Distribution of phyllosilicates in relation with topographic features on Utopia Region, Mars

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Various studies suggest that there was once abundant liquid water on the surface of Mars, but now there is no liquid water on the Martian surface. Our long-term objective is to obtain clues to understand the water environment of Mars in the past by investigating the distribution and types of hydrous minerals. The hydrous minerals are formed by contact with water for a long time. Among them, phyllosilicates tend to contain water inside due to its layered crystal structure and is considered to be the typical hydrous minerals.
It is interpreted that the smaller number of detecting hydrous minerals in the northern lowlands on Mars [Carter et al., 2013] is due to the coverage by the younger surface although ancient ocean existed there. Recently, however, Sugawara [2016] used the latest observation data and showed new detection sites of phyllosilicates. The results imply the further extensive distribution of phyllosilicates. In this study, the purpose is to expand the analysis area throughout the Utopia region and investigate the distribution of phyllosilicate there.
This study selected the southern part of Utopia region (10-25N, 115-140E) and the northeastern part of its region (25N-70N, 140-160E) as analysis areas because of having not analyzed by Sugawara [2016.] We focused on craters and channels/grabens. Because these topographies were formed by meteorite collision and landslide, it is considered likely that underground minerals are exposed on the surface. This study used visible - near infrared spectral data observed by Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) mounted on Mars Reconnaissance Orbiter (MRO). This study investigated the absorption bands characteristic to phyllosilicates to identify the mirerals and tried to clarify the distribution.
As a result, the phyllosilicates were detected at 5 craters and 2 channels/grabens out of the investigated 15 craters and 2 channels/grabens. Around the craters, the detected spots were located at the rim, floor and ejecta. As for the channels/grabens, the detection spots were located at the cliff and landslide places. The topographies of the detected spots are locally erosional places. The types of detected phyllosilicate were serpentine, saponite, smectite, kaolinite-serpentine. The areas where phyllosilicate were detected are mostly volcanic units formed in the geologic era of late Hesperian ~ middle Amazonian and were distributed at elevations of -2000m or less. According to Achille and Hynek [2010], the shoreline at -2544m±177m exitst in the northern lowlands of Mars.
Combining the results of this study with Sugawara [2016], the distribution of phyllosilicate in the Utopia region possibly concentrates in the places where the ancient ocean existed which should be below the elevation of -2000m and in erosional spots with the age of Late Hesperian~Middle Amazonian. It is thought that phyllosilicates were generated from having been contacted lava flow cause of volcanic activity between Late Hesperian and Middle Amazonian with water for long time. Also, It’ s interpreted that phyllosilicates under young crusts exposed to surface because of erosion behavior (for example, impact gardening, landslides, weathering and so on.)

Keywords: Mars, Utopia Planitia, phyllosilicates, CRISM data, Visible - Near Infrared spectral analysis, Crater

