

The extraterrestrial dust accretion rate on Earth at Dome C, Antarctica: a fresh look with ³He

Annexe D. Table results giving the He isotopic compositions and total masses deduced by size range of cosmic dust extracted from the CONCORDIA snow

Size range Results	> 62 µm (1)	62-25 µm	25-5 µm	< 5 µm	Total snow tank	62-250 µm (7)	62-500 µm (7)
Mass of steel filters and aluminium capsules (mg) Tank F4 – 15,852 g Tank F6 – 14,981 g Tank F1 Sac 1 – 3,353 g Sac 2 – 2,023 g Sac 3 – 2,006 g Sac 4 – 3,064 g	551 503 403 427 380 482	327 375 527 440 478 489	991, 880 and 910 848, 936 and 946 903 903 850 990	598 297 338	-	-	-
[³He] (at g⁻¹ of snow) (2)	(1.46±0.04)×10 ³ (1.34±0.03)×10 ³ (2.51±0.11)×10 ² (4.54±0.71)×10 ¹ (1.84±0.52)×10 ¹ (3.14±0.47)×10 ¹	(2.00±0.03)×10 ³ (1.46±0.02)×10 ³ (1.15±0.02)×10 ⁴ (3.07±0.06)×10 ³ (1.47±0.03)×10 ³ (3.08±0.05)×10 ³	(1.34±0.02)×10 ⁴ (9.68±0.13)×10 ³ (3.37±0.04)×10 ³ (5.02±0.09)×10 ³ (1.08±0.01)×10 ⁴ (5.96±0.07)×10 ³	40.20±0.03 ∅ 47.4±3.3	(1.26±0.01)×10 ⁴ (1.25±0.01)×10 ⁴ (1.52±0.01)×10 ⁴ (8.18±0.11)×10 ³ (1.23±0.01)×10 ⁴ (9.12±0.09)×10 ³	-	-
[⁴He] (at.g⁻¹ of snow) (3)	(6.74±0.03)×10 ⁷ (3.63±0.02)×10 ⁷ (5.20±0.04)×10 ⁷ (1.06±0.13)×10 ⁷ (4.2±0.9)×10 ⁶ (4.09±0.07)×10 ⁷	(5.21±0.01)×10 ⁷ (5.51±0.02)×10 ⁷ (1.66±0.01)×10 ⁸ (2.25±0.02)×10 ⁸ (2.22±0.02)×10 ⁸ (7.32±0.08)×10 ⁷	(3.76±0.001)×10 ⁸ (8.27±0.05)×10 ⁷ (3.70±0.01)×10 ⁷ (1.84±0.03)×10 ⁸ (2.81±0.03)×10 ⁸ (1.24±0.02)×10 ⁸	(8.11±0.52)×10 ⁵ ∅ (1.47±0.02)×10 ⁷	(3.78±0.01)×10 ⁸ (1.61±0.01)×10 ⁸ (2.69±0.01)×10 ⁸ (4.34±0.03)×10 ⁸ (5.19±0.03)×10 ⁸ (2.53±0.02)×10 ⁸	-	-

