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Neoarchean Bird River greenstone belt in southeastern Manitoba: lithostratigraphic details of two transects through the arc-type, volcanosedimentary sequence in the north panel of the belt (parts of NTS 52L5N and 6)

by H.P. Gilbert

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Introduction

A geological mapping project was initiated by the Manitoba Geological Survey in 2005 in the Neoarchean Bird River belt (BRB) of southeastern Manitoba (Figure 1). The project focused on the stratigraphy and volcanic geochemistry of supracrustal rocks in the belt, and led to revisions of the previously accepted stratigraphic sequence (Cerny et al., 1981; Manitoba Energy and Mines, 1987). Results of this mapping project are reported in Gilbert, 2005 and 2006a. Additional information that complements these publications is provided in this data repository, which contains detailed descriptions of stratigraphic rock units in the north half of the greenstone belt.

Two south to north transects were made in the north part of the BRB - Highway Junction section in the west and Bird Lake section in the east (Figure 2). Stratigraphic units are numbered 1W to 15W in the western transect (Figure 3), and 1E to 8E in the eastern transect (Figure 4). The following lithologic descriptions are accompanied by 37 field photographs (Figure 5 to 42).

BRB north panel

The BRB north panel is that part of the greenstone belt between the Maskwa Lake Batholith to the north and the Booster Lake Formation to the south (Figure 2). A MORB-like basaltic formation (Lamprey Falls Formation) is the northernmost component of the BRB and is interpreted to be in fault contact with an arc-type volcanosedimentary sequence to the south, which is interpreted as younger than the MORB-type basalt. Reconnaissance mapping and the detailed stratigraphic transects have led to the provisional interpretation that the arc-type sequence is a south-facing monocline. The mafic to ultramafic Bird River Sill, which is coincident with the inferred fault between the MORB-type and arc-type rocks, is locally seen to intrude the Lamprey Falls Formation.

Lamprey Falls Formation

The Lamprey Falls Formation at the north margin of the BRB, which is geochemically akin to modern BABB (Gilbert, 2005), consists mainly of massive to pillowed, aphyric flows that are invariably south facing. Basaltic flow-breccia, mafic tuff and synvolcanic gabbro are subordinate components, and a unit of plagioclase-megacrystic basalt occurs close to the top of the formation (Trueman, 1980).

Arc-type volcanosedimentary sequence

Highway Junction Section

The 3.75 km Highway Junction section (Figure 3) contains 15 separate map units in a predominantly south-facing sequence. The northernmost 0.65 km part of this section comprises 7 units that consist exclusively of sedimentary and reworked volcaniclastic rocks, except for a minor unit of aphyric pillowed basalt. Southward stratigraphic facing in this northern part of the section is indicated by exceptionally well preserved turbidite features within the epiclastic rock units, as well as by scouring in reworked volcaniclastic rocks at the base of the sequence. However, localized folding is indicated approximately 0.5 km above the base by a north-facing scoured contact within south-facing turbidite beds. M. Duguet also reports top reversals in this part of the sequence (Duguet et al., 2006). The remaining part of the Highway Junction section consists of felsic and subordinate mafic flows and volcanic fragmental rocks that are locally redeposited by subaqueous mass flows.

Stratigraphic transect

The northernmost (basal) unit in the Highway Junction section (1W) is a volcaniclastic deposit, which contains of three intercalated components. This unit consists mainly of pale grey-weathering, felsic lapilli-tuff and very fine grained, thinly laminated green intermediate tuff. The lapilli-tuff contains unsorted, angular felsic clasts as well as sporadic blocks and partially disrupted interlayers of the green-weathering tuff (Figure 5). The latter contains laminae locally truncated as a result of scouring by gravity-induced mass flow (Figure 6). Subordinate interlayers of massive dacite were disrupted and brecciated prior to their incorporation into the tuffaceous deposit, possibly by mass flow (Figure 7). The green laminated tuff units are interpreted as turbidites, whereas the coarser, unsorted lapilli tuff may represent subaqueous mass-flow deposits that were emplaced, together with contemporaneous dacite, by gravity-induced slumping into the turbidite basin. The basal unit (1W) is overlain by dark gray, non-layered mafic tuff and heterolithic lapilli tuff (2W) that contains a wide variety of mafic to felsic, volcanic to hypabyssal clast types (Figure 8); these two units together are at least 190 m thick.

Greywacke-siltstone turbidite with minor chert laminae (3W) overlies the basal volcaniclastic rocks. Rip-ups of chert occur locally in the pale grey to beige weathering greywacke-siltstone unit (Figure 9), in which graded bedding tops south. Ovoid feldspathic (?) porphyroblasts are locally characteristic of siltstone beds. The turbidite is in apparent conformable contact with an overlying 15-30 m thick, aphyric basalt unit (4W). Sporadic pillow selvage remnants occur in the dark green weathering basalt, which is characterised by a 1.5 m wide spherulitic zone at its upper (south) margin.

A conspicuous, 23 m thick chert member (5W) occurs immediately south of the basaltic unit. The chert is thinly laminated at a scale of 2 mm to 20 cm, with alternating very dark gray, yellow-cream and white, semi-translucent layers (Figure 10). Locally, contorted dark grey laminae define rare tight folds, assumed to be due to soft-sediment deformation (Figure 11). Unlike many Archean chert formations of inferred volcanic exhalative origin, this unusually thick chert unit is devoid of magnetiferous or sulphide-bearing laminae. The chert is overlain by a thick (175 m), pale grey to beige-weathering greywacke-siltstone unit (6W) that is characterized by a wide variety of turbidite features such as reverse to normal graded bedding, flame structures and cross bedding which indicate unequivocal top directions, almost invariably to the south (Figure 12).

