Glacial Geomorphology of the Williams and Schmidt Hills, Pensacola Mountains, Antarctica

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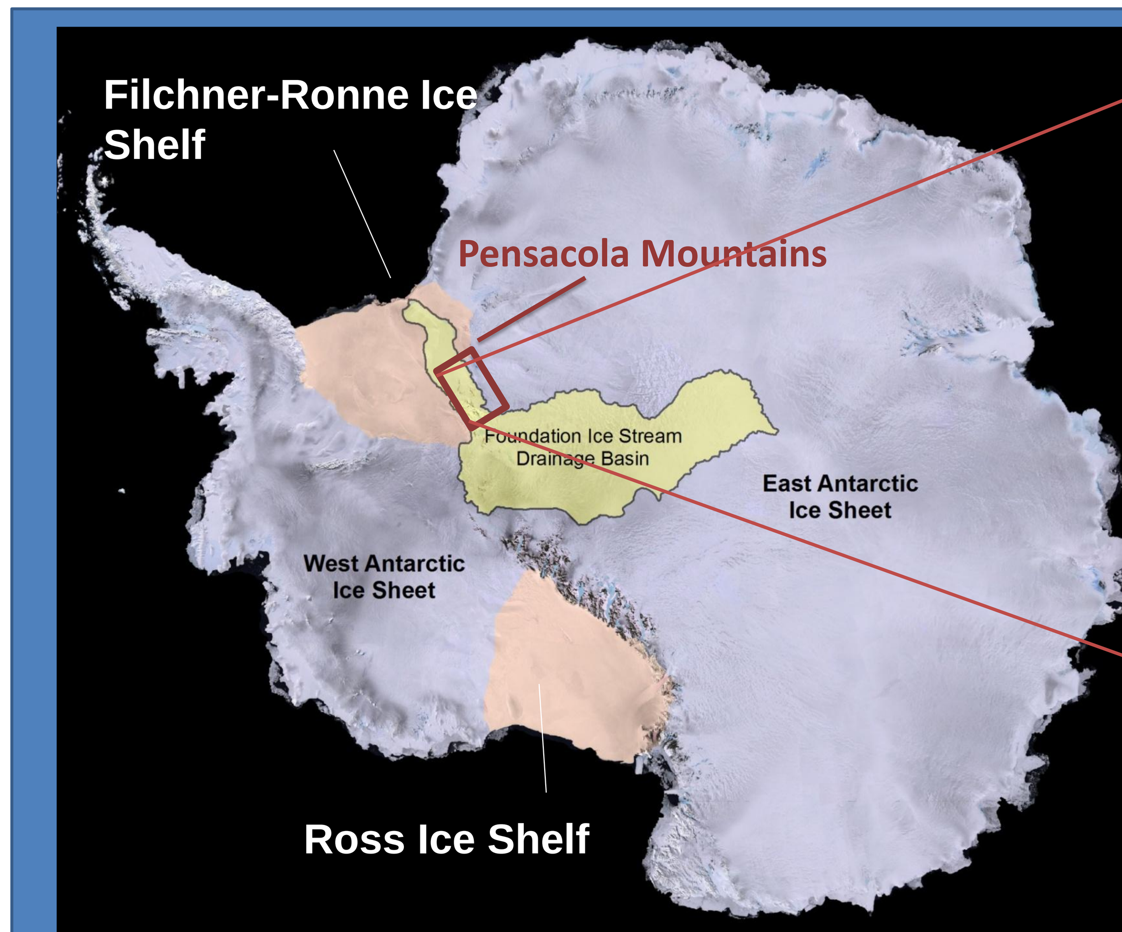
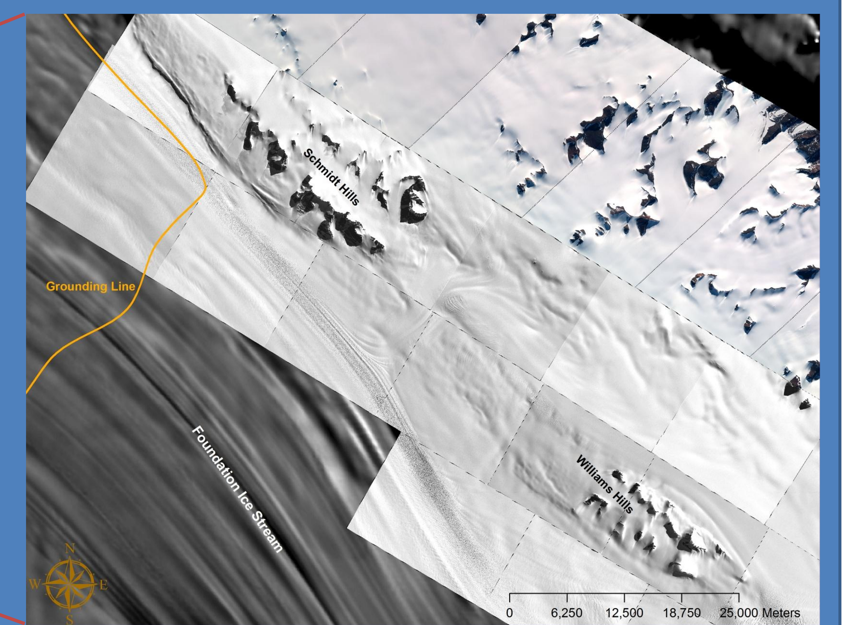


