GS2020-6

Surficial geology mapping from Manigotagan to Berens River, southeastern Manitoba (parts of NTS 62P1, 7, 8, 10, 15, 63A2, 7)

by M.S. Gauthier and T.J. Hodder

In Brief:

- Surficial mapping along the newly expanded East Side Road
- Collection of till samples to determine provenance and drift-exploration potential
- Collection of ice-flow data to reconstruct the glacial history

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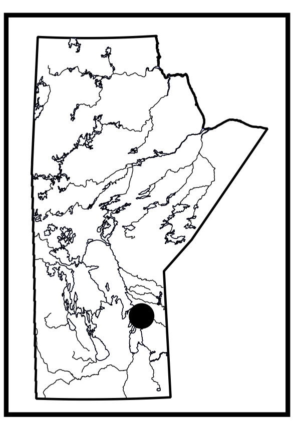


Summary

Quaternary geology fieldwork, including regional-scale surficial geology mapping, till sampling and ice-flow–indicator mapping, was conducted for 10 days in July 2020 along the newly built East Side Road between Manigotagan and Berens River in southeastern Manitoba. Sixteen 2 kg till samples were collected for matrix geochemistry (<63 µm size-fraction) and clast lithology (2–30 mm size-fraction) analysis.

Paleo–ice-flow indicators were documented at 48 field sites, and at least four ice-flow phases are recognized. Southwest-trending paleo-ice flow (220–250°) is the dominant ice-flow phase. Remnants of older ice-flow phases to the south-southeast to south-southwest and southeast were mapped, as were younger, spatially restricted, ice-flow phase(s) to the southeast.

Most of the area is covered by a veneer of glaciolacustrine silt, clay or sand (0.1 to ~1.0 m thick) over bedrock, though thicker glaciolacustrine deposits were observed (up to 2.75 m). Sparse till drapes bedrock in some of the area, at thicknesses between 0.15 and 4.0 m.

Introduction

Quaternary geology fieldwork, including till sampling and ice-flow–indicator mapping, was conducted for 10 days in July 2020 along East Side Road (constructed between 2011 and 2017) between the communities of Manigotagan and Berens River in southeastern Manitoba (Figure GS2020-6-1). A total of 93 field sites were visited to both document glacial sediments and measure the orientation of ice-flow indicators. The goals of this project were to

- conduct regional-scale mapping (sites spaced between 1 and 10 km apart);
- sample till, where present, to assess the till composition of the area; and
- map paleo–ice-flow indicators to assist reconstructions of the glacial dynamics of this area of Manitoba, which in turn guides drift exploration studies.

Physiography

The study area is located in the southeastern part of Manitoba (Figure GS2020-6-1). Elevation varies between 200 and 260 metres above sea level (m asl). Local relief is generally 1 to 30 m, generated by smooth, bare to thinly drift-covered outcrops separated by low ground.

The study area is characterized by moderately drained, mixed coniferous and deciduous forests, underlain by both mineral and organic soils. Well-drained upland sites are dominated by closed stands of medium to tall black spruce, jack pine, trembling aspen, balsam poplar and some paper birch. On sandier or rockier upland sites, more open stands of jack pine are common. Closed to open stands of black spruce, with Labrador tea and ground cover of mixed sphagnum moss and feathermoss, form the dominant vegetation on poorly drained mineral soils. On bog peatlands, the black spruce is more stunted and open.

Bedrock geology

The study area is located in southeastern Manitoba, overlying the Precambrian shield (Ermanovics, 1970) and near the margin of Paleozoic cover (Figure GS2020-6-1). The contact between the Paleozoic platform and the Precambrian shield is underwater, west of the Lake Winnipeg shoreline (Bezys, 1996; Todd et al., 1997). Road-access bedrock mapping was also completed during this study (see Rinne, 2020).