Polymictic conglomerate (7W) approximately 75 m thick constitutes the uppermost sedimentary unit within the northern, epiclastic-volcaniclastic part of the Highway Junction section. The contact between the conglomerate and underlying turbidites immediately to the north is not exposed but assumed to be disconformable. The polymictic conglomerate is clast-supported and unsorted; sporadic boulders (up to 65 x 12 cm) occur in the predominantly cobble-size assemblage of clasts. The main clast types, constituting over 75% of the coarse fragmental component, are dark green weathering, aphyric basalt and related, slightly coarser grained gabbro (Figure 13), which are probably derived from mafic volcanic units reported to be interbedded with the conglomerate along strike from the Highway Junction section (M. Duguet, pers. comm., 2006). A wide variety of other fragment types are present in the deposit, including coarse-grained gabbro, pegmatitic leucogabbro, rhyolite (variously plagioclase-phyric, aphanitic or spherulitic) and related hypabyssal intrusive rocks, greywacke-siltstone and chert (Figure 14). Banded chert fragments in the conglomerate (Figure 15) match very closely the well-bedded chert of unit 5W, approximately 175 m stratigraphically below the conglomerate deposit. If these banded chert clasts are derived from unit 5W, a considerable amount of localized erosion must have occurred prior to deposition of the conglomerate. Most clasts are rounded to subrounded but a minority of fragments, in particular those of chert, are angular, consistent with greater resistance to attrition and possibly a relatively short distance of transport (Figure 16). The matrix of the conglomerate constitutes less than 25% of the rock and consists of finely comminuted, mainly basaltic detritus.

The polymictic conglomerate is followed to the south by an aphyric basalt unit (8W) at least 27 m in width (possibly up to 150 m). Its relationship to the previous rocks is uncertain as contact relationships and facing directions in this part of the Highway Junction section are not known. The massive, undeformed basaltic rock locally contains small quartz amygdales and also mafic, chlorite-filled vesicles that result in pitted weathered surfaces. South of the basalt, unit 9W consists of a reworked felsic volcanic breccia deposit over 72 m (but less than 240 m) in width. The breccia contains aphyric to sparsely plagioclase-phyric rhyolite fragments that are mostly angular to irregular in shape. The clasts are unsorted and range in size from lapilli to blocks up to 50 cm x 15 cm. The matrix consists of comminuted felsic detritus gradational with the coarser clastic components; the latter locally appear to have been partly fractured and disrupted during transport, consistent with ‘cold’ fragmentation in a subaqueous mass flow rather than autoclastic flow brecciation (Figure 17). South of this felsic breccia, a unit at least 65 m wide of bluish-grey weathering, aphyric basalt constitutes the next stratigraphic unit (10W). The basalt is homogeneous and locally quartz-amygdaloidal, not unlike the mafic volcanic unit (8W) to the north.

Bedrock exposure is lacking over a 200 m wide interval in the Highway Junction section south of unit 10W. The next three units south of this interval (11W - 13W) are devoid of features to indicate stratigraphic tops, but unit 14W is south facing, consistent with the top direction of several units in the lower part of the section (1W - 7W). Units 11W - 13W in the central part of the sequence are provisionally assumed to also be south facing, on the basis of structural data in the stratigraphic section to the north (1W - 7W) and in the contiguous unit (14W) to the south.

Unit 11W is approximately 400 m wide and consists of massive rhyolite and related breccia. Massive domains are gradational, through zones of ‘in situ’ brecciation, with fragmental rocks (Figure 18). The breccia contains rounded to angular fragments mostly of lapilli size, together with sporadic, elongate tabular blocks up to 25 cm long. Massive and fragmental domains are intercalated at outcrop scale (1-5 m) and also at larger intervals. For example, within the south part of unit 11W, massive rhyolite is gradational southwards with related, probably overlying breccia over a 100 m wide section, consistent with a south-facing stratigraphic sequence. Massive flows are aphyric to sparsely porphyritic, with up to 10% plagioclase ± quartz phenocrysts. Sericite is pervasive both in 0.5-2 cm wide, anastomosing fractures attributed to thermal contraction during cooling of the volcanic flow (Figure 19), as well as in the matrix of brecciated rhyolite, which consists of comminuted fragments of rhyolite, plagioclase and quartz.

Unit 12W consists largely of rhyolite flow-breccia characterized by spheroidal to elongate, ovoid clasts that locally display primary folds showing a plastic style of deformation. Although these rocks are similar to autoclastic breccia in unit 11W immediately to the north, the ovoid to spheroidal clasts in breccia of unit 12W breccia display a vitreous, partly translucent texture characteristic of highly silicic rhyolite or chert (Figure 20). This unit, approximately 200 m thick, is provisionally interpreted as felsic volcanic breccia; a volcanic exhalative, chert component within the fragmental rock cannot be ruled out.

A quartz-plagioclase porphyry sill at least 90 m thick occurs along strike to the east of the south part of unit 12W. Phenocrysts of quartz (2-5 mm, 15%) and subordinate plagioclase (0.5-1.5 mm, 5%) are locally accompanied by up to 10% hornblende porphyroblasts. South of the felsic porphyry, unit 13W consists of at least 230 m of non-layered, felsic crystal-lithic tuff. Quartz and plagioclase crystals (1-4 mm) each constitute up to 15% of the tuff, which locally contains small (1-10 mm), ragged white fragments interpreted as devitrified glass shards and lapilli (Figure 21). Elsewhere, the rock contains ragged, black chloritic clasts that may have a similar origin to the small white fragments, which they resemble closely in both size and shape. Rare, aphyric dacite lapilli and blocks (up to 20 cm long) occur sporadically in the tuff (Figure

22). Plagioclase laths are locally aligned, consistent with an ash-flow origin for this felsic tuff deposit.

A reworked volcaniclastic deposit (unit 14W), assumed to overlie the inferred felsic ash-flow tuff unit (13W), consists of a lower member (> 28 m) of intercalated, partly disrupted tuff, lapilli tuff and epiclastic rocks, overlain by an upper member of remarkably homogeneous, non-layered tuff (> 50 m). The lower member contains laminated to massive intermediate greywacke-siltstone, siliceous to cherty siltstone, very coarse grained, lithic greywacke and reworked lapilli tuff. Disrupted layers and rip-ups of laminated chert are a minor component of the section (Figure 23). Lenses and discontinuous, locally contorted, layers of lapilli tuff contain angular to subangular fragments of mainly felsic composition, with subordinate intermediate and mafic types (Figure 24). The same components occur in very coarse grained lithic wacke, which is locally scoured into underlying, finer grained sedimentary beds (Figure 25). Scour, graded bedding and irregular flame structures at siltstone-greywacke contacts, which are attributed to deposition by turbidity currents and post-depositional loading, confirm the unit is south facing. In addition to the turbidite features, greywacke beds are locally characterized by disrupted interlayers and large (25 cm) angular rafts of siliceous siltstone (Figure 26), interpreted as evidence for deposition of the reworked tuffaceous deposits by mass flows.

