# GS2024-8

# Preliminary field observations of Mesoarchean metamorphosed sedimentary and intrusive rocks in the Rice Lake greenstone belt, eastern Manitoba (parts of NTS 52L14, 52M3, 62P1)

**by E. Tonboe[1], P. Waterton[1], R. Haugaard[2], S.D. Anderson[3] and C.G. Couëslan**

**In Brief:**

- Field observations and samples of Mesoarchean metamorphosed sedimentary and intrusive rocks were collected with the goal of understanding the early western Superior province crust
- 3.0 Ga tonalitic gneisses of the North Caribou terrane contain several serpentinized ultramafic pods and are overlain by mature Mesoarchean metasediments.

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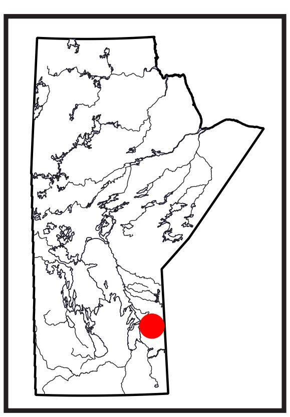

## Summary

This report provides field observations from the eastern shore of Lake Winnipeg (Lewis-Storey assemblage), and from Wallace (Wallace assemblage) and Garner (Garner Lake intrusive complex) lakes. Fieldwork was carried out in August 2024 to collect samples for a Ph.D. project involving the nature, composition and growth of early crust of the western Superior province. Highlights of the fieldwork include findings of fuchsite-bearing quartzite in the Lewis-Storey assemblage as well as ultramafic pods within the tonalitic gneiss of the North Caribou terrane.

## Introduction

The Rice Lake greenstone belt in eastern Manitoba is well studied and mapped due to its significant lode-gold deposits, good exposure and easy access, providing a good framework for geological fieldwork. In August 2024, fieldwork was carried out along the eastern shore of Lake Winnipeg, and at Wallace and Garner lakes with a focus on Mesoarchean metamorphosed sedimentary and intrusive rocks. The purpose of the fieldwork was to collect data via observations of type exposures and samples (n = 91) for a Ph.D. project that will investigate the nature, composition and formation of the early crust of the western Superior province, primarily through the study of clastic sedimentary rocks.

The eastern shore of Lake Winnipeg (Black Island–Seymourville area) was mapped at 1:20 000 scale by Bailes and Percival (2005) and has been the subject of several studies (e.g., Percival and Whalen, 2000; Percival et al., 2006). The Wallace Lake area has not been mapped recently but is relatively well described and studied (e.g., Sasseville and Tomlinson, 2000; Sasseville et al., 2006; Fralick et al., 2008), whereas the Garner Lake area was mapped in 1:20 000 by Anderson (2013a). These well characterized areas allowed for targeted and detailed fieldwork.

Mature, clastic sediments contain the concentrated detritus of exposed landmasses over a large region. They can therefore provide insights into the composition and history of their source area, and many inferences on the nature and evolution of the Archean crust come from such sediments and resulting sedimentary rocks (e.g., O'Neil et al., 2024). However, interpreting the nature of this crust is not straightforward and may depend on the geochemical proxies used. For example, estimates of the relative proportions of mafic and felsic rocks in the Archean crust range from mafic-dominated, when determined using trace element ratios involving Ni and Cr (e.g., Tang et al., 2016), to felsic-dominated, when using Sm/Nd ratios (Garçon, 2021) or major element contents (Lipp et al., 2021). Existing methods for reconstructing the timing of the growth of Earth's continental crust are also significantly biased toward detecting felsic crust formation. This is due to their reliance on isotopes, such as Sm-Nd, which are present in much higher concentrations in felsic rocks, or on zircon, which predominantly crystallizes in felsic magmas (e.g., Dhiume et al., 2017).

Haugaard et al. (2021) demonstrated a new method for detecting mafic and ultramafic crust using detrital chromite in terrigenous clastic sedimentary rocks. Chromite crystallizes exclusively in mafic and ultramafic magmas, contains information about the magma from which it crystalized (e.g., Barnes and Roeder, 2001; Barnes et al., 2022) and can be dated using the rhenium-osmium (Re-Os) method (Haugaard et al., 2021). Detrital chromite can thus be used to reconstruct the growth of mafic and ultramafic crust in a manner similar to that which uses Hf isotopes in zircon to trace felsic crust evolution. Chromite is resistant to transport and weathering and is often found as heavy-mineral laminations or within fuchsite-rich horizons (Cr-rich mica) in quartz arenites. Quartz arenites are chemi-

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cally mature sedimentary rocks that likely sampled large source areas, potentially making them representative of the regional crust that was exposed during their deposition.

The oldest rocks in the Rice Lake greenstone belt area are 3.0 Ga tonalitic gneisses of the North Caribou terrane, which are overlain by mature quartzites of the Lewis-Storey and Wallace assemblages. The maximum depositional age for the Lewis-Storey quartzite is constrained by detrital zircons to be 2991 Ma, with a minimum age of 2978 Ma defined by a crosscutting rhyolite sill (Percival et al., 2006). Little is known of the crustal precursors to the tonalitic gneisses, as well as whether or not mafic and ultramafic rocks were a common component of the early North Caribou terrane crust. Detrital chromite and zircon of the Lewis-Storey and Wallace assemblages might contain this information.

During fieldwork, samples of quartzites and associated metasedimentary rocks were collected at Wallace Lake and along the eastern shore of Lake Winnipeg to recover detrital chromite and zircon. Additionally, samples of the basement gneisses and associated ultramafic pods were collected as potential sources of detrital zircon and chromite. Finally, a layered intrusion, the Garner Lake intrusive complex, was investigated to understand the magmatic processes associated with such an intrusion. Although too young to be a source of detrital chromite in the metasedimentary rocks sampled at Lake Winnipeg and Wallace Lake, the intrusion might be an analogue to the heavily serpentinized ultramafic pods of unknown age within the 3.0 Ga tonalitic gneiss at the eastern shore of Lake Winnipeg.

