



## **‘Traction ribs’ on the palaeo-ice stream tracks of the Interior Plains, North America**

Martin Margold and Chris R. Stokes

Department of Geography, Durham University, United Kingdom

Spatially distinct pattern of basal shear stress beneath a number of Antarctic and Greenlandic ice streams has recently been discovered by inverse methods using high resolution data of ice velocity, elevation and thickness. Surrounded by regions of near-zero basal shear stress, these areas of high basal shear stress have been termed ‘traction ribs’ and hold important implications for the force balance of ice streams. The cause of the traction ribs is unknown (i.e. whether they have a topographic expression), but their horizontal dimensions and pattern lie somewhere between typical ribbed (Rogen) moraines and recently described mega-scale ribbed moraines identified on palaeo-ice sheet beds. However, whilst both of these landform types form with their long axis transverse to the ice flow direction, the traction ribs are most commonly oriented oblique to the ice flow at angles of 30-60 degrees. Here, we report new findings from the beds of palaeo-ice streams on the Interior Plains in Alberta and Saskatchewan where landform assemblages, similar to traction ribs, occur at several sites. Individual landforms at the mapped sites have typical lengths (transverse to flow) of 5-10 km, width of ~2 km, and their spacing is ~2-3 km. As such, they appear to represent an intermediate scale of ribbed landform that overlaps with the more extreme (larger) values of classic ribbed moraine and the smaller values of mega-ribs. Unlike mega-ribs and ribbed moraines, we also note that many of the ribbed features we mapped are aligned obliquely to ice flow direction at angles and mimic the arcuate patterns of traction ribs seen under modern ice streams. Profiles across the ridges indicate that they have amplitudes of 10-15 m which is comparable, but slightly lower than the mean value for ribbed moraines. The resemblance of our newly mapped features to the traction ribs of modern ice streams is close not only in the size and shape but also in the overall pattern of the whole landform assemblage. We therefore suggest that traction ribs have a topographic expression that sits on a continuum between ribbed moraine and mega-ribs. However, it is not clear which mechanisms lead to their formation or how widespread they are on other palaeo-ice stream beds. Future work might search for these landforms and their assemblages using higher resolution DEMs and fieldwork would allow sedimentological investigation of till properties and characteristics.