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Asymmetric exhumation of the Mount Everest region: implications for the tectono-topographic evolution of the Himalaya

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[Data Repository contains Analytical details and data tables]

$^{40}Ar/^{39}Ar$ DATING TECHNIQUE (INFRA-RED LASER SINGLE GRAIN FUSION)

$^{40}Ar/^{39}Ar$ analyses were performed at Arizona State University (ASU). Mineral grains were handpicked, and cleaned in acetone, methanol, followed by deionised water. Samples were then individually wrapped in aluminium foil packets, loaded into small aluminium disks, which were stacked and secured together to make up the irradiation package. Biotite age standard HD-B1 (24.18 ± 0.09 Ma, 1σ; Schwarz and Trieloff, 2007) were regularly interspersed in the aluminium disks with the samples to monitor the neutron flux, and Kalsilite and CaF_2 salts were added to determine interfering nuclear production ratios. The irradiation package was Cd shielded and irradiated with fast neutrons for 1.7 hours in the Cd-Lined In-Core Irradiation Tube (CLICIT) position at Oregon State University (OSU) nuclear reactor, Corvallis, Oregon, USA.

Upon return, individual age standard and samples of unknown ages were loaded into a 61 mm diameter aluminium palette containing a series of 2 x 2 x 2 mm holes. The palette and a glass coverslip were loaded into an ultra-high vacuum 4.5" laser chamber with a Kovar viewport and baked at 120°C for one day and then turbo pumped for one day to remove adsorbed atmospheric argon from the samples and chamber walls.

A 60 W IPG Photonics infrared (970 nm) diode laser, with computer-controlled Photon Machine optics and X-Y-Z stages linked to a Newport controller, was fired at 15 W, for 2 minutes with a 0.6 mm beam diameter and the X-Y stage being jogged around, to totally fuse a single grain. The laser system was fitted with a camera and a light source for sample illumination and X-Y-Z stages calibration.

The gases released by laser heating were cleaned for an additional 2 minutes using two SAES NP10 getter pumps (one at 450°C and one at room temperature) to remove all active gases. The remaining noble gases were equilibrated into a high sensitivity multi-collector mass spectrometer (Nu Instruments Noblesse), containing a Nier-type source, operated at 400 mA, and zoom optics. The Ar isotopes were measured using one Faraday detector (fitted with a 1 x 1011 Ohms resistor) and one ETP ion counting multiplier. Depending on the signal size, the ^{40}Ar peak was measured using either the Faraday or ion counting multiplier detectors, but the ^{39}Ar to ^{36}Ar peaks were only measured using one ion counting multiplier. The fully automated laser heating, automated valves operation, and data acquisition was computer controlled using Alan Deino's "Mass Spec" software program.

The maximum and minimum 4 minute extraction system blanks Ar isotope measurements obtained during the experiments ranged from 2.41-4.36e^{-16}, 0.627-2.13e^{-18}, 1.65-4.87e^{-19}, 3.29-6.16e^{-18}, and 1.05-1.91e^{-18} moles STP (standard temperature and pressure) for ^{40}Ar, ^{39}Ar, ^{38}Ar, ^{37}Ar, and ^{36}Ar, respectively, from 3/26/14 to 5/17/14 when these detrital analyses were undertaken. Sample analyses were corrected for mass spectrometer discrimination using air shots with ^{40}Ar/^{36}Ar ratios that ranged from 307.82 ± 0.93 to 322.43 ± 1.90 (1σ) from 5/25/14 to 5/17/14, and nuclear interference reactions (^{40}Ar/^{39}ArK = 0.018949 ± 0.00232, ^{38}Ar/^{39}ArK = 0.012810 ± 0.0000796, ^{37}Ar/^{39}ArK = 0.0016055 ± 0.0000794, ^{39}Ar/^{37}ArCa= 0.0006783 ± 0.00000209, and ^{39}Ar/^{37}ArCa = 0.000267 ± 0.00000134 (1σ)). Air pipette shots were regularly analysed to allow for Faraday/ion counting multiplier intercalibration of the ^{40}Ar peak on the Faraday detector (Turrin et al., 2010). Errors are quoted at 1 and 2σ, and the ^{40}Ar/^{39}Ar ages were calculated using the decay constants quoted by (Steiger and Jager, 1977). J values and errors are reported in Table DR4.

APATITE (U-Th/He) DATING

Sample EV2 was analyzed for apatite (U-Th)/He. Four apatites were dated using the methods described by House et al. (2000). Fish Canyon Tuff (28.48 ± 0.06 Ma) and Durango Apatite (31.9 ± 2.2 Ma) were used as apatite standards (Reiners et al. 2004). Apatite grains were selected on the basis of clarity, lack of visible inclusions, and half-widths greater than 60 μm (Farley et al. 1996). Analyses were conducted at the Arizona Radiogenic Helium Dating Laboratory. Apatites were placed in 1mm Nb foil envelopes to avoid volatilization of parent nuclides during He extraction. A Nd:YAG laser, cryogenic purification and quadrupole mass spectrometry were used for He extraction and analysis. Following He measurements, the Nb foil packets were transferred to Teflon vials for isotope dilution and HR-ICP-MS for U, Th, and Sm analysis. For isotope dilution, all samples were spiked with a 50 ml shot of a mixed spike containing 7.55 ± 0.10 ng/ml 233 U and 12.3 ± 0.10 ng/ml 229 Th and with 50 ml of a 97%-enriched 147 Sm with 10.8 ± 0.10 ng/ml Sm. Apatite is dissolved in 20 % warm HNO_3 and diluted with 2.5 ml of 18 MO H_20 to final concentrations of ~0.1-0.2 ppb ^{229}Th and ^{233}U. Element 2 ICP-MS analysis follows the procedures outlined in Reiners and Nicolescu (2006). Data are reported in Data Repository (Table DR3). The fact that no correlation exists between grain size, eU and ages (see Table DR3) suggests that the un-reproducibility of the AHe ages may be due to other factors other than radiation damage such as He implantation (e.g. Spiegel et al., 2009) or He loss.

APATITE FISSION TRACK DATING

Samples were analyzed with an Olympus microscope with drawing tube located above a digitizing tablet and a Kinetek computer-controlled stage driven by the FTStage program (Dumitru, 1993). Analyses were performed with reflected and transmitted light at 1600x magnification at the University of Arizona fission track laboratory (https://sites.google.com/site/arizonaftlab/home). Samples were irradiated at Oregon State University. Samples where etched in 5.5 molar nitric acid at 21^{o}C for 20 seconds. Following irradiation, the mica external detectors were etched at 21^{o}C in 40% hydrofluoric acid for 45 minutes (Donelick, 1993). The pooled age is reported in Table DR1 as the samples analyzed pass the χ^2 test, suggesting that they represent a single population. Error is one σ, calculated using the zeta calibration method (Hurford and Green, 1983). The full dataset is presented in Table DR2. The low U-concentration of the analyzed samples results in low numbers of natural tracks and high analytical errors.

CALCULATION OF DETRITAL DISTRIBUTIONS AND POPULATIONS

For detrital samples Kernel density distributions were calculated using Density Plotter (Vermeesch, 2012) and detrital populations were calculated using both Binomfit (Brandon, 2002) for the Rongbuk River sample (for which significant 0 Ns tracks were present) and Density Plotter for Gyachung Chhu River sample (7.9.14 2PK) (Figure 2; Table DR1).

THERMOKINEMATIC NUMERICAL MODELING

We use the 2012 version of Pecube (Braun, 2003; Braun, 2012), a finite element code that solves the three-dimensional heat transport equation in a crustal block affected by vertical and/or horizontal advection with evolving topography. Forward modeling predicts various thermochronologic ages (U-Th)/He and fission tracks on apatites and zircons, $^{40}Ar/^{39}Ar$ ages on micas and feldspars) on the present-day surface. Inverse modeling based on observations (i.e. acquired thermochronologic ages) is used to understand the sensitivity of the model for given parameters, or to constrain some parameters.

We use the SRTM 90 m digital elevation model (DEM) v4.1 (Jarvis et al., 2008) for the present day surface of the model, that we degrade to a ~1 km pixel to get a grid of 132 and 156 points respectively in the longitude and latitude directions. The model is 35 km thick.

Models run over 17 m.y.; for each set of models we impose the same thermal parameters that lead to a thermal gradient of 36°/km throughout of the model with a thermal diffusivity of 25 km^2/m.y., a temperature at the base of the model of 850°C, a temperature at the surface of 20°C at z = 0 km, a lapse rate of 6.49°C /km and a heat production of 9°C/m.y.

The tectonic setting only consists of a 15° north dipping normal fault that we assume to be the STDS; this cuts the surface along the line between the points defined by the longitude/latitude (87.7°N; 27.97°E) and (86.6°N; 27.97°W). The northern block is moving in regards to the southern one. The velocity on that structure is assumed to be 11 km/Ma. We also impose a homogeneous background exhumation rate of 1 mm/yr.

Forward modeling with a proto-plateau

The topography can be changed through time by:

1) Multiplying the present-day topography by a given amplification factor for a given time step. If this factor is >1, the relief grows, if it is <1, the relief decreases and we flatten the DEM.

2) Adding a vertical offset to the topography to keep a given altitude at a given time step. We use this to model a proto plateau from 20 to 12 Ma, and then to erode it. The topography (h) can be describe for a time i at the position (x,y) as $h_i(x,y) = Z_i + R_i*h_0(x,y)$, where $h_0(x,y)$ is the present day topography, R_i the amplification factor for the time step i (If this factor is >1, the relief grows, if it is <1, the relief decrease and we flatten the DEM), and Z_i the vertical offset factor at the time i (if $Z_i = 1$, we add 1 km to the topography).We use the two parameters Z_i and R_i to model a proto plateau from 20 to 12 Ma, and then to erode it (see table DR5).

—> To get a 5 km plateau, $R_i = 0$ and $Z_i = 5$;

—> Lowering the vertical offset = lower Z_i, the global DEM

—> Increasing relief = increasing R_i

In order to change topography, we play with the 2 parameters Z_i and R_i and we make sure to be geologically consistent: i.e. if we are not careful, it is very easy to produce:

- a topography with no relief and no plateau ($Z_i = 0$ and $R_i = 0$) —> $h_i = 0$ m
- a topography with very high relief, for example in the case of Mt. Everest: $Z_i = 5$ and $R_i = 0.5$ —> $h_i = 8800 * 0.5 + 5000 = 9500$ m (which is not geologically supported).

We ran a set of models with different input parameters. Table DR5 presents the parameters we used for the most relevant models, while Figure DR3 shows comparison of predictions and observations. None of the models permit to reproduce both apatite fission track (AFT) and zircon fission track (ZFT) data. The timing of the STDS controls Miocene ages to the north, whereas post-Miocene erosion controls Pliocene ages to the south (Figure DR3). The reason why the ZFT fit is poor is because of the low sensitivity of the zircon fission track system to processes acting in the upper ca. 5-6 km of crust; ZFT is a system with relatively high closure Temperature (~230/250°C) and as discussed in previous papers (e.g. Robert et al., 2011), relatively high-temperature thermochronometers such as ZFT are not strongly affected by low angle faults active over several m.y., whereas they should track deeper processes such as duplexing. Unfortunately, these processes are not easily modeled by Pecube, and therefore we did not take duplexing into account.

Forward modeling without a proto-plateau

For this exercise, we remove the evolving topography by setting the initial topography identical as the present day topography. The topography stays in steady state. We also use the same kinematic and thermal parameters used for RUN04. Figure DR4 evidences the low fit between predictions and data. A model with no proto-plateau erosion does not explain the observed ages.

Forward modeling with channel flow

In order to test the channel flow model we use a geometry similar to the STDS but with the footwall moving southwards to mimic rock extrusion. We keep a velocity of 11 km/m.y.; we do not model any proto-plateau and we input the same thermal parameters used in RUN04. Figure DR5 shows the low fit between predictions and data.

Inverse modelling

Inverse modeling permits to understand the behavior of the system and/or constrain some input parameters as exhumation and relief histories by comparing data and predictions. Here, to check on the behavior of the system, we used the inverse method NA (Sambridge, 1999) described in Braun (2012) and references therein.

We compare data ($\alpha_{i,dat}$) and predictions ($\alpha_{i,mod}$) with a misfit function defined by:

$$\Phi = \frac{1}{N}\sqrt{\sum_{i=1}^{N}\frac{\left(\alpha_{i,mod}-\alpha_{i,dat}\right)^2}{\sigma_i^2}}$$

where N is the number of data point and σ_i the uncertainty of the data (Figure DR6). We use the data published in this paper and the data from Streule et al. (2012) to calculate the misfit.

For each inversion, we ran at 216 models (9 iterations of 24 models with 12 cells resampled) on ISTerre cluster. We choose the boundaries of each parameter to keep a geologically consistent model (Table DR6). We test the behavior of the system for different parameters one by one while keeping the other parameters fixed. Figure DR6 shows NA inversions for the vertical offset at 12 Ma (A), the vertical offset at 17 Ma (B), the time of onset of topography (when we begin to erode the proto-plateau (C), the basal Temperature (E), the end of the STDS activity (D), the amplification factor of the topography at 5 Ma (F), and the exhumation rate (G). For each inversion, only one parameter is set free, the other parameters remain fixed at the value defined for model RUN04. Inverse modeling indicates that the misfit is lower when the timing is under 5-6 Ma; we add a lower limit of < 2 Ma based on thermochronological constraints.

CALCULATION OF THE DEPTH OF CLOSURE

The depth of closure for samples in Figure DR1 from north (this study) and south of Mt. Everest (Streule et al., 2012) was calculated using the method described by Willett and Brandon (2013). The model was run in steady state; average elevations were calculated using the radius pertinent to the calculated closure depth for AFT system (Braun, 2002; Stüwe et al., 1994). We used an initial geothermal gradient of 25^{o}C/km and increased it as needed.