The upper tuff member in unit 14W consists mainly of medium-grained, intermediate to felsic volcanic detritus, with rare mafic lapilli. This member is provisionally interpreted as an ash-flow deposit, based on its homogeneity, absence of layering over several tens of metres and volcaniclastic texture, characterized by subhedral to euhedral, subparallel plagioclase laths.

Unit 14W is similar in some respects to the basal two units (1W and 2W) of the Highway Junction section; these units, approximately 2 km apart in the stratigraphic sequence, are characterized by similar detrital components (intermediate to felsic volcanic) and similar modes of emplacement (subaqueous density currents and mass flow).

Data is lacking in an approximate 350 m wide interval south of unit 14W due to lack exposure. The uppermost unit (15W) in the Highway Junction section is over 400 m thick and consists mainly of felsic volcanic breccia and tuff. A minor felsic porphyry sill and a dacitic flow unit were encountered at the north and south margins of this unit respectively. A topographic low devoid of bedrock exposures occurs between unit 15W and the Booster Lake Formation, which marks the south margin of the Highway Junction section.

Bird Lake section

Stratigraphic details of the north, 0.5 km to 1 km wide part of the Bird Lake section (Figure 4) are incomplete because much of the section there is covered by the lake, but some comparisons can be made between the northern parts of the Bird Lake section and the Highway Junction section (Figure 3) on the basis of facies types. Higher metamorphic grade and stronger deformation in the Bird Lake section has resulted in the loss of some primary features, thus hindering direct comparison between individual, lithologically defined units within the two sections.

The north part of the Bird Lake section is a predominantly epiclastic sequence that may correspond to the lower (northern) part of the Highway Junction section (units 1W - 7W in Figure 3). Stratigraphic top indicators are virtually absent in the Bird Lake area, but the section is assumed to face south on the basis of its similarity with the sequence in the south-facing Highway Junction section to the west. A single case of south-facing cross-beds in the west part of Bird Lake is consistent with this interpretation. The south parts of both sections consist largely of massive to fragmental felsic volcanic rocks and related intrusive units. The Bird Lake sequence appears to be relatively less diverse overall; for example, there are no counterparts of several units that were documented in the Highway Junction section (e.g., 1W, 2W, 5W, 7W and 14W). On the other hand, in the latter section there are no analogues to the oxide-facies iron formation and remarkable porphyroblastic metasedimentary rocks that occur in the central and west parts of Bird Lake.

Stratigraphic transect

Fine-grained metasedimentary rocks (1E) extend for over 3.5 km along the south shore of eastern Bird Lake; the estimated maximum width of the unit is 0.65 km. These epiclastic rocks display poorly-defined graded bedding and are interpreted to have been deposited by turbidity currents, although other diagnostic features (e.g., flame structures, scour and cyclic bedding) are absent. At the east end of the available shoreline outcrop, the fine-grained sedimentary rocks contain a thin (15 cm) bed of coarse-grained grit that is interpreted as a channel deposit, associated with ephemeral, localized high-energy currents in the turbidite basin (Figure 27). Further west, at a shoreline outcrop close to Nopiming Lodge (Gilbert, 2006b), siltstone strata contain a 1 m wide porphyroblastic unit characterized by post-tectonic muscovite blades that overprint S_1 foliation defined by quartz+plagioclase+biotite+andalusite+cordierite. Secondary carbonatization is locally pervasive in the turbiditic unit and results in recessive, 'dished' weathered surfaces similar to karst-type surfaces of weathered limestone.

A massive to fragmental, felsic volcanic unit over 200 m thick (2E) occurs within the north (inferred lower) part of unit 1E (Figure 4). The felsic rocks are located at Dean Islands in the east-central part of Bird Lake (Gilbert, 2006b), and consist of plagioclase-quartz-phyric, predominantly fragmental rhyolite deposits; subordinate massive flows up to 35 m thick are intercalated with the felsic breccia. Massive rhyolite, characterized by anastomosing, thermal contraction fractures or more irregular domains of 'in situ' brecciation, is gradational with rhyolite breccia that contains angular to lensoid fragments ranging from lapilli to blocks over 0.5 m long (Figure 28). Contact relationships of unit 2E are not seen because the felsic volcanic rocks are largely confined to several small islands in Bird Lake; furthermore, where the felsic volcanic unit extends to the south shore of Bird Lake, its contacts are not exposed. Unit 2E is provisionally interpreted as stratigraphically conformable with the flanking turbidite deposits (1E), but the unit could also be a fault-slice.

Aphyric, pillowed basalt (3E), assumed to overlie the thick turbidite sequence (unit 1E), has been mapped at two localities in the eastern Bird Lake area. The mafic flow unit is at least 110 m thick where it intersects Booster Creek, immediately north of Provincial Road 315. It is massive to fragmental and variously silicified, metasomatized (hornblende blastesis) or metamorphosed to garnetiferous amphibolite; the latter forms units up to 8 m thick. Moderate to strong deformation is characteristic of the mafic volcanic rocks at this locality. A pillowed basalt flow, which is inferred to be stratigraphically equivalent to the unit at Booster Creek, occurs 3 km west of the Booster Creek locality, at a small island close to the south shore of Bird Lake. This flow is at least 13 m thick, and weathers out in elongate, slender spires due to a combination of a steeply plunging lineation and pervasive carbonatization (Figure 29). This flow is flanked by a minor (1 m thick) magnetiferous, pyritized zone to the north as well as a mineralized, oxide-facies iron formation and associated porphyroblastic gneiss to the south (4E).

