THE COSMIC-RAY EXPOSURE AND RADIOGENIC GAS RETENTION AGES OF PARK FOREST (L5)

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Introduction: As part of an ongoing project to determine the (^{3}He, ^{21}Ne, ^{38}Ar) cosmic-ray exposure and radiogenic gas (^{4}He, ^{40}Ar) retention ages of all meteorites with precisely known (photographic) orbits, we have analyzed two samples from the Park Forest (L5) chondrite. This meteorite fell shortly before midnight (local time) on March 26th, 2003 in a suburb of Chicago, delivering at least 18 kg to the ground. The meteorite shows a dark-light breccia-like texture [1]. Based on video recordings of the widely observed fall, Brown et al. [2] determined the meteoroid orbit and calculated a pre-atmospheric mass of ~11±3 tons (1.8 m diameter with L chondrite density). We report He, Ne, Ar for Park Forest.

Methods: Samples were provided by the Field Museum of Natural History in Chicago. After setting aside some material for cosmogenic radionuclide (^{10}Be, ^{26}Al, ^{36}Cl) analysis (to be reported at the meeting), two fragments of ~300 mg each were wrapped in Al foil, pumped to ultra-high vacuum and heated to 100° C for two days to remove adsorbed atmospheric gases. The He, Ne, and Ar was extracted using pyrolysis in a single temperature step to ~1800° C and analyzed on a custom-built noble gas mass spectrometer according to a protocol described in [3].

Results & Discussion: The Ne isotopic composition of Park Forest indicates that Ne is almost purely cosmogenic, with a ^{22}Ne/^{21}Ne-ratio of 1.08, indicating moderate shielding. He and Ar are predominantly cosmogenic, and we assumed that all non-cosmogenic ^{4}He is radiogenic. No solar wind noble gases were found, making Park Forest a fragmental breccia. We calculated production rates for the cosmogenic nuclides ^{3}He, ^{21}Ne and ^{38}Ar based on the 85 cm-radius model from Leya & Masarik [4], where a ^{22}Ne/^{21}Ne-ratio of 1.08 corresponds to a burial depth of ~20 cm. The corresponding cosmic-ray exposure (CRE) ages are 14±1, 17±2 Ma for ^{3}He, ^{21}Ne, respectively, suggesting only minor loss of He (the data points of the two fragments also plot slightly below the "Bern-line" in a ^{3}He/^{21}Ne vs. ^{22}Ne/^{21}Ne diagram). However, the ^{38}Ar age is significantly higher, 30±6 Ma. The very low $^{21}Ne_{cos}/^{38}Ar_{cos}$ ratios of ~4-5 are lower than even in the smallest meteoroids included in the Leya & Masarik model (~6). This suggests that Park Forest has at least once in its history lost cosmogenic He and Ne. Such elevated Ar-exposure ages have been reported for chondrites from the Almahata Sitta breccia [5]. An exposure age of ~17 Ma does not place Park Forest near any known, prominent peak in the CRE age histograms of L chondrites [6]. The U, Th-^{4}He ages of the two samples are 380 and 250 Ma, respectively, and the K-Ar ages are 1.2 Ga and 890 Ma, respectively (with average L chondritic U, Th, K concentrations). Therefore, the last (partial) gas-loss event happened (less than) 250 Ma ago, which is more recent than the L chondrite parent body break-up event, ~470 Ma ago (e.g., [7]).

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