COSMOGENIC NOBLE GASES OF THE GEBEL KAMIL IRON METEORITE.

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Introduction: The Kamil crater in southern Egypt was first identified during a Google Earth survey. A closer inspection during a geophysical expedition in February 2010 not only revealed details of its structure but also identified several thousand iron meteorite specimens with a total weight of ~1.7 tons [1, 2]. The meteorite is classified as an ungrouped Ni-rich ataxite [3]. He, Ne and Ar measurements have been performed on samples from the only regmaglypted 83 kg individual as well as from a piece of the shrapnel produced during the impact [1, 2].

Experimental: We measured two samples each from the individual and the shrapnel, separated by a distance of ~1 cm in each case. Material from in between is being used for accelerator mass spectrometry of long-lived cosmogenic radionuclides. Because of instabilities in the gain of the electron multiplier, the noble gas abundances were not determined by the (standard) peak height method, but rather by isotope dilution. For that, about 1/3 of the sample gas was "spiked" with a gas mixture (^{3}He/^{4}He/^{22}Ne/^{36}Ar ~ 1.2x10^{-8}/1.1x10^{-6}/1.0x10^{-10}/3.8x10^{-9} cc, Ne and Ar isotopic compositions atmospheric).

Results: As normal for iron meteorites, noble gases are purely spallogenic. Relevant results are listed in Table 1 (concentrations in 10^{-8} cc/g units; uncertainties in the last digits in parentheses; I = individual, S = shrapnel).

Sample	^{3}He	^{4}He	^{21}Ne	^{38}Ar
I-C	147 (10)	622 (18)	1.59 (4)	9.47 (29)
I-g	138 (9)	604 (20)	1.58 (4)	8.20 (34)
S-C	44 (5)	214 (16)	0.42 (1)	2.39 (10)
S-f	41 (5)	193 (18)	0.35 (1)	2.31 (11)

Discussion: Using the model calculations of [4], we can derive bounds on the pre-atmospheric size of the object and can define a possible range of cosmic ray exposure ages. Most useful is the ^{4}He/^{38}Ar ratio (cf. Fig. 13 in [4]). Based on the maximum ratio of ~90 (S-C), a minimum radius for the meteoroid is ~85 cm. This implies a preatmospheric mass of >20,000 kg, in excellent agreement with the estimate of [1]. Furthermore, the shrapnel samples must originate from further inside the meteoroid than the individual (35-45 cm vs. 15-25 cm). To reach agreement between ^{4}He/^{38}Ar and ^{4}He/^{21}Ne, a sulfur / phosphorus content in the range 0.4-0.8 wt % contributing to ^{21}Ne production is required ([4, 5; cf. Fig. 11 in [4]). Conflicting cosmic ray exposure ages, however, follow from the relation between ^{4}He/^{38}Ar ratio and ^{38}Ar production rate according to [4]. While for the individual an age on the order of 400 to 500 Ma is indicated, estimates for the shrapnel samples are lower in the 200 to 300 Ma range. The discrepancy may be solved by the radionuclide measurements, which are in progress.

References: [1] Folco L. et al. 2010. *Science* 329:804. [2] Folco L. et al. 2011. *Geology* 39:179-182. [3] Weisberg M. K. et al. 2010. *Meteoritics & Planetary Science* 45:1530-1551. [4] Ammon K. et al. 2009. *Meteoritics & Planetary Science* 44:485-503; in detail at: http://noblegas.unibe.ch/index.php?content=noblegas/data. [5] Ammon K. et al. 2008. *Meteoritics & Planetary Science* 43:685-699.