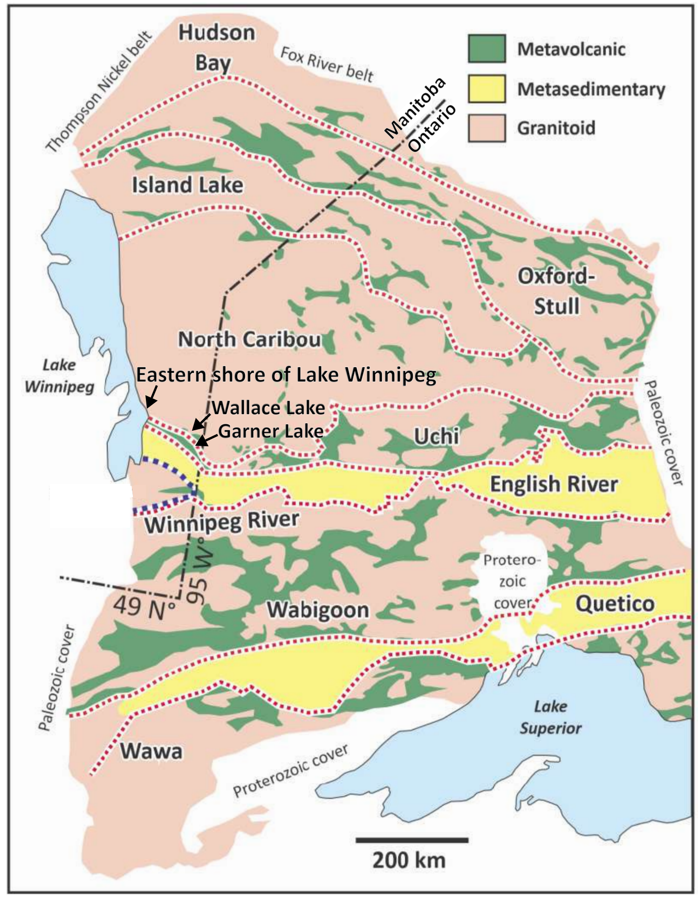


*__Figure GS2024-8-1:__ Simplified geology of the northwestern Superior province from Martins et al. (2023). The black arrows indicate the locations of the three study areas and the red dashed lines represent the terrane and subprovince boundaries.*

## Geological setting

The western Superior province can be divided into terranes and subprovinces that generally form large east-trending blocks (Figure GS2024-8-1). Terranes are defined by tectonic packages, whereas subprovinces are defined by lithological assemblages (Card and Ciesielski, 1986). The North Caribou terrane is considered to be the protocratonic nucleus of the western Superior craton, to which other terranes were accreted during the Neoarchean (Percival, 2007). Its southern margin consists of a 3.0 Ga tonalitic gneiss complex that is intruded by several different phases of granitoid plutons, the youngest of which was regional in scale and spanned 2.75–2.69 Ga (Corfu and Stone, 1998; Whalen et al., 2003). The tonalitic gneisses are nonconformably overlain by platform-rift deposits of the Lewis-Storey and Wallace assemblages, which are interpreted to record a plume-driven break-up event of Mesoarchean age (Sasseville and Tomlinson, 2000; Percival et al., 2006). These Mesoarchean units are juxtaposed against much younger Neoarchean supracrustal rocks forming part of the Uchi subprovince (Percival et al., 2006).

The Rice Lake greenstone belt in eastern Manitoba is part of the Uchi subprovince. Its boundary with the North Caribou terrane to the north is marked by the Wanipigow fault and it is bounded to the south by the English River subprovince. The Rice Lake greenstone belt consists primarily of Neoarchean supracrustal rocks that were accreted onto the southern margin of the North Caribou terrane (Percival et al., 2006). Mesoarchean intrusive and supracrustal rocks in the Garner Lake area were likewise accreted to the southern margin of the North Caribou terrane, as part of an older arc–back-arc complex (Anderson, 2013b). In the study area, volcaniclastic and epiclastic rocks are intruded by the Garner Lake intrusive complex. The intrusive complex consists of alternating layers of serpentinized peridotite and clinopyroxenite, overlain by gabbro (Anderson, 2013b). In the west, the top of the intrusive complex is marked by an angular unconformity overlain by younger volcaniclastic and epiclastic rocks. In the east, the contact is intrusive into older rhyolitic volcaniclastic rocks (Anderson, 2013b).

## Lewis-Storey assemblage

The Lewis-Storey assemblage unconformably overlies a 3.0 Ga tonalitic gneiss and has previously been described as a platform-rift deposit consisting of basal arkosic grit, quartz arenite, komatiite, carbonate and iron formation (Percival et al., 2001). The basal arkosic grit has been interpreted to have formed through chemical weathering and slight downslope transport of weathered tonalitic basement as a result of rift-related uplift (Percival et al., 2001, 2006). Alternatively, it has also been described as a cataclasite derived from the adjacent tonalite gneiss (Brown, 1981). The term 'grit' has generally been discontinued but refers to a sedimentary rock with angular clasts between 2 to 4 mm. In this report, the term 'arkosic grit' is used for consistency with the most recent geological map by Bailes and Percival (2005) and previous studies (e.g., Percival et al., 2001, 2006). Deposition of the quartz arenite, carbonate and iron formation is thought to reflect shallow-to-deeper water deposition as a result of thermal subsidence (Percival et al., 2001).

The Lewis-Story supracrustal sequence and its relationship to the underlying orthogneisses is shown in Figure GS2024-8-2 and described in the following sections from stratigraphic base to top. A stratigraphic section of a transect through the southern part of the study area is presented in Figure GS2024-8-3. Fieldwork along the shoreline revealed a consistent stratigraphy consisting of tonalitic gneiss (unit 1) overlain by arkosic grit (unit 2), quartz arenite (unit 4) and an ultramafic lava flow (unit 5). A mafic sill (unit 3) cuts the arkosic grit and can be traced for at least 2.5 km along the shoreline. In the northern part of the study area the sill has been subject to significantly more shear and forms a mylonite.