Continental Antarctica
Map showing continental Antarctica and the East and West Antarctic Ice Sheets. Two main ice shelves are shown, as well as the Pensacola Mountains. The Weddell Sea Sector is made up of areas adjacent to the Filchner-Ronne Ice Shelf. Approximate drainage basin, as extrapolated by ArcHydro is shown in the yellow polygon.



Pensacola Mountains
Map shows the Schmidt and Williams Hills. Adjacent to the hills is the Foundation Ice Stream, joining the Filchner-Ronne Ice Shelf.

Abstract: We mapped glacial geologic features in the Schmidt and Williams Hills, ranges of nunataks adjacent to Foundation Ice Stream (FIS). FIS, which flows past the western flanks of the Pensacola Mountains in West Antarctica, drains ice from the central EAIS into the WAIS, and discharges into the Weddell Sea Embayment. Our maps allow us to identify past changes in ice thickness, which improve our understanding of ice sheet response to climate change. Glacial erratics with distinct extents of weathering reveal at least two periods of glaciation. Evidence indicates that during a glacial maximum local ice thickness exceeded current ice thickness by 700 m, and was thick enough to flow obliquely over the hills, toward FIS. During subsequent deglaciation, ice flow became topographically constrained and only ice-stream-parallel flow is recorded. In addition, the preservation of erratics perched on patterned ground and frost-shattered bedrock represent at least two glaciations, and suggest the presence of thin, cold-based ice cover. This interpretation is supported by sparse evidence of glacial erosion. Future work will use surface-exposure dating to determine the timing of glacial advance and retreat.

Background

Data concerning deglaciation within the Weddell Sea Sector following the last glacial maximum is sparse and unconstrained. Ice elevation extents for the last glacial maximum are still widely varied, ranging from 200 m (Fogwill et al., 2004) to 800 m (Hofle et al., 1995) above present day ice surfaces and the rate at which ice retreated is unknown. Published last glacial maximum exposure ages range from 6,500 (Bentley, 1998) years ago to 1.2 million years ago (Fogwill et al., 2004), with little to no data concerning subsequent deglaciation rates.

The Schmidt and Williams Hills, located in the western Pensacola Mountains are adjacent to the Foundation Ice Stream (FIS). The close proximity of the hills to FIS allows for a thorough study of FIS elevation changes through geomorphic remains.

Patterned Ground
Patterned ground on *Camp Rock*, indicating frost heave within a periglacial environment.

Frost Heave
Frost-heaved slope on lower Mt. Coulter

Erratic Weathering Extents
a) an unweathered erratic, exposed just above the ice level, and **b)** a weathered erratic with a flaking rind, representing long periods of exposure in periglacial regimes.

Results

GEOMORPHIC TRENDS ON EXPOSED NUNATAKS
Thin bedrock ridges lead to steep frost-heaved slopes. Downhill from frost-heaved slopes, elevation gradients lessen as patterned ground appears. Patterned ground is more developed at higher elevations; ice margins show little to no development of patterned ground.

