate and has a larger affect on dates. In the literature whole rock data are used for the Th/U ratio or, if available, melt inclusion data in quartz/amphibole phenocrysts that are uniform for the entire magmatic system. The ^{206}Pb/^{238}U ratios were corrected for initial disequilibrium in ^{230}Th/^{238}U using Th/U [magma] ratio of 3.3 (KPT-04, Kos, Greece;[44]), 3.0, 4.6, 2.9 (059-01, 029-5, 248-2, Buchim, Macedonia;[45]), 4.2 (DG026, Ezeris, Romania) and 3.5 (Avq244, Trun region, West Bulgaria;[46]).

Sakata et al. 2013[47] have demonstrated that the correction formula of Schärer[42] leads to "less-corrected" age results for extremely young zircon crystals (< 300 ka), e.g. calculated ^{206}Pb/^{238}U ages between 200 a and 10'000 a lead to Th-corrected ages[42] of ~ 100'000 – 120'000 a. The initial assumption and the derivation of equation (1) can be found in Sakata et al. (2013)[47].

$$\frac{^{206}Pb}{^{238}U} = \left(e^{\lambda_{238}t} - 1\right) + \frac{\lambda_{238}}{\lambda_{230}}\left(f_{\frac{Th}{U}} - 1\right)\left(1 - e^{-\lambda_{230}t}\right)e^{\lambda_{238}t} \quad (1)$$

As the ages measured for KPT-04 range from 190 to 400 ka, equation 1 was used to get accurate results. A comparison of ages determined by using both equations is discussed below (KPT-04, Table 5, 6). The Th disequilibrium correction returns a corrected age of ~120 ka, the extent of the offset depends of the Th/U ratio of the zircon and magma; the Th disequilibrium correction is trivial for most of the $^{206}Pb/^{238}U$ ages at 24 Ma, 74 Ma and 330 Ma which were obtained by the LA-ICP-MS technique.

Results and discussion

TIMS data

Analytical results and morphological features for single zircon grain analyses of the five selected samples are given in Table 5 and presented individually in the concordia diagrams of Figs. 4-8.

The set of analyses of sample KPT-04 (Table 5) includes nine single zircon crystals. Compared to the average igneous zircon the uranium concentration[48, 49] for the young zircon crystals are high between 557 ppm – 1693 ppm and the corresponding $^{206}Pb/^{238}U$ age calculations range from 0.205 Ma to 0.417 Ma[42] or from 0.187 to 0.410 Ma[47]. All calculated $^{206}Pb/^{238}U$ ages are not overlapping within their errors and thus the spread of > 200 ka reflects the existence of individual magma pulses within one big magma chamber[20, 44]. Only the three youngest zircon grains, which are concordant and overlapping within their errors, give a Th-corrected Concordia age, reflecting the youngest magmatic event at 0.2070 ± 0.0062 Ma[42] or at 0.1964 ± 0.0058 Ma[47]. All zircon data in Table 5 were corrected for U-Th disequilibrium using the method of Schaerer (1984)[42] and Sakata et al. 2013[47]. Both Th disequlibrium-corrected ID-TIMS ages, 0.2070 Ma and 0.1964 Ma, are overlapping with a published spread of U-Pb SHRIMP-RG ages[44, 50], in this case with the lower part of U-Pb ages.

The next two samples represent magmatic pulses of the Cu-Au porphyry at Buchim, Macedonia[45]. Six euhedral zircon grains of an andesite (029-5) gave a precise Concordia age of 24.480 ± 0.084 Ma (Fig. 5); five out of six zircon crystals of the andesite 248-2 yield overlapping concordant U-Pb ID-TIMS ages of 24.422 ± 0.025 Ma (Fig. 6). The high uranium concentrations between 794 ppm and 2298 ppm result in high $^{206}Pb/^{204}Pb$ ratios and reduce the influence of common lead for the U-Pb calculation (Table 5). One zircon crystal (248-2-1, Table 5) from sample 248-2 gives an age of 20.3 Ma (not plotted); for this sample, the CA-technique probably didn't work acceptably and modern Pb loss is the excuse given for this younger but still concordant analysis. Both U-Pb concordant ages of the samples 029-5 and 248-2 are not distinguishable within analytical uncertainty and thus the life time of the two magmatic pulses is less than 170 ka.

The U-Pb concordant age calculation of a Cretaceous granodioritic sample, DG026, is plotted in Fig. 7. Six zircon crystals, with Uranium concentrations between 498 ppm and 682 ppm and no inherited lead components were treated by CA. The calculation leads to a Concordia age of 76.413 ± 0.088 Ma. The obtained U-Pb age for this granodiorite confirms it is part of the > 1600 km long Cretaceous magmatic belt[6] in Eastern Europe, hosting several active Cu-Au porphyry deposits.

The granite sample AvQ244 belongs to the geological basement in western Bulgaria[46, 51] and its TIMS result is the most complicated. The zircon grains have a Uranium concentration between 332 ppm and 2171 ppm. Of the 7 TIMS analyses, one is older than, and 2 younger than the main population of 4 aliquots. Together they can be taken to indicate a discordia with an upper intercept of ~340 Ma. The interpretation is that there is some inherited zircon in the sample, and that CA-treatment has failed to eradicate zones that have lost Pb now represented in the two younger aliquots (Table 5). The four consistent concordant analyses give a concordia age of 333.60 ± 0.66 Ma (Fig. 8) confirming that this granite sample is part of the Variscan Lutzkan magmatic complex. CA-ID-TIMS U-Pb zircon dating of all four samples provide very precise Concordia ages with 2 sigma uncertainties of 0.1-0.2 % [5].

LA-ICP-MS U-Pb results

The laser ablation ICP-MS results are given in Table 6, available in the ESI (Electronic Supplementary Information), and individual U-Pb age calculations of the selected samples (Table 7) are presented in Figs. 9-14 as $^{206}Pb/^{238}U$ weighted mean ages. All samples (248-2, 059-1, DG026, AvQ244) except the youngest (KPT-04) were analysed using the Elan 6100 system, sample KPT-04 was analysed using the Element-XR; more details about the second system is given by Guillong et al. (2014)[20]. We have selected Temora, Plesovice and 91500 as secondary SRM to exclude any age offsets using non-CA and CA GJ-1 as primary SRM; it seems that the CA-treated GJ-1 standard zircon shows slightly younger $^{206}Pb/^{238}U$ ages, but all ages overlap within the uncertainty (Table 2).

A total of 29 analyses with a spot diameter of 30 µm were performed on non-CA treated zircon crystals of sample KPT-04 (Fig. 9a); 37 analyses with the same spot size were done on CA-treated zircon grains of sample KPT-04 (Fig. 9b). All $^{206}Pb/^{238}U$ ages (non-CA) show a broad range between 457 ka and ~ 209 ka (Fig. 9a); both Th corrections[42, 47] result in similar results overlapping within the analytical uncertainties however the Th correction of Sakata *et al.*[47] produces slightly younger $^{206}Pb/^{238}U$ ages. Including the four zircon grains with higher $^{206}Pb/^{238}U$ ages of > 400 ka, the remaining non-CA treated zircon grains show two distinct average $^{206}Pb/^{238}U$ ages of 292.9 ± 13.7 ka (Th correction[42]) and 281.1 ± 14.4 ka (Th correction[47]). The U-Pb analyses of the CA-treated zircon grains are plotted in Fig. 9b; after CA-treatment the U-Pb ages range from 359 ka to 183 ka; the CA-zircons exhibit a smaller range in $^{206}Pb/^{238}U$ ages than that of the non-CA-treated zircons. The results of Th disequilibrium correction using both methods[42, 47] result in an increase of age differences towards younger ages (< 350 ka, Fig. 9b). The result of the ID-TIMS measurements is indicated by a red line at ~ 196 ka in Figs. 9a, b. Two distinct average $^{206}Pb/^{238}U$ ages of 269.8 ± 7.8 ka (Th correction[42]) and 256.4 ± 8.3 ka (Th correction[47]) were calculated for the CA treated zircon grains . The U-Pb ages of the CA-treated zircons show a surprisingly ca. 30 ka younger average $^{206}Pb/^{238}U$ age than the non-CA treated zircons, which might be a result of sample bias during zircon selection (Table 6).

In Table 6 a total of 112 analyses of non-CA and 160 analyses of CA-treated zircon grains of Oligocene samples 029-5, 248-2 and 059-1 are presented. Evidence of inherited Pb components is rare for all samples. Most of the analysed zircon crystals belong to the Late Oligocene intrusion period, and only some analyses point to an earlier magmatic phase (Table 6). The calculated $^{206}Pb/^{238}U$ ages of the non-CA-treated zircon grains are 23.76 ± 0.27 Ma, 23.28 ± 0.25 Ma and 24.01 ± 0.29 (059-1, 029-5, 248-2; Figs. 10-12). The maximum time range including the uncertainties covers a period of 1.27 Ma. There are some local maxima within the age spectrum, e.g. the seven youngest U-Pb analyses of sample 029-5 (Fig. 11) build up a slightly younger group, sample 248-2 has a large range of $^{206}Pb/^{238}U$ ages from ca. 25.5 Ma to 22.4 Ma; the ages > 24.5 Ma are offset from the smooth curve. All CA-treated zircons from samples 059-1, 248-2 and 029-5 show an even distribution based on the age difference between the lowest and highest obtained $^{206}Pb/^{238}U$ age. The obtained $^{206}Pb/^{238}U$ average ages of the CA-treated zircons are 24.57 ± 0.28 Ma, 24.41 ± 0.21 Ma (059-1, 029-5) and 24.28 ± 0.15 Ma (248-2) and they overlap perfectly with the target ID-TIMS result. Based on geological field relationships[38] all of these magmatic rocks which formed the Cu and Au ore deposit intruded in a short time window. The CA-ID-TIMS $^{206}Pb/^{238}U$ Concordia age is 24.45 Ma (029-5 & 248-2) and using the CA-LA-ICP-MS method an age of 24.35 Ma (029-5 & 248-2) was obtained, both ages overlap within the uncertainty. The age difference of 0.81 Ma, 1.13 Ma and 0.27 Ma (Figs. 10-12) (> 4 %) between non-CA/CA treated zircon crystals lies outside the external reproducibility (~ 1-1.5 %)[20] of well-tuned LA-ICP-MS systems[24]. Another important observation is that CA treatment appears to reduce age scatter. Scatter of the $^{206}Pb/^{238}U$ ages of 0.16 Ma for CA-treated zircons (059-1, 029-5, 248-2) is lower, compared to a 450 % greater scatter (0.73 Ma) for non-CA zircons.

Sample DG026 clearly shows the difference in $^{206}Pb/^{238}U$ ages acquired from non CA and CA treated zircons (Fig. 13). The obtained $^{206}Pb/^{238}U$ ages are 76.13 ± 0.45 Ma and 74.14 ± 0.65 Ma (95% conf.) for the CA and non-CA treated zircons, respectively; the range of the U-Pb ages increases from 4.3 Ma (CA zircons, 5.8 %, 74.1-78.4 Ma) up to 6.4 Ma (non-CA zircons, 8.9 %, 71.7 – 78.1 Ma). The obtained ages of CA-treated zircons coincide within uncertainty for LA-ICP-MS and ID-TIMS methods[5, 52].

A total of 48 analyses were performed on the "oldest" Carboniferous geological sample AvQ244, a Variscan basement granite from western Bulgaria[60]. The obtained U/Pb ages are plotted in Fig. 14, data from inherited cores are omitted. The zircon sets for CA and non-CA treated zircons show distribution patterns of $^{206}Pb/^{238}U$ ages that are similar to the Upper Cretaceous and Oligocene zircons. The non-CA and CA treated zircon data set shows high MSWD values (>10) which returns to the interpretation that the data set includes more than one population. Nevertheless, the CA-LA-ICP-MS $^{206}Pb/^{238}U$ average age of 331.8 ± 4.7 Ma coincides with the CA-ID-TIMS Concordia age of 333.60 ± 0.66 Ma. Non-CA treated zircons of sample AvQ244 yield a considerably younger mean average $^{206}Pb/^{238}U$ age 306.2 ± 10 Ma and the data scatter is wider (280 - 340 Ma).

The obtained $^{206}Pb/^{238}U$ ages of all non-CA, CA- LA-ICP-MS and CA-ID-TIMS samples (Table 7) are plotted in Figure 15. A grey box references the 2% level of variability[21] and is centered to the non-CA ages. The Figure 15 highlights $^{206}Pb/^{238}U$ age difference between non-CA and CA ages and an increasing age difference up to older $^{206}Pb/^{238}U$ ages. One sample with an age around 24 Ma shows an age overlapping between non-CA and CA treated zircon grains, but sample 059-1 and 029-5 are not overlapping between non-CA and CA treated zircon grains.

Conclusion and outlook

1) The CA procedure employed on zircon grains leads to a U/Pb age precision of 0.1 – 0.2 % (CA-ID-TIMS) and to < 1.5 % (CA-LA-ICP-MS). $^{206}Pb/^{238}U$ dates obtained by CA-ID-TIMS and LA-ICP-MS overlap within the analytical uncertainty.

2) LA-ICP-MS ages for zircon grains, which have been treated by chemical abrasion (CA)[3], show less scatter of the U/Pb data compared to the non-CA treated zircon set. The CA technique efficiently eliminates discordance caused by Pb loss or crystal damage caused by the alpha dose[9] and reduces the data scatter and consequently also the relative uncertainties by up to 50%. The remaining scatter of age data is close to the common analytical uncertainties of the LA-ICP-MS technique or there are still inherited grains.

3) All analyzed zircon crystals with magmatic ages > 24 Ma (our study) have greater average $^{206}Pb/^{238}U$ ages, when treated with the CA technique. Furthermore, they overlap with the CA-ID-TIMS ages. As the CA-ID-TIMS technique provides high-precision, accurate and geologically reasonable geochronological data[4, 39, 52, 53], we have demonstrated in our study of samples with different ages, that the CA-treated zircon crystals yield geologically accurate ages when dated with the LA-ICP-MS technique.

4) The differences of the $^{206}Pb/^{238}U$ weighted mean ages obtained from CA- and non-CA treated zircon crystals are in a range up to 4-6%. These differences are suggested to correlate with the U and Th content in zircons[9]. Crystal radiation damage increases with time, more substantially in zircon grains with higher content of radioactive elements.

5) All non-CA treated zircon analyses have shown that Pb-loss is a real issue for LA analyses and will affect the determined age. The Pb-loss effects will affect all LA results and also lead to increased scatter in the data.

6) For studies of short-lived processes, e.g. life-times of magma chamber processes[6, 39, 52] or of magmatic-hydrothermal systems in porphyry-Cu-Au deposits (estimated at 1-2 Ma to <0.01 Ma) the CA-LA-ICP-MS technique will be of clear advantage; otherwise the problems with Pb-loss will be coupled with the usual 4-6% uncertainties leading to unrealistic timescales. The technique is also highly recommended for applications like definition of U/Pb closure temperature paths[54], or cooling paths, or for comparisons of U/Pb zircon ages to other radiometric age data (Ar-Ar, Re-Os).). It will be of clear advantage in any geological reconstructions that are based on LA-ICP-MS dating, especially in Paleozoic and older metamorphic terrains, as it will "simplify" the interpretation through the removal of the lead-loss.

7) The analyzed sample KPT-04 (rhyolitic tuff from Kos island, Greece) with a geological age < 1 Ma is different from the older samples. It shows an identical age (overlapping within uncertainty) of CA-treated and non-CA-treated grains, the latter, however, show a higher $^{206}Pb/^{238}U$ weighted mean average age. It seems that for the very young zircons the Pb-loss in U-Th-decay damaged parts is not important, but the scatter of data possibly reflects zircon growth in a magma chamber over a longer period (0.2-0.3 Ma) prior to eruption[20, 44]. However, the scatter of $^{206}Pb/^{238}U$ age for CA-treated zircon crystals is ~ 10 % lower than that for non-CA treated zircon grains. This could be related either to sample bias during grain selection in the analyzed mounts or to removal of inclusions in the zircons that contain common Pb (and therefore consequently reveal older apparent ages). The two methods of U-Th disequilibrium correction[42, 47] lead to distinct $^{206}Pb/^{238}U$ ages, but both obtained U/Pb ages (CA-ID-TIMS) overlap with the lower range of U/Pb measurements of the LA-ICP-MS data set. We demonstrate for young samples that the CA technique is not a one-size-fits-all method.

8) LA-ICP-MS analyses of non-CA and CA-treated zircons of the youngest sample (<1 Ma) show a $^{206}Pb/^{238}U$ age range from 190 ka to 460 ka; the main age difference of ~30 ka can be explained by 'missing' $^{206}Pb/^{238}U$ age points (>400 ka) in the CA-treated zircon aliquot. Most age data of the non-CA and CA treated zircons overlap within the uncertainty.

9) CA technique as applied here might only partial work on some crystals. CA and even only annealing changes the crystal structure and therefore the ablation rate might be affected[55] which in return may affect the downhole fractionation including its correction. The influence of the CA technique on reference zircons and the impact on the method is part of further investigations.

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Notes and references

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Electronic Supplementary Information (ESI) available: [Figures 1-3, Table 6]. See DOI:

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Table 1: Sample description

sample	rock type	main components	geological age	Locality
KPT-04	Rhyolitic tuff	plag, bio, qtz, sani	M. Pleistocene, Quaternary	Kos Island, Greece
248-2	Andesite/Trachy-Andesite	plag, qtz, bio	U. Oligocene	Vrsnik, Macedonia
059-1	Andesite/Trachy-Andesite	plag, qtz, bio	U. Oligocene	Borov Dol, Macedonia
029-5	Andesite/Trachy-Andesite	plag, qtz, bio	U. Oligocene	Borov Dol, Macedonia
DG028	Diorite	plag, amph, qtz	Campanian, U. Cretaceous	Ezeris, Romania
DG026	Granodiorite	plag, qtz, bio	Campanian, U. Cretaceous	Ezeris, Romania
AvQ 244	granite	plag, qtz, bio	M. Carboniferous	Trun region, West.-Bulgaria

abbreviation: plag=plagioclase, bio=biotite, qtz=quartz, sani=sanidine, amph=amphibole

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Table 2 Summary of LA-ICP-MS data (zircon standards)

March 2014, Dept. E.Sci, ETH Zurich					Data for Tera-Wasserburg plot					Data for Wetherill plot							Ages							
Identifier	ICPMS Type	quantity	Uppm[1]	Th/U	238U/206Pb	1σ %	207Pb/206Pb	1σ %		207Pb/235U	1σ %	206Pb/238U	1σ %	Rho	208Pb/232Th	1σ %	207Pb/206Pb	2σ abs	206Pb/238U	2σ abs	207Pb/235U	2σ abs	208Pb/232Th	2σ abs
non-CA[2]																								
GJ-1	Elan	n = 64	386	0.0286	10.248	0.19	0.06035	0.47		0.8120	0.46	0.09760	0.193		0.03030	1.13	614	19.9	600.2	2.3	603.7	4.2	603.2	13.4
Plesovice	Elan	n = 22	721	0.0566	18.283	0.42	0.05496	1.45		0.4146	1.59	0.05472	0.416		0.01904	4.02	402	61.2	343.4	2.8	351.9	9.3	381.0	30.3
non-CA[2]																								
GJ-1	Element-XR	n = 36	318	0.0214	10.240	0.06	0.06019	0.07		0.8097	0.37	0.09766	0.374		0.03016	2.78	609	2.8	600.7	0.7	602.3	0.5	600.3	5.6
Plesovice	Element-XR	n = 9	595	0.1003	18.742	0.28	0.05325	0.29		0.3915	0.37	0.05336	0.276		0.01669	0.97	339	5.6	335.1	0.6	335.4	0.7	334.5	4.3
Temora 2	Element-XR	n = 13	152	0.4748	14.889	0.54	0.05521	0.55		0.5109	0.39	0.06717	0.541		0.02085	2.96	414	8.0	419.1	1.2	418.8	0.8	417.1	6.8
91500	Element-XR	n = 18	76	0.5572	5.559	0.50	0.07507	0.59		1.8600	0.84	0.17989	0.495		0.05388	1.46	1068	5.1	1066.3	2.3	1066.3	2.6	1060.3	7.0
CA[3]																								
GJ-1	Element-XR	n = 30	326	0.0363	10.260	0.46	0.06019	0.47		0.8083	0.74	0.09747	0.427		0.03035	3.04	607	3.7	599.6	1.3	601	1.4	603.6	7.2
Temora 2	Element-XR	n = 10	176	0.4509	14.958	0.57	0.05543	0.89		0.5111	1.27	0.06685	0.576		0.02062	2.34	419	12.5	417.2	1.6	418.6	2.9	412.3	6.5
non CA[2]																								
Temora 2[4]	Element-XR	n = 24	89	0.45	14.89	1.00	0.05516	0.87		0.5091	#####	0.06717	0.995		0.02080	2.82	405.5	7.4	419.1	1.6	417.4	2.1	415.8	4.6

[1] *concentration uncertainty c.20%*
[2] *data not treated by chemical annealing, primary zircon standard GJ-1 non-CA*
[3] *data are treated by chemical annealing, primary zircon standard GJ-1, CA*
[4] *non CA Temora is referenced to a CA GJ-1*

Decay constants of Jaffey et al 1971 used
bd = below detection; #N/A = not available
Uncertainties quoted without components related to systematic error unless otherwise stated

Table 1 LA-ICP-MS instrumentation and operational setting (Elan 6100)

Laboratory & Sample Preparation	
Laboratory name	Dept of Earth Science, ETH Zurich
Sample type/mineral	zircons
Sample preparation	Conventional mineral separation, 1 inch resin mount, 1um polish to finish
Imaging	CL, Jeol 5000, 10nA, 15mm working distance
Laser ablation system	
Make, Model & type	Prototype similar to Geolas (Coherent)
Ablation cell & volume	Homemade, rhombic shape ~7 cm^3
Laser wavelength (nm)	193 nm
Pulse width (ns)	25 ns
Fluence ($J.cm^{-2}$)	4.0 $J.cm^{-2}$
Repetition rate (Hz)	10 Hz
Spot size (um)	40 um
Sampling mode / pattern	Single hole drilling
Carrier gas	100% He
Ablation duration (secs)	50 secs
Cell carrier gas flow (l/min)	1.1l/min
ICP-MS Instrument	
Make, Model & type	Elan 6100 DRC Q-ICP-MS
Sample introduction	Ablation aerosol only, squid aerosol homogenization device
RF power (W)	1450W
Make-up gas flow (l/min)	0.8l/min Ar
Detection system	Single detector dual mode SEM, analog
Masses measured	202, 204, 206, 207, 208, 232, 235, 238
Integration time per peak (ms)	10 ms (masses 202, 204, 208, 232), 20 ms (masses 235, 238), 30 ms (masses 206, 207)
Total integration time per reading (secs)	0.14 sec
IC Dead time (ns)	30 ns
Data Processing	
Gas blank	40 second prior to each ablation spot
Calibration strategy	GJ-1 used as primary reference material, Plesovice, 91500 & Temora used as secondaries for quality control
Reference Material info	91500 (Wiedenbeck et al 1995)[37], Plesovice (Slama et al 2008)[34]; GJ1 (Jackson et al., 2004)[36], Temora (Black et al., 2004)[38]
Data processing package used / Correction for LIEF	Iolite 2.5 with VizualAge, Glitter
Mass discrimination	Mass bias correction for all ratios normalized to primary reference material
Common-Pb	No common lead correction applied
Quality control / Validation	1) primary zircon standard (GJ1, non-CA): Plesovice: Wtd. Ave. $^{206}Pb/^{238}U$ age = 340.6 ± 2.7 (95% conf., MSWD = 2.8, n = 22), 91500: Wtd ave.

	$^{206}Pb/^{238}U$ = 1066.4 ± 3.8 Ma (95% conf., MSWD = 1.8, n=11); GJ-1: Wtd ave. $^{206}Pb/^{238}U$ = 600.1 ± 2.3 Ma (95% conf., MSWD = 0.85, n=64);
Uncertainty level & propagation	Ages are quoted at 2 SE absolute, propagation is by quadratic addition. Reproducibility of reference material uncertainty is propagated.
Th disequilibrium correction and error propagation	$^{206}Pb/^{238}U$ ages of all samples were corrected using equation of Schaerer, 1984[42] or Sakata et al., 2013[47]. All errors from $^{206}Pb/^{238}U$ ratios and ages are propagated.

