APPENDIX DR1

1) ^{10}Be measurements and denudation rate calculations

Samples were sieved into three size fractions. The 250 – 500 μm size fraction was cleaned following a modified version of the protocol of Kohl and Nishiizumi (1992). 10Be/9Be ratios were measured at the SUERC AMS facility, using NIST SRM 4325 with a nominal value of ^{10}Be/^{9}Be = 3.06 x 10^{-11} (Middleton et al., 1993), 14% higher than the NIST certified value (^{10}Be/^{9}Be = 2.68 x 10^{-11}). ^{10}Be/^{9}Be ratios were corrected by a full chemistry procedural blank that yielded <3% of the number of ^{10}Be atoms in the samples. Independent repeat measurements of AMS samples were combined as weighted means with the larger of the total statistical error or mean standard error. Final analytical error in concentrations (atoms/g quartz) are derived from a quadrature sum of the standard mean error in AMS ratio, 2% for AMS standard reproducibility, and 2% in Be spike assay.

Catchment-wide model denudation rates were calculated following Bierman and Steig (1996) and Granger et al. (1996), using a ^{10}Be production rate of 5.1 ± 0.3 atoms/g/yr scaled for altitude and latitude variations using Stone (2000). Topographic shielding corrections were made following the method of Codilean (2006). We used a ^{10}Be half-life of 1.51 Myrs (Yiou & Raisbeck, 1972; Hofmann et al., 1987; Inn et al., 1987).

References:
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Stone, J.O., 2000, Air pressure and cosmogenic isotope production: Journal of Geophysical Research, v. 105, p. 23,753-23,759.
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2) ^{21}Ne measurements

Each clast was crushed, washed and sieved into three size fractions. The 120–210 μm fraction was leached in 10% HNO$_3$ for 5 hours at 80°C, followed by leaching in 2% HF-2% HNO$_3$ for 24 hours at 80°C under constant ultrasonic agitation. The clean quartz was thoroughly rinsed in water, then washed in ultra-pure acetone and ~500 mg from each sample packed in two aluminium foil cylinders. Samples were placed into branches of a Monax glass "tree" mounted directly above an ultra-high vacuum resistance furnace. Samples were dropped sequentially into the furnace through an ultra-high vacuum valve used to minimize the effect of atmospheric He and Ne that diffuses in through the glass. The furnace comprises a Mo liner contained within a 25 mm diameter Ta crucible. The W heating element is mounted within the furnace outer vacuum where low pressure (~10^{-7} torr) is maintained by a 30 litre sec^{-1} ion pump. Heat loss is minimized by use of several Mo heat shields mounted on Mo rods within the furnace outer vacuum, and the outer jacket is water-cooled. Furnace temperatures were calibrated prior to the analytical program using an optical pyrometer through a sapphire window. Temperatures below 800°C were estimated by extrapolating from the measured temperature versus furnace power curve. Absolute furnace temperatures are governed by uncertainty in optical pyrometer measurements which are of the order of ±20°C.

Cosmogenic Ne was extracted by heating each sample to 1000°C for 25 minutes. Initially samples were re-heated to 1600°C but this routinely yielded <1% of the cosmogenic Ne released in the lower temperature step and was

subsequently only performed intermittently. The active gases were removed by exposure to two hot SAES (ZrAl) getters during gas extraction and for a further 20 minutes as the furnace cooled. The heavy noble gases (Ar, Kr and Xe) and residual gases were subsequently absorbed on liquid nitrogen cooled charcoal for 20 minutes and exposed to a ZrAl getter at room temperature to absorb hydrogen. Neon was subsequently absorbed on activated charcoal in a cryostatic cold head at 33K. After Ne absorption the charcoal trap was isolated and warmed to 100K to release the Ne, while the He and residual gases in the extraction line were pumped in order to minimize the deleterious effect on sensitivity.

Neon isotopes were analyzed statically in a Mass Analyser Products MAP 215 magnetic sector mass spectrometer equipped with a modified Nier-type ion source, a Faraday detector and an axial electron multiplier (Burle channeltron) operated in pulse-counting mode. All analyses were undertaken at an electron voltage of 88 V, a trap current of 500 μA and an acceleration voltage of 4 kV. A room temperature SAES G50 getter and a liquid nitrogen-cooled charcoal trap are mounted adjacent to the source block in order to minimize the contribution of interfering species during analysis. A slit in front of the electron multiplier was used to achieve a resolving power (m/Δm) of approximately 400. For all samples and calibrations the abundances of masses 18, 19, 21, 22, 40 and 44 were determined by integrating counts recorded in 40-100 blocks of 5 seconds each. Peak heights of masses 2, 16 and 20 were measured on the Faraday detector.

