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CaSSIS observations of fresh bright slope streak candidates in Arabia Terra

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1. Introduction

Bright slope streaks are elusive increased albedo surface features found on Martian slopes in low thermal inertia regions [1, 2]. These elongated features are thought to result from the more common dark slope streaks [3, 4], which gradually fade or brighten with time [5]. Several hypotheses attempt to explain dark slope streak origin. Dry-based models encompass dust mass wasting, avalanching or granular flows [1, 6-7]. Aqueous models include subsurface aquifers, lubricated dust flows and ground staining from saline fluids [8-12]. Various properties of dark slope streak populations were studied in detail to address their origin [13-15]. However, previous global surveys of bright slope streaks relied on Mars Orbiter Camera images, and so were limited by resolution, lighting conditions and color [e.g. 5]. Here, using The Colour and Stereo Surface Imaging System (CaSSIS) [17] onboard the ExoMars Trace Gas Orbiter (TGO) we report observations of possibly fresh bright slope streak candidates in Arabia Terra. To provide context for our measurements, we map bright slope streak distributions in Arabia Terra using a high coverage mosaic of Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) images.

2. Data & Methods

TGO is in a circular orbit with an inclination of 74°. Hence, unlike MRO and other orbiters, which are in Sun-synchronous orbits, CaSSIS can monitor surface changes at varying local solar times (LST), several times per Martian season. We acquire multiple morning observations of bright slope streaks in Arabia Terra and compare them with data acquired by MRO's CTX and the High Resolution Imaging Science Experiment (HiRISE). A global CTX mosaic [18] was used within ArcGIS to extensively map the Arabia Terra region. We ap-plied a grid mapping technique [19] to map bright slope streak distributions on a grid of ~16,000 hexa-gons, each 20 km in diameter.

3. Results

Our study reveals plausibly fresh bright slope streaks in several locations in Arabia Terra. For example, two images taken by CTX show a region with several dark slope streaks, but bright slope streaks in this location are only visible in CaSSIS (see Fig. 1). However, some bright slope streaks can be seen in both CTX frames, outside of the area shown in the figure. Important image details are shown in Table 1. The mapped spatial distribution of bright slope streaks within Arabia Terra showed that they are more common than reported by [5]. The majority of streaks are found clustered on crater walls and rims as well as on steep slopes within channels. Some bright slope streaks are observed to be originating within isolated outcrops inside craters (Fig. 1). We also report more streaks on west facing slopes. A map of bright slope streak distributions in Arabia Terra will be presented at the conference.

4. Discussion

Our study suggests that some bright streaks are not genetically linked to the origin of dark slope streaks and can form separately. This implies differences in either composition or particle size. Stains left by saline fluids in Antarctic Dry Valleys have been shown to be likely analogs for dark slope streaks [11] and a similar analog for bright slope streaks could likely point to compositional origin. Bright slope streaks have been hypothesized to not penetrate the entire dust layer and expose only an indurated surface layer [1]. This hypothesis is unsatisfactory because bright slope streaks have been shown to be deeper than dark slope streaks [20-21]. Lastly, it was observed that some bright slope streak surfaces exhibit different morphological structure in comparison to surrounding material [22]. However, this photometric effect explains only observed brightness differences in and outside the streak and cannot explain the invisible streaks in the CTX data (see Fig. 1c). It appears that local solar time (LST) could play a role in the bright slope streak detection. For example, in Fig. 1 CTX images were taken in the afternoon (~15:30 LST), while the CaSSIS image was acquired during late morning (11:25 LST). However, our survey in Arabia Terra revealed that bright slope streaks in CTX images are visible under various local lighting conditions. Further, we observed bright slope streaks in shadows and on well illuminated slopes. We also identified several locations in Arabia Terra where dark slope streaks are undergoing albedo change. At the apexes the streaks are bright, they begin to darken towards the middle, and at the distal ends it is indistinguishable from a dark slope streak. The fading rate of dark slope streaks has been shown to be around 40 years [15] but the contrast reversal rate is unknown. These locations will be studied in greater detail with subsequent CaSSIS and HiRISE observations**.**

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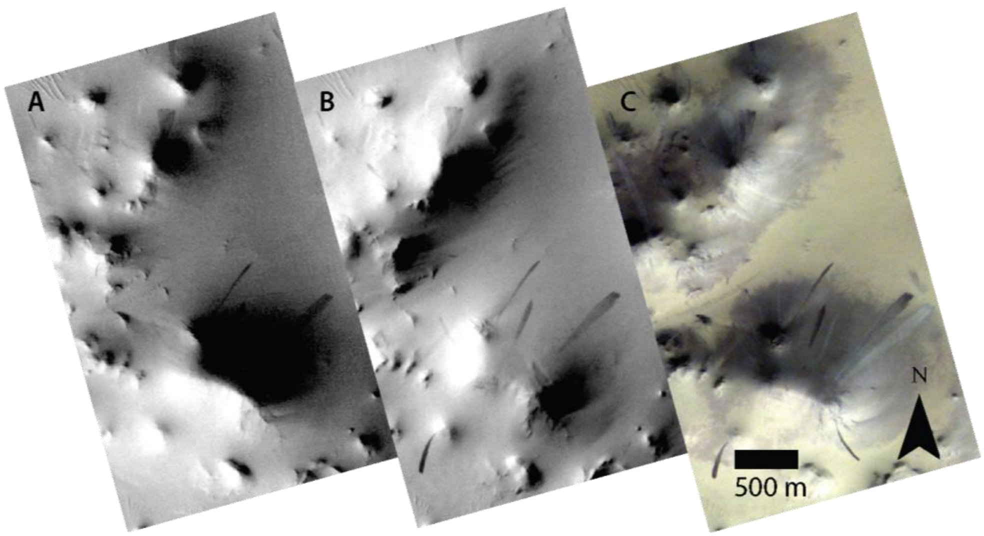

Figure 1. Dark and bright slope streaks observed at three different local solar times in Arabia Terra. A) and B) CTX images P07_003799_1961_XN_16N311W and P19_008282_1982_XN_18N311W, respectively. C) CaSSIS image MY34_005562_162. Several new bright slope streaks originating at the northern and southern outcrops are visible in the CaSSIS image. One especially large bright slope streak (1 km in length) can be observed pointing N45°E, which is only visible in C). Location coordinates (lat, lon): 18.30°, 48.91°.

Table 1. Additional Image Information.

Image ID	Local Solar Time (LST)	Solar Longitude (°)	Martian Year (MY)	Incidence Angle (°)	Resolution (m/px)	Image Acq. Time
P07_003799_1961_XN_16N311W	15:28	240.9	28	61.4°	5.5	2007-05-19
P19_008282_1982_XN_18N311W	15:16	66.6	29	44.3°	5.6	2008-05-02
MY34_005562_162	11:25	344.5	34	26.4	4.7	2019-02-21