Garnetiferous amphibolite contiguous with the carbonatized basalt flow (3E) is part of a diverse stratigraphic unit (4E) at least 50 m wide that consists of oxide-facies iron formation, metasedimentary rocks and various porphroblastic gneisses that contain garnet (1-2 cm), as well as staurolite and cordierite (yet to be confirmed). Meta-siltstone at the south margin of the unit contains garnet (1-2 cm) and ovoid porphyroblasts of altered cordierite (?) up to 7 x 2 cm (Figure 30). Oxide-facies iron formation (6 m thick) north of the meta-siltstone contains chloritic amphibolite layers and alternating magnetite and chert laminae (0.2 to 4 cm); the magnetiferous unit also contains several concordant, gossan-stained zones derived from pyritic domains.

The iron formation is located at a small off-shore island and thus the contact between this unit and felsic volcanic rocks to the south (5E) is not exposed. The north margin of unit 5E consists of highly sheared, massive to fragmental rhyolite and felsic tuff. These lithologic components are predominant in the approximately 1.25 km thick volcanic sequence that extends throughout the area south of Bird Lake between Provincial Road 315 and the Booster Lake Formation (Gilbert, 2006b), at the south margin of the section shown in Figure 4. Most felsic fragmental rocks in unit 5E are monolithic and intimately associated with massive flows but heterolithic breccia and lapilli tuff are locally intercalated with massive rhyolite, especially in the area south of the junction between Bird River and Bird Lake. Quartz-plagioclase porphyry sills are interspersed with the volcanic units, and at least 2 rhyolitic phases are distinguished on the basis of porphyritic texture (sparsely plagioclase-phyric and coarsely quartz-plagioclase-phyric). Intermediate, garnet-biotite-chlorite-bearing gneiss derived from both massive and fragmental rhyolitic rocks occurs sporadically within unit 5E. Recrystallization and garnet blastesis is initiated along thermal contraction fractures that are common in the massive flows, as well as within the matrix of fragmental rhyolite deposits (Figure 31). The south margin of the extensive felsic volcanic terrane (5E), close to the inferred faulted contact with the Booster Lake Formation, is characterized by a highly silicic, black-weathering mylonitic member over 35 m thick (Figure 32).

Oxide-facies iron formation (6E) occurs within the felsic volcanic unit (5E) at a locality east of Booster Creek (Gilbert, 2006b). The exact stratigraphic position of this member is uncertain due to sparse outcrop; it occurs either within the rhyolitic sequence (5E), or at the south margin of the section where it is in contact with the Booster Lake Formation to the south. The iron formation (6E) contains several individual members up to 8 m (or more) in thickness, which consist of thinly interlayered magnetiferous siltstone and chert (Figure 33). Patchy pyrite mineralization is characteristic of these strata and locally extends over large areas of outcrop (e.g., 25 x 40 m). A prominent positive aeromagnetic anomaly is coincident with the magnetiferous zone (Geological Survey of Canada, 1966).

Southwest Bird Lake area

Heterolithic breccia (7E) and turbidite deposits (8E) in the southwest part of Bird Lake are of uncertain age and stratigraphic position relative to units 1E to 6E in the Bird Lake section (Figure 4). Heterolithic volcanic breccia at least 850 m thick (7E) extends for 2.8 km along the south shore of western Bird Lake. This east to northeast-trending lensoid unit consists of two subunits: a heterolithic, volcanic fragmental deposit to the north (> 580 m thick) and dimictic volcanic breccia to the south (> 270 m). The heterolithic breccia subunit contains a variety of fragment types assumed to be derived from the arc-type volcanic sequence, including mafic to felsic volcanic clasts, subordinate fine-grained tonalite and possible sedimentary detritus. Pervasive carbonatization, strong deformation and attenuation are typical of the breccia at the shore of Bird Lake, where the outcrops are characterized by deep, recessive weathering of the tuffaceous matrix. The deposit is unsorted, with angular to subrounded fragments and sporadic boulders ranging up to 2 m in diameter (Figure 34). Elsewhere, the breccia contains rows of felsic volcanic blocks, possibly aligned during mobilization and emplacement of the unit by subaqueous mass flow (Figure 35). At several localities, the fragmental deposit contains sporadic clasts with a penetrative foliation that appears to predate emplacement of the mass flow (Figure 36, Figure 37).

Close to the southwest end of Bird Lake, the dimictic volcanic breccia subunit of unit 7E contains mafic and felsic volcanic fragments that are mostly angular (Figure 38). The tuffaceous matrix is porphyroblastic, with small micaceous aggregates (2-4 mm) as well as larger cordierite porphyroblasts. The cordierite occurs both as rare dark-blue, pseudohexagonal crystals (Figure 39) and anhedral elongate porphyroblasts up to 25 cm x 4 cm in size (Figure 40). Fascicular shaped blasts were observed at one locality (Figure 41).

Well layered turbidite (8E) over 20 m thick is assumed to overlie the dimictic breccia unit at the west end of Bird Lake (Figure 42). The partly carbonatized, intermediate to felsic wacke and siltstone, interlayered at a scale of 3-35 cm, contain abundant, ovoid cordierite porphyroblasts up to 1 cm long.

Discussion

Both the structural setting and age of units 7E and 8E are unknown because their contacts are not exposed, although strong shearing at the east end of the volcanic fragmental deposit (7E) is consistent with the inferred major fault at the contact with felsic volcanic rocks (5E) to the southeast (Gilbert, 2006b). Unit 7E appears to occupy an equivalent stratigraphic position to that of the fine-grained sedimentary rocks of unit 1E in the east part of Bird Lake: both units occupy the northernmost part of the supracrustal sequence in the Bird Lake area (Gilbert, 2006b). Heterolithic breccia of unit 7E locally contains foliated fragments that appear to have been metamorphosed prior to their incorporation in the mass flow deposit. If this deposit does contain previously metamorphosed detritus derived from the arc-type volcanosedimentary assemblage (1E to 6E), a significant difference in age is indicated between the volcanism and the deposition of unit 7E. Assuming a relatively younger, post-volcanic age for unit 7E, stratigraphic correlation may be considered between this unit and epiclastic rocks known to be approximately 30 m.y. younger than the volcanism (Booster Lake Formation and Flanders Lake Formation, Gilbert, 2006a). However, field data do not support such a correlation because heterolithic breccia of unit 7E type has not been documented in either of the ‘younger’ epiclastic formations.

