GS2020-1

Results of reconnaissance bedrock mapping along East Side Road, southeastern Manitoba (parts of NTS 62P1, 7, 8, 10, 15, 63A2, 7)

by M.L. Rinne

In Brief:
- Reconnaissance bedrock mapping was carried out along the new ~160 km route near the southeast shore of Lake Winnipeg
- Gneissic granitoid units were encountered along with gabbro and granitic pegmatite dikes
- Sites near Bloodvein First Nation may be suitable for dimension stone quarrying

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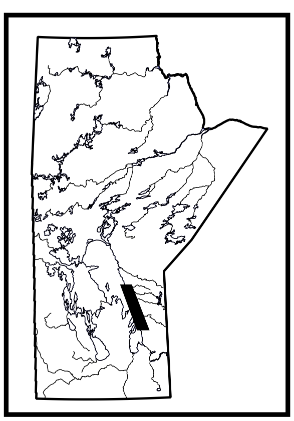

Summary

The recently constructed East Side Road was selected for new geological mapping by the Manitoba Geological Survey (MGS). Reconnaissance bedrock mapping was carried out by truck and short inland traverses along the approximately 160 km route near the southeastern shore of Lake Winnipeg. Dominantly gneissic units of tonalite, quartz diorite, granite to granodiorite, megacrystic granite and porphyritic granite of the Berens River domain were encountered, along with minor gabbro dikes and widespread granitic pegmatite dikes. Most of the outcrops along East Side Road display a well-developed gneissosity followed in places by late shears, faults and fractures. Preliminary results indicate that some sites near Bloodvein First Nation could be suitable for dimension stone (e.g., polished granite slab) quarrying.

Introduction

In 2020, bedrock exposures including new roadcuts and quarry walls were examined along East Side Road, an all-season road that connects the First Nation communities of Berens River and Bloodvein to Provincial Road 304 near Hollow Water First Nation (Figure GS2020-1-1a). Quaternary investigations, including ice-flow mapping and till sampling, were carried out along the same route; the preliminary results of that work are described in Gauthier and Hodder (2020). In addition to the results reported here, an Open File release of geochemical and geochronological data from this project is planned following receipt of results from analyses of the 2020 field samples.

The southernmost 40 km of East Side Road (previously Rice River Road) has been mapped and described by several workers, particularly in areas nearest Provincial Road 304; much of that work was compiled by Bailes et al. (2003). The remaining 120 km of road from Loon Bay to Berens River is new, extending through a region that lacks geochronological data and has seen little mapping, mostly limited to shoreline surveys and helicopter-supported regional work by the Geological Survey of Canada (Ermanovics, 1970a, b). Current understanding of the geology in the study area relies heavily on interpretations from 1970 and earlier, despite complications such as inconsistent legends and unit names that do not correspond to the nomenclature (Streckeisen, 1974) currently employed by the MGS.

Regional geology

Rocks mapped along East Side Road are located in the Berens River domain, a large region dominated by Neoarchean granitoid plutons that occupies most of the eastern shoreline of Lake Winnipeg and extends into Ontario across the western part of the Superior province. In Manitoba, the Berens River domain is bounded to the north by an unnamed regional shear zone through the Cobham River–Gorman Lake greenstone belt and to the south by the Wanipigow shear zone (Figure GS2020-1-1a). Supracrustal units are rare in the Berens River domain; notable examples are located in the Horseshoe Lake area in Manitoba (northeast of the map area shown in Figure GS2020-1-1a), and around Oooowee Sahkaheekahn/McInnes Lake (formerly McInnes Lake), Hornby Lake and Cherrington Lake in Ontario (Stone, 1998). Ultramafic intrusions have also been documented at several locations within granitoid units near the Wanipigow shear zone, including the English Lake intrusive complex (ELC in Figure GS2020-1-1a).

The Berens River domain forms the core of the North Caribou superterrane, which extends from the Uchi domain in the south to the Oxford–Stull domain in the north. The North Caribou superterrane represents a crustal block that was assembled relatively early during the amalgamation of the Superior province; its extent can be defined by ca. 3.0 Ga mantle-extraction ages (Hollings et al., 1999; Percival et al., 2006). Later magmatism and deformation have substantially

