Observations on frost mounds in the Jutulsessen, Antarctica

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Seasonal and perennial frost mounds have been described for a number of locations and form due to the presence of frost processes and ice (Muller 1945). Thirty-five frost mounds were investigated in the Vassdalen valley (72°01'S, 02°37'W), Jutulsessen, Antarctica, during the early Austral summer of 2015. Similar mounds were once found in the vicinity of the Norwegian station of Troll and described as pingos (Dallmann *et al.* 1990). However, these have disappeared since construction commenced of the base in the early 1990s.

Eight thermistors, using an XR5 logger, were wired into a selected mound and logged for app. two days at 30-second intervals. Two sensors were placed at each aspect, one at the near surface and one at a depth of ten centimetres. In addition, 24 sediment samples were taken to determine gravimetric moisture content, sediment characteristics and physical measurements of mounds obtained. Mounds appear beyond the toe of a rock glacier located in the southern confines of the valley (Rudolph 2015); some situated on ice, others on substrate. Thermal contraction polygons (ground or sand-wedge polygons) found on Mimelia (Hansen *et al.* 2014) and the Vassdalen rock glacier (Rudolph 2015) and with mean annual soil temperatures below -5°C (Hansen *et al.* 2016) mounds occur within a continuous permafrost zone (French & Demitroff 2001), although summer active layer thickness is variable (Hansen *et al.* 2016). Mounds approach symmetry, are cone shaped, range from app. one to five meters in height, have fairly steep slopes (~20°), and are arranged along a predominant east-west orientation. They consist of mixed material with larger stones mixed into the matrix; have ice-cemented centres and low moisture content ($\theta_g < 0.1$), with more moisture present towards the bottom of mounds. Although ice lensing is evident, it is not present in all excavated mounds. Temperature regimes for the North-East and South-West aspect pairings exhibit similarity. Furthermore, surface measurements exhibit statistical difference to subsurface measurements and a thermal damping effect is evident.

The paucity of ice lensing and other characteristics suggest that these are not typical pingos or debris cones, similar to landforms described by French and Guglielmin (2000). However, their characteristics suggest they may be described as a form of frost mound. Data from these mounds suggests they are not of the closed-system pingo variety. The landforms do not occur within drained lake basins nor abandoned river channels, although they do occur on a continuous permafrost zone (French & Demitroff 2001). Certain characteristics also speak against these landforms being open-system pingos. First, the landforms are not located on a region of high relative relief. Second, there is no evidence of perennial ground water discharge being present, even though discontinuous permafrost is present for the area. Third, a hydrostatic head or pressure would be required to move water towards the freezing plane (French & Demitroff 2001). Research from the region has shown that moisture is rare (Hansen *et al.* 2014). Nevertheless, the presence of ice in the area and some lensing in evidence suggests ice as a driving factor and their formation. Mound proximity to the toe of the rock glacier also suggests mounds may be partially driven by ice retreat and loss of interstitial ice of the glacier.

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