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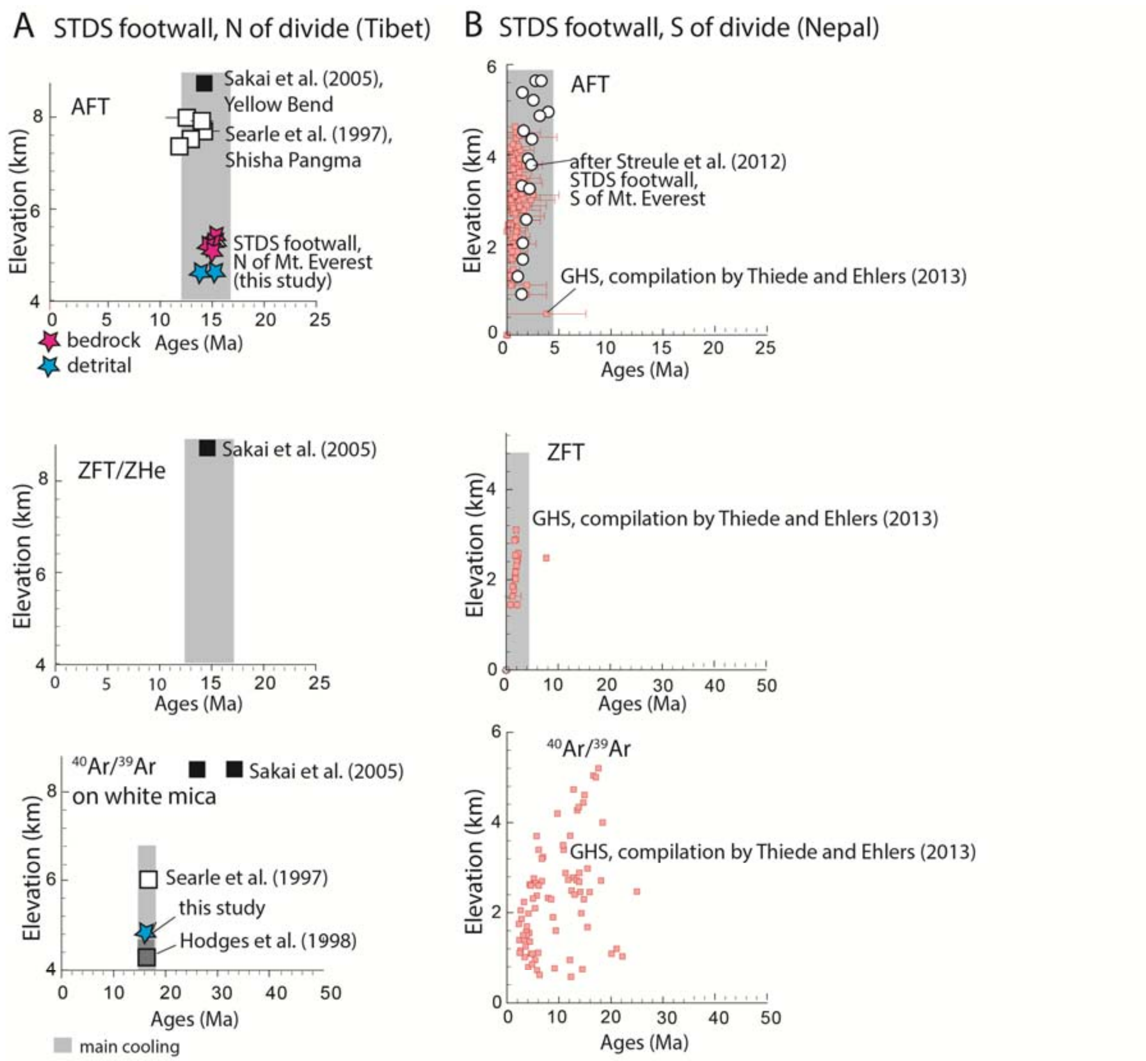

212 **Figure DR1.** Compilation of low-temperature thermochronology data from GHS rocks in

213 Nepal after (Thiede and Ehlers, 2013); B) Low-temperature thermochronology data of

214 GHS rocks from Tibet.

215

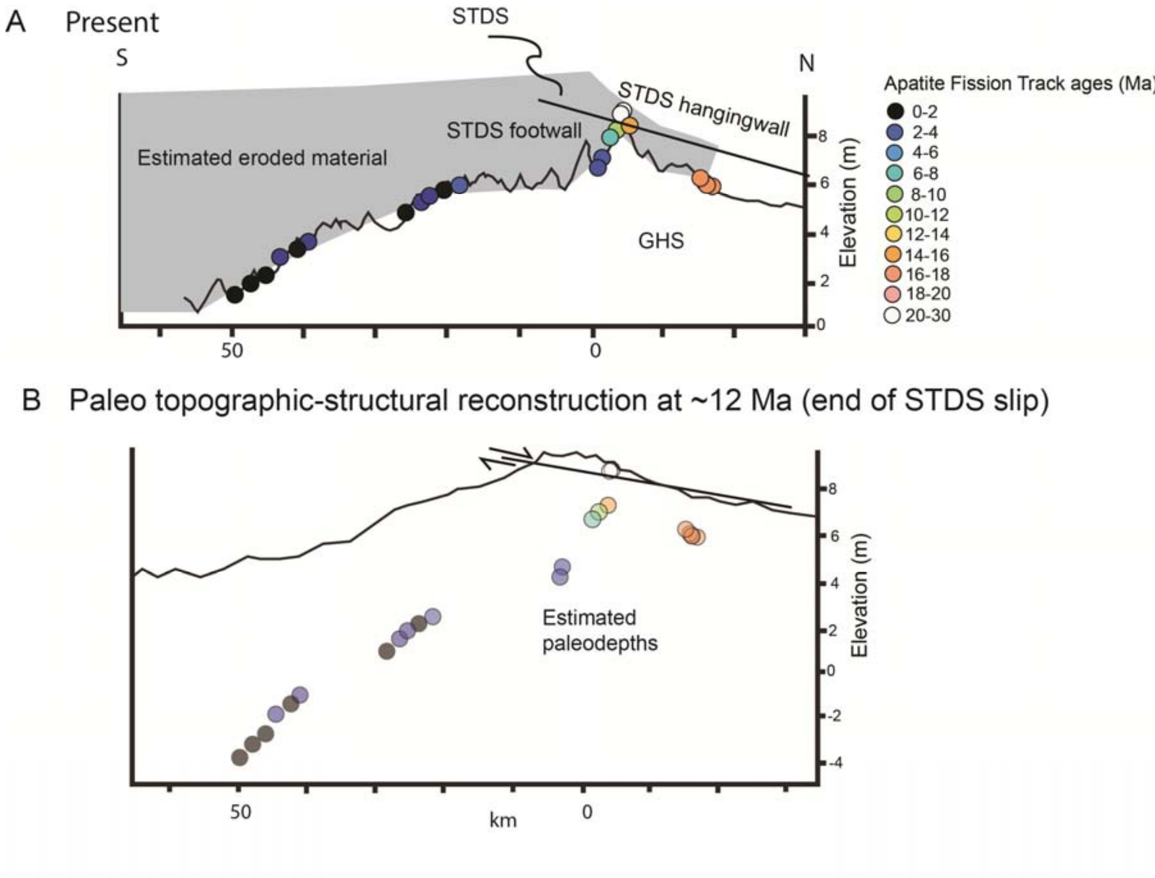

Figure DR2

Figure DR2. A) Modern topographic profile across Mt. Everest with location of the samples from this study and from Streule et al. (2012). B) Estimates of paleodepths (and eroded material in A) are based on closure result from modeling available ages using the method described by Willett and Brandon (2013); the error on the closure depth is ca. 10%.

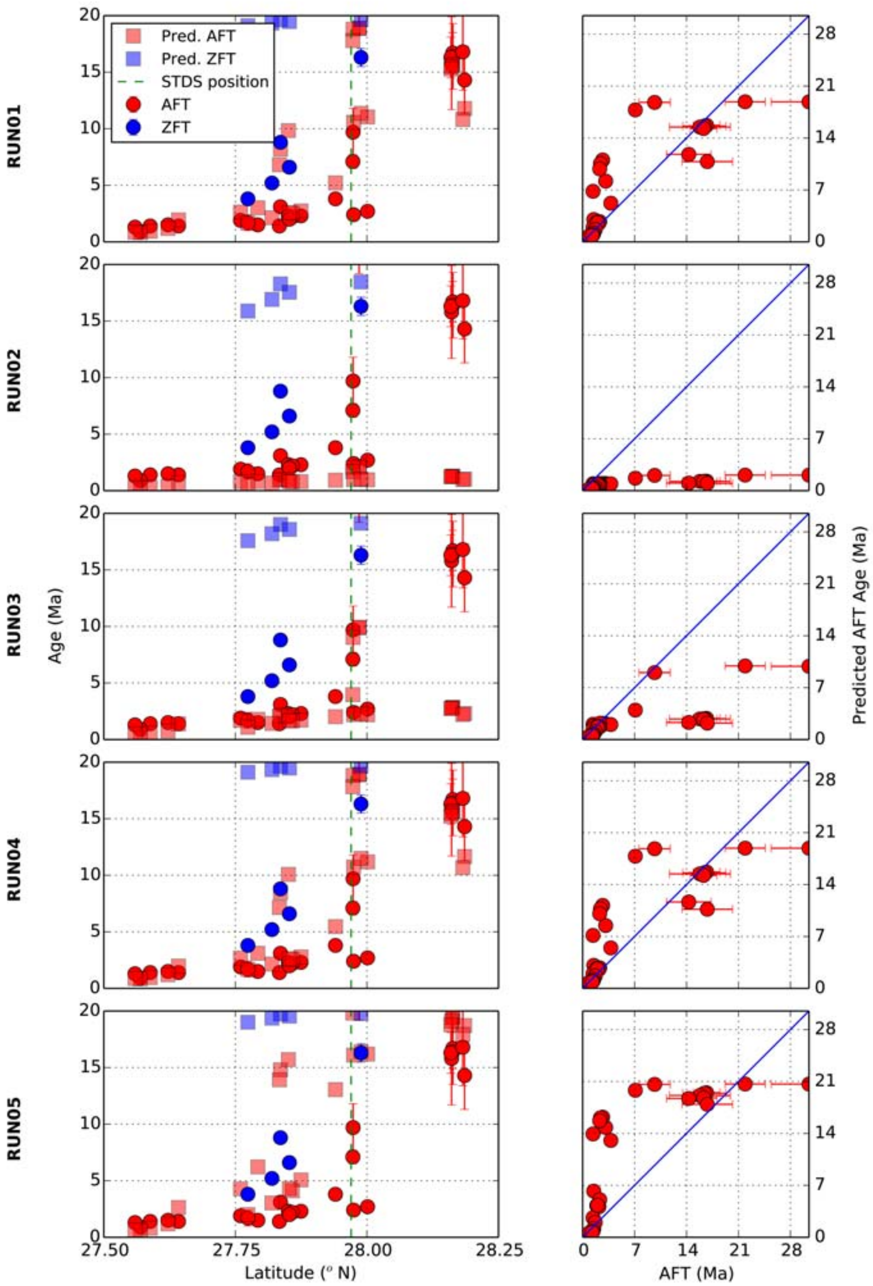

Figure DR3. Comparison of predicted and observed AFT and ZFT data for each forward model with a proto-plateau.

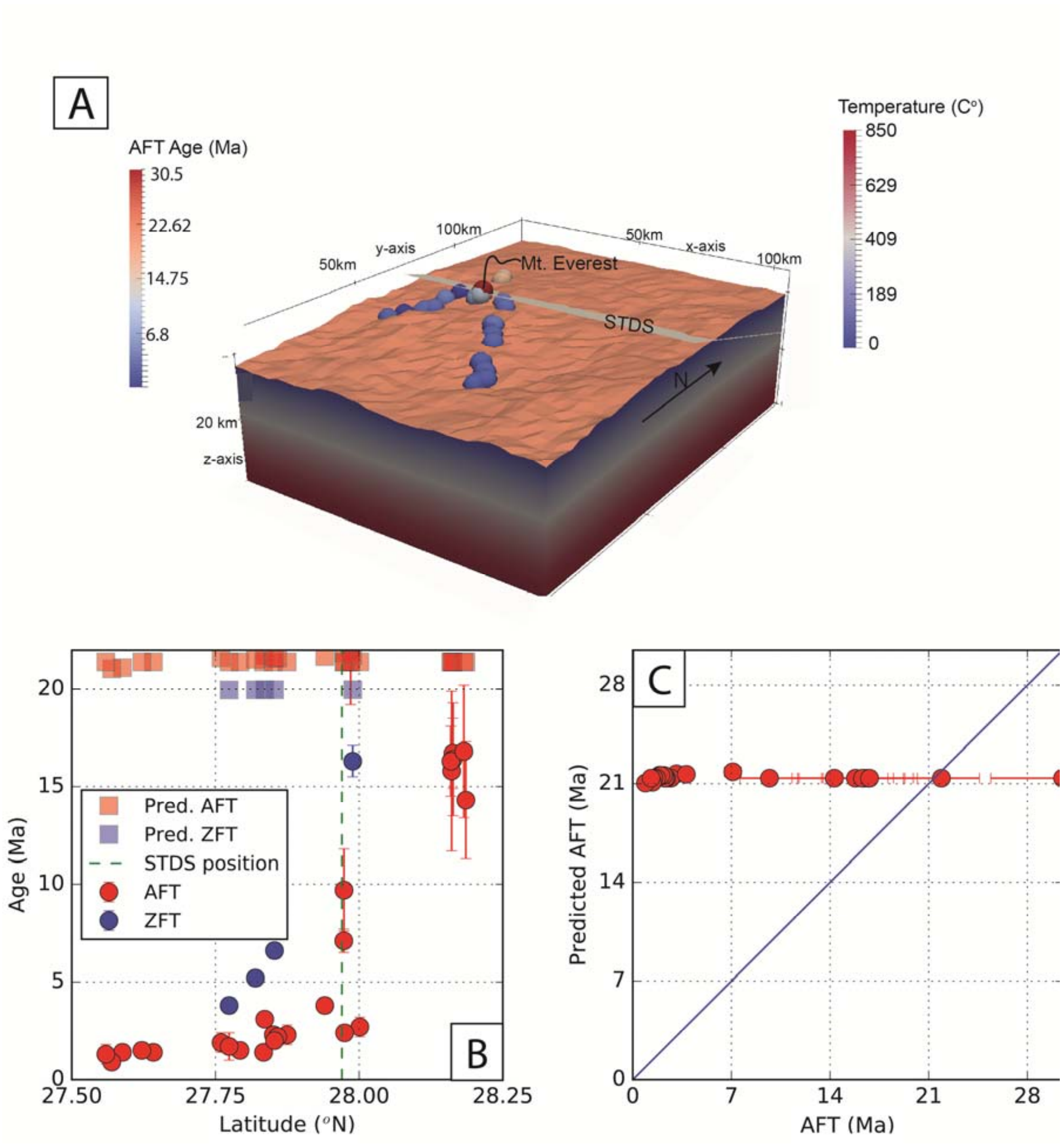

Figure DR4a. A) Forward model without any proto-plateau but with other parameters similar to RUN04; B) AFT and ZFT data and predicted ages along the modeled latitudinal transect; C) AFT data versus AFT predictions.