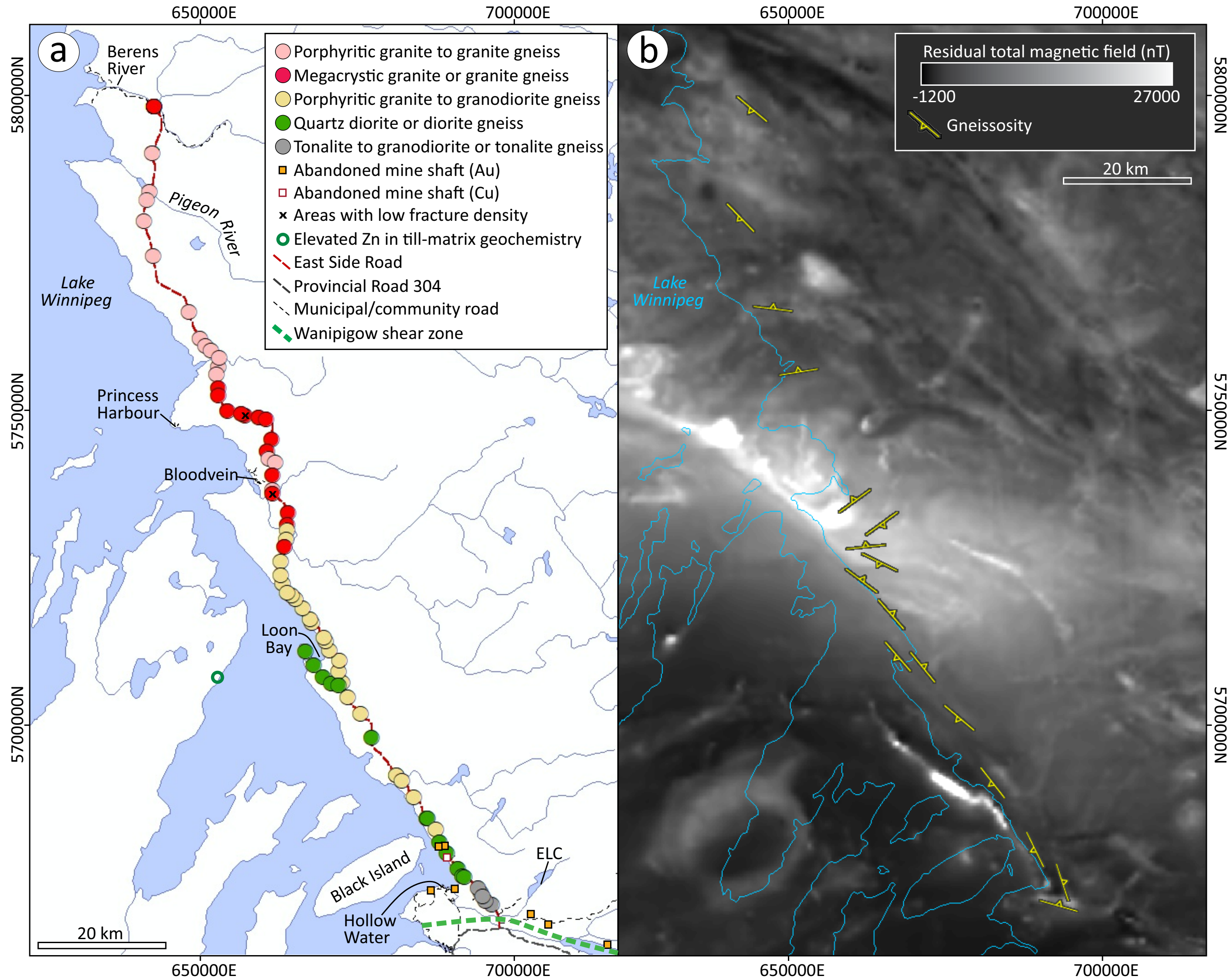

***Figure GS2020-1-1**: Bedrock mapping along East Side Road in southeastern Manitoba showing **a)** 2020 station locations coloured according to dominant rock unit; **b)** greyscale map of the residual total magnetic field, with selected but regionally representative gneissosity measurements (same area as in panel a). First Nation communities and other locations mentioned in the text are labeled. Roads on the western side of Lake Winnipeg are not shown. The elevated Zn value across from Loon Bay refers to a till-matrix (<177 µm-size fraction) analysis with 236 ppm Zn, which far exceeds background values (Hodder and Bater, 2016). The Wanipigow shear zone marks the boundary between the Uchi and Berens River domains. Aeromagnetic data are from Viljoen et al. (1999). Co-ordinates are in UTM Zone 14, NAD83. Abbreviation: ELC, English Lake complex.*

overprinted the older crustal remnants, including voluminous arc magmatism in the Berens River domain at ca. 2.75–2.71 Ga (Percival et al., 2006).

The Uchi domain, forming the southern part of the North Caribou superterrane, includes prolific gold camps such as the Red Lake district in Ontario and the Rice Lake greenstone belt in Manitoba. The southern end of East Side Road traverses only a few kilometres of the Uchi domain; most of the route, including stations described in this report, is located in the southwestern part of the Berens River domain.

Geology of East Side Road

Geological units are described below in estimated order of emplacement, from earliest to latest. Geochronological analyses are planned for several of the 2020 field samples. Although the rocks underwent amphibolite– to lower-granulite–facies metamorphism, the 'meta' prefix is omitted from this report.

