53-MN IN A SLAB OF THE LOST CITY METEORITE

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Specimens recovered from observed meteorite falls rather than meteorite finds are fascinating extraterrestrial samples. They provide the rare chance to study short- and long-lived ray produced radionuclides in the same object. The St. Severin and Jilin chondrites can be considered as outstanding examples [1,2]. Of the meteorite falls, those for which the orbits are known are of special interest, as they might give clues about the spatial variation of the galactic cosmic radiation and cosmogenic nuclide production [3,4]. The trajectory of the Lost City meteorite was observed by the Prairie Network cameras, enabling the precise determination of its orbital parameters [5]. Rapid distribution of the well-documented Lost City specimens led to the determination of many short-lived, long-lived and stable cosmogenic nuclides [e.g. 6-9].

In this study, samples of different locations of slab 1 of specimen NMNH 4848, which had previously been analyzed for cosmic ray track densities by Lorin and Pellas [10], were investigated for 53-Mn. The cosmic ray track densities and the preliminary 53-Mn activities of slab 4848 are presented in Figure 1. Samples 1A and 2B are directly adjacent to a 418 g subsample No. 5, in which many other short- and long-lived radionuclides were studied by Cressy [7] in detail. These circumstances allow the consideration of samples 1A, 2B, and 5 as fulfilling the "same sample requirement". Both cosmic ray track densities, ranging from 2.3 to 0.5 x 10^6 cm^{-2} and 53-Mn activities ranging from 328 $\pm$ 16 to 366 $\pm$ 18 dpm/kg Fe do not show a very steep gradient with depth. Within the limits of uncertainty, a 53-Mn activity of 317 $\pm$ 25 dpm/kg Fe, determined by Fruchter et al. [11] in a different sample of the Lost City meteorite, is in agreement with this result. In St. Severin and Keyes [1,12,13], both the cosmic ray track and 53-Mn gradients are steeper than in Lost City, indicating that the preatmospheric size of Lost City is smaller than that of these meteorites. Lorin and Pellas [10] estimated a preatmospheric mass of less than 200 kg on the basis of CR-tracks only and Mc Crosky et al. [5] estimated it to be as small as 50 - 100 kg.

Additional information can be obtained if the production rates of CRTs and 53-Mn can be calculated. This requires a reliable estimation of the exposure age of Lost City. Baxter et al. [14] proposed as the most probable exposure age 8 $\pm$ 2 x 10^6 years. A reevaluation using the 21-Ne production rates as well as cosmogenic nuclide production rate ratios of Nishiizumi et al. [15] and Moniot et al. [16] and Herpers and Englert [17] yields 10 $\pm$ 2 x 10^6 years. In Figure 2, 53-Mn production rates are plotted as a function of the CRT production rates. The Lost City data points indicate a preatmospheric radius of approximately 20 cm, only a bit smaller than the radius of St. Severin. A preatmospheric mass of approximately 120 kg can be calculated assuming a density of 3.7 g/cm^3 and a spherical shape for Lost City. This value exceeds the previously mentioned predictions of Mc Crosky et al. [5] and the results of Bhandari et al. [18], who assings Lost City to the ablation class II or III and postulates a preatmospheric mass of 65 kg.

A preatmospheric radius of 20 cm or less is also supported by the low 60-Co content of only 19 $\pm$ 0.4 dpm/kg [7], indicating low secondary particle

fluxes. The spectra of these fluxes may also influence the 53-Mn/54-Mn production rate ratio as the obtained value of 1.34 for slab 1 of specimen NMNH 4848 of Lost City is higher than the expected ratio of close to unity. However, the 22-Na/26-Al ratio is also lower than predicted [7], but there is no reasonable explanation yet as to why the the two short-lived isotopes 54-Mn and 22-Na have such low activities especially as the 53-Mn/26-Al production rate ratio of 1.42 {(dpm/kg Fe)/(dpm/kg Si_{equ})} is very close to the average over all meteorites [11].

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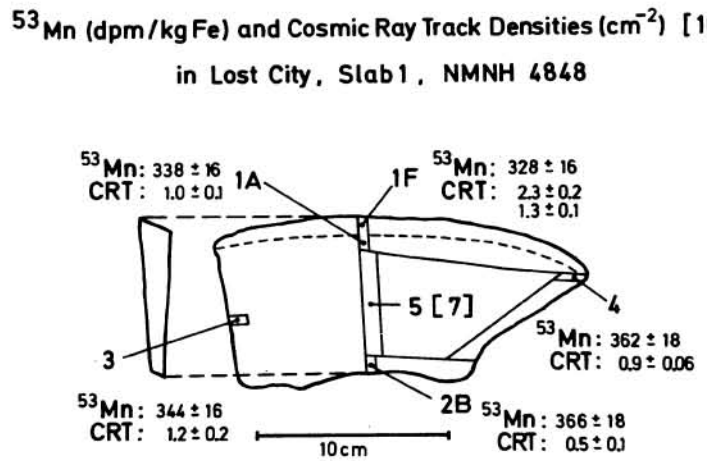

Figure 1

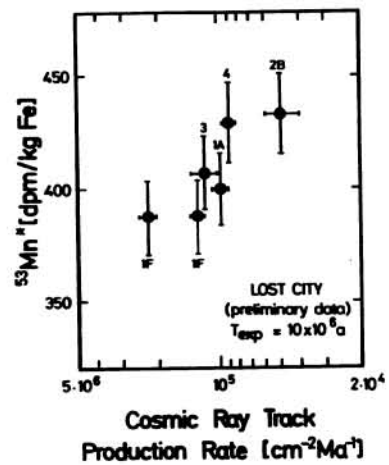

Figure 2

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