SELECTIVE FLUVIAL EROSION ON MARS: GLACIAL SELECTIVE LINEAR EROSION ON DEVON ISLAND, NUNAVUT, ARCTIC CANADA, AS A POSSIBLE ANALOG. Pascal Lee[1], [1]NASA Ames Research Center, Moffett Field, CA 94035-1000, USA, pclee@mail.arc.nasa.gov.

Introduction: The apparent selective nature of fluvial erosion on Mars is discussed in light of observations of landscapes of glacial selective linear erosion observed on Devon Island, Arctic Canada, and at other high-latitude sites on Earth where valley formation and fluvial erosion are tied to the presence of geologically transient, dominantly cold-based ice covers. Possible implications for Mars are explored.

Selective linear erosion on Mars: A remarkable characteristic of much of the record of "fluvial erosion" revealed on Mars by Mariner 9, Viking and MGS imaging is the selective distribution of martian fluvial features, both on local and regional scales. *Small valley networks* for instance display dendritic patterns that leave relatively large internetwork and interbranch areas on surrounding upland terrains very little dissected (a characteristic among a few others often deemed "unusual" by terrestrial standards), while the valleys themselves are generally discrete and may display anywhere from very subdued and poorly graded sections and profiles to ones that are well-incised and graded. Larger *small valleys* winding over greater distances across the martian landscape, such as Ma'Adim Vallis, also present a remarkable contrast between their discrete entrenchment and the relatively sparse, selective, and generally subdued erosion of surrounding uplands. The tributary canyons on the north-facing south rim of Ius Chasma provide yet another example of the apparent selectiveness of "fluvial" erosion, in this case probably among other contributions, interpreted on Mars (Figure 1).

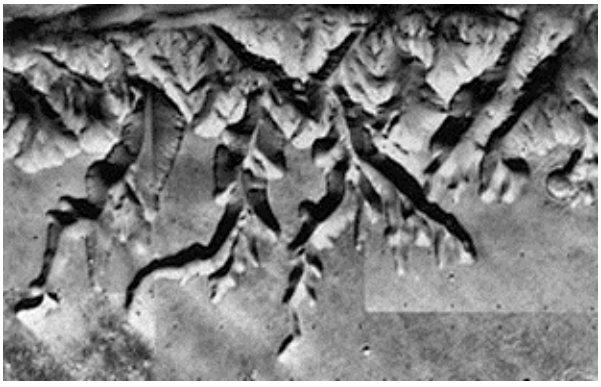

Figure 1. The system of V-shaped tributary canyons along the south rim of Ius Chasma on Mars (7°S, 82°W). Sapping has been invoked as a possible origin for these "fluvial" features [1, 2]. The scene is 110 km across. (Viking Orbiter mosaic 211-5158. Detail).

This characteristic of martian valleys is important because it is commonly invoked as a key argument for favoring the release of underground water as the likely fluvial erosional agent for the formation of many valleys on Mars, over precipitation followed by surface runoff which would be expected to have led to more widespread, less selective fluvial erosion. We report here on a suite of observations of landscapes of glacial selective linear erosion made at and near Haughton Crater on Devon Island in the Canadian High Arctic where Mars analog field studies are currently in progress under the auspices of the NASA Haughton-Mars Project (HMP) [3,4]. Glacial selective linear erosion on Devon Island has produced landscapes and specific geologic features, including valley forms and adjacent landscapes of little or no glacial erosion, that are morphologically and contextually similar to possible counterparts observed on Mars. I discuss these features and will explore whether there might be a viable alternative, i.e., an explanation at least as plausible as the ubiquitous release of groundwater, for the pattern of selective fluvial erosion observed on Mars.

Landscape of glacial selective linear erosion on Devon Island:

The landscape of Devon Island, like that of many islands of the Candian Arctic Archipelago, is in effect a textbook example of one of *glacial selective linear erosion* [5,6,7]. Such a landscape is characterized by localized, deep, and often sinuous troughs, separated by vast tracks of plateau surfaces presenting only a relatively sparse distribution of discrete networks of meltwater channels and otherwise little modification. It is generally thought that such landscapes develop beneath ice sheets, with the troughs marking former ice streams and the intervening plateaux marking areas of slowly moving or cold-based ice [e.g., 8]. Positive feedbacks between subglacial topography, ice thickness and velocity, basal temperature and erosion rates are often invoked to explain trough location and formation. The geologic features typifying glacial selective linear erosion on Devon Island are examined below:

Glacial meltwater channel networks. The glacial meltwater channel networks of Devon Island have been considered previously and were discussed as possible

analogs for small valley networks on Mars [6,7]. In the context of selective linear erosion, those reported on Devon Island likely reflect the preferential erosion of ice-marginal and/or subglacial bedrock in areas where streams of glacial meltwater would converge and flow. Surrounding areas may remain protected by a static ice cover and hence experience contrastingly little erosion.

*Glacial trough valleys.*The larger scale trough valleys of Devon Island form a network of deeply incised, often winding, U-shaped and V-shaped "canyons" gouging the surrounding plateau, in many places down to the crystalline basement underlying the island's top sequence of Paleozoic carbonate-dominated sediments.

Figure 2. Aerial photograph of a 1 km-wide, deeply-incised, winding, V-shaped glacial trough valley on Devon Island with its tributaries. Note that the surrounding plateau is otherwise little dissected and that there are no major streams feeding onto this canyon. Field observations indicate that sapping does not play a significant role in the formation of such valleys. (Photo NASA HMP).

The troughs concentrate along the coastal areas of Devon, thereby revealing their probable origin as outlet glacial troughs carved at the periphery of a broader regional ice cover that rested on Devon Island during at least the Last Glacial Maximum [5]. That even the V-shaped winding trough valleys of Devon Island are fundamentally glacial in nature is supported by the combined observation of: a) the systematic transition of the larger troughs to more classic U-shaped forms and fjords downstream, b) the common lack of any apparent deep-seated structural control in the distribution of the troughs, c) the observation that the troughs currently emerging from underneath the edge of the receding ice cap in the eastern part of Devon Island are still partially filled with ice displaying streaming flow lines and, in the summer at least, often torrential subglacial meltwater streams, d) the ubiquitous presence of preglacial forms such as tors along the rim of the troughs, and e) the frequent absence of any significant feeder stream and the negligible role of sapping.

Landscapes of little or no glacial erosion.. Surrounding uplands spared from glacial and meltwater erosion (protected by the cold-based ice cover) may display remarkably little evidence of any former glacial occupation. Vast intervening areas of the Devon Island plateau present such landscapes of little or no glacial erosion (Figure 3).

Figure 3. Von Braun Planitia, Devon Island. A view of inter-valley upland terrains showing a lack of obvious evidence of former glacial occupation (NASA HMP).

Conclusion: The possibility that valley formation on Mars might have involved glacial (and meltwater) selective linear erosion will be discussed.

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