Cordierite-bearing, turbiditic sedimentary rocks of unit 8E are either part of the arc assemblage or belong to a younger, post-volcanic suite of epiclastic rocks. Possible correlative map units for unit 8E are (1) greywacke turbidite of unit 1E in eastern Bird Lake (assumed to be part of the arc assemblage) and (2) Booster Lake Formation turbidite. Although the latter is lithologically more comparable to unit 8E turbidite, there is no definitive data to correlate these two rock units. In conclusion, units 7E and 8E are provisionally assigned to the arc-type volcanosedimentary sequence, pending further investigation of the local and regional stratigraphy.

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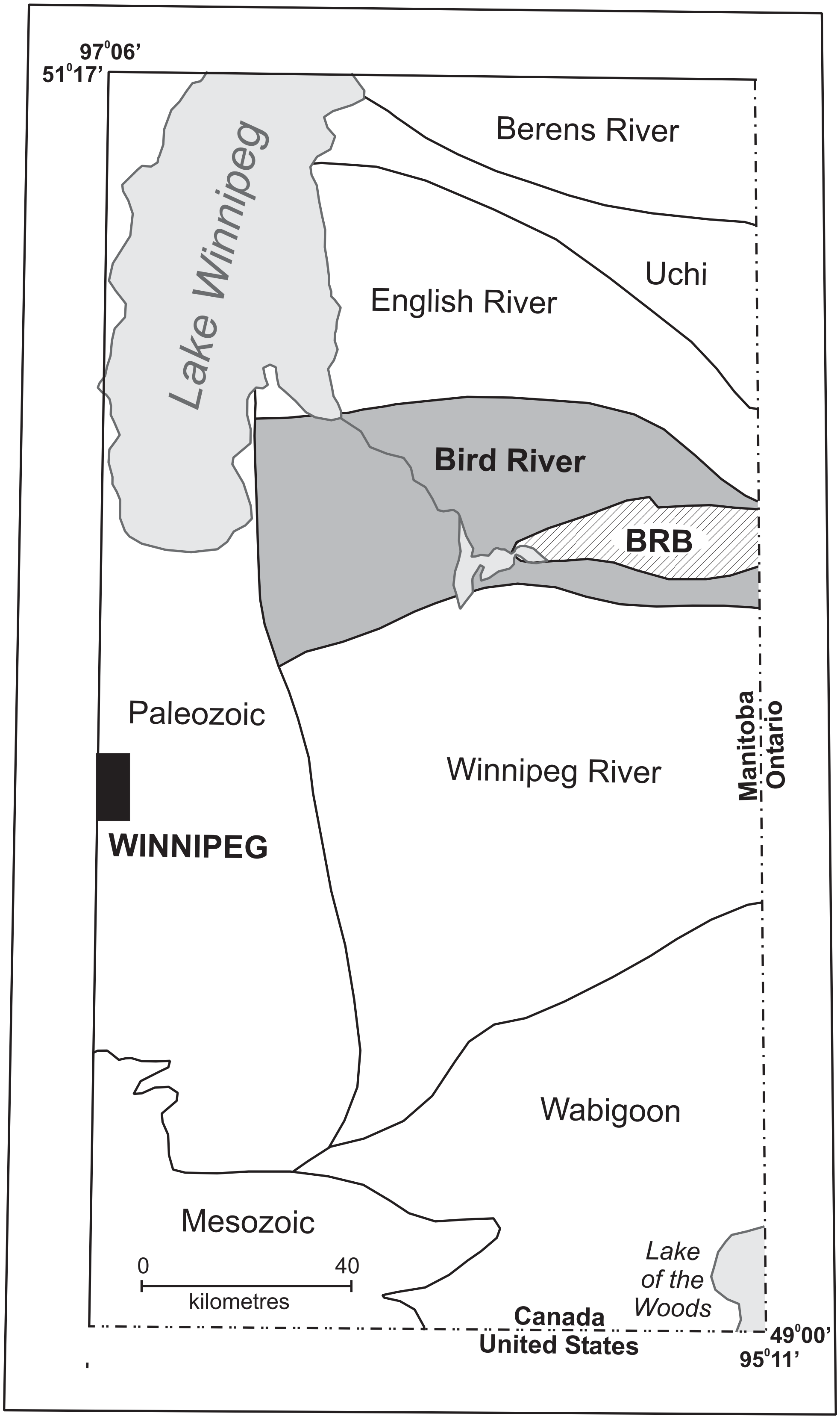

Figure 1: Regional map showing the Bird River Belt (BRB) and geological domains in southeastern Manitoba.