Table 2 LA-ICP-MS instrumentation and operational setting (Element-XR)

Laboratory & Sample Preparation	
Laboratory name	Dept of Earth Science, ETH Zurich
Sample type/mineral	zircons
Sample preparation	Conventional mineral separation, 1 inch resin mount, 1um polish to finish
Imaging	CL, Jeol 5000, 10nA, 15mm working distance
Laser ablation system	
Make, Model & type	Resonetics Resolution 155
Ablation cell & volume	Laurin Technics 155, constant geometry, aerosol dispersion volume < 1 cm^3
Laser wavelength (nm)	193 nm
Pulse width (ns)	25 ns
Fluence ($J.cm^{-2}$)	~ 2.0 $J.cm^{-2}$
Repetition rate (Hz)	5Hz
Spot size (um)	30 um
Sampling mode / pattern	Single hole drilling, 5 cleaning pulses
Carrier gas	100% He, Ar make-up gas combined inside ablation cell funnel.
Ablation duration (secs)	40 seconds
He Cell carrier gas flow (l/min)	0.7l/min
ICP-MS Instrument	
Make, Model & type	Thermo Element XR SF-ICP-MS
Sample introduction	Ablation aerosol only, squid aerosol homogenization device
RF power (W)	1500W
Make-up gas flow (l/min)	0.95l/min Ar
Detection system	Single detector triple mode SEM, analog, Faraday
Masses measured	202, 204, 206, 207, 208, 232, 235, 238
Integration time per peak (ms)	12 ms (masses 202, 204), 20 ms (masses 208, 232, 235, 238), 40 ms (masses 206, 207)
Total integration time per reading (secs)	0.202 sec
IC Dead time (ns)	8 ns
Typical oxide rate (ThO/Th)	0.18 %
Typical doubly charged rate (Ba^{++}/Ba^{+})	3.5 %
Data Processing	
Gas blank	10 second prior to each ablation spot
Calibration strategy	GJ-1 used as primary reference material, Plesovice, 91500 & Temora used as secondaries for quality control
Reference Material info	91500 (Wiedenbeck et al 1995)[37], Plesovice (Slama et al 2008)[34]; GJ1 (Jackson et al., 2004)[36], Temora (Black et al. 2004)[38]

Data processing package used / Correction for LIEF	Iolite 2.5 with VizualAge
Mass discrimination	Mass bias correction for all ratios normalized to primary reference material
Common-Pb correction, composition and uncertainty	No common lead correction applied
Quality control / Validation	1) primary zircon standard (GJ1, non-CA): Plesovice: Wtd. Ave. $^{206}Pb/^{238}U$ age = 335.1 ± 0.75 (95% conf., MSWD= 0.63, n = 9), 91500: Wtd ave. $^{206}Pb/^{238}U$ = 1066.2 ± 2.4 Ma (95% conf., MSWD = 1.8, n=18); GJ1: Wtd ave. $^{206}Pb/^{238}U$ = 600.5 ± 0.63 Ma (95% conf., MSWD = 1.02, n=36); Temora 2: Wtd. Ave. $^{206}Pb/^{238}U$ age = 419.3 ± 1.2 (95% conf., MSWD = 1.8, n = 13) 2) primary zircon standard (GJ1, CA): GJ1-CA: Wtd. Ave. $^{206}Pb/^{238}U$ age = 599.6 ± 1.7 (95% conf., MSWD = 2.2, n = 30); Temora-CA: Wtd. Ave. $^{206}Pb/^{238}U$ age = 416.4 ± 0.81 (95% conf., MSWD = 0.92, n = 10)
Uncertainty level & propagation	Ages are quoted at 2 sigma absolute, propagation is by quadratic addition. Reproducibility of reference material uncertainty is propagated
Th disequilibrium correction and error propagation	$^{206}Pb/^{238}U$ ages of all samples were corrected using equation of Schaerer, 1984[42] or Sakata et al. 2013[47]. All errors from $^{206}Pb/^{238}U$ ratios and ages are propagated.

Table 5 TIMS U-Th-Pb isotopic data

Sample	Compositional Parameters: Wt.	U	Th/U	Pb	Pb*/Pb$_c$	Pb$_c$	^{206}Pb/^{204}Pb	Radiogenic Isotope Ratios: ^{208}Pb/^{206}Pb	^{207}Pb/^{206}Pb	2 sigma	^{207}Pb/^{235}U	2 sigma	^{206}Pb/^{238}U	2 sigma	corr.	Isotopic ages, Ma: ^{207}Pb/^{206}Pb	2 sigma	^{207}Pb/^{235}U	2 sigma	^{206}Pb/^{238}U	2 sigma	^{206}Pb/^{238}U	2 sigma
	mg	ppm		ppm		(pg)				% err		% err		% err	coef.		±		±		±		±
(a)	(b)	(c)	(d)	(c)	(e)	(e)	(f)	(g)	(g)	(h)	(g)	(h)	(g)	(h)		(i)	(h)	(i)	(h)	(i, j)	(h)	(I, k)	(i)
KPT-04																							
KPT014-13-1	0.0084	937	0.167	0.40	0.04	3.19	21.467	0.102	0.046144	44.1	0.000216	47.2	0.0000340	8.59	0.44	5.13971	847	0.22	0.10	0.219	0.010	0.203	0.015
KPT014-13-2	0.0069	1119	0.432	0.13	0.19	0.78	29.065	0.264	0.046053	31.5	0.000202	33.6	0.0000317	2.86	0.75	0.38683	606	0.20	0.07	0.205	0.003	0.187	0.011
KPT014-13-3	0.0084	933	0.398	0.25	0.10	1.92	24.394	0.216	0.046090	35.3	0.000237	37.7	0.0000373	3.99	0.63	2.35379	703	0.24	0.09	0.241	0.006	0.229	0.015
KPT014-13-6	0.0077	557	0.859	0.25	0.16	1.66	27.094	0.348	0.046145	41.0	0.000412	42.5	0.0000647	2.62	0.58	5.21123	899	0.42	0.18	0.417	0.009	0.410	0.027
KPT014-13-8	0.0065	1032	0.551	0.28	0.11	1.62	24.779	0.287	0.046054	39.8	0.000241	42.0	0.0000379	3.57	0.65	0.45121	801	0.24	0.10	0.244	0.005	0.230	0.019
KPT014-13-7	0.0058	717	0.370	0.24	0.10	1.24	24.374	0.186	0.046054	65.6	0.000269	68.1	0.0000424	4.10	0.63	0.44763	1334	0.27	0.19	0.273	0.007	0.262	0.016
KPT014-13-10	0.0058	1693	0.586	0.28	0.15	1.41	26.631	0.339	0.046112	33.1	0.000206	34.9	0.0000325	2.83	0.66	3.48032	646	0.21	0.07	0.209	0.003	0.190	0.017
029-5																							
029-5-6	0.0187	1929	0.328	7.38	46.80	2.89	3023	0.106	0.046780	0.138	0.024463	3.895	0.0037926	3.893	1.00	37.99	3.31	24.54	0.94	24.40	0.94		
029-5-1	0.0242	864	0.191	3.20	40.70	1.86	2733	0.062	0.046805	0.173	0.024576	0.211	0.0038082	0.124	0.57	39.31	4.13	24.65	0.05	24.50	0.03		
029-5-5	0.0187	2298	0.359	8.81	57.81	2.80	3698	0.116	0.046684	0.171	0.024341	0.285	0.0037815	0.232	0.80	33.12	4.09	24.42	0.07	24.33	0.06		
029-5-2	0.0079	1590	0.351	6.30	19.75	2.40	1278	0.114	0.046748	0.251	0.024459	0.383	0.0037946	0.289	0.75	36.37	6.00	24.54	0.09	24.42	0.07		
029-5-3	0.0079	939	0.300	3.81	10.96	2.52	728	0.097	0.046517	0.917	0.024354	0.928	0.0037971	0.208	0.16	24.49	22.0	24.43	0.22	24.43	0.05		
029-5-4	0.0169	834	0.277	3.37	10.93	4.77	732	0.089	0.046520	0.396	0.024400	0.470	0.0038041	0.264	0.54	24.64	9.48	24.48	0.11	24.48	0.06		
248-2																							
248-2-1	0.0214	1913	0.400	7.48	42.27	3.70	2681	0.129	0.046635	0.224	0.024384	0.778	0.0037922	0.748	0.96	30.57	5.36	24.46	0.19	24.40	0.18		
248-2-6	0.0166	2002	0.475	7.91	77.66	1.67	4797	0.154	0.046656	0.169	0.024411	0.211	0.0037947	0.134	0.60	31.67	4.03	24.49	0.05	24.42	0.03		
248-2-4	0.0094	1555	0.397	6.18	22.37	2.49	1427	0.128	0.046650	0.210	0.024292	0.308	0.0037767	0.225	0.73	31.32	5.03	24.37	0.07	24.30	0.05		
248-2-3	0.0070	794	0.253	3.37	6.38	3.20	437	0.082	0.046570	0.901	0.024416	0.924	0.0038025	0.196	0.22	27.21	21.6	24.49	0.22	24.47	0.05		
248-2-5	0.0267	1214	0.340	4.67	44.75	2.72	2881	0.110	0.046739	0.151	0.024434	0.291	0.0037915	0.251	0.86	35.89	3.60	24.51	0.07	24.40	0.06		
248-2-2	0.0214	1322	0.350	4.36	19.72	4.50	1278	0.113	0.046709	0.219	0.020335	0.256	0.0031575	0.141	0.52	34.37	5.24	20.44	0.05	20.32	0.03		
DG026																							
DG026-1	0.0067	522	0.821	7.46	15.98	2.94	919	0.263	0.04752	0.30	0.0781	0.340	0.01192	0.098	0.52	75.31	7.1	76.38	0.25	76.41	0.074		
DG026-2	0.0059	498	0.636	6.84	14.19	2.66	856	0.204	0.04752	0.50	0.0781	0.524	0.01192	0.134	0.33	75.20	12	76.37	0.39	76.41	0.102		
DG026-3	0.0058	571	0.654	7.69	21.64	1.97	1289	0.209	0.04754	0.32	0.0782	0.355	0.01193	0.099	0.46	76.64	7.6	76.44	0.26	76.44	0.075		
DG026-4	0.0034	609	0.627	9.30	5.14	5.15	323	0.201	0.04756	0.71	0.0782	0.753	0.01192	0.157	0.34	77.47	17	76.45	0.55	76.42	0.119		
DG026-5	0.0056	614	0.492	11.54	1.90	22.2	136	0.156	0.04716	1.26	0.0775	1.310	0.01192	0.287	0.27	57.46	30	75.80	0.96	76.39	0.217		
DG026-6	0.0052	682	0.633	6.66	9.46	3.31	577	0.204	0.04730	0.36	0.0535	0.400	0.00821	0.099	0.55	64.17	8.5	52.93	0.21	52.69	0.052		
AvQ244																							
AvQ244-7	0.0067	332	0.975	20.03	34.4	3.79	1871	0.309	0.05285	0.17	0.36406	0.24	0.04996	0.15	0.69	322.26	3.91	315.24	0.65	314.29	0.47		
AvQ244-8	0.0036	1688	0.302	92.88	39.6	8.24	2546	0.095	0.05332	0.14	0.39951	5.51	0.05434	5.51	1.00	342.61	3.10	341.29	16.0	341.10	18.3		
AvQ244-9	0.0057	1936	0.439	106.11	111	5.39	6859	0.139	0.05322	0.12	0.38875	0.30	0.05298	0.23	0.93	338.05	2.77	333.46	0.86	332.80	0.76		
AvQ244-10	0.0070	1684	0.441	91.57	59.6	10.6	3678	0.140	0.05316	0.16	0.38200	0.48	0.05211	0.42	0.94	335.72	3.67	328.50	1.35	327.49	1.35		
AvQ244-11F	0.0024	2171	0.400	131.69	7.9	35.6	507	0.126	0.05323	0.50	0.38942	2.28	0.05306	2.21	0.98	338.46	11.2	333.95	6.48	333.30	7.17		
AvQ244-12F	0.0057	893	0.493	49.34	170	1.64	10354	0.156	0.05317	0.12	0.38734	0.41	0.05283	0.36	0.96	336.13	2.77	332.43	1.15	331.90	1.16		
AvQ244-13F	0.0045	1594	0.493	88.96	92.4	4.29	5623	0.156	0.05325	0.10	0.38977	0.12	0.05309	0.08	0.58	339.54	2.29	334.20	0.35	333.43	0.25		

(a) z1, z2 etc. are labels for fractions composed of single zircon grains or fragments; all fractions annealed and chemically abraded after Mattinson (2005).
(b) Nominal fraction weights measured after chemical abrasion.
(c) Nominal U and total Pb concentrations subject to uncertainty in weighting zircons.
(d) Model Th/U ratio calculated from radiogenic ^{208}Pb/^{206}Pb ratio and ^{207}Pb/^{235}U age.
(e) Pb* and Pbc represent radiogenic and common Pb, respectively; mol % ^{206}Pb* with respect to radiogenic, blank and initial common Pb.
(f) Measured ratio corrected for spike and fractionation only. Mass fractionation correction of 0.11 ± 0.02 (1-sigma) %/amu (atomic mass unit) was applied to all single-collector Daly analyses, based on analysis of NBS-981 and NBS-982.
(g) Corrected for fractionation, spike, and common Pb; all common Pb was assumed to be procedural blank: ^{206}Pb/^{204}Pb = 18.30 ± 0.26%; ^{207}Pb/^{204}Pb = 15.47± 0.32%; ^{208}Pb/^{204}Pb = 37.60 ± 0.74% (all uncertainties 1-sigma). ^{206}Pb/^{238}U and ^{207}Pb/^{206}Pb ratios corrected for initial disequilibrium in ^{230}Th/^{238}U using Th/U [magma] = 3.3 (KPT04), 3.0 (059-1), 4.6 (029-5), 2.9 (248-2), 4.2 (DG026), 3.5 (AvQ244).
(h) Errors are 2-sigma, propagated using the algorithms of Schmitz and Schoene (2007) and Crowley et al. (2007).
(i) Calculations are based on the decay constants of Jaffey et al. (1971). ^{206}Pb/^{238}U and ^{207}Pb/^{206}Pb ages corrected for initial disequilibrium in ^{230}Th/^{238}U using Th/U [magma]
(j) Disequilibrium U-Th corrected after Schärer, 1984 [42].
(k) Disequilibrium U-Th corrected after Sakata *et al., 2013* [47].

Table 6 LA-ICP-MS U/Pb data

2012-2013, ETH Zurich					Data for Tera-Wasserburg plot				Data for Wetherill plot								Ages		
Identifier	Comments	206 cps	Uppm[1]	Th/U	$^{238}U/^{206}Pb$	1σ %	$^{207}Pb/^{206}Pb$	1σ %	$^{207}Pb/^{235}U$	1σ %	$^{206}Pb/^{238}U$	1σ %	Rho	$^{208}Pb/^{232}Th$	1σ %	$^{207}Pb/^{206}Pb$	2σ	$^{206}Pb/^{238}U$	
non-CA	**029-5**																		
1	1r	892	1117	0.234	274.29	1.92	0.04684	6.66	0.02355	6.84	0.00365	1.92	0.57	0.00126	8.73	41	159	23.46	
2	1c	419	520	0.308	271.35	2.17	0.04831	9.69	0.02455	10.0	0.00369	2.17	0.55	0.00134	9.70	114	229	23.71	
3	3r	758	959	0.187	277.31	1.94	0.04637	7.70	0.02306	7.72	0.00361	1.94	0.56	0.00117	9.40	17	185	23.20	
4	3c	520	657	0.190	275.79	2.21	0.04720	9.43	0.02360	9.62	0.00363	2.21	0.55	0.00106	11.32	59	225	23.33	
5	4r	1042	1364	0.224	285.24	2.00	0.04509	8.80	0.02180	8.58	0.00351	2.00	0.55	0.00156	9.62	-51	214	22.56	
6	4cr	660	801	0.192	264.13	1.85	0.04748	7.20	0.02479	7.26	0.00379	1.85	0.56	0.00143	9.09	74	171	24.36	
7	5rc	1192	1526	0.335	278.16	1.95	0.04670	6.55	0.02315	6.70	0.00360	1.95	0.57	0.00133	8.27	34	157	23.13	
8	6r	1384	1730	0.183	271.29	1.90	0.04133	7.60	0.02101	7.71	0.00369	1.90	0.56	0.00153	9.15	-267	193	23.72	
9	7r	460	570	0.321	267.73	2.14	0.04658	9.43	0.02399	9.59	0.00374	2.14	0.55	0.00122	9.84	28	226	24.03	
10	7c	659	853	0.201	282.01	3.10	0.04556	14.1	0.02228	13.6	0.00355	3.10	0.55	0.00105	16.19	-25	342	22.82	
11	9rc	500	629	0.206	271.30	2.44	0.04694	12.0	0.02386	12.0	0.00369	2.44	0.55	0.00109	13.76	46	286	23.72	
12	9c	406	464	0.204	247.77	2.73	0.04350	12.8	0.02421	11.8	0.00404	2.73	0.55	0.00097	16.49	-139	318	25.96	
13	11rc	851	1099	0.156	278.07	2.22	0.03601	10.2	0.01786	10.0	0.00360	2.22	0.55	0.00120	12.50	-630	280	23.14	
14	11rc	763	957	0.242	271.32	2.17	0.04458	9.22	0.02266	9.05	0.00369	2.17	0.56	0.00120	10.83	-78	226	23.72	
15	15rc	520	737	0.339	297.18	2.67	0.04353	13.0	0.02020	12.1	0.00337	2.67	0.55	0.00146	10.27	-137	322	21.66	
16	15r	862	1137	0.333	275.10	2.20	0.04622	8.48	0.02317	8.07	0.00364	2.20	0.56	0.00139	8.63	9	204	23.39	
17	15rc	399	533	0.174	276.54	2.49	0.04550	11.2	0.02269	10.9	0.00362	2.49	0.55	0.00116	13.79	-29	272	23.27	
18*	14r	794	780	0.175	203.00	4.67	0.06323	19.1	0.04295	18.4	0.00493	4.67	0.55	0.00357	17.37	716	406	31.68	
19	16r	1428	1894	0.194	272.04	1.90	0.04364	7.88	0.02212	7.51	0.00368	1.90	0.56	0.00149	9.40	-131	195	23.65	
20	16c	611	769	0.242	256.70	2.05	0.04622	9.15	0.02483	8.78	0.00390	2.05	0.55	0.00110	10.00	9	220	25.06	
21	17r	1141	1670	0.320	297.17	2.08	0.04913	8.20	0.02280	7.90	0.00337	2.08	0.56	0.00124	8.87	154	192	21.66	
22	17c	516	678	0.221	264.84	2.38	0.04736	10.7	0.02466	10.8	0.00378	2.38	0.55	0.00178	10.67	68	255	24.29	
23	18cr	1444	2014	0.173	280.42	2.52	0.04431	10.5	0.02179	10.1	0.00357	2.52	0.56	0.00131	12.21	-93	258	22.95	
24	19r	738	1024	0.218	275.04	2.75	0.04621	12.4	0.02317	12.4	0.00364	2.75	0.55	0.00108	13.89	9	299	23.40	
25	21cr	577	813	0.192	278.09	2.78	0.04618	11.6	0.02290	11.6	0.00360	2.78	0.56	0.00134	13.43	7	279	23.14	
26	21cr	507	698	0.337	269.90	2.16	0.04954	9.85	0.02531	10.0	0.00371	2.16	0.55	0.00135	11.11	173	230	23.84	
27	22c	453	686	0.155	295.31	2.95	0.04664	14.7	0.02178	14.7	0.00339	2.95	0.55	0.00095	18.95	31	353	21.79	
28	22r	503	685	0.231	264.15	3.70	0.04611	17.9	0.02407	17.7	0.00379	3.70	0.55	0.00047	25.53	3	432	24.36	
29	24cr	988	1402	0.196	273.53	1.91	0.04638	7.03	0.02338	7.19	0.00366	1.91	0.57	0.00126	11.11	17	169	23.52	
30	24r	660	950	0.248	272.06	2.18	0.04650	8.54	0.02357	8.57	0.00368	2.18	0.56	0.00096	9.38	24	205	23.65	
31	25r	260	358	0.259	258.70	4.92	0.04604	23.4	0.02454	22.9	0.00387	4.92	0.55	0.00104	20.19	0	564	24.87	
32	25c	780	1239	0.235	296.23	3.85	0.04558	18.4	0.02122	17.7	0.00338	3.85	0.55	0.00105	16.19	-24	446	21.72	
33	27cr	413	608	0.164	273.51	3.56	0.05028	15.3	0.02535	16.4	0.00366	3.56	0.55	0.00083	21.69	208	355	23.53	
34	28r	427	662	0.228	285.25	2.85	0.04745	12.8	0.02294	12.9	0.00351	2.85	0.55	0.00135	11.85	72	305	22.56	
35	28c	553	854	0.205	282.81	2.26	0.04651	10.1	0.02268	10.0	0.00354	2.26	0.55	0.00081	12.35	24	242	22.75	
36	31r	611	910	0.230	271.32	2.44	0.04614	9.90	0.02345	9.85	0.00369	2.44	0.56	0.00110	10.91	5	239	23.72	
37	31c	295	437	0.232	266.97	3.20	0.04877	14.3	0.02519	14.4	0.00375	3.20	0.55	0.00096	15.63	137	337	24.10	
38	32r	1387	2305	0.195	295.34	2.36	0.04718	9.24	0.02203	9.08	0.00339	2.36	0.56	0.00097	12.37	58	220	21.79	
39	32c	919	1485	0.187	285.22	2.57	0.04672	11.3	0.02259	11.4	0.00351	2.57	0.55	0.00119	13.45	35	272	22.56	
40	33r	357	610	0.196	298.87	4.78	0.04662	25.8	0.02151	25.2	0.00335	4.78	0.54	0.00138	21.01	30	619	21.53	
41	33c	184	312	0.188	295.33	3.25	0.04435	17.5	0.02071	16.6	0.00339	3.25	0.54	0.00101	16.83	-91	428	21.79	
42	34r	350	553	0.223	272.79	2.73	0.04552	12.4	0.02301	12.2	0.00367	2.73	0.55	0.00089	14.61	-28	300	23.59	
43	34rc	619	970	0.312	269.17	2.15	0.04722	9.72	0.02419	9.76	0.00372	2.15	0.56	0.00100	12.00	60	232	23.91	
CA	**029-5**																		
1	029-5-2	2070	324	0.058	252.72	6.44	0.04644	11.8	0.02534	11.6	0.00396	2.53	0.55	0.00140	12.14	21	569	25.46	
2	029-5-3	1492	789	0.051	255.95	4.63	0.04646	6.63	0.02503	6.83	0.00391	1.79	0.57	0.00142	10.56	22	318	25.14	
3	029-5-4	1874	673	0.040	259.27	5.43	0.04245	7.87	0.02258	8.15	0.00386	2.07	0.57	0.00160	12.50	-200	394	24.94	

