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On 10 to 30 m-scale fracture networks in Gale Crater: Contraction of fine-grained sediments due to drying or of frozen sediments due to cooling?

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The area in Gale Crater north of the Curiosity landing site has been identified as an alluvial fan [1] and features diverse geological units [2], some with abundant contraction cracks that delineate polygons on the order of 10-30 meters across. These polygons are much larger than the < 1m flagstones seen in Yellowknife by Curiosity [3] and are more suggestive of polygonal patterned ground seen at higher latitudes on Mars [4] and Earth; however, current conditions indicate that ground ice is not stable in Gale Crater [4]. Nevertheless, past conditions, e.g. obliquity changes, may have allowed permafrost to develop and ground ice to form. The domains between the larger polygons are several meters wide, which is consistent with cyclic ratcheting of ice-cemented permafrost (thermal contraction with fractures opening, debris infilling the fractures, and the fractures not closing fully when the ground warms and expands). On the other hand, the large-scale crack networks often seem to be associated with certain lithologic units, including the thinly-bedded, lightly-colored mudstones exposed at Yellowknife. This suggests that the contraction cracks defining these 10 to 30-m polygons, as well as those defining the < 1m flagstones, formed in moist fine-grained sediments that contracted upon desiccation. If the fractures were due to contraction of ice-cemented permafrost, they would be insensitive to the type of sediments they formed in because the mechanical properties would be dominated by ice. The interpretation of the larger-scale crack network is limited to satellite images since Curiosity did not visit this area, and to evidence about surface materials elsewhere in the vicinity of the rover. This evidence points to the former presence of flowing water in Gale Crater and existence of shallow lakes of relatively low salinity and near-neutral pH at Yellowknife [5]. The large amount of contraction in Yellowknife deposits is consistent with a desiccation origin in these deposits as they are fine-grained and contain expandable clay minerals as found by Curiosity [6]. The crack networks may help interpret the past environment in Gale crater. Whether they are formed by ice-cemented permafrost contraction or desiccating lacustrine deposits requires the presence of water; however, the latter case argues for much more extensive presence of liquid water.

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References: [1] Williams, R. M. E (2013) Science, 340(6136), 1068-1072., [2] Sumner, D.Y. et al. (2013) LPI Contributions, 1719, 1699, [3] Stewart, W. et al. (2013), GSA Abstracts. v. 45, no. 7, p.4, [4] Mellon, M. T. et al. (1997) J. Geophys. Res., 102(E11), 25617-25628, [5] Grotzinger, J. P (2013) 10.1126/science.1242777, [6] Vaniman, D. T (2013) 10.1126/science.1243480