Tonalite to granodiorite/tonalite gneiss

Outcrops of tonalite to granodiorite were mapped in the southern part of East Side Road, near Hollow Water First Nation (Figure GS2020-1-1a). The rocks are light grey-beige on most weathered surfaces and light grey to grey-green on fresh surfaces (Figure GS2020-1-2a). They contain abundant phenocrysts of quartz and subhedral to rounded plagioclase 1–5 mm across in a fine-grained groundmass that commonly displays conchoidal fractures. Two outcrops appear slightly pink on weathered surfaces and have sparse phenocrysts of what is

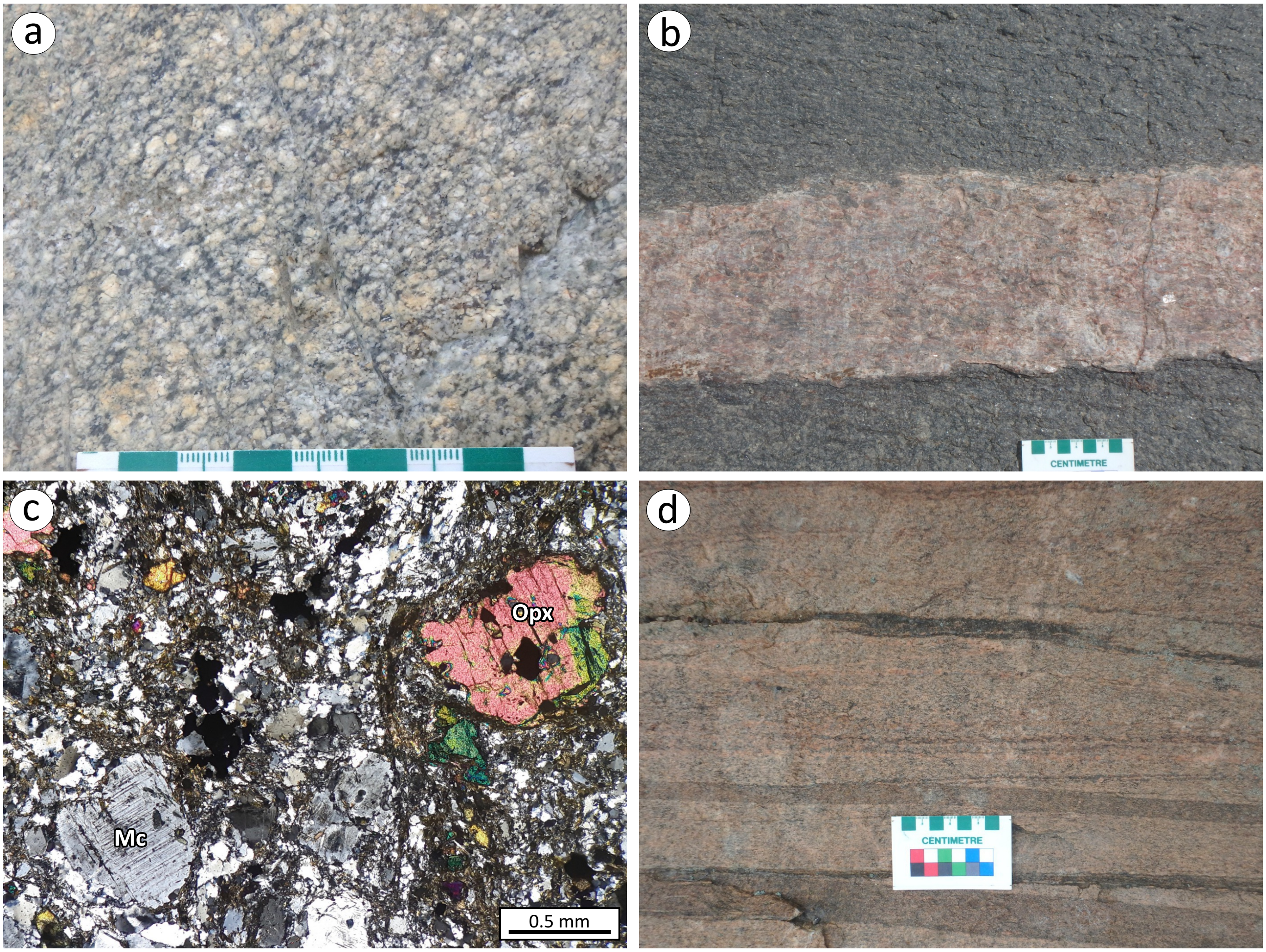

Figure GS2020-1-2: *Outcrop and thin-section photographs of East Side Road units mapped in 2020, showing* ***a)*** *tonalite with rounded plagioclase and smaller quartz phenocrysts on weathered surface (scale in centimetres);* ***b)*** *fresh surface of moderately foliated quartz diorite (dark grey) and a medium- to coarse-grained granite dike;* ***c)*** *photomicrograph of porphyritic granite with orthopyroxene and microcline in a groundmass consisting mostly of K-feldspar, quartz and biotite (cross-polarized light);* ***d)*** *porphyritic granite gneiss from the southern portion of the road, with discrete gneissic bands and possible examples of deformed mafic xenoliths (black streaks). Abbreviations: Mc, microcline; Opx, orthopyroxene.*

