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THE CABOT LAKE ICE STREAM: A PALEO-ICE STREAM NEAR THE ANCESTRAL LABRADOR ICE DIVIDE OF THE LAURENTIDE ICE SHEET'S QUEBEC–LABRADOR DOME

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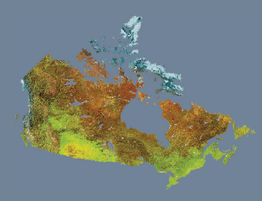


Overview

The Cabot Lake Ice Stream (CLIS) is located along the border of Quebec and Labrador in northeastern Canada. This area experienced a complex ice-flow history during the last glaciation, driven by the development and subsequent migration of the Ancestral Labrador ice divide (Vincent, 1989; Rice et al., 2019). Several ice-flow phases have been classified within the region surrounding the CLIS:

1. The oldest ice-flow phase (Flow 1) was to the northeast, associated with the buildup of the early Laurentide Ice Sheet (LIS) in the Quebec highlands to the south (Veillette et al., 1999),

2. Following Flow 1, an ice divide developed on or just east of the De Pas Batholith, and is associated with ice flow to the northeast (Flow 2). Flow 2 is associated with ice streaming in Ungava Bay (Clark et al., 2000; Rice et al., 2019)

3. As ice streaming in Ungava Bay migrated west, the ice divide migrated west as well, resulting in east-trending ice flow (Flow 3), including the development of the CLIS at the eastern edge of the De Pas batholith.

The CLIS occupies the lowland region near the headwaters of the Geroge River and is bounded on its onset zone and terminus by large bedrock upland regions. A small Mesoproterozoic syenite pluton within the southern extent of the CLIS forms a topographic high, flanking the southern extent to the CLIS (Signal Hill). Streamlined landforms were not identified on the flat top, or up-ice of the bedrock upland. In addition, transverse till ridges occur on the stoss-side of the upland, whereas MSGLs occur around Signal Hill. Also, the sharp northern margin of the CLIS all the way to its terminus is defined by a topographic high corresponding to the Zeni tonalite (yellow unit on the bedrock map figure). This suggests that a combination of bedrock geology and bedrock structure played a significant role in the acceleration of the ice flow. Although the Zeni Tonalite (yellow) and amphibolite (green) show bedrock structure parallel to the ice stream direction with a strong signature indicated on the aeromagnetic map (Dumont et al., 2010), only the amphibolite has streamlined landforms, indicating additional unknown controls on landforms development. Similar bedrock influences have been reported on Baffin Island (De Angelis and Kleman, 2007), within the Hudson Strait (Ross et al., 2011), and in Scotland (Krabbendam and Bradwell, 2011).

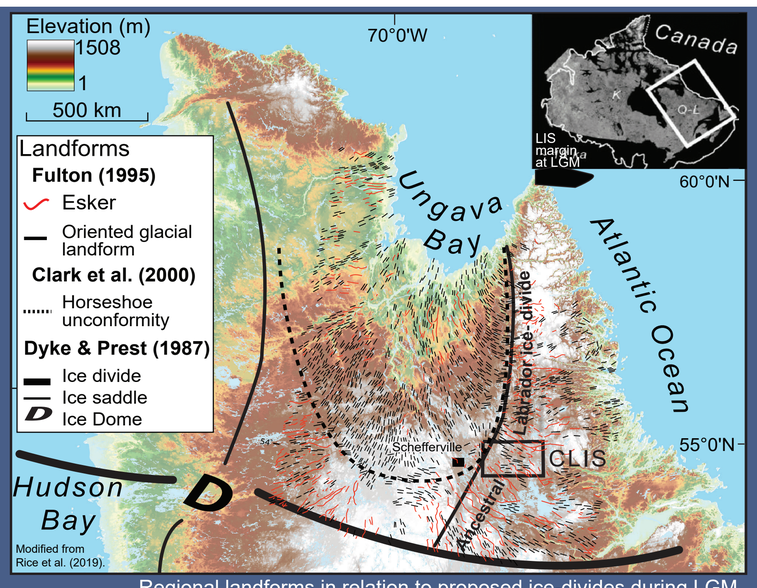
The CLIS characterized as:

- up to 40 km wide with a characteristic converging flow pattern and sharp lateral margins (Stokes and Clark, 1999)

