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C. Sasseville and K.Y. Tomlinson

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Authors' addresses

C. Sasseville *(csassev@geosci.lan.mcgill.ca)*
McGill University
Earth and Planetary Sciences Department
3450 University Street
Montreal, Quebec H3A 2A7

K.Y. Tomlinson *(ktomlins@NRCan.gc.ca)*
Continental Geoscience Division
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario K1A 0E8

Tectonostratigraphy, structure, and geochemistry of the Mesoarchean Wallace Lake greenstone belt, southeastern Manitoba[1]

C. Sasseville and K.Y. Tomlinson
Continental Geoscience Division, Ottawa

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Abstract: In the Wallace Lake greenstone belt, the Conley and Overload Bay formations make up the Wallace Lake assemblage (<3.0 Ga, >2.92 Ga), and comprise a platformal sedimentary sequence and an associated mafic-ultramafic volcanic sequence with iron-formation. The Big Island composite assemblage contains three superposed tectonic slivers comprising mafic-ultramafic rocks, gabbro, and pillow lavas. The Siderock Lake assemblage comprises volcanogenic polymictic conglomerates. Geochemically, mafic-ultramafic rocks low in the stratigraphy appear to be contaminated, whereas upper units do not. The Wallace Lake, Big Island composite, and Siderock Lake assemblages are separated by layer-parallel D_1 high-strain zones which are folded by northwest- and west-trending close and reclined D_2 folds. Dextral shearing and east-northeast-trending folds represent a D_3 event, and D_4 produced S-shaped kink bands within older high-strain zones.

Résumé : Dans la ceinture de roches vertes de Wallace Lake, les formations de Conley et d'Overload Bay constituent l'assemblage de Wallace Lake (<3.0 Ga, >2.92 Ga) et se composent d'une sequence sédimentaire de plate-forme et d'une séquence volcanique mafique-ultramafique avec de la formation de fer. L'assemblage composite de Big Island contient trois copeaux tectoniques superposés contituées de roches mafiques-ultramafiques, de gabbro et de laves en coussins. L'assemblage de Siderock Lake est constitué de conglomerats volcanogènes polygéniques. D'après la geochimie, les roches mafiques-ultramafiques dans la partie inférieure de la suite seraient contaminées alors que les unités situées aux niveaux supérieurs ne le seraient pas. L'assemblage de Wallace Lake, l'assemblage composite de Big Island et l'assemblage de Siderock Lake sont séparés par des zones de forte contrainte D_1 parallèles aux couches, lesquelles sont déformées par des plis F_2 fermés et réclinés à orientation nord-ouest et ouest. Un cisaillement dextre et des plis à orientation est-nord-est représentent un événement D_3 et une déformation D_4 a produit des bandes kinkées en forme de S dans les zones de forte contrainte plus anciennes.

[1] Contribution to the Western Superior NATMAP Project

INTRODUCTION

The Western Superior NATMAP (National Mapping Program) focuses on the relationship between fragments of old (3.0–2.8 Ga) continental crust that occur sporadically throughout the region, and the predominant 2.75–2.70 Ga supracrustal sequences that have arc and oceanic affinities (Thurston and Chivers, 1990). Where well preserved, the old continental blocks comprise ca. 3 Ga tonalite unconformably overlain by thin quartzite and carbonate units, interpreted as platformal cover sequences (Thurston and Chivers, 1990). The sedimentary cover is generally overlain by komatiitic and tholeiitic volcanic rocks, which have locally been demonstrated to have plume-like geochemical affinities (e.g. Steep Rock; Tomlinson et al., 1996, 1999), and may represent the onset of volcanism associated with rifting of a 3 Ga Superior protocraton. The Wallace Lake greenstone belt is similar to other Mesoarchean greenstone belts, and contains a basal platformal sedimentary sequence overlain by mafic to ultramafic volcanic rocks. It is of key importance, because the sedimentary cover is cut by a 2.92 Ga tonalite dyke (Davis, 1994), thereby establishing a minimum age of deposition of the platformal sequence. This indicates that rifting of the 3 Ga protocontinent did not immediately precede the ca. 2.70 Ga Kenoran assembly event, but is more likely to have occurred during the Mesoarchean.

