SOLAR FLARE TRACKS AND NEUTRON CAPTURE EFFECTS IN GAS-RICH METEORITES

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Last year, we reported the first evidence for precompaction neutron capture effects in the gas-rich meteorite, Kapoeta, using Samarium isotopes (Rajan and Lugmair, 1987). We have extended this line of research and have measured solar flare tracks and $^{150}Sm/^{149}Sm$ ratios in several samples from the gas-rich meteorites, Kapoeta and Fayetteville. A reason for this line of approach is an intriguing result of Caffee *et al.* (1983), who observed a near-perfect correlation between the precompaction spallation neon and solar flare tracks in several gas-rich meteorites. Such a coupling is not *a priori* expected, due to the large differences in depth dependences of the two processes. This coupling was one of the major drivers in their conclusion that these effects were produced during the T-tauri phase of the early sun.

We plan to check on the above hypothesis by looking for correlations (or otherwise) between precompaction neutron capture effects and solar flare track parameters. Our results should establish major constraints on the broad picture of how these effects were acquired. Furthermore, our results in concert with the neon data should give valuable insights into the nature of regolithic processes prevalent in the asteroidal parent bodies at the time of brecciation.

For this purpose, we have studied several samples for solar flare tracks from the gas-rich meteorites, Kapoeta and Fayetteville. A subset of these samples with widely varying solar flare effects were chosen for the study of neutron capture effects using Samarium isotopes. The Samarium isotope measurements were performed using the VG-54E mass spectrometer at the Scripps Institute of Oceanography. The experimental techniques and chemical separation procedures used are similar to that described in Lugmair *et al.* (1975). Results from our work are summarized in Table 1.

TABLE 1
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Sample	Weight (mg)	$^{150}SM/^{149}SM$	Relative Excess (in ε Units) *	Abundance of Track-rich Grains (%)
Terrestrial STD	—	0.53400 ± 2	≡ 0	
Kapoeta				
K-1	67	0.53421 ± 4	4.0 ± 0.8	2
K-2	220	0.53401 ± 3	0.2 ± 0.7	0
K-5	122	0.53417 ± 3	3.2 ± 0.7	2
K-6	171	0.53400 ± 3	0 ± 0.7	5
Fayetteville				
FAY-1	143	0.53412 ± 3	2.3 ± 0.7	12
FAY-2	105	0.53399 ± 3	-0.2 ± 0.7	3

* One ε unit refers to 1 part in 10^4.

Several points are worth emphasizing in the above table. Individual entries in the above table represent the summary of multiple repeat runs (typically three) on aliquots of the samples. We have demonstrated the existence of precompaction neutron capture effects in different samples of both gas-rich meteorites. The ^{150}Samarium excess thus joins host of other effects as a valuable tool for characterizing the regolithic histories of gas-rich meteorites.

Further, there is no apparent correlation between the solar flare effects and the ^{150}Samarium excesses. This is in sharp contrast to the precompaction spallation neon, which is inexplicably coupled with only the track-rich grains in several gas-rich meteorites (Caffee *et al.*, 1983). The implications of this dichotomy to the irradiation environments for gas-rich meteorites will be addressed at the meeting.

Finally, following the line of reasoning described in Lugmair *et al.*, (1975), it is possible to derive the neutron fluences experienced by these samples. They range from $2.0 \pm 0.4 \times 10^{15} n/cm^2$ for K-1, and $3.8 \pm 1.2 \times 10^{15} n/cm^2$ for Fay-1. Comparing the present results to that from lunar rock 75075 (Lugmair *et al.*, 1975), we infer residence times for Kapoeta and Fayetteville in their asteroidal regoliths of about 33 ± 6 and 63 ± 21 million years respectively.

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References

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