4	029-5-5	1503	652	0.035	264.06	5.63	0.04592	9.15	0.02398	9.38	0.00379	2.11	0.56	0.00121	14.05	-7	441	24.39
5	029-5-6	1462	360	0.055	269.77	6.61	0.04672	11.0	0.02388	11.0	0.00371	2.43	0.56	0.00150	14.00	35	525	23.85
6	029-5-7	563	191	0.041	261.98	6.93	0.04702	13.8	0.02475	14.3	0.00382	2.62	0.55	0.00149	16.11	50	661	24.54
7	029-5-8	744	597	0.058	261.31	5.51	0.04673	7.81	0.02466	8.15	0.00383	2.09	0.57	0.00139	13.67	35	374	24.62
8	029-5-9	1856	163	0.039	261.30	7.58	0.04190	14.9	0.02211	14.6	0.00383	2.87	0.55	0.00123	18.70	-233	750	24.77
9	029-5-10	1630	325	0.034	251.44	6.38	0.04526	11.0	0.02482	10.9	0.00398	2.51	0.56	0.00161	16.15	-42	536	25.63
10	029-5-11	1617	1452	0.375	259.42	5.43	0.04669	9.04	0.02482	8.99	0.00385	2.08	0.56	0.00139	10.07	34	433	24.80
11	029-5-12	912	1368	0.217	269.85	6.61	0.05010	9.94	0.02560	9.92	0.00371	2.43	0.56	0.00123	12.20	199	462	23.74
12	029-5-14	523	1297	0.217	250.26	5.68	0.04592	9.28	0.02530	9.37	0.00400	2.25	0.56	0.00137	11.68	-7	448	25.73
13	029-5-15	1678	811	0.280	255.40	6.57	0.04741	12.2	0.02560	11.9	0.00392	2.55	0.55	0.00113	13.27	70	581	25.16
14	029-5-16	484	1223	0.358	249.70	5.03	0.04880	8.54	0.02695	8.65	0.00400	2.00	0.56	0.00134	10.45	138	401	25.69
15	029-5-18	1024	1295	0.191	263.43	5.60	0.04205	10.4	0.02201	10.6	0.00380	2.11	0.55	0.00142	12.68	-224	522	24.56
16	029-5-19	1273	1178	0.443	253.53	5.18	0.04696	9.29	0.02554	9.44	0.00394	2.03	0.56	0.00123	12.20	47	444	25.36
17	029-5-21	1152	1245	0.186	257.33	8.68	0.05266	14.7	0.02822	14.3	0.00389	3.35	0.55	0.00090	21.11	314	670	24.81
18	029-5-22	573	1535	0.247	274.30	6.07	0.05003	8.42	0.02515	8.59	0.00365	2.19	0.57	0.00117	13.68	196	391	23.35
19	029-5-23	1170	749	0.389	269.93	7.34	0.04532	12.7	0.02315	12.8	0.00370	2.70	0.55	0.00127	14.17	-39	616	23.87
20	029-5-24	717	917	0.163	265.52	6.40	0.05388	10.3	0.02798	10.3	0.00377	2.39	0.56	0.00164	15.24	366	464	24.01
21	029-5-25	1099	1286	0.203	255.37	5.26	0.05128	9.03	0.02769	8.78	0.00392	2.04	0.56	0.00119	11.76	253	415	25.04
22	029-5-26	899	1177	0.187	247.77	4.95	0.04621	8.92	0.02572	8.94	0.00404	1.98	0.56	0.00129	10.85	9	429	25.98
23	029-5-27	1096	1043	0.191	269.83	5.88	0.05121	9.31	0.02617	9.40	0.00371	2.16	0.56	0.00113	12.39	250	429	23.71
24	029-5-28	1036	1042	0.221	262.76	6.27	0.04790	10.1	0.02514	9.91	0.00381	2.36	0.56	0.00121	11.57	95	479	24.44
25	029-5-29	566	988	0.200	270.57	6.65	0.04707	12.2	0.02399	12.0	0.00370	2.44	0.55	0.00106	14.15	53	581	23.76
26	029-5-32	1073	686	0.333	276.62	7.72	0.05392	12.4	0.02688	12.4	0.00362	2.77	0.55	0.00102	13.73	368	561	23.05
27	029-5-34	1235	564	0.171	270.55	7.38	0.04693	13.7	0.02392	13.9	0.00370	2.71	0.55	0.00097	18.56	46	653	23.77
28	029-5-38	613	629	0.357	274.36	6.83	0.03911	14.8	0.01966	14.5	0.00364	2.47	0.54	0.00111	13.51	-409	775	23.67
29	029-5-39	759	700	0.178	273.52	6.79	0.04673	11.4	0.02356	11.2	0.00366	2.46	0.55	0.00127	11.81	36	545	23.52
30	029-5-40	1150	654	0.191	265.53	6.40	0.04633	11.9	0.02406	11.5	0.00377	2.39	0.55	0.00116	12.93	15	572	24.24
31	029-5-41	1102	925	0.330	271.37	5.94	0.04229	12.2	0.02149	12.1	0.00369	2.17	0.54	0.00112	9.82	-209	610	23.84
32	029-5-42	913	1007	0.189	269.83	7.34	0.04804	12.4	0.02455	12.0	0.00371	2.70	0.55	0.00101	14.85	101	585	23.80
33	029-5-43	953	1855	0.273	269.15	5.11	0.04446	8.19	0.02278	8.12	0.00372	1.88	0.56	0.00119	9.24	-85	401	23.97
34	029-5-44	893	1498	0.471	263.57	5.60	0.04698	8.60	0.02458	8.46	0.00379	2.11	0.56	0.00123	8.94	48	411	24.40
35	029-5-45	587	1127	0.308	274.33	6.07	0.04164	10.7	0.02093	10.4	0.00365	2.19	0.55	0.00116	11.21	-248	541	23.60
36	029-5-46	616	1044	0.399	267.05	6.47	0.04766	10.9	0.02461	10.7	0.00374	2.40	0.55	0.00110	11.82	82	517	24.06
37	029-5-47	646	1071	0.347	261.44	5.51	0.04618	9.55	0.02436	9.65	0.00382	2.09	0.55	0.00132	11.36	7	460	24.62
38	029-5-48	447	904	0.305	258.05	6.04	0.05212	10.3	0.02785	10.4	0.00388	2.32	0.56	0.00110	12.73	291	472	24.76
39	029-5-49	563	372	0.196	262.75	11.14	0.04693	24.6	0.02463	22.7	0.00381	4.20	0.54	0.00160	20.63	46	1175	24.48
40	029-5-50	844	1277	0.249	268.41	7.27	0.05217	11.8	0.02680	11.2	0.00373	2.68	0.56	0.00128	14.84	293	538	23.80
41	029-5-51	698	1846	0.450	260.13	5.45	0.04201	8.90	0.02227	9.03	0.00384	2.08	0.56	0.00115	12.17	-226	448	24.87
42*	029-5-52	4078	1500	0.189	279.64	6.31	0.04979	9.36	0.02455	9.25	0.00358	2.24	0.56	0.00138	13.77	185	436	22.92
43	029-5-53	657	1230	0.329	254.77	5.89	0.05194	9.20	0.02811	9.29	0.00393	2.29	0.56	0.00128	10.16	283	421	25.08
44	029-5-54	713	1320	0.339	266.31	5.72	0.04554	9.40	0.02358	9.42	0.00376	2.13	0.55	0.00116	10.34	-27	455	24.19
45	029-5-55	678	1165	0.372	253.50	5.83	0.04585	9.73	0.02494	9.78	0.00394	2.28	0.56	0.00121	9.92	-10	470	25.40
46	029-5-56	917	664	0.247	247.18	6.16	0.04962	12.2	0.02768	12.4	0.00405	2.47	0.55	0.00133	12.78	177	569	25.93
47	029-5-57	988	1566	0.267	260.04	6.14	0.04841	9.54	0.02567	9.70	0.00385	2.34	0.56	0.00121	11.57	119	450	24.68
48	029-5-58	1789	1737	0.185	264.13	6.33	0.04819	10.1	0.02516	10.2	0.00379	2.38	0.56	0.00110	13.64	109	478	24.31
non-CA	**059-1**																	
1	2r	587	1009	0.290	287.74	2.59	0.04666	11.3	0.02236	11.3	0.00348	2.59	0.55	0.00154	9.74	32	271	22.36
2	2c	375	586	0.237	264.15	2.64	0.04626	13.6	0.02415	13.5	0.00379	2.64	0.54	0.00124	12.90	11	328	24.36
3	2cr	527	869	0.202	278.87	2.51	0.04684	11.8	0.02316	11.7	0.00359	2.51	0.55	0.00104	11.54	41	283	23.08
4	4c	477	765	0.372	270.65	2.44	0.04659	11.2	0.02374	11.2	0.00369	2.44	0.55	0.00106	10.38	29	269	23.77
5	4r	787	1268	0.356	272.12	1.90	0.04801	7.81	0.02433	8.14	0.00367	1.90	0.56	0.00105	8.57	100	185	23.65
6	5r	421	669	0.274	269.15	2.42	0.04801	11.4	0.02460	11.7	0.00372	2.42	0.55	0.00146	10.27	100	269	23.91
7	5c	735	1187	0.219	273.54	2.74	0.04673	12.2	0.02356	12.0	0.00366	2.74	0.55	0.00107	13.08	36	292	23.52
8	6rc	654	1128	0.318	293.67	4.70	0.04804	22.7	0.02256	21.0	0.00341	4.70	0.55	0.00136	16.91	101	538	21.91

9	6cr	522	868	0.302	283.67	3.40	0.04789	15.6	0.02328	15.9	0.00353	3.40	0.55	0.00097	15.46	94	369	22.69
10	7c	534	858	0.370	275.12	2.20	0.04657	9.60	0.02334	9.64	0.00363	2.20	0.56	0.00116	11.21	27	230	23.39
11	7r	663	1060	0.281	274.32	2.19	0.04725	9.38	0.02375	9.69	0.00365	2.19	0.56	0.00117	11.97	62	223	23.46
12	8r	854	1408	0.461	283.75	2.27	0.04883	8.40	0.02373	8.72	0.00352	2.27	0.57	0.00130	10.77	140	197	22.68
13	8c	479	793	0.375	285.33	2.85	0.04947	12.4	0.02391	13.2	0.00350	2.85	0.55	0.00112	13.39	170	288	22.55
14	9c	363	586	0.224	278.88	2.79	0.04757	13.6	0.02352	13.9	0.00359	2.79	0.55	0.00050	20.00	78	324	23.07
15	10cr	702	1134	0.347	269.91	3.51	0.04946	14.9	0.02527	14.8	0.00370	3.51	0.55	0.00139	12.23	170	347	23.84
16	11c	1057	1710	0.227	268.40	2.15	0.04669	8.03	0.02399	8.13	0.00373	2.15	0.56	0.00112	8.93	34	192	23.97
17	11r	750	1174	0.369	258.08	2.32	0.04713	9.04	0.02518	9.10	0.00387	2.32	0.56	0.00102	9.80	56	216	24.93
18	12r	688	1115	0.303	264.88	3.18	0.04894	13.9	0.02548	13.8	0.00378	3.18	0.55	0.00135	11.85	145	327	24.29
19	13c	431	731	0.261	274.31	2.19	0.05025	9.55	0.02526	10.0	0.00365	2.19	0.55	0.00080	11.25	207	222	23.46
20	13r	443	730	0.258	264.86	2.38	0.02856	13.2	0.01487	13.3	0.00378	2.38	0.54	0.00102	10.78	-1313	421	24.29
21	14c	359	576	0.336	256.08	2.82	0.04652	12.5	0.02505	12.4	0.00391	2.82	0.55	0.00093	11.83	25	300	25.12
22	14rc	871	1407	0.284	255.40	2.04	0.04664	7.18	0.02518	7.39	0.00392	2.04	0.57	0.00151	9.27	31	172	25.19
23	15c	406	683	0.291	260.06	2.86	0.05571	11.8	0.02954	11.8	0.00385	2.86	0.55	0.00064	15.63	441	263	24.74
24	15r	1374	2391	0.402	266.34	1.86	0.04551	6.04	0.02356	6.24	0.00375	1.86	0.58	0.00128	10.16	-29	146	24.16
25	16r	713	1365	0.336	291.12	2.91	0.04826	12.6	0.02286	13.1	0.00344	2.91	0.55	0.00108	12.96	112	298	22.11
26	16c	785	1366	0.339	262.12	2.10	0.04695	8.75	0.02470	9.07	0.00382	2.10	0.56	0.00119	11.76	47	209	24.55
27	17r	646	1158	0.345	267.74	2.68	0.04679	11.1	0.02410	11.4	0.00373	2.68	0.56	0.00115	13.04	39	266	24.03
28	17c	245	424	0.280	255.40	3.32	0.04756	14.8	0.02568	15.1	0.00392	3.32	0.55	0.00057	21.05	78	351	25.19
29	19r	983	1902	0.414	280.54	3.65	0.04775	15.9	0.02347	15.7	0.00356	3.65	0.55	0.00136	12.50	87	376	22.94
30	19c	246	454	0.242	264.85	5.83	0.04431	30.2	0.02307	28.4	0.00378	5.83	0.54	0.00180	22.22	-93	742	24.29
31	19cr	400	762	0.261	272.07	4.35	0.04619	21.9	0.02341	21.7	0.00368	4.35	0.54	0.00151	17.22	7	528	23.65
32	20rc	344	643	0.319	264.89	2.38	0.04533	13.8	0.02360	13.4	0.00378	2.38	0.54	0.00127	12.60	-38	334	24.29
33	21c	762	1416	0.304	262.80	2.37	0.04522	9.55	0.02373	9.36	0.00381	2.37	0.56	0.00154	11.04	-44	232	24.48
34	21r	1339	2895	0.341	303.49	3.03	0.05203	13.0	0.02364	12.6	0.00329	3.03	0.55	0.00118	14.41	287	297	21.21
35	22c	722	1477	0.336	285.30	3.42	0.04483	17.4	0.02167	16.6	0.00351	3.42	0.55	0.00143	15.38	-65	424	22.56
36	22rc	417	898	0.308	298.04	3.28	0.04677	14.9	0.02164	14.9	0.00336	3.28	0.55	0.00136	15.44	38	356	21.59
37	23rc	693	1420	0.273	278.13	1.95	0.04556	8.65	0.02259	8.72	0.00360	1.95	0.56	0.00177	14.12	-25	209	23.14
38	23c	373	735	0.317	264.89	2.38	0.04628	13.0	0.02409	13.0	0.00378	2.38	0.55	0.00179	15.64	12	313	24.29
39	24rc	449	919	0.321	273.59	2.46	0.04694	11.1	0.02366	11.3	0.00366	2.46	0.55	0.00177	16.38	46	264	23.52
40	24c	397	819	0.282	273.57	2.46	0.05136	9.99	0.02589	10.0	0.00366	2.46	0.56	0.00154	17.53	257	230	23.52
41	25rc	294	558	0.319	250.30	3.50	0.04876	15.3	0.02686	15.7	0.00400	3.50	0.55	0.00194	20.62	136	359	25.70
42	25r	126	216	0.325	223.46	5.14	0.05014	26.9	0.03094	24.9	0.00448	5.14	0.55	0.00278	23.74	201	624	28.78
CA	**059-1**																	
1	059-1-2	787	937	0.335	252.20	2.27	0.04415	10.0	0.02414	10.5	0.00397	2.27	0.56	0.00120	11.67	-102	493	25.59
2	059-1-4	510	522	0.332	255.42	4.85	0.04747	24.9	0.02563	25.9	0.00392	4.85	0.54	0.00103	21.36	73	1183	25.16
3	059-1-5	439	866	0.331	262.81	2.37	0.04593	11.5	0.02410	11.8	0.00381	2.37	0.55	0.00133	12.78	-6	554	24.50
4	059-1-6	699	864	0.453	252.26	2.27	0.05892	9.30	0.03221	10.0	0.00396	2.27	0.56	0.00118	12.71	564	405	25.11
5	059-1-7	726	1443	0.316	252.83	2.02	0.04941	8.38	0.02695	9.17	0.00396	2.02	0.57	0.00115	13.04	168	391	25.35
6	059-1-8	1209	1711	0.353	255.43	2.04	0.04273	8.49	0.02307	9.32	0.00391	2.04	0.57	0.00116	13.79	-183	424	25.31
7	059-1-9	1418	1293	0.233	248.40	2.73	0.04608	12.3	0.02558	13.2	0.00403	2.73	0.55	0.00127	12.60	2	594	25.91
8	059-1-10	1113	1402	0.329	262.81	2.37	0.04871	9.71	0.02556	10.2	0.00381	2.37	0.56	0.00115	10.43	134	456	24.42
9	059-1-11	1142	1490	0.525	278.26	2.78	0.04847	11.9	0.02402	12.0	0.00359	2.78	0.55	0.00107	11.21	122	559	23.07
10	059-1-12	1147	891	0.362	262.13	2.36	0.04699	11.2	0.02472	11.4	0.00381	2.36	0.55	0.00129	10.85	49	537	24.53
11	059-1-13	730	1056	0.348	268.46	2.95	0.05371	12.1	0.02759	12.3	0.00372	2.95	0.56	0.00113	12.39	359	548	23.75
12	059-1-14	842	696	0.347	268.46	4.30	0.04881	20.1	0.02507	21.0	0.00372	4.30	0.55	0.00146	15.75	139	944	23.90
13	059-1-15	557	937	0.194	264.13	2.64	0.04814	13.3	0.02513	13.6	0.00379	2.64	0.55	0.00175	13.71	106	626	24.31
14	059-1-16	761	801	0.229	275.81	3.86	0.04780	19.0	0.02390	18.4	0.00363	3.86	0.55	0.00095	20.00	89	901	23.29
15	059-1-18	628	734	0.221	263.45	2.63	0.04700	14.0	0.02460	14.4	0.00380	2.63	0.55	0.00141	15.60	49	667	24.41
16	059-1-19	912	981	0.433	253.53	2.54	0.04721	11.6	0.02568	11.9	0.00394	2.54	0.55	0.00124	13.71	60	553	25.36
17	059-1-20	601	791	0.290	266.29	3.46	0.04673	17.2	0.02420	16.9	0.00376	3.46	0.55	0.00127	17.32	36	826	24.16
18	059-1-21	832	1077	0.367	243.02	2.43	0.04573	11.5	0.02595	12.0	0.00411	2.43	0.55	0.00131	15.27	-16	558	26.50
19	059-1-23	639	815	0.283	255.40	2.30	0.04521	11.4	0.02441	11.7	0.00392	2.30	0.55	0.00127	11.81	-44	553	25.23

20	059-1-24	953	1106	0.379	250.33	2.00	0.04624	9.17	0.02547	9.27	0.00399	2.00	0.55	0.00142	9.86	10	441	25.71
21	059-1-26	682	1181	0.304	258.72	2.07	0.05184	8.99	0.02763	9.19	0.00387	2.07	0.56	0.00127	11.81	278	412	24.70
22	059-1-30	680	879	0.431	268.50	2.95	0.04595	14.4	0.02360	14.7	0.00372	2.95	0.55	0.00131	14.50	-5	696	23.98
23	059-1-31	932	551	0.075	274.21	3.02	0.04090	17.6	0.02057	17.5	0.00365	3.02	0.54	0.00184	23.91	-294	899	23.63
24	059-1-32	485	471	0.350	271.38	3.26	0.04670	18.0	0.02373	17.4	0.00368	3.26	0.54	0.00121	17.36	34	862	23.71
25	059-1-34	959	1134	0.453	252.25	2.27	0.04632	9.78	0.02532	9.80	0.00396	2.27	0.56	0.00131	15.27	14	470	25.51
26	059-1-35	758	1248	0.484	253.55	2.28	0.04328	9.50	0.02354	9.90	0.00394	2.28	0.56	0.00142	15.49	-151	471	25.48
27	059-1-36	773	775	0.339	262.81	2.63	0.05134	11.4	0.02694	11.4	0.00381	2.63	0.56	0.00142	16.90	256	525	24.33
28	059-1-37	598	91	0.003	273.43	2.73	0.04721	13.9	0.02381	13.8	0.00366	2.73	0.55	0.00141	12.77	60	660	23.51
29	059-1-38	676	245	0.008	265.45	2.65	0.04658	12.9	0.02420	12.6	0.00377	2.65	0.55	0.00139	12.23	28	617	24.24
30	059-1-40	418	505	0.026	284.32	2.84	0.04643	13.8	0.02252	13.9	0.00352	2.84	0.55	0.00132	14.39	20	661	22.63
31	059-1-42	360	647	0.029	271.22	2.44	0.04770	10.2	0.02425	10.1	0.00369	2.44	0.56	0.00124	11.29	84	485	23.69
32	059-1-43	622	1644	0.042	268.31	3.49	0.05660	17.8	0.02909	17.9	0.00373	3.49	0.55	0.00158	17.72	476	785	23.68
33	059-1-44	912	293	0.003	271.94	2.99	0.04603	14.9	0.02334	15.3	0.00368	2.99	0.55	0.00111	14.41	-1	721	23.68
34	059-1-45	996	379	0.003	271.94	2.72	0.04887	13.9	0.02478	14.5	0.00368	2.72	0.55	0.00122	15.57	142	651	23.59
35	059-1-46	595	853	0.008	269.74	2.43	0.04603	10.7	0.02353	11.2	0.00371	2.43	0.56	0.00122	13.11	-1	518	23.87
36	059-1-47	857	1156	0.008	254.63	3.31	0.05309	14.7	0.02875	15.1	0.00393	3.31	0.55	0.00145	15.86	333	666	25.06
non-CA	**248-2**																	
1	1r	721	881	0.325	269.90	3.78	0.04613	17.9	0.02357	17.5	0.00371	3.78	0.55	0.00153	15.03	5	431	23.84
2	2c	615	738	0.333	265.60	2.12	0.04784	8.61	0.02484	8.66	0.00377	2.12	0.56	0.00137	10.95	92	204	24.23
3	2r	372	485	0.258	287.72	2.88	0.04726	13.6	0.02265	13.6	0.00348	2.88	0.55	0.00201	11.94	62	325	22.37
4	3cr	585	721	0.372	272.87	2.73	0.04460	12.1	0.02254	11.7	0.00366	2.73	0.55	0.00145	11.72	-77	296	23.58
5	3r	475	572	0.438	266.36	2.40	0.04491	9.82	0.02325	9.64	0.00375	2.40	0.56	0.00156	10.90	-61	239	24.16
6	4r	387	489	0.374	279.74	2.80	0.04481	13.4	0.02209	12.9	0.00357	2.80	0.55	0.00201	11.94	-66	328	23.00
7	4cr	316	366	0.268	256.71	2.57	0.04494	11.7	0.02414	11.4	0.00390	2.57	0.55	0.00107	15.89	-59	285	25.06
8	4r2	396	458	0.235	256.69	2.57	0.04434	11.7	0.02382	11.2	0.00390	2.57	0.55	0.00091	18.68	-92	287	25.06
9	5r	414	485	0.308	259.39	2.33	0.04733	10.4	0.02516	10.8	0.00386	2.33	0.55	0.00203	13.79	66	247	24.80
10	5c	440	510	0.291	257.38	2.57	0.04750	10.3	0.02545	10.6	0.00389	2.57	0.56	0.00159	15.09	75	244	25.00
11	5rc	568	682	0.375	266.33	2.13	0.04749	8.13	0.02459	8.38	0.00375	2.13	0.57	0.00165	14.55	74	193	24.16
12	6r	473	549	0.337	258.06	2.32	0.04671	9.80	0.02496	10.1	0.00388	2.32	0.56	0.00209	15.31	34	235	24.93
13	6cr	567	637	0.349	250.94	2.26	0.04540	9.05	0.02495	9.26	0.00398	2.26	0.57	0.00206	15.53	-34	220	25.64
14	6rc	642	802	0.368	278.18	2.78	0.04698	12.0	0.02329	12.1	0.00359	2.78	0.56	0.00219	16.89	48	288	23.13
15	7rc	526	641	0.355	270.64	2.44	0.04492	10.2	0.02289	10.3	0.00369	2.44	0.56	0.00242	16.94	-60	249	23.77
16	8r	817	1068	0.565	285.43	2.00	0.04494	8.66	0.02171	8.43	0.00350	2.00	0.56	0.00199	9.05	-59	211	22.55
17	8cr	537	668	0.417	272.15	2.72	0.04632	11.7	0.02347	11.6	0.00367	2.72	0.55	0.00180	11.11	14	282	23.64
18	8c	856	1130	0.389	287.80	2.01	0.04560	8.73	0.02185	8.61	0.00347	2.01	0.55	0.00194	9.28	-23	211	22.36
19	9cr	589	722	0.382	267.04	2.14	0.04694	8.59	0.02424	8.42	0.00374	2.14	0.56	0.00177	9.60	46	205	24.09
20	9r	556	676	0.320	264.89	2.12	0.04587	8.35	0.02388	8.33	0.00378	2.12	0.56	0.00150	10.00	-9	202	24.29
21	10r	470	586	0.321	270.63	2.71	0.04557	13.6	0.02322	13.2	0.00370	2.71	0.55	0.00135	12.59	-25	329	23.78
22	10c	410	501	0.392	264.93	2.38	0.04619	10.6	0.02404	10.5	0.00377	2.38	0.55	0.00169	10.65	7	254	24.29
23	11rc	529	648	0.489	265.68	2.13	0.04531	9.91	0.02352	9.61	0.00376	2.13	0.55	0.00183	9.84	-39	241	24.22
24	11c	602	761	0.331	272.85	2.18	0.04594	8.66	0.02322	8.70	0.00367	2.18	0.56	0.00179	10.06	-5	209	23.58
25	11r	318	392	0.357	265.61	2.39	0.04580	11.4	0.02378	11.4	0.00376	2.39	0.55	0.00175	10.29	-13	275	24.22
26	12r	618	764	0.448	267.07	2.67	0.04813	10.5	0.02485	10.9	0.00374	2.67	0.56	0.00141	11.35	106	249	24.09
27	13r	542	705	0.277	278.13	2.50	0.04490	10.1	0.02226	10.2	0.00360	2.50	0.57	0.00098	13.27	-61	246	23.14
28	13c	289	342	0.282	254.75	3.31	0.04700	16.3	0.02544	16.5	0.00393	3.31	0.55	0.00039	28.21	49	389	25.26
29	14r	537	674	0.345	269.91	2.16	0.04666	8.89	0.02384	9.23	0.00370	2.16	0.56	0.00144	10.42	32	213	23.84
30	14cr	592	745	0.430	271.41	2.17	0.04625	8.30	0.02350	8.64	0.00368	2.17	0.57	0.00137	10.22	11	200	23.71
CA	**248-2**																	
1	248-2-1	918	592	0.147	266.93	2.14	0.04713	9.21	0.02403	9.45	0.00375	2.14	0.56	0.00145	11.72	55	207	24.11
2	248-2-3	1242	796	0.219	267.68	2.14	0.04372	9.90	0.02220	10.1	0.00374	2.14	0.55	0.00157	11.46	0	102	24.04
3	248-2-4	631	833	0.212	258.67	2.07	0.04506	8.28	0.02434	8.67	0.00387	2.07	0.57	0.00155	11.61	0	137	24.87
4	248-2-6	1366	449	0.201	253.42	2.28	0.04489	10.6	0.02478	10.9	0.00395	2.28	0.55	0.00141	13.48	0	179	25.39

