NICKEL-59 IN IMPACT GLASSES FROM METEOR CRATER, ARIZONA: IMPLICATIONS FOR THE CRATERING PROCESS. P. Ma[1], G. F. Herzog[1], M. L. di Tada[2], P. A. Hausladen[2], L. K. Fifield[2], and D. W. Mittlefehldt[3], [1]Department of Chemistry, Rutgers University, 610 Taylor Road, Piscataway NJ 08854-8087, USA (herzog@rutchem.rutgers.edu), [2]Department of Nuclear Physics, Research School of Physical Science and Engineering, Australian National University, Canberra, ACT 0200, Australia (keith.fifield@anu.edu.au), [3]Lockheed-Martin, Houston TX 77058, USA (david.w.mittlefehldt1@jsc.nasa.gov).

Introduction: Material from the Canyon Diablo impactor is preserved not only in meteorites, but also in impact glasses and in large numbers of millimeter size spheroids found in and around Meteor Crater. Accelerator mass spectrometry (AMS) measurements of ^{59}Ni [1] suggest that the spheroids typically came from 0.5 to 1 m deeper in the impactor than did the meteorites. In an extension of this work, we report measurements of ^{59}Ni in impact glasses from Meteor Crater. The ^{59}Ni activities serve to indicate the depth in the impactor at which the meteoritic material in the impact glasses originated. We also report elemental compositions of the impact glasses. Based on the work of [2], we hypothesized that these data might furnish clues to the original stratigraphic position of the terrestrial component in the glasses.

Experiment: Eight impact glasses were obtained from Collections Research for Museums, Kansas, Denver. These dark-brown and weathered glasses were collected from Section 30, southeast rim of Meteor Crater. In order to recover sufficient Ni for AMS measurements (10 mg NiO), masses of 1–1.5 g of impact glasses were dissolved. Separation and purification of Ni were performed following the procedure of [3]. We used accelerator mass spectrometry to measure the ^{59}Ni/Ni ratios of the samples [3]. Trace element contents in the glasses were determined with instrumental neutron activation analysis (INAA) following JSC procedures [4].

Table 1. ^{59}Ni in Impact Glasses

Sample	Ni (%)	^{59}Ni/Ni (10^{-12})	^{59}Ni* (dpm/kg)
Impact glasses			
2	1.29	<0.28	<0.57
5	1.63	0.84 ± 0.11	16.8
6	0.83	1.1 ±0.14	22.1
8	1.33	0.84 ± 0.11	16.8
Spheroids[1]	7.1	0.70	13±3
Meteorites[1]	7.1	4.4	87±15

*In dpm/(kg Canyon Diablo) at the time of fall, calculated assuming 7.1% Ni in Canyon Diablo and a terrestrial age of 50 ka [5,6].

Results and Discussion: ^{59}Ni/Ni ratios (Table 1) have been normalized by reference to reactor-irradiated Ni with a ^{59}Ni/Ni ratio of $(3.04 \pm 0.15) \times 10^{-11}$. Three of the impact glasses have ^{59}Ni/Ni ratios between 0.84×10^{-12} and 1.11×10^{-12}, values similar to those measured in spheroids ($\sim 0.7 \times 10^{-12}$). We infer that the meteoritic material bearing the ^{59}Ni in the impact glasses and in the spheroids came from similar depths in the impactor. The ^{59}Ni/Ni ratios of all four impact glasses are much lower than those of Canyon Diablo meteorites (4.4×10^{-12}) and, according to nuclear modeling calculations [1], could not have been produced at a depth less than 1.2 m.

INAA results for eight impact glasses that include those in Table 1, show compositional homogeneity and enrichments in siderophile elements relative to the target rocks. Based on the average concentrations (by mass) of siderophile elements (Fe = 20 ± 2%; Ni = 1.2 ± 0.2%; Co = 0.88 ± 0.09‰; Ir = 0.50 ± 0.07 ppm), we estimate that the impact glasses contain 15–20% of meteoritic material. The elements Fe, Ni, Co, and Ir in the impact glasses occur in the same ratios as in Canyon Diablo iron meteorite [7], showing that there has been little elemental fractionation due to oxidation, evaporation, or terrestrial alteration. By comparing the composition of the impact glasses with those of samples from the Meteor Crater stratigraphic section [2], we infer that the glasses examined so far are mixtures of material from the topmost (Moenkopi) and the underlying (Kaibab) terrestrial layers with the impactor. At present, we have too few results to draw firm conclusions, but we note that ^{59}Ni/Ni correlates roughly with Sc and with Th in the four impact glasses analyzed by both techniques. High Sc and Th indicate a higher Moenkopi component in the glass [2]. If this correlation holds up with further analyses, it would suggest that the shallower layers of the impactor preferentially mixed with the upper portion of the target stratigraphy.

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