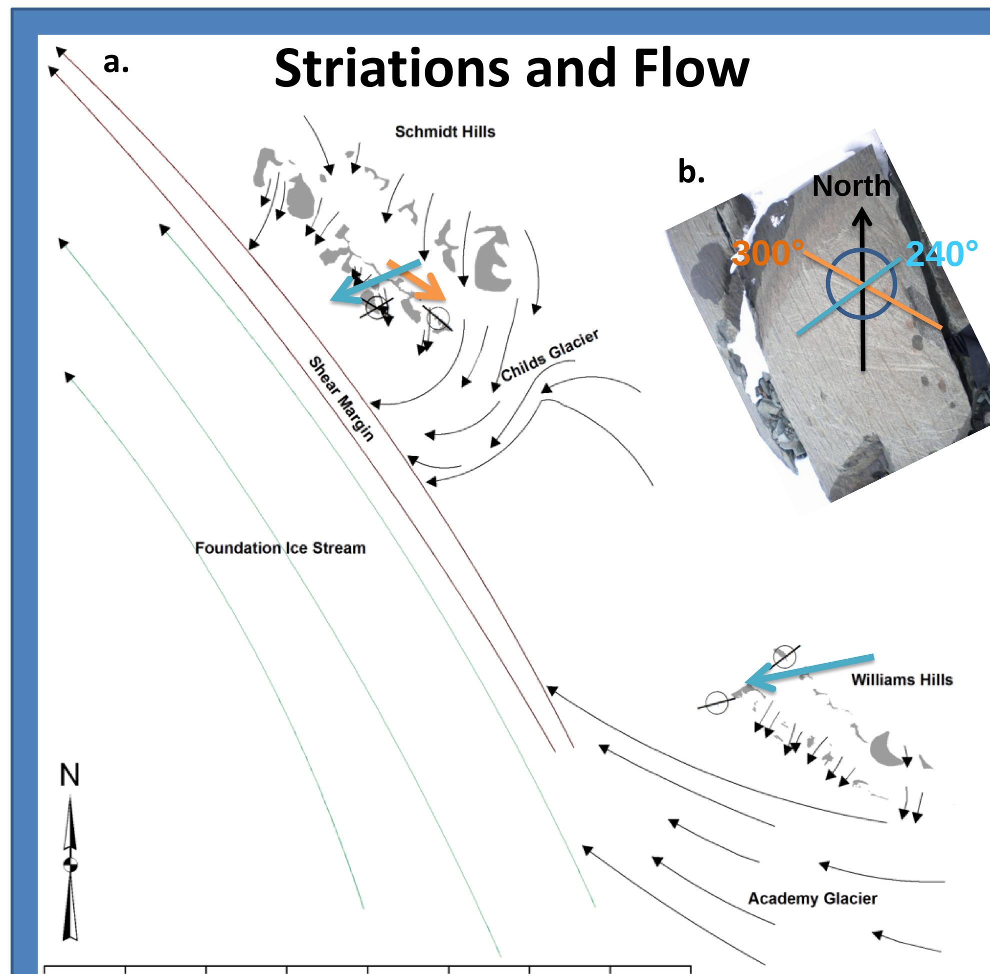
FOUR SETS OF STRIATIONS IN SCHMIDT HILLS
At an elevation of 290 m above the present ice surface, a set of striations were found on Mt. Nervo, transverse to the hills. *No Name Nunatak* had two sets of striations in a crosscutting relationship. One set was oriented at 300°, the other crosscutting at 240°. Striations were also found on the northern portion of *Point 700*, oriented at 230°.

TWO SETS OF STRIATIONS FOUND IN WILLIAMS HILLS
One set was located on *Teeny Rock*, oriented at 280-290°. The other set was located on Pillow Knob, oriented at 305- 310°.

TALLEST PEAK HAS A SCOURED SURFACE
562 m above present day ice, Mt. Hobbs, has a scoured and rounded peak.

GLACIAL ERRATICS WITH VARIOUS WEATHERING EXTENTS
Many nunataks had glacial erratics with varying extents of surficial weathering. Notably, Mt. Hobbs' peak was scattered with highly weathered erratics; less weathered erratics were found ~100 m below.

Striations and Flow



a) The Schmidt and Williams Hills and the approximate surrounding glaciology. Strike lines indicate striation orientation.
b) *No Name Nunatak's* crosscutting striations with orientations superimposed.

Interpretations

MULTIPLE PERIODS OF GLACIATION
The presence of glacial erratics with varying weathering extents indicates multiple glaciations. Perched erratics on patterned ground and frost-heaved surfaces indicate cold-based glaciers preserved landforms (Atkins et al., 2002).

