Cosmic-ray exposure histories of lunar meteorites

HIROSHI HIDAKA[1]*, KUNIHIKO NISHIIZUMI[2], AND SHIGEKAZU YONEDA[3]

[1]Department of Earth and Planetary Sciences, Nagoya University, Nagoya 464-8601, Japan (hidaka@eps.nagoya-u.ac.jp)

[2]Space Sciene Laboratory, University of California, Berkeley, CA 94720-7450, USA (kuni@ssl.berkeley.edu)

[3]Department of Science and Engineering, National Museum of Nature and Science, Tsukuba 305-0005, Japan (s-yoneda@kahaku.go.jp)

Most lunar meteorites have complicated cosmic-ray exposure histories with relatively longer exposure times than the other stony meteorites, although they have been generally known from the analyses of the cosmogenic radionuclides that their transfer times from moon to earth are generally quite short [1].

In this study, cosmic-ray irradiation histories of six lunar meteorites, Dhofar 489, Northwest Africa 032 (NWA 032), NWA 479, NWA 482, NWA 2995, and NWA 5000, were characterized from neutron-captured isotopic shifts of Sm and Gd, and from the abundances of long-lived cosmogenic radionuclides like ^{10}Be, ^{26}Al, ^{36}Cl and ^{41}Ca. Sm and Gd isotopic data of all of six meteorites show significant isotopic shifts of ^{149}Sm-^{150}Sm and ^{157}Gd-^{158}Gd caused by accumulation of neutron capture reactions due to cosmic-ray irradiation, corresponding to the neutron fluences of (1.3 to 9.6)x10^{16} n cm^{-2}. In particular, very large Sm and Gd isotopic shifts of NWA 482 are over those of a lunar regolith 70002 having the largest isotopic shifts among the Apollo regolith samples [2], corresponding to cosmic-ray exposure duration over 800 million years in the lunar surface (2π irradiation). Meanwhile, the concentrations of cosmogenic radionuclides for individual six meteorites show the short irradiation time less than one million years as their bodies in space (4π irradiation). Our data reveal that most of lunar meteorites have long exposure ages at shallow depths on the Moon and short transit times from the Moon to the Earth.

[1] Nishiizumi et al. (1996) *MAPS* **31,** 893-896. [2] Hidaka and Yoneda (2003) *GCA* **71,** 1074-1086.