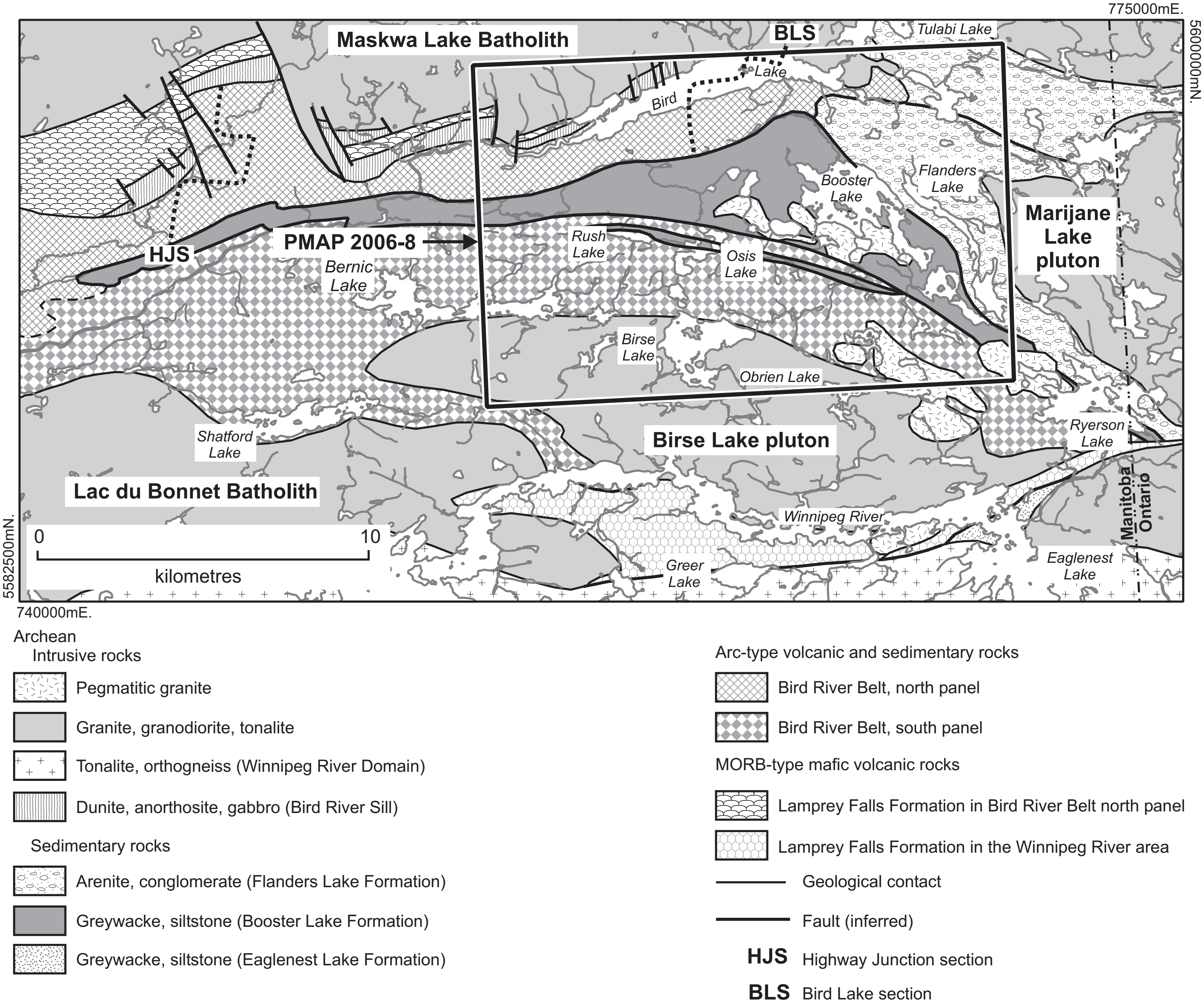

Figure 2: Geological map of the Bird River belt.

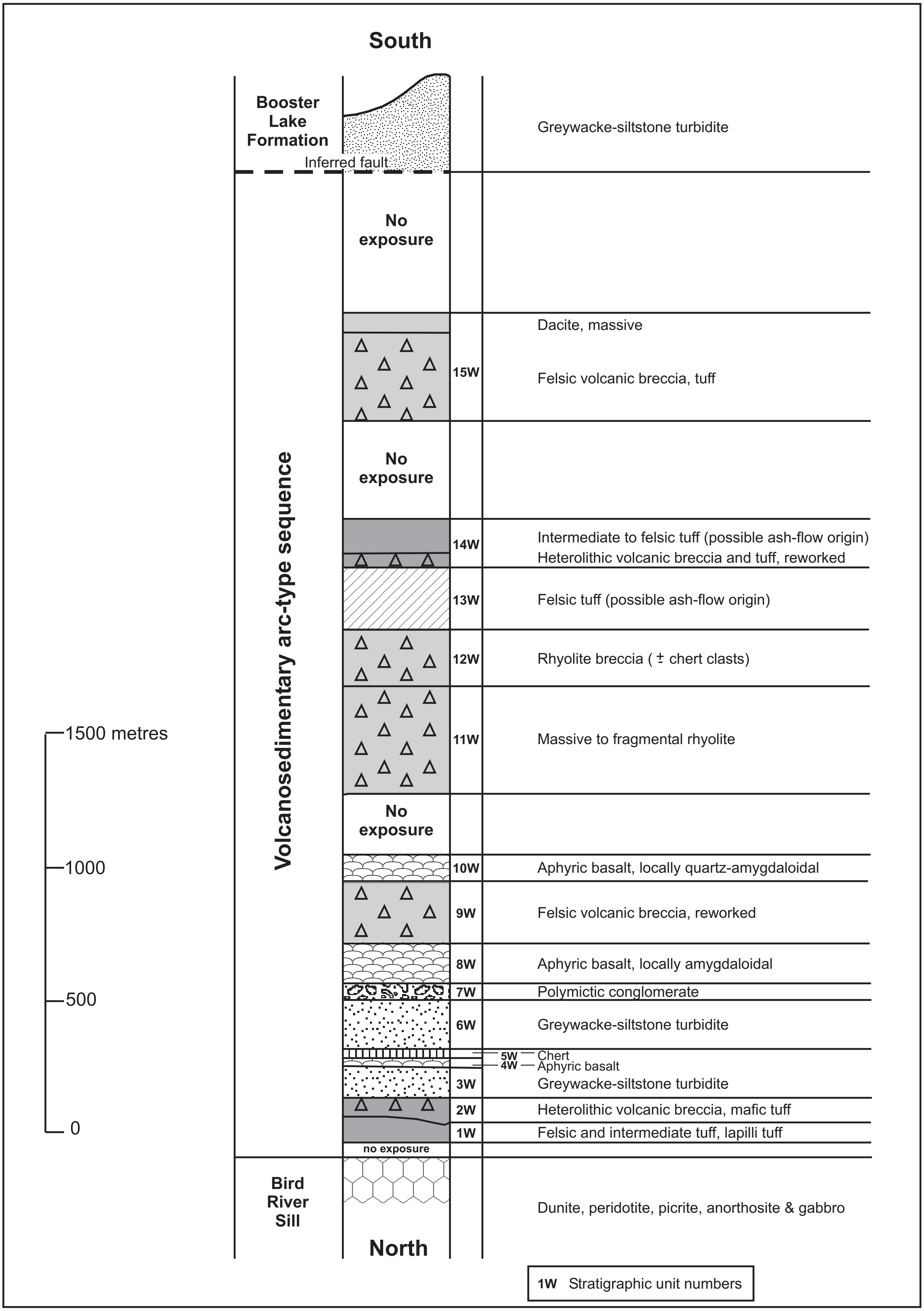

Figure 3: South-north stratigraphic section of the north panel of the Bird River belt, in the vicinity of the junction between Provincial Roads 314 and 315 (‘Highway Junction section’).

