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SUPPLEMENTARY INFORMATION

Figure Captions:

Figure DR1: N-S cross-section across Mount Everest (modified after Searle, 2003; Jessup et al., 2006; 2008) showing the upper brittle Qomolangma Detachment and the lower ductile Lhotse Detachment merging towards the north into the South Tibetan Detachment shear zone; position of studied section indicated.

Figure DR2: Photographs (viewed towards the east) showing the sampling sites. (A) Samples R-03-23 and R-03-24 (Fig. 2 and Supplementary Table 1) are from the Northern transect previously described by Law et al. (2011). (B) Detail of the outcrop where samples M1, M2, M3, and R-05 and R-07 series samples (Fig. 2 and Supplementary Table 1) are taken from.

Figure DR3: SRTM digital elevation model filtered using a 55 km wavelength Gaussian filter (weighted averaging with Gaussian weights). Isocontours are indicated each 250 m. Shaded unfiltered topography is used as background.









Rongbuk sampling site indicated by circled black dot. Modern mean elevation (M.E.) of 5189 ± 390 m (minimum and maximum mean elevations of 4553 m and 5982 m at the chosen grid spacing, respectively) has been calculated for an area (black square) between latitudes 27.8° N-28.6°N and longitudes 86.4° E-87.2°E ($^{\sim}$ 45 km radius from our sampling site (black dot)).

The studied area (blue square) and the location of the N-S elevation profile (red line) along which modern $\delta^{18}O_{water}$ (SMOW) values from Quade et al. (2011) are shown on Fig. 3A are indicated. The South Tibetan Detachment (white rectangle) and Main Central Thrust system (white triangle) are also mentioned.

Table DR1: Hydrogen isotope compositions of biotite and hornblende from footwall mylonite of the South Tibetan Detachment and associated
calculated δD_{water} values, with error taking into account the precision on isotopic analyses and temperature of recrystallization (±50°C).
Paleoaltimetry calculations are obtained from difference in oxygen isotope composition of water ($\Delta \delta^{18}O_{water}$) between the STD footwall and
foreland ($\delta^{18}O_{water} = -5.8 \pm 1.0\%$ obtained from $\delta^{18}O_{carbonate} = -21.5\%$ at T= 29°C) at 16.4 Ma (see Fig. 3). We used the global meteoric water line to
convert δD_{water} to $\delta^{18}O_{water}$ (Craig, 1961).