## *Stratigraphy*

### Tonalitic gneiss (unit 1)

The light brown to grey tonalitic gneiss of unit 1 (not shown) is medium to coarse grained and contains a characteristic blue quartz. The gneiss is generally weakly foliated but locally contains more intensely foliated zones. The gneiss is cut by fine-grained felsic and mafic dikes and rare granitic pegmatites; fine-grained felsic dikes are abundant near the nonconformity with the overlying Lewis-Storey assemblage. The gneiss contains heavily serpentinized ultramafic pods, which extend well to the east along strike (around 30 km) and range up to 5 km in length, as defined by aeromagnetic data (Natural Resources Canada, 1986). Four of these pods were investigated within the study area. Here

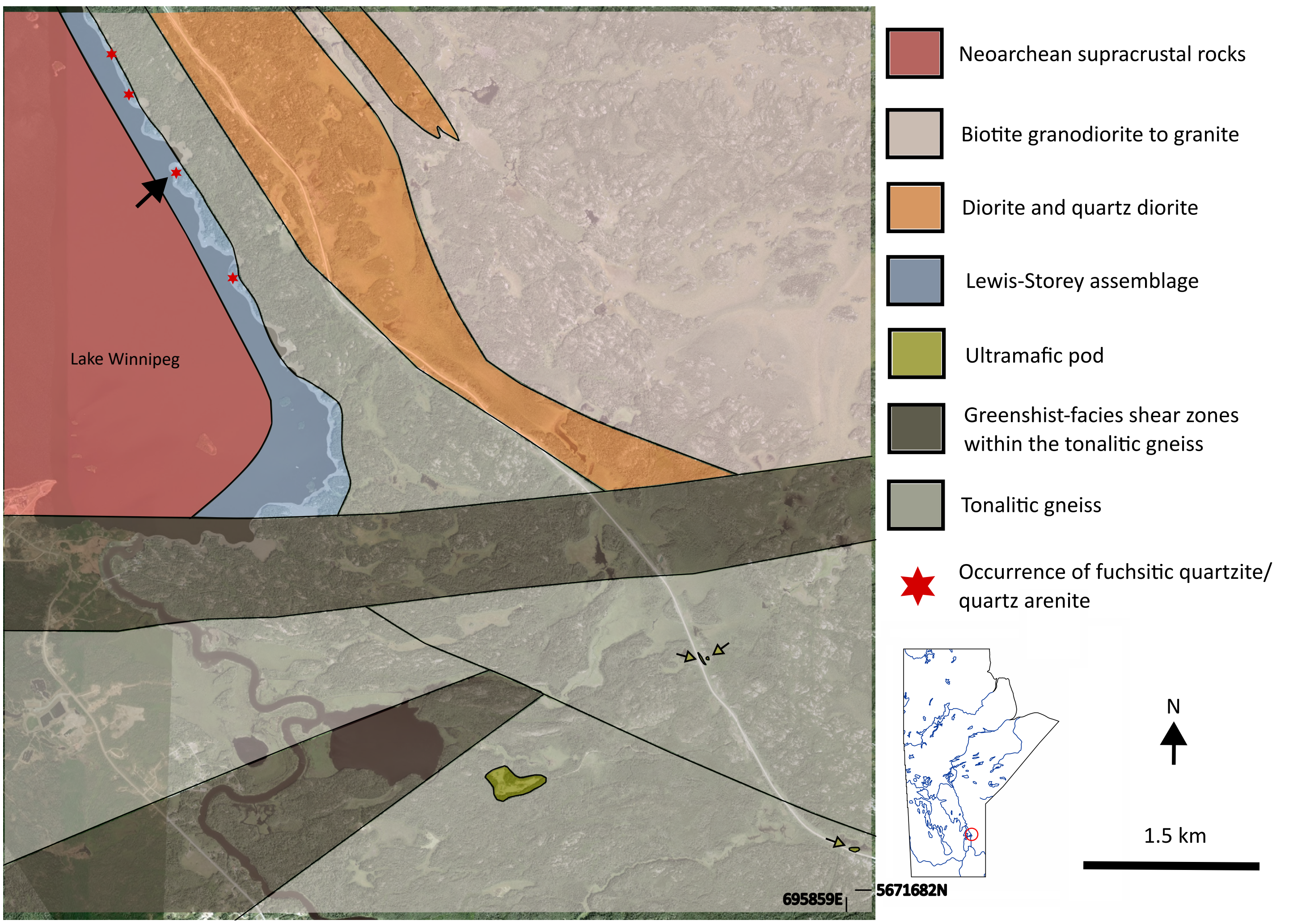


*Figure GS2024-8-2: Simplified bedrock geology of the Lewis-Storey assemblage area (modified from Bailes and Percival, 2005). The red stars indicate the locations of fuchsite-bearing quartzite/quartz arenite and the black arrow shows the location of Figure GS2024-8-3. Three small ultramafic pods are highlighted by green arrows. Inset map shows location of the study area (outlined in red). Corner co-ordinates are in UTM Zone 14, NAD83.*