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$^3\text{He}/^4\text{He}$ (.Ra $^{-1}$) (4)	15.7 ± 0.4 26.6 ± 0.7 3.5 ± 0.2 3.1 ± 0.7 3.2 ± 1.1 0.6 ± 0.1	27.7 ± 0.4 25.0 ± 0.4 50.3 ± 0.6 9.9 ± 0.2 4.8 ± 0.1 30.4 ± 0.6	25.8 ± 0.3 84.6 ± 1.3 65.7 ± 1.7 19.8 ± 0.5 27.7 ± 0.4 34.8 ± 0.6	35.8 ± 2.3 $\emptyset$ 2.0 ± 0.2	-	-	-
$^3\text{He}_{\text{ET}}$ fraction (%) (4)	99.88 ± 0.06 99.93 ± 0.03 99.44 ± 0.28 99.36 ± 0.34 99.38 ± 0.98 99.4 ± 1.9	99.93 ± 0.03 99.93 ± 0.04 99.97 ± 0.02 99.81 ± 0.10 99.59 ± 0.20 99.94 ± 0.03	99.93 ± 0.03 99.98 ± 0.01 99.98 ± 0.01 99.91 ± 0.05 99.94 ± 0.03 99.95 ± 0.02	99.95 ± 0.02 $\emptyset$ 99.03 ± 0.49	-	-	-
[^4He] Terrigenous (at.g $^{-1}$ of snow)	$(6.21\pm0.27)\times10^7$ $(3.15\pm0.24)\times10^7$ $(5.11\pm0.04)\times10^7$ $(1.04\pm0.13)\times10^7$ $(4.1\pm0.9)\times10^6$ $(4.08\pm0.01)\times10^7$	$(4.49\pm0.36)\times10^7$ $(4.82\pm0.26)\times10^7$ $(1.24\pm0.01)\times10^8$ $(2.14\pm0.02)\times10^8$ $(2.17\pm0.02)\times10^8$ $(6.20\pm0.08)\times10^7$	$(3.28\pm0.24)\times10^8$ $(4.8\pm1.8)\times10^7$ $(2.49\pm0.08)\times10^7$ $(1.65\pm0.03)\times10^8$ $(2.42\pm0.03)\times10^8$ $(1.02\pm0.02)\times10^8$	$(6.66\pm0.85)\times10^5$ $\emptyset$ $(1.45\pm0.02)\times10^7$	$(3.33\pm0.17)\times10^8$ $(1.16\pm0.18)\times10^8$ $(2.06\pm0.01)\times10^8$ $(3.92\pm0.03)\times10^8$ $(4.62\pm0.04)\times10^8$ $(2.09\pm0.02)\times10^8$	-	-
$^3\text{He}_{\text{ET}}$ flux (pcc STP.cm $^{-2}$.ka $^{-1}$)	0.15 ± 0.01 0.13 ± 0.01 $(2.51\pm0.14)\times10^{-2}$ $(4.56\pm0.73)\times10^{-3}$ $(1.84\pm0.53)\times10^{-3}$ $(3.16\pm0.47)\times10^{-3}$	0.20 ± 0.01 0.15 ± 0.01 1.16 ± 0.04 0.31 ± 0.01 $(14.8\pm0.6)\times10^{-2}$ 0.31 ± 0.01	1.35 ± 0.05 0.97 ± 0.04 $(33.9\pm1.3)\times10^{-2}$ 0.51 ± 0.02 1.08 ± 0.04 0.60 ± 0.02	$(4.04\pm0.15)\times10^{-3}$ $\emptyset$ $(4.16\pm0.36)\times10^{-3}$	1.27 ± 0.05 1.25 ± 0.04 1.52 ± 0.05 0.83 ± 0.02 1.23 ± 0.04 0.91 ± 0.03	-	-

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	$\overline{\text{Flux}}$ (pico cc STP.cm ⁻² .Ka ⁻¹) 1.25±0.03 (weighted mean±1SD)					-	-
ET mass flux from weighted mean (μg.m ⁻² .a ⁻¹) (5)	4.4 ± 0.8 4.0 ± 0.8 0.7 ± 0.1 0.1 ± 0.03 0.055 ± 0.010 0.09 ± 0.01	1.4 ± 0.9 1.0 ± 0.7 8.0 ± 5.0 2.1 ± 1.4 1.0 ± 0.6 2.1 ± 1.4	0.6 ± 0.7 0.4 ± 0.5 0.15 ± 0.18 0.23 ± 0.27 0.5 ± 0.6 0.3 ± 0.3	--- ∅ ---	6.8 ± 2.4 5.4 ± 1.9 9 ± 5.5 2.5 ± 1.7 1.6 ± 1.2 2.5 ± 1.7	8.6 ± 1.6 7.9 ± 1.5 1.5 ± 0.3 0.27 ± 0.05 0.11 ± 0.02 0.19 ± 0.03	37 ± 11 33 ± 10 6.5 ± 2.0 1.2 ± 0.4 0.46 ± 0.14 0.79 ± 0.25
	$\overline{\text{Flux}}$ (μg.m ⁻² .a ⁻¹) 3.4 ± 0.6 1.9 ± 1.2 0.44 ± 0.58 5.7±1.5 (weighted mean±1SD)						
ET mass flux from regression (μg.m ⁻² .a ⁻¹) (5)	6.7 ± 2.0 6.2 ± 1.8 1.2 ± 0.4 0.2 ± 0.1 0.08 ± 0.03 0.14 ± 0.05	1.3 ± 0.4 0.9 ± 0.3 7.4 ± 2.0 2.0 ± 0.5 1.0 ± 0.3 2.0 ± 0.5	0.24 ± 0.05 0.17 ± 0.04 0.06 ± 0.01 0.09 ± 0.02 0.19 ± 0.04 0.11 ± 0.02	$(2.84 \pm 0.43) \times 10^{-7}$ ∅ $(2.92 \pm 0.49) \times 10^{-7}$	9 ± 2 7 ± 2 9 ± 2 2.3 ± 0.5 1.2 ± 0.3 2.2 ± 0.6	25 ± 8 23 ± 7 4 ± 1 0.8 ± 0.3 0.3 ± 0.1 0.5 ± 0.2	60 ± 20 66 ± 22 11 ± 4 2.3 ± 0.9 0.8 ± 0.4 1.4 ± 0.5

