M.Sc. Geology and Planetary Science & Exploration Public Lecture

Candidate: Simona Ruso

Supervisor: Gordon Osinski

Characterization of Subglacial Meltwater Features and Meltwater Drainage Dynamics on Devon Island, Nunavut, Canada, with Implications to Mars

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Abstract

Subglacial channels are morphologically and morphometrically distinct in comparison to fluvial channels. On Devon Island, Nunavut, Canada, although covered by the thin (<1000 m), cold-to-polythermal based Innuitian Ice Sheet at the Last Glacial Maximum, there is a conspicuous lack of typical glacial landforms, such as eskers, moraines, and striations. Instead, subglacial channel networks dominate the interior plateau of the island. This thesis presents a detailed morphological description of subglacial channels on Devon Island and, for the first time, applies fluvial scaling relationships to assess downstream trends in channel morphometry. Moreover, highly anastomosing terrain termed labyrinth terrain is described for the first time and potential formative mechanisms are discussed with analogies to Antarctica and the Channeled Scablands. This research contributes to the current set of criteria distinguishing subglacial meltwater channels in the geologic record and improves the understanding of subglacial drainage under dominantly cold-based ice sheets. It is demonstrated that subglacial channels are m-scale features that comprise isolated, finger-like networks that drain into a larger main stem. Cross-sections are flat-bottomed with steep walls and longitudinal profiles are convex and undulous, typical of pressurized subglacial water flow. Anastomosis and labyrinth terrain indicates short-lived changes in flow conditions to high energy or discharge events.

Devon Island's polar desert climate and barren landscape make it a prime analogue for glacial and subglacial processes on Mars. The formation of valley networks on Mars was previously attributed mainly to erosion by surface runoff and sapping erosion, implying warm, wet climate conditions. However, the protracted presence of liquid surface water is hard to reconcile with climate models that predict a much colder and drier early Mars. Instead, erosion of a fraction of valley networks was likely the result of localized basal meltwater flow under a polythermal-based highlands ice sheet, consistent with Mars climate modelling and valley network geomorphology. This thesis presents a detailed morphological description of potential subglacial meltwater channels on Mars with comparisons to subglacial channels on Devon Island. Overall, this thesis demonstrates that subglacial channels formed under dominantly cold-based ice sheets are distinct landforms, and that some valley networks on Mars likely formed in a subglacial environment.

ALL WELCOME!