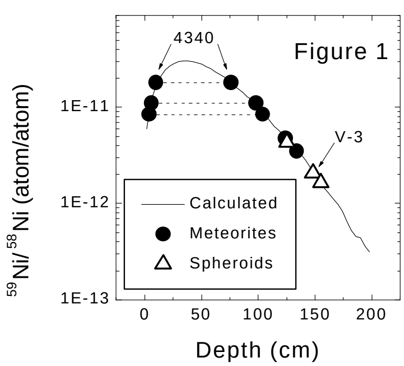
NICKEL-59 IN CANYON DIABLO SPHEROIDS AND METEORITES. G. F. Herzog[1], C. Schnabel[1], S. Xue[2], J. Masarik[3], R. G. Cresswell[4], M. L. di Tada[4], K. Liu[4], and L. K. Fifield[4], [1]Department of Chemistry., Rutgers University, Piscataway NJ 08854-8087, USA (herzog@rutchem.rutgers.edu), [2]Graduate School of Oceanography, University of Rhode Island, Narragansett RI 02882-1197, USA, [3]Department of Nuclear Physics, Komensky University, Mlynska dolina F/1, SSSSK-842 15 Bratislava, Slovakia, [4]Department of Nuclear Physics, Research School of Physical Science and Engineering, Australian National University, Canberra, ACT 0200, Australia (keith.fifield@anu.edu.au).

Introduction: Canyon Diablo spheroids formed by the rapid quenching of melted projectile [1]. Just as noble gas data first indicated the portion of the projectile that fragmented to produce meteorites -- the outermost meter or so [2] -- so the ^{59}Ni contents of spheroids can help identify the portion that melted [3]. Because the spheroids underwent both heating and oxidation, other commonly measured cosmogenic nuclides such as ^{21}Ne, ^{10}Be, and ^{26}Al are inappropriate for this purpose. Our approach has three parts: to measure ^{59}Ni ($T_{1/2}$=76 ka) in various spheroid samples; to measure ^{59}Ni in Canyon Diablo meteorite specimens for comparison; and to carry out modeling calculations of ^{59}Ni production to aid in interpretation.

Experimental methods: Samples analyzed included a Ni standard kindly supplied by J. Klein; the Canyon Diablo meteorite specimen 4340; and a 122-mg collection of Canyon Diablo spheroids. The spheroids had an average mass of 10 mg and were cleaned by repeated etching with 5% HF, washing, and magnetic raking. For the measurement of ^{59}Ni by accelerator mass spectrometry we enhanced the methods of [4] by adding a velocity filter.

Results & Discussion: Results of the measurements are as follows: (sample, ^{59}Ni/Ni÷0.68=^{59}Ni/^{58}Ni [10^{-12} atom/atom]): (Standard, 37.7±5%); (Canyon Diablo 4340, 9.5± 15%); (Canyon Diablo spheroids V-3, 1.1± 25%). The results for the standard agree well with those reported previously [4]. Figure 1 shows the ^{59}Ni/^{58}Ni ratios of the spheroids corrected for a terrestrial age of 50 ka [6] and plotted at depths inferred from the calculated production rate curve (i.e., *not* at independently determined depths). The ^{59}Ni/^{58}Ni ratio for the spheroid sample V-3, agrees well with that of sample SC-P but is lower than that of SC-O (Fig. 1) [3].



Published ^{59}Ni/^{58}Ni ratios for Canyon Diablo meteorites range from ~2-7 $\times 10^{-12}$ [5]. All these values are consistent with depths of less than 140 cm (Fig. 1). For three of the meteorites the ^{59}Ni activities allow two depth assignments (dashed tie-lines). Most Canyon Diablo specimens, however, have ^{10}Be, ^{26}Al, and ^{36}Cl activities that imply depths well below the surface [7]. For this reason, we favor the higher depth estimates.

The range of ^{59}Ni contents in the meteorite specimens corresponds to a range of depths of ~40 cm (320 g/cm^2), which is comparable to the range inferred from the ^{10}Be, ^{26}Al, and ^{36}Cl activities [7]. The absolute ^{59}Ni-based depth of 76 cm for Canyon Diablo 4340 disagrees with depths of ~48 cm based on ^{10}Be, ^{26}Al and ^{36}Cl [7]. Similarly, the ^{59}Ni-based depths inferred for various Canyon Diablo samples reported in the literature are systematically larger than those inferred for the set of samples studied by [7]. Three possible reasons for these discrepancies are measurement errors; overestimates in the ^{59}Ni production rate calculation; and an incorrect terrestrial age. A terrestrial age of 100 ka would reconcile the depth estimates.

Even allowing for a factor-of-two error in the terrestrial age, however, the ^{59}Ni contents of the spheroids are well below values expected at the projectile surface and generally lower than those measured in meteorites. These observations strongly suggest that the spheroids came from larger depths in the impactor than did the meteorites and add to the arguments against stripping and ablation as important mechanisms for spheroid formation [8].

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