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Topographic control of sorted circle morphology on Svalbard

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Patterned ground is a typical phenomenon in polar, subpolar and alpine regions [1]. As it is commonly (but not necessarily!) related to freeze-thaw cycles, its presence on Mars could possibly point to locations and periods where and when liquid water existed in the recent past [2]. Sorted circles are a class of patterned ground that was tentatively identified in Elysium Planitia (Mars) [3], but this interpretation has been challenged on the basis of physical considerations [4]. Without direct access to potential patterned ground on Mars, the analysis of terrestrial analogues can inform the interpretation of Martian landforms. Svalbard (Norway) offers a wide variety of permafrost features that are morphologically analogous to Martian cold-climate landforms [5]. It hosts some of the best examples of sorted circles on Earth, which are located on the westernmost tip of Brøgger peninsula, on a broad strand flat that is characterized by a series of postglacial beach ridges [6]. Here we report on our analysis of sorted circle morphology (especially their plan-view shape, i.e. their "roundness" or ellipticity) and its correlation with local topography (slopes, curvature). Sorted circle morphology was determined from HRSC-AX images (for details on the flight campaign and image properties see ref [5]) and through field work. Topographic information comes from a 50 cm gridded DEM derived from HRSC-AX stereo images.

We measured sorted circle morphology (ellipticity, azimuth of major axis) along a WNW-ESE traverse that runs from the inland towards the sea and is oriented perpendicular to the local beach ridge trend. Selected areas with homogeneous sorted circle appearance were visually mapped, and compared to the average slope, aspect, and the calculated topographic wetness index (TWI). Furthermore the whole traverse was classified into four different morphologies of the sorted patterned ground (sorted circles, sorted "ellipses", sorted nets and areas without patterned ground). For these morphologies, we also measured the slope, aspect and TWI to correlate the topographical parameters with the geomorphological characteristics of the patterned ground, and with predictions from modeling [7].

Our results confirm that the dependence of morphology on topography of sorted circles can be measured using a combination of plan-view and topographic remote sensing data. Thus, as the same quality of data is available on Mars, these same measurements could be made there in order to test whether the circle morphology depends on the local relief patterns in the same ways as in our terrestrial study. A positive result would argue that the Martian features may have formed in the same way (freeze-thaw) as the terrestrial ones.

[1] Washburn, A.L. (1956) Geol. Soc. Amer. Bull. 67, 823-866. [2] Balme et al. (2013) Prog. Phys. Geog. 37, 289-324. [3] Balme et al. (2009) Icarus 200, 30-38. [4] Kreslavsky, M.A., Head, J.W. (2014) LPSC 45, abstract 2715. [5] Hauber et al. (2011) GSA Spec. Paper 483, 177–201. [6] Tolgensbakk, J., Sollid, J.L. (1987) Kvadehuksletta, Geomorfologi og Kvartærgeologi (geomorphological map; scale 1:10,000), Universitet i Oslo. [7] Kessler, M.A., Werner, B.T. (2003) Science 299, 380-383.