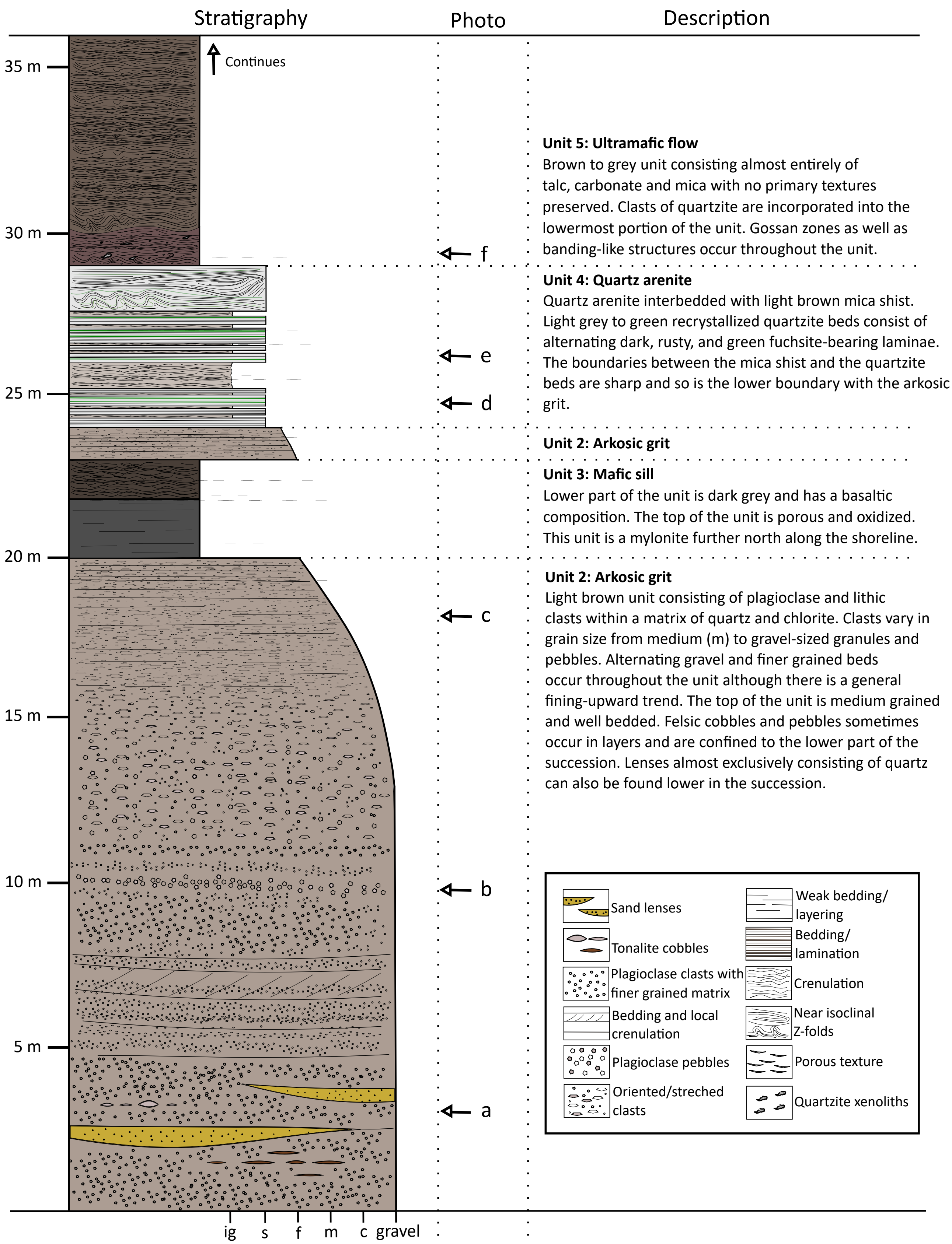


***Figure GS2024-8-3:*** *Schematic stratigraphic section of the clastic sedimentary rocks of the Lewis-Storey assemblage. The location of the stratigraphic section is indicated on Figure GS2024-8-2 and the letters show the locations of the field photographs from Figure GS2024-8-4a–f. Abbreviations: c, coarse; f, fine; ig, igneous; m, medium; s, silt.*

the pods range from small (10 by 5 m) to relatively large (400 by 250 m). The pods contain several generations of serpentinite veins and there are little to no primary textures preserved in the small pods; however, the largest pod locally contained coarse-grained (up to 1 cm), mesh-textured olivine. The gneiss was observed to contain a reaction zone of biotite schist near one of the small pods. Here the gneiss is also intruded by two pegmatite veins that clearly crosscut the gneissosity.

### Arkosic grit (unit 2)

The light brown arkosic grit of unit 2 (Figure GS2024-8-3) is rich in plagioclase and lithic fragments, which are surrounded by a matrix consisting of chlorite and quartz. The unit is textually immature with poorly sorted beds of medium- to pebble-sized clasts. The clasts are generally subangular and are locally oriented subparallel to the bedding plane, especially near the top of the unit. The unit becomes finer grained (clasts of 0.35–0.5 mm) and well bedded near the top.

Rare felsic cobbles occur near the bottom of the unit (Figure GS2024-8-4a). The cobbles are often boudinaged and appear in isolated layers, surrounded by finer grained matrix. Coarse and pebbly intervals (Figure GS2024-8-4b) are sometimes replaced by more well-sorted and finer grained beds with a relatively short lateral extension. Rare lenses rich in recrystallized quartz and up