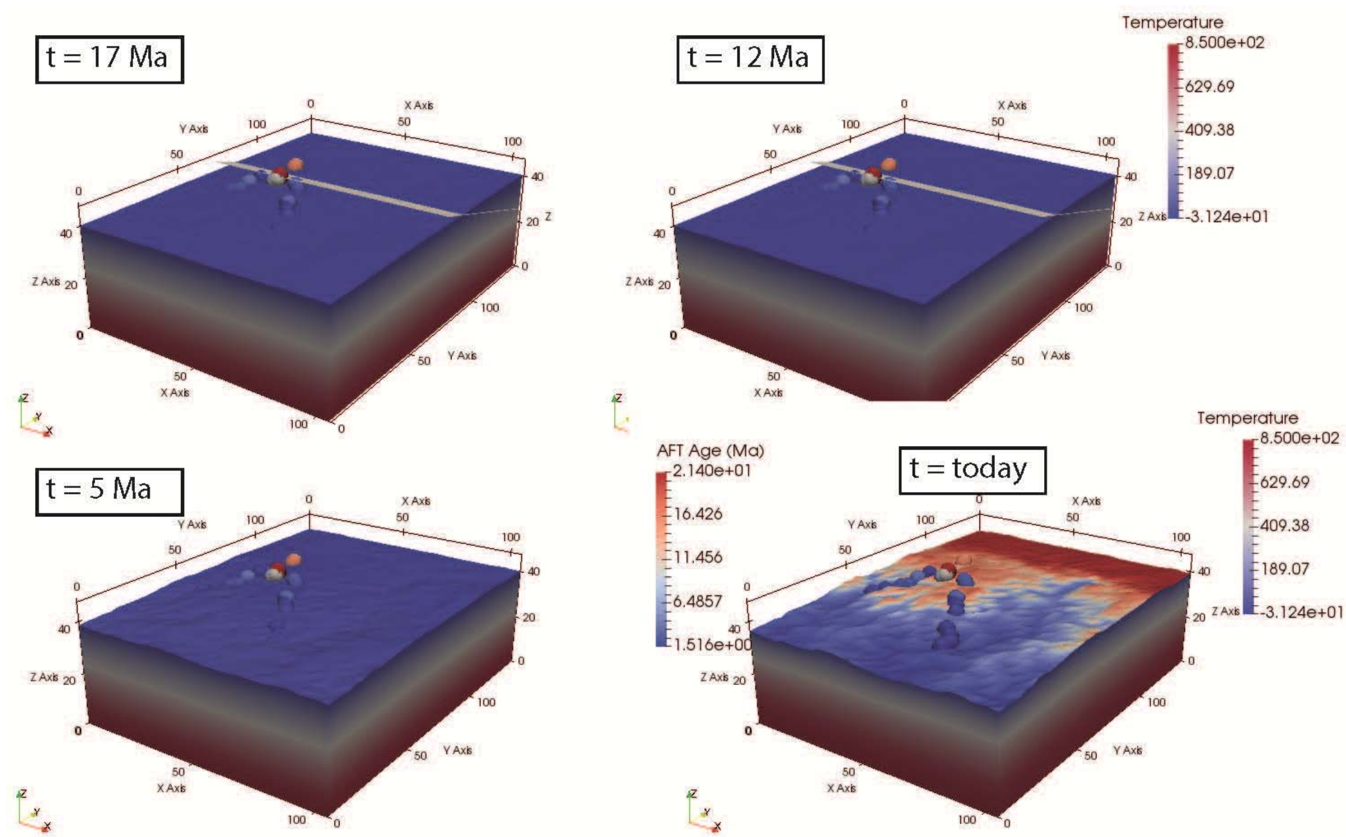

Figure 4b. Complete evolution of forward model presented in Figure 4a; x-y-k axes are in km.

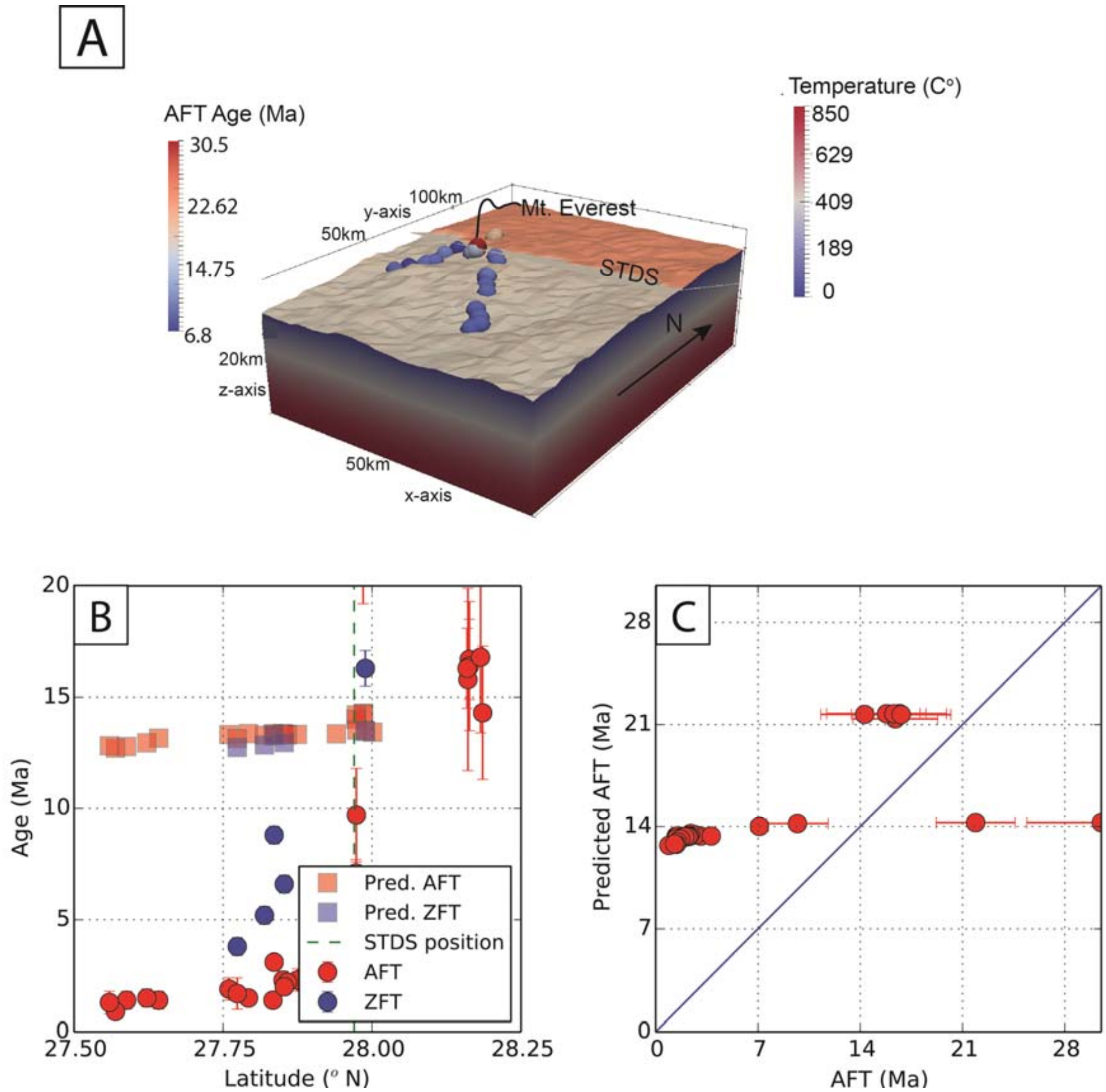

Figure DR5. Forward model mimicking channel flow (footwall moves southward) and without a proto-plateau but with other parameters similar to RUN04; A) AFT predictions; B) AFT and ZFT data and along a latitudinal transect; C) AFT data versus AFT predictions.

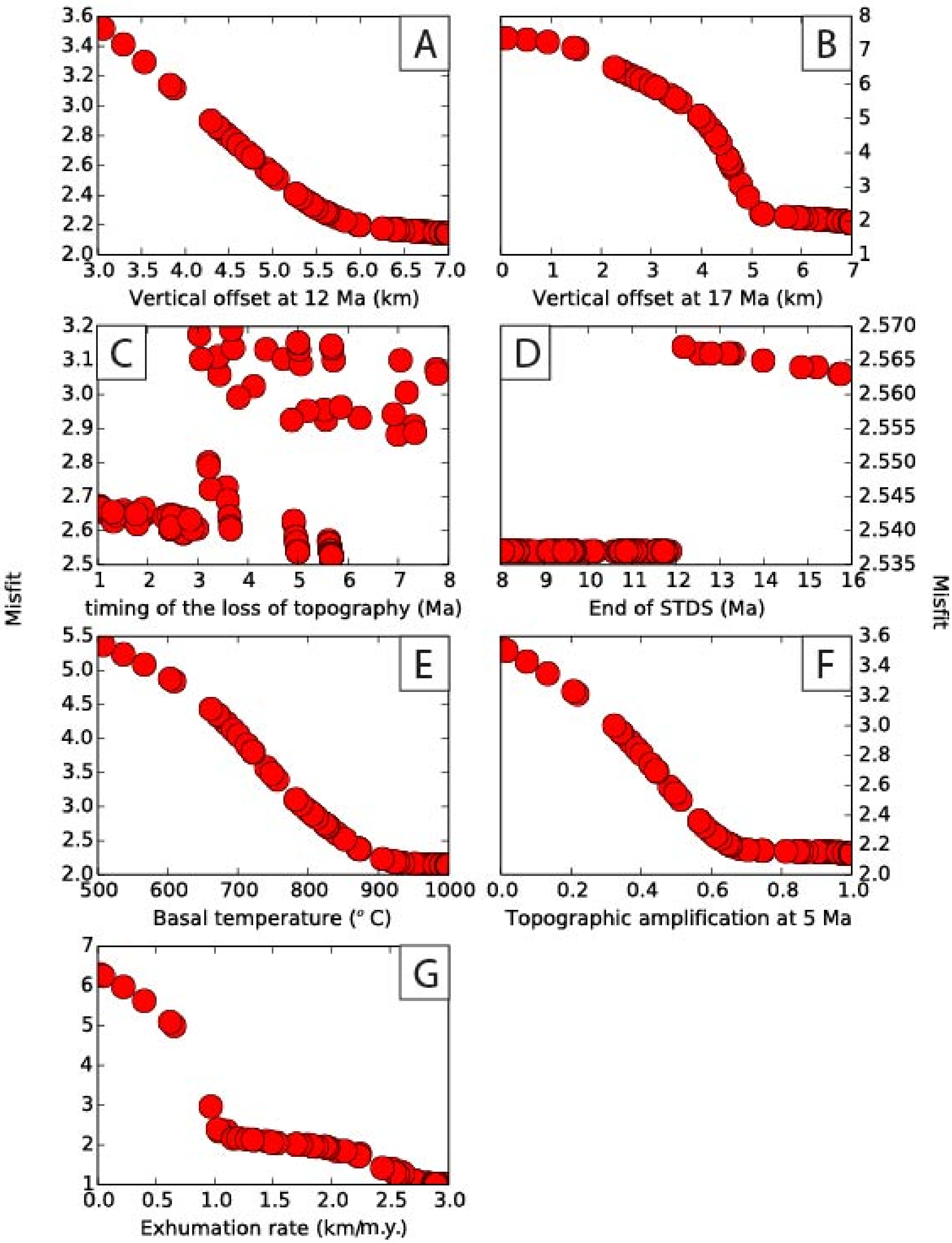

Figure DR6. Results from inverse modeling.

DATA RESPOSITORY TABLES

Table DR1. Summary table with AFT data, sample locations and types of analyses.

Table DR2. AFT data.

Table DR3. Apatite (U-Th)/He data.

Table DR4. $^{40}Ar/^{39}Ar$ ages of Rongbuk River sand sample.

Table DR5. Pecube modelling input parameters.

Table DR6. Range of parameters used for the different inversions

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Table DR1. Apatite Fission Track data

Sample name	Lithology sample	No Xls*	Rho-S (e5)†	NS	Rho-I (e5)†	NI	P(χ)2 (%) #	Rho-D (e5) **	ND ††	Age (Ma)	± 1 σ	U ppm	Lat	Long	Elevation (m)	Other ages
Rongbuck Granite																
11RLHS-02 bc, st	leucogranite	30	1.471	50	24.98	849	96	13.14	2523	*13.7*	*2*	20.9	28.1631	86.85600	5595	
11RLHS-04st	metasediments	20	2.847	86	52.57	1588	99	13.28	2549	12.7	1.5	43.5	28.1634	86.85513	5565	
11RLHS-03bc	leucogranite	17	1.641	34	27.02	560	99.5	14.05	3533	15.6	2.8	21.2	28.1634	86.85513	5563	Zhe*
11RLHS-05bc	paragneiss	13	1.089	15	18.29	252	89.9	14.21	3533	*15.5*	*4.1*	14.2	28.1609	86.85440	5453	
EV2-1bc	leucogranite	12	1.368	25	24.89	455	64.16	14.60	3533	14.7	3	18.8	28.1857	86.84065	5410	U-Pb*, Zhe*
11RLHS-07bc, st	leucogranite	20	4.458	101	69.30	1570	99	13.54	2600	15.4	1.6	56.3	28.1596	86.85345	5361	
EV2-3bc	leucogranite	10	1.124	24	19.81	423	96.61	14.75	3533	15.3	3.2	14.8	28.1822	86.83837	5126	AHe
									Mean Age	14.7	2.6					
Modern river sand										Populations						
Rongbuck River bc		104	1.30	188	22.3	3218	82.4	14.83	3533	15.1	1.2	18	28.1455	86.84855	5148	$^{40}Ar/^{39}Ar$, U-Pb#
Gyachung Chhu River (Everest 7-9-14 2PK) st		32	2.06	397	30	5790	100	10.80	3457	13.8	1	30.6	28.2748	86.806317	4822	

Table DR2

Sample Number	**11 RLHS 02**		Mineral	**Apatite**
Position (#)	4		Glass (U ppm)	11
Area of Graticule Square	3.948E-07		Irradiation	UA-12-2
No. of Crystals	22		Analyst	BC
Zeta Factor ± Error	367.4	7.5	Count Date	
Rho d (% Relative Error)	1.397E+06	1.68	Locality	
N d	3533		Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
4	52	100	-	-	#VALUE!	1.013E+05	1.317E+06	0.0769	10.4	**19.71**	**0.00**	23.16	30.27	17.98
15	206	100	-	-	#VALUE!	3.800E+05	5.218E+06	0.0728	41.1	**18.66**	**5.01**	19.52	11.95	9.26
8	78	50	-	-	#VALUE!	4.053E+05	3.952E+06	0.1026	31.1	**26.27**	**9.78**	28.58	25.66	17.61
2	34	50	-	-	#VALUE!	1.013E+05	1.723E+06	0.0588	13.6	**15.08**	**10.98**	20.35	38.27	18.60
4	89	50	-	-	#VALUE!	2.027E+05	4.509E+06	0.0449	35.5	**11.52**	**5.90**	13.51	17.00	10.43
4	95	35	-	-	#VALUE!	2.895E+05	6.876E+06	0.0421	54.1	**10.80**	**0.00**	12.65	15.87	9.77
6	131	100	-	-	#VALUE!	1.520E+05	3.318E+06	0.0458	26.1	**11.74**	**4.91**	13.09	13.14	8.85
3	38	49	-	-	#VALUE!	1.551E+05	1.965E+06	0.0789	15.5	**20.23**	**12.14**	24.97	38.57	20.97
3	52	64	-	-	#VALUE!	1.187E+05	2.058E+06	0.0577	16.2	**14.79**	**8.79**	18.22	27.35	15.26
4	42	40	-	-	#VALUE!	2.533E+05	2.660E+06	0.0952	20.9	**24.40**	**12.78**	28.71	38.31	22.34
7	124	100	-	-	#VALUE!	1.773E+05	3.141E+06	0.0565	24.7	**14.47**	**5.64**	15.90	14.78	10.19
4	99	50	-	-	#VALUE!	2.027E+05	5.016E+06	0.0404	39.5	**10.36**	**5.29**	12.14	15.20	9.37
7	87	60	-	-	#VALUE!	2.955E+05	3.673E+06	0.0805	28.9	**20.62**	**0.00**	22.67	21.56	14.61
2	39	50	-	-	#VALUE!	1.013E+05	1.976E+06	0.0513	15.6	**13.15**	**0.00**	17.73	32.91	16.19
5	92	50	-	-	#VALUE!	2.533E+05	4.661E+06	0.0543	36.7	**13.93**	**6.41**	15.86	17.80	11.43
5	77	60	-	-	#VALUE!	2.111E+05	3.251E+06	0.0649	25.6	**16.64**	**7.69**	18.95	21.52	13.69
8	136	60	-	-	#VALUE!	3.378E+05	5.742E+06	0.0588	45.2	**15.08**	**5.50**	16.38	14.15	9.99
5	60	50	-	-	#VALUE!	2.533E+05	3.040E+06	0.0833	23.9	**21.35**	**9.95**	24.34	28.18	17.65
5	82	50	-	-	#VALUE!	2.533E+05	4.154E+06	0.0610	32.7	**15.63**	**7.21**	17.79	20.12	12.85
3	49	48	-	-	#VALUE!	1.583E+05	2.586E+06	0.0612	20.4	**15.69**	**9.34**	19.34	29.17	16.20
7	61	50	-	-	#VALUE!	3.546E+05	3.090E+06	0.1148	24.3	**29.38**	**11.75**	32.36	31.75	21.01
0	61	50	-	-	#VALUE!	0.000E+00	3.090E+06	0.0000	24.3	**0.00**	**0.00**	2.93	9.97	2.93
**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********
111	1784	1316	#DIV/0!	#DIV/0!	#VALUE!	2.137E+05	3.434E+06	0.0622	27.0	**15.95**	**1.62**	16.05	3.27	3.00