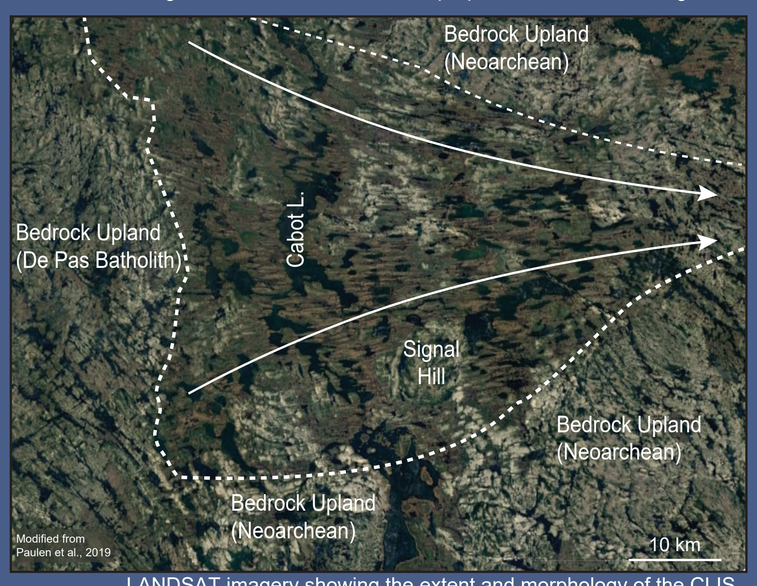
-dominated by streamlined landforms, many with elongation ratios of 10:1 or greater

-crosscut by large southeast-trending eskers which formed obliquely to the orientations of the elongate landforms during deglaciation (Occhietti et al., 2004).

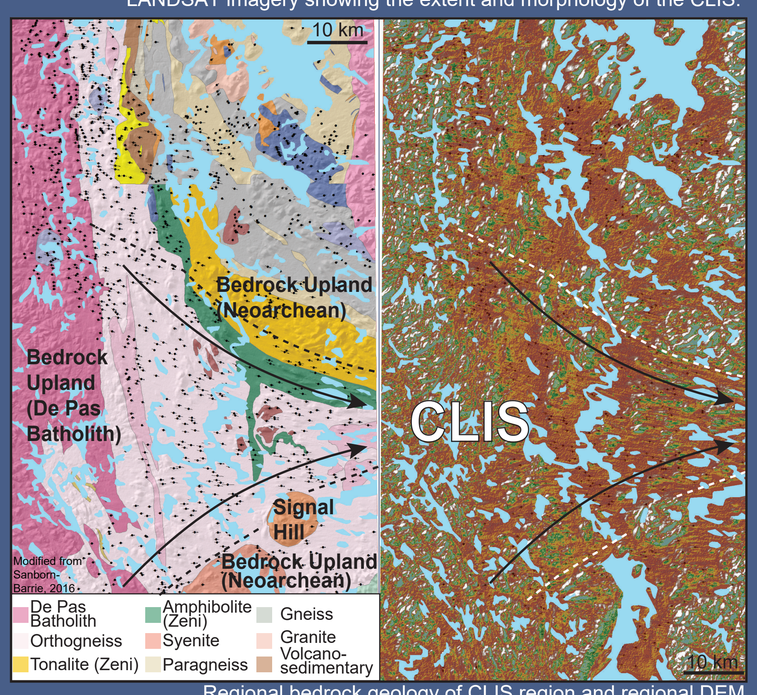
The CLIS is a previously unidentified east-trending ice stream on the Canadian Shield that provides evidence for rapid basal-flow acceleration in close proximity an ice-divide. The timing and duration of the ice stream remain undefined; however, it shares a similar orientation and scale to the Happy Valley-Goose Bay ice stream to the south (IS#186 of Margold et al., 2015), another short ice stream that is suggested to have been active around 8.9 cal ka BP (Margold et al., 2018). The eskers, which are oblique to the main orientation of the ice stream landforms, indicate the ice streaming event predates the establishment of the channelized drainage network responsible for esker formation. The location of the CLIS in such close proximity to an ice-divide, in conjunction with the inferred operation of other contemporary ice streams along the eastern margin of the retreating LIS margin, suggests these ice streams had an important impact on ie mass flux at a late stage of ice sheet collapse (prior to local esker formation).



