CHANGES IN REFLECTANCE SPECTRA OF A CM2 CARBONACEOUS CHONDRITE: SIMULATION OF SPACE WEATHERING BY ULTRAVIOLET IRRADIATION.

H. Kaiden[1,2], T. Hiroi[3], K. Misawa[1,2], H. Tanaka[4], S. Sasaki[4], K. M. Robertson[3], R. E. Milliken[3], H. Masai[5], J. Terao[5], [1]Geoscience Group, National Institute of Polar Research, Tokyo 190-8518, Japan (kaiden@nipr.ac.jp), [2]Department of Polar Science, SOKENDAI (The Graduate University for Advanced Studies), Tokyo 190-8518, Japan, [3]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912, USA, [4]Department of Earth and Space Science, Osaka University, Osaka 560-0043, Japan, [5]Department of Basic Science, The University of Tokyo, Tokyo 153-8902, Japan.

Introduction: Space weathering is the alteration of the regolith of airless bodies and causes chemical, physical, and optical changes of the regolith. Solar wind bombardment and micrometeorite impacts are considered major causes of space weathering, and thus various laboratory experiments have been conducted to simulate such causes [e.g., 1]. For example, ion beam [2] and pulse-laser [3] irradiation experiments were carried out to simulate solar wind bombardment and micrometeorite impacts, respectively. It is important, however, to consider other causes of space weathering to fully understand its processes and effects on materials on asteroid surfaces. In our previous study [4], we obtained spectral changes of ultraviolet (UV)-irradiated olivine and the Murchison CM2 carbonaceous chondrite, which suggests that space weathering could occur by UV light from the Sun. In this study, UV irradiation experiments on another CM2 carbonaceous chondrite were performed to further investigate possible mechanisms of space weathering on asteroid surfaces.

Material and Methods: A chip of Meteorite Hills (MET) 00630 was used for this experiments. MET 00630 is classified as a CM2 carbonaceous chondrite [5], which is one of the proposed compositional analogs to asteroids 162173 Ryugu [6] and 101955 Bennu [7]. Experimental procedures were the same as our previous study [4] except for the form of the sample. The chip of MET 00630 was placed in a vacuum chamber (~10^{-4} Pa) and irradiated with focused (5.0 mm in diameter) UV light in the wavelength range of 250–385 nm emitted from a 300 W xenon arc lamp housed in the Asahi Spectra MAX-303 at the University of Tokyo. The duration of UV irradiation was 312 and 624 hours. The duration of UV irradiation for 312 hours with the xenon light source is estimated to be equivalent to that for 2–3 years with the Sun at a distance of 1 AU. Bidirectional UV–visible–near-infrared (VNIR) diffuse reflectance spectra of the unirradiated and the irradiated samples were obtained using a Bunko Keiki DRS-25 UV-VNIR spectrometer at Osaka University.

Results and Discussion: Reflectance spectra of the MET 00630 chip sample before and after UV irradiation were compared. The spectra became brighter with increasing the duration of UV irradiation. The spectral changes were inconsistent with those of UV-irradiated olivine and Murchison pellet samples obtained by our previous study [4], in which the spectra became darker with increasing the duration of UV irradiation. The timescale for the spectral changes corresponds to the order of years of UV irradiation by the Sun at 1 AU. Although we still need to investigate and explain the mechanisms of the spectral changes by UV irradiation, our results that space weathering by UV light could occur in the order of years would be applicable to interpreting the spectroscopic data obtained by Hayabusa2 for Ryugu and by OSIRIS-REx for Bennu.

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