IRON-60 ACTIVITIES OF CANYON DIABLO, GRANT, AND DOROFEEVKA

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Introduction: In meteoroids, cosmic rays produce the β^- emitter ^{60}Fe ($t_{1/2}$=1.5 Ma) mainly through nuclear reactions with the minor isotopes of nickel. Even in nickel-rich iron meteorites, however, ^{60}Fe production rates are low and only a few measurements of ^{60}Fe activities have been reported to date [1]. The utility of ^{60}Fe in interpreting cosmic-ray exposure histories depends on understanding its production rate systematics. To contribute toward such an understanding, we have measured the activities of ^{60}Fe in six samples representing a large range of shielding conditions in three iron meteorites.

Experimental methods: Samples with masses of ~100 mg were dissolved in HCl. Iron was separated by ion exchange and precipitated as the hydroxide. Ratios (atom/atom) of ^{60}Fe to Fe were measured by accelerator mass spectrometry (AMS) [1].

Results and discussion: Table 1 shows measured ^{60}Fe activities; Ni contents are from the literature. Published activities (dpm/[kg Ni]) range from ~0.7 for metal from chondrites to 2.0±0.6 for a 2.5-kg(!) sample of Odessa [see 1,2].

Production rates of spallogenic nuclides such as ^{3}He, ^{10}Be, ^{21}Ne, and ^{36}Cl generally decrease with increasing depth in large iron meteorites, [e.g., 3] as we also find for ^{60}Fe in Canyon Diablo. With sample depths based on [4], we obtain a half thickness of 11.5±5.0 cm for ^{60}Fe. In contrast, modeling calculations for iron meteoroids with radii <40 cm [1] predict an increase with depth of ~30% in the production of ^{53}Mn and ^{60}Fe. If we use for Grant the size and the depth scale proposed in [5], our ^{60}Fe activities for O +10 and K -47 (distances from center 28.6 cm and 19.0 cm, respectively) confirm an increase of ^{60}Fe with depth, although uncertainties are appreciable. Dorofeevka's small recovered mass (12.6 kg) and rather high ^{10}Be and ^{26}Al activities [6] indicate relatively light shielding. Its ^{60}Fe activity is consistent with these observations.

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Table 1. Activities of ^{60}Fe (dpm/[kg Ni]) in iron meteorites.

Sample	Counts	Ni	Activity
Canyon Diablo			
266	9	6.91	0.84±0.36
4340	3	6.98	0.11±0.09
4367	7	6.98	0.41±0.20
Grant 836			
O+10	30	9.29	1.01±0.20
K-47	28	9.29	1.21±0.25
Dorofeevka	50	11.3	0.99±0.15