Distribution of phyllosilicates on Utopia Planitia, Mars

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Many studies suggest that abundant liquid water existed in the past on the Martian surface, although there is currently no liquid water on the surface of Mars. The hydrated minerals are generally formed through long-term contact with water or alternation by water. We can get a key to understand the water environment of Mars by studying the observed hydrated minerals.

The wider distribution of hydrated minerals on the southern hemisphere on Mars has been reported in previous studies [e.g. Carter et al., 2013], however, only a limited number of outcrops of hydrated minerals are detected so far in the northern lowlands. The surface of northern lowlands is basically young being covered with lava materials in Hesperian through Amazonian ages. We expect that the deposition below the younger crust of the northern lowlands should host hydrated minerals commonly. The purpose of this study is to examine the distribution of hydrated minerals in the northern lowlands of Mars.

We focus on the comparatively larger craters which should expose the subsurface minerals by impact gardening in the northern lowlands of Mars. Our analysis targets are the craters with diameters ≥ 10km in Utopia Planitia ranging 25-50N, 90-140E. The number of the craters amounts to 14 in total. We used the data from CRISM (Compact Reconnaissance Imaging Spectrometer for Mars) onboard Mars Reconnaissance Orbiter. The spectral data cover near-infrared wavelengths. We tried to detect the absorption features characteristic to the phyllosilicates. We used CAT (CRISM Analysis Toolkit) combined with ENVI spectral analyst tool to analyze the latest CRISM data observed in the study area in detail.

As a result, phyllosilicates-bearing minerals were detected at 5 impact craters among 14 impact craters examined in this study. The 5 craters are: 2 craters where phyllosilicate hadn't been detected by Fairén et al. [2012], 2 craters not examined so far and 1 crater where phyllosilicates are already detected by Fairén et al. [2012]. The four kinds of phyllisilicates were detected: illite, smectite, vermiculate and a small number of saponite. We saw no discrete distribution according to the kind of minerals but we found that the distribution of phyllosilicates-bearing minerals strongly connects with erosional areas. We observed that phyllosillicates distribute at the rim, wall, floor, ejecta and around the central peak of the craters. These detected phyllosilicates are interpreted that deposited under the younger crust of the northern lowlands are emitted on the surface by impact gardening by Carter et al. [2010].

The number of samples in this study is still small, but the detection ratio of phyllosilicates seems significantly larger than Carter et al. [2013]. The results imply that hydrated minerals are possibly more widespread in the northern lowlands of Mars. Such detailed examination that uses the latest observation data and smart tools should result in increasing ratio of detecting phyllosilicates and contribute to clarification of water environment in the northern lowlands of Mars.

Keywords: Mars, hydrated minerals, phyllosilicate, infrared spectra, CRISM/MRO