Pooled Ratio	0.0622	±	0.0063	
Mean Ratio	0.0638	±	0.0052	
Pooled Age	15.95	±	1.62	1 S.E.
Mean Crystal Age	16.34	±	1.33	1 S.E.
Binomial Age	**16.05**	**+**	**3.27**	**"+95%"**
		-	**3.00**	**"-95%"**
Central Age	**15.95**	**±**	**1.62**	
Age Dispersion	**0.00** %			
Chi-squared	**12.795**	with	21	degrees of freedom
P (Chi-Sq)	**91.56 %**			

Table DR2. continuation

Sample Number	**11 RLHS 02**		Mineral	**Apatite**
Position (#)	4		Glass (U	11
Area of Graticule Squ	6.400E-07		Irradiatior	UA-12-2
No. of Crystals	30		Analyst	SNT
Zeta Factor ± Error	354.2	7.5	Count Da	25.4.2015
Rho d (% Relative Er	1.314E+06	1.99	Locality	
N d	2523		Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
0	20	15	-	-	-	0.000E+00	2.083E+06	0.0000	17.4	**0.00**	**0.00**	8.20	29.29	8.20
1	22	15	2.14	0.53	0.805	1.042E+05	2.292E+06	0.0455	19.2	**10.57**	**10.81**	18.00	47.11	17.75
2	37	20	2.06	0.63	0.811	1.563E+05	2.891E+06	0.0541	24.2	**12.57**	**9.13**	16.95	31.63	15.48
4	54	24	1.99	0.51	0.816	2.604E+05	3.516E+06	0.0741	29.4	**17.21**	**8.93**	20.22	26.35	15.69
2	23	20	2.07	0.51	0.810	1.563E+05	1.797E+06	0.0870	15.0	**20.20**	**14.91**	27.40	53.98	25.09
0	22	20	-	-	-	0.000E+00	1.719E+06	0.0000	14.4	**0.00**	**0.00**	7.44	26.41	7.44
3	30	15	2.16	0.69	0.804	3.125E+05	3.125E+06	0.1000	26.2	**23.23**	**14.08**	28.74	45.66	24.20
1	14	20	2.24	0.42	0.798	7.813E+04	1.094E+06	0.0714	9.2	**16.60**	**17.19**	28.52	79.81	28.13
1	18	16	2.09	0.86	0.809	9.766E+04	1.758E+06	0.0556	14.7	**12.92**	**13.27**	22.07	59.29	21.76
1	8	12	2.40	0.55	0.787	1.302E+05	1.042E+06	0.1250	8.7	**29.02**	**30.80**	50.75	162.65	50.10
2	40	25	2.27	0.54	0.796	1.250E+05	2.500E+06	0.0500	20.9	**11.62**	**8.43**	15.67	29.04	14.31
1	24	18	1.93	0.52	0.820	8.681E+04	2.083E+06	0.0417	17.4	**9.69**	**9.89**	16.48	42.70	16.25
0	8	12	-	-	-	0.000E+00	1.042E+06	0.0000	8.7	**0.00**	**0.00**	21.03	83.82	21.03
0	15	21	-	-	-	0.000E+00	1.116E+06	0.0000	9.3	**0.00**	**0.00**	11.00	40.24	11.00
2	47	21	1.78	0.55	0.829	1.488E+05	3.497E+06	0.0426	29.3	**9.89**	**7.15**	13.32	24.38	12.16
2	31	12	2.13	0.57	0.806	2.604E+05	4.036E+06	0.0645	33.8	**15.00**	**10.95**	20.26	38.47	18.52
2	24	20	1.90	0.41	0.821	1.563E+05	1.875E+06	0.0833	15.7	**19.36**	**14.26**	26.24	51.40	24.02
2	32	24	2.11	0.43	0.808	1.302E+05	2.083E+06	0.0625	17.4	**14.53**	**10.60**	19.62	37.14	17.93
2	30	16	2.39	0.49	0.787	1.953E+05	2.930E+06	0.0667	24.5	**15.50**	**11.33**	20.94	39.91	19.15
3	29	15	1.89	0.72	0.822	3.125E+05	3.021E+06	0.1034	25.3	**24.03**	**14.59**	29.74	47.46	25.05
2	46	16	1.86	0.65	0.824	1.953E+05	4.492E+06	0.0435	37.6	**10.11**	**7.31**	13.61	24.96	12.42
0	15	16	-	-	-	0.000E+00	1.465E+06	0.0000	12.3	**0.00**	**0.00**	11.00	40.24	11.00
5	39	15	1.70	0.52	0.834	5.208E+05	4.063E+06	0.1282	34.0	**29.77**	**14.17**	34.04	41.27	24.86
1	46	28	1.91	0.65	0.821	5.580E+04	2.567E+06	0.0217	21.5	**5.06**	**5.11**	8.55	21.01	8.42
2	30	15	1.84	0.50	0.825	2.083E+05	3.125E+06	0.0667	26.2	**15.50**	**11.33**	20.94	39.91	19.15
2	20	12	1.85	0.45	0.825	2.604E+05	2.604E+06	0.1000	21.8	**23.23**	**17.24**	31.57	63.52	28.93
4	39	18	2.02	0.42	0.814	3.472E+05	3.385E+06	0.1026	28.3	**23.82**	**12.53**	28.05	37.77	21.86
3	43	18	1.98	0.54	0.816	2.604E+05	3.733E+06	0.0698	31.2	**16.22**	**9.69**	20.00	30.53	16.78
0	31	12	-	-	-	0.000E+00	4.036E+06	0.0000	33.8	**0.00**	**0.00**	5.26	18.31	5.26
0	12	20	-	-	-	0.000E+00	9.375E+05	0.0000	7.8	**0.00**	**0.00**	13.82	51.83	13.82
**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********
50	849	531	2.03	0.55	0.813	1.471E+05	2.498E+06	0.0589	20.9	**13.69**	**2.03**	13.88	4.33	3.80

Pooled Ratio	0.0589	±	0.0087	
Mean Ratio	0.0553	±	0.0072	
Pooled Age	13.69	±	2.03	1 S.E.
Mean Crystal Age	12.86	±	1.67	1 S.E.
Binomial Age	**13.88**	**+**	**4.33**	**"+95%"**
		-	**3.80**	**"-95%"**
Central Age	**13.69**	**±**	**2.03**	

Age Dispersion	**0.00** %			
Chi-squared	**16.513**	with	29	degrees of freedom
P (Chi-Sq)	**96.92** %			

Table DR2. continuation

Sample Number	**11 RLHS 03**		Mineral	**Apatite**
Position (#)	5		Glass (U ppm)	11
Area of Graticule Square	3.948E-07		Irradiation	UA-12-2
No. of Crystals	17		Analyst	BC
Zeta Factor ± Error	365.6	14.4	Count Date	
Rho d (% Relative Error)	1.405E+06	1.68	Locality	
N d	3533		Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
3	34	50	-	-	-	1.520E+05	1.723E+06	0.0882	13.5	**22.62**	**0.00**	27.95	43.70	23.50
1	18	40	-	-	-	6.333E+04	1.140E+06	0.0556	8.9	**14.25**	**14.66**	24.36	65.38	24.01
2	48	24	-	-	-	2.111E+05	5.066E+06	0.0417	39.7	**10.69**	**7.73**	14.39	26.30	13.13
1	8	24	-	-	-	1.055E+05	8.444E+05	0.1250	6.6	**32.02**	**33.99**	55.99	179.12	55.26
1	16	30	-	-	-	8.444E+04	1.351E+06	0.0625	10.6	**16.03**	**16.54**	27.46	75.04	27.08
1	28	40	-	-	-	6.333E+04	1.773E+06	0.0357	13.9	**9.17**	**0.00**	15.56	39.68	15.34
1	19	21	-	-	-	1.206E+05	2.292E+06	0.0526	17.9	**13.50**	**13.87**	23.05	61.42	22.73
4	59	28	-	-	-	3.619E+05	5.338E+06	0.0678	41.8	**17.39**	**9.01**	20.42	26.40	15.82
4	77	50	-	-	-	2.027E+05	3.901E+06	0.0519	30.5	**13.33**	**6.86**	15.63	19.84	12.08
3	27	30	-	-	-	2.533E+05	2.280E+06	0.1111	17.9	**28.47**	**17.37**	35.27	56.80	29.73
2	18	16	-	-	-	3.166E+05	2.850E+06	0.1111	22.3	**28.47**	**21.26**	38.76	79.34	35.55
4	68	42	-	-	-	2.413E+05	4.101E+06	0.0588	32.1	**15.09**	**7.79**	17.70	22.66	13.70
1	10	32	-	-	-	7.916E+04	7.916E+05	0.1000	6.2	**25.63**	**0.00**	44.44	133.60	43.85
1	8	16	-	-	-	1.583E+05	1.267E+06	0.1250	9.9	**32.02**	**0.00**	55.99	179.12	55.26
1	13	12	-	-	-	2.111E+05	2.744E+06	0.0769	21.5	**19.72**	**20.49**	33.95	96.25	33.48
2	44	40	-	-	-	1.267E+05	2.786E+06	0.0455	21.8	**11.66**	**8.45**	15.71	28.88	14.34
2	65	30	-	-	-	1.689E+05	5.489E+06	0.0308	43.0	**7.90**	**5.68**	10.61	19.04	9.67
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34	560	525	#DIV/0!	#DIV/0!	#DIV/0!	1.641E+05	2.702E+06	0.0607	21.2	**15.57**	**2.83**	15.89	6.12	5.21

Pooled Ratio	0.0607	±	0.0110	
Mean Ratio	0.0730	±	0.0076	
Pooled Age	15.57	±	2.83	1 S.E.
Mean Crystal Age	18.71	±	1.95	1 S.E.
Binomial Age	**15.89**	**+**	**6.12**	**"+95%"**
		-	**5.21**	**"-95%"**
Central Age	**15.57**	**±**	**2.83**	
Age Dispersion	**0.00** %			
Chi-squared	**5.152**	with	16	degrees of freedom
P (Chi-Sq)	**99.49 %**			

Table DR 2. continuation

Sample Number	**11 RLHS 04**	Mineral	**Apatite**
Position (#)	6	Glass (U	11
Area of Graticule Squ	6.400E-07	Irradiatior	UA-12-2
No. of Crystals	20	Analyst	SNT
Zeta Factor ± Error	354.2 7.5	Count Da	24.4.2015
Rho d (% Relative Er	1.328E+06 1.98	Locality	
N d	2549	Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
8	120	40	2.18	0.55	0.803	3.125E+05	4.688E+06	0.0667	38.8	**15.66**	**5.74**	17.02	14.81	10.40
3	76	24	2.47	0.71	0.781	1.953E+05	4.948E+06	0.0395	41.0	**9.28**	**5.47**	11.40	16.71	9.53
1	47	16	2.56	0.61	0.774	9.766E+04	4.590E+06	0.0213	38.0	**5.00**	**5.06**	8.45	20.76	8.33
3	51	18	2.27	0.69	0.796	2.604E+05	4.427E+06	0.0588	36.7	**13.82**	**8.22**	17.02	25.61	14.26
6	127	20	2.50	0.75	0.779	4.688E+05	9.922E+06	0.0472	82.2	**11.10**	**4.65**	12.37	12.44	8.37
10	165	50	2.33	0.60	0.792	3.125E+05	5.156E+06	0.0606	42.7	**14.24**	**4.66**	15.22	11.61	8.51
5	65	28	2.31	0.55	0.793	2.790E+05	3.627E+06	0.0769	30.0	**18.07**	**8.40**	20.59	23.68	14.91
3	65	20	2.21	0.70	0.801	2.344E+05	5.078E+06	0.0462	42.1	**10.85**	**6.41**	13.34	19.73	11.16
5	81	21	2.17	0.56	0.803	3.720E+05	6.027E+06	0.0617	49.9	**14.50**	**6.70**	16.51	18.69	11.92
2	64	18	2.18	0.63	0.803	1.736E+05	5.556E+06	0.0313	46.0	**7.35**	**5.28**	9.87	17.73	9.00
2	42	21	2.41	0.76	0.786	1.488E+05	3.125E+06	0.0476	25.9	**11.19**	**8.11**	15.08	27.83	13.76
2	50	18	2.41	0.52	0.786	1.736E+05	4.340E+06	0.0400	36.0	**9.40**	**6.78**	12.65	23.06	11.54
4	62	18	2.17	0.85	0.803	3.472E+05	5.382E+06	0.0645	44.6	**15.16**	**7.83**	17.79	22.92	13.78
3	69	24	2.24	0.68	0.798	1.953E+05	4.492E+06	0.0435	37.2	**10.22**	**6.03**	12.57	18.52	10.51
6	80	32	2.39	0.66	0.787	2.930E+05	3.906E+06	0.0750	32.4	**17.62**	**7.47**	19.66	20.32	13.38
3	47	16	2.35	0.74	0.790	2.930E+05	4.590E+06	0.0638	38.0	**14.99**	**8.94**	18.48	27.99	15.49
9	173	20	2.29	0.83	0.795	7.031E+05	1.352E+07	0.0520	112.0	**12.22**	**4.19**	13.16	10.57	7.66
1	39	16	1.86	0.65	0.824	9.766E+04	3.809E+06	0.0256	31.5	**6.03**	**6.11**	10.20	25.34	10.05
5	84	24	2.33	0.55	0.792	3.255E+05	5.469E+06	0.0595	45.3	**13.98**	**6.45**	15.92	17.98	11.49
5	81	28	2.03	0.53	0.813	2.790E+05	4.520E+06	0.0617	37.4	**14.50**	**6.70**	16.51	18.69	11.92
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86	1588	472	2.28	0.66	0.795	2.847E+05	5.257E+06	0.0542	43.5	**12.72**	**1.46**	12.83	2.98	2.70

Pooled Ratio	0.0542	±	0.0062	
Mean Ratio	0.0522	±	0.0035	
Pooled Age	12.72	±	1.46	1 S.E.
Mean Crystal Age	12.26	±	0.81	1 S.E.
Binomial Age	**12.83**	**+**	**2.98**	**"+95%"**
		-	**2.70**	**"-95%"**
Central Age	**12.72**	**±**	**1.46**	

