Geomorphologic Processes Associated with a Thermokarst Developing in a Dub-Arctic Watershed

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Several unique geomorphologic processes were observed during the rapid evolution of a developing thermokarst in the Caribou-Poker Creeks Research Watershed (CPCRW). The watershed located about 50 kilometers north of Fairbanks, lies in a region of discontinuous permafrost. The thermokarst has been growing at a rate of 3.5 m/yr with significant changes to the terrain configuration. During the course of a two year study, which was initiated in 2004, various cryogenic and fluvial phenomenons transpired at the study site. Significant among these were fluvio-thermal erosion, cryogenic piping, subsurface flow in the unsaturated active layer (interflow), and bed load transport and associated deposition process. Fluvio-thermal erosion, widespread at one of the thermokarst observation and sampling locations, lead to extensive bank erosion due to the formation and subsequent failure of structures known as “thermo-erosional niche”. Subsurface piping was the main reason for the very high rate of sediment transport along the entire thermokarst reach. Groundwater flow within the shallow active layer caused sediment infilling of approximately 60 cm in a preexistent depression. Characteristic bedforms due to bed sediment transport of fine sands were visible during the thermokarst initiation. Most of these processes have an analogy to processes seldom observed in sub-arctic settings. Fluvio-thermal erosion is more commonly associated with coastal river morphology. Piping is usually seen in association with vegetal change in peat lands. Sediment deposition process which occurred after precipitation events is akin to that seen in man made structures like reservoirs and which modify sediment trap efficiency due to the process of reservoir sedimentation. The role of these geomorphologic processes in thermokarst formation has been generally overlooked by the scientific community. The current study was an attempt to better understand the processes involved in the newly initiated and catastrophically evolving thermokarst. These processes have contributed to additional cryogenic structures to develop at the study site thus putting the surrounding areas at a higher risk to erosion and landscape modifications.

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