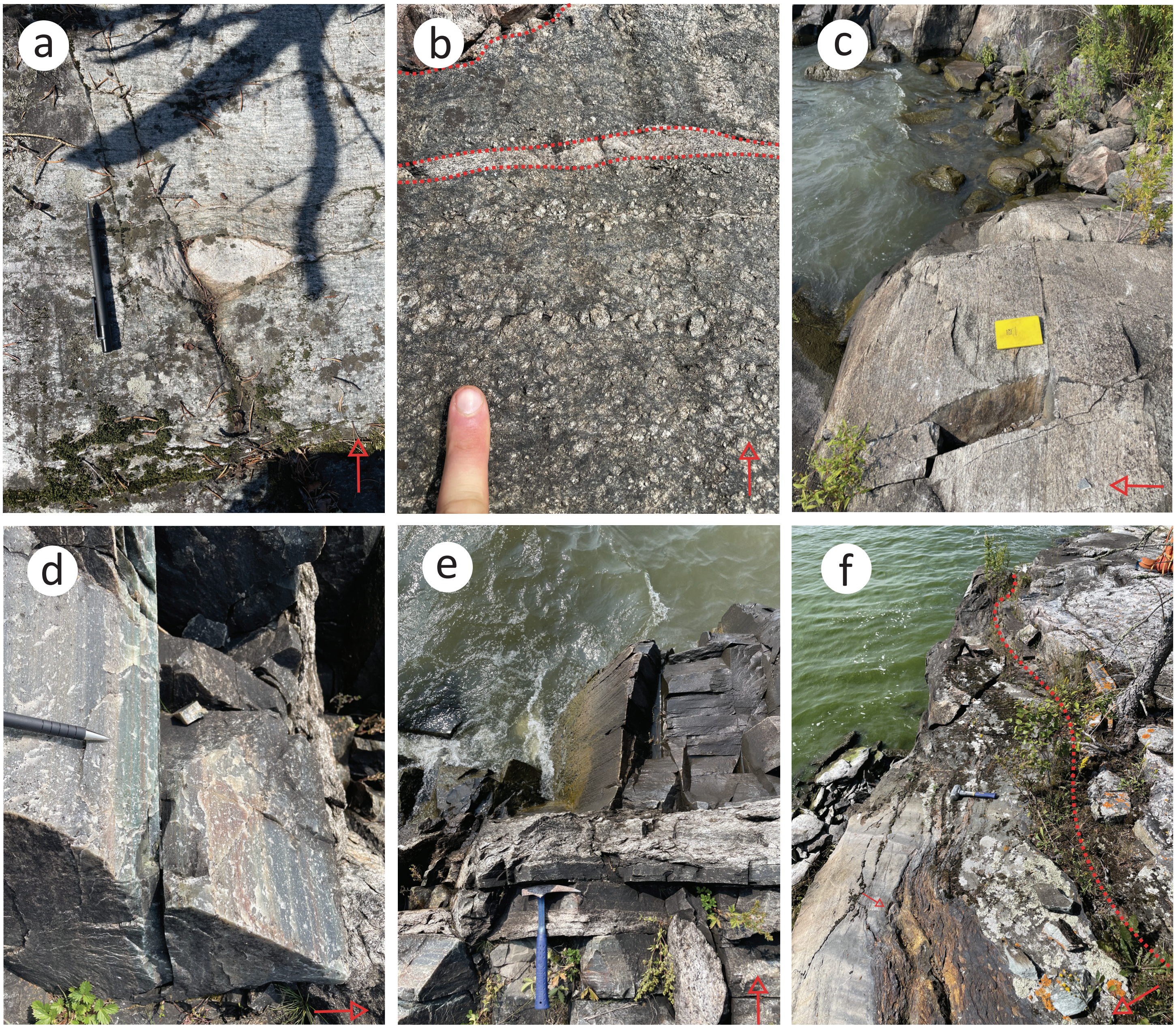


***Figure GS2024-8-4:*** *Field photographs of the Lewis-Storey assemblage:* ***a)*** *arkosic grit with tonalitic cobble;* ***b)*** *grain size variations in arkosic grit, with felsic dikes outlined in red;* ***c)*** *well-bedded arkosic grit near the top of the unit;* ***d)*** *fuchsite-bearing quartzite bed;* ***e)*** *quartz arenite interbedded with mica schist;* ***f)*** *quartz arenite (right) overlain by an ultramafic lava flow (left), with contact marked by the red line and gossan zone highlighted by the small red arrow (bottom left). The red arrow at the bottom right of each panel indicates stratigraphic up-direction.*

to a few metres in length can also be found near the base of the unit.

Mafic rocks commonly crosscut and appear to intrude the arkosic grit. Some of the mafic dikes are laterally discontinuous and contain abundant small offshoots and dikelets. Fine-grained felsic dikes also intrude the unit, especially further north along the shoreline. In the northern part of the study area, the arkosic grit is more massive and cut by numerous felsic dikes, giving it an orthogneiss-like texture. The boundary with the underlying gneiss is thus difficult to confidently place. A potential boundary between the gneiss and arkosic grit is marked by a quartz-rich bed 40 cm thick, followed by a coarse- to medium-grained bedded interval 1.5 m thick that transitions into a coarse, pebbly layer, which is cut by abundant felsic and mafic dikes. This grades into the finer grained (clasts of 0.35–0.5 mm) and well-bedded sandstone at the top of the arkosic grit (Figure GS2024-8-4c).

#### Mafic sill (unit 3)

A mafic sill (unit 3; Figure GS2024-8-3) intrudes the arkosic grit in the southern part of the study area. The lower part of the sill is dark grey-green. The massive, fine-grained lower part of the sill sharply transitions into a brown, porous, crenulated zone, which marks the top of the sill. The lower boundary of the sill is undulose and locally cuts the foliation in the grit. Further north along the shoreline this mafic unit appears to transition into a mylonite containing boudinaged clasts of felsic material.

#### Quartz arenite (unit 4)

The light grey to green fuchsite-bearing quartz arenite unit 4 (Figure GS2024-8-3) predominantly consists of finely laminated quartzite beds with alternating dark and light laminae, and occasional green (fuchsitic) and orange-brown horizons (Figure GS2024-8-4d). The dark, green and orange-brown horizons contain scattered black grains, which are difficult to see due to the recrystallized nature of the quartzite beds. The quartz arenite is interbedded with mica schist (Figure GS2024-8-4e) that is internally layered with beds ranging between 2 to 5 cm in thickness. The mica schist intervals are usually thin (<30 cm) although thicker intervals up to 1 m also occur. The quartzite beds are typically thicker and more abundant than the mica schist. The boundary between the arkosic grit and quartz arenite is sharp, as are the boundaries between the quartzite beds and the mica schist. The top of the quartz arenite is locally characterized by near-isoclinal Z-folds occurring in a range of scales (metre to centimetre).

#### Ultramafic flow (unit 5)

The brown to grey ultramafic unit 5 (Figure GS2024-8-3) consists almost entirely of talc, carbonate and mica with no primary textures preserved. Clasts of quartzite are incorporated into the lowermost portion of the unit. Gossan zones as well as banding of uncertain origin or crenulations occur throughout the unit (Figure GS2024-8-4f). The lower contact with the quartzite is undulose.