Instrumental sensitivity was calculated from 27 analyses of air samples metered into the system from a 10 litre reservoir before and throughout the sample analysis. Each air aliquot yielded 9.6×10^{10} atoms ^{20}Ne. The uncertainty in the reproducibility of the sensitivity (5 %) is the dominant source of the uncertainty in the measured cosmogenic ^{21}Ne abundances. Isotopic mass discrimination was 0.5 ± 0.03 %/amu. The multiplier gain was determined after each analysis at mass 20 and demonstrated no systematic relationship with source pressure (average value was 3.6×10^{8}).

Blanks were measured routinely between sample measurements. The average 1000°C ^{20}Ne blank was 1.4×10^{8} atoms. There was no observed increase when empty Al foil was heated. The ^{20}Ne blank never exceeded 5% of sample signal. The Ne isotopic composition of blank measurements after correction for interfering species (see below) was indistinguishable from air ratios. Since it is likely that a significant amount of air-derived Ne is released from the samples during heating no blank correction has been made to the data. The abundance of cosmogenic ^{21}Ne (^{21}Ne$_c$) is calculated assuming that all the measured ^{20}Ne (^{20}Ne$_m$) is atmospheric in origin from:

$$^{21}\text{Ne}_c = {}^{21}\text{Ne}_m * (({}^{21}\text{Ne}/{}^{20}\text{Ne})_m - ({}^{21}\text{Ne}/{}^{20}\text{Ne})_{air})/({}^{21}\text{Ne}/{}^{20}\text{Ne})_m \qquad (A1)$$

Unresolved contributions to ^{20}Ne occur as a result of $H_2^{18}O^+$, $^{40}Ar^{2+}$ and HF^+. Interference at $m/e = 20$ from $H_2^{18}O^+$ was calculated from measurement of $H_2^{16}O^+$ at mass 18. The contribution never exceeded 0.03%. No $H^{19}F^+$ signal was observed in blanks and mass spectrometer backgrounds. The $^{19}F^+$ signal was constant in mass spectrometer background, blank, calibration and sample measurements indicating that the fluorine is dominantly in the mass spectrometer. The absence of an effect of $H^{19}F^+$ on blank measurements implies that it is unimportant for measurement of samples ^{20}Ne. The dominant interference at $m/e = 20$ came from $^{40}Ar^{2+}$. The charge state ratio $^{40}Ar^+/^{40}Ar^{2+}$ is governed by the partial pressure of other species in the mass spectrometer ionization region. A first-order relationship between $^{40}Ar^+/^{40}Ar^{2+}$ and H beam size has been recorded (hydrocarbon and He partial pressures were low during the period of measurement). The partial pressure of H remained remarkably constant throughout the analysis of unknowns so a value of $2.31 \pm .01$ for $^{40}Ar^+/^{40}Ar^{2+}$ was used. The contribution to the measured ^{20}Ne signal in samples was usually <1%, but exceeded 3% in one case.

A small excess of ^{21}Ne (equivalent to 4.9×10^5 atoms) is consistently recorded in measurements. By correlation with 21.67 ($^{65}Cu^{3+}$) this excess is fully accounted for by $^{63}Cu^{3+}$ ($^{63}Cu/^{65}Cu \sim 7/3$). The abundance of ^{65}Cu is constant irrespective of the nature of the measurement (background, blank, sample or air calibration) indicating that the Cu ions originate in the mass spectrometer (perhaps evaporating from Cu gaskets in the source). The correction for $^{63}Cu^{3+}$ in air calibration shots and samples is always less than 0.05%. $^{20}NeH^+/^{20}Ne^+$ were approximately 1×10^{-5} and correction at $m/e = 21$ is insignificant for the experiments performed here.

Correction for $^{12}C^{16}O_2^{2+}$ at $m/e = 22$ was calculated from measured mass 44 ($^{12}C^{16}O_2^+$) using a $CO_2^{2+}/CO_2^+ = 55.3$

determined by repeated measurements interspersed with sample measurements. No pressure dependence on the CO_2^+/CO_2^{2+} ratio was recorded for a 50-fold variation in the partial pressure of H and CO_2. Correction for interfering $^{12}C^{16}O_2^{2+}$ never exceeded 1.1% in this study.

We use a normalised sea level high latitude production rate for ^{21}Ne of 19 atoms/g/yr (Niedermann, 2000).

References:
Niedermann, S., 2000, The ^{21}Ne production rate in quartz revisited: Earth and Planetary Science Letters, v. 183, p. 361-364.