5	248-2-8	888	474	0.141	262.77	2.36	0.04640	10.8	0.02441	10.9	0.00381	2.36	0.55	0.00154	11.04	18	242	24.49
6	248-2-7	763	623	0.243	264.86	2.12	0.04952	8.66	0.02600	8.77	0.00378	2.12	0.56	0.00139	10.79	173	190	24.29
7	248-2-10	1007	675	0.248	265.62	2.12	0.04939	8.42	0.02534	8.56	0.00376	2.12	0.56	0.00149	9.40	166	186	24.22
8	248-2-11	869	837	0.380	265.60	2.66	0.04835	12.3	0.02509	12.4	0.00377	2.66	0.55	0.00141	12.06	117	268	24.23
9	248-2-13	935	611	0.340	261.38	2.61	0.05269	12.4	0.02812	12.4	0.00383	2.61	0.55	0.00188	12.77	316	259	24.62
10	248-2-14	1160	560	0.206	267.05	2.14	0.05337	9.52	0.02661	9.70	0.00374	2.14	0.55	0.00136	12.50	344	202	24.09
11	248-2-16	848	358	0.221	269.18	1.88	0.04886	7.25	0.02431	7.65	0.00372	1.88	0.57	0.00156	12.18	141	162	23.90
12	248-2-18	702	667	0.436	267.01	2.40	0.04160	11.0	0.02136	11.2	0.00375	2.40	0.55	0.00149	13.42	0	7	24.10
13	248-2-20	507	617	0.395	270.65	2.44	0.04798	9.82	0.02389	10.1	0.00369	2.44	0.56	0.00167	13.77	97	219	23.77
14	248-2-23	880	1283	0.347	269.16	2.69	0.04806	12.17	0.02312	12.2	0.00372	2.69	0.55	0.00152	11.84	102	265	23.91
15	248-2-22	4390	1191	0.339	264.25	2.38	0.04897	10.27	0.02432	10.4	0.00378	2.38	0.56	0.00157	10.19	146	224	24.35
16	248-2-29	3819	617	0.312	264.84	2.12	0.05079	9.88	0.02523	10.0	0.00378	2.12	0.55	0.00139	12.2	232	213	24.29
17	248-2-28	1643	1206	0.376	257.37	2.32	0.05029	11.0	0.02605	11.1	0.00389	2.32	0.55	0.00170	11.8	208	237	25.00
18	248-2-27	860	674	0.348	260.75	2.35	0.04895	9.81	0.02488	10.0	0.00384	2.35	0.56	0.00127	11.8	145	215	24.68
19	248-2-25	1660	1865	0.005	262.75	3.42	0.05518	16.4	0.02863	16.4	0.00381	3.42	0.55	0.00170	17.1	419	330	24.49
20	248-2-26	926	667	0.310	258.77	2.33	0.04298	11.3	0.02185	11.5	0.00386	2.33	0.55	0.00146	12.3	0	89	24.86
21	248-2-2	627	469	0.179	266.94	2.67	0.03678	15.3	0.01930	15.4	0.00375	2.67	0.54	0.00149	13.4	0	0	24.10
22	248-2-5	946	678	0.438	268.39	2.15	0.05621	9.07	0.02875	9.43	0.00373	2.15	0.56	0.00151	12.6	460	190	23.97
23	248-2-9	828	597	0.218	259.31	2.33	0.04976	12.7	0.02894	9.68	0.00386	2.33	0.57	0.00179	14.5	184	271	24.81
24	248-2-15	773	544	0.273	280.56	2.24	0.04725	10.8	0.02310	10.9	0.00356	2.24	0.55	0.00152	11.2	61	239	22.94
25	248-2-17	1006	720	0.320	292.83	2.93	0.04793	13.5	0.02216	13.6	0.00341	2.93	0.55	0.00159	13.8	95	294	21.98
26	248-2-19	691	502	0.205	259.41	2.08	0.03968	10.4	0.02042	10.7	0.00385	2.08	0.55	0.00146	14.4	0	0	24.80
27	248-2-24	3917	798	0.414	277.31	2.50	0.06099	11.2	0.02896	11.3	0.00361	2.50	0.55	0.00206	12.1	102	265	23.20
28	248-2-46	1109	1139	0.374	267.01	2.14	0.05779	8.81	0.03056	8.97	0.00375	2.14	0.56	0.00150	10.0	522	183	24.10
29	248-2-51	1543	1050	0.344	260.00	2.08	0.04188	8.95	0.02198	9.10	0.00385	2.08	0.56	0.00162	11.1	0	0	24.75
30	248-2-50a	1443	344	0.217	258.02	2.84	0.03960	14.6	0.02063	14.6	0.00388	2.84	0.55	0.00136	14.0	0	0	24.94
31	248-2-59	456	529	0.370	265.58	2.39	0.05929	9.80	0.03065	10.1	0.00377	2.39	0.56	0.00162	13.6	578	200	24.23
32	248-2-60	700	1589	0.318	274.29	3.02	0.06008	13.1	0.03047	13.3	0.00365	3.02	0.55	0.00132	16.7	607	261	23.46
33	248-2-61	2062	634	0.276	269.88	2.70	0.04749	15.4	0.01742	15.3	0.00371	2.70	0.54	0.00142	15.5	73	331	23.84
34	248-2-68	827	665	0.308	258.04	2.06	0.05936	8.54	0.03138	8.73	0.00388	2.06	0.56	0.00189	10.1	580	175	24.93
35	248-2-32	771	758	0.176	263.52	2.11	0.04861	7.88	0.02454	8.35	0.00379	2.11	0.57	0.00206	12.1	129	176	24.42
36	248-2-30	1067	597	0.233	258.73	2.59	0.04398	12.0	0.02212	12.3	0.00386	2.59	0.55	0.00168	12.5	0	161	24.87
37	248-2-31	1083	604	0.365	266.96	3.74	0.05831	18.3	0.02901	18.3	0.00375	3.74	0.55	0.00163	13.5	541	357	24.10
38	248-2-33	909	644	0.339	265.62	2.39	0.05528	10.5	0.02728	10.9	0.00376	2.39	0.56	0.00139	20.1	424	218	24.22
39	248-2-35	1641	564	0.285	269.17	2.15	0.04886	9.21	0.02406	9.73	0.00372	2.15	0.56	0.00149	14.8	141	203	23.91
40	248-2-37	729	987	0.343	255.40	3.32	0.04800	15.6	0.02554	15.9	0.00392	3.32	0.55	0.00168	14.3	98	334	25.19
41	248-2-50	1190	538	0.083	265.62	2.39	0.04301	12.1	0.02208	12.2	0.00376	2.39	0.55	0.00157	10.8	0	110	24.22
42	248-2-53	785	710	0.308	260.08	2.34	0.04628	10.3	0.02476	10.4	0.00385	2.34	0.55	0.00139	10.8	12	230	24.74
43	248-2-52	967	1028	0.303	251.55	3.02	0.04608	14.1	0.02549	14.1	0.00398	3.02	0.55	0.00169	13.0	2	308	25.58
44	248-2-55	845	1295	0.385	258.73	2.85	0.04780	12.2	0.02465	12.3	0.00386	2.85	0.55	0.00149	12.1	89	268	24.87
45	248-2-54	719	536	0.281	274.22	2.47	0.05283	11.3	0.02661	11.5	0.00365	2.47	0.55	0.00149	18.8	322	238	23.47
46	248-2-57	836	720	0.222	268.44	2.42	0.04357	10.7	0.02288	10.9	0.00373	2.42	0.56	0.00134	12.7	0	110	23.97
47	248-2-56	904	1005	0.294	258.72	2.07	0.04993	7.79	0.02602	8.23	0.00387	2.07	0.57	0.00141	12.1	192	172	24.87
48	248-2-58	905	692	0.311	264.22	1.85	0.04952	7.19	0.02565	7.72	0.00378	1.85	0.57	0.00137	12.4	173	160	24.35
49	248-2-62	1056	785	0.306	267.01	2.14	0.04881	10.1	0.02471	10.2	0.00375	2.14	0.55	0.00151	9.93	139	221	24.10
50	248-2-63	836	458	0.237	258.72	2.33	0.04872	10.5	0.02613	10.6	0.00387	2.33	0.55	0.00162	9.88	135	230	24.87
51	248-2-65	819	845	0.261	258.02	2.58	0.04549	12.4	0.02420	12.4	0.00388	2.58	0.55	0.00143	11.9	0	246	24.94
52	248-2-64	888	600	0.214	266.27	2.13	0.04791	8.85	0.02402	8.99	0.00376	2.13	0.56	0.00161	9.94	94	198	24.16
53	248-2-66	801	800	0.318	262.06	2.62	0.04690	12.9	0.02474	12.9	0.00382	2.62	0.55	0.00146	12.3	44	282	24.55
54	248-2-67	696	806	0.287	265.59	2.12	0.05246	9.04	0.02641	9.20	0.00377	2.12	0.56	0.00164	10.4	305	193	24.23
55	248-2-69	937	542	0.236	278.11	2.78	0.04770	14.4	0.02379	14.5	0.00360	2.78	0.55	0.00137	13.9	83	312	23.14
non-CA	**DG026**																	
1	DG026-1	2183	146	0.675	85.40	1.62	0.05078	5.53	0.07950	6.08	0.01171	1.62	0.50	0.00338	5.00	231	123	75.1
2	DG026-2	1032	62	0.730	89.37	1.61	0.04952	5.33	0.07662	5.89	0.01119	1.61	0.50	0.00344	6.43	172	120	71.7

3	DG026-3	4212	295	0.426	84.39	1.86	0.05291	6.63	0.08521	7.26	0.01185	1.86	0.50	0.00347	5.35	325	143	75.9
4	DG026-4	1566	104	0.524	88.03	1.94	0.04530	7.95	0.07018	8.56	0.01136	1.94	0.50	0.00392	5.27	0	143	72.8
5	DG026-5	1582	109	0.436	85.03	2.04	0.04724	8.15	0.07527	8.83	0.01176	2.04	0.50	0.00361	3.92	61	184	75.3
6	DG026-6	1467	98	0.463	82.44	1.73	0.04703	6.23	0.07910	6.85	0.01213	1.73	0.50	0.00426	5.72	50	143	77.7
7	DG026-7	1717	111	0.619	86.13	1.55	0.05405	4.81	0.08839	5.48	0.01161	1.55	0.50	0.00381	5.59	373	104	74.4
8	DG026-8	1925	130	0.449	83.26	1.50	0.05128	4.72	0.08375	5.37	0.01201	1.50	0.50	0.00372	9.37	254	105	77.0
9	DG026-9	1631	106	0.532	82.78	1.57	0.04931	5.07	0.08014	5.76	0.01208	1.57	0.50	0.00363	7.35	162	114	77.4
10	DG026-10	1419	92	0.435	82.03	1.72	0.04874	6.50	0.08015	7.22	0.01219	1.72	0.50	0.00408	4.46	135	146	78.1
11	DG026-11	1148	74	0.616	84.67	1.78	0.05073	6.41	0.07971	7.18	0.01181	1.78	0.50	0.00338	4.56	229	141	75.7
12	DG026-12	1204	76	0.520	85.91	1.80	0.04785	6.96	0.07474	7.75	0.01164	1.80	0.50	0.00386	4.10	91	158	74.6
13	DG026-13	1488	99	0.458	88.18	1.94	0.05161	7.19	0.07838	7.81	0.01134	1.94	0.50	0.00357	6.24	268	157	72.7
14	DG026-14	1717	116	0.534	85.84	1.89	0.04668	7.54	0.07652	8.18	0.01165	1.89	0.50	0.00352	6.50	33	172	74.7
15	DG026-15	1471	102	0.530	85.76	1.54	0.05494	4.71	0.08772	5.30	0.01166	1.54	0.50	0.00396	7.37	410	102	74.7
16	DG026-16	1651	112	0.507	85.76	1.46	0.04964	4.67	0.08085	5.27	0.01166	1.46	0.50	0.00361	3.86	178	106	74.8
17	DG026-17	1420	96	0.493	85.84	1.72	0.05227	6.14	0.08362	6.78	0.01165	1.72	0.50	0.00363	4.53	297	134	74.6
18	DG026-18	1603	108	0.455	89.21	1.87	0.04481	7.45	0.07137	8.14	0.01121	1.87	0.50	0.00381	6.96	0	107	71.9
19	DG026-19	1523	111	0.465	88.65	2.04	0.04496	8.52	0.07274	9.29	0.01128	2.04	0.50	0.00354	5.00	0	138	72.3
20	DG026-20	1595	107	0.434	84.10	2.35	0.05231	9.75	0.08392	10.64	0.01189	2.35	0.50	0.00476	3.94	299	208	76.2
21	DG026-21	1002	68	0.476	88.50	2.12	0.04683	8.78	0.07193	9.56	0.01130	2.12	0.50	0.00358	6.15	41	198	72.5
22	DG026-22	1578	111	0.516	88.03	2.11	0.04737	8.66	0.07375	9.48	0.01136	2.11	0.50	0.00353	3.68	67	195	72.8
23	DG026-23	1948	136	0.629	88.89	1.60	0.04968	5.35	0.07595	6.19	0.01125	1.60	0.50	0.00381	6.89	180	120	72.1
24	DG026-24	1089	72	0.566	86.66	2.08	0.05697	7.85	0.09074	8.78	0.01154	2.08	0.50	0.00441	2.91	490	165	74.0
25	DG026-25	1940	135	0.482	88.50	1.59	0.04863	5.63	0.07559	6.18	0.01130	1.59	0.50	0.00353	5.95	130	128	72.4
26	DG026-26	1380	96	0.629	89.13	1.78	0.05222	6.38	0.07815	6.97	0.01122	1.78	0.50	0.00347	4.43	295	139	71.9
27	DG026-27	2423	170	0.588	87.95	1.50	0.04559	4.74	0.06981	5.26	0.01137	1.50	0.50	0.00354	5.43	0	86	72.9
28	DG026-28	1372	94	0.517	86.58	1.65	0.04715	5.98	0.07481	6.55	0.01155	1.65	0.50	0.00335	7.67	57	137	74.0
29	DG026-29	1745	122	0.369	87.41	2.62	0.04668	11.8	0.07645	12.71	0.01144	2.62	0.50	0.00330	7.31	33	261	73.3
30	DG026-30	2207	156	0.597	87.80	2.11	0.04960	8.29	0.07760	9.02	0.01139	2.11	0.50	0.00370	13.0	176	183	73.0
31	DG026-31	2049	143	0.419	84.60	2.12	0.04688	8.75	0.07863	9.51	0.01182	2.12	0.50	0.00352	10.0	43	197	75.7
CA	**DG026**																	
1	DG026-1	1832	102	0.521	82.37	1.32	0.04629	4.54	0.07803	4.65	0.01214	1.32	0.64	0.00391	3.84	13	106	77.8
2	DG026-2	2806	155	0.722	81.70	1.23	0.04651	3.53	0.07816	3.63	0.01224	1.23	0.65	0.00412	3.16	24	83	78.4
3	DG026-3	2242	127	0.532	83.82	1.26	0.04764	3.67	0.07777	3.79	0.01193	1.26	0.64	0.00410	3.41	81	86	76.5
4	DG026-4	7121	99	0.591	84.96	1.19	0.04838	3.53	0.07735	3.67	0.01177	1.19	0.64	0.00360	3.61	118	81	75.5
5	DG026-5	2268	135	0.650	84.60	1.27	0.04742	3.82	0.07645	3.99	0.01182	1.27	0.64	0.00393	4.07	70	89	75.7
6	DG026-6	2171	130	0.603	83.06	1.33	0.04769	4.30	0.07891	4.50	0.01204	1.33	0.64	0.00394	4.57	83	100	77.2
7	DG026-7	2658	154	0.551	83.96	1.34	0.05344	4.23	0.08627	4.45	0.01191	1.34	0.64	0.00407	4.91	348	93	76.3
8	DG026-8	2116	120	0.682	82.64	1.24	0.04819	3.07	0.07999	3.19	0.01210	1.24	0.65	0.00408	3.19	109	71	77.5
9	DG026-9	2527	148	0.500	84.39	1.35	0.04824	4.23	0.07834	4.35	0.01185	1.35	0.64	0.00382	3.93	111	97	75.9
10	DG026-10	2499	152	0.564	83.40	1.33	0.04757	4.06	0.07870	4.19	0.01199	1.33	0.64	0.00380	3.68	77	95	76.8
11	DG026-11	2106	121	0.622	84.18	1.35	0.04746	3.92	0.07773	4.07	0.01188	1.35	0.64	0.00385	3.64	72	91	76.1
12	DG026-12	1806	110	0.467	85.40	1.54	0.04965	5.46	0.08093	5.59	0.01171	1.54	0.63	0.00372	4.57	179	122	75.0
13	DG026-13	1966	115	0.687	86.43	1.30	0.04860	3.66	0.07824	3.81	0.01157	1.30	0.64	0.00346	3.76	128	84	74.2
14	DG026-14	1721	105	0.451	82.44	1.48	0.04841	5.08	0.08180	5.26	0.01213	1.48	0.65	0.00385	4.94	120	116	77.7
15	DG026-15	1449	80	0.475	82.17	1.31	0.04909	3.99	0.08217	4.17	0.01217	1.31	0.65	0.00397	4.53	152	91	78.0
16	DG026-16	3811	224	0.599	84.39	1.35	0.04971	4.10	0.08093	4.29	0.01185	1.35	0.64	0.00374	4.55	181	93	75.9
17	DG026-17	1768	107	0.560	84.10	1.35	0.04754	4.04	0.07666	4.24	0.01189	1.35	0.64	0.00379	4.75	76	94	76.2
18	DG026-18	2274	136	0.500	86.51	1.38	0.04755	4.19	0.07583	4.39	0.01156	1.38	0.64	0.00390	4.87	76	97	74.1
19	DG026-19	2497	151	0.432	83.61	1.42	0.04767	4.38	0.07869	4.63	0.01196	1.42	0.65	0.00400	5.25	82	102	76.6
20	DG026-20	1389	85	0.530	83.54	1.34	0.04770	3.73	0.07794	3.85	0.01197	1.34	0.64	0.00424	3.54	83	87	76.7
21	DG026-21	2970	184	0.488	82.37	1.32	0.04758	3.83	0.07852	3.95	0.01214	1.32	0.64	0.00420	3.57	78	89	77.8
22	DG026-22	1368	81	0.485	82.85	1.33	0.04948	4.22	0.08184	4.34	0.01207	1.33	0.64	0.00443	3.84	171	96	77.3
23	DG026-23	2064	123	0.740	84.10	1.35	0.04822	3.84	0.07658	3.98	0.01189	1.35	0.63	0.00426	3.52	110	88	76.2
24	DG026-24	1968	120	0.505	84.25	1.35	0.04743	4.07	0.07849	4.19	0.01187	1.35	0.64	0.00389	3.86	70	94	76.0