## Wallace assemblage

The supracrustal Wallace assemblage (Figure GS2024-8-1) consists of the Conley and Overload Bay formations. The metasedimentary Conley formation was examined on the northern shoreline of Wallace Lake, where it is strongly transposed on the northern limb of a map-scale syncline and ranges up to approximately 400 m in thickness. The Conley formation consists predominantly of sandstone and conglomerate capped by carbonates, iron formation and argillites (Fralick et al., 2008). The sandstone contains ca. 2.99 Ga detrital zircons and is cut by a 2.92 Ga felsic porphyry dike (Poulsen et al., 1996). These are thus the oldest supracrustal rocks in the Wallace Lake area and comparable in age to the quartz arenite of the Lewis-Storey assemblage. The Conley formation is overlain by komatiitic and mafic volcanic rocks and iron formation of the Overload Bay formation, which marks the top of the Wallace assemblage (Sasseville and Tomlinson, 2000; Sasseville et al., 2006).

Fieldwork was focused on the base of the Conley formation, which revealed a nonconformable lower boundary with tonalitic orthogneiss. This was overlain by sandstone interbedded with matrix-supported conglomerate overlain by pillowed basalt. An approximately 190 m long transect from the basal contact to the northern shoreline revealed a heterogeneous succession. Examples of the different lithologies are shown in Figure GS2024-8-5 and described below.

### *Stratigraphy*

The contact between the tonalitic orthogneiss and the Conley formation (UTM Zone 14N, 756405E, 5659609N [NAD83]) was observed in several locations approximately 190 m from the northern shoreline of Wallace Lake. At one of these localities, a felsic dike cuts the lower part of the Conley formation. Near the contact abundant quartz veins also cut both the dike and the metasedimentary rocks (Figure GS2024-8-5a).

Further up the succession the metasedimentary rocks become more quartz rich. Coarse-grained, quartz- and feldspar-rich beds are locally interbedded with dark grey, fine-grained and laminated beds (Figure GS2024-8-5b, c). These are overlain by a matrix-supported cobble-boulder conglomerate (Figure GS2024-8-5d) approximately 50 m upsection and 65 m from the contact. The matrix is dark grey, fine grained and contains abundant biotite. The cobbles and boulders are generally subrounded and resemble the underlying basement. However, two types of boulders and cobbles can be identified: a light brown to grey, foliated, medium-grained rock; and a light grey, massive to weakly foliated, coarse-grained rock. The cobbles and boulders are concentrated in the middle of the conglomerate bed. The top of the bed is sharply overlain by a quartz-rich bed, which in turn, is sharply overlain by the dark grey, fine-grained, biotite-rich unit.