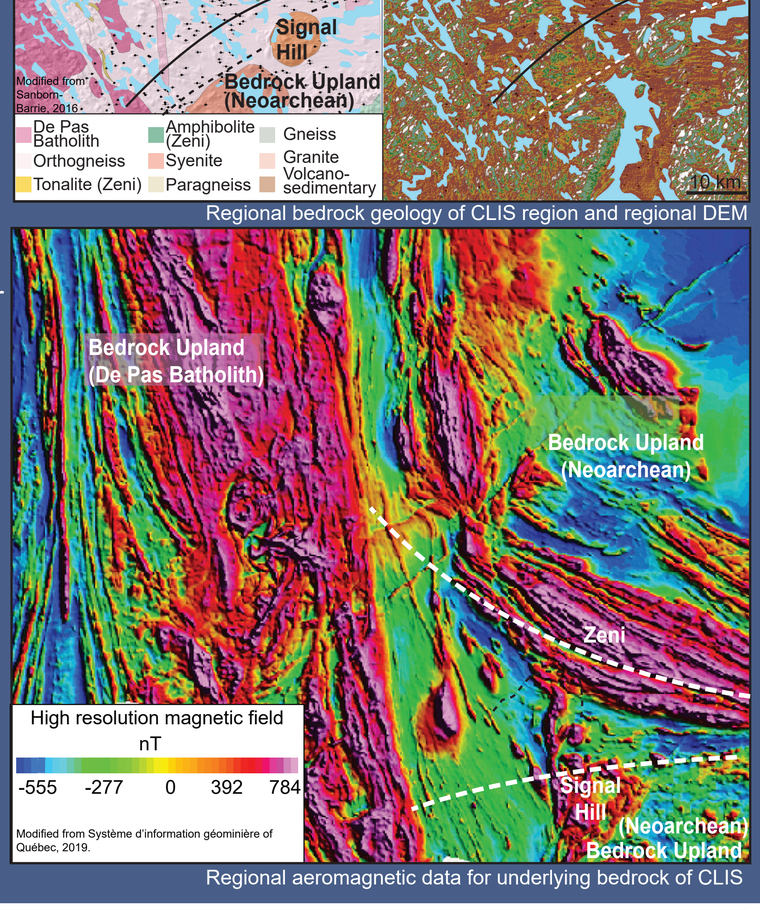
Regional landforms in relation to proposed ice-divides during LGM.



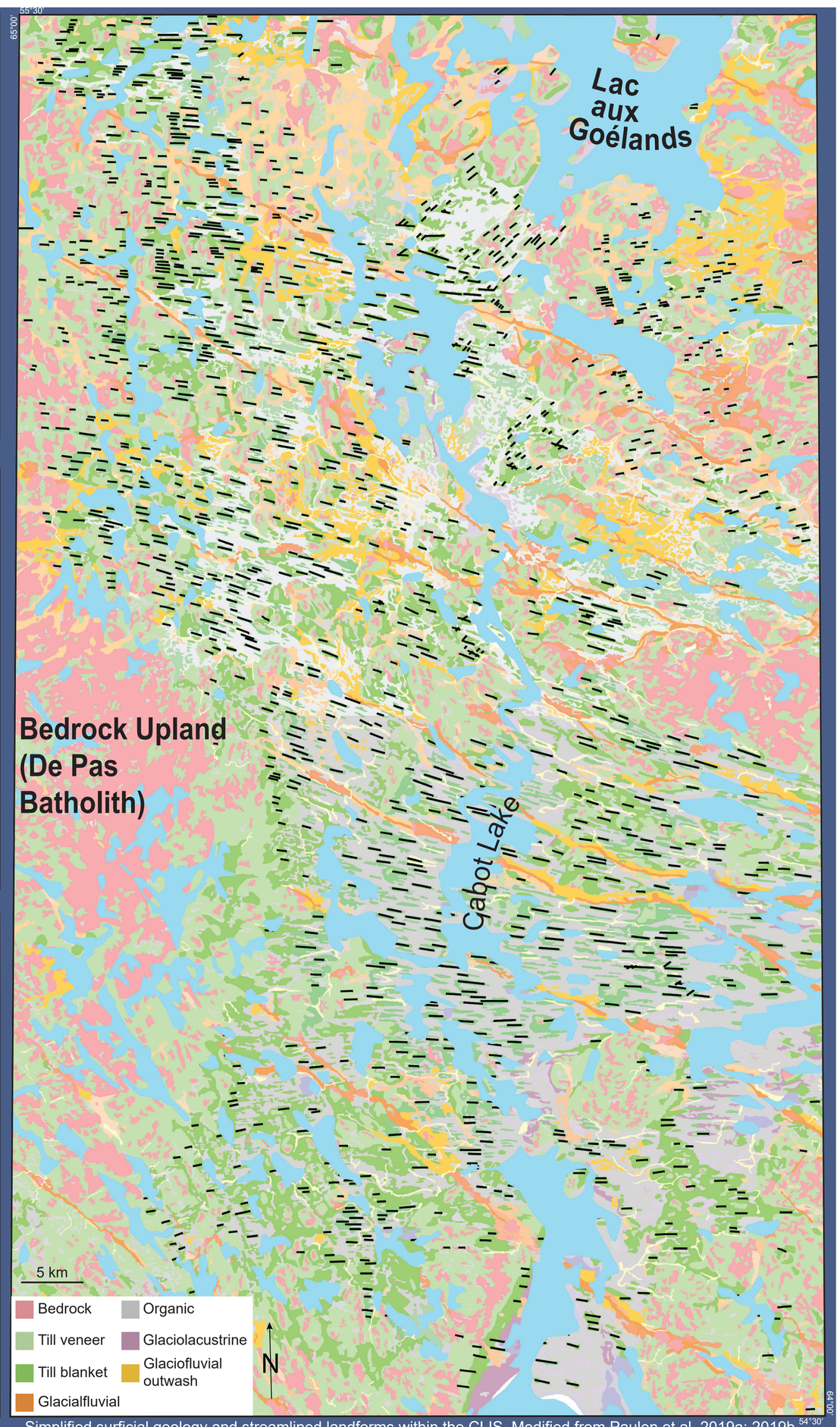
LANDSAT imagery showing the extent and morphology of the CLIS.