25	DG026-25	2449	149	0.550	85.98	1.38	0.04625	3.91	0.07317	4.06	0.01163	1.38	0.63	0.00383	3.92	11	91	74.5
26	DG026-26	2024	127	0.478	82.10	1.40	0.04959	4.56	0.08447	4.77	0.01218	1.40	0.65	0.00359	4.74	176	103	78.0
27	DG026-27	1391	82	0.401	86.51	1.73	0.04852	6.74	0.07742	6.91	0.01156	1.73	0.63	0.00348	6.03	125	152	74.1
28	DG026-28	1771	108	0.604	86.21	1.29	0.04984	3.65	0.08002	3.89	0.01160	1.29	0.64	0.00348	4.60	188	83	74.3
29	DG026-29	2452	151	0.584	85.40	1.37	0.04806	3.97	0.07861	4.22	0.01171	1.37	0.65	0.00350	4.86	102	91	75.1
30	DG026-30	2362	143	0.474	85.76	1.46	0.05070	5.03	0.08030	5.16	0.01166	1.46	0.63	0.00374	4.28	227	112	74.7
31	DG026-31	1890	115	0.648	86.58	1.30	0.04772	4.09	0.07568	4.22	0.01155	1.30	0.63	0.00360	3.61	85	95	74.1
32	DG026-32	3553	220	0.519	85.76	1.37	0.05277	4.17	0.08534	4.31	0.01166	1.37	0.64	0.00393	4.07	319	92	74.8
33	DG026-33	1991	124	0.481	82.92	1.33	0.04753	3.66	0.07752	3.82	0.01206	1.33	0.64	0.00385	3.90	75	85	77.3
34	DG026-34	1682	100	0.533	84.10	1.35	0.04764	4.30	0.07702	4.45	0.01189	1.35	0.64	0.00383	4.18	80	100	76.2
non-CA	**AvQ244**																	
1	19c	3802	82	2.140	22.59	1.11	0.06519	1.99	0.39787	1.97	0.04426	1.11	0.61	0.01051	4.85	781	42	279
2	14c	3344	82	1.447	22.30	1.18	0.06727	2.50	0.41590	2.45	0.04484	1.18	0.59	0.01073	5.78	846	52	283
4	5r	2889	72	0.164	22.13	1.15	0.05827	2.33	0.36311	2.30	0.04520	1.15	0.60	0.01183	5.24	540	51	285
5	1r	1002	76	0.385	21.92	1.14	0.06257	2.13	0.39355	2.11	0.04562	1.14	0.60	0.00597	4.86	694	45	288
6	6r	6431	58	0.270	21.86	1.14	0.06836	2.09	0.43118	2.08	0.04575	1.14	0.61	0.01598	4.76	879	43	288
7	22c	3165	24	0.767	21.44	1.16	0.05548	2.49	0.35672	2.45	0.04663	1.16	0.59	0.01216	5.26	432	55	294
8	24c	3503	101	0.319	21.09	1.16	0.05779	2.49	0.37784	2.43	0.04742	1.16	0.59	0.00556	6.29	522	55	299
9	12r	3665	117	0.577	20.55	1.19	0.06727	2.78	0.41590	2.96	0.04866	1.19	0.59	0.01418	5.64	846	58	306
10	31r	4265	66	0.154	20.18	1.17	0.06135	2.62	0.41910	2.57	0.04955	1.17	0.59	0.01542	6.87	651	56	312
11	11r	2447	80	0.175	19.95	1.18	0.05804	2.53	0.40119	2.49	0.05014	1.18	0.59	0.01033	5.71	531	55	315
12	3r	3918	60	0.237	19.78	1.13	0.05554	1.98	0.38714	1.97	0.05056	1.13	0.61	0.01091	4.77	434	44	318
14	23c	3296	38	0.457	19.46	1.15	0.06066	2.31	0.42970	2.27	0.05137	1.15	0.60	0.01249	5.60	627	50	323
12	16r	3102	56	0.225	19.17	1.21	0.05524	2.70	0.39737	2.65	0.05218	1.21	0.59	0.00598	6.19	422	60	328
13	10r	1366	65	0.157	19.13	1.17	0.05483	2.33	0.39528	2.29	0.05229	1.17	0.60	0.01171	5.47	405	52	329
14	18r	2895	69	0.174	19.02	1.10	0.05412	2.03	0.39225	2.01	0.05257	1.10	0.60	0.01546	4.79	376	46	330
15	15r	3256	59	0.172	18.82	1.19	0.05432	2.67	0.39806	2.61	0.05315	1.19	0.59	0.01089	5.97	384	60	334
16	23r	2756	47	0.168	18.48	1.15	0.05398	2.33	0.40272	2.30	0.05411	1.15	0.60	0.01536	5.53	370	53	340
17*	30c	4256	34	0.099	13.86	1.37	0.05633	4.01	0.56042	3.92	0.07216	1.37	0.57	0.02280	8.60	465	89	449
18*	5c2	3985	40	0.296	13.78	1.36	0.05887	3.82	0.58907	3.73	0.07258	1.36	0.57	0.02066	5.71	562	83	452
19*	6c	5245	122	0.330	13.20	1.62	0.06402	5.12	0.66899	4.99	0.07579	1.62	0.56	0.02501	6.20	742	108	471
20*	31c	5008	23	0.202	11.15	1.47	0.06171	4.41	0.76297	4.30	0.08967	1.47	0.57	0.03229	7.87	664	94	554
21*	32r	6325	49	0.125	11.12	1.28	0.05792	3.35	0.71798	3.26	0.08990	1.28	0.58	0.02647	8.05	527	73	555
22*	5c1	5690	66	0.314	11.10	1.28	0.08909	2.84	1.10631	2.78	0.09007	1.28	0.59	0.04252	5.13	1406	54	556
23*	17c	8540	134	0.269	10.32	1.23	0.05978	2.88	0.79898	2.81	0.09693	1.23	0.58	0.02534	6.24	596	62	596
24*	20c	5245	34	0.158	7.77	1.31	0.06507	3.32	1.15489	3.25	0.12872	1.31	0.58	0.03630	6.03	777	70	781
25*	25c	3956	150	0.217	6.67	1.41	0.09251	3.55	1.91296	3.44	0.14997	1.41	0.58	0.09057	6.94	1478	67	901
CA	**AvQ244**																	
1	AvQ244-1	676	226	0.722	20.19	0.97	0.08473	2.24	0.47621	2.82	0.04952	0.97	0.88	0.00940	6.28	1309	43	312
2	AvQ244-2	418	789	0.686	19.93	1.18	0.11050	2.24	0.42011	4.78	0.05017	1.18	0.89	0.01484	6.06	1808	40	316
3	AvQ244-3	360	777	0.543	19.74	1.16	0.09346	2.21	0.42453	3.87	0.05065	1.16	0.89	0.01391	5.82	1497	41	318
4	AvQ244-4	622	91	0.139	19.51	1.40	0.05263	3.63	0.37447	4.30	0.05125	1.40	0.90	0.01504	7.45	313	81	322
5	AvQ244-5	912	40	0.423	19.39	1.45	0.05311	4.07	0.39501	4.68	0.05157	1.45	0.90	0.01714	5.37	334	89	324
6	AvQ244-6	996	40	0.492	19.24	1.50	0.05621	4.50	0.38507	5.15	0.05197	1.50	0.89	0.01457	4.94	460	98	327
7	AvQ244-7	595	85	0.762	18.92	1.32	0.04965	3.18	0.36025	3.72	0.05286	1.32	0.90	0.01760	5.91	179	73	332
8	AvQ244-8	1208	76	0.013	18.86	1.32	0.05107	3.07	0.37548	3.60	0.05303	1.32	0.90	0.01878	12.8	244	70	333
9	AvQ244-9	5798	18	0.158	18.84	2.49	0.04866	10.8	0.44218	12.41	0.05307	2.49	0.91	0.03008	9.71	132	235	333
10	AvQ244-10	9868	68	0.668	18.75	1.39	0.05669	3.51	0.39816	4.05	0.05333	1.39	0.89	0.01815	4.90	479	76	335
11	AvQ244-11	3693	128	0.009	18.69	1.27	0.05326	2.59	0.38773	3.00	0.05351	1.27	0.90	0.01423	14.1	340	58	336
12	AvQ244-12	4994	55	0.129	18.52	1.44	0.05306	3.92	0.39354	4.65	0.05399	1.44	0.90	0.01679	8.16	331	86	339
13	AvQ244-13	3898	75	0.489	18.51	1.41	0.05280	3.60	0.39050	4.33	0.05402	1.41	0.90	0.01577	7.61	320	80	339
14	AvQ244-14	2600	61	0.974	18.49	1.33	0.05300	3.17	0.39679	3.75	0.05408	1.33	0.90	0.01729	6.25	329	71	340
15	AvQ244-15	2524	147	0.230	18.39	1.32	0.05280	3.05	0.39456	3.71	0.05438	1.32	0.91	0.01610	7.08	320	68	341

16	AvQ244-16	5448	58	0.139	18.39	1.34	0.05310	3.33		0.39975	3.84	0.05438	1.34	0.90	0.01711	5.67	333	74	341
17	AvQ244-17	5006	81	0.019	18.38	1.29	0.05448	2.73		0.42463	3.24	0.05440	1.29	0.91	0.01301	10.4	391	60	342
18	AvQ244-18	5566	48	0.209	18.16	2.47	0.05951	10.3		0.52416	11.96	0.05506	2.47	0.91	0.02109	9.91	586	208	346
19	AvQ244-19	4079	23	0.177	17.93	3.26	0.05389	16.3		0.40995	18.19	0.05578	3.26	0.90	0.01564	18.4	366	331	350
20*	AvQ244-20	3562	225	0.057	17.30	1.52	0.05520	4.69		0.43886	5.44	0.05782	1.52	0.91	0.02045	9.14	420	101	362
21*	AvQ244-21	4582	176	0.259	17.16	1.48	0.05317	4.50		0.44597	5.25	0.05826	1.48	0.91	0.01622	5.9	336	99	365
22*	AvQ244-22	5245	30	0.180	17.13	2.84	0.05563	13.5		0.42138	15.11	0.05838	2.84	0.90	0.02289	13.1	437	275	366
23*	AvQ244-23	3912	242	0.049	17.02	1.33	0.05394	3.45		0.45181	4.04	0.05874	1.33	0.91	0.02014	7.55	368	76	368

November 2013, ETH Zurich					Data for Tera-Wasserburg plot					Data for Wetherill plot							Ages		
Identifier	Comments	206 cps	U ppm	Th/U	$^{238}U/^{206}Pb$	1σ %	$^{207}Pb/^{206}Pb$	1σ %		$^{206}Pb/^{238}U^{c}$	1σ %	$^{206}Pb/^{238}U^{b}$	1σ %	Rho	$^{208}Pb/^{232}Th$	1σ %	$^{207}Pb/^{206}Pb$	2σ	$^{206}Pb/^{238}U^{a}$
non-CA	**KPT-04**																		
1	1C	95	340	0.455	30769		#	#		########	8.92	#	#	#	#	#	#	#	297104
2	1R	100	504	0.522	44444		#	#		########	8.44	#	#	#	#	#	#	#	224938
3	2	53	234	0.439	43860		#	#		########	14.47	#	#	#	#	#	#	#	229781
4	3	56	236	0.413	40000		#	#		########	12.80	#	#	#	#	#	#	#	246345
5	4C	153	310	0.532	17544		#	#		########	8.77	#	#	#	#	#	#	#	457288
6	4R	114	498	0.622	38023		#	#		########	8.37	#	#	#	#	#	#	#	248743
7	5	28	64	1.311	25445		#	#		########	19.59	#	#	#	#	#	#	#	315243
8	6	55	215	1.588	37594		#	#		########	12.03	#	#	#	#	#	#	#	220396
9	7C	139	411	0.574	25253		#	#		########	6.57	#	#	#	#	#	#	#	341162
10	7D	184	804	0.704	31949		#	#		########	15.65	#	#	#	#	#	#	#	280796
11	8	112	610	0.611	45662		#	#		########	9.59	#	#	#	#	#	#	#	217734
12	9	92	492	0.472	46296		#	#		########	8.80	#	#	#	#	#	#	#	220012
13	10R	111	606	0.598	46512		#	#		########	7.44	#	#	#	#	#	#	#	215228
14	10C	456	1625	1.476	28249		#	#		########	4.52	#	#	#	#	#	#	#	283831
15	11	67	280	0.728	38462		#	#		########	10.38	#	#	#	#	#	#	#	243222
16	12	138	631	0.885	38462		#	#		########	6.15	#	#	#	#	#	#	#	238214
17	13C	142	318	0.684	19231		#	#		########	6.92	#	#	#	#	#	#	#	419572
18	13R	128	388	0.530	25840		#	#		########	8.53	#	#	#	#	#	#	#	336579
19	14C	89700	161	0.230	14		#	#		########	1.37	#	#	#	#	#	#	#	454306
20	14R	159	826	0.402	42735		#	#		########	10.68	#	#	#	#	#	#	#	235293
21	15	105	556	0.470	46083		#	#		########	8.29	#	#	#	#	#	#	#	220817
22	16	203	714	0.633	27473		#	#		########	7.69	#	#	#	#	#	#	#	317743
23	17R	130	668	0.643	42918		#	#		########	8.15	#	#	#	#	#	#	#	226790
24	17A	199	844	0.668	31847		#	#		########	9.24	#	#	#	#	#	#	#	282653
25	17D	61	308	0.462	47393		#	#		########	17.54	#	#	#	#	#	#	#	438721
26	17C	124	250	0.858	17921		#	#		########	16.85	#	#	#	#	#	#	#	216697
27	2-1	238	982	0.658	31546		#	#		########	7.57	#	#	#	#	#	#	#	228204
28	2-1	130	645	0.577	43103		#	#		########	9.05	#	#	#	#	#	#	#	285008
29	2-2	121	676	0.766	46729		#	#		########	7.94	#	#	#	#	#	#	#	209157
CA	**KPT-04**																		
1	1C	120	519	1.168	35211		#	#		########	8.45	#	#	#	#	#	#	#	245953
2	1R	109	762	0.664	57471		#	#		########	10.34	#	#	#	#	#	#	#	182759
3	2	79	441	0.524	46729		#	#		########	15.89	#	#	#	#	#	#	#	216892

4	1	23	494	0.639	30675	#	#	########	7.06	#	#	#	#	#	#	#	291776
5	2C	137	822	0.698	39526	#	#	########	5.53	#	#	#	#	#	#	#	239265
6	3	167	774	0.570	39063	#	#	########	6.25	#	#	#	#	#	#	#	245506
7	3B	157	611	0.864	22883	#	#	########	7.55	#	#	#	#	#	#	#	358978
8	4	195	365	0.580	29674	#	#	########	9.79	#	#	#	#	#	#	#	301188
9	5	109	435	0.789	24450	#	#	########	8.80	#	#	#	#	#	#	#	342816
10	6	138	649	0.826	46083	#	#	########	8.76	#	#	#	#	#	#	#	209430
11	6	113	358	0.651	48077	#	#	########	18.27	#	#	#	#	#	#	#	208430
12	7	68	777	1.154	37037	#	#	########	7.04	#	#	#	#	#	#	#	236691
13	8	162	714	0.582	37313	#	#	########	6.72	#	#	#	#	#	#	#	253540
14	10	152	881	0.880	24752	#	#	########	5.45	#	#	#	#	#	#	#	336518
15	1B	274	678	1.038	33670	#	#	########	13.13	#	#	#	#	#	#	#	259039
16	11	171	395	0.691	37736	#	#	########	9.43	#	#	#	#	#	#	#	247947
17	12	89	1111	0.905	42017	#	#	########	5.46	#	#	#	#	#	#	#	222023
18	13	200	606	0.777	34965	#	#	########	8.04	#	#	#	#	#	#	#	259815
19	14	138	564	0.497	41667	#	#	########	12.08	#	#	#	#	#	#	#	236498
20	14	106	447	1.282	31746	#	#	########	12.06	#	#	#	#	#	#	#	263616
21	13C	119	897	0.634	49261	#	#	########	9.85	#	#	#	#	#	#	#	205330
22	15	133	705	0.722	49261	#	#	########	10.34	#	#	#	#	#	#	#	202543
23	16	120	304	0.750	26385	#	#	########	7.65	#	#	#	#	#	#	#	324026
24	17	94	734	0.773	47847	#	#	########	6.70	#	#	#	#	#	#	#	205311
25	18	123	790	0.693	42553	#	#	########	5.96	#	#	#	#	#	#	#	226640
26	19	144	786	0.917	39063	#	#	########	6.25	#	#	#	#	#	#	#	234395
27	20	155	671	0.737	42373	#	#	########	6.78	#	#	#	#	#	#	#	225936
28	21	124	633	0.527	37453	#	#	########	6.37	#	#	#	#	#	#	#	254645
29	22	135	1760	0.717	38760	#	#	########	5.43	#	#	#	#	#	#	#	242182
30	23	320	911	0.657	39841	#	#	########	5.98	#	#	#	#	#	#	#	239161
31	24	172	451	0.721	46729	#	#	########	9.35	#	#	#	#	#	#	#	210594
32	25	76	528	0.541	39841	#	#	########	7.97	#	#	#	#	#	#	#	242905
33	26	105	810	0.791	31250	#	#	########	5.63	#	#	#	#	#	#	#	282781
34	27	196	269	0.823	28571	#	#	########	8.00	#	#	#	#	#	#	#	302122
35*	28	78	596	0.565	54645	#	#	########	9.84	#	#	#	#	#	#	#	192667
36	29	87	485	0.739	17857	#	#	########	5.18	#	#	#	#	#	#	#	443959
37	30	204	1042	0.991	30960	#	#	########	4.95	#	#	#	#	#	#	#	278365
38	32	251	725	0.661	33445	#	#	########	6.02	#	#	#	#	#	#	#	272553

a) age in years, U-Th disequilibrium correction after Sakata et al., 2013
b) age in years, U-Th correction after Schaerer, 1984
c) raw data
* = data excluded of age calculation

[1] concentration uncertainty c.20%
[2] Concordance calculated as (^{206}Pb-^{238}U age/^{207}Pb-^{235}Pb age)*100
Decay constants of Jaffey et al 1971 used
bd = below detection; #N/A = not available
Uncertainties quoted without components related to systematic error unless otherwise stated
Total systematic uncertainties (σ_{sys}): ^{206}Pb/^{238}U = 2.0%, ^{207}Pb/^{206}Pb = 0.55% (2σ)

2σ abs	$2\sigma_{sys}$ abs	$^{207}Pb/^{235}U$	2σ abs	$2\sigma_{sys}$ abs	$^{208}Pb/^{232}Th$	2σ abs	$2\sigma_{sys}$ abs	% conc[2]
0.90	1.24	23.63	3.19	4.60	25.45	2.22	5.01	99.3
1.03	1.51	24.62	4.87	7.01	27.07	2.62	6.12	96.3
0.90	1.21	23.15	3.53	4.90	23.63	2.22	5.45	100.3
1.03	1.47	23.68	4.50	6.24	21.41	2.42	6.16	98.5
0.90	1.32	21.89	3.71	5.35	31.51	3.03	6.62	103.0
0.90	1.32	24.86	3.56	4.81	28.88	2.62	6.12	98.0
0.90	1.38	23.24	3.07	4.26	26.86	2.22	5.18	99.6
0.90	1.21	21.11	3.22	4.46	30.90	2.82	6.70	112.4
1.03	1.51	24.07	4.56	6.32	24.64	2.42	5.72	99.9
1.41	2.03	22.37	6.01	8.65	21.21	3.43	8.58	102.0
1.16	1.66	23.94	5.66	8.16	22.02	3.03	7.57	99.1
1.41	2.04	24.29	5.66	7.64	19.60	3.23	7.53	106.9
1.03	1.26	17.97	3.57	5.51	24.24	3.03	7.31	128.8
1.03	1.47	22.75	4.07	6.27	24.24	2.62	6.12	104.2
1.16	1.52	20.30	4.85	7.18	29.49	3.03	7.56	106.7
1.03	1.47	23.26	3.71	5.19	28.08	2.42	6.16	100.6
1.16	1.49	22.78	4.90	6.61	23.43	3.23	7.66	102.2
2.95	4.08	42.70	15.30	22.74	72.03	12.48	29.61	74.2
0.90	1.20	22.21	3.30	4.45	30.09	2.82	7.06	106.5
1.03	1.50	24.90	4.32	6.21	22.22	2.22	4.78	100.7
0.90	1.29	22.89	3.57	5.00	25.05	2.22	5.45	94.6
1.16	1.60	24.73	5.28	7.13	35.95	3.83	9.75	98.2
1.16	1.70	21.88	4.37	6.11	26.46	3.23	7.41	104.9
1.28	1.73	23.26	5.69	5.55	21.82	3.03	6.08	100.6
1.28	1.84	22.99	5.25	5.25	27.07	3.63	5.97	100.7
1.03	1.51	25.38	5.00	5.05	27.27	3.03	4.90	93.9
1.28	1.89	21.87	6.35	6.29	19.19	3.63	6.05	99.6
1.80	2.75	24.15	8.43	7.82	9.50	2.42	3.60	100.9
0.90	1.21	23.46	3.33	3.24	25.45	2.82	4.71	100.3
1.03	1.51	23.65	4.00	4.08	19.39	1.82	2.74	100.0
2.44	3.50	24.61	11.09	11.53	21.01	4.24	7.90	101.0
1.67	2.40	21.32	7.46	7.76	21.21	3.43	5.99	101.9
1.67	2.41	25.42	8.20	8.20	16.77	3.63	3.89	92.6
1.28	1.58	23.03	5.89	5.58	27.27	3.23	4.90	98.0
1.03	1.47	22.77	4.50	4.39	16.37	2.02	3.64	99.9
1.16	1.52	23.53	4.58	4.76	22.22	2.42	4.44	100.8
1.54	2.21	25.26	7.16	7.84	19.39	3.03	5.46	95.4
1.03	1.33	22.12	3.97	4.13	19.60	2.42	4.52	98.5
1.16	1.60	22.68	5.10	5.24	24.04	3.23	6.02	99.5
2.06	2.74	21.61	10.77	10.57	27.87	5.85	10.05	99.7
1.41	2.06	20.81	6.81	6.75	20.40	3.43	5.81	104.7
1.28	1.84	23.10	5.55	5.99	17.98	2.62	4.41	102.1
1.03	1.26	24.27	4.67	5.31	20.20	2.42	4.09	98.5
1.33	1.80	25.41	5.79	6.10	28.28	6.86	10.90	100.2
0.92	1.27	25.10	3.38	3.61	28.68	6.05	9.84	100.2
1.05	1.42	22.67	3.65	4.07	32.31	8.07	12.82	110.0

1.06	1.46	24.06	4.46	4.82	24.44	6.86	11.15	101.4
1.20	1.76	23.96	5.21	5.56	30.30	8.48	14.69	99.5
1.35	1.81	24.82	7.00	7.45	30.09	9.69	15.30	98.9
1.05	1.51	24.73	3.98	4.44	28.08	7.67	12.94	99.5
1.47	2.17	22.20	6.41	6.88	24.85	9.29	16.09	111.5
1.33	1.95	24.89	5.36	5.46	32.52	10.49	18.19	103.0
1.06	1.62	24.89	4.41	4.56	28.08	5.65	10.17	99.6
1.19	1.61	25.66	5.02	5.40	24.85	6.06	9.62	92.5
1.19	1.75	25.37	4.69	5.11	27.67	6.46	11.19	101.4
1.33	1.91	25.66	6.03	6.62	22.83	6.06	10.22	98.0
1.06	1.52	27.00	4.60	4.98	27.07	5.65	9.54	95.2
1.07	1.54	22.10	4.62	5.36	28.68	7.27	0.00	111.1
1.06	1.31	25.60	4.77	6.28	24.85	6.06	13.46	99.1
1.73	2.48	28.25	7.94	11.44	18.18	7.67	19.89	87.8
1.05	1.38	25.22	4.27	6.35	23.63	6.46	15.33	92.6
1.33	1.91	23.24	5.87	8.21	25.65	7.27	18.84	102.7
1.20	1.54	28.02	5.68	7.67	33.12	10.09	23.54	85.7
1.06	1.47	27.73	4.80	6.47	24.04	5.65	14.13	90.3
1.06	1.42	25.78	4.55	6.31	26.06	5.65	13.64	100.8
1.06	1.55	26.23	4.86	6.74	22.83	5.65	14.93	90.4
1.19	1.71	25.21	4.93	6.49	24.44	5.65	14.65	97.0
1.21	1.48	24.07	5.70	7.70	21.41	6.06	13.46	98.7
1.33	1.84	26.93	6.57	9.20	20.61	5.65	14.13	85.6
1.34	1.82	24.00	6.57	9.47	19.60	7.27	17.85	99.0
1.22	1.57	19.77	5.69	7.49	22.42	6.06	14.13	119.8
1.20	1.52	23.64	5.23	6.89	25.65	6.06	13.90	99.5
1.20	1.61	24.14	5.47	6.94	23.43	6.06	14.62	100.4
1.08	1.44	21.59	5.14	7.41	22.63	4.44	10.72	110.4
1.33	1.87	24.62	5.82	8.38	20.40	6.06	15.42	96.7
0.93	1.22	22.87	3.67	5.28	24.04	4.44	10.54	104.8
1.06	1.46	24.65	4.12	5.77	24.85	4.44	11.10	99.0
1.07	1.45	21.03	4.31	5.56	23.43	5.25	12.89	112.2
1.20	1.49	24.68	5.21	7.50	22.22	5.25	11.85	97.5
1.06	1.37	24.44	4.65	6.70	26.66	6.06	14.13	100.8
1.20	1.63	27.89	5.70	7.91	22.22	5.65	13.88	88.8
2.17	3.06	24.70	11.05	15.32	32.31	13.32	33.90	99.1
1.33	1.61	26.85	5.92	8.53	25.86	7.67	16.78	88.6
1.06	1.37	22.36	3.99	5.39	23.23	5.65	13.19	111.2
1.06	1.37	24.62	4.49	6.23	27.87	7.67	17.90	93.1
1.19	1.56	28.15	5.15	7.14	25.86	5.25	12.45	89.1
1.06	1.39	23.66	4.40	6.10	23.43	4.85	11.45	102.2
1.19	1.65	25.01	4.83	6.95	24.44	4.84	12.11	101.6
1.34	1.85	27.72	6.75	9.72	26.86	6.86	17.16	93.5
1.19	1.53	25.73	4.92	6.65	24.44	5.65	13.19	95.9
1.19	1.59	25.23	5.08	7.84	22.22	6.06	14.62	96.4
1.16	1.63	22.45	5.00	7.00	31.10	3.03	7.70	99.6
1.28	1.68	24.23	6.43	8.69	25.05	3.23	7.66	100.5
1.16	1.52	23.25	5.35	7.95	21.01	2.42	5.75	99.3
1.16	1.60	23.82	5.27	7.11	21.41	2.22	5.55	99.8
0.90	1.07	24.41	3.92	5.65	21.21	1.82	3.91	96.9
1.16	1.57	24.67	5.72	8.01	29.49	3.03	7.44	96.9
1.28	1.81	23.64	5.59	7.54	21.62	2.83	7.19	99.5
2.06	2.61	22.65	9.37	13.12	27.47	4.64	10.65	96.8

