IRON-60 IN METEORITES. S. Merchel[1*], U. Herpers[1], K. Knie[2], T. Faestermann[3], G. Korschinek[3], M. Gloris[4], and R. Michel[4], [1]Abteilung Nuklearchemie, Universität zu Köln, 50674 Köln, Germany, (silke.merchel@uni-koeln.de), [2]Max-Planck-Institut für Astrophysik, 85740 Garching, Germany, [3]Fakultät für Physik, Technische Universität München, 85748 Garching, Germany, [4]Zentrum für Strahlenschutz und Radioökologie, Universität Hannover, 30167 Hannover, Germany, *present adress: Max-Planck-Institut für Chemie, 55020 Mainz, Germany.

Measurements of cosmogenic nuclides in meteorites are necessary to test and improve the physical models with which we try to understand the course of events in space. Furthermore, radionuclides archive information about the cosmic radiation and the meteorites themselves e.g. their exposure history.

One of the most interesting cosmogenic nuclide is ^{60}Fe. The only relevant targets for the production of ^{60}Fe in extraterrestrial matter are the two heavy nickel isotopes. Because of their rare abundances of 3.6 % (^{62}Ni) and 0.9 % (^{64}Ni) of natural nickel and the low cross sections of nuclear reactions, the production rate is expected to be very low. Furthermore, there are two difficulties to measure this long-lived radionuclide ($T_{1/2}$ = 1.49 My [1]). On the one hand, counting is only possible via detection of the daughter nuclide ^{60}Co after radiochemical separation and waiting for ^{60}Co built-up. This method was first and only done by Goel and Honda [2] with about 2.5 kg of the iron meteorite Odessa. On the other hand, the generally high content of natural iron in extraterrestrial matter results in low ^{60}Fe/Fe ratios of about 10^{-14} which need special features to make it measurable via accelerator mass spectrometry (AMS). Besides of one attempt at the Argonne National Laboratory in the iron meteorite Treysa [3], we present the first ^{60}Fe AMS data of meteorites.

After improving the gas-filled analyzing system GAMS [4] and radiochemical separation methods, we were able to measure meteorite samples at run times of about 1 hour. In detail, we measured the ^{60}Fe activities in two iron meteorites (Dermbach, Tlacotepec) and in magnetic fractions of the mesosiderite Emery and the LL chondrite Saint-Séverin. They show, as expected, a strong correlation to the nickel content of the samples.

Furthermore, we calculated theoretical depth- and size-dependent production rates of ^{60}Fe by galactic cosmic ray (GCR) particles in analogy to earlier model calculations [5] based, however, on purely theoretical cross sections for the n- and p-induced production. In spite of this crude approximation, the theoretical production rates for iron meteoroids, normalized to the main target element nickel, are in good agreement with the experimental values of Dermbach and Tlacotepec (Fig. 1).

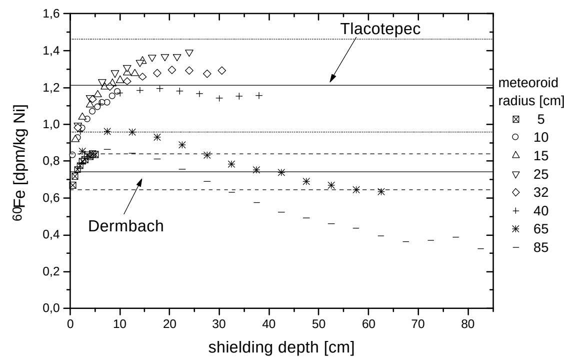

Fig. 1. Theoretical depth- and size-dependent production rates of ^{60}Fe in iron meteoroids by GCR particles on the basis of physical model calculations in comparison to experimental data of the iron meteorites Dermbach and Tlacotepec.

Due to the large errors of the determination of ^{60}Fe we cannot estimate a preatmospheric radius of the meteoroid or a shielding position of the analyzed sample from this radionuclide alone. But, together with measurements and calculations of other cosmogenic nuclides e.g. ^{10}Be, ^{26}Al, ^{53}Mn, we can reveal the exposure and terrestrial history of meteorites. Last but not least, there is a big advantage of ^{60}Fe: Its production rates are - in contrast to those of almost all cosmogenic nuclides - nearly independent of the chemical composition of the meteorite. Direct comparison by normalizing to nickel contents is possible through all types of iron and stony meteorites.

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