

Detection of phyllosilicates around outflow channels in the northeast of the Hellas basin, Mars

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Many studies suggest that abundant liquid water had existed in the past around the surface of Mars, although there is currently no liquid water on the surface. The hydrated minerals are generally formed through long-term contact with water or alternation by water. The purpose of our study is to get a key to understand the water environment of Mars by investigating the potential distribution of the hydrated minerals. The distribution of hydrated minerals on the whole Mars is reported by Carter et al. [2013]. However, the number of studies are very limited and possibly the examination were not detailed enough. Phyllosilicates-bearing minerals are typical hydrated minerals and account for about 90% of the detected hydrated minerals on Mars [Carter et al., 2013]. The goal of this study is to investigate the presence or absence of phyllosilicate by using the latest observation data in the area which is yet investigated or almost no hydrated mineral was detected. We focused on the Hellas basin in the southern part of Mars. Hellas basin (about 2300 km in diameter) is the largest basin of Mars. Two outflow channels distribute in the northeastern area of Hellas basin: Dao Vallis (33-40N, 82-94E, and about 800 km in length) and Harmakhis Vallis (39-43N, 86-95E, about 500 km in length). The areas around the two outflow channels seem not to have been analyzed in detail yet. Outflow channels are generally interpreted as traces of erosion by flooded liquid water. However, the number of detecting hydrated minerals is small in the vicinity of outflow channels. There is a large possibility that we could detect phyllosilicates newly around there if we examine minutely, depending on the preservation condition. We used the data from CRISM (Compact Reconnaissance Imaging Spectrometer for Mars) onboard Mars Reconnaissance Orbiter for the analysis. The CRISM spectra cover visible to near-infrared wavelengths. The observed absorption band features characteristic to hydrated minerals are examined by analyzing the CRISM data. For CRISM spectral analysis, we used CRISM Analysis Tool (CAT). Phyllosilicates-bearing minerals were detected in the 6 CRISM data scenes among the 17 CRISM data scenes in the area of around Dao Vallis. In the area of Harmakhis Vallis, phyllosilicates-bearing minerals were detected in the 2 CRISM data scenes among the 3 scenes. It turned out that phyllosilicates-bearing minerals distribute locally on the walls of the outflow channels. The kinds of detected phyllosilicate were illite, vermiculite, saponite, smectite, which are diverse. There was no particular relation or systematic trend relating the mineral species and local distribution. 3 CRISM data scenes among 17 CRISM data scenes around Dao Vallis were already analyzed by Carter et al. [2013]. In the result of Carter et al. [2013], no detection was reported in any scene, while, in this study, we detected phyllosilicates-bearing minerals in two scenes. The reason why the results are different could be the difference of calibration version of data. After Carter et al. [2013], the calibration coefficients of CRISM data were updated and the accuracy of CRISM data increased, which could explain why we newly detected phyllosilicates. The analysis procedure using CAT consists of many steps. In some cases, the input images need to be adjusted to a uniform image size. We recognized that phyllosilicates-bearing minerals were detected in all 6 CRISM data where no resize step is needed. Resize process lowers spatial resolution and average the reflectance between pixels. So there is a high possibility that the signal of the absorption band indicating phyllosilicates originally contained in each pixel is erased by resize step. The distribution of phyllosilicates detected by this study would be the minimum estimate. There is much possibility that phyllosilicates will be detected with further updated CRISM data in future and the distribution would be more extensive.

Keywords: Mars, Hellas basin, Outflow channel, phyllosilicates, CRISM data, Visible - Near Infrared spectral analysis