EXPOSURE HISTORY OF MOUNT DEWITT 12007 AND PROPOSED LAUNCH-PAIRED NORTHWEST AFRICA 4884, 7611, AND 8277 LUNAR METEORITES.

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Introduction: Cosmogenic nuclide studies of lunar meteorites have contributed significantly to our understanding of these objects. Most lunar meteorites have complex cosmic ray exposure histories, having been exposed both at some depth on the lunar surface (2π irradiation) before their ejection, and as small bodies in space (4π irradiation) during transport from the Moon to Earth. These exposures were then followed by residence on Earth's surface, a time commonly referred to as the terrestrial age. Unraveling the complex history of these objects requires the measurement of at least four cosmogenic nuclides. The specific goals of these measurements are to constrain or set limits on the following shielding or exposure parameters: (1) the depth of the sample at the time of ejection from the Moon; (2) the transit time (4π exposure age) from ejection off the lunar surface to the time of capture by the Earth; and (3) the terrestrial residence time. The sum of the transit time and residence time yields an ejection age. We report here results for the cosmogenic radionuclides, ^{10}Be (half-life=$1.36x10^6$ yr), ^{26}Al ($7.05x10^5$ yr), ^{36}Cl ($3.01x10^5$ yr), and ^{14}C (5,730 yr) in an Antarctic lunar meteorite Mount DeWitt 12007 (DEW 12007) and proposed launch-paired lunar meteorites Northwest Africa (NWA) 4884, 7611, and 8277 [e.g., 1, 2].

Sample Description and Experimental Procedures: Two chips with fusion crust were obtained from the DEW 12007 lunar meteorite described in [1]. To investigate solar cosmic ray (SCR) effects, one chip was divided into three, based on depth. The interior sample of DEW 12007 and three NWA lunar meteorites were split for ^{14}C and other radionuclides measurements. Each sample was melted, the $^{14}CO_2$ was extracted, followed by ^{14}C measurements at the University of Arizona NSF-AMS facility [3]. After acid dissolution of each sample, ^{10}Be, ^{26}Al, and ^{36}Cl were chemically separated and measured at the PRIME Lab, Purdue University [4]. Concentrations of major target elements were measured by ICP-OES.

Results and Discussion: Cosmogenic radionuclide concentrations are shown in Table 1. There was no SCR-produced ^{26}Al in the two fusion crust (~25 mm apart) samples, indicating that the ablation depth of DEW 12007 is more than a few cm. The ejection depths of lunar meteorites are estimated by comparison with radionuclide depth profiles in Apollo 15 drill core. The inferred ejection depths are 340-360 g/cm^2 for DEW 12007, 185-215 g/cm^2 for NWA 4884, 420-460 g/cm^2 for NWA 7611, and 585-625 g/cm^2 for NWA 8277. The terrestrial age of DEW 12007 is 0-30 kyr, which was preceded by a negligible 4π exposure time from the Moon to Earth. The terrestrial ages of NWA 4884 and 7611 are a few kyr, preceded by a transition time from the Moon to Earth of a few kyr. The terrestrial age of NWA 8277 is 10-20 kyr with a few kyr transition time. The chemical composition and the radionuclide inventory, except ^{14}C, of NWA 8277 are similar to that of the proposed launch pairs EET 87521/96008 [2, 5-7]. Our measurement indicate that all the meteorites studied in this work are potentially launch-paired lunar meteorites. Without the measurement of one or two other additional cosmogenic nuclides this hypothesis is still tentative.

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References: [1] Collareta A. et al. 2016. *Meteoritics & Planetary Science* 51:351-371. [2] Korotev R. L. et al. 2009. *Meteoritics & Planetary Science* 44:1287-1322. [3] Jull A. J. T. et al. 1998. *Geochimica et Cosmochimica Acta* 62:3025-3036. [4] Sharma P. et al. 2000. *Nuclear Instruments and Methods* B 172:112-123. [5] Jull A. J. T. and Donahue D. J. 1992. *Lunar and Planetary Science* XXIII:637-638. [6] Nishiizumi K. et al. 1991. *Lunar and Planetary Science* XXII:977-978.

Table 1. Cosmogenic nuclide concentrations (dpm/kg) of DEW 12007, NWA 4884, 7611, and 8277.

Name	^{10}Be	^{26}Al	^{36}Cl	^{36}Cl*	^{14}C
DEW 12007 (fusion crust)	2.712±0.038	15.01±0.45	3.52±0.12	4.30±0.14	
DEW 12007 (0-2.5 mm)	2.607±0.039	14.25±0.37	3.45±0.13	4.35±0.17	
DEW 12007 (2.5-5.0 mm)	2.742±0.045	15.26±0.42	4.89±0.16	5.85±0.19	
DEW 12007 (10-12 mm)	2.736±0.024	15.41±0.44	3.95±0.14	4.69±0.17	
NWA 4884	5.848±0.085	30.72±0.97	8.14±0.24	10.25±0.31	19.0±1.4
NWA 7611	1.765±0.056	8.50±0.62	n.d.	-	11.22±0.24
NWA 8277	0.646±0.007	3.46±0.14	0.838±0.025	1.064±0.031	3.46±0.22

*dpm ^{36}Cl/kg(16K+8Ca+Fe)