Many aims of the Western Superior NATMAP project are achievable through mapping and associated studies in the Wallace Lake greenstone belt. The immediate goals of the project are to address a number of specific problems:

1. The nature of the basal contact of the sedimentary sequence with surrounding granitoid bodies is unknown; the contact may be unconformable or tectonic, or the granitoid bodies may be intrusive.
2. The internal stratigraphy of the Wallace Lake greenstone belt requires re-examination in the light of regional observations of Mesoarchean sequences. These rocks may represent “one of the best developed and exposed sections of the Mesoarchean platform assemblage in the Superior Province” (Poulsen et al., 1996).
3. Of particular importance is the age and relationship of the volcanic rocks (particularly the komatiite units) to the sedimentary sequence. Komatiitic rocks in the adjacent Garner Lake area to the south have been dated at ca. 2.85 Ga (Brommecker et al., 1993). Are the Wallace Lake komatiite units equivalent to the Garner Lake komatiite units, or part of an older sequence? Are the 2.75–2.70 Ga volcanic and sedimentary rocks found in the main Rice Lake belt to the south also represented in the Wallace Lake belt, and if so, what is the relationship to the older units?
4. Finally, it is important to understand the structural history of the Wallace Lake greenstone belt. The three phases of deformation postdating 2.705 Ga documented in the Rice Lake belt should also be recorded at Wallace Lake, but the nature of early (predating 2.92 Ga) deformation (Poulsen et al., 1996) is cryptic.

In this paper we present results of recent fieldwork, geochemical, and Nd isotopic studies. The 1999 field season focused on the structure and stratigraphy within the Wallace Lake greenstone belt. The stratigraphy is presented first and involves redefinition of some of the sequences previously described in the belt and the introduction of assemblage nomenclature. The nature of the contacts between assemblages, and the internal stratigraphy of these assemblages is presented, followed by a discussion of the stratigraphic position of various komatiitic units. The geochemistry of the volcanic rocks follows, and finally, the structural history of the Wallace Lake greenstone belt is described. Sasseville and Tomlinson (1999) summarized previous work related to the Wallace Lake greenstone belt.

METHODOLOGY

Fieldwork in 1999 focused primarily on resolving map-scale structures through detailed mapping and structural analysis. Particular attention was given to establishing facing directions and foliation relationships. Foliations were commonly distinguished based on their style, intensity, and other prominent characteristics. Correlations of foliation type with folding events, as well as fold vergences, were used as mapping tools. It is important to note that lithological nomenclature is entirely field based. For clastic sediments, the classification of Pettijohn et al. (1972) was used. For intrusive rocks, the classification of Lemaitre et al. (1989) was used.

RESULTS

New stratigraphic nomenclature

The authors introduce here a new, but informal, stratigraphic nomenclature for the Wallace Lake greenstone belt to improve the previous stratigraphic definitions (McRitchie, 1971; Sasseville and Tomlinson, 1999). This nomenclature accommodates newly described units within the Wallace Lake belt (Fig. 1). The Wallace Lake assemblage contains the sedimentary Conley Formation and the newly defined, predominantly volcanic, Overload Bay formation (Fig. 2; see below). The Big Island composite assemblage contains volcanic rocks previously assigned to the Big Island Formation (McRitchie, 1971), but reflects new interpretations of the assemblage that contains three tectonically bounded panels (Fig. 2). The Siderock Lake assemblage contains rocks previously defined as the Siderock Lake Formation (McRitchie, 1971). From this point onwards, this paper refers to the new nomenclature presented herein.

Nature of contacts

The Wallace Lake, Big Island composite, and Siderock Lake assemblages, which constitute the Wallace Lake greenstone belt, consist of a platformal sedimentary sequence with associated ultramafic volcanic rocks, a mafic-ultramafic volcanic package, and a sequence of volcanogenic polymictic conglomerates, respectively (Fig. 1; Sasseville and Tomlinson, 1999).

