

COSMOGENIC Mn-53 IN METEORITES. V.A. Alexeev, V.V. Malishev, A.K. Lavrukhina; V.I. Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow, USSR.

Cosmogenic Mn-53 favored by its large production cross-section and long half-life (3.7 m.y.), is one of the most interesting nuclides to get valuable information about the radiation history of cosmic objects, to determine the meteorite preatmospheric sizes, to investigate the temporal variations of cosmic rays and the anomalous processes on the Sun for the last ~ 10 m.y. The direct counting of Mn-53 presents difficulties because of the soft K-radiation; also rather large amounts of precious material would be needed. Millard (1965) pointed out the possibility of converting Mn-53 into the γ -emitting Mn-54 by a neutron capture. The large cross-section affords much greater sensitivity for the determination of Mn-53.

We studied the different procedures on the Mn isolation from the meteoritic metal, found the optimal conditions of the irradiation, and determined the Mn-53 content in the iron meteorites and in the metal of chondrites. About 1 g of meteoritic metal along with the Mn carrier (5 mg) were dissolved in HNO₃. Pre- and post-irradiation chemical procedures were mainly to those reported by Imamura et al. (1). The manganese was isolated by ion exchange procedures and then in the form MnO₂ was irradiated 1156 hours in the research reactor. In the same irradiation Al capsule, a set of "normal" MnO₂ and monitors were activated. The samples of Fe₂O₃, Fe metal, Ni metal, ZnCl₂, and Co (NO₃)₂ were used as monitors. The radiometric measurements were done with well-type ϕ 2" x 3" NaI (Tl) crystal and multichannel analyzer. The samples were independently checked with a Ge(Li)-detector. Absolute neutron flux calibration was done by measuring the neutron induced activity in the internal Co standard (Co-60-activity, $\delta_{\text{therm}} = 37.5$ barn, $t_{1/2} = 5.273$ years). The integral flux of $F = (1.4 \pm 0.1)10^{19}$ cm⁻². The flux ratio of $F, \text{fast}/F, \text{therm}$ was only <0.001 as measured by the reactions Ni-58 (n,p) Co-58 and Co-59 (n, γ) Co-60.

Our Mn-53 data are presented in Table 1. The samples of two meteorites (Sikhote-Alinskii, 2093,B and Pribram) were duplicated to obtain more reliable data and to check the reproducibility of results. The results of individual measurements differ from the average values less than $\pm 5\%$. The lower Mn-53 content for sample 2093,B in comparison with the sample 2093,A is due to the deeper location of the sample 2093,B out of the atmospheric surface (~20 cm). This value agrees with the estimated value (2).

For the Boguslavka meteorite the Mn-53 content in the sample No. 105,A was higher than that in the sample No. 105,B. At that time for the Ar-39 content (3) was observed the inverse relation: 16.2 ± 0.6 and 19.3 ± 0.8 dpm/kg for the samples No. 105,A and No. 105,B, respectively. These data can be explained by the location of both samples near the surface of preatmospheric body. In this case the location depth of the sample No. 105,A of ~10 cm. According to the estimations (2), the Mn-53 production rate is maximum for this depth in iron meteorites with $R \geq 10$ cm. The location depth of the sample No. 105,B of $d \sim 5$ cm, where the Ar-39 production rate is higher but that of Mn-53 is lower than for the location depth of $d = 10$ cm. The comparison of the estimated (2,3) and measured contents of these two isotopes allows us to conclude the preatmospheric radius of Boguslavka of $R \sim 30$ cm.

If the radiation age of Morasko is fairly high (≥ 10 m.y.) to reach the Mn-53 saturation activity the low Mn-53 content points to the large preatmospheric radius of the meteorite ($R > 30$ cm).

The low Mn-53 content in the metal of Gorlovka chondrite can be due to the studied sample has been located at the small depth of $d = 7 \pm 2$ cm in the preatmospheric body of $R = 25 \pm 5$ cm (4).

The relatively high Mn-53 content in the metal of Pribram, whose preatmospheric radius of $R = 100 (+25, -16)$ cm (5), can be due to the large orbit aphelion of this meteorite. Owing to this meteorite was irradiated by high intensity flux of galactic cosmic rays.

The Mn-53 content in Dhajala was obtained essentially lower than that obtained by Fruchter et al. (6). The further measurements are needed to find reasons for this difference.

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Table 1. Mn-53 contents in the iron meteorites and in the metal of chondrites.

Meteorites	Mn-53, dpm/kg metal	
	This work	Literature data
<u>A. Iron</u>		
Sikhote-Alinskii, II B		103-338 /7-9/x)
No. 2093,A	320 ± 50	
No. 2093,B	210 ± 20	
	230 ± 20	
Av:	220 ± 20	
Boguslavka, II A		
No. 105,A	540 ± 50	
No. 105,B	430 ± 40	
Morasko	380 ± 30	
<u>B. Chondrites</u>		
Pribram, H5	330 ± 30	
	310 ± 30	
Av:	320 ± 30	
Gorlovka, H3-4	240 ± 20	
Dhajala, H3		275 ± 25 /6/
No. T-67	200 ± 20	

x) Different fragments.