COSMIC RAY EXPOSURE AGES OF SIX CHONDRITIC ALMAHATA SITTA FRAGMENTS.

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Introduction: In 2008 asteroid 2008 TC_3 exploded in the atmosphere above Sudan and created a large strewn field [1]. The resulting meteorites are collectively known as Almahata Sitta [1]. Most of the Almahata Sitta fragments are ureilitic [1,2]. However, ~30% of the specimens found in the strewn field were chondritic [2]. Almahata Sitta has a pre-atmospheric radius of ~300 g/cm^2 and the ureilites have a cosmic ray exposure (CRE) age of ~20 Ma [3]. Two chondrites from the strewn field yield ^{21}Ne CRE ages of ~20 Ma; cosmogenic ^{38}Ar suggests a possible pre-irradiation of 10-20 Ma [4]. In this study we investigate six additional chondritic Almahata Sitta fragments by analyzing noble gases and radionuclides: MS-181 (CB), MS-CH (unique R-like), MS-197 (LL4/5), MS-179, MS-D and MS-52 (EL).

Results and Discussion: The cosmogenic $^{22}Ne/^{21}Ne$ ratios of 1.07-1.14 are larger than values of ~1.05-1.06 commonly observed for relatively large bodies. Some model calculations [5] suggest that $^{22}Ne/^{21}Ne$ increases at very high shielding (above ~60 cm). Unless all samples analyzed were irradiated close to the surface of 2008 TC_3, these data appear to provide empirical evidence for this increase, as already observed in Gold Basin (L4) [6]. We conclude that $^{22}Ne/^{21}Ne$ cannot be used to derive shielding-corrected production rates for Almahata Sitta. We therefore calculate $^{21}Ne/^{26}Al$-based production rates, using the model by [7].

There is no clear evidence for pre-exposure in any of the samples. All samples except the EL-breccia MS-179 have $^{21}Ne/^{26}Al$-based CRE ages of ~20 Ma, in agreement with previously determined CRE ages [3,4]. One sample (MS-181, CB) has an elevated ^{38}Ar CRE age of ~30 Ma. However, this age has large uncertainties due to sample heterogeneity and a large correction for trapped Ar. MS-179 has a lower $^{21}Ne/^{26}Al$ CRE age of ~10 Ma. This might indicate that this sample, although as fresh as the other samples, was from a fall unrelated to asteroid 2008 TC_3, or, that this is the true 4π irradiation age of 2008 TC_3, and all other samples are pre-irradiated. Both explanations are problematic. MS-179 has a very high concentration of neutron-capture ^{36}Cl (~600 dpm/kg, more than 10× the other E-chondrites). A separate fall would thus also have to be from a large body, and it appears unlikely that two large falls occurred in the same area. It also seems unlikely that all other samples would have had the same pre-irradiation. This issue needs further investigation.

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