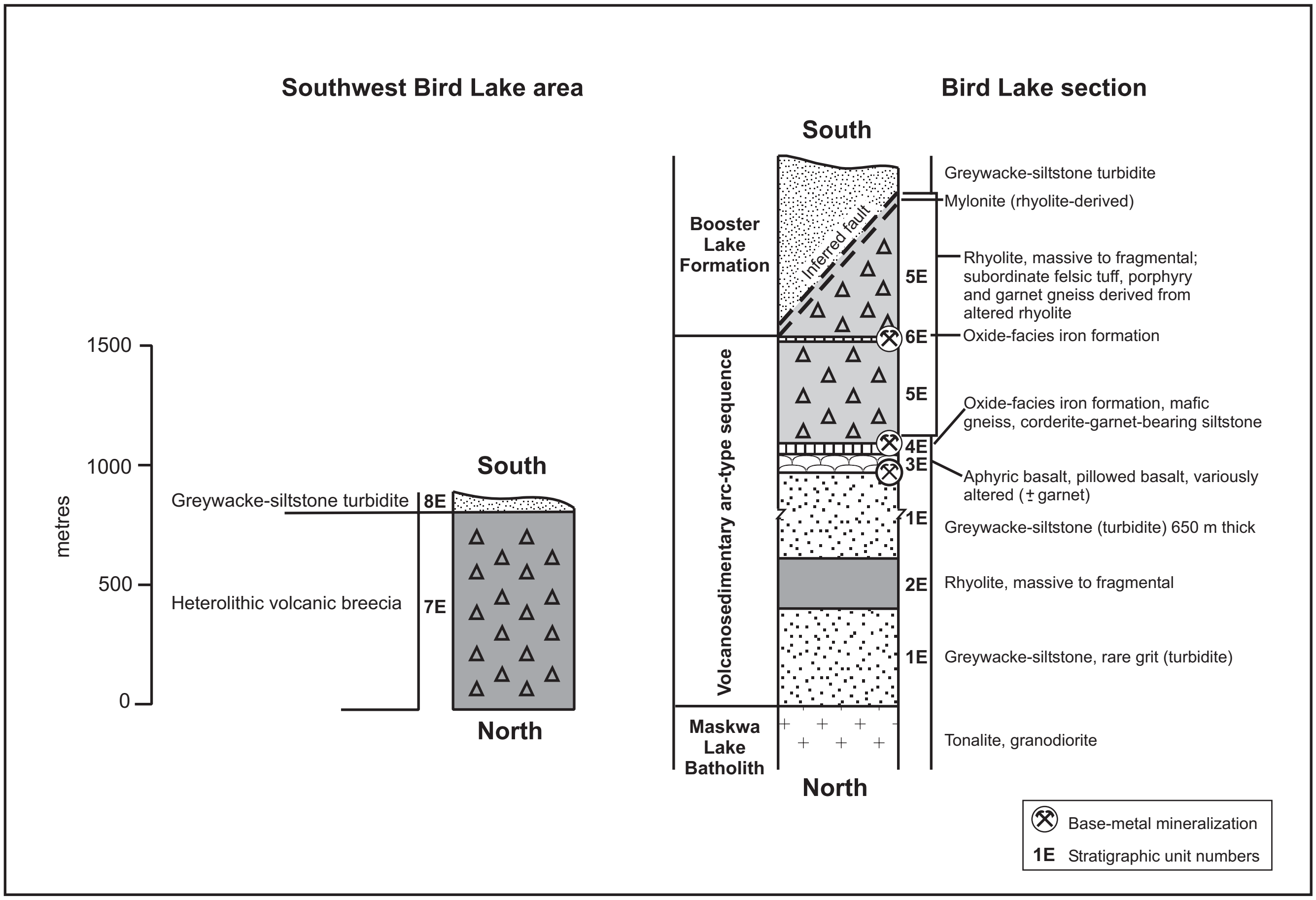

Figure 4: South-north stratigraphic section of the north panel of the Bird River belt, from the Booster Lake Formation to Bird Lake ('Bird Lake section').


