

Deep material eroded from retrogressive thaw slump: case study in Peel Plateau, west Canadian Arctic

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Ice-rich permafrost thaw is highly sensitive to the creation of local landscape subsidence in the Arctic, known as thermokarst structures. Upon thaw, these structures can erode, unlocking organic and mineral constituents and transferring this material downstream potentially affecting the ecosystem at larger scale. Such hillslope landscape processes have recently developed in Peel Plateau, west Canadian Arctic, as Retrogressive Thaw Slumps (RTS). We investigate whether material eroded from RTS and transported downstream originates from upper or deeper soil horizons with potentially distinct organic and mineral contents. The total elemental content and soluble element fractions were determined in soils from different depths at the slump headwall (active layer, Holocene permafrost, and Pleistocene permafrost) and in downstream eroded material (mud, and debris) for eight RTS structures. We observe a similar total content in Ca, K, Al and Sr, and soluble content in Ca, K, Mg, Na between the downstream mud and debris and the Pleistocene permafrost. The data highlight that the eroded material originates from the deeper Pleistocene permafrost, and contributes solute element concentrations that are significantly higher (by at least one order of magnitude) than in previously thawed active layer or locally Holocene permafrost. We hypothesize that RTS development is responsible for horizontal transfer of perennially frozen materials downstream originating from deep Pleistocene permafrost deposits. This means that in addition to exposing deep organic carbon to mineralization, modern RTS development likely affect local ecosystem chemistry by releasing soluble elements.

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