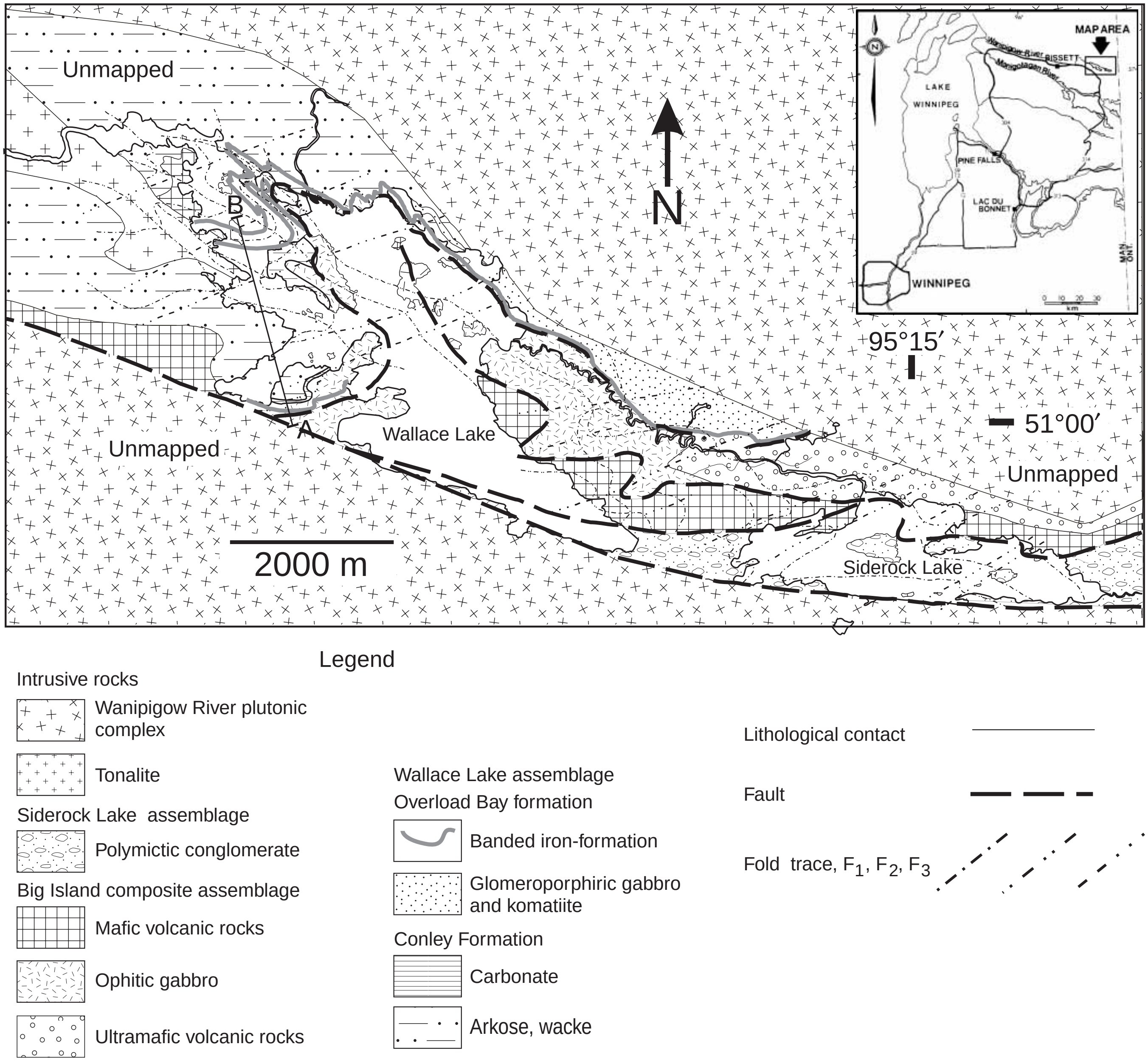

Figure 1. *Geological map showing structural interpretations of the Wallace Lake greenstone belt. Line A-B represents the cross-section shown in Figure 7.*

Field relationships indicate that D_1 high-strain zones separate the three assemblages. Although the Conley Formation of the Wallace Lake assemblage is known to be Mesoarchean, based on the 2920 Ma age of a crosscutting dyke and 3000–2998 Ma detrital zircons contained within arkose units (Davis, 1994; Poulsen et al., unpub. rept., 1999), the age of the Big Island composite assemblage and Siderock Lake assemblage, which are in tectonic contact with the Wallace Lake assemblage, remain unknown.