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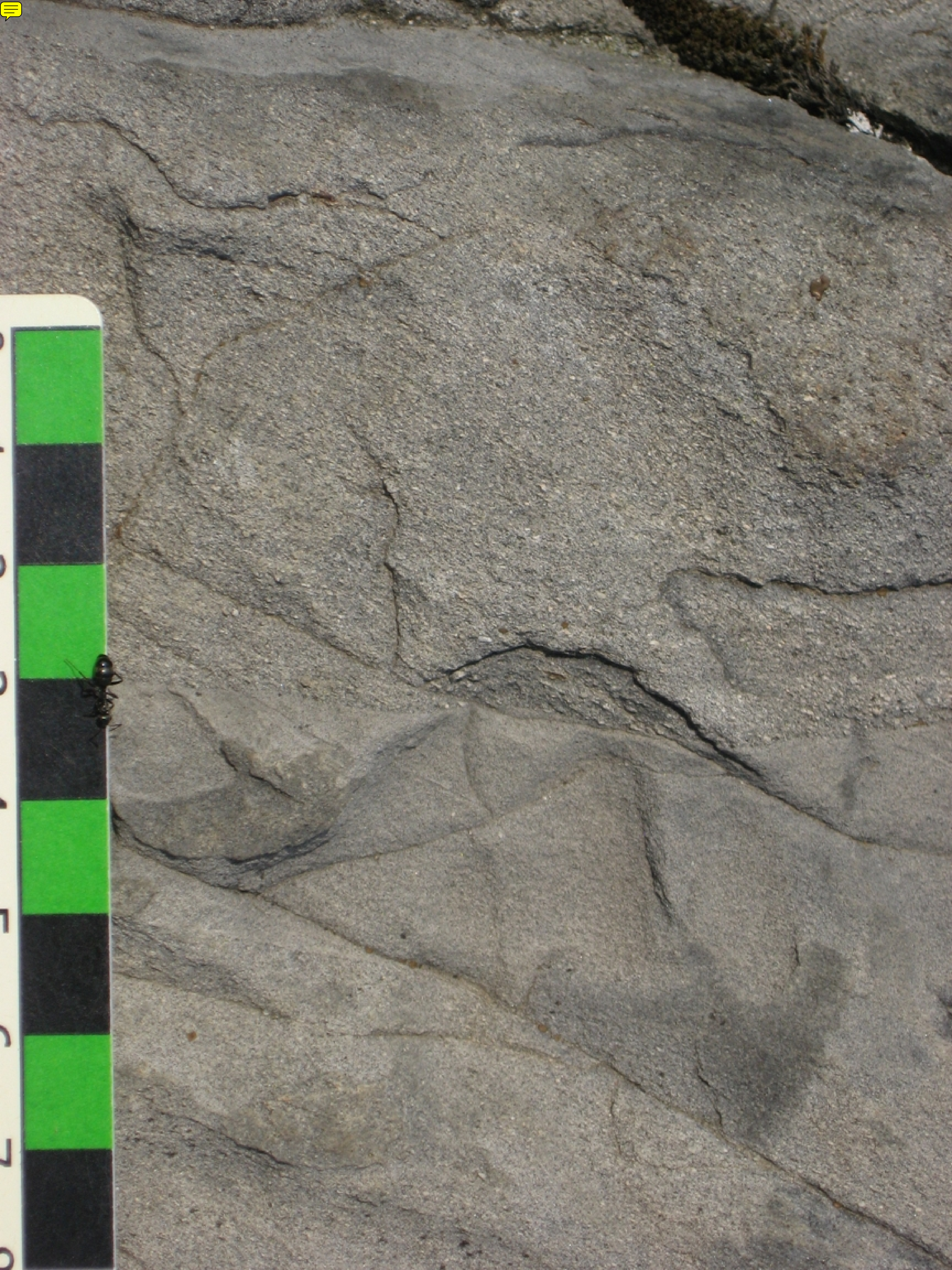


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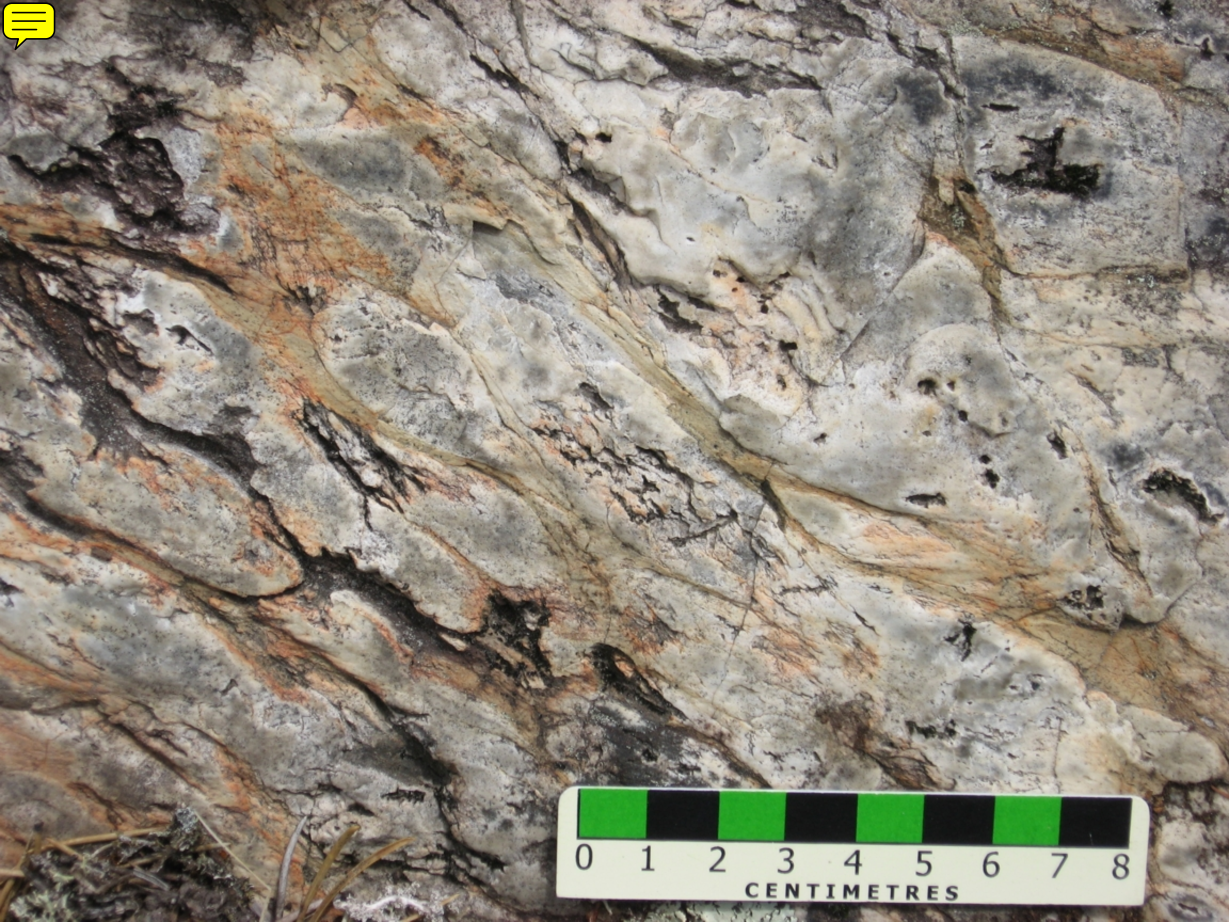
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