RADAR INVESTIGATION OF THE SUBSURFACE OF SORTED STONE CIRCLES ON SVALBARD, NORWAY – AN ANALOG STUDY FOR MARS

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We use Ground Penetrating Radar (GPR) and orbital polarimetric Synthetic Aperture Radar (SAR) to characterize the subsurface of different sorted stone circles' morphologies. Stone circles are a form of sorted patterned ground in the Arctic regions. They are characterized by their circular shape (Kessler et al., 2001) and a fine-grained center bordered by coarser-grained material (Hallet, 1998). Here, we investigate the subsurface of sorted stone circles located on Kvadehuksletta, at the northwestern tip of the Broegger Peninsula, located at the west coast of Spitsbergen (Hauber et al., 2011 and Sander et al. 2021). Radar instruments help visualize the subsurface, successfully detecting and mapping buried ice and sediments in permafrost (Brandt et. al, 2007). This work compares the size and depth of different sorted stone circles' morphologies, including the stone circle wall and its active layer. This is relevant to planetary geoscience as networks of possible sorted stone circles have been observed on the margin of an erosional channel known as Lethe Vallis in Elysium Planitia on Mars (Balme et al., 2009). Additionally, identifying and characterizing the locations of shallow (0–10 m) subsurface ice on the Moon and Mars is important for addressing high-priority science and human exploration objectives (MEPAG, 2019 and LEAG, 2016). Through assessing the capabilities of these radar systems to characterize stone circle subsurface morphology and ice, we are more prepared for future investigations on Mars.

References (format style Heading)

Balme, M. R., Gallagher, C. J., Page, D. P., Murray, J. B., & Muller, J. P., 2009. Sorted stone circles in Elysium Planitia, Mars: Implications for recent martian climate. *Icarus*, 200(1), 30-38.

Brandt, O., Langley, K., Kohler, J., & Hamran, S.-E., 2007: Detection of buried ice and sediment layers in permafrost using multi-frequency Ground Penetrating Radar: A case examination on Svalbard. Remote Sensing of Environment, 111(2), 212–227.

Hallet, B., 1998: Measurement of Soil Motion in Sorted Circles, Western Spitsbergen. *Permafrost – Seventh International Conference*, Collection Nordicana No 55

Hauber, E., Reiss, D., Ulrich, M., Preusker, F., Trauthan, F., Zanetti, M., ... & McDaniel, S., 2011. Periglacial landscapes on Svalbard: Terrestrial analogs for cold-climate landforms on Mars. *Geological Society of America* Special Papers, 483

Kessler, M. A., Murray, A. B., Werner, B. T., & Hallet, B., 2001. A model for sorted circles as self-organized patterns. *Journal of Geophysical Research: Solid Earth*, 106(B7), 13287-13306.

LEAG, 2016: The Lunar Exploration Roadmap, https://www.lpi.usra.edu/leag/roadmap/.

MEPAG ICE-SAG Final Report, 2019, http://mepag.nasa.gov/reports.cfm.

Sander, H., Hiesinger, H., Hauber, E., Johnsson, A., & Schmedemann, N., 2021: Movement of Sorted Stone Circles on Svalbard, Norway. *LPSC*, No. 2548