SPACE WEATHERING OF OLIVINE AND THE MURCHISON CM2 CARBONACEOUS CHONDRITE SIMULATED BY ULTRAVIOLET IRRADIATION. H. Kaiden1,2, T. Hiroi3, K. Misawa1,2, H. Tanaka4, S. Sasaki4, K. M. Robertson3, R. E. Milliken3, H. Masai5 and J. Terao5, 1Geoscience Group, National Institute of Polar Research, Tokyo 190-8518, Japan (kaiden@nipr.ac.jp), 2Department of Polar Science, The Graduate University for Advanced Studies (SOKENDAI), Tokyo 190-8518, Japan, 3Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912, USA, 4Department of Earth and Space Science, Osaka University, Osaka 560-0043, Japan, 5Department of Basic Science, The University of Tokyo, Tokyo 153-8902, Japan.

Introduction: Numerous laboratory experiments have been conducted to simulate space weathering [e.g., 1]. Ion beam [e.g., 2] and pulse-laser [e.g., 3] irradiation experiments were carried out to simulate the alteration of asteroid surfaces by solar wind bombardment and by micrometeoroid impacts, respectively. It is important to consider other causes of space weathering to fully understand its processes. In this study, ultraviolet (UV) irradiation experiments on olivine and the Murchison CM2 carbonaceous chondrite were performed to investigate possible mechanisms of space weathering on asteroid surfaces.

Experimental Procedures: Pressed pellet samples of powdered (< 75 μm) olivine (Fa11−15) and the Murchison chondrite were 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 for olivine and that for Murchison was 63 and 312 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 olivine and the Murchison pellet samples before and after UV irradiation are shown in Fig. 1. The spectra of olivine became darker and redder with increasing the duration of UV irradiation. The spectral changes are consistent with those of space weathering of S-type asteroids [3]. The spectra of Murchison also became darker with increasing the duration of UV irradiation. The spectral changes both for olivine and Murchison occurred very rapidly, i.e., equivalent to <10 years of UV irradiation by the Sun at 1 AU. Our results would be applicable to interpreting the spectroscopic data of asteroids Ryugu and Bennu, which are the targets of the sample-return missions of Hayabusa2 and OSIRIS-REx, respectively. We will continue the UV irradiation experiments and investigate the mechanism of the spectral changes for a better understanding of space weathering on asteroids.

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Fig. 1. Reflectance spectra of (a) olivine and (b) Murchison pellet samples with different duration of UV irradiation.