TABLE DR1. 10Be DATA

| ID | GPS Latitude (deg) | GPS Longitude (deg) | Catchment area (km^2)* | Catchment elevation* | | | Weighted mean slope (deg)*,† | 10Be concentration (at/g) | Error | Mean catchment prod. rate (at/g/year)†,§ | Error# | Maximum limiting mean denudation rate (m/Myrs) | Error |
				Min (m)	Max (m)	Weighted mean (m)†							
N2C	-23.485	16.231	45.90	1050	1937	1565.50	12.02	465490.71	17728.31	11.96	0.71	14.12	0.88
N2G	-23.470	16.312	91.83	1117	2110	1613.94	11.72	539440.22	17912.08	12.30	0.73	12.50	0.77
N3E	-23.342	16.419	48.66	1729	1915	1832.78	2.58	1416983.46	45542.61	14.21	0.84	5.35	0.34
N3F	-23.328	16.346	78.23	1769	2351	1865.91	5.20	989666.64	32252.98	14.55	0.86	7.97	0.49

*Calculated from SRTM DEM.
†Calculated as $\sum(V_i * W_i) / \sum(W_i)$, where V_i is value i and W_i is the number of DEM cells with value i.
§HLSL production rate used: 5.1 ± 0.3 at/g/yr (Stone, 2000). Corrected for altitude-latitude variations following Stone (2000) and topographic shielding following Codilean (2006).
#Incorporates the error in HLSL production rate only (=5.9%).

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TABLE DR2. COMPLETE Ne ISOTOPE RESULTS
FROM GAUB RIVER CATCHMENT CLASTS

ID[*]	Weight (mg)	$^{21}Ne/^{20}Ne$	±1σ	$^{22}Ne/^{20}Ne$	±1σ	^{20}Ne (10^9atoms/g)	±1σ	ex ^{21}Ne (10^6atoms/g)	±1σ
A0	533.7	0.00556	0.00003	0.1049	0.0007	22.67	0.09	58.32	1.79
A8	558.8	0.00377	0.00002	0.1033	0.0007	10.19	0.04	8.16	0.25
A1	529.0	0.00348	0.00002	0.1029	0.0007	16.95	0.07	8.79	0.27
B6	554.6	0.00374	0.00003	0.1023	0.0008	10.09	0.06	7.79	0.24
B9	539.3	0.00558	0.00008	0.1037	0.0015	4.19	0.06	10.88	0.37
B1	566.0	0.00432	0.00003	0.1039	0.0007	23.95	0.10	32.28	1.97
B2	573.9	0.00459	0.00003	0.1036	0.0007	21.69	0.11	35.03	1.09
C9	550.8	0.00403	0.00003	0.1027	0.0007	16.33	0.07	17.36	0.53
F5	541.6	0.00762	0.00005	0.1073	0.0007	14.34	0.06	66.21	2.03
C7	559.7	0.00359	0.00002	0.1017	0.0007	21.96	0.09	13.71	0.42
E3	540.6	0.00898	0.00005	0.1092	0.0007	12.05	0.05	71.88	2.21
C3	549.6	0.01018	0.00006	0.1096	0.0007	9.24	0.04	66.06	2.02
A3	555.7	0.00558	0.00006	0.1048	0.0012	4.21	0.04	10.94	0.35
A2	590.6	0.00526	0.00005	0.1033	0.0010	3.12	0.02	7.11	0.23
C0	541.2	0.00425	0.00004	0.1043	0.0009	12.32	0.09	15.79	0.49
D9	540.3	0.00403	0.00006	0.1027	0.0017	4.07	0.06	4.30	0.15
A6	559.5	0.00727	0.00007	0.1068	0.0011	7.55	0.07	32.20	1.02
D8	560.4	0.00592	0.00011	0.1058	0.0020	3.64	0.07	10.68	0.39
C4[†]	558.5	0.02783	0.00025	0.1337	0.0012	6.55	0.05	161.18	5.05
D3	585.7	0.00829	0.00005	0.1093	0.0007	7.66	0.03	40.46	1.24
C1	550.9	0.00367	0.00002	0.1022	0.0007	18.42	0.08	12.90	0.40
F7	542.9	0.01016	0.00007	0.1121	0.0009	12.65	0.07	90.21	2.79
E8	570.9	0.01571	0.00012	0.1178	0.0009	8.53	0.05	107.73	3.35
A5	556.8	0.00310	0.00002	0.1028	0.0006	51.54	0.19	7.15	0.22
D1	570.4	0.00687	0.00010	0.1089	0.0016	4.92	0.07	19.05	0.63
F8	555.6	0.00405	0.00003	0.1030	0.0007	9.83	0.05	10.60	0.33
F2	542.0	0.00350	0.00003	0.1028	0.0010	4.91	0.04	2.63	0.08
E7	527.8	0.00675	0.00004	0.1044	0.0007	8.44	0.04	31.64	0.98
E1	528.3	0.00355	0.00002	0.1026	0.0007	14.36	0.07	8.42	0.26
D0	534.6	0.00346	0.00002	0.1040	0.0007	13.24	0.06	6.56	0.20
F9	554.7	0.00402	0.00004	0.1039	0.0010	8.28	0.06	8.67	0.27
D7	558.6	0.00553	0.00003	0.1074	0.0007	14.59	0.06	37.13	1.15

[*]Site location: Witberg Farm; long = 16.08733 deg, lat = -23.48000 deg, altitude ~ 966 m.
[†]Furnace temperature 1100° C.