likely orthoclase; these were identified in the field as granodiorite. The rocks vary from moderately foliated to gneissic and locally intensely sheared, with mylonitic bands parallel to the gneissosity. Gneissic examples contain quartz and plagioclase phenocrysts preserved as porphyroclasts or augen.

Ermanovics (1981) described small lenses of ultramafic rock hosted within the tonalite near Manigotagan. Ultramafic rocks were not documented during the 2020 fieldwork, except for one thin exposure of serpentine-chlorite–altered cataclasite within faulted tonalite; geochemical results are pending.

Quartz diorite/diorite gneiss

Quartz diorite was mapped along the route directly east of Black Island and extending along the peninsula that forms the western part of Loon Bay (Figure GS2020-1-1a). The diorite is light grey-beige or rarely light grey-green on weathered surfaces and dark grey on fresh surfaces (Figure GS2020-1-2b). It consists of approximately 40–60% quartz and plagioclase phenocrysts (or porphyroclasts in areas of higher strain) 0.5–2 mm across, within a darker grey groundmass containing up to 35% mafic minerals (secondary actinolite, hornblende and minor orthopyroxene). The diorite outcrops vary from moderately foliated to intensely foliated with gneissic layering, which is defined by centimetre-scale variations in mafic-mineral abundance in more strongly deformed outcrops, along with variations in porphyroclast size.

Porphyritic granite to granodiorite gneiss

Porphyritic granite to granodiorite gneiss occupies a large region from near the northern tip of Black Island to near Bloodvein First Nation (Figure GS2020-1-1a). All outcrops of this unit contain gneissic banding, though the banding is in places subtle and more easily identified on large fresh exposures such as roadcuts. The gneiss is typically light pink-grey on weathered surfaces and tan-grey on fresh surfaces. Near Loon Bay, some outcrops contain alternating layers up to 30 cm thick of granitic gneiss and a grey-beige gneiss apparently lacking K-feldspar, interpreted as intermixed layers of the quartz diorite described above.

The granite to granodiorite gneiss contains an assemblage of K-feldspar (microcline and orthoclase, as porphyroclasts), quartz, plagioclase, orthopyroxene, biotite and hornblende, in addition to later (or retrograde) chlorite and calcite (Figure GS2020-1-2c). Trace phases include pyrite and zircon. The orthopyroxene-bearing assemblage is consistent with the findings of Ermanovics (1970, 1973), who noted regional metamorphism ranging mostly from amphibolite– to lower-granulite–facies in the study region.

Driving north of Loon Bay, the gneiss demonstrates a gradual change in overall colour, becoming darker grey especially on fresh surfaces, reflecting a northward increase in the abundance of mafic minerals (biotite, hornblende and orthopyroxene). This change appears to correspond to a regional increase in total magnetic intensity (Figure GS2020-1-1b), although no magnetism was noted in outcrops of the granite to granodiorite gneiss.

Although the overall composition of the unit remains felsic, pronounced gneissic banding within some of the slightly darker outcrops along the northern portion of the road has produced a few isolated layers of dark material that can resemble xenoliths of mafic rock, particularly on small exposures (Figure GS2020-1-2d). These features may correspond to the small zones of “mafic gneiss” described by Ermanovics (1970a, unit 9), though they are distinct from the gabbro unit described below.

Megacrystic granite/granite gneiss

Megacrystic granite was mapped mostly near Princess Harbour and Bloodvein, as well as at a single station at the northern end of East Side Road, at the turnoff toward Berens River First Nation (Figure GS2020-1-1a). The granite is light pink-grey on most weathered surfaces and dark tan-grey to red on fresh surfaces. Most of the rock comprises a groundmass of equigranular to weakly porphyritic granite with quartz and K-feldspar phenocrysts 2–4 mm across and 5 to 20% hornblende and biotite. Scattered subhedral K-feldspar megacrysts 3–8 cm across are distinctive (Figure GS2020-1-3a) and make up between 1 and 15% of the outcrops. Titanite is a common accessory phase in the megacrystic granite, occurring as disseminated euhedral rhombs 0.5–3 mm across, and is in places altered to a distinctive yellow (likely a mixture of calcite and anatase).