Sample	Distance to hanging wall (m)	Rock type	δDBt (‰)	δDHbl (‰)	Fraction size (mm)	T°C recrystallization	calculated δD _{water} (‰) STD	δD _{water} error	Convertion to $\delta^{18}O_{water}$ (‰)	δ ¹⁸ O _{water} error (‰)	D δ ¹⁸ O (‰)
M1	-8	leucogranite	-88		250 <f<500< td=""><td>581</td><td>-56</td><td>+5 / -4</td><td>-8.2</td><td>+0.6 / -0.5</td><td>2.4</td></f<500<>	581	-56	+5 / -4	-8.2	+0.6 / -0.5	2.4
M2	-9	pegmatite	-156		250 <f<500< td=""><td>581</td><td>-124</td><td>+5 / -4</td><td>-16.7</td><td>+0.6 / -0.5</td><td>10.9</td></f<500<>	581	-124	+5 / -4	-16.7	+0.6 / -0.5	10.9
M3	-9	bt-schist	-170		100 <f<180< td=""><td>565</td><td>-137</td><td>±5</td><td>-18.4</td><td>±0.6</td><td>12.6</td></f<180<>	565	-137	±5	-18.4	±0.6	12.6
R-05-06	-24	calc-silicate	-174		250 <f<500< td=""><td>555</td><td>-140</td><td>±5</td><td>-18.8</td><td>±0.6</td><td>13</td></f<500<>	555	-140	±5	-18.8	±0.6	13
R-05-06	-24	calc-silicate		-183	250 <f<500< td=""><td>555</td><td>-156</td><td>±5</td><td>-20.8</td><td>±0.6</td><td>15</td></f<500<>	555	-156	±5	-20.8	±0.6	15
R-05-07	-25	leucogranite	-182		250 <f<500< td=""><td>581</td><td>-150</td><td>+5 / -4</td><td>-20.0</td><td>+0.6 / -0.5</td><td>14.2</td></f<500<>	581	-150	+5 / -4	-20.0	+0.6 / -0.5	14.2
R-03-23	-30	calc-silicate	-176		250 <f<500< td=""><td>555</td><td>-142</td><td>±5</td><td>-19</td><td>±1</td><td>13.2</td></f<500<>	555	-142	±5	-19	±1	13.2
R-03-24	-31	leucogranite	-169		250 <f<500< td=""><td>581</td><td>-137</td><td>+5 / -4</td><td>-18.4</td><td>+0.6 / -0.5</td><td>12.6</td></f<500<>	581	-137	+5 / -4	-18.4	+0.6 / -0.5	12.6
R-07-01	-97	leucogranite	-126		250 <f<500< td=""><td>581</td><td>-94</td><td>+5 / -4</td><td>-13</td><td>±0.5</td><td>7.2</td></f<500<>	581	-94	+5 / -4	-13	±0.5	7.2
R-07-02	-98	calc-silicate		-181	250 <f<500< td=""><td>555</td><td>-154</td><td>±5</td><td>-20.5</td><td>±0.6</td><td>14.7</td></f<500<>	555	-154	±5	-20.5	±0.6	14.7
R-05-09	-100	bt-schist	-163		250 <f<500< td=""><td>565</td><td>-130</td><td>+5 / -4</td><td>-17.5</td><td>+0.6 / -0.5</td><td>11.7</td></f<500<>	565	-130	+5 / -4	-17.5	+0.6 / -0.5	11.7
R-07-03	-104	bt-schist	-152		250 <f<500< td=""><td>565</td><td>-119</td><td>+5 / -4</td><td>-16.1</td><td>+0.6 / -0.5</td><td>10.3</td></f<500<>	565	-119	+5 / -4	-16.1	+0.6 / -0.5	10.3
R-07-03	-104	bt-schist	-148		180 <f<250< td=""><td>565</td><td>-115</td><td>+5 / -4</td><td>-15.6</td><td>+0.6 / -0.5</td><td>9.8</td></f<250<>	565	-115	+5 / -4	-15.6	+0.6 / -0.5	9.8
R-07-04	-107	bt-schist	-132		250 <f<500< td=""><td>565</td><td>-99</td><td>+5 / -4</td><td>-13.6</td><td>+0.6 / -0.5</td><td>7.8</td></f<500<>	565	-99	+5 / -4	-13.6	+0.6 / -0.5	7.8
R-07-05	-109	bt-schist	-135		250 <f<500< td=""><td>565</td><td>-102</td><td>+5 / -4</td><td>-14</td><td>+0.6 / -0.5</td><td>8.2</td></f<500<>	565	-102	+5 / -4	-14	+0.6 / -0.5	8.2
R-07-05	-109	bt-schist	-135		180 <f<250< td=""><td>565</td><td>-102</td><td>+5 / -4</td><td>-14</td><td>+0.6 / -0.5</td><td>8.2</td></f<250<>	565	-102	+5 / -4	-14	+0.6 / -0.5	8.2
R-07-06	-132	calc-silicate	-94		250 <f<500< td=""><td>555</td><td>-60</td><td>+5 / -4</td><td>-8.8</td><td>+0.6 / -0.5</td><td>3</td></f<500<>	555	-60	+5 / -4	-8.8	+0.6 / -0.5	3
R-07-07	-134	bt gneiss	-90		250 <f<500< td=""><td>565</td><td>-57</td><td>+5 / -4</td><td>-8.4</td><td>+0.6 / -0.5</td><td>2.6</td></f<500<>	565	-57	+5 / -4	-8.4	+0.6 / -0.5	2.6
R-07-08	-156	bt gneiss	-85		250 <f<500< td=""><td>565</td><td>-52</td><td>+5 / -4</td><td>-7.8</td><td>+0.6 / -0.5</td><td>2</td></f<500<>	565	-52	+5 / -4	-7.8	+0.6 / -0.5	2
R-07-09	-177	bt gneiss	-97		250 <f<500< td=""><td>565</td><td>-64</td><td>+5 / -4</td><td>-9.3</td><td>+0.6 / -0.5</td><td>3.5</td></f<500<>	565	-64	+5 / -4	-9.3	+0.6 / -0.5	3.5

Hydrogen isotope measurements were performed in the Stable Isotope Laboratory at the Johann Wolfgang Goethe-Universität, Frankfurt am Main. δD values of biotite and hornblende were determined by continuous flow mass spectrometry using a high temperature elemental analyzer (Thermo Finnigan TC/EA) coupled to a Finnigan MAT 253 mass spectrometer in continuous flow mode. Three internationally referenced standard materials and additional in-house working standards were run with the samples. After correction for mass bias, daily drift of the thermal combustion reactor, and offset from the certified reference values, NBS30 (biotite), NBS22 (oil), CH7 (polyethylene foil) had δD = -65.7‰, -117‰, and -100.3‰, respectively. Repeated measurements of various standards and unknowns gave a precision of ± 2‰ for δD . All isotopic ratios are reported relative to standard mean ocean water (SMOW). To calculate hydrogen isotope ratios of water present during deformation in the detachment from measured δD values of hydrous silicates we applied the temperature-dependent fractionation equations from Suzuoki and Epstein (1976).

Supplementary References

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