Following 1998 fieldwork, we reported a possible unconformity between conglomerate and arkose of the Conley Formation and a tonalite body, which displays petrological similarities to some tonalite clasts in Conley Formation conglomeratic units (Sasseville and Tomlinson, 1999). Further work during the 1999 season documented an outcrop-scale angular and intrusive relationship between banded iron-formation, greywacke, and the tonalite. On this outcrop the greywacke faces towards the tonalite, implying an intrusive contact. Furthermore, the observed contact shows no high-strain features. At a larger scale, the sedimentary beds face towards the tonalite contact, which is also discordant to the stratigraphy, indicating that this tonalite body intruded the Conley Formation.

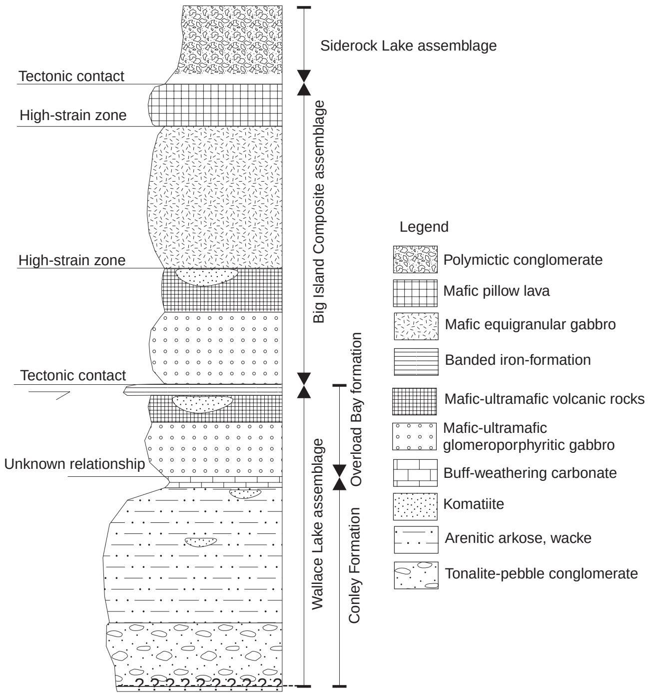

Figure 2. *Schematic tectonostratigraphic section of the Wallace Lake greenstone belt comprising three assemblages. The platformal sediments of the Conley Formation, and mafic-ultramafic rocks and banded iron-formation of the Overload Bay formation constitute the two formations of the Wallace Lake assemblage. The Big Island composite assemblage is tectonically built up of three superposed mafic and ultramafic panels. Finally, a thick volcanogenic, and polymictic conglomerate sequence constitutes the Siderock Lake assemblage.*

Fieldwork during 1999 also demonstrated that the Big Island composite assemblage tectonically overlies the Wallace Lake assemblage, contrary to the conformable relationship previously reported (Sasseville and Tomlinson, 1999). A ten m wide high-strain zone separates these assemblages. The high-strain zone can be traced throughout the greenstone belt, at a low angle to the stratigraphy. The shear zone is an early structure, affected at map scale by second- and third-generation folds. All field kinematic indicators associated with the shear zone indicate an apparent dextral sense, but further analysis is continuing. Since the original attitude of the D_1 shear zone is unknown, only an apparent dextral motion could be established at this stage.

The Siderock Lake assemblage tectonically overlies the Big Island composite assemblage, separated by a high-strain zone a few tens of metres thick. Unfortunately, no kinematic indicators were found in the field, and only a very penetrative foliation defines this shear zone. This shear zone is an early structure, subparallel to the first deformation fabric. A second-generation spaced cleavage cuts the shear zone, and is itself folded by third generation folds (Fig. 1).