The megacrystic granite is generally massive in outcrop, except for local strain partitioning and fracture development, and in places displays a subtle, shallow eastward-plunging linear fabric from the orientation of K-feldspar megacrysts. However, east and south of Bloodvein, the unit occurs as a granite gneiss in which megacrysts are preserved as large (~4 cm) K-feldspar porphyroclasts.

Porphyritic granite to granite gneiss

Porphyritic granite to granite gneiss occupies most of the stretch from Princess Harbour to Berens River and is interpreted as a marginal phase to the megacrystic granite. The granite along the northern part of the road is identical to the groundmass of the megacrystic granite described above (Figure GS2020-1-3b) and contacts with the megacrystic granite appear to be gradational over hundreds of metres on the basis of a decreasing abundance or gradual disappearance of megacrysts between outcrops. Both the megacrystic and the porphyritic granite contain partially assimilated xenoliths of probable diorite (Figure GS2020-1-3c), possibly derived from the quartz diorite unit near Loon Bay.

Gabbro dikes

Gabbro dikes were documented at five locations between Loon Bay and the area east of Black Island, but they do not form a mappable unit. The gabbro is fine-grained and appears dark grey-green on both fresh and weathered surfaces. The dikes range from 2 to 80 cm in width, with sharp contacts transposed parallel to the regional gneissosity, and are commonly boudinaged (Figure GS2020-1-3d), dismembered and folded about axial planes that parallel the gneissosity. The gabbro dikes crosscut the quartz diorite and granite-granodiorite gneiss units, and were themselves cut by late granite dikes.

Granitic pegmatite dikes

Fifteen examples of granitic pegmatite were documented along East Side Road, from Loon Bay to the Pigeon River (Figure GS2020-1-1a). Pegmatite occurs in dikes that range between 5 cm and 3 m in thickness (Figure GS2020-1-4a), with crystals reaching up to 11 cm in length. The mineralogy of the dikes consists of approximately 60% K-feldspar (locally containing perthitic lamellae and graphic quartz intergrowths), 20% quartz, 10% plagioclase, 5–10% biotite and muscovite, trace hornblende and, in a few locations, up to 5% magnetite in aggregates up to 4 cm across (Figure GS2020-1-4b). Secondary chlorite and actinolite (after micas) and epidote and sericite (after feldspars) are also common. Although geochemical data are pending, the mineralogy of these simple pegmatites suggests little potential for pegmatite-hosted rare-metal mineralization (e.g., lithium).

The pegmatite dikes have mostly sharp and irregular margins transposed subparallel to the gneissosity. In the megacrystic granite, a few pegmatite dike contacts appear to be diffuse over several centimetres. In areas of higher strain, particularly