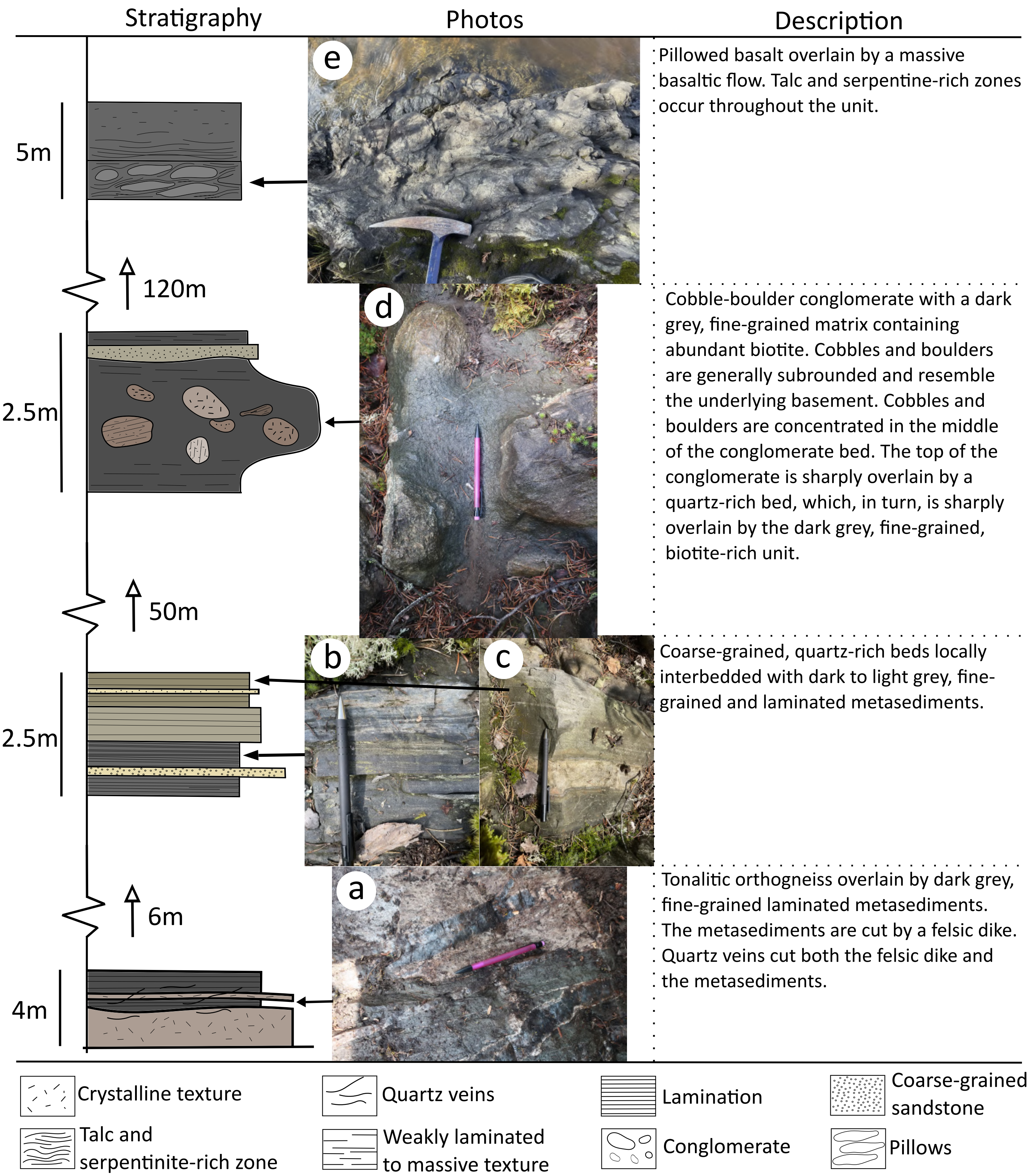


***Figure GS2024-8-5:*** *Stratigraphic variation through the Conley formation, as observed in the Wallace Lake assemblage area:* ***a)*** *tonalitic orthogneiss overlain by laminated metasediments;* ***b)*** *coarse-grained quartz-rich beds;* ***c)*** *fine-grained, laminated metasediments;* ***d)*** *cobble-boulder conglomerate;* ***e)*** *pillowed basalt overlain by a massive basaltic flow.*

Pillowed basalt at the shoreline of Wallace Lake (756278E, 5659467N) is overlain by a massive basaltic flow (Figure 2024-8-5e). Pillowed basalt is also exposed on an island 200 m to the northwest, suggesting that this unit is relatively thick.

## Garner Lake intrusive complex

The Garner Lake intrusive complex consists of a variety of lithologies. The base of the intrusion comprises alternating layers of serpentinized peridotite and pyroxenite. The top of the intrusion consists of layered gabbro cut by two generations of dikes: coarse-grained pegmatitic leucogabbro and fine-grained granitoid that contains xenoliths of leucogabbro.

The grey to light brown peridotite ranges from fine-grained, equiangular harzburgite (Figure GS2024-8-6a) to coarser grained harzburgite with oikocrystic pyroxene (Figure GS2024-8-6b). Contacts between the peridotite and pyroxenite are undulose. The pyroxenite is generally coarse grained and contains pseudomorphic hornblende as well as rare bronzite (orthopyroxene; Figure GS2024-8-6c). Internally the pyroxenite is quite heterogeneous with coarse-grained pegmatitic pods containing large amphiboles (up to 5 cm). Undulose boundaries between coarse- and fine-grained pyroxenite are also observed (Figure GS2024-8-6d). The coarser grained pyroxenite tends to have more pegmatitic pods. Although not found in situ, abundant boulders with large pyroxene crystals were found along the beach near the