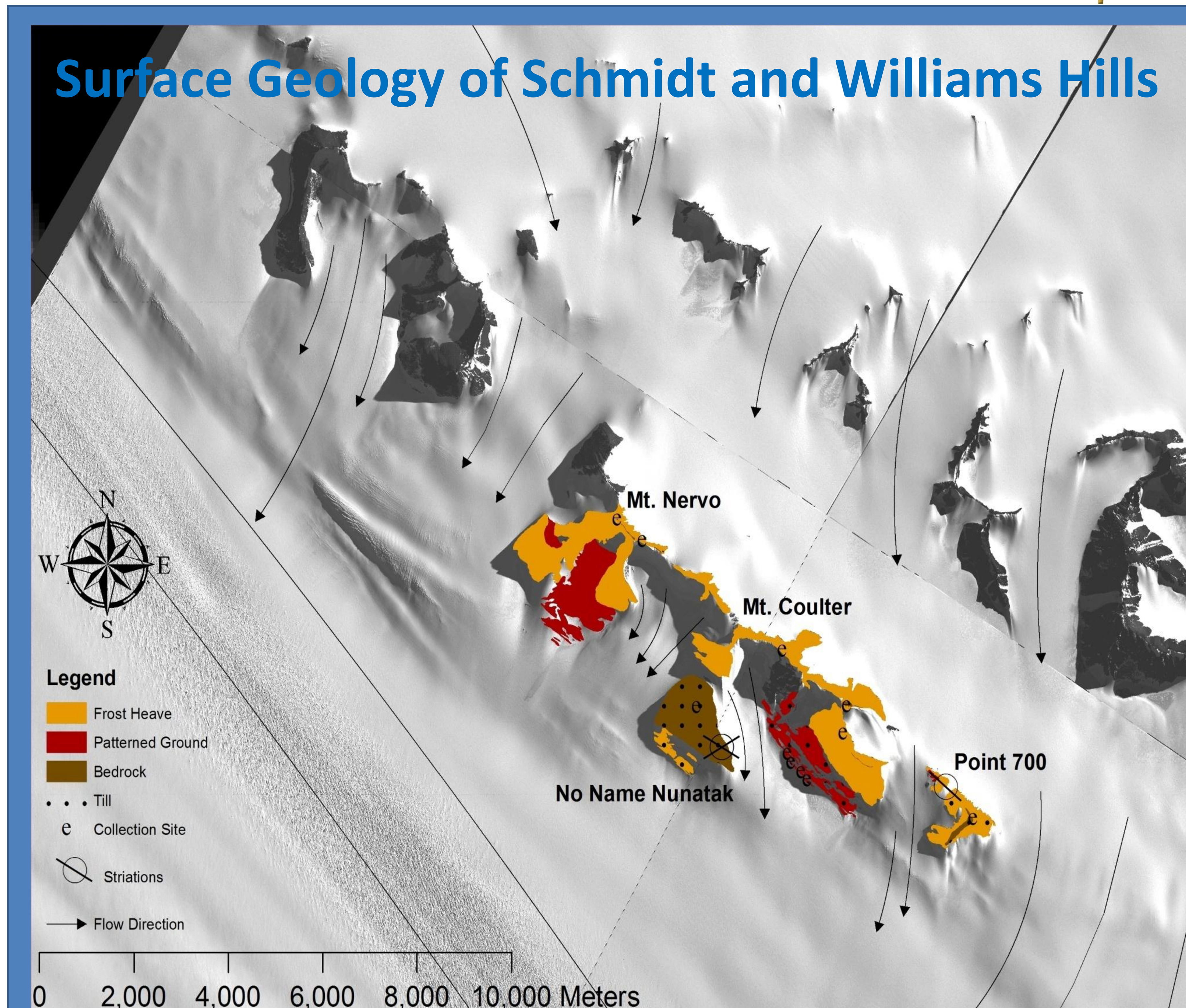
ALL NUNATAKS WERE OVERRUN AT LEAST ONCE
Glacial erratics found on scoured peaks show that ice eroded peaks during a maximum and exposed deposited erratics during retreat. The erosive power needed to scour peaks to this extent would require a warm-based glacier (Robinson, 1984).