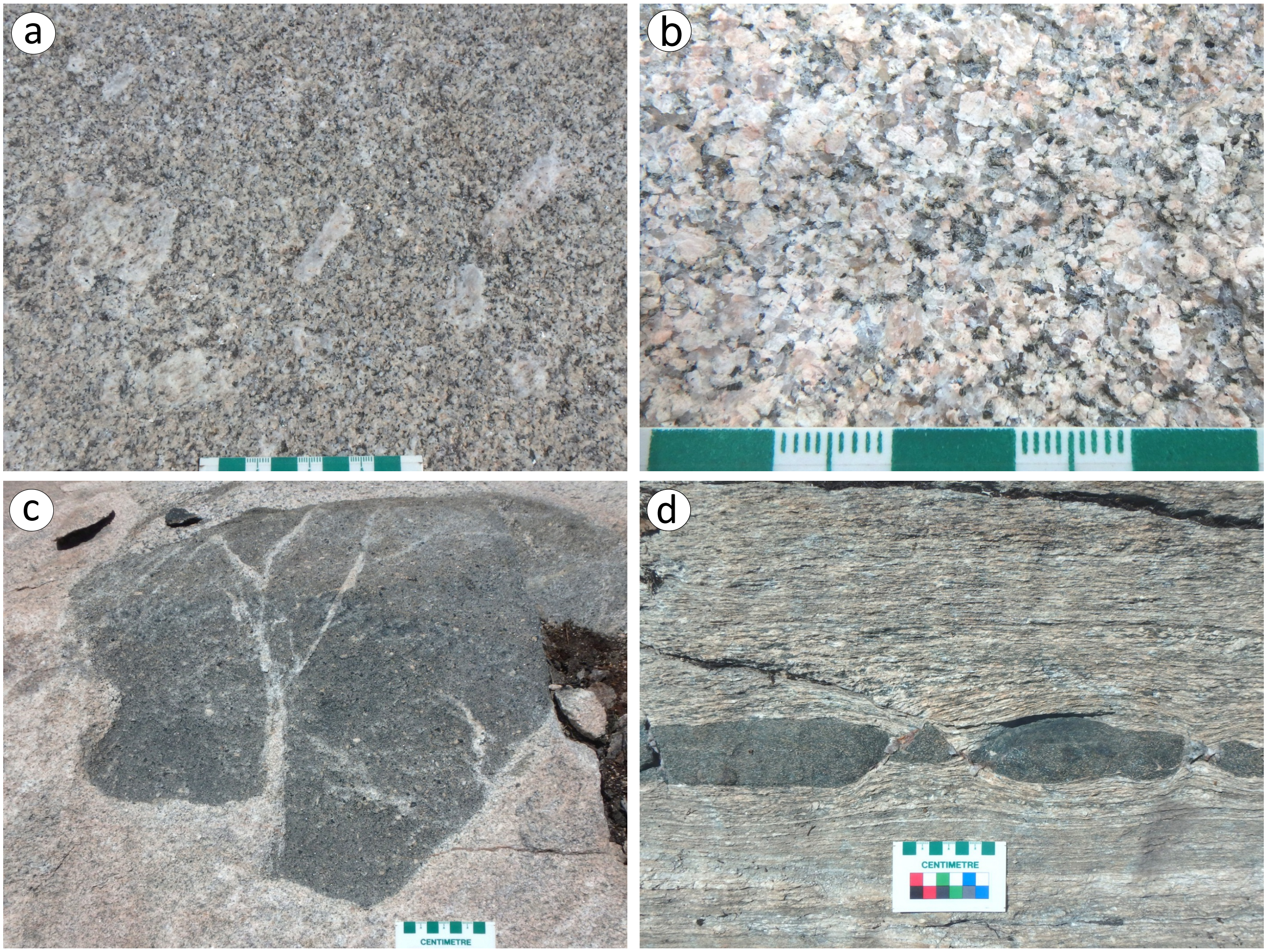

Figure GS2020-1-3: *Outcrop photographs of East Side Road units mapped in 2020, showing* ***a)*** *granite containing K-feldspar megacrysts (scattered throughout image centre) in a coarse-grained granite groundmass (scale in centimetres);* ***b)*** *porphyritic to equigranular granite similar to the groundmass in panel a, with K-feldspar phenocrysts only slightly larger than the surrounding groundmass (scale in centimetres);* ***c)*** *angular quartz diorite xenolith in northern porphyritic granite;* ***d)*** *boudinaged gabbro dike in gneissic quartz diorite.*

around Loon Bay, the pegmatite dikes commonly show grain-size reduction toward dike margins, with micas deformed into seams or stringers, and larger quartz and K-feldspar crystals preserved as porphyroclasts up to 6 cm in diameter.

Granite dikes

Granite dikes are common along the entire length of East Side Road and were found to crosscut all plutonic units as well as the gabbro and granitic pegmatite dikes. The dikes are 1 cm to 2 m thick, with an equigranular to weakly porphyritic texture that ranges from fine- to coarse-grained (Figure GS2020-1-2b). In gneissic outcrops, the dikes were transposed parallel to the gneissosity and are commonly folded about axial planes that parallel the gneissosity. Most of the dikes have sharp, irregular margins; a few exceptions were found in the megacrystic granite, where granite dikes contain contacts that are diffuse over several centimetres into the host granite. Similar features were noted in some of the pegmatite dikes and may imply a coeval relationship (i.e., the dikes represent a late stage of a multiphase granitic intrusion) and/or that the megacrystic granite was hot and plastic during the intrusion of both the granite and granitic pegmatite dikes.

Post-gneissosity granite dikes

Relatively undeformed granite dikes between 1 and 25 cm thick were found at three locations near Bloodvein First Nation. In the field, these dikes are indistinguishable from the granite dikes described above, except that they postdate the development of gneissic banding and folding (Figure GS2020-1-4c), and contain weak K-feldspar alteration haloes. The dikes are fine- to medium-grained and weakly porphyritic, trending north-northwest and dipping steeply to the east.

Structural geology

Most of the outcrops along East Side Road display a well-developed gneissosity in addition to late shears and fractures.