Age Dispersion	**0.00** %			
Chi-squared	**4.959**	with	19	degrees of freedom
P (Chi-Sq)	**99.95 %**			

Table DR2. continuation

Sample Number	**11 RLHS 05**	Mineral	**Apatite**
Position (#)	7	Glass (U ppm)	11
Area of Graticule Square	3.948E-07	Irradiation	UA-12-2
No. of Crystals	13	Analyst	BC
Zeta Factor ± Error	367.4 7.5	Count Date	
Rho d (% Relative Error)	1.421E+06 1.68	Locality	
N d	3533	Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
0	15	30	-	-	#VALUE!	0.000E+00	1.267E+06	0.0000	9.8	**0.00**	**0.00**	12.33	45.10	12.33
1	7	15	-	-	#VALUE!	1.689E+05	1.182E+06	0.1429	9.2	**37.17**	**39.75**	65.37	218.46	64.54
2	64	15	-	-	#VALUE!	3.378E+05	1.081E+07	0.0313	83.7	**8.15**	**5.86**	10.95	19.66	9.98
1	19	30	-	-	#VALUE!	8.444E+04	1.604E+06	0.0526	12.4	**13.72**	**14.08**	23.42	62.40	23.09
1	8	20	-	-	#VALUE!	1.267E+05	1.013E+06	0.1250	7.8	**32.54**	**34.52**	56.88	181.93	56.15
3	44	24	-	-	#VALUE!	3.166E+05	4.644E+06	0.0682	36.0	**17.77**	**0.00**	21.91	33.36	18.37
3	45	64	-	-	#VALUE!	1.187E+05	1.781E+06	0.0667	13.8	**17.37**	**10.37**	21.42	32.55	17.96
1	7	12	-	-	#VALUE!	2.111E+05	1.478E+06	0.1429	11.4	**37.17**	**39.75**	65.37	218.46	64.54
0	8	24	-	-	#VALUE!	0.000E+00	8.444E+05	0.0000	6.5	**0.00**	**0.00**	23.57	93.87	23.57
1	8	30	-	-	#VALUE!	8.444E+04	6.755E+05	0.1250	5.2	**32.54**	**34.52**	56.88	181.93	56.15
1	7	25	-	-	#VALUE!	1.013E+05	7.093E+05	0.1429	5.5	**37.17**	**39.75**	65.37	218.46	64.54
1	10	30	-	-	#VALUE!	8.444E+04	8.444E+05	0.1000	6.5	**26.04**	**27.32**	45.16	135.71	44.56
0	10	30	-	-	#VALUE!	0.000E+00	8.444E+05	0.0000	6.5	**0.00**	**0.00**	18.70	71.80	18.70
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15	252	349	#DIV/0!	#DIV/0!	#VALUE!	1.089E+05	1.829E+06	0.0595	14.2	**15.51**	**4.14**	16.23	9.84	7.67

Pooled Ratio	0.0595	±	0.0159	
Mean Ratio	0.0767	±	0.0158	
Pooled Age	15.51	±	4.14	1 S.E.
Mean Crystal Age	19.99	±	4.11	1 S.E.
Binomial Age	**16.23**	**+**	**9.84**	**"+95%"**
		-	**7.67**	**"-95%"**
Central Age	**15.51**	**±**	**4.14**	

Age Dispersion	**0.00** %			
Chi-squared	**6.319**	with	12	degrees of freedom
P (Chi-Sq)	**89.92 %**			

Table DR2. continuation

Sample Number	**11 RLHS 07**		Mineral	**Apatite**
Position (#)	10		Glass (U ppm)	11
Area of Graticule Square	3.948E-07		Irradiation	UA-12-2
No. of Crystals	19		Analyst	BC
Zeta Factor ± Error	365.6	14.4	Count Date	
Rho d (% Relative Error)	1.444E+06	2.08	Locality	
N d	2320		Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
10	126	40	-	-	#VALUE!	6.333E+05	7.980E+06	0.0794	60.8	**20.91**	**6.93**	22.37	17.32	12.57
4	54	24	-	-	#VALUE!	4.222E+05	5.700E+06	0.0741	43.4	**19.52**	**10.15**	22.93	29.87	17.79
6	78	30	-	-	#VALUE!	5.066E+05	6.586E+06	0.0769	50.2	**20.27**	**8.64**	22.63	23.43	15.40
9	144	50	-	-	#VALUE!	4.560E+05	7.296E+06	0.0625	55.6	**16.48**	**5.71**	17.74	14.38	10.35
7	92	24	-	-	#VALUE!	7.388E+05	9.711E+06	0.0761	74.0	**20.05**	**7.91**	22.05	20.88	14.20
2	40	30	-	-	#VALUE!	1.689E+05	3.378E+06	0.0500	25.7	**13.18**	**9.57**	17.77	32.92	16.23
2	33	32	-	-	#VALUE!	1.583E+05	2.612E+06	0.0606	19.9	**15.98**	**11.66**	21.57	40.67	19.71
5	164	70	-	-	#VALUE!	1.809E+05	5.935E+06	0.0305	45.2	**8.04**	**3.67**	9.14	10.00	6.56
6	110	40	-	-	#VALUE!	3.800E+05	6.966E+06	0.0545	53.1	**14.38**	**6.06**	16.03	16.24	10.86
8	126	35	-	-	#VALUE!	5.790E+05	9.119E+06	0.0635	69.5	**16.74**	**6.15**	18.18	15.77	11.11
3	119	30	-	-	#VALUE!	2.533E+05	1.005E+07	0.0252	76.6	**6.65**	**3.90**	8.16	11.73	6.81
12	166	40	-	-	#VALUE!	7.600E+05	1.051E+07	0.0723	80.1	**19.05**	**5.76**	20.15	13.99	10.50
3	44	24	-	-	#VALUE!	3.166E+05	4.644E+06	0.0682	35.4	**17.97**	**10.75**	22.16	33.74	18.59
4	54	18	-	-	#VALUE!	5.629E+05	7.600E+06	0.0741	57.9	**19.52**	**10.15**	22.93	29.87	17.79
10	153	40	-	-	#VALUE!	6.333E+05	9.689E+06	0.0654	73.8	**17.23**	**5.68**	18.42	14.10	10.31
1	37	30	-	-	#VALUE!	8.444E+04	3.124E+06	0.0270	23.8	**7.13**	**7.23**	12.07	30.08	11.90
5	64	50	-	-	#VALUE!	2.533E+05	3.242E+06	0.0781	24.7	**20.59**	**9.60**	23.46	27.01	16.99
1	10	36	-	-	#VALUE!	7.037E+04	7.037E+05	0.1000	5.4	**26.34**	**27.65**	45.67	137.24	45.07
2	8	20	-	-	#VALUE!	2.533E+05	1.013E+06	0.2500	7.7	**65.65**	**51.98**	91.40	231.05	84.58
**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********
100	1622	663	#DIV/0!	#DIV/0!	#VALUE!	3.821E+05	6.197E+06	0.0617	47.2	**16.25**	**1.82**	16.36	3.53	3.22

Pooled Ratio	0.0617	±	0.0069	
Mean Ratio	0.0731	±	0.0108	
Pooled Age	16.25	±	1.82	1 S.E.
Mean Crystal Age	19.26	±	2.84	1 S.E.
Binomial Age	**16.36**	**+**	**3.53**	**"+95%"**
		-	**3.22**	**"-95%"**
Central Age	**16.25**	**±**	**1.82**	
Age Dispersion	**0.01** %			
Chi-squared	**11.800**	with	18	degrees of freedom
P (Chi-Sq)	**85.74 %**			

Table DR2. continuation

Sample Number	**11 RLHS 07**	Mineral	**Apatite**
Position (#)	10	Glass (U ppm)	11
Area of Graticule Sq	6.400E-07	Irradiation	UA-12-2
No. of Crystals	20	Analyst	SNT
Zeta Factor ± Error	354.2 7.5	Count Date	24.4.2015
Rho d (% Relative E	1.354E+06 1.96	Locality	
N d	2600	Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
2	46	21	1.86	0.53	0.824	1.488E+05	3.423E+06	0.0435	27.8	**10.42**	**7.53**	14.03	25.71	12.80
6	104	30	1.78	0.49	0.829	3.125E+05	5.417E+06	0.0577	44.0	**13.82**	**5.82**	15.41	15.66	10.45
4	92	10	1.89	0.36	0.822	6.250E+05	1.438E+07	0.0435	116.8	**10.42**	**5.33**	12.21	15.35	9.43
1	37	21	1.85	0.55	0.825	7.440E+04	2.753E+06	0.0270	22.4	**6.48**	**6.57**	10.97	27.34	10.81
1	8	20	2.41	0.61	0.786	7.813E+04	6.250E+05	0.1250	5.1	**29.90**	**31.73**	52.29	167.49	51.61
13	149	12	1.68	0.49	0.835	1.693E+06	1.940E+07	0.0872	157.6	**20.89**	**6.07**	22.01	14.77	11.13
8	103	24	1.61	0.50	0.839	5.208E+05	6.706E+06	0.0777	54.5	**18.60**	**6.85**	20.22	17.76	12.39
5	54	10	1.90	0.47	0.821	7.813E+05	8.438E+06	0.0926	68.5	**22.16**	**10.38**	25.29	29.56	18.36
5	64	9	1.99	0.47	0.816	8.681E+05	1.111E+07	0.0781	90.3	**18.71**	**8.70**	21.32	24.55	15.44
5	105	18	1.86	0.47	0.824	4.340E+05	9.115E+06	0.0476	74.0	**11.41**	**5.23**	12.98	14.47	9.35
2	56	15	2.13	0.53	0.806	2.083E+05	5.833E+06	0.0357	47.4	**8.56**	**6.16**	11.51	20.82	10.50
7	149	30	1.80	0.55	0.828	3.646E+05	7.760E+06	0.0470	63.0	**11.26**	**4.37**	12.36	11.39	7.91
6	105	20	1.67	0.49	0.836	4.688E+05	8.203E+06	0.0571	66.6	**13.69**	**5.76**	15.26	15.50	10.35
2	39	14	1.98	0.69	0.816	2.232E+05	4.353E+06	0.0513	35.4	**12.29**	**8.91**	16.56	30.76	15.12
3	34	10	1.85	0.38	0.825	4.688E+05	5.313E+06	0.0882	43.2	**21.12**	**12.74**	26.10	40.83	21.95
5	85	15	1.73	0.48	0.832	5.208E+05	8.854E+06	0.0588	71.9	**14.09**	**6.50**	16.04	18.10	11.58
3	47	18	1.81	0.47	0.827	2.604E+05	4.080E+06	0.0638	33.1	**15.29**	**9.11**	18.84	28.53	15.80
4	59	12	1.68	0.48	0.835	5.208E+05	7.682E+06	0.0678	62.4	**16.24**	**8.40**	19.06	24.66	14.78
5	56	15	1.65	0.39	0.837	5.208E+05	5.833E+06	0.0893	47.4	**21.37**	**10.00**	24.38	28.40	17.69
14	178	30	1.83	0.43	0.826	7.292E+05	9.271E+06	0.0787	75.3	**18.83**	**5.26**	19.77	12.64	9.67
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101	1570	354	1.85	0.49	0.824	4.458E+05	6.930E+06	0.0643	56.3	**15.41**	**1.64**	15.51	3.33	3.04

Pooled Ratio	0.0643	±	0.0069	
Mean Ratio	0.0659	±	0.0053	
Pooled Age	15.41	±	1.64	1 S.E.
Mean Crystal Age	15.78	±	1.27	1 S.E.
Binomial Age	**15.51**	**+**	**3.33**	**"+95%"**
		-	**3.04**	**"-95%"**
Central Age	**15.41**	**±**	**1.64**	

Age Dispersion **0.00** %
Chi-squared **7.637** with 19 degrees of freedom
P (Chi-Sq) **99.00 %**

Table DR2. continuation

Sample Number	**EV2-1**		
Position (#)	4		
Area of Graticule Square	3.948E-07		
No. of Crystals	12		
Zeta Factor ± Error	367.4	7.5	
Rho d (% Relative Error)	1.460E+06	1.68	
N d	3533		

Mineral	**Apatite**
Glass (U ppm)	11
Irradiation	UA-12-2
Analyst	BC
Count Date	
Locality	
Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
1	23	20	-	-	#VALUE!	1.267E+05	2.913E+06	0.0435	22.0	**11.65**	**0.00**	19.83	51.57	19.54
1	32	25	-	-	#VALUE!	1.013E+05	3.242E+06	0.0313	24.4	**8.37**	**8.51**	14.20	35.77	13.99
1	37	25	-	-	#VALUE!	1.013E+05	3.749E+06	0.0270	28.3	**7.24**	**7.34**	12.26	30.56	12.08
2	47	40	-	-	#VALUE!	1.267E+05	2.976E+06	0.0426	22.4	**11.40**	**8.24**	15.35	28.08	14.00
1	28	35	-	-	#VALUE!	7.238E+04	2.027E+06	0.0357	15.3	**9.57**	**9.74**	16.25	41.41	16.01
3	47	21	-	-	#VALUE!	3.619E+05	5.669E+06	0.0638	42.7	**17.09**	**0.00**	21.06	31.89	17.66
2	14	20	-	-	#VALUE!	2.533E+05	1.773E+06	0.1429	13.4	**38.19**	**28.89**	52.25	112.40	48.03
2	11	14	-	-	#VALUE!	3.619E+05	1.990E+06	0.1818	15.0	**48.57**	**37.36**	66.87	152.72	61.62
1	20	25	-	-	#VALUE!	1.013E+05	2.027E+06	0.0500	15.3	**13.39**	**13.73**	22.85	60.43	22.52
1	38	45	-	-	#VALUE!	5.629E+04	2.139E+06	0.0263	16.1	**7.05**	**7.15**	11.94	29.69	11.76
3	44	30	-	-	#VALUE!	2.533E+05	3.715E+06	0.0682	28.0	**18.26**	**10.90**	22.51	34.27	18.88
1	30	28	-	-	#VALUE!	9.047E+04	2.714E+06	0.0333	20.5	**8.93**	**9.08**	15.15	38.39	14.93
1	20	50	-	-	#VALUE!	5.066E+04	1.013E+06	0.0500	7.6	**13.39**	**0.00**	22.85	60.43	22.52
2	41	50	-	-	#VALUE!	1.013E+05	2.077E+06	0.0488	15.7	**13.07**	**0.00**	17.61	32.55	16.08
3	23	35	-	-	#VALUE!	2.171E+05	1.665E+06	0.1304	12.5	**34.88**	**21.43**	43.29	71.44	36.58
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25	455	463	#DIV/0!	#DIV/0!	#VALUE!	1.368E+05	2.489E+06	0.0549	18.8	**14.72**	**3.05**	15.12	6.87	5.69

Pooled Ratio	0.0549	±	0.0114	
Mean Ratio	0.0650	±	0.0137	
Pooled Age	14.72	±	3.05	1 S.E.
Mean Crystal Age	17.42	±	3.68	1 S.E.
Binomial Age	**15.12**	**+**	**6.87**	**"+95%"**
		-	**5.69**	**"-95%"**
Central Age	**14.72**	**±**	**3.05**	

Age Dispersion	**0.00** %			
Chi-squared	**8.787**	with	11	degrees of freedom
P (Chi-Sq)	**64.16 %**			

