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Ice composition at active Mars Gullies

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1. Introduction

Current activity at gullied sites includes occurrence of bright/dark deposits within pre-existing gullies, channel widening/lengthening, and formation of new channels [e.g., 1]. Whether present-day gully formation and modification mechanisms are representative or not of all gullies formation pathways remains an open question [e.g., 2]. This activity is observed during winter / spring seasons in relation with surface ice which strongly suggests that condensed volatiles are a key factor controlling present-day gully modifications [e.g., 1]. CO_2 ice, the main component of seasonal ice, is thought to be the main driver of current gully activity [e.g., 1], which could imply that gullies are not primarily formed by liquid water, as previously thought. However, CO_2 ice has not yet been detected at all currently active gullies [1, 3]. In this study, we perform an extended survey of near-infrared observations of active gullies to identify the presence and composition of seasonal ice.

2. Observations

We use the available datasets from the OMEGA and CRISM imaging spectrometers to detect ice at the exact location of reported active gullies. CO_2 and H_2O ice are identified as a function of solar longitude (L_S). Ice can be detected even if dusty or transparent. Observations without ice also provide reliable clues about the actual lack of ice onsite due to the high signal to noise ratio of both spectrometers, the high spatial sampling of CRISM (20 m per pixels), and the elevated sensitivity of near-IR spectroscopy to thin amount of surface ice (down to a few micrometers thick for water ice) [4].

3. Discussion

The available dataset is sufficient to characterize the presence of ice during winter and spring seasons with a time sampling of typically 10° of L_S. At equatorward latitudes (30°S – 35°S), we frequently only observe the formation of a thin layer of water ice during winter, without detection of CO_2 ice. Activity at these locations is generally restricted to the formation of new bright/dark deposits [1]. At poleward latitudes, where new channels have been detected [1], we observe a more complex history of seasonal ice formation and sublimation. During winter, mm to cm thick layers of CO_2 ice contaminated by H_2O ice are observed. During spring, this layer sublimates and a water ice layer is sometime observed afterward during a few ° or tens of ° of L_S. Changes are sometimes reported to occur at that time, while water ice is the only component of seasonal ice.

4. Conclusions

This ongoing work suggests that all gully activity may not be caused by CO_2 ice, in particular activity restricted to new deposits at the most equatorward latitudes. On the other hand, the most impressive gully changes, including new channel formation, do occur at location and time where/when CO_2 ice is indeed largely condensing in winter. However, even at these sites, water ice only timeframes are observed, and may coincide with some of the reported activity.

References

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