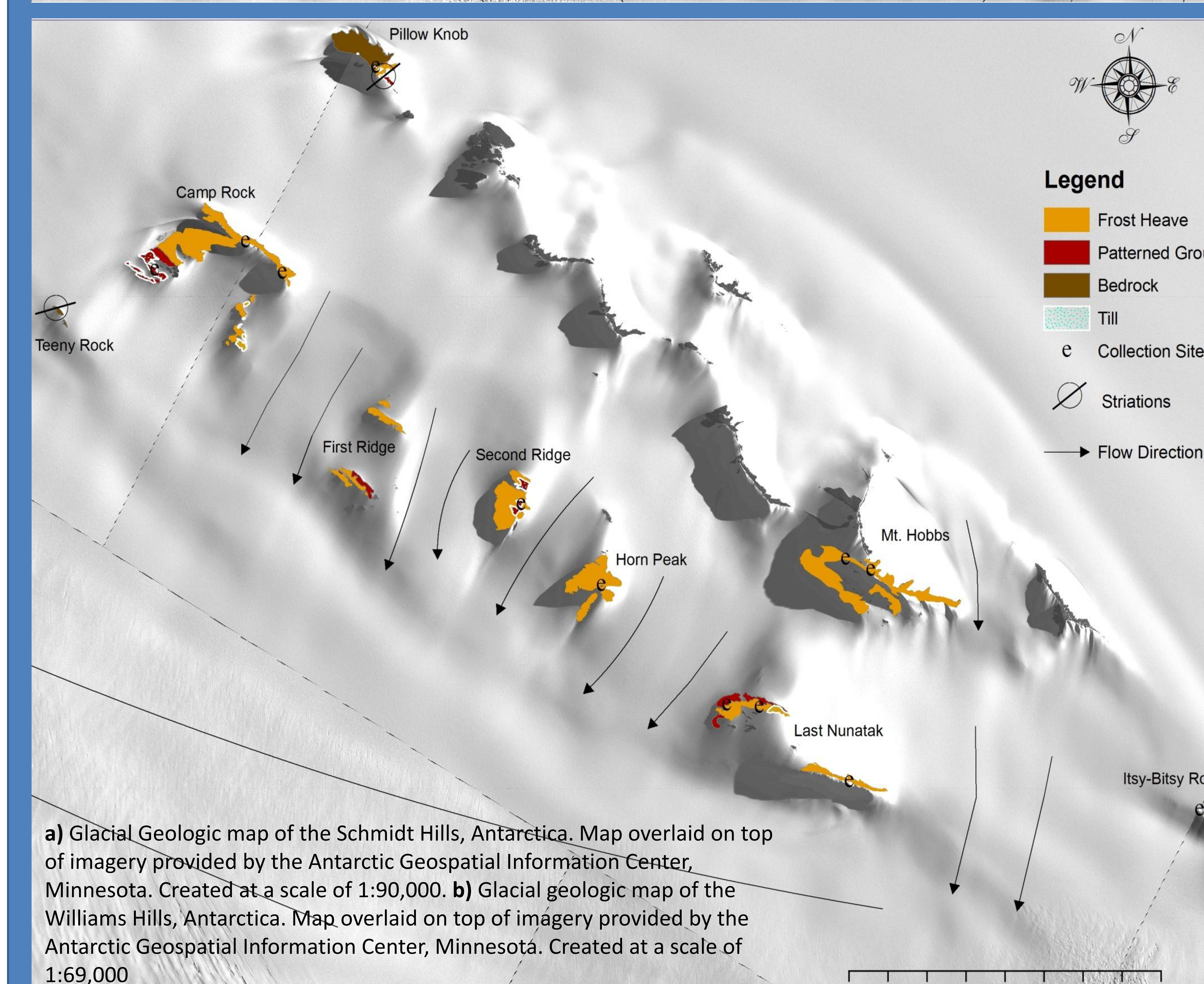
ERRATICS FOUND WITH VARYING WEATHERING EXTENTS
Adjacent erratics with different amounts of weathering indicate cold-based ice cover and weakly erosive conditions. Relatively weathered erratics in close proximity to unweathered erratics on Mt. Hobbs records either a thermal regime boundary or a recent glaciation depositing erratics next to erratics deposited during an earlier glaciation.

SURFACE DEPOSITS REFLECT LONG-TERM PERIGLACIATION
Down slope geomorphic trends result from prolonged periods of exposure within periglacial regimes. Prolonged exposure leads to shucking material from bedrock ridges onto slopes. Down slope movement continues until lower elevation gradients are reached, allowing in-situ sorting (Brook, 1972).

STRIATIONS RECORD CHANGING FLOW DIRECTION
Crosscutting striations in the Schmidt Hills indicate local changes in ice thickness and flow direction. Crosscutting striations indicate a change from ice-stream-parallel flow to thicker ice surfaces with oblique flow. Striations found on Pillow Knob were at 200 m above present day ice, indicating ice thick enough to cover much of both sets of hills.

Surface Geology of Schmidt and Williams Hills





a) Glacial Geologic map of the Schmidt Hills, Antarctica. Map overlaid on top of imagery provided by the Antarctic Geospatial Information Center, Minnesota. Created at a scale of 1:90,000. **b)** Glacial geologic map of the Williams Hills, Antarctica. Map overlaid on top of imagery provided by the Antarctic Geospatial Information Center, Minnesota. Created at a scale of 1:69,000

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