Table DR2. continuation

Sample Number	**EV2-3**	Mineral	**Apatite**
Position (#)	14	Glass (U ppm)	11
Area of Graticule Square	3.948E-07	Irradiation	UA-12-2
No. of Crystals	10	Analyst	SNT
Zeta Factor ± Error	367.4 7.5	Count Date	24.4.2015
Rho d (% Relative Error)	1.475E+06 1.68	Locality	
N d	3533	Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
1	30	60	2.18	0.55	0.803	4.222E+04	1.267E+06	0.0333	9.4	**9.03**	**9.18**	15.32	38.79	15.09
3	80	40	2.47	0.71	0.781	1.900E+05	5.066E+06	0.0375	37.8	**10.15**	**5.98**	12.48	18.23	10.43
1	26	70	2.56	0.61	0.774	3.619E+04	9.409E+05	0.0385	7.0	**10.41**	**10.62**	17.70	45.44	17.44
2	38	36	2.27	0.69	0.796	1.407E+05	2.674E+06	0.0526	19.9	**14.25**	**10.34**	19.21	35.74	17.54
2	36	70	2.50	0.75	0.779	7.238E+04	1.303E+06	0.0556	9.7	**15.04**	**10.93**	20.29	37.93	18.53
5	97	60	2.33	0.60	0.792	2.111E+05	4.095E+06	0.0515	30.5	**13.95**	**6.41**	15.88	17.77	11.44
4	55	70	2.31	0.55	0.793	1.448E+05	1.990E+06	0.0727	14.8	**19.68**	**10.20**	23.11	30.05	17.93
2	22	60	2.21	0.70	0.801	8.444E+04	9.288E+05	0.0909	6.9	**24.59**	**18.17**	33.36	66.08	30.55
3	30	60	2.17	0.56	0.803	1.267E+05	1.267E+06	0.1000	9.4	**27.04**	**16.39**	33.46	53.10	28.17
1	9	15	2.18	0.63	0.803	1.689E+05	1.520E+06	0.1111	11.3	**30.04**	**31.68**	52.28	161.44	51.59
**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********
24	423	541	2.32	0.64	0.793	1.124E+05	1.981E+06	0.0567	14.8	**15.36**	**3.25**	15.80	7.36	6.06

Pooled Ratio	0.0567	±	0.0120	
Mean Ratio	0.0644	±	0.0088	
Pooled Age	15.36	±	3.25	1 S.E.
Mean Crystal Age	17.42	±	2.38	1 S.E.
Binomial Age	**15.80**	**+**	**7.36**	**"+95%"**
		-	**6.06**	**"-95%"**
Central Age	**15.36**	**±**	**3.25**	

Age Dispersion	**0.00** %			
Chi-squared	**2.954**	with	9	degrees of freedom
P (Chi-Sq)	**96.61 %**			

Table DR2. continuation

Sample Number	**Gyachung Chhu River (7-9-14 2PK-1)**		Mineral	**Apatite**
Position (#)	29		Glass (U ppm)	11
Area of Graticule Square	6.400E-07		Irradiation	UA-15-2
No. of Crystals	33		Analyst	SNT
Zeta Factor ± Error	354.2	7.5	Count Date	3.5.2015
Rho d (% Relative Error)	1.080E+06	1.70	Locality	
N d	3457		Rock Type	

N s	N i	N g	Dpar	Dper	Rmr0	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error	50% Age	"+95%"	"-95%"
10	105	100	5.62	2.03	-	1.563E+05	1.641E+06	0.0952	16.7	**18.19**	**6.04**	19.47	15.29	10.98
10	147	100	5.23	2.07	-	1.563E+05	2.297E+06	0.0680	23.4	**13.00**	**4.26**	13.90	10.67	7.79
5	81	70	5.49	1.48	-	1.116E+05	1.808E+06	0.0617	18.4	**11.80**	**5.45**	13.43	15.21	9.70
3	38	40	5.27	1.62	-	1.172E+05	1.484E+06	0.0789	15.1	**15.08**	**9.05**	18.62	28.80	15.64
12	184	100	6.22	1.90	-	1.875E+05	2.875E+06	0.0652	29.3	**12.46**	**3.73**	13.18	9.10	6.85
11	202	100	6.34	2.41	-	1.719E+05	3.156E+06	0.0545	32.1	**10.41**	**3.23**	11.06	7.95	5.94
16	231	100	4.90	1.66	-	2.500E+05	3.609E+06	0.0693	36.8	**13.23**	**3.44**	13.81	8.13	6.36
20	247	100	4.02	1.45	0.591	3.125E+05	3.859E+06	0.0810	39.3	**15.47**	**3.62**	16.01	8.39	6.72
16	214	100	3.94	1.33	0.608	2.500E+05	3.344E+06	0.0748	34.1	**14.28**	**3.72**	14.90	8.82	6.88
6	74	100	4.90	1.38	-	9.375E+04	1.156E+06	0.0811	11.8	**15.49**	**6.59**	17.29	18.00	11.78
10	146	100	4.26	1.39	0.526	1.563E+05	2.281E+06	0.0685	23.2	**13.09**	**4.29**	13.99	10.75	7.84
11	147	70	4.38	1.50	0.476	2.455E+05	3.281E+06	0.0748	33.4	**14.30**	**4.49**	15.20	11.11	8.21
4	56	70	4.02	1.48	0.591	8.929E+04	1.250E+06	0.0714	12.7	**13.65**	**7.07**	16.03	20.84	12.43
11	216	100	3.09	1.32	0.726	1.719E+05	3.375E+06	0.0509	34.4	**9.73**	**3.02**	10.34	7.41	5.55
14	210	100	3.33	1.12	0.700	2.188E+05	3.281E+06	0.0667	33.4	**12.74**	**3.53**	13.37	8.47	6.52
23	271	100	4.07	1.24	0.580	3.594E+05	4.234E+06	0.0849	43.1	**16.21**	**3.55**	16.70	8.12	6.59
8	164	100	3.71	1.29	0.649	1.250E+05	2.563E+06	0.0488	26.1	**9.32**	**3.39**	10.12	8.67	6.16
8	130	100	4.27	1.66	0.522	1.250E+05	2.031E+06	0.0615	20.7	**11.76**	**4.30**	12.77	11.07	7.80
9	157	100	3.89	1.19	0.618	1.406E+05	2.453E+06	0.0573	25.0	**10.96**	**3.77**	11.79	9.52	6.87
24	333	100	4.00	1.47	0.596	3.750E+05	5.203E+06	0.0721	53.0	**13.77**	**2.93**	14.17	6.67	5.46
15	195	100	4.45	1.80	0.435	2.344E+05	3.047E+06	0.0769	31.0	**14.70**	**3.96**	15.38	9.45	7.30
30	452	100	3.95	1.36	0.606	4.688E+05	7.063E+06	0.0664	71.9	**12.68**	**2.42**	12.97	5.38	4.51
6	62	50	4.12	1.62	0.567	1.875E+05	1.938E+06	0.0968	19.7	**18.48**	**7.92**	20.65	21.83	14.12
10	164	100	4.99	1.59	-	1.563E+05	2.563E+06	0.0610	26.1	**11.65**	**3.81**	12.46	9.51	6.97
7	104	100	5.81	1.79	-	1.094E+05	1.625E+06	0.0673	16.6	**12.86**	**5.03**	14.13	13.29	9.09
12	176	100	5.38	1.89	-	1.875E+05	2.750E+06	0.0682	28.0	**13.03**	**3.90**	13.78	9.54	7.17
12	163	100	5.01	1.74	-	1.875E+05	2.547E+06	0.0736	25.9	**14.07**	**4.22**	14.88	10.35	7.75
19	260	100	4.60	1.67	-	2.969E+05	4.063E+06	0.0731	41.4	**13.96**	**3.34**	14.47	7.76	6.20
15	215	100	5.23	2.03	-	2.344E+05	3.359E+06	0.0698	34.2	**13.33**	**3.58**	13.95	8.52	6.61
14	202	100	5.57	2.36	-	2.188E+05	3.156E+06	0.0693	32.1	**13.24**	**3.68**	13.90	8.83	6.78
15	243	100	4.66	1.66	-	2.344E+05	3.797E+06	0.0617	38.7	**11.80**	**3.15**	12.34	7.50	5.83
6	116	64	4.23	1.64	0.536	1.465E+05	2.832E+06	0.0517	28.8	**9.89**	**4.15**	11.02	11.14	7.46
5	85	48	4.49	1.57	0.403	1.628E+05	2.767E+06	0.0588	28.2	**11.24**	**5.18**	12.80	14.45	9.24
**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********
397	5790	3012	4.65	1.63	0.572	2.059E+05	3.004E+06	0.0686	30.6	**13.10**	**0.77**	13.12	1.38	1.32

Pooled Ratio	0.0686	±	0.0040	
Mean Ratio	0.0691	±	0.0020	
Pooled Age	13.10	±	0.77	1 S.E.
Mean Crystal Age	13.21	±	0.37	1 S.E.
Binomial Age	**13.12**	**+**	**1.38**	**"+95%"**
		-	**1.32**	**"-95%"**
Central Age	**13.10**	**±**	**0.77**	

Age Dispersion	**0.00** %			
Chi-squared	**7.636**	with	32	degrees of freedom
P (Chi-Sq)	**100.00 %**			

Table DR2. continuation

Sample Number	Gyachung Chhu River (**7-9-14 2PK)**	Mineral	**Apatite**
Position (#)	46	Glass (U ppı	15
Area of Graticule Square	6.400E-07	Irradiation	UA-A21
No. of Crystals	15	Analyst	SNT
Zeta Factor ± Error	368.1 14.9	Count Date	22.12.2015
Rho d (% Relative Error)	1.092E+06 1.69	Locality	
N d	3495	Rock Type	

N s	N i	N g	Dpar	Dper	ρ s	ρ i	ρ s / ρ i	U ppm	Age (Ma)	Age error
18	197	100	2.24	0.79	2.813E+05	3.078E+06	0.0914	42.3	**18.34**	**4.59**
20	195	80	2.08	0.50	3.906E+05	3.809E+06	0.1026	52.3	**20.58**	**4.92**
10	116	100	2.02	0.44	1.563E+05	1.813E+06	0.0862	24.9	**17.30**	**5.75**
10	106	100	2.60	0.65	1.563E+05	1.656E+06	0.0943	22.8	**18.93**	**6.32**
12	144	100	2.23	0.91	1.875E+05	2.250E+06	0.0833	30.9	**16.73**	**5.08**
6	73	100	2.33	0.66	9.375E+04	1.141E+06	0.0822	15.7	**16.50**	**7.04**
18	175	100	1.96	0.38	2.813E+05	2.734E+06	0.1029	37.6	**20.64**	**5.19**
12	154	100	2.18	0.47	1.875E+05	2.406E+06	0.0779	33.1	**15.64**	**4.74**
12	131	100	2.51	0.83	1.875E+05	2.047E+06	0.0916	28.1	**18.38**	**5.60**
26	254	100	2.11	0.52	4.063E+05	3.969E+06	0.1024	54.5	**20.54**	**4.32**
14	130	100	1.99	0.67	2.188E+05	2.031E+06	0.1077	27.9	**21.61**	**6.15**
4	38	100	1.92	0.55	6.250E+04	5.938E+05	0.1053	8.2	**21.12**	**11.14**
11	144	100	2.06	0.55	1.719E+05	2.250E+06	0.0764	30.9	**15.33**	**4.84**
3	26	100	1.81	0.57	4.688E+04	4.063E+05	0.1154	5.6	**23.15**	**14.15**
4	50	60	2.25	0.66	1.042E+05	1.302E+06	0.0800	17.9	**16.06**	**8.37**
**********	**********	**********	**********	**********	**********	**********	**********	**********	**********	**********
180	1933	1440	2.15	0.61	1.953E+05	2.097E+06	0.0931	28.8	**18.69**	**1.67**

Pooled Ratio	0.0931	±	0.0083	
Mean Ratio	0.0933	±	0.0031	
Pooled Age	18.69	±	1.67	1 S.E.
Mean Crystal Age	18.72	±	0.63	1 S.E.
Binomial Age	**18.76**	**+**	**3.02**	**"+95%"**
		-	**2.81**	**"-95%"**
Central Age	**18.69**	**±**	**1.67**	

Age Dispersion	**0.00** %			
Chi-squared	**2.119**	with	14	degrees of freedom
P (Chi-Sq)	**99.99 %**			
MSWD	**0.15**			

Table DR2. continuation

Sample	elevation	Number of grains	ND	glass
Rongbuk River sand		104	3533	CN_5
Zeta:	349.57	Zeta err.:	11.29	
Irrad.:	UA12-02-15/16	RhoD:	14.83	
Grid Size:	39.4761	Nd:	3533	

Cryst	Ns	Ni	Area	RhoS (e5)	RhoI (e5)	Age (Ma)	+ 1s	U (ppm)
1.001	2	20	36	1.407	14.073	25.87	19.21	11.55
1.002	1	13	35	0.724	9.409	19.91	20.67	7.72
1.003	1	22	30	0.844	18.577	11.77	12.04	15.24
1.004	1	66	24	1.055	69.662	3.93	3.96	57.17
1.005	2	37	35	1.448	26.779	14	10.17	21.98
1.006	1	10	40	0.633	6.333	25.87	27.15	5.2
1.007	2	10	48	1.055	5.277	51.63	40.04	4.33
1.008	5	23	28	4.524	20.808	56.1	27.76	17.08
1.009	3	13	35	2.171	9.409	59.54	38.2	7.72
1.01	1	20	18	1.407	28.146	12.95	13.28	23.1
1.011	4	39	40	2.533	24.698	26.53	13.96	20.27
1.012	2	29	28	1.809	26.236	17.85	13.07	21.53
1.013	3	45	100	0.76	11.399	17.26	10.31	9.35
1.014	2	27	40	1.267	17.099	19.17	14.07	14.03
1.015	2	13	40	1.267	8.233	39.76	30.23	6.76
1.016	0	5	40	0	3.166	0	0	2.6
1.017	3	19	60	1.267	8.022	40.8	25.39	6.58
1.018	5	117	40	3.166	74.095	11.07	5.07	60.81
1.019	1	8	30	0.844	6.755	32.32	34.3	5.54
1.02	1	28	30	0.844	23.643	9.25	9.42	19.4
1.021	4	22	30	3.378	18.577	46.96	25.58	15.24
1.022	1	53	70	0.362	19.18	4.89	4.94	15.74
1.023	1	44	50	0.507	22.292	5.89	5.96	18.29
1.024	1	26	40	0.633	16.466	9.96	10.16	13.51
1.025	2	54	50	1.013	27.358	9.59	6.92	22.45
1.026	1	13	50	0.507	6.586	19.91	20.67	5.4
1.027	1	24	50	0.507	12.159	10.79	11.02	9.98
1.028	2	66	32	1.583	52.247	7.85	5.64	42.88
1.029	4	62	56	1.809	28.046	16.7	8.64	23.02
1.03	3	27	32	2.375	21.374	28.74	17.52	17.54
1.031	2	5	16	3.166	7.916	102.86	86.14	6.5
1.032	2	38	20	2.533	48.13	13.63	9.9	39.5
1.033	2	14	30	1.689	11.821	36.92	27.94	9.7
1.034	0	70	30	0	59.107	0	0	48.51
1.035	1	7	12	2.111	14.777	36.92	39.5	12.13
1.036	1	49	32	0.792	38.789	5.29	5.34	31.83
1.037	0	11	28	0	9.952	0	0	8.17
1.038	1	10	16	1.583	15.832	25.87	27.15	12.99
1.039	1	69	100	0.253	17.479	3.76	3.79	14.34
1.04	1	10	28	0.905	9.047	25.87	27.15	7.42
1.041	6	109	42	3.619	65.742	14.25	6	53.95
1.042	1	12	16	1.583	18.999	21.56	22.46	15.59
1.043	1	66	60	0.422	27.865	3.93	3.96	22.87
1.044	1	19	28	0.905	17.189	13.63	13.99	14.11
1.045	1	10	32	0.792	7.916	25.87	27.15	6.5
1.046	1	24	24	1.055	25.332	10.79	11.02	20.79
1.047	2	46	40	1.267	29.132	11.26	8.14	23.91
1.048	5	62	36	3.518	43.627	20.87	9.73	35.8
1.049	5	35	25	5.066	35.464	36.92	17.7	29.1
1.05	1	23	20	1.267	29.132	11.26	11.51	23.91
1.051	2	21	40	1.267	13.299	24.64	18.26	10.91
1.052	1	25	30	0.844	21.11	10.36	10.57	17.32
1.053	1	13	28	0.905	11.761	19.91	20.67	9.65
1.054	1	7	32	0.792	5.541	36.92	39.5	4.55
1.055	1	42	50	0.507	21.279	6.17	6.25	17.46
1.056	1	21	20	1.267	26.598	12.33	12.63	21.83
1.057	3	38	24	3.166	40.109	20.43	12.28	32.91
1.058	1	69	50	0.507	34.958	3.76	3.79	28.69

