Examination of the origin of NaCl on the surface of Jupiter’ s moon Europa by telescope observation and laboratory experiment

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Geysers from the mantle plume have been observed by Hubble Space Telescope (HST) on Jupiter's satellite Europa (Roth et al., 2014), some of which are deposited on the surface of Europa. Observations of Europa by HST in the previous study confirmed absorption at a wavelength of 460 nm in a geologically active chaotic region extending over the leading hemisphere (Trumbo et al., 2019). This absorption wavelength coincides with one of the wavelengths absorbed by lattice defects called color centers that occurred in experiments in which NaCl was irradiated with radiation that imitated the Europa surface environment (Poston et al., 2017). This suggests that NaCl is present on the surface of Europa. However, observations by HST are limited to four times in a specific four months, and yearly long-term fluctuations in Europa’ s spectra have not been investigated.
The purpose of this study is to investigate long-term fluctuations in the spectra of NaCl deposited on the surface of Europa and to limit the age of deposition and weathering of NaCl in Europa.
In this study, the spectra of Europa were observed 17 times from August 17 to October 20, 2020 and July 3 to December 8, 2021 using the spectral imager MSI on the 1.6 m primary mirror aperture Pirka telescope owned by Hokkaido University. The observation wavelengths are between 400-550 nm and 650-800 nm, with bandwidths of 3.90-10.2 nm and 4.17-7.62 nm, and an interval of 10 nm between the center wavelengths. The analysis method calculated the difference between the observed spectra and its cubic approximation curve, and determined the absorption wavelength and the absorbance. Furthermore, the observed longitudes of Europa were classified into four, and the mean value and variation of reflectance were derived for each longitude. As a result, no significant fluctuations could be confirmed.
In the electron irradiation experiment scheduled for February 2022, we will confirm the contribution of high-energy electrons to the rate of color center formation of NaCl in the Europa environment by measuring the spectra of NaCl irradiated with MeV units larger than those in the previous study, and convert the Europa observations into the depositional age of NaCl.
According to the observation results so far, no absorption was observed at the wavelengths of 460 and 720 nm confirmed by the laboratory experiments. On the other hand, absorption was observed at wavelengths of 430 and 520 nm. Since this wavelength coincides with the Fraunhofer line, it is possible that the observation results of Europa reflect the spectra of sunlight. Currently, we are carefully proceeding with the work of removing the influence of sunlight from the observation results by using the observation results of the moon, which also reflects sunlight.

Keywords: Europa, Ground observation, Electronic linear accelerator