The entire Wallace Lake greenstone belt is bounded by granodiorite of the Wanipigow plutonic complex (Sasseville and Tomlinson, 1999). The southern belt margin is defined by the east-west-trending Wanipigow Lake–Wallace Lake fault (Fig. 1), whereas the northern margin of the belt is an intrusive contact with ca. 2730 Ma granodiorite (Turek et al., 1989) of the Wanipigow plutonic complex (Fig. 1).

Internal stratigraphy

The Conley Formation is a shallow-water sedimentary succession comprising tonalite-pebble conglomerate, overlain by arenitic arkose with rare komatiite lenses, overlain by chert and carbonate (Fig. 2). The base of the Conley Formation was not established within the mapped area (Fig. 1). However, the abundant occurrence of tonalite conglomerate towards the west end of the mapped area suggests that an unconformity with tonalitic basement may be present. Unfortunately, the new and thickly growing vegetation is rapidly reducing the exposure and accessibility, thereby reducing the chance to identify such an unconformity.

The Overload Bay formation overlies the Conley Formation and contains spinifex-textured and pyroclastic komatiite units, mafic-ultramafic glomeroporphyritic gabbro (of volcanic or hypabyssal intrusive origin), and pillow lava, and is capped by a thin sequence of pelagic sedimentary rock and banded iron-formation (Fig. 2). The iron-formation can be traced magnetically and on the ground throughout the Wallace Lake greenstone belt at a single stratigraphic level, thereby forming a valuable stratigraphic marker.

A high-strain zone occurs at the top of the iron-formation, marking the structural top of the Overload Bay formation and also the Wallace Lake assemblage. It is exposed along the Wanipigow River (Fig. 1), where it separates the Wallace Lake assemblage to the north, from volcanic rocks of the Big Island composite assemblage to the south. On the north side of the high-strain zone, mafic rocks are characterized by amphibole, garnet, and plagioclase assemblages indicative of the upper greenschist facies, whereas to the south, mafic rocks contain actinolite and chlorite, suggesting lower greenschist facies. It is not clear whether the apparent difference in grade reflects different pressure-temperature conditions, or bulk compositional effects. If the mineral assemblages represent a metamorphic discontinuity across the D_1 shear zone, it implies metamorphism prior to the D_1 event. Mylonite fabrics characterize the shear zone where garnet porphyroblasts are rotated.

The Big Island composite assemblage replaces the previously defined Big Island Formation (McRitchie, 1971). Its relative age and original relationship with the Wallace Lake assemblage are at present unknown. It appears to be a complex tectonic assemblage of mafic and ultramafic rocks contained within three tectonically bounded panels. The basal panel is made up of mafic to ultramafic rocks, and is structurally overlain by a mafic gabbro sequence, which is in turn overlain by a thick sequence of pillow basalt (Fig. 2).

The basal panel consists of a lower mafic-ultramafic glomeroporphyritic gabbro, spinifex-textured komatiite, and pillowed komatiitic basalt, overlain by pillow basalt and minor pelagic sedimentary rocks. This sequence is similar to, but at this stage has not been correlated with, the Overload Bay formation.

The second structural panel of the Big Island composite assemblage consists of homogeneous, slightly D_1-foliated, equigranular gabbro. Within the least strained gabbro, primary equigranular textures are preserved. Only local, minor (1–3 m wide) D_3 schistose zones are present.

A 10 m wide shear zone, characterized by schistose mafic rocks and sheath folds, separates the gabbro sequence from pillow lava of the upper panel. The kinematics of this shear zone were not established based on field observations. The upper panel consists of moderately strained pillow basalt. Despite pillow flattening ratios on the order of 1:10, many primary structures such as lava tubes and amygdular flow tops are well preserved, providing excellent way-up indicators, which document an F_1 folded sequence of lavas.

The Siderock Lake assemblage tectonically overlies the Big Island composite assemblage (Fig. 2) and their relative age and original relationship is unknown. The assemblage comprises turbidite, a thick volcanogenic and polymictic conglomerate sequence including rare ultramafic lenses, and an upper felsic tuff unit.