Table DR2. continuation
Everest River sand

1.059	5	135	60	2.111	56.997	9.59	4.38	46.77
1.06	1	5	15	1.689	8.444	51.63	56.59	6.93
1.061	1	50	42	0.603	30.157	5.18	5.24	24.75
1.062	1	25	20	1.267	31.665	10.36	10.57	25.99
1.063	1	36	25	1.013	36.478	7.2	7.3	29.93
1.064	3	39	25	3.04	39.518	19.91	11.95	32.43
1.065	1	29	16	1.583	45.914	8.93	9.09	37.68
1.066	2	38	50	1.013	19.252	13.63	9.9	15.8
1.067	1	25	24	1.055	26.387	10.36	10.57	21.65
1.068	1	8	28	0.905	7.238	32.32	34.3	5.94
1.069	1	35	40	0.633	22.165	7.4	7.51	18.19
1.07	2	18	30	1.689	15.199	28.74	21.44	12.47
1.071	1	19	30	0.844	16.043	13.63	13.99	13.17
1.072	1	14	36	0.704	9.851	18.49	19.15	8.08
1.073	1	16	24	1.055	16.888	16.18	16.69	13.86
1.074	1	19	24	1.055	20.054	13.63	13.99	16.46
1.075	3	19	60	1.267	8.022	40.8	25.39	6.58
1.076	2	21	25	2.027	21.279	24.64	18.26	17.46
1.077	1	34	24	1.055	35.887	7.62	7.74	29.45
1.078	1	13	30	0.844	10.977	19.91	20.67	9.01
1.079	1	32	40	0.633	20.265	8.1	8.23	16.63
1.08	3	24	25	3.04	24.319	32.32	19.83	19.96
1.081	3	83	70	1.086	30.036	9.36	5.51	24.65
1.082	2	22	40	1.267	13.932	23.52	17.39	11.43
1.083	1	8	25	1.013	8.106	32.32	34.3	6.65
1.084	1	28	50	0.507	14.186	9.25	9.42	11.64
1.085	3	28	18	4.222	39.405	27.71	16.87	32.34
1.086	1	35	30	0.844	29.554	7.4	7.51	24.25
1.087	2	14	36	1.407	9.851	36.92	27.94	8.08
1.088	1	31	36	0.704	21.813	8.36	8.5	17.9
1.089	1	23	30	0.844	19.421	11.26	11.51	15.94
1.09	1	9	40	0.633	5.7	28.74	30.31	4.68
1.091	2	30	16	3.166	47.497	17.26	12.62	38.98
1.092	5	46	28	4.524	41.617	28.11	13.28	34.15
1.093	2	23	24	2.111	24.276	22.5	16.61	19.92
1.094	4	73	35	2.895	52.835	14.19	7.3	43.36
1.095	3	38	50	1.52	19.252	20.43	12.28	15.8
1.096	1	25	32	0.792	19.79	10.36	10.57	16.24
1.097	3	44	36	2.111	30.961	17.65	10.55	25.41
1.098	1	26	30	0.844	21.954	9.96	10.16	18.02
1.099	1	10	16	1.583	15.832	25.87	27.15	12.99
1.1	1	11	30	0.844	9.288	23.52	24.58	7.62
1.101	3	37	60	1.267	15.621	20.98	12.62	12.82
1.102	1	18	20	1.267	22.799	14.38	14.79	18.71
1.103	1	7	28	0.905	6.333	36.92	39.5	5.2
1.104	1	15	40	0.633	9.499	17.26	17.83	7.8

Pooled age: **15.1** **P(%):** **82.44**
error: **1.3**

Table DR3. AHe data

Sample name	pmol He	1s ± pmol He	ng U	1s ± ng U	ng Th	1s ± ng Th	Th/U	raw date (Ma)	1s ± date (Ma)	Ft 238U	Ft 235U	Ft 232Th	Ft 147Sm	Rs (um)	**corr date (Ma)**	**1s ± date (Ma)**	ppm eU	ppm U	ppm Th	ppm Sm	nmol 4He/g
13B283_DO_EV2-3ap1	0.000360043	2.95713E-05	0.01094	0.000159	0.030918	0.000448694	2.899225	3.631703327	0.300583594	0.708763	0.669607	0.669607	0.90588	48.52595	5.24	0.43	7.01	4.21	11.91	38.76	0.138655622
13B284_DO_EV2-3ap2	0.00123283	4.23623E-05	0.013067	0.000189	0.030354	0.000438694	2.383105	11.13777629	0.399394025	0.715592	0.677229	0.677229	0.908197	49.8045	15.82	0.57	10.29	6.66	15.46	110.56	0.627923048
13B285_DO_EV2-3ap3	0.000842726	3.93253E-05	0.021484	0.000316	0.03242	0.000471121	1.548063	5.344486589	0.256373004	0.607257	0.557215	0.557215	0.870432	34.70972	9.00	0.43	36.77	27.14	40.96	89.49	1.064617183
13B286_DO_EV2-3ap4	0.000246624	1.4718E-05	0.014078	0.000201	0.05676	0.000810426	4.136183	1.660384271	0.100419149	0.594519	0.543244	0.543244	0.86585	33.45697	2.92	0.18	26.18	13.44	54.21	15.31	0.235527469

	Comments
13B283_DO_EV2-3ap1	Beautifully clear grain; one tip missing, but more than half the grain intact.
13B284_DO_EV2-3ap2	Both ends missing; "Fat" apatite. Minor inclusions. Picked due to size compared to rest of the batch
13B285_DO_EV2-3ap3	One tip missing, good size, minor inclusions
13B286_DO_EV2-3ap4	very clear; tips flattened

Table DR4.40Ar/39Ar Ar ages of Rongbuk River sand.

Lab ID#	$^{40}Ar^{*}/^{39}Ar$	± 2σ	$^{40}Ar/^{39}Ar$	± 2σ	$^{38}Ar/^{39}Ar$	± 2σ	$^{36}Ar/^{39}Ar$	± 2σ	Ca/K	$^{37}Ar/^{39}Ar$	± 2σ	^{39}Ar (moles)	$\%^{40}Ar^{*}$	Age (Ma)	± 2σ
Sample	**Rongbuk River sand**														
Material	**white mica**														
725-01	19.558	0.081	20.108	0.104	0.0120	0.0006	0.0018	0.0004	0.007	0.0037	0.0011	3.06E-16	97.4	15.21	0.13
725-02	20.773	0.061	21.374	0.088	0.0126	0.0005	0.0020	0.0003	0.000	0.0031	0.0008	4.24E-16	97.3	16.15	0.09
725-03	20.963	0.099	21.271	0.122	0.0130	0.0008	0.0010	0.0005	0.005	0.0028	0.0015	2.12E-16	98.6	16.30	0.15
725-04	20.299	0.091	20.968	0.117	0.0123	0.0005	0.0022	0.0005	0.009	0.0048	0.0013	2.59E-16	96.9	15.79	0.14
725-05	20.538	0.147	21.132	0.164	0.0118	0.0008	0.0019	0.0008	0.005	0.0026	0.0023	1.46E-16	97.3	15.97	0.23
725-06	20.863	0.449	20.910	0.281	0.0150	0.0021	0.0001	0.0029	0.001	0.0008	0.0079	4.20E-17	99.9	16.22	0.69
725-07	20.829	0.128	21.563	0.146	0.0134	0.0008	0.0024	0.0007	0.016	0.0087	0.0020	1.67E-16	96.7	16.20	0.20
725-08	21.257	0.081	21.780	0.112	0.0127	0.0006	0.0017	0.0004	0.004	0.0021	0.0010	2.89E-16	97.7	16.53	0.12
725-09	21.223	0.263	21.260	0.211	0.0137	0.0015	0.0001	0.0016	0.001	0.0005	0.0046	6.80E-17	99.9	16.50	0.41
725-10	20.627	0.172	21.548	0.179	0.0118	0.0010	0.0031	0.0010	0.004	0.0023	0.0028	1.17E-16	95.8	16.04	0.27
725-11	21.162	0.173	21.933	0.161	0.0125	0.0011	0.0025	0.0010	0.001	0.0003	0.0025	1.23E-16	96.6	16.46	0.27
725-12	20.451	0.049	20.880	0.072	0.0124	0.0004	0.0014	0.0002	0.000	0.0001	0.0005	5.77E-16	98.0	15.91	0.08
725-13	20.710	0.094	20.938	0.122	0.0120	0.0007	0.0007	0.0005	0.063	0.0352	0.0015	2.46E-16	99.0	16.11	0.15
725-14	21.113	0.057	21.565	0.101	0.0122	0.0004	0.0015	0.0002	0.003	0.0017	0.0004	7.60E-16	98.0	16.42	0.09
725-15	21.130	0.144	21.157	0.153	0.0117	0.0009	0.0000	0.0008	0.011	0.0059	0.0024	1.51E-16	100.0	16.43	0.22
725-16	20.867	0.072	21.775	0.088	0.0125	0.0005	0.0030	0.0004	0.016	0.0087	0.0010	3.84E-16	95.9	16.23	0.11
725-17	21.767	0.236	22.237	0.221	0.0119	0.0013	0.0015	0.0014	0.036	0.0201	0.0038	8.96E-17	98.0	16.92	0.36
725-18	20.675	0.186	20.705	0.176	0.0114	0.0012	0.0000	0.0011	0.014	0.0077	0.0033	1.04E-16	99.9	16.08	0.29
725-19	20.587	0.088	20.905	0.118	0.0113	0.0006	0.0010	0.0004	0.002	0.0011	0.0012	2.57E-16	98.6	16.01	0.14
725-20	20.591	0.127	20.950	0.152	0.0123	0.0007	0.0012	0.0007	0.011	0.0062	0.0020	1.71E-16	98.4	16.01	0.20
725-21	20.815	0.084	20.990	0.105	0.0121	0.0005	0.0005	0.0004	0.033	0.0182	0.0015	2.64E-16	99.3	16.19	0.13
725-22	20.808	0.110	21.822	0.129	0.0128	0.0007	0.0034	0.0006	0.006	0.0031	0.0017	2.10E-16	95.4	16.18	0.17
725-23	21.131	0.149	21.574	0.162	0.0129	0.0010	0.0014	0.0009	0.007	0.0040	0.0026	1.30E-16	98.0	16.43	0.23
725-24	20.582	0.080	21.895	0.105	0.0130	0.0006	0.0044	0.0004	0.007	0.0039	0.0010	3.34E-16	94.1	16.01	0.12
725-25	20.364	0.171	20.944	0.168	0.0121	0.0010	0.0019	0.0010	0.017	0.0096	0.0031	1.19E-16	97.3	15.84	0.26
725-26	19.788	0.238	20.070	0.184	0.0116	0.0013	0.0009	0.0015	0.017	0.0095	0.0042	8.69E-17	98.7	15.39	0.37
725-27	20.442	0.132	21.060	0.150	0.0122	0.0008	0.0020	0.0007	0.008	0.0046	0.0020	1.69E-16	97.2	15.90	0.20
725-28	20.719	0.146	23.170	0.151	0.0143	0.0008	0.0082	0.0009	0.010	0.0056	0.0023	1.45E-16	89.5	16.11	0.23
725-29	20.259	0.111	21.184	0.120	0.0131	0.0008	0.0031	0.0006	0.005	0.0029	0.0017	1.88E-16	95.7	15.76	0.17
725-30	20.610	0.085	21.037	0.102	0.0122	0.0006	0.0014	0.0005	0.004	0.0025	0.0012	2.61E-16	98.1	16.03	0.13
725-31	19.298	0.237	19.331	0.194	0.0128	0.0013	0.0000	0.0015	0.001	0.0004	0.0038	8.38E-17	99.9	15.01	0.37
725-32	20.341	0.067	20.638	0.093	0.0125	0.0005	0.0009	0.0003	0.002	0.0009	0.0009	3.76E-16	98.7	15.82	0.10
725-33	20.723	0.077	20.982	0.101	0.0120	0.0006	0.0008	0.0004	0.046	0.0260	0.0012	3.15E-16	98.9	16.12	0.12
725-34	20.504	0.112	20.720	0.142	0.0128	0.0007	0.0007	0.0006	0.004	0.0025	0.0015	2.10E-16	99.0	15.95	0.17
725-35	20.490	0.092	20.881	0.114	0.0124	0.0006	0.0013	0.0005	0.012	0.0065	0.0014	2.70E-16	98.2	15.94	0.14
725-36	20.351	0.113	22.016	0.114	0.0125	0.0007	0.0056	0.0007	0.004	0.0020	0.0017	2.29E-16	92.5	15.83	0.18
725-37	19.772	0.124	19.994	0.135	0.0122	0.0009	0.0007	0.0007	0.012	0.0067	0.0021	1.74E-16	99.0	15.38	0.19
725-38	20.712	0.066	23.611	0.097	0.0140	0.0004	0.0098	0.0003	0.011	0.0061	0.0007	5.52E-16	87.8	16.11	0.10
725-39	20.269	0.216	20.943	0.208	0.0122	0.0012	0.0022	0.0013	0.030	0.0167	0.0036	9.41E-17	96.9	15.76	0.33
725-40	20.037	0.109	20.885	0.125	0.0128	0.0007	0.0028	0.0006	0.028	0.0157	0.0019	1.91E-16	96.0	15.58	0.17
725-41	20.519	0.194	21.266	0.166	0.0123	0.0012	0.0025	0.0012	0.001	0.0003	0.0038	1.02E-16	96.6	15.96	0.30
725-42	20.052	0.136	21.066	0.140	0.0123	0.0009	0.0034	0.0008	0.000	0.0001	0.0024	1.49E-16	95.3	15.60	0.21
725-43	19.006	0.174	20.062	0.148	0.0121	0.0011	0.0035	0.0011	0.020	0.0109	0.0030	1.16E-16	94.8	14.79	0.27
725-44	20.371	0.122	21.010	0.139	0.0126	0.0008	0.0021	0.0007	0.010	0.0056	0.0018	1.83E-16	97.0	15.84	0.19
725-45	20.205	0.167	21.218	0.175	0.0131	0.0010	0.0034	0.0010	0.022	0.0122	0.0028	1.35E-16	95.3	15.72	0.26
725-46	20.649	0.098	21.100	0.112	0.0128	0.0007	0.0015	0.0005	0.010	0.0055	0.0014	2.62E-16	98.0	16.06	0.15
725-47	19.159	0.120	21.361	0.126	0.0137	0.0007	0.0074	0.0007	0.018	0.0102	0.0017	2.17E-16	89.8	14.91	0.19
725-48	19.691	0.101	20.291	0.112	0.0115	0.0007	0.0020	0.0006	0.015	0.0085	0.0015	2.21E-16	97.1	15.32	0.16
725-49	19.214	0.245	20.615	0.197	0.0115	0.0015	0.0047	0.0015	0.046	0.0258	0.0045	7.66E-17	93.3	14.95	0.38