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	Flux (μg.m⁻².a⁻¹) 5±11.73±0.280.17±0.03(2.86±0.32)×10⁻⁷ 7±1 (weighted mean±1SD)						
Mass flux of terrestrial silicate particles (mg.m ⁻² .a ⁻¹) (6)	1.42±0.06 0.72±0.43 1.17±0.03 0.24±0.03 0.01±0.03 0.93±0.04	6.15±0.50 5.07±0.36 16.98±0.35 29.3±1.9 29.7±1.8 8.6±0.3	77.2±5.7 11.2±4.1 5.86±0.23 39.0±2.7 57.1±3.6 24.14±0.85	0.29±0.04 ∅ 6.33±0.29	16.2±1.1 17.0±4.1 26.8±0.4 69.4±3.3 87.8±4.0 35.4±0.9	-	-
	Flux (mg/m²/an) 1.46±0.0511.5±0.439.0±3.01.96±0.09 44±3 (weighted mean±1SD)					-	-

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The results in color correspond to the different snow tanks. Data are reported for different particle size ranges. The snow masses were weighed prior to melting. The size range labeled '< 5 μm ' shows results for evaporated meltwater in aluminum capsules. In one of the three capsules, ^3He was below the aluminum blank level ($[^3\text{He}_{\text{ET}}] = (6.06 \pm 0.54) \times 10^5$ atoms of $^3\text{He.g}_{\text{Al}}^{-1}$). Arithmetic means of the $^3\text{He}_{\text{ET}}$ flux and total cosmic dust mass were calculated across the snow tanks and integrated over the particle size ranges. Two ET mass flux estimates are provided: one using the weighted mean of $^3\text{He}_{\text{ET}}$ for each size range and, and the second one from $[^3\text{He}_{\text{ET}}]$ -Mass regression described in [Fig.6](#). Units are given in brackets in the first column. Errors are 1σ and were calculated using Taylor's uncertainty propagation. The symbol ' $\emptyset$ ' indicates abundances below the blank level.

- (1) ET mass flux estimates, based on $^3\text{He}_{\text{ET}}$ concentrations, are obtained using 62-100 microns size range.
- (2) Helium isotopic abundances obtained from total snow masses (see, [Annexe A](#) gives exposure-parameters for each snow tank).
- (3) He isotopic ratios in Ra, the Earth atmospheric ratio ($Ra = 1.384 \times 10^{-6}$, [Ozima and Podosek, \(2002\)](#)).
- (4) $^3\text{He}_{\text{ET}}$ fractions calculated using a two components mixing equation (e.g., [Marcantonio et al., \(1995\)](#); [McGee and Mukhopadhyay, \(2013\)](#)) ($(^3\text{He}/^4\text{He})_{\text{extraterrestrial}} = 0.02 \text{ Ra}$ ([Benkert et al., \(1993\)](#); [Heber et al., \(2009\), \(2012\)](#)) ; $(^3\text{He}/^4\text{He})_{\text{terrestrial}} = 200 \text{ Ra}$; (e.g., [Marcantonio et al., \(1995\)](#); [Farley and Patterson, \(1995\)](#); [Winckler et al., \(2005\)](#)).
- (5) Cosmic mass fluxes are calculated from $^3\text{He}_{\text{ET}}$ abundances measured from the filters and using the $[^3\text{He}_{\text{ET}}]$ weighted mean and $[^3\text{He}_{\text{ET}}]$ -Mass empirical relationship obtained from the exhaustive database ([Fig.6](#)). For the first method, masses were converted into fluxes taking into account the snow accumulation rate of $R_{\text{snow}} = 2.7 \pm 0.1 \text{ g.cm}^{-2}.\text{a}^{-1}$ ([Frezzotti et al., \(2005\)](#); [Le Meur et al., \(2018\)](#)). Uncertainties of the cosmic dust density were computed considering two endmembers: (0.8 g.cm^{-3}) (cometary dust 67P-Churyumov-Gerasimenko, [Fulle et al., \(2016\)](#)) to 2.2 g.cm^{-3} (carbonaceous chondrites mean-density, [Consolmagno et al., \(2008\)](#); [Flynn and Sutton, \(1991\)](#); [Joswiak et al., \(2007\)](#); [Love et al., \(1994\)](#))) and propagated using parent body contributions from [Carrillo-Sánchez et al., \(2021\)](#). For the second method, we fixed a mean density of 1 g.cm^{-3} .
- (6) Mass flux of terrestrial dust was calculated considering ^4He concentrations in dust from [McGee et al. \(2016\)](#), following: $(1.18 \pm 0.03) \times 10^{15}$, $(1.97 \pm 0.05) \times 10^{14}$, $(1.15 \pm 0.03) \times 10^{14}$ and $(6.20 \pm 0.79) \times 10^{15} \text{ at.g}^{-1}$ for > 62 μm , 25-62 μm , 5-25 μm and < 5 μm size ranges, respectively.
- (7) Cosmic Mass flux by changing the upper limit of the integrated $^3\text{He}_{\text{ET}}$ concentrations.