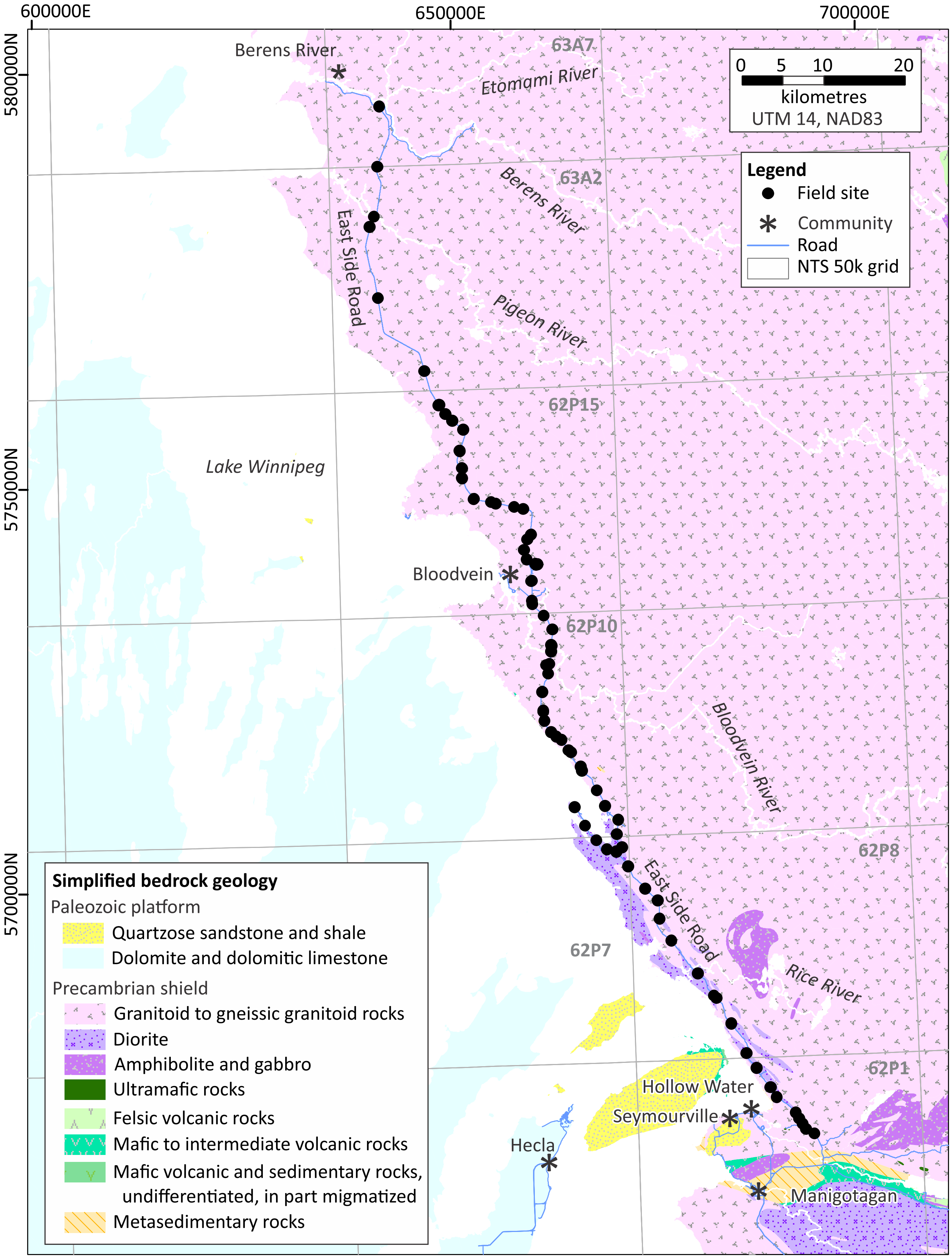


Figure GS2020-6-1: *Surficial geology field sites completed along East Side Road, southeastern Manitoba, overlain on the simplified regional bedrock geology (map modified from 1:250 000 scale unpublished Manitoba Geological Survey data). The contact between the Paleozoic platform and the Precambrian shield is underwater, west of the Lake Winnipeg shoreline.*

Surficial geology

During ice retreat, the entire study area was inundated by glacial Lake Agassiz, which resulted in extensive deposition of glaciolacustrine sediments within topographic lows. Most of the area is covered by veneers of glaciolacustrine silt, clay or sand (0.1 to ~1.0 m thick) over bedrock, though thicker deposits were observed (up to 2.75 m). Sparse till was mapped along parts of the road, amongst bedrock outcrops, at thicknesses between 0.15 and 4.0 m. Till is generally absent west of the road (and under Lake Winnipeg), as seismostratigraphic interpretations suggest fine-grained sediments deposited in glacial Lake Agassiz rest directly over bedrock within most of the lake basin (Todd et al., 1997).