J value	4.3300E-04
J value error (2σ)	6.4756E-06

Table DR4.continuation

725-50	20.169	0.218	20.936	0.187	0.0117	0.0012	0.0025	0.0013	0.035	0.0198	0.0035	8.88E-17	96.4	15.69	0.34
725-51	20.387	0.179	20.885	0.165	0.0122	0.0009	0.0016	0.0011	0.022	0.0125	0.0028	1.21E-16	97.7	15.86	0.28
725-52	20.473	0.113	20.740	0.116	0.0115	0.0007	0.0008	0.0007	0.015	0.0086	0.0019	1.83E-16	98.8	15.92	0.17
725-53	20.640	0.106	21.354	0.130	0.0128	0.0007	0.0024	0.0006	0.016	0.0089	0.0017	2.04E-16	96.7	16.05	0.16
725-54	20.722	0.054	21.104	0.084	0.0121	0.0005	0.0012	0.0002	0.005	0.0030	0.0007	5.32E-16	98.3	16.12	0.08
725-55	20.951	0.076	22.361	0.100	0.0131	0.0005	0.0047	0.0004	0.014	0.0076	0.0010	3.69E-16	93.8	16.29	0.12
725-56	19.399	0.087	19.946	0.105	0.0130	0.0006	0.0018	0.0005	0.003	0.0016	0.0015	2.83E-16	97.3	15.09	0.14
725-57	20.375	0.240	20.914	0.224	0.0130	0.0012	0.0018	0.0014	0.009	0.0051	0.0043	8.80E-17	97.5	15.85	0.37
725-58	19.427	0.166	20.070	0.143	0.0123	0.0010	0.0021	0.0010	0.007	0.0040	0.0030	1.22E-16	96.9	15.11	0.26
725-59	20.180	0.147	20.881	0.158	0.0121	0.0011	0.0023	0.0009	0.017	0.0093	0.0026	1.40E-16	96.7	15.70	0.23
725-60	19.630	0.198	20.369	0.170	0.0113	0.0013	0.0024	0.0012	0.014	0.0077	0.0038	9.49E-17	96.5	15.27	0.31
725-61	20.537	0.246	21.592	0.203	0.0137	0.0013	0.0035	0.0015	0.000	0.0002	0.0043	8.52E-17	95.2	15.97	0.38
725-62	20.667	0.091	20.933	0.123	0.0127	0.0007	0.0008	0.0005	0.000	0.0001	0.0013	2.62E-16	98.8	16.07	0.14
725-63	20.471	0.351	24.265	0.283	0.0140	0.0017	0.0128	0.0022	0.033	0.0183	0.0055	6.40E-17	84.4	15.92	0.54
725-64	20.318	0.103	21.033	0.119	0.0124	0.0007	0.0024	0.0006	0.040	0.0221	0.0019	2.21E-16	96.7	15.80	0.16
725-65	20.301	0.081	20.662	0.105	0.0121	0.0006	0.0012	0.0004	0.011	0.0062	0.0012	3.18E-16	98.3	15.79	0.13
725-66	20.693	0.092	21.276	0.105	0.0134	0.0006	0.0019	0.0005	0.006	0.0035	0.0013	3.03E-16	97.3	16.09	0.14
725-67	20.412	0.088	20.737	0.109	0.0120	0.0006	0.0010	0.0005	0.029	0.0163	0.0014	2.99E-16	98.5	15.88	0.14
725-68	20.003	0.418	22.140	0.281	0.0110	0.0019	0.0072	0.0027	0.040	0.0224	0.0075	4.99E-17	90.4	15.56	0.65
725-69	20.458	0.097	20.657	0.117	0.0118	0.0007	0.0006	0.0005	0.008	0.0044	0.0014	2.43E-16	99.1	15.91	0.15
725-70	20.520	0.189	22.104	0.200	0.0119	0.0010	0.0053	0.0011	0.027	0.0149	0.0030	1.18E-16	92.9	15.96	0.29
725-71	20.674	0.182	20.873	0.170	0.0124	0.0011	0.0006	0.0011	0.021	0.0119	0.0033	1.17E-16	99.1	16.08	0.28
725-72	19.534	0.270	21.503	0.238	0.0128	0.0014	0.0066	0.0017	0.024	0.0131	0.0047	7.16E-17	90.9	15.20	0.42
725-73	19.462	0.505	20.931	0.309	0.0111	0.0026	0.0049	0.0033	0.049	0.0276	0.0093	3.55E-17	93.1	15.14	0.78
725-74	20.163	0.220	20.882	0.186	0.0119	0.0012	0.0024	0.0014	0.018	0.0102	0.0035	9.37E-17	96.6	15.68	0.34
725-75	20.623	0.053	21.088	0.077	0.0122	0.0004	0.0015	0.0002	0.008	0.0043	0.0006	6.21E-16	97.9	16.04	0.08
725-76	20.625	0.207	21.248	0.177	0.0114	0.0011	0.0020	0.0013	0.002	0.0012	0.0034	1.12E-16	97.2	16.04	0.32
725-77	19.788	0.299	20.954	0.202	0.0133	0.0014	0.0039	0.0019	0.023	0.0128	0.0050	7.14E-17	94.5	15.39	0.46
725-78	19.644	0.418	21.705	0.286	0.0135	0.0019	0.0069	0.0027	0.014	0.0081	0.0067	4.87E-17	90.6	15.28	0.65
725-79	19.791	0.714	25.156	0.402	0.0125	0.0032	0.0181	0.0047	0.057	0.0319	0.0108	2.83E-17	78.7	15.39	1.11
725-80	19.233	0.338	22.557	0.286	0.0126	0.0017	0.0112	0.0021	0.026	0.0145	0.0052	6.01E-17	85.3	14.96	0.52
725-81	19.987	0.172	20.158	0.144	0.0116	0.0011	0.0005	0.0011	0.005	0.0030	0.0029	1.29E-16	99.2	15.55	0.27
725-82	20.466	0.363	21.553	0.242	0.0102	0.0017	0.0036	0.0023	0.021	0.0118	0.0067	5.44E-17	95.0	15.92	0.56
725-83	20.578	0.093	21.328	0.118	0.0126	0.0006	0.0025	0.0005	0.011	0.0062	0.0015	2.55E-16	96.6	16.00	0.14
725-84	20.251	0.163	21.047	0.148	0.0119	0.0010	0.0026	0.0010	0.013	0.0074	0.0028	1.25E-16	96.3	15.75	0.25
725-85	19.749	0.353	22.923	0.251	0.0129	0.0019	0.0107	0.0023	0.010	0.0057	0.0066	5.93E-17	86.2	15.36	0.55
725-86	20.794	0.078	21.774	0.102	0.0127	0.0005	0.0033	0.0004	0.005	0.0028	0.0011	3.55E-16	95.6	16.17	0.12
725-87	20.131	0.162	20.825	0.155	0.0132	0.0010	0.0023	0.0010	0.001	0.0007	0.0028	1.29E-16	96.8	15.66	0.25
725-88	20.105	0.164	20.433	0.155	0.0132	0.0011	0.0010	0.0010	0.008	0.0046	0.0027	1.26E-16	98.5	15.64	0.25
725-89	20.203	0.250	21.508	0.204	0.0132	0.0014	0.0044	0.0016	0.022	0.0122	0.0042	7.97E-17	94.0	15.71	0.39
725-90	19.602	0.203	20.625	0.184	0.0122	0.0011	0.0034	0.0012	0.040	0.0224	0.0033	1.06E-16	95.1	15.25	0.31
725-91	20.362	0.128	20.561	0.127	0.0114	0.0007	0.0006	0.0008	0.059	0.0327	0.0020	1.86E-16	99.1	15.84	0.20
725-92	20.500	0.238	20.877	0.192	0.0131	0.0014	0.0012	0.0015	0.020	0.0112	0.0038	8.33E-17	98.3	15.94	0.37
725-93	19.374	0.330	20.989	0.238	0.0134	0.0015	0.0054	0.0021	0.054	0.0300	0.0059	5.98E-17	92.4	15.07	0.51
725-94	18.864	0.349	19.944	0.251	0.0144	0.0018	0.0036	0.0022	0.032	0.0178	0.0058	5.72E-17	94.7	14.68	0.54
725-95	20.848	0.277	21.854	0.205	0.0149	0.0015	0.0033	0.0018	0.027	0.0153	0.0049	7.30E-17	95.5	16.21	0.43
725-96	20.639	0.165	20.927	0.160	0.0116	0.0010	0.0009	0.0010	0.004	0.0024	0.0029	1.34E-16	98.7	16.05	0.26
725-97	20.358	0.142	20.385	0.141	0.0119	0.0010	0.0000	0.0008	0.000	0.0001	0.0024	1.49E-16	100.0	15.83	0.22
725-98	20.324	0.146	21.095	0.154	0.0130	0.0010	0.0025	0.0009	0.018	0.0102	0.0024	1.42E-16	96.4	15.81	0.23
725-99	20.445	0.321	22.882	0.242	0.0138	0.0018	0.0082	0.0020	0.031	0.0171	0.0050	6.38E-17	89.4	15.90	0.50
725-100	20.475	0.499	20.982	0.271	0.0135	0.0024	0.0017	0.0033	0.112	0.0624	0.0100	3.81E-17	97.7	15.92	0.77
725-101	20.771	0.330	21.362	0.224	0.0108	0.0018	0.0019	0.0021	0.009	0.0050	0.0065	6.20E-17	97.3	16.15	0.51
725-102	20.961	0.161	21.229	0.174	0.0118	0.0011	0.0008	0.0009	0.020	0.0111	0.0027	1.24E-16	98.8	16.30	0.25
725-103	20.560	0.129	21.017	0.138	0.0121	0.0008	0.0015	0.0007	0.022	0.0121	0.0020	1.68E-16	97.9	15.99	0.20
725-104	21.008	0.310	21.044	0.228	0.0124	0.0017	0.0001	0.0019	0.030	0.0168	0.0055	6.32E-17	99.9	16.34	0.48
725-105	19.724	0.087	21.262	0.108	0.0125	0.0005	0.0051	0.0005	0.047	0.0263	0.0014	3.19E-16	92.8	15.34	0.13
725-106	20.235	0.324	20.712	0.229	0.0144	0.0016	0.0016	0.0021	0.024	0.0136	0.0063	6.60E-17	97.8	15.74	0.50
725-107	20.788	0.103	21.128	0.113	0.0136	0.0006	0.0011	0.0006	0.013	0.0074	0.0018	2.21E-16	98.5	16.17	0.16
725-108	18.002	1.396	21.012	0.562	0.0251	0.0057	0.0101	0.0093	0.086	0.0481	0.0259	1.36E-17	85.8	14.01	2.16
725-109	19.928	0.275	20.497	0.215	0.0112	0.0015	0.0019	0.0017	0.022	0.0122	0.0050	7.20E-17	97.3	15.50	0.43
725-110	20.714	0.144	21.201	0.151	0.0127	0.0009	0.0016	0.0008	0.021	0.0115	0.0022	1.61E-16	97.8	16.11	0.22
725-111	20.745	0.360	20.783	0.239	0.0112	0.0020	0.0001	0.0023	0.002	0.0012	0.0060	6.06E-17	99.9	16.13	0.56
725-112	19.513	0.228	20.012	0.181	0.0126	0.0013	0.0016	0.0014	0.011	0.0061	0.0037	9.69E-17	97.6	15.18	0.35
725-113	20.585	0.268	21.314	0.196	0.0125	0.0013	0.0024	0.0017	0.022	0.0123	0.0045	7.48E-17	96.7	16.01	0.42
725-114	20.575	0.124	20.668	0.152	0.0127	0.0008	0.0003	0.0007	0.005	0.0029	0.0020	1.78E-16	99.6	16.00	0.19
725-115	19.561	0.330	22.731	0.262	0.0127	0.0017	0.0107	0.0021	0.002	0.0011	0.0054	6.53E-17	86.1	15.22	0.51
725-116	20.516	0.149	21.221	0.157	0.0119	0.0009	0.0023	0.0009	0.000	0.0001	0.0023	1.60E-16	96.8	15.96	0.23
725-117	20.913	0.066	22.184	0.088	0.0128	0.0005	0.0042	0.0003	0.000	0.0000	0.0008	4.54E-16	94.4	16.26	0.10
725-118	20.015	0.310	23.337	0.196	0.0135	0.0014	0.0112	0.0020	0.001	0.0006	0.0052	6.74E-17	85.8	15.57	0.48
725-119	19.448	0.053	19.665	0.070	0.0127	0.0005	0.0007	0.0003	0.012	0.0067	0.0008	4.79E-16	99.0	15.13	0.08
725-120	20.567	0.102	20.650	0.121	0.0118	0.0006	0.0002	0.0006	0.000	0.0002	0.0017	2.57E-16	99.7	16.00	0.16

Table DR5: Parameters of the most relevant models discussed in the text: RUN01 to RUN05.

Model	**RUN01**	**RUN02**	**RUN03**	**RUN04**	**RUN05**
Amplification factor at 17 Ma	0.1	0.1	0.1	0.1	0.1
Vertical offset at 17 Ma	5	5	5	5	5
Amplification factor at 12 Ma	0.1	0.1	0.1	0.1	0.1
Vertical offset at 12 Ma	5	5	5	5	5
Amplification factor at 5 Ma	0.1	0.1	0.1	0.1	0.1
Vertical offset at 5 Ma	5	5	5	5	5
Beginning of exhumation (Ma)	14	14	12	14	12
Exhumation since 12 Ma (mm/yr)	1	2	1	1	0.2
End of STDS (Ma)	12	12	12	12	12
STDS slip rate (km/Ma)	11	11	11	11	11

Table DR6. Range of parameters used for the different inversions

Topographic amplification factor at 2 Ma	End of the STDS activity (Ma)	Vertical offset at 17 Ma (km)	Vertical offset at 12 Ma (km)	Time of onset of topography (Ma)	Basal Temperature (°C)	Exhumation rate
0 – 1	8 – 16	0 – 7	3 – 7	0 – 12	600 – 1000	0 – 3