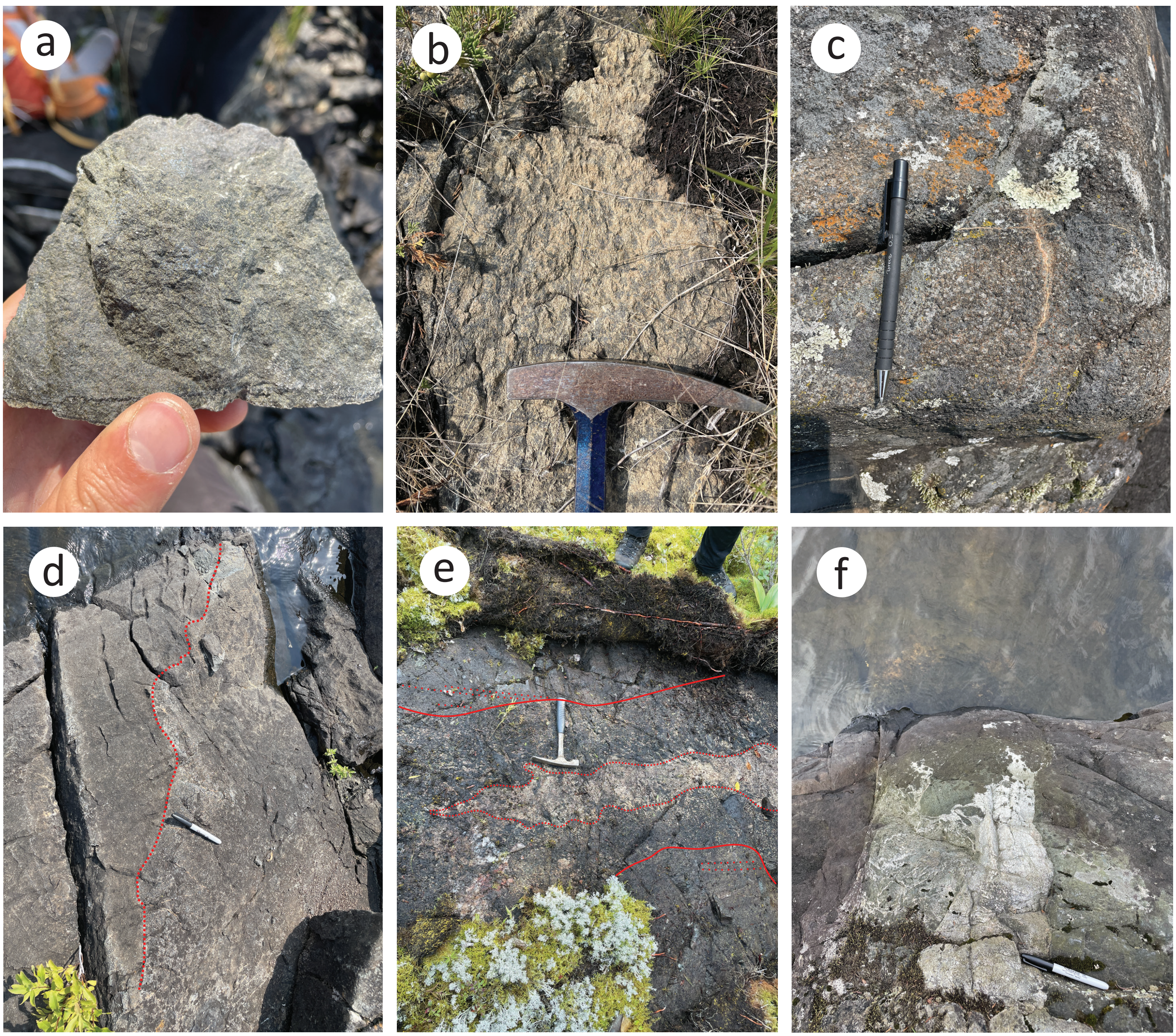


***Figure GS2024-8-6:*** *Field photographs of the Garner Lake intrusive complex:* ***a)*** *fine-grained harzburgite;* ***b)*** *pyroxene oikocrysts in peridotite;* ***c)*** *coarse-grained pyroxenite;* ***d)*** *grain size variations within the pyroxenite (dotted line marks contact between coarse- and fine-grained pyroxenite);* ***e)*** *pegmatitic leucogabbro cutting a layered gabbro (layering indicated by the solid lines and contact with the leucogabbro by the dotted lines);* ***f)*** *fine-grained felsic dike cutting the layered gabbro.*

coarse-grained pyroxenite. One particular boulder contained hollow pyroxene crystals 25 cm long, which were altered to amphibole along the grain margins and surrounded by plagioclase.

Farther up in the complex, layered gabbro is cut by pegmatitic leucogabbro (Figure GS2024-8-6e). These pegmatite intrusions are locally zoned with a fine-grained centre surrounded by a coarse-grained zone in which grain size decreases slightly toward the margin of the dike. The pegmatite intrusions and layered gabbro are cut by fine-grained felsic dikes containing xenoliths of the surrounding gabbro (Figure GS2024-8-6f).

## Discussion

### *The Lewis-Storey assemblage*

The arkosic grit of the Lewis-Storey assemblage has been variously described as detritus shed from weathered tonalite, making it a sedimentary unit (e.g., Bailes and Percival, 2000; Percival et al., 2001, 2006), or a cataclasite derived from the adjacent tonalite gneiss (Brown, 1981). In places, the orthogneiss-like texture of the grit, the lack of a clear boundary with the adjacent orthogneiss and the evidence of shear in the overlying units (especially in the northern part of the study area), favour the latter. However, the presence of cobbles, sand lenses and grain-size variations throughout the unit point to a sedimentary origin. The overlying quartz arenite with which the underlying grit seems to be associated contains detrital zircons and is undoubtedly of clastic sedimentary origin.

Distinguishing primary and secondary features is challenging due to the pervasive effects of structural deformation and metamorphism. The features interpreted to be primary within the arkosic grit, including the cobbles, bedding, grain-size variations and sand lenses, could potentially be due to intense shearing of orthogneiss containing felsic dikes and later metamorphism. However, the laminae in the quartzite beds as well as the mica schist likely represent primary compositional differences. The mica schist may have been deposited as more feldspar-rich layers, clay-rich layers or even volcanic-ash units, which have since been altered to their present mica-rich composition. Thin sections and chemical analysis are needed to confidently determine the origin of the arkosic grit and the quartz arenite. Likely environments for Archean quartz arenites include a fluvial system or a shallow-marine environment (Donaldson and de Kemp, 1998), which is consistent with previous interpretations (Percival et al., 2001).

### *The Wallace assemblage*

The Wallace assemblage is often correlated with the Lewis-Storey assemblage because of their similar age constraints and stratigraphy (e.g., Sasseville et al., 2006). However, the Conley formation is significantly thicker, more heterogeneous and lacks the fuchsite-bearing quartz arenite found at the eastern shore of Lake Winnipeg. Sasseville et al. (2006) noted that intrusive granitoid rocks have cut off the base of the Conley formation and that the contact relationship near the base of the formation was generally difficult to establish. However, the contact between the orthogneiss and the Conley formation is interpreted here as a nonconformity. The metasedimentary rocks directly overlie the orthogneiss and contain cobble-boulder conglomerate that includes orthogneiss clasts similar in appearance to the underlying orthogneiss. The heterogenous nature of the units suggests a dynamic depositional environment but overall reflects a deepening trend similar to that observed in the Lewis-Storey assemblage.

## Economic considerations

Crustal architecture has a first-order control on the location of many major mineral systems. For example, orogenic gold deposits often occur proximal to the major transcrustal structures forming the faulted margins of successor basins within Archean greenstone belts (Thurston, 2015). Understanding the crustal architecture, nature and history of the western Superior province therefore has implications for understanding its mineral potential.

Mole et al. (2019) used Lu-Hf isotopes in zircon to generate 'time-slice' maps of the Yilgarn craton in Australia. This allowed them to identify both crustal-growth events and the cratonic architecture through time. They found that many older, thick, stable crustal blocks contained internal 'ribbons' and peripheral plateaus of juvenile crust. This framework provided pathways that localized later magmas and fluids leading to mineral endowment, and it was demonstrated that many gold and Ni-Cu systems could be correlated with the crustal architecture.

The North Caribou terrane is an old, thick and stable crustal block (e.g., Percival et al., 2006). Studying its early history through the detrital zircon and chromite record could reveal information about its crustal architecture and therefore the location of mineral deposits. Because detrital chromite can detect mafic and ultramafic crust in sedimentary source regions, it could potentially be used as an indicator mineral pointing to as yet unknown ultramafic systems that could host copper–nickel–platinum-group element (Cu-Ni-PGE) deposits.

Finally, knowledge about the early history of the western Superior province might also provide clues to understanding why the Rice Lake greenstone belt is less gold endowed than comparable and possibly correlated gold-producing regions (e.g., Red Lake). For example, if evidence from detrital zircon and chromite suggests that there was older crust predating the Mesoarchean 3 Ga events in the Rice Lake area, this could further support the importance of juvenile crust as a prerequisite for high-grade gold mineralization, focusing future exploration efforts.

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