Previous work

Prior to this study, the southernmost portion of the road was mapped at a 1:100 000 scale in the late 1980s (Nielsen, 1987) and at 1:50 000 scale in the 1990s (NTS 62P1, Henderson, 1998). The remainder of the area was mapped in 2004 at a reconnaissance scale using a Shuttle Radar Topography Mission digital elevation model (90 m resolution, United States Geological Survey, 2014) without ground-truthing (Matile and Keller, 2004). Till-composition surveys were conducted in the NTS 62P1 map area (Manigotagan) and adjacent NTS 52M4 map area (Henderson, 1994). Henderson collected till samples and analyzed the <2 µm (clay) and <63 µm (silt and clay) size-fractions by inductively coupled plasma–emission spectrometry (ICP-ES), atomic absorption spectrometry (AAS) following HCl digestion (<63 µm size-fraction only) and fire assay followed by inductively coupled plasma–atomic fluorescence spectrometry (ICP-AFS; Au, Pt, Pd; <63 µm size-fraction only). Texture of the <2 mm size-fraction and pebble composition of the 4 to 8 mm size-fraction was also determined.

Methods

Road-based fieldwork was undertaken over 10 days in July 2020, based out of the community of Manigotagan (Figure GS2020-6-1). A total of 93 field sites were visited to ground-truth the surficial geology mapping, collect till samples and identify ice-flow indicators. The surficial material at each field site was investigated in a road-cut exposure, a hand-dug shovel hole, a Dutch auger (1.2 m long) hole or an Oakfield soil probe hole (1.75 m long).

Sixteen 2 kg till samples were collected for matrix geochemistry (<63 µm size-fraction) and clast lithology (2–30 mm size-fraction) analysis. Till samples were collected from the C-horizon soil, except where thin till draped bedrock and only the B horizon was present. An additional six till samples (22.7 L each) were collected for heavy mineral analysis. At this time, these samples have not been submitted for analysis but will be archived for future consideration.

The orientations of striations, grooves, chattermarks and crescentic gouges and fractures were measured at 48 sites and are contained in Data Repository Item DRI2020025 (Gauthier and Hodder, 2020)[1].

Ice-flow history

New ice-flow measurements were obtained from striations, grooves, chattermarks, crescentic gouges and fractures at 48 field sites in the study area (Figure GS2020-6-2; Gauthier and Hodder, 2020). Throughout the area, construction-exposed bedrock surfaces were grooved and moulded by ice flowing to the southwest (220–255°, Figure GS2020-6-3a). Variations within this dominant flow were mapped by Henderson (1994), summarized as 227–233° followed by 250–260° and 238–245°ice flows, though some of the relative relationships at some field sites contradict this (Figure GS2020-6-2). Southwest-trending ice flow reached as far west as the community of Fisher Branch, situated 100 km west of the community of Manigotagan (Groom, 1985). There are also rarer and older preserved field-based ice-flow indicators that trend to the south-southeast to south-southwest (170–214°; Figure GS2020-6-3b). Perhaps problematically, there are also southeast-trending ice-flow indicators (108–170°) that were mapped as both older and younger than the dominant southwest-trending ice-flow phase. The older southeast-trending ice-flow indicators were mapped at four sites and include smoothed chattermarks (Figure GS2020-6-3c) and rough shovel-width grooves on protected slopes (Figure GS2020-6-3d). The younger southeast-trending ice-flow indicators were mapped at four spatially restricted sites near the community of Bloodvein (Figure GS2020-6-2), and include grooves, crescentic fractures and striations (Figure GS2020-6-3e–g). Additional southeast-trending indicators without relative age information were mapped at two sites.