1.54	1.71	23.36	7.35	7.17	19.60	3.03	6.09	97.1
1.03	1.44	23.42	4.46	4.46	23.43	2.62	4.31	99.9
1.03	1.41	23.83	4.56	4.60	23.63	2.83	4.57	98.4
1.03	1.46	23.81	4.10	4.06	26.26	2.83	4.71	95.2
1.28	1.62	23.99	6.24	5.79	22.62	3.03	4.50	94.0
1.28	1.82	23.60	6.50	6.33	10.10	2.02	3.37	97.8
1.67	2.14	25.34	7.37	7.51	28.08	3.43	5.17	94.1
1.03	1.63	24.07	3.86	4.02	22.62	2.02	3.76	99.6
1.16	1.72	25.25	4.53	4.71	20.61	2.02	3.53	98.7
1.54	1.40	25.55	6.96	6.96	27.27	3.23	3.46	95.1
1.03	1.33	25.33	5.00	4.75	16.16	1.82	2.76	92.6
1.16	1.77	14.98	3.94	3.84	20.61	2.22	4.01	162.1
1.41	2.20	25.12	6.15	6.40	18.79	2.22	4.07	100.0
1.03	1.57	25.25	3.68	4.03	30.50	2.83	5.09	99.8
1.41	2.24	29.56	6.89	7.17	12.93	2.02	3.77	83.7
0.90	1.42	23.64	2.91	3.00	25.86	2.62	4.89	102.2
1.28	1.88	22.95	5.95	5.84	21.82	2.83	4.86	96.3
1.03	1.48	24.77	4.43	4.39	24.04	2.83	4.78	99.1
1.28	1.83	24.18	5.43	5.86	23.23	3.03	5.09	99.4
1.67	2.39	25.74	7.67	8.71	11.52	2.42	4.09	97.9
1.67	2.46	23.55	7.31	8.49	27.47	3.43	5.95	97.4
2.83	4.29	23.16	12.98	14.47	36.35	8.07	14.41	104.9
2.06	2.77	23.49	10.04	10.56	30.50	5.25	8.33	100.7
1.16	1.60	23.68	6.26	6.68	25.65	3.23	5.25	102.6
1.16	1.56	23.81	4.40	4.91	31.10	3.43	5.45	102.8
1.28	1.77	23.72	5.88	6.36	23.84	3.43	5.58	89.4
1.54	2.27	21.77	7.14	7.62	28.88	4.44	7.70	103.6
1.41	1.90	21.74	6.41	6.82	27.47	4.24	6.70	99.3
0.90	1.29	22.68	3.91	4.36	35.74	5.04	8.51	102.0
1.16	1.70	24.17	6.22	6.68	36.15	5.65	9.79	100.5
1.16	1.70	23.74	5.31	5.41	35.74	5.85	10.14	99.1
1.16	1.77	25.95	5.14	5.32	31.10	5.45	9.81	90.6
1.80	2.43	26.91	8.35	8.97	39.17	8.07	12.81	95.5
2.95	4.35	30.94	15.09	16.43	56.11	13.30	23.05	93.0
1.19	1.71	24.22	5.03	5.84	24.24	5.65	0.00	105.7
2.55	2.89	25.69	13.10	17.27	20.81	8.88	19.74	97.9
1.20	1.59	24.18	5.64	8.13	26.86	6.86	17.79	101.3
1.20	1.45	32.19	6.34	9.43	23.84	6.06	14.37	78.0
1.06	1.40	27.00	4.88	6.83	23.23	6.06	15.70	93.9
1.06	1.26	23.16	4.26	5.76	23.43	6.46	15.07	109.3
1.46	1.86	25.64	6.66	8.99	25.65	6.46	16.15	101.1
1.19	1.46	25.62	5.14	7.13	23.23	4.85	11.70	95.3
1.32	1.78	24.10	5.72	7.94	21.62	4.85	12.80	95.7
1.20	1.59	24.79	5.58	7.35	26.06	5.65	14.65	98.9
1.46	1.65	27.63	6.71	9.06	22.83	5.65	12.56	86.0
2.13	2.72	25.14	10.41	14.58	29.49	9.28	23.21	95.1
1.34	1.68	25.20	6.76	9.74	35.34	9.68	23.78	96.5
1.87	2.23	23.98	8.71	11.47	19.19	7.67	17.90	97.1
1.35	1.58	24.67	6.98	9.20	28.48	8.88	20.38	98.9
1.33	1.64	25.74	6.05	7.69	25.05	6.86	16.57	98.5
1.74	2.14	24.28	8.09	11.65	25.65	8.88	21.44	99.5
1.33	1.73	26.01	6.15	8.85	26.46	8.07	20.55	101.9
1.20	1.46	24.49	5.66	8.15	25.65	6.06	14.37	103.1

1.06	1.36	25.54	4.67	6.54	28.68	5.65	14.13	100.7
1.06	1.33	27.67	5.01	6.46	25.65	6.06	14.87	89.3
1.47	1.69	23.68	6.89	9.92	26.46	7.67	17.32	101.3
1.49	1.77	20.67	7.13	10.27	37.16	17.75	41.42	114.3
1.62	2.03	23.81	8.20	11.36	24.44	8.48	20.82	99.6
1.19	1.55	25.39	4.91	6.80	26.46	8.07	20.55	100.5
1.19	1.33	23.62	4.62	6.65	28.68	8.88	19.42	107.9
1.33	1.58	26.99	6.08	8.21	28.68	9.69	22.60	90.2
1.34	1.60	23.89	6.50	9.01	28.48	7.27	16.95	98.4
1.34	1.62	24.28	6.06	8.40	28.08	6.86	16.28	99.8
1.34	1.61	22.61	6.19	8.58	26.66	7.67	18.13	100.1
1.19	1.52	24.33	4.85	6.99	25.05	5.65	14.13	97.4
1.76	2.24	29.11	10.25	14.77	31.91	11.30	28.25	81.3
1.47	1.75	23.42	7.07	9.55	22.42	6.46	15.07	101.1
1.34	1.65	24.85	7.10	10.96	24.64	7.67	18.52	94.9
1.19	1.42	23.61	5.21	8.04	24.64	6.46	15.07	101.1
1.73	2.21	28.78	8.53	12.62	29.29	9.28	23.21	87.1
1.80	2.18	23.65	8.18	12.15	30.90	4.64	11.01	100.8
1.03	1.31	24.91	4.26	5.75	27.67	3.03	7.57	97.2
1.28	1.41	22.74	6.09	8.77	40.59	4.84	10.43	98.4
1.28	1.61	22.63	5.24	7.33	29.29	3.43	8.43	104.2
1.16	1.50	23.33	4.44	5.99	31.51	3.43	8.73	103.5
1.28	1.50	22.18	5.67	7.94	40.59	4.84	11.11	103.7
1.28	1.32	24.22	5.45	5.31	21.62	3.43	6.90	103.5
1.28	1.08	23.90	5.27	5.27	18.38	3.43	5.64	104.9
1.16	1.59	25.23	5.36	5.41	40.99	5.65	9.14	98.3
1.28	1.82	25.52	5.36	5.31	32.11	4.84	8.07	98.0
1.03	1.30	24.66	4.08	3.79	33.32	4.84	7.20	98.0
1.16	1.64	25.03	4.97	4.84	42.20	6.45	10.76	99.6
1.16	1.48	25.02	4.57	4.65	41.59	6.45	9.72	102.5
1.28	2.04	23.37	5.59	5.81	44.22	7.46	13.91	99.0
1.16	1.72	22.98	4.66	4.85	48.85	8.27	14.43	103.5
0.90	0.82	21.81	3.63	3.63	40.18	3.63	3.88	103.4
1.28	1.66	23.55	5.39	5.11	36.35	4.03	6.13	100.4
0.90	1.38	21.94	3.73	3.64	39.17	3.63	6.55	101.9
1.03	1.60	24.32	4.04	4.20	35.74	3.43	6.29	99.1
1.03	1.57	23.96	3.94	4.32	30.30	3.03	5.46	101.4
1.28	2.04	23.30	6.08	6.33	27.27	3.43	6.40	102.0
1.16	1.83	24.12	4.99	5.13	34.13	3.63	6.77	100.7
1.03	1.50	23.60	4.48	4.40	36.95	3.63	6.24	102.6
1.03	1.48	23.30	4.01	3.97	36.15	3.63	6.15	101.2
1.16	1.65	23.86	5.35	5.78	35.34	3.63	6.10	101.5
1.28	1.84	24.92	5.34	6.07	28.48	3.23	5.45	96.7
1.16	1.70	22.35	4.50	5.23	19.80	2.62	4.55	103.5
1.67	2.53	25.51	8.28	9.23	7.88	2.22	3.97	99.0
1.03	1.39	23.92	4.36	4.59	29.08	3.03	4.81	99.7
1.03	1.42	23.58	4.02	4.29	27.67	2.83	4.59	100.5
1.03	1.51	24.10	2.25	2.40	29.20	3.41	5.91	100.0
1.03	1.38	22.20	2.24	2.38	31.80	3.61	5.70	108.3
1.03	1.47	24.40	2.09	2.33	31.40	3.71	6.26	101.9
1.16	1.70	24.80	2.69	2.89	28.60	3.84	6.66	102.4

1.16	1.70	24.40	2.64	2.69	31.20	3.43	5.95	100.4
1.03	1.57	26.00	2.26	2.34	28.10	2.96	5.33	93.4
1.03	1.39	25.40	2.15	2.31	30.10	2.91	4.62	95.4
1.28	1.89	25.10	3.07	3.34	28.50	3.38	5.86	96.5
1.28	1.84	28.10	3.45	3.79	37.90	4.85	8.18	87.6
1.03	1.47	26.60	2.56	2.77	27.40	3.33	5.62	90.6
0.90	1.03	24.30	1.84	2.13	31.50	3.85	0.00	98.4
1.16	1.35	21.40	2.38	3.14	30.00	4.05	9.00	112.6
1.16	1.58	23.90	2.39	3.44	33.70	4.56	11.82	99.5
1.28	1.61	23.20	2.80	4.16	30.60	3.55	8.42	103.0
1.16	1.58	24.40	2.51	3.51	31.60	3.31	8.58	99.8
1.03	1.26	25.30	2.51	3.39	28.10	3.46	8.07	96.0
1.16	1.52	26.10	2.87	3.87	34.40	4.09	10.23	95.8
1.16	1.47	24.90	2.47	3.43	25.70	3.08	7.43	99.1
1.67	2.32	28.60	4.64	6.43	34.40	5.78	15.27	85.6
1.16	1.58	21.90	2.50	3.29	29.50	3.73	9.67	113.5
1.28	1.50	19.40	2.97	4.01	30.20	3.94	8.76	124.2
1.03	1.35	28.70	2.68	3.75	30.40	3.84	9.60	83.5
1.16	1.50	25.30	3.24	4.67	36.10	5.32	13.07	98.1
1.03	1.26	23.10	2.49	3.28	30.70	3.36	7.84	99.3
1.28	1.55	22.20	2.99	3.94	32.20	4.38	10.05	99.0
1.03	1.31	20.50	2.17	2.76	29.60	4.14	9.99	121.0
1.16	1.47	23.20	2.80	4.03	30.60	3.55	8.57	100.0
1.03	1.38	30.50	2.70	3.89	30.30	3.13	7.97	79.0
1.03	1.28	22.00	1.99	2.87	32.80	3.59	8.52	112.5
1.41	1.86	20.70	2.99	4.19	27.40	3.78	9.45	120.5
1.16	1.50	30.60	3.07	3.96	32.70	4.46	10.95	79.2
1.41	1.68	30.40	3.99	5.75	26.70	4.47	10.09	77.2
1.28	1.58	23.90	3.69	5.31	28.60	4.46	10.41	99.8
1.03	1.33	31.30	2.70	3.74	38.10	3.91	9.60	79.7
1.03	1.38	24.60	2.03	2.81	34.00	4.20	10.69	99.3
1.28	1.48	22.20	2.70	3.89	32.90	4.53	9.91	112.0
1.80	2.21	29.00	5.25	7.09	28.00	5.70	13.30	83.1
1.16	1.42	27.30	2.93	4.06	30.00	4.35	10.15	88.7
1.03	1.28	24.10	2.32	3.22	33.80	4.90	11.63	99.2
1.67	2.08	25.60	4.01	5.56	35.80	6.13	14.49	98.4
1.16	1.52	22.10	2.67	3.84	31.80	3.47	8.68	109.6
1.16	1.52	24.80	2.56	3.69	28.10	3.10	7.75	99.8
1.54	1.89	25.50	3.57	4.82	34.20	4.40	10.27	100.3
1.41	1.80	24.70	3.01	4.64	30.20	3.69	8.91	100.7
1.16	1.42	26.60	3.02	4.66	30.20	5.59	13.04	88.2
1.16	1.52	22.90	2.48	3.67	27.20	3.44	8.60	104.7
1.03	1.38	26.00	2.12	2.97	28.60	3.52	8.96	95.6
0.90	1.12	25.70	1.96	2.65	27.60	3.39	8.04	94.8
1.03	1.28	24.70	2.48	3.68	30.60	2.95	7.00	97.6
1.16	1.52	26.10	2.74	3.70	32.60	3.24	8.10	95.3
1.28	1.46	24.20	2.98	4.29	28.80	3.40	7.32	103.0
1.03	1.33	24.00	2.15	3.01	32.50	3.15	7.74	100.7
1.28	1.72	24.80	3.17	4.28	29.40	3.70	9.42	99.0
1.03	0.89	26.40	2.40	3.36	33.20	3.36	7.71	91.8
1.28	1.10	23.80	3.42	3.34	27.60	3.75	7.54	97.2
1.23	1.74	77.7	4.54	4.50	68.2	2.95	4.92	96.7
1.16	1.47	75.0	4.25	3.94	69.4	2.91	4.33	95.6

1.39	1.97	83.0	5.80	5.65	70.0	3.98	6.63	91.4
1.41	1.81	68.9	5.70	5.80	79.0	4.26	6.42	105.7
1.53	2.42	73.7	6.28	6.53	72.9	4.59	8.56	102.2
1.33	1.97	77.3	5.10	5.30	86.0	4.35	7.60	100.5
1.15	1.05	86.0	4.51	4.51	76.9	3.67	3.93	86.5
1.15	1.48	81.7	4.22	4.00	75.1	3.80	5.77	94.2
1.20	1.84	78.3	4.34	4.23	73.3	3.85	6.94	98.9
1.34	2.09	78.3	5.44	5.66	82.3	4.87	8.93	99.7
1.33	2.04	77.9	5.38	5.89	68.3	4.12	7.43	97.2
1.36	2.16	73.2	5.47	5.69	77.9	4.94	9.21	101.9
1.38	2.19	76.6	5.76	5.92	72.0	4.16	7.76	94.9
1.40	2.05	74.9	5.91	5.80	71.0	3.99	6.86	99.7
1.14	1.64	85.4	4.34	4.30	79.8	3.62	6.13	87.5
1.11	1.59	78.9	4.00	4.32	72.8	3.44	5.78	94.8
1.27	1.82	81.5	5.32	6.04	73.1	4.02	6.78	91.5
1.34	1.97	70.0	5.51	6.40	76.8	4.78	8.29	102.7
1.49	2.26	71.3	6.40	7.14	71.5	4.93	8.80	101.4
1.79	2.42	81.8	8.37	8.81	96.0	7.18	11.40	93.2
1.54	2.13	70.5	6.52	6.95	72.2	5.24	8.52	102.8
1.52	2.05	72.3	6.61	7.37	71.3	5.14	8.16	100.7
1.17	1.62	74.3	4.43	4.79	76.8	4.62	7.51	97.0
1.53	2.25	88.2	7.42	7.91	88.9	6.22	10.78	83.9
1.17	1.57	74.0	4.41	4.69	71.2	3.27	5.17	97.8
1.28	1.84	76.4	5.13	5.72	70.0	3.33	5.62	94.1
1.08	1.59	68.5	3.48	3.74	71.4	2.93	5.08	106.4
1.22	1.80	73.3	4.63	4.71	67.5	3.23	5.60	101.0
1.93	2.95	74.8	9.16	9.47	66.6	5.98	10.76	98.0
1.53	2.07	75.9	6.60	7.09	74.7	4.26	6.77	96.2
1.60	2.36	76.9	7.04	7.67	71.1	4.72	8.18	98.4
1.03	1.48	76.3	3.42	3.97	78.8	2.93	0.00	102.0
0.95	1.18	76.4	2.68	3.53	83.2	2.66	5.91	102.6
0.94	1.37	76.0	2.78	4.00	82.7	2.84	7.36	100.7
0.92	1.22	75.7	2.67	3.97	72.7	2.70	6.41	99.7
0.95	1.38	74.8	2.88	4.03	79.3	3.29	8.53	101.2
1.02	1.34	77.1	3.34	4.51	79.5	3.66	8.54	100.1
1.02	1.43	84.0	3.59	4.85	82.2	4.05	10.13	90.8
0.94	1.27	78.1	2.40	3.33	82.2	2.70	6.52	99.2
1.01	1.50	76.6	3.21	4.45	77.1	2.97	7.85	99.1
1.02	1.48	76.9	3.10	4.08	76.7	2.90	7.52	99.9
0.99	1.23	76.0	2.97	4.01	77.8	2.89	6.42	100.1
1.13	1.58	79.0	4.25	5.95	75.1	3.50	8.75	94.9
0.95	1.31	76.5	2.80	4.03	69.8	2.66	6.53	97.0
1.13	1.48	79.8	4.03	5.31	77.7	3.73	8.70	97.4
1.04	1.34	80.2	3.22	4.24	80.1	3.59	8.24	97.3
1.02	1.38	79.0	3.26	4.14	75.4	3.42	8.26	96.1
1.01	1.37	75.0	3.07	4.42	76.4	3.56	8.59	101.6
1.00	1.43	74.2	3.15	4.54	78.7	3.81	9.70	99.9
1.05	1.40	76.9	3.43	4.94	80.6	4.25	10.08	99.6
1.00	1.40	76.2	2.83	3.96	85.5	3.00	7.50	100.7
1.03	1.42	76.7	2.92	3.76	84.7	3.06	7.52	101.4
1.05	1.33	79.9	3.33	4.80	89.3	3.33	7.52	96.7
1.02	1.34	74.9	2.87	4.13	86.0	2.99	6.98	101.7
1.02	1.41	76.7	3.10	4.30	78.6	2.98	7.32	99.1

0.99	1.41	71.7	2.81	3.90	77.3	2.97	7.56	103.9
1.11	1.36	82.3	3.77	5.43	72.4	3.44	7.53	94.8
1.28	1.68	75.7	5.04	6.80	70.2	4.15	9.68	97.9
0.98	1.28	78.2	2.93	4.06	70.1	3.22	7.51	95.0
1.02	1.36	76.8	3.12	4.33	70.6	3.38	8.02	97.8
1.08	1.43	78.4	3.89	5.39	75.5	3.17	7.49	95.3
0.98	1.37	74.1	3.01	4.33	72.6	2.69	6.73	100.0
1.01	1.42	83.1	3.44	4.95	79.3	3.12	7.80	90.0
1.00	1.31	75.8	2.79	3.77	77.6	3.12	7.28	102.0
1.02	1.38	75.3	3.23	4.98	77.3	3.25	7.84	101.2
6.05	8.64	340	11.33	15.86	211	10.20	25.96	82.1
6.54	8.70	353	14.51	19.59	216	12.39	29.41	80.1
6.41	8.54	315	12.37	18.38	238	12.38	29.38	90.6
6.41	8.99	337	12.06	16.28	120	5.83	14.56	85.3
6.41	7.74	364	12.64	18.21	320	15.11	32.55	79.2
6.65	9.16	310	13.03	18.24	244	12.78	31.38	94.9
6.77	9.66	325	13.48	18.20	112	7.03	17.90	91.8
7.13	9.18	353	16.58	23.21	285	15.94	36.58	86.8
7.12	8.03	355	15.32	14.95	309	21.09	42.39	87.7
7.24	10.12	343	14.38	14.38	208	11.80	19.40	92.1
6.99	9.62	332	11.13	11.22	219	10.39	16.81	95.7
7.23	10.25	363	13.77	13.64	251	13.97	23.28	89.0
7.72	9.75	340	15.22	14.13	121	7.43	11.05	96.5
7.47	10.58	338	13.13	12.78	235	12.78	21.30	97.1
7.10	9.10	336	11.43	11.64	310	14.72	22.19	98.3
7.71	12.22	340	15.01	15.61	219	12.99	24.22	98.1
7.58	11.25	344	13.34	13.88	308	16.91	29.53	98.9
11.90	10.82	452	28.27	28.27	456	38.69	41.40	99.4
11.89	15.36	470	27.81	26.37	413	23.35	35.47	96.0
14.73	22.58	520	39.99	38.94	499	30.54	55.07	90.5
15.61	24.32	576	37.19	38.67	642	49.67	91.06	96.2
13.60	20.84	549	27.34	29.93	528	41.90	75.55	101.0
13.59	21.54	756	29.16	30.33	842	42.22	78.71	73.5
13.98	22.15	596	25.07	25.79	506	31.12	58.02	100.0
19.17	28.01	780	34.76	34.13	721	42.67	73.33	100.1
23.63	33.99	1086	44.49	44.06	1752	116.21	196.67	83.0
2.99	4.41	396	9.25	10.74	189	11.83	20.51	78.8
3.62	5.49	549	11.88	13.25	298	17.89	31.95	57.5
3.61	4.87	474	10.45	11.00	279	16.17	25.68	67.1
4.40	6.08	323	11.89	12.68	302	22.38	36.37	99.8
4.59	6.20	338	13.44	14.99	344	18.29	29.05	95.9
4.80	6.63	331	14.55	15.73	292	14.40	23.40	98.7
4.29	6.32	312	10.00	10.67	353	20.59	35.69	106.3
4.27	5.73	324	9.98	10.62	376	47.82	75.56	102.9
8.08	11.59	372	38.63	43.08	599	57.33	96.74	89.6
4.55	6.70	340	11.72	12.59	364	17.68	30.65	98.4
4.16	6.13	333	8.52	8.67	286	39.76	68.92	101.0
4.75	7.27	337	13.33	13.79	337	27.31	49.16	100.6
4.64	6.26	335	12.34	13.26	316	23.86	37.90	101.3
4.40	6.48	339	10.82	11.78	347	21.48	37.23	100.1
4.42	6.34	338	10.66	11.70	323	22.71	38.32	101.1

4.49	6.44	342	11.15	12.07	343	19.28	32.54	100.0
4.28	6.00	359	9.81	11.38	261	26.92	0.00	95.0
8.30	15.68	428	41.76	55.02	422	41.31	91.80	80.7
11.09	24.44	349	53.69	77.31	314	57.13	148.11	100.3
5.36	10.81	370	16.86	25.05	409	37.09	88.01	98.1
5.26	11.59	375	16.43	23.00	325	18.82	48.79	97.5
10.12	20.07	357	45.49	61.41	457	59.12	137.95	102.4
4.77	10.14	379	12.77	17.24	403	30.03	75.08	97.2

2σ abs		$^{206}Pb/^{238}U^{b}$	2σ abs		$^{208}Pb/^{232}Th$	2σ		% conc[4]
29217		305608	29217		#	#		#
24197		239785	24197		#	#		#
32917		244048	32917		#	#		#
31313		258754	31313		#	#		#
43786		462513	43786		#	#		#
27949		262043	27949		#	#		#
77682		326281	77682		#	#		#
52245		236725	52245		#	#		#
29149		348357	29149		#	#		#
48029		290823	48029		#	#		#
27396		233354	27396		#	#		#
23354		235134	23354		#	#		#
23509		231692	23509		#	#		#
39499		296767	39499		#	#		#
33532		256153	33532		#	#		#
28591		251885	28591		#	#		#
37659		425361	37659		#	#		#
33052		343559	33052		#	#		#
65150		454203	65150		#	#		#
26222		249056	26222		#	#		#
22558		236201	22558		#	#		#
31762		326742	31762		#	#		#
26403		241476	26403		#	#		#
33372		293809	33372		#	#		#
79152		445609	79152		#	#		#
36746		232413	36746		#	#		#
26629		243285	26629		#	#		#
29713		295061	29713		#	#		#
27339		226119	27339		#	#		#
39321		260173	39321		#	#		#
26617		202918	26617		#	#		#
35558		232726	35558		#	#		#