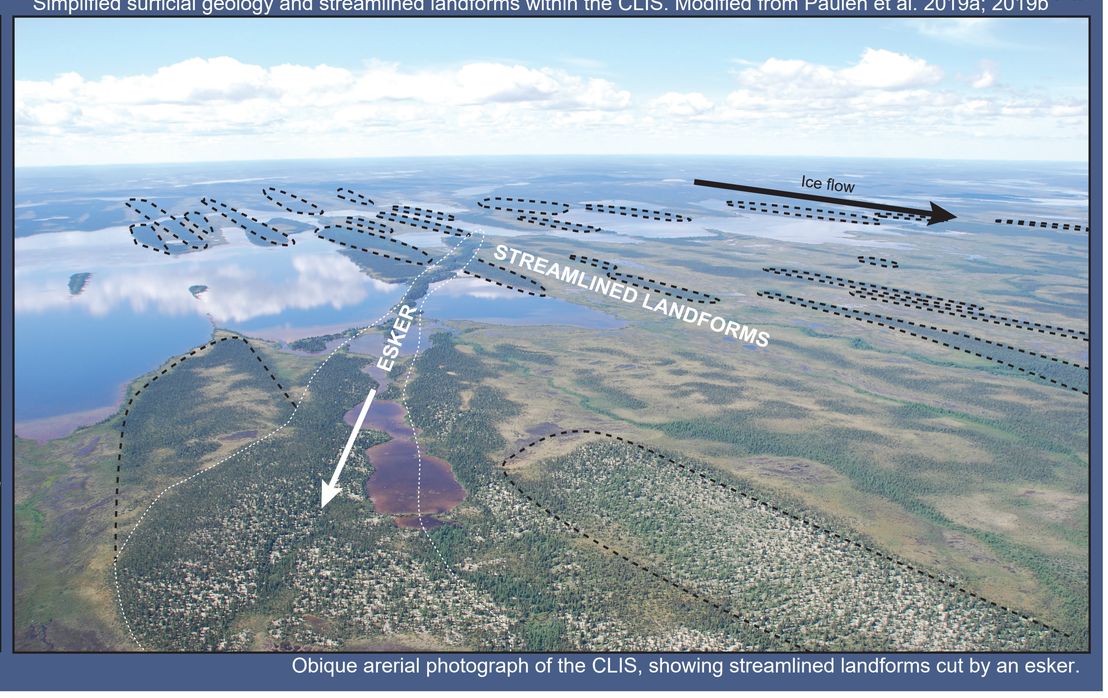
Regional bedrock geology of CLIS region and regional DEM



Regional aeromagnetic data for underlying bedrock of CLIS



Simplified surficial geology and streamlined landforms within the CLIS. Modified from Paulen et al. 2019a; 2019b



Obique arerial photograph of the CLIS, showing streamlined landforms cut by an esker.

Implications

- The CLIS appears to be largely topographically controlled, as it is bounded at its onset zone, along its lateral shear margins, and its terminus by local topographical highs.

-The close proximity of the CLIS to the inferred ice-divide position, in conjunction with other contemporaneous ice streams in the region, indicate these ice streams had an important impact on the LIS at a late stage of deglaciation.

- The large eskers that obliquely crosscut the landforms within the ice stream indicate they postdate the ice stream itself and suggest there was a hydraulic gradient adjustment (and possibly ice sheet profile) following the ice steam event.

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