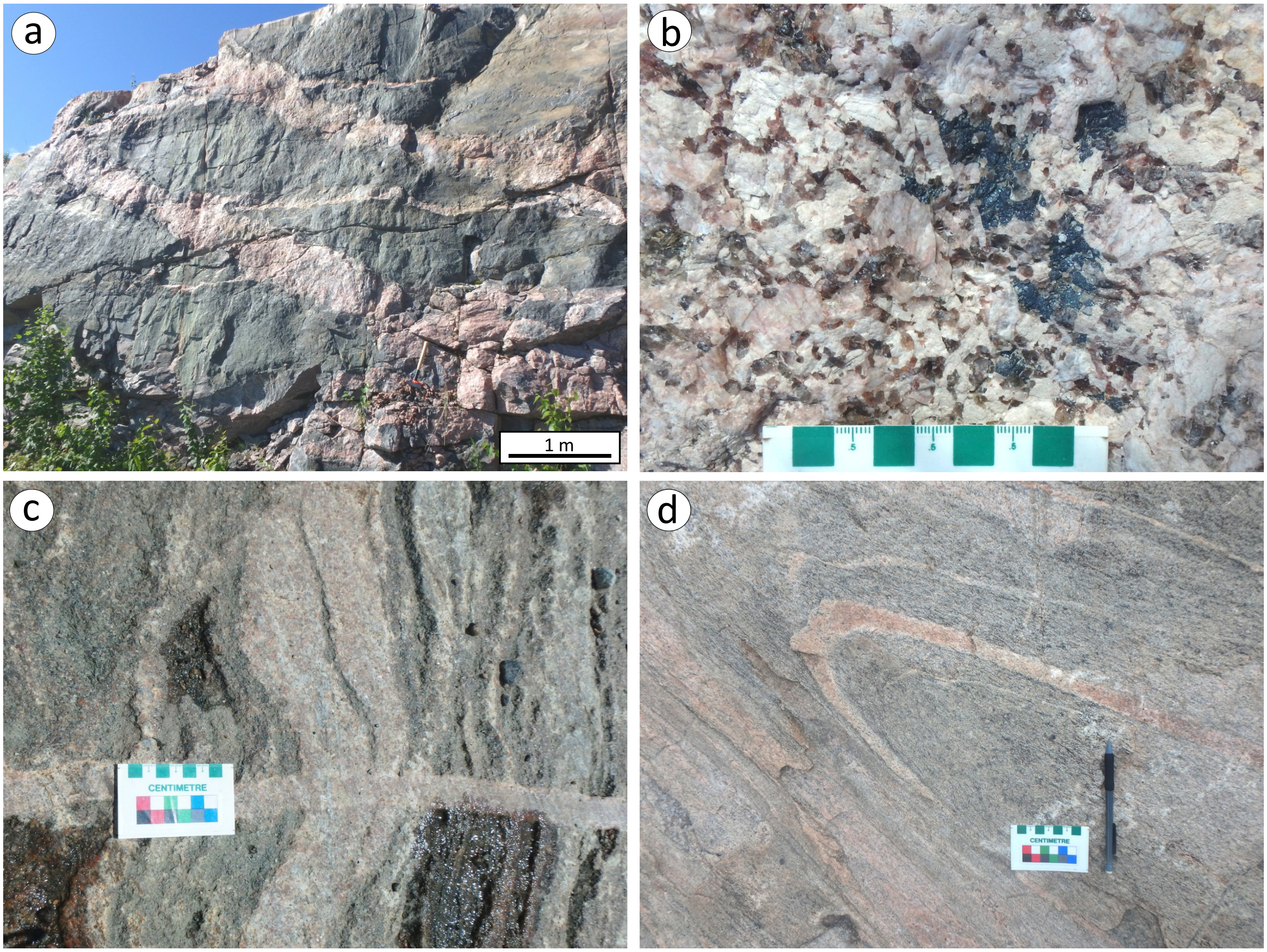

***Figure GS2020-1-4:** Outcrop photographs of East Side Road units mapped in 2020, showing **a)** granitic pegmatite dikes (pink) exposed along a subvertical slickenside face; **b)** magnetite aggregates (right of centre) within a coarse-grained portion of a granitic pegmatite dike (scale in centimetres); **c)** megacrystic granite gneiss (containing large porphyroclasts not visible in photo) and a deformed pegmatite dike (vertical pink dike through image centre) crosscut by a post-gneissosity granite dike (horizontal across image); **d)** tight to isoclinal folds, with axial plane parallel to the regional gneissosity in granite gneiss (pencil pointing north).*

In granitoid rocks, the gneissic banding is defined by the relative abundance of biotite and hornblende. The thickness of the bands correlates mostly with the degree of strain; the most strongly deformed outcrops—especially around Loon Bay and the area east of Black Island—contain bands a few centimetres wide (e.g., Figure GS2020-1-2d) and locally grade into thin (<30 cm) shear zones with mylonite subparallel to the gneissosity. Sigmoid porphyroclasts at several locations record evidence of both sinistral and dextral movement, with no clear prevalence observed in any area. The gneissic banding is also commonly accompanied by tight to isoclinal folds (Figure GS2020-1-4d), with axial planes parallel to the regional gneissosity.