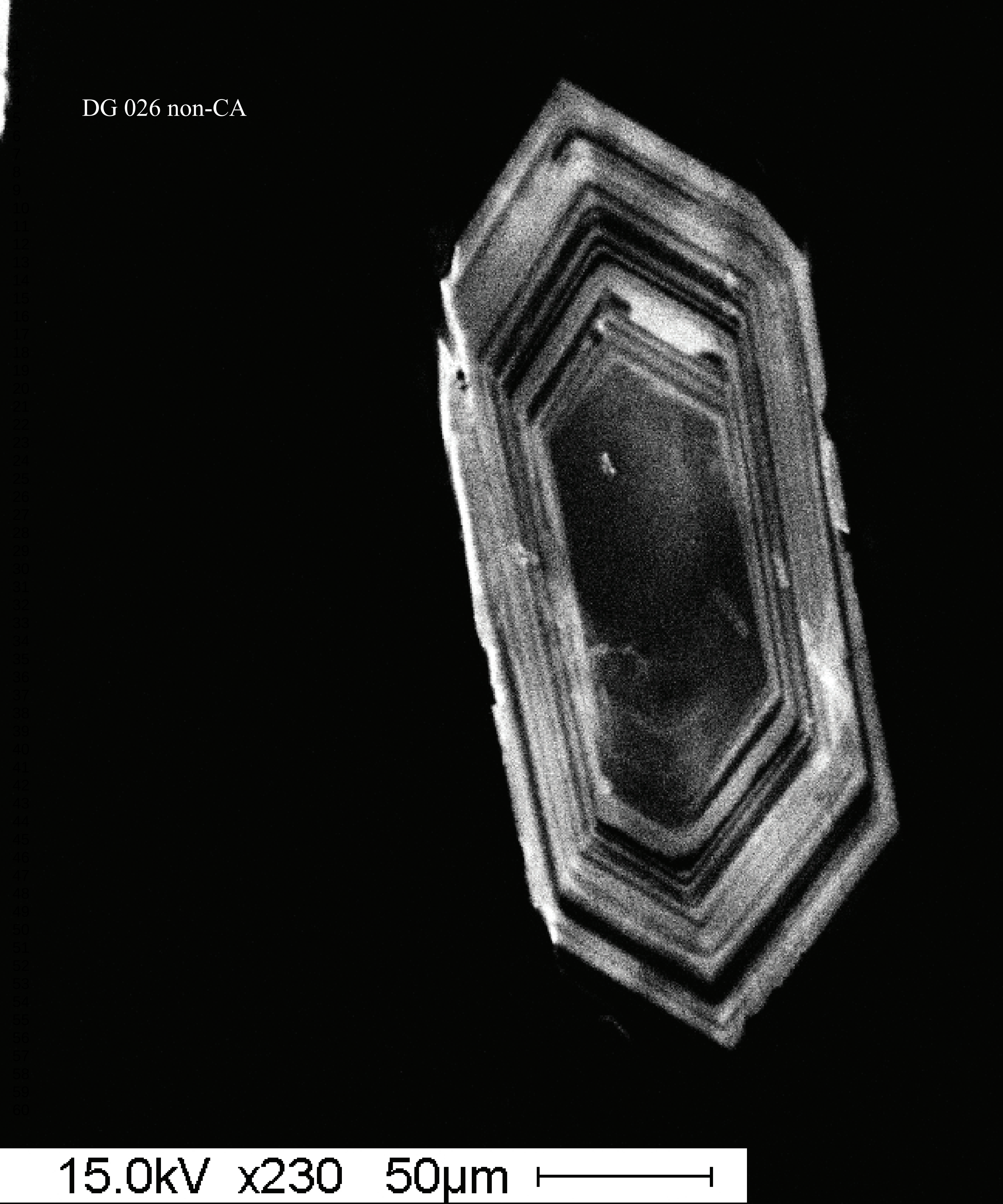
28620		301577	28620		#	#		#
23717		252984	23717		#	#		#
22722		258473	22722		#	#		#
39338		367448	39338		#	#		#
34314		310185	34314		#	#		#
39988		350493	39988		#	#		#
29882		225248	41082		#	#		#
41082		226479	29882		#	#		#
35577		251563	35577		#	#		#
24321		265129	24321		#	#		#
32353		346012	32353		#	#		#
47412		272703	47412		#	#		#
31356		261181	31356		#	#		#
26858		237439	26858		#	#		#
31420		272827	31420		#	#		#
30876		250456	30876		#	#		#
51010		277064	51010		#	#		#
27248		220339	29598		#	#		#
29598		222731	27248		#	#		#
34629		332557	34629		#	#		#
25270		222741	25270		#	#		#
23684		241429	23684		#	#		#
29181		249023	29181		#	#		#
25948		240919	25948		#	#		#
22557		266650	22557		#	#		#
24057		255466	24057		#	#		#
23674		253096	23674		#	#		#
28732		227353	28732		#	#		#
25068		256262	25068		#	#		#
28075		293458	28075		#	#		#
35451		311572	35451		#	#		#
24713		211605	24713		#	#		#
34086		449874	34086		#	#		#
30475		289993	30475		#	#		#
25677		283989	25677		#	#		#

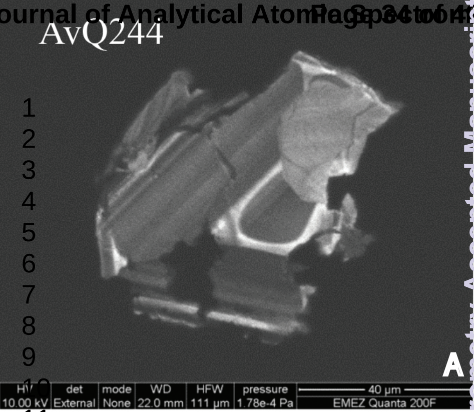
Table 7 U-Pb age summary of non-CA, CA-LA-ICP-MS and CA-ID-TIMS measurements

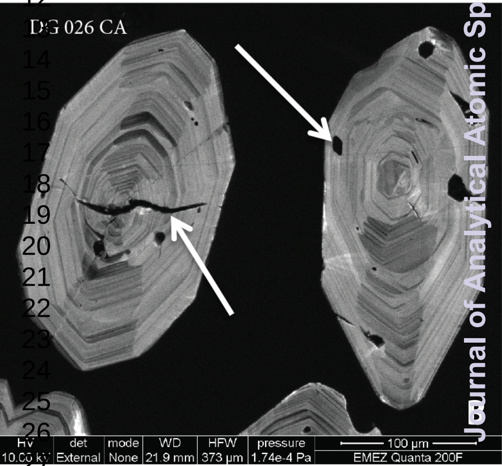
sample	rock type	non-CA LA-ICPMS age	error	CA LA-ICPMS age	error	CA-ID-TIMS age	error	age in Ma
KPT-04	Rhyolitic tuff[a]	0.2929	0.0137	0.2698	0.0078	0.2070	0.0062	
	Rhyolitic tuff[b]	0.2811	0.0144	0.2564	0.0083	0.1964	0.0058	
248-2	Andesite/Trachy-Andesite	24.01	0.29	24.28	0.15	24.42	0.025	Ma
059-1	Andesite/Trachy-Andesite	23.76	0.27	24.57	0.28			Ma
029-5	Andesite/Trachy-Andesite	23.28	0.25	24.41	0.21	24.48	0.084	Ma
DG026	Granodiorite	74.14	0.65	76.13	0.45	76.41	0.088	Ma
AvQ244	Granite	306.2	10	331.8	4.7	333.6	0.66	Ma

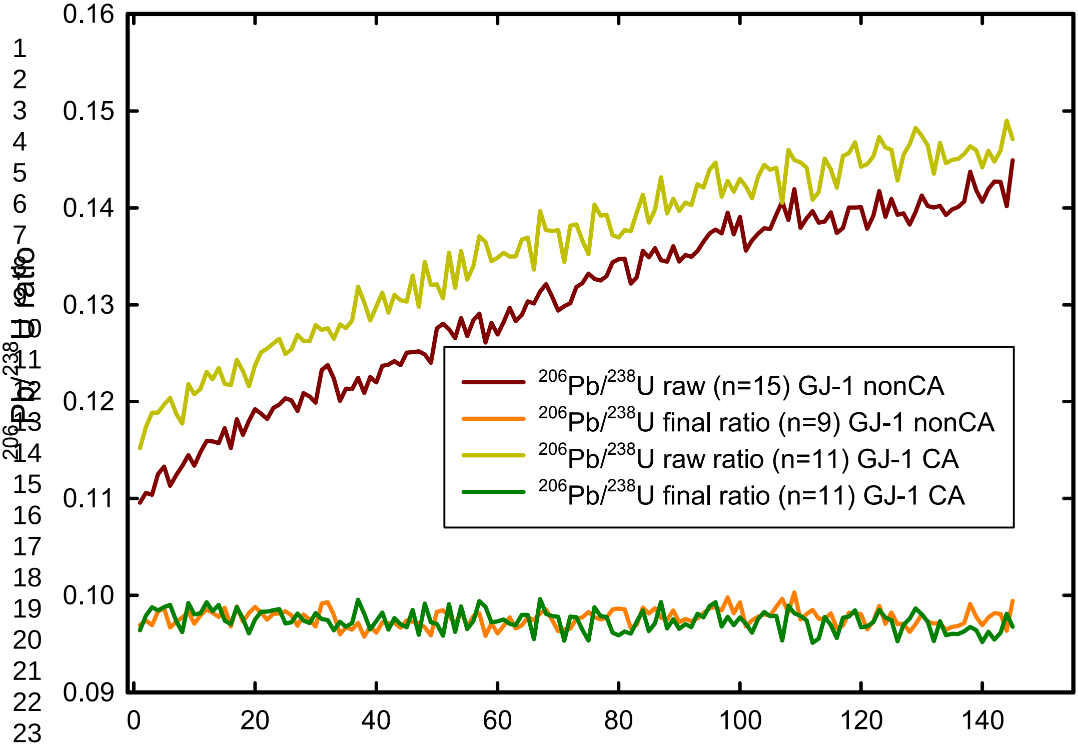
a - U-Th disequilibrium correction after Schaerer, 1984[42]

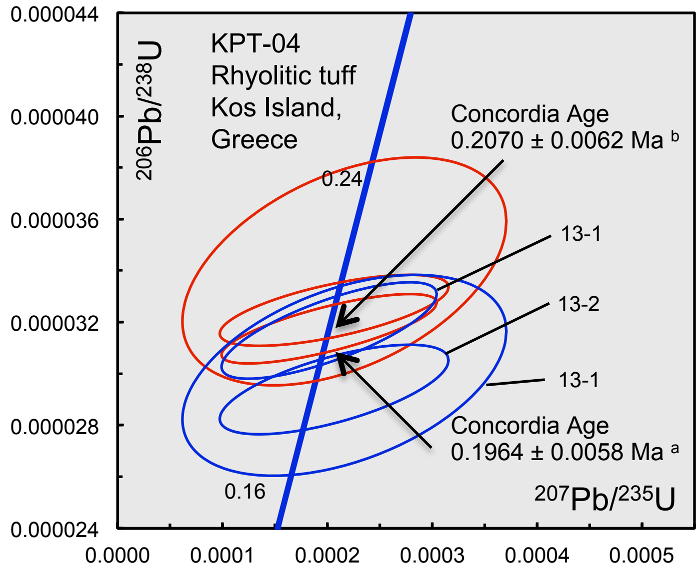
b - U-Th disequilibrium correction after Sakata et al., 2013[47]

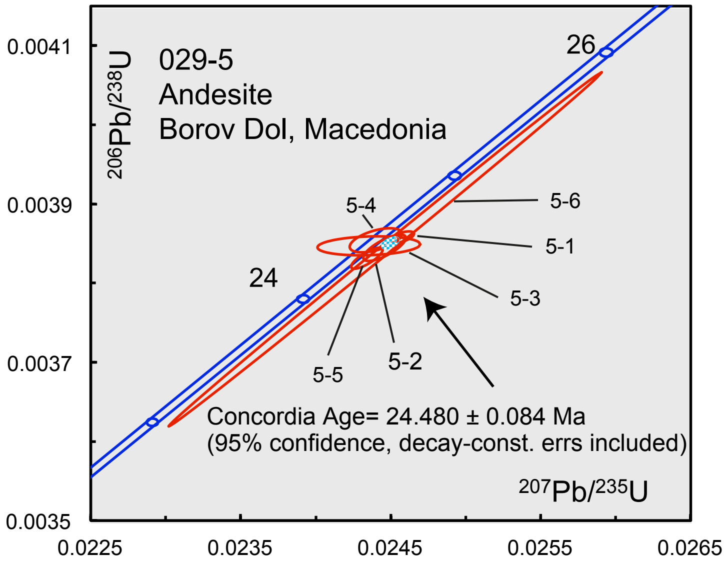

DG 026 non-CA
15.0kV x230 50μm


AvQ244
A
HV 10.00 kV
det External
mode None
WD 22.0 mm
HFW 111 µm
pressure 1.78e-4 Pa
40 µm
EMEZ Quanta 200F

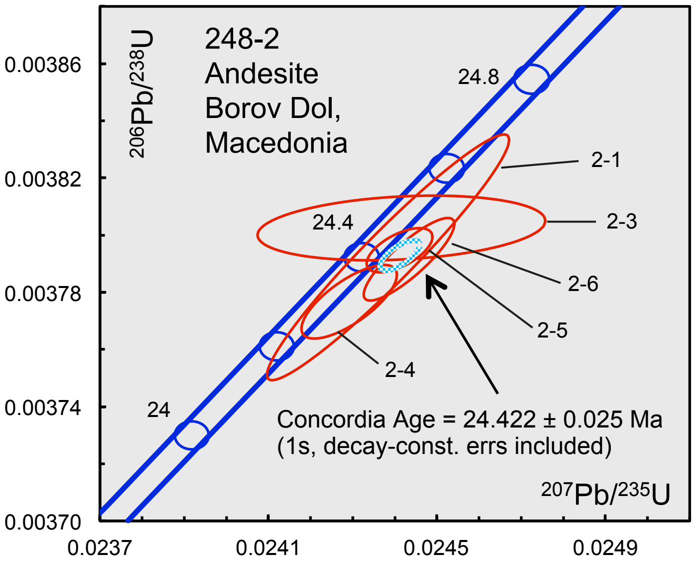

DG 026 CA
HV 10.00 kV
det External
mode None
WD 21.9 mm
HFW 373 µm
pressure 1.74e-4 Pa
100 µm
EMEZ Quanta 200F

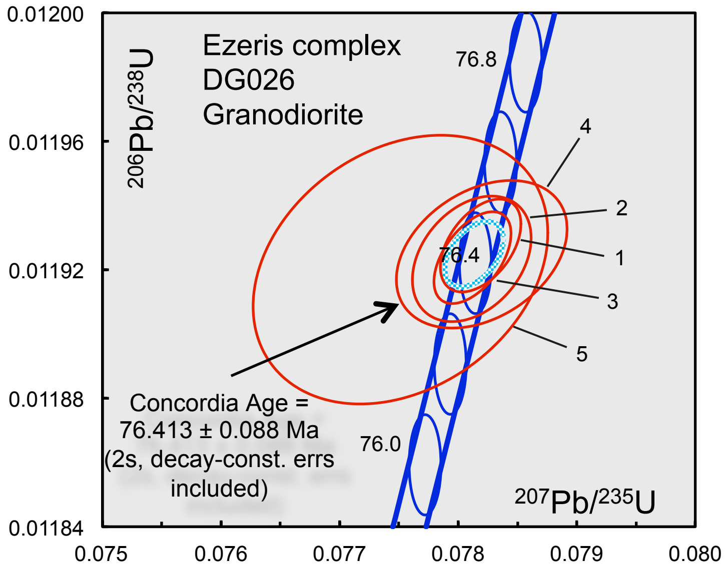

0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0
20
40
60
80
100
120
140
206Pb/238U ratio
206Pb/238U raw (n=15) GJ-1 nonCA
206Pb/238U final ratio (n=9) GJ-1 nonCA
206Pb/238U raw ratio (n=11) GJ-1 CA
206Pb/238U final ratio (n=11) GJ-1 CA


0.000044
0.000040
0.000036
0.000032
0.000028
0.000024
0.0000
0.0001
0.0002
0.0003
0.0004
0.0005
206Pb/238U
207Pb/235U
KPT-04
Rhyolitic tuff
Kos Island,
Greece
Concordia Age
0.2070 ± 0.0062 Ma b
13-1
13-2
13-1
Concordia Age
0.1964 ± 0.0058 Ma a
0.24
0.16

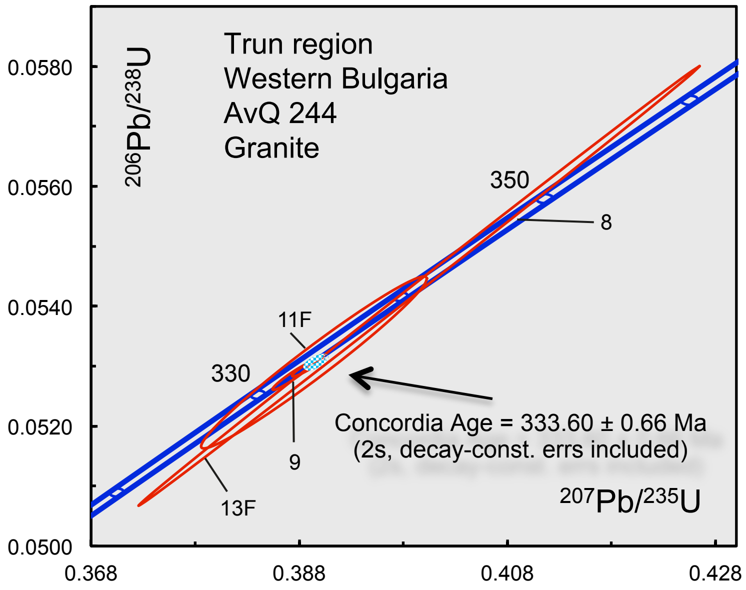


029-5
Andesite
Borov Dol, Macedonia
26
24
5-4
5-6
5-1
5-3
5-5
5-2
Concordia Age= 24.480 ± 0.084 Ma
(95% confidence, decay-const. errs included)
$^{207}Pb/^{235}U$
$^{206}Pb/^{238}U$
0.0041
0.0039
0.0037
0.0035
0.0225
0.0235
0.0245
0.0255
0.0265

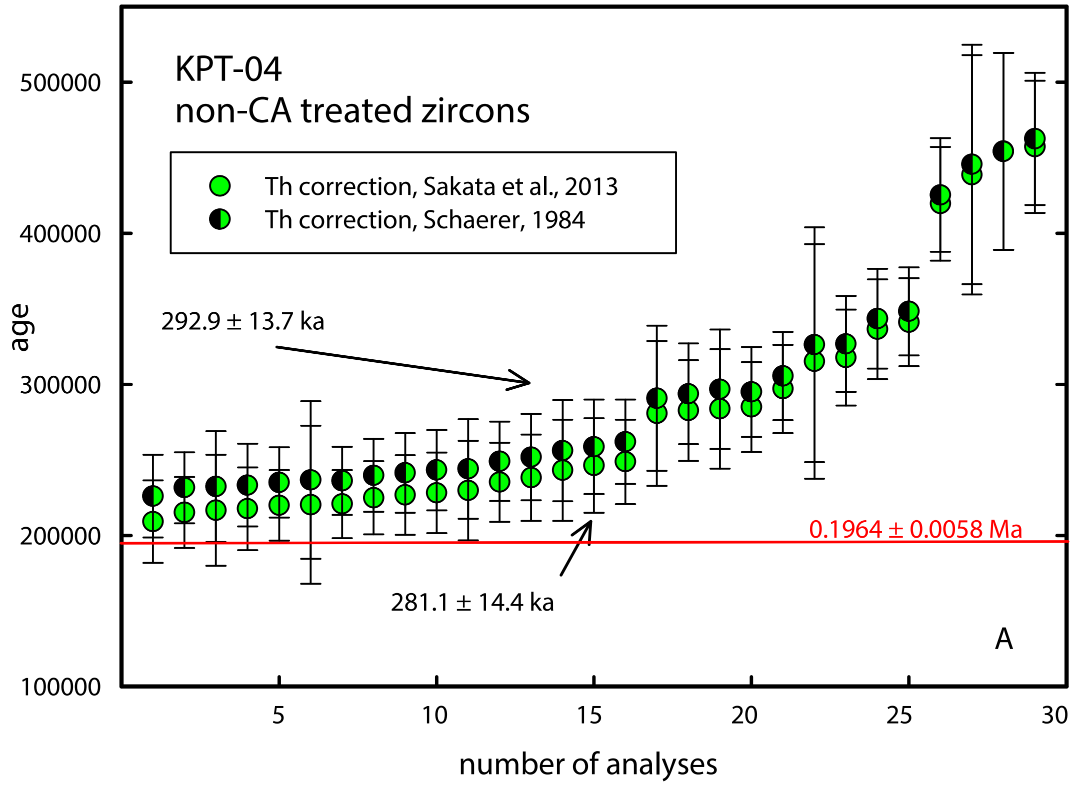

248-2
Andesite
Borov Dol,
Macedonia
$^{206}Pb/^{238}U$
$^{207}Pb/^{235}U$
0.00386
0.00382
0.00378
0.00374
0.00370
0.0237
0.0241
0.0245
0.0249
24.8
24.4
24
2-1
2-3
2-6
2-5
2-4
Concordia Age = 24.422 ± 0.025 Ma
(1s, decay-const. errs included)

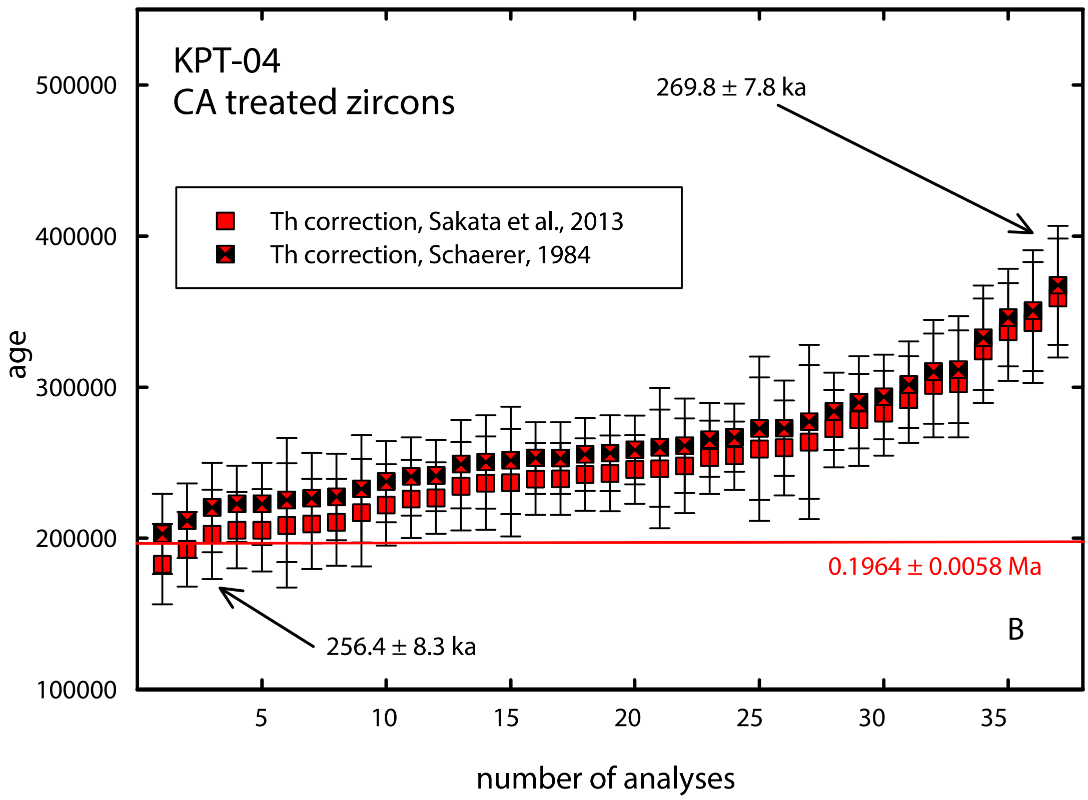

Ezeris complex
DG026
Granodiorite
Concordia Age =
76.413 ± 0.088 Ma
(2s, decay-const. errs
included)
76.8
76.4
76.0
1
2
3
4
5
0.01200
0.01196
0.01192
0.01188
0.01184
0.075
0.076
0.077
0.078
0.079
0.080
206Pb/238U
207Pb/235U

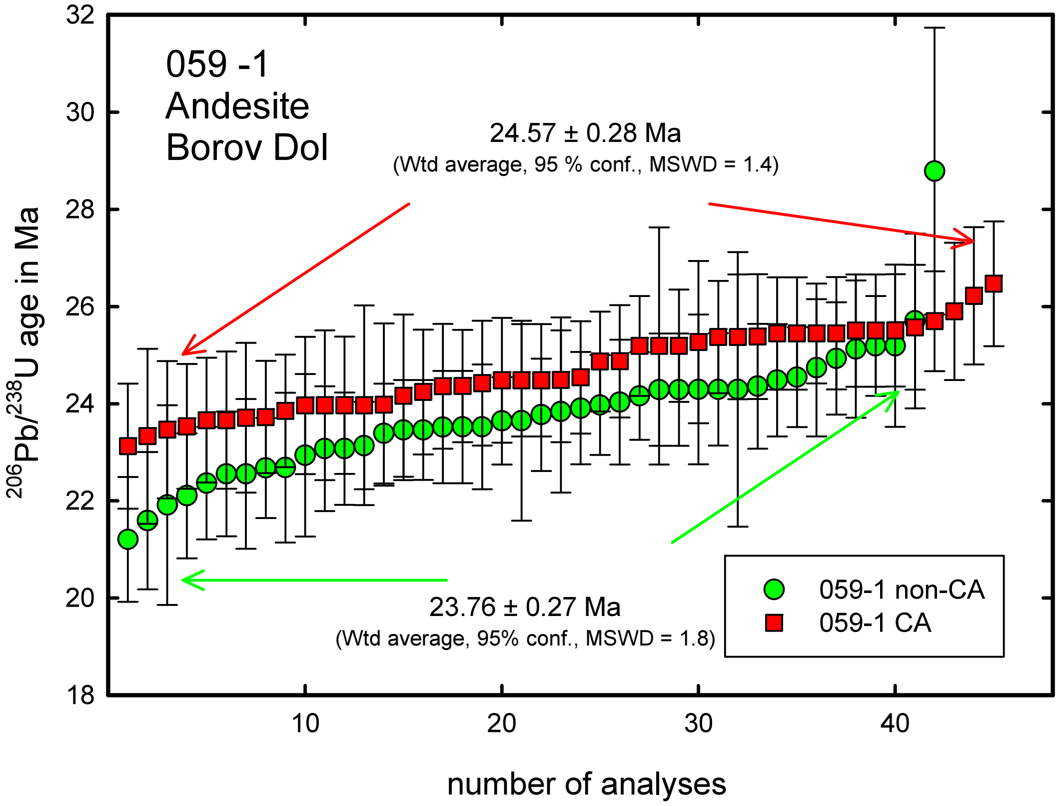
!
!
!