Streamlined landforms were mapped, at a variety of resolutions from remotely sensed imagery (Gauthier and Keller, 2020), on the west side of Lake Winnipeg (Figure GS2020-6-2). In the Fisher Branch area, just west of the study area, late deglacial ice-flow indicators oriented toward the southeast overlie older southwest-trending striations (Groom, 1985).

The repetition and overlap between striation orientations probably indicates similar ice-flow events formed over time, either during the interaction of several ice lobes or over a longer period of glaciation (cf. Henderson, 1994).

[1] MGS Data Repository Item DRI2020025 containing the data or other information sources used to compile this report is available online to download free of charge at https://www.manitoba.ca/iem/info/library/downloads/index.html, or on request from minesinfo@gov.mb.ca, or by contacting the Resource Centre, Manitoba Agriculture and Resource Development, 360–1395 Ellice Avenue, Winnipeg, MB R3G 3P2, Canada.

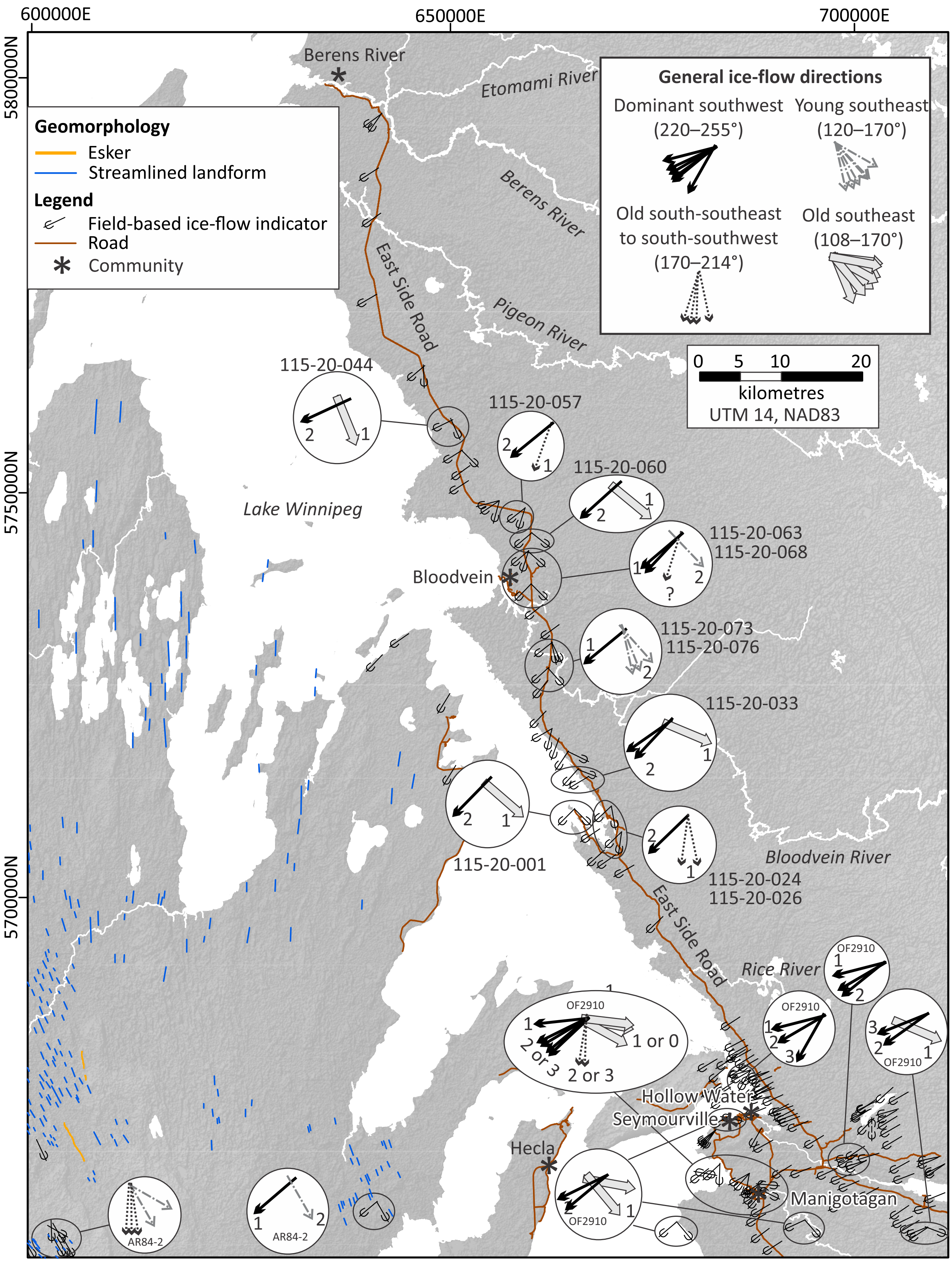
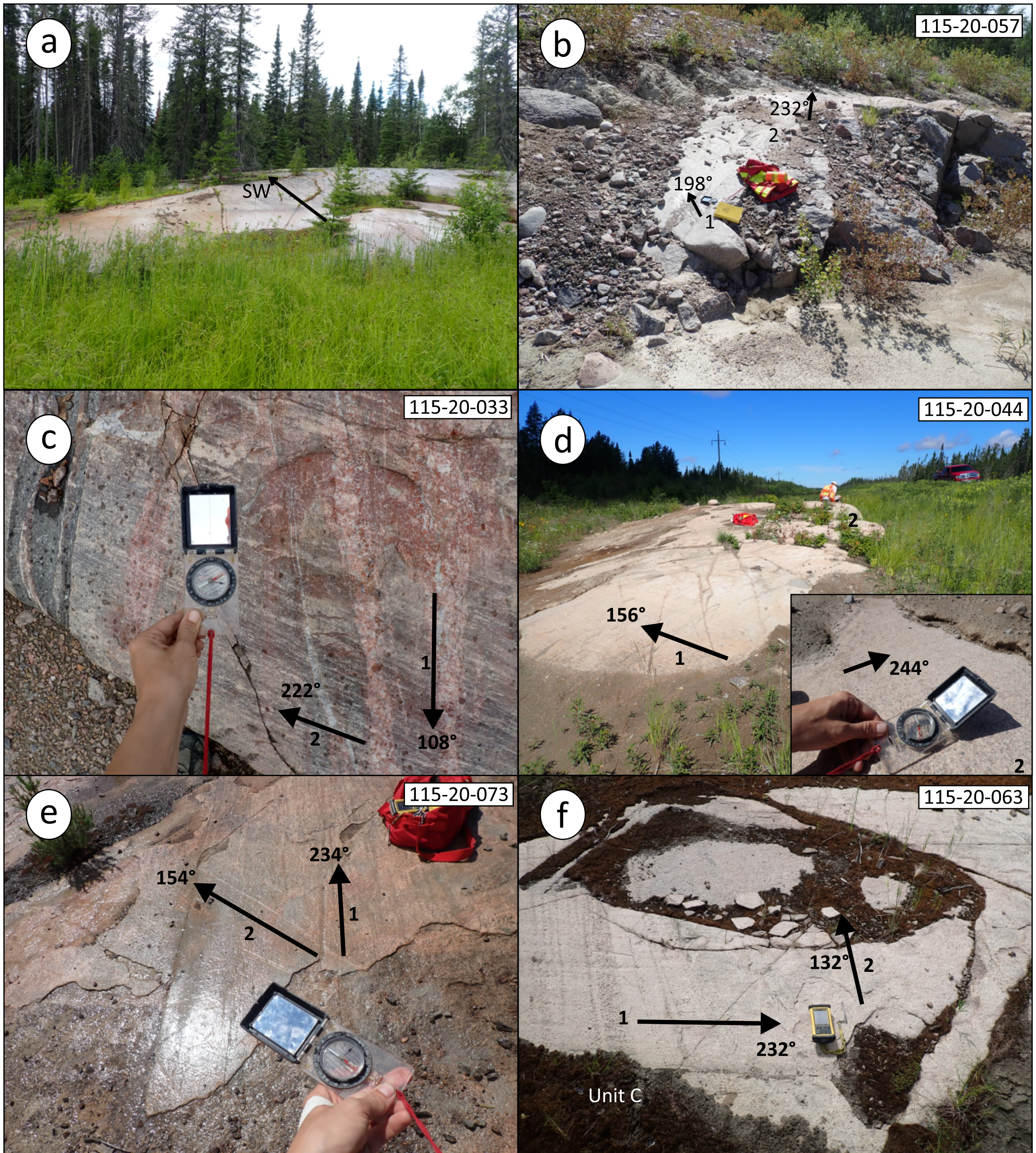