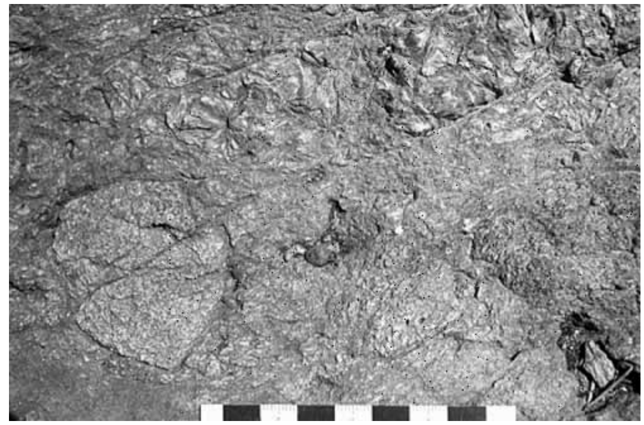

Figure 3. *Ultramafic pyroclastic breccia and spinifex-textured volcanic rocks, north shore of Wallace Lake.*

Distribution of ultramafic rocks

Based on fieldwork, ultramafic rocks occur at three distinct stratigraphic levels within the Wallace Lake greenstone belt: 1) within the arkose of the Conley Formation, 2) within the Overload Bay formation beneath iron-formation, and 3) in the basal panel of the Big Island composite assemblage (Fig. 2). In all locations, volcanic features were observed, in the form of pillows, spinifex texture, or pyroclastic breccia. The lowest level (1), occurs as isolated lenses of spinifex-textured flows. They occur in arenitic arkose units in northwestern Wallace Lake, and possibly correlative talc schist was reported as layers within limestone in drill logs (Cameron, unpub. company rept., 1979). These komatiite units are part of the Conley Formation arkose and are therefore bracketed between 2998 and 2920 Ma. Therefore, a correlation with the Garner Lake belt to the south, dated at ca. 2.85 Ga (Brommecker et al., 1993) is not warranted as proposed in the introduction.

The second ultramafic volcanic unit (2) is a continuous body within the Overload Bay formation. It has a strike length of approximately 5700 m where it outcrops in northeastern Wallace Lake (Fig. 1). Spinifex textures and exceptional pyroclastic breccias are present locally (Fig. 3). A body of glomeroporphyritic mafic-ultramafic gabbro occurs within this unit. Although volcanic features were not observed in the gabbro, the grain-size heterogeneity and presence of local sedimentary lenses suggest a volcanic or hypabyssal intrusive origin.

The third unit of ultramafic rocks (3) occurs within the basal panel of the Big Island composite assemblage, and outcrops on the north of Siderock Lake and in Twin Bays on northwestern Wallace Lake (Fig. 1, 2). Obviously volcanic, these ultramafic rocks display abundant pillows, spinifex-textured flows (Sasseville and Tomlinson, 1999), glomeroporphyritic mafic-ultramafic gabbro, and minor interflow sedimentary rocks. Geochemically, this unit comprises both komatiite and komatiitic basalt (*see* below).

Geochemistry and Nd isotopes of the volcanic rocks

The komatiite and komatiitic basalt units analyzed occur in three main areas: on the northeastern shore of Wallace Lake (Overload Bay formation), in Twin Bays on northwestern Wallace Lake (basal Big Island composite assemblage), and on Siderock Lake (also basal Big Island composite assemblage; Fig. 1). The ultramafic lenses that occur within arkose of the Conley Formation have not been analyzed, but are the focus of further geochemical study. Spinifex-textured and pyroclastic rocks of the Overload Bay formation are komatiitic, with 22–35 weight per cent MgO. The schistose ultramafic rocks from Twin Bays are less Mg rich, with 11–19 weight per cent MgO. The spinifex-textured flows, pillowed flows, and schists from Siderock Lake are both komatiitic and komatiitic basalt with 25–26 weight per cent MgO and 12–15 weight per cent MgO, respectively. The komatiite and komatiitic basalt units from each area are Al undepleted (Al_2O_3/TiO_2 of 20–30). Mantle-normalized multi-element profiles are shown for the rocks in Figure 4