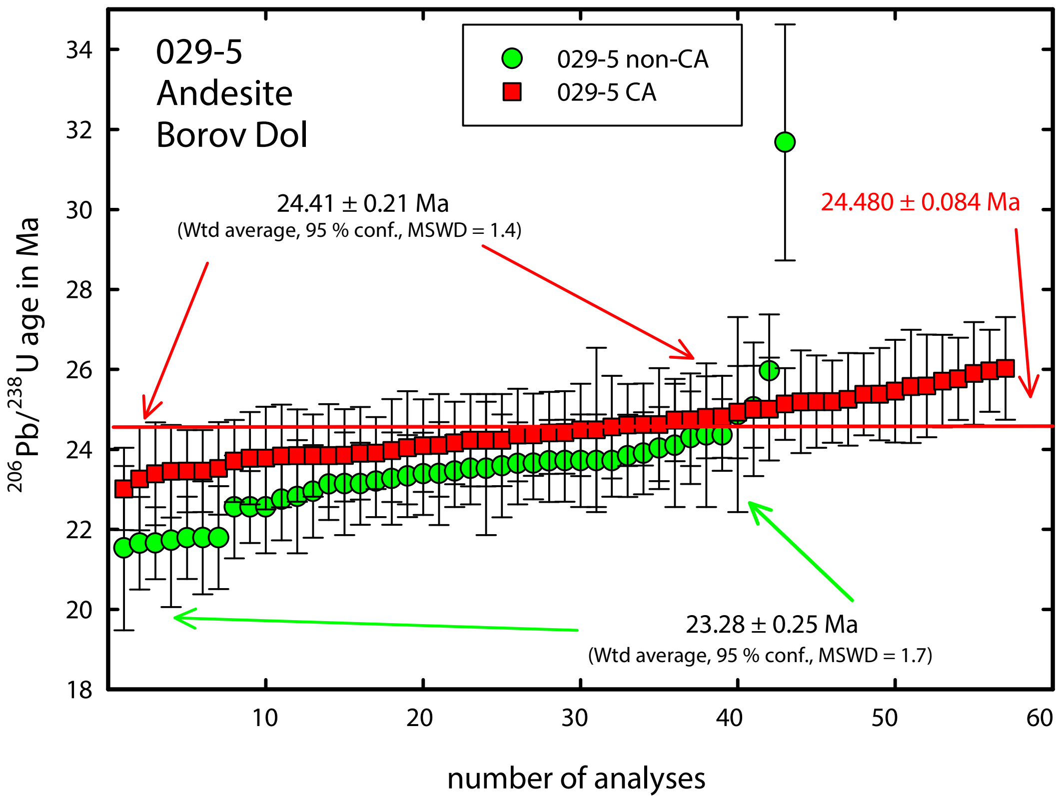

Trun region
Western Bulgaria
AvQ 244
Granite
$^{206}Pb/^{238}U$
$^{207}Pb/^{235}U$
0.0580
0.0560
0.0540
0.0520
0.0500
0.368
0.388
0.408
0.428
350
330
8
11F
9
13F
Concordia Age = 333.60 ± 0.66 Ma
(2s, decay-const. errs included)

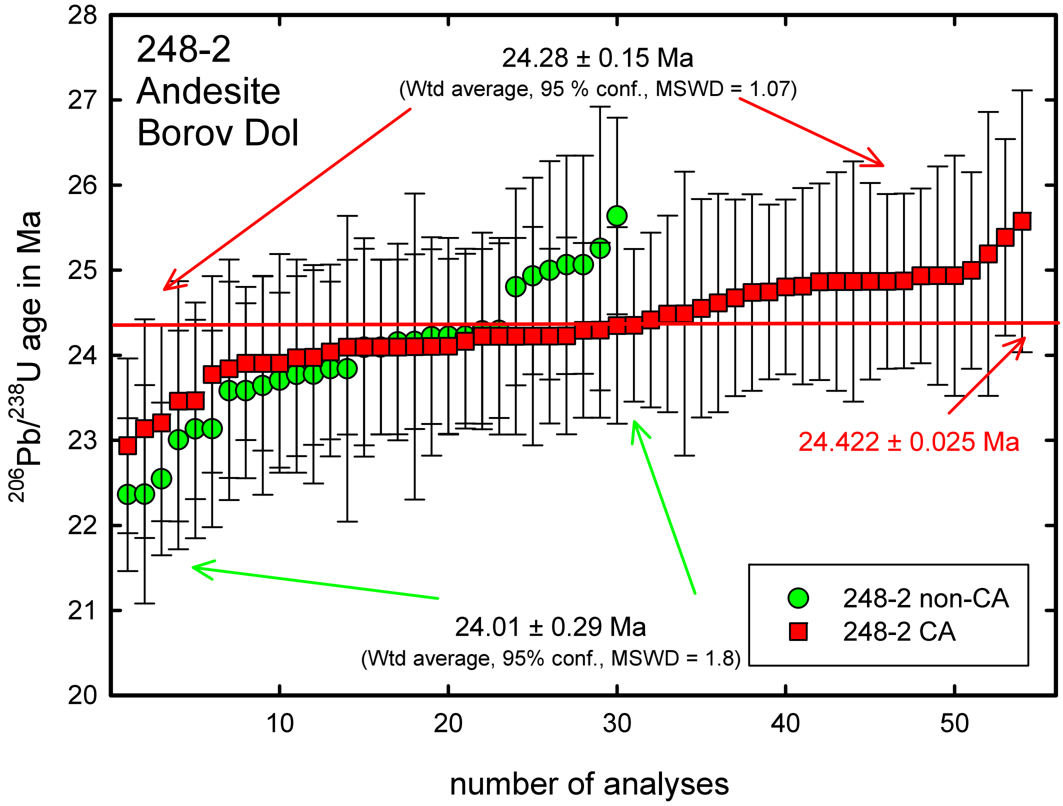
!


KPT-04
non-CA treated zircons
Th correction, Sakata et al., 2013
Th correction, Schaerer, 1984
292.9 ± 13.7 ka
281.1 ± 14.4 ka
0.1964 ± 0.0058 Ma
A
age
500000
400000
300000
200000
100000
5
10
15
20
25
30
number of analyses

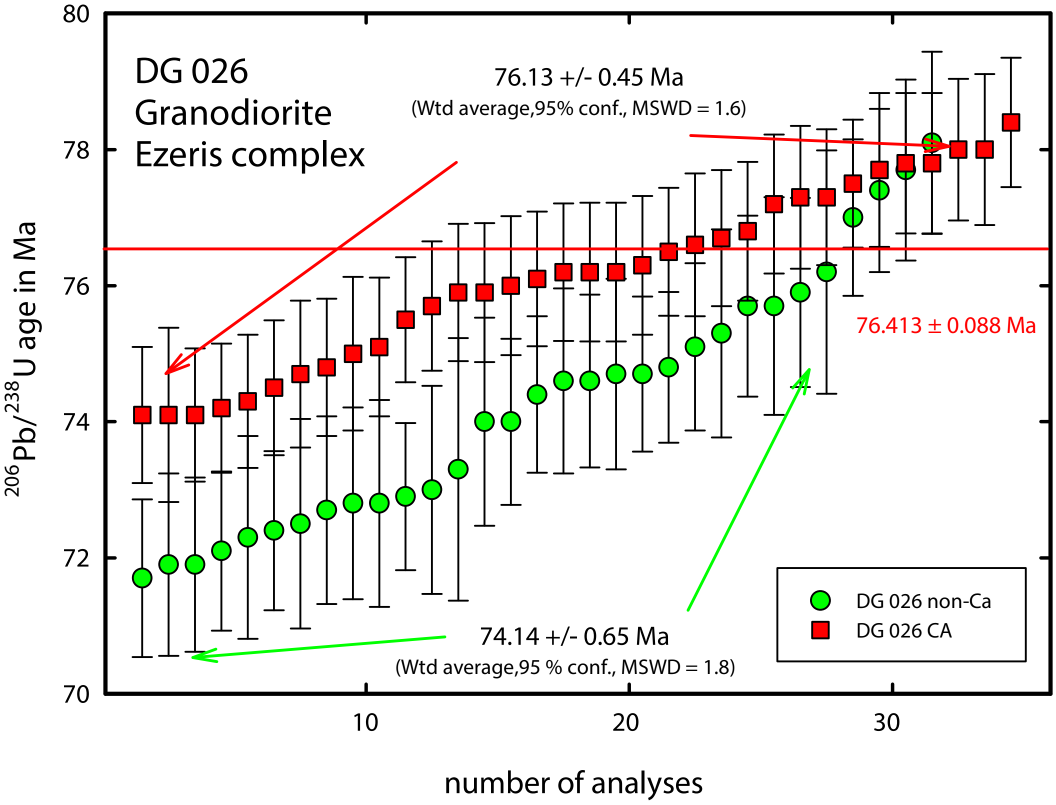

KPT-04
CA treated zircons
269.8 ± 7.8 ka
Th correction, Sakata et al., 2013
Th correction, Schaerer, 1984
0.1964 ± 0.0058 Ma
256.4 ± 8.3 ka
B
age
500000
400000
300000
200000
100000
5
10
15
20
25
30
35
number of analyses

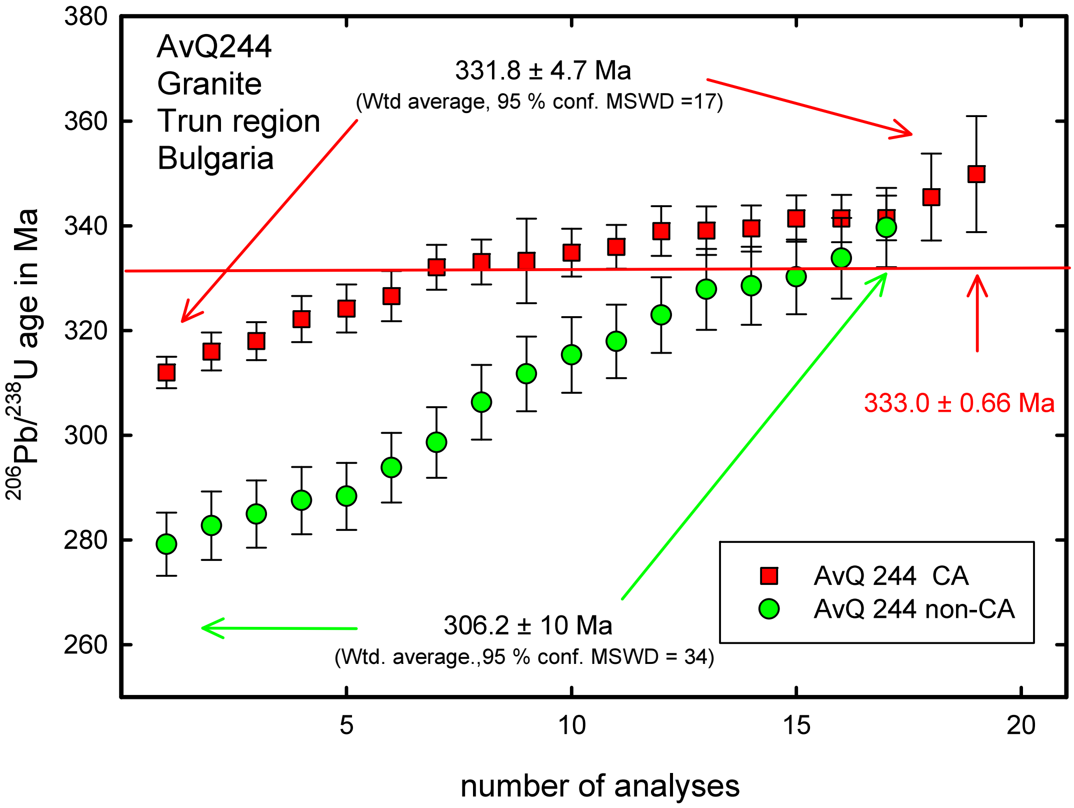

059 -1
Andesite
Borov Dol
24.57 ± 0.28 Ma
(Wtd average, 95 % conf., MSWD = 1.4)
23.76 ± 0.27 Ma
(Wtd average, 95% conf., MSWD = 1.8)
059-1 non-CA
059-1 CA
$^{206}Pb/^{238}U$ age in Ma
number of analyses
32
30
28
26
24
22
20
18
10
20
30
40


029-5
Andesite
Borov Dol
029-5 non-CA
029-5 CA
24.41 ± 0.21 Ma
(Wtd average, 95 % conf., MSWD = 1.4)
24.480 ± 0.084 Ma
23.28 ± 0.25 Ma
(Wtd average, 95 % conf., MSWD = 1.7)
206Pb/238U age in Ma
number of analyses
18
20
22
24
26
28
30
32
34
10
20
30
40
50
60

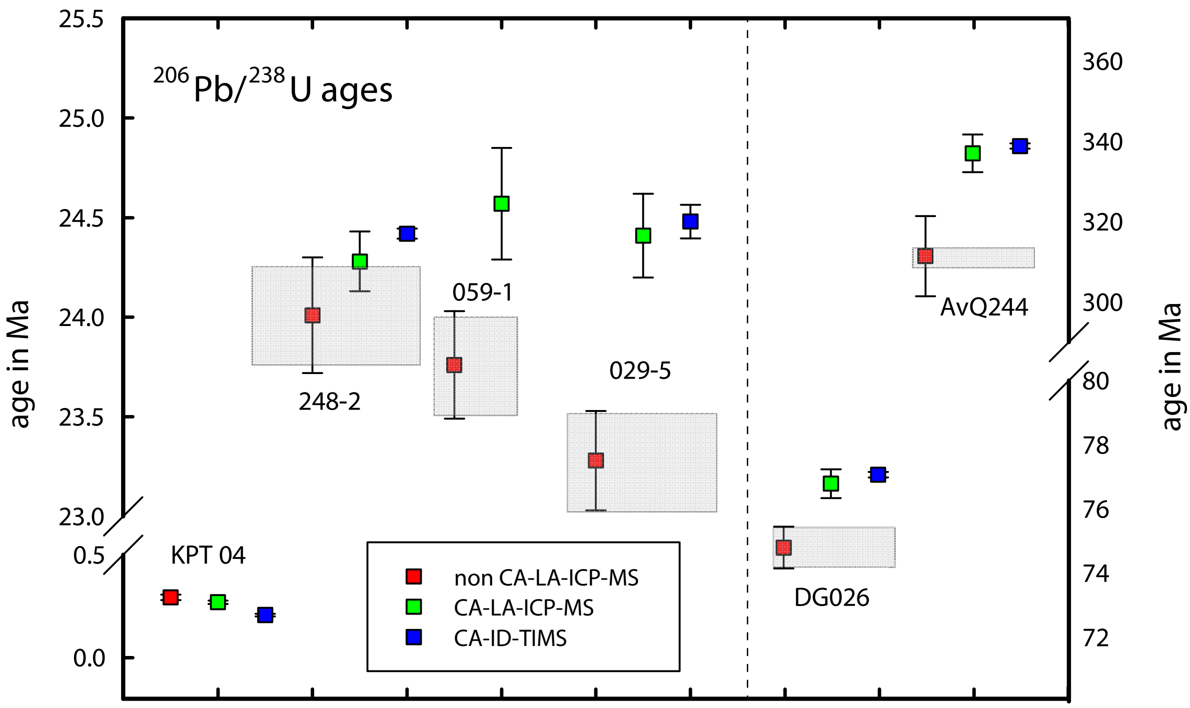


248-2
Andesite
Borov Dol
24.28 ± 0.15 Ma
(Wtd average, 95 % conf., MSWD = 1.07)
24.422 ± 0.025 Ma
24.01 ± 0.29 Ma
(Wtd average, 95% conf., MSWD = 1.8)
248-2 non-CA
248-2 CA
206Pb/238U age in Ma
number of analyses
28
27
26
25
24
23
22
21
20
10
20
30
40
50


DG 026
Granodiorite
Ezeris complex
76.13 +/- 0.45 Ma
(Wtd average,95% conf., MSWD = 1.6)
76.413 ± 0.088 Ma
74.14 +/- 0.65 Ma
(Wtd average,95 % conf., MSWD = 1.8)
DG 026 non-Ca
DG 026 CA
$^{206}Pb/^{238}U$ age in Ma
number of analyses
80
78
76
74
72
70
10
20
30



AvQ244
Granite
Trun region
Bulgaria
331.8 ± 4.7 Ma
(Wtd average, 95 % conf. MSWD =17)
333.0 ± 0.66 Ma
306.2 ± 10 Ma
(Wtd. average.,95 % conf. MSWD = 34)
AvQ 244 CA
AvQ 244 non-CA
206Pb/238U age in Ma
number of analyses
380
360
340
320
300
280
260
5
10
15
20



206Pb/238U ages
age in Ma
25.5
25.0
24.5
24.0
23.5
23.0
0.5
0.0
360
340
320
300
80
78
76
74
72
248-2
059-1
029-5
KPT 04
AvQ244
DG026
non CA-LA-ICP-MS
CA-LA-ICP-MS
CA-ID-TIMS

Figure captions:

Figure 4: Concordia plot of U-Pb analyses of the rhyolitic tuff KPT-04. All zircons are CA-treated and the three youngest zircons give a concordia age of 0.1964 ± 0.0058 Ma (a: Th-corr.[48]) and 0.2070 ± 0.0062 Ma (b: Th-corr.[43]). All ellipses are plotted with 2 SE.

Figure 5: Concordia plot of U-Pb analyses of the andesite 029-5 of Borov Dol (Macedonia). All zircons are CA-treated and *the three youngest* zircons give a concordia age of 24.480 ± 0.084 Ma. All ellipses are plotted with 2 SE.

Figure 6: Concordia plot of U-Pb analyses of the andesite 248-2. All zircons are CA-treated and six zircons give a concordia age of 24.422 ± 0.025 Ma. All ellipses are plotted with 2 SE.

Figure 7: Concordia plot of U-Pb analyses of the granodiorite DG026. All zircons are CA-treated and five zircons give a concordia age of 76.413 ± 0.088 Ma. All ellipses are plotted with 2 SE.

Figure 8: Concordia plot of U-Pb analyses of the granite AvQ244 of the Trun region (Western Bulgaria). All zircons are CA-treated and four zircons give a concordia age of 332.57 ± 0.60 Ma. All ellipses are plotted with 2 SE.

Figure 9a, b: a: $^{206}Pb/^{238}U$ age plot of non-CA treated zircons of KPT-04; U-Th disequilibrium correction after Schaerer (1984)[43] and Sakata et al. (2013)[48]; b) $^{206}Pb/^{238}U$ age plot of CA treated zircons of KPT-04; U-Th disequilibrium correction after Schaerer (1984)[43] and Sakata et al. (2013)[48]. The red line shows the ID-CA-TIMS age including the Th correction[55].

Figure 10: $^{206}Pb/^{238}U$ age plot of non-CA and CA treated zircons of 059-1; U-Th disequilibrium correction after Schaerer (1984) [43] and Sakata et al. (2013)[48].

Figure 11: $^{206}Pb/^{238}U$ age plot of non-CA and CA treated zircons of 029-5; U-Th disequilibrium correction after Schaerer (1984)[43] and Sakata et al. (2013)[48]. The red line shows the ID-CA-TIMS age including the Th correction[52].

Figure 12: $^{206}Pb/^{238}U$ age plot of non-CA and CA treated zircons of 248-2; U-Th disequilibrium correction after Schaerer (1984)[43] and Sakata et al. (2013)[48]; the red line shows the ID-CA-TIMS age including the Th correction[52].

Figure 13: $^{206}Pb/^{238}U$ age plot of non-CA and CA treated zircons of DG026; U-Th disequilibrium correction after Schaerer (1984)[43] and Sakata et al. (2013)[48]; the red line shows the ID-CA-TIMS age including the Th correction[52].

Figure 14: $^{206}Pb/^{238}U$ age plot of non-CA and CA treated zircons of AvQ244; U-Th disequilibrium correction after Schaerer (1984)[43] and Sakata et al. (2013)[48]; the red line shows the ID-CA-TIMS age including the Th correction[52].

Figure 15: Summary of the obtained $^{206}Pb/^{238}U$ ages of all samples; sample KPT 04, 248-2, 059-1 amd 029-5 are related to the left y-axis and sample DG026 and AvQ244 are linked to the right y-axis; the grew box is centered to the non-CA $^{206}Pb/^{238}U$ age and reflect the 2% level of variability[22].

Table 1: Sample description

Table 2: LA-ICP-MS U/Pb data (zircon standards)

Table 5: U-Th-Pb isotopic data (TIMS)

Electronic Supplementary Information (ESI):

Figure 1: Cathodoluminescence image (CL) of a non-CA treated zircon of DG026.

Figure 2: Cathodoluminescence images (CL) of CA treated zircon of DG026 and AvQ244; note the visible open cracks and holes.

Figure 3: $^{206}Pb/^{238}U$ ratios of non-CA and CA treated GJ-1 zircon standard show the raw and final $^{206}Pb/^{238}U$ ratios over time.

Table 3: LA-ICP-MS instrumentation and operational setting (Elan 6100)

Table 4: LA-ICP-MS instrumentation and operational setting (Element-XR)

Table 6: LA-ICP-MS U/Pb data (samples)

Table 7: U-Pb age summary of non-CA, CA-LA-ICP-MS and CA-ID-TIMS measurements