Detection and Assessment of Subsurface Ice with Ground-Penetrating Radar on Herschel Island, Yukon Territory

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The general aim of this thesis is to map and estimate the thickness of ground ice at retrogressive thaw slumps on Herschel Island using ground-penetrating radar (GPR). Profiles normal to the slump headwall at Collinson Head reveal possible changes in ice structure as a function of distance away from the headwall. Upslope, the ice structure shifts from straight continuous reflections to chaotic patterns characterized by multiple point (hyperbolic) reflectors with GPR. This change in structure corresponds with the surface transition from an old stabilized thaw slump to an undisturbed surface. Surface debris flow sediments in the earliest slump floor unconformably overly older ice-rich materials. In addition, 3D models of the subsurface suggest a mean ground ice thickness of 3.34 m with a standard deviation of 0.75 m within 50 m of the headwall (see figure below). The deepest diffraction patterns are likely indicative of discrete objects (e.g. boulders) mixed with subsurface gravel deposits. The detection of gravel deposits underneath the ice, as well as cryostratigraphic evidence of fine-grained material above the ice, suggest intrasedimental ice formation. The limited thickness of the residual ice-rich layer may indicate an end of polycyclic slump activity at this site.