

¹⁰Be CONTENTS OF SNC METEORITES; D.K. Pal, C. Tuniz¹, R.K. Moniot², W. Savin³, S. Vajda, T. Kruse, and G.P. Herzog, Depts. Chemistry and Physics, Rutgers Univ., New Brunswick NJ 08903. ¹Istituto di Fisica, Univ. degli Studi, Trieste, Italy and Istituto Nazionale Fisica Nucleare, Sez. di Trieste, Italy, ²Div. Sci. Math., Fordham Univ., New York, NY 10023, ³Dept. Physics, NJ Inst. Tech., Newark, NJ 07100

Several authors have explored the possibility that the Shergottites, Nakhilites, and Chassigny came from Mars (e.g., 1-3). The spallogenic gas contents of the SNC meteorites have been used to constrain the sizes of the SNC's during the last few million years, to establish groupings independent of the geochemical ones and to estimate the likelihood of certain entries in the catalog of all conceivable passages from Mars to Earth (3-5).

Measurements of the radioactive, cosmogenic nuclides supplement the stable isotope data. The ²⁶Al contents of six of the SNC meteorites are known but their interpretation is complicated by the sensitivity of the ²⁶Al production rate to the bulk Al content, a property that varies more than tenfold among the SNC meteorites. In contrast, differences in chemical composition are expected to induce variations of less than 10% in the ¹⁰Be contents (6). Furthermore, the ¹⁰Be production rate, P₁₀, varies relatively little over the typical range of meteoroid sizes, i.e., in bodies with preatmospheric radii between 20 and 150 g/cm² although it does fall rapidly in larger bodies and rises in the interior of St-Severin-sized objects (7-11). The particular shielding dependence of ¹⁰Be makes the isotope a good probe of the irradiation conditions experienced by the SNC meteorites. We have measured the ¹⁰Be contents of all the members of the group by using the technique of accelerator mass spectrometry (9). The results appear in Table 1.

Samples. With the possible exception of Chassigny, the samples analyzed for ¹⁰Be come from the same meteorite fragments as those analyzed for the noble gases. The ²⁶Al measurements for EETA 79001, ALHA 77005 and Nakhla also refer to the same fragments. The samples of EETA 79001 had been prepared by E. Jarosewich for other purposes. We used about 50 mg of meteorite for each ¹⁰Be determination.

Adjustments for Chemical Composition. To remove the effects of chemical composition from the ¹⁰Be and ²¹Ne data we multiplied each one by a chemical normalization factor, C, calculated according to the relation $C = P_{\text{Shergotty}}/P_X$. The production rates were obtained from equations and composition data in the literature.

¹⁰Be Contents and Shielding. The ¹⁰Be contents of Nakhla, Governador Valadares, Chassigny, and probably Lafayette, about 20 dpm/kg, exceed the values expected from irradiation of the surface of a large body. The ¹⁰Be data therefore do not support scenario III of Bogard et al. (5), one in which most of the ¹⁰Be in the SNC meteorites would have formed on the Martian surface; they resemble rather the ¹⁰Be contents found in many ordinary chondrites subjected to 4π exposures. Judging from the calculations of Reedy (10), the meteorites named above orbited for several million years as bodies with radii less than 2 m or so.

¹⁰Be Exposure Ages. The uncertainties of the ¹⁰Be contents lead to appreciable errors in the ¹⁰Be ages, $t_{10} = -1/\lambda \ln(1 - {}^{10}\text{Be}/{}^{10}\text{Be}_0)$, given in Table 1. Nonetheless, the ¹⁰Be ages are consistent with the ²¹Ne ages calculated assuming conventional, small-body production rates and short terrestrial ages for the finds. We believe that this concordance strengthens the case for at least 3 different irradiation ages for the SNC meteorites (5). Given the similar half-thicknesses of the ¹⁰Be and ²¹Ne production rates, the ratios of

the ^{10}Be and ^{21}Ne contents do not appear consistent with common ages for any of the groups. In view of the general agreement between the ^{10}Be and ^{21}Ne ages it does not seem useful at this time to construct multiple-stage irradiation histories for the SNC meteorites.

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Table 1. ^{10}Be Contents of SNC Meteorites.

Meteorite	ID ^a	^{21}Ne ($10^{-8}\text{cm}^3\text{STP/g}$)	Ref.	C ₂₁	t ₂₁ ^b (Ma)	^{10}Be (dpm/kg)	C ₁₀	t ₁₀ ^b (Ma)
Shergotty	U817	0.58	15	1.0	3.2	13±1.5	1	2.2
Zagami	01966,54	0.69	15	0.95	3.6	18.6±2.6	0.99	4.6
ALHA 77005	U/EJ	0.75	5	0.56	2.3	15±3	0.95	2.6
EETA 79001A	U/EJ	0.14	4,5	0.78	0.6	7.8±1.1	0.96	1.0
EETA 79001B	U/EJ	0.12d	5	1.06	0.7	8.5±1.1	0.99	1.2
Nakhla	Me804	3.10	16	0.95	16.3	19.7±3.3	1.02	>5c
Lafayette	Me2116	2.70	16	0.95	14.2	18.1±2.5	1.02	>5c
Governador Valadares	LN	2.10	5	1.0	11.7	25.6±3.6	1.03	>5c
Chassigny	P2523	4.14	17,18	0.53	12.2	20.5±3.1	0.97	>5c

a) We thank the sample donors: LN=L. Nyquist (JSC); Me=E. Olsen (Field Museum); O=R. Hutchinson (Brit. Museum); U=E. Jarosewich (Smithsonian).

b) Assumes $P_{10}=21.3$ dpm/kg and $P_{21}=0.18 \times 10^{-8}\text{cm}^3\text{STP/g-Ma}$ in Shergotty. Uncertainties in t₁₀ range from 25 to 50%.

c) High gas and ^{10}Be contents indicate unreliable ^{10}Be age.

d) Considered doubtful by Bogard et al. (Ref. 5).