Figure GS2020-6-2: *Ice-flow–indicator data in the study area. Larger circles show a summary of the relative ages (1 = oldest) and trends of field-based ice-flow indicators for a single site or sites in close proximity to each other. The generalized ice-flow directions provide a key for differentiating between old and young ice flows of similar orientation. OF2910 refers to Henderson (1994) and AR84-2 refers to Groom (1985). Background hillshade was generated using a Shuttle Radar Topography Mission digital elevation model (United States Geological Survey, 2014).*



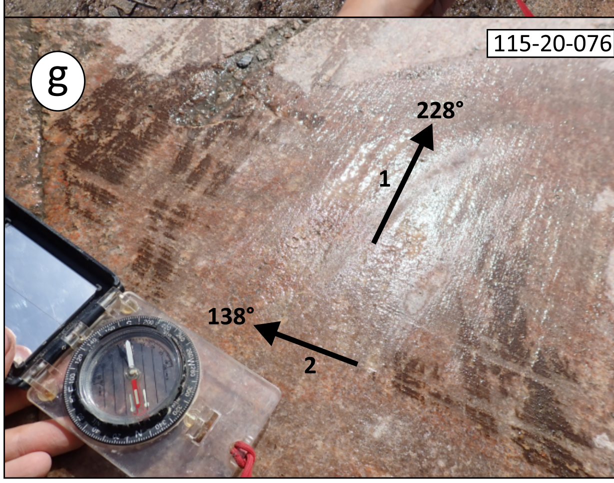


Figure GS2020-6-3: *Examples of ice-flow indicators in the study area include* ***a)*** *typical low-lying outcrop, just after a rainstorm, with a gently sloping stoss surface that is consistently grooved toward the southwest (SW);* ***b)*** *grooves toward 198° are preserved on a slope that was till-protected during a younger ice flow toward 232°;* ***c)*** *a set of smoothed chattermarks toward 108° are cross-cut by abundant grooves and striations toward 222°;* ***d)*** *shovel-width grooves toward 156° on a south-southwest-facing slope were protected during younger ice flow evidenced by abundant finer grooves toward 244° on an upper south-southeast-facing slope;* ***e)*** *abundant grooves toward 234° are cross-cut by deeper grooves and crescentic fractures toward 154°;* ***f)*** *several rough grooves toward 232° are cross-cut by deeper grooves and crescentic fractures toward 132°;* ***g)*** *striations toward 228° are cross-cut by striations toward 138°.*

Future work

Ongoing surficial geological analysis focuses on updating the 1:50 000 scale surficial mapping along the road, as well as characterizing the till composition. The latter will be accomplished by clast-lithology counts and geochemical analysis of the 16 collected till sample matrices. Results of these analyses will

- provide a better understanding of the surficial geology variability in the area;
- identify favourable geochemical or mineralogical indicators within till to aid mineral exploration; and
- establish compositional till characteristics (where sparse till is present).

Economic considerations

A thorough understanding of surficial geology is essential for drift prospecting in Manitoba's largely drift-covered regions. Till-sample analysis is commonly used in drift-covered regions to help determine the source area for mineralized erratics and boulder trains. Interpretation of till composition depends on exactly what material was sampled, as well as detailed attention to the potential for palimpsest dispersal patterns in areas that have been modified by more than one ice advance and transport direction. The extensive glaciolacustrine deposits and the sparse till deposits suggest different exploration tools are necessary in this area.

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