The orientation of gneissic banding varies at outcrop scales, but on average it tends to follow the regional magnetic fabric visible in aeromagnetic data (Figure GS2020-1-1b). In areas south of Loon Bay, gneissosity along East Side Road dips steeply (>70°) and trends generally south-southeast or north-northwest. Driving north from Loon Bay to Bloodvein, the overall strike rotates counterclockwise (Figure GS2020-1-1b), shallowing locally to subhorizontal, and strain gradually decreases into weakly foliated outcrops of megacrystic granite east of Princess Harbour. North of this area and extending up to Berens River, gneissosity is steeply dipping and trends west or southeast, again broadly tracing the regional magnetic fabric.

Small shears were measured at seven locations along the southern half of East Side Road. Both sinistral and dextral shears were noted, which range from 3 to 20 cm in thickness. The shears crosscut the gneissosity and are subvertical, trending generally northeast or south-southeast. Three fault planes were also noted along roadcut faces in the southern half of East Side Road: one fault striking northwest and dipping ~74° northeast in granite gneiss (with slickenside producing the dark surface pictured in Figure GS2020-1-4a); and a further two subvertical faults striking south-southeast in the tonalite near Hollow Water. Slickenside fabric along the fault planes is subhorizontal in all three cases, indicating transfer movement along the south-southeast-trending structures. A section of chlorite- and serpentine-altered cataclasite preserved at one location suggests a minimum fault thickness of 1.5 m. Elsewhere, the thickness of the faults is unclear as only one face was preserved along each roadcut.

Minor joints or fractures are present in every outcrop mapped along East Side Road and are the latest structures documented in the study area. The fractures are approximately 1 mm wide and are slightly undulating. Preliminary measurements indicate four dominant fracture orientations: one set striking ~225° and dipping 55–85°; a second at ~300° and subvertical; a third at ~75° and subvertical; and a fourth set of subhorizontal fractures. The combination of these fracture orientations typically results in blocky faces along roadside outcrops.

Most outcrops contain abundant fractures spaced at most a few metres apart. However, two large exposures near East Side Road (marked by × symbols in Figure GS2020-1-1a) were found to contain only sparse fractures, in places between 20 and 40 m apart. These flat outcrops of megacrystic granite and granite gneiss contain few vertical exposures; therefore, subhorizontal fractures may be underrepresented. The apparently low fracture density may make these rocks suitable for dimension stone (e.g., polished granite slab) quarrying.

Economic considerations

East Side Road provides a small transect through the southwestern part of the Berens River domain. Several features in this area indicate potential for mineral resources, most notably

- Dimension stone quarries can be economically viable in areas with appropriate rock types, low fracture density and proximity to transportation infrastructure (e.g., Schmidtke, 1994). Preliminary findings along East Side Road point to two areas (Figure GS2020-1-1a) in which these conditions may be met.
- Gold is a substantial resource in the Rice Lake belt of the Uchi domain. North of the Wanipigow shear zone, shears through granitoid rocks of the Berens River domain are host to several gold occurrences and deposits, mostly east of the area shown in Figure GS2020-1-1a. Results of the 2020 reconnaissance mapping did not point to alteration or major structures with obvious connections to lode-gold mineralization. Further investigation may be warranted, as there are limited records concerning historical gold (±copper) mine shafts near the southern parts of East Side Road (Figure GS2020-1-1a).
- Pegmatite-associated rare-metal mineralization has been discovered in parts of the Superior province both north and south of the study area, though most known occurrences and deposits are hosted in granite-greenstone (as opposed to granitoid-dominated) domains. Granitic pegmatite dikes are common along East Side Road, but all appear to be simple pegmatites with little potential for rare metals. These results do not discount the potential for mineralized pegmatites elsewhere in the Berens River domain.
- Base-metal deposits, including zinc, are unlikely in granitoid-dominated regions such as the Berens River domain. However, an elevated zinc value in till matrix collected along the southwestern shore of Lake Winnipeg could imply a source to the northeast (up ice), potentially across the study area. Depending on the size of the possible dispersal train, there is a chance that upcoming till geochemistry results from the East Side Road project (Gauthier and Hodder, 2020) can help to resolve the anomaly.
- Ultramafic intrusions have been mapped along and near the northern flank of the Rice Lake belt, including the nickel- and copper-mineralized English Lake complex (ELC in Figure GS2020-1-1a; Assessment File 73929). Although no ultramafic units were encountered along East Side Road (with the possible exception of one thin exposure of serpentine- and chlorite-altered cataclasite), there is related, albeit minor, potential for nickel-copper mineralization near the southern part of East Side Road.
- There is currently little information to assess diamond potential along East Side Road. The Berens River domain represents old crust that was formed prior to the accretion of much of the rest of the Superior province; such conditions can be favourable for diamond formation. Kimberlite indicator mineral analyses of till samples collected this summer (Gauthier and Hodder, 2020) could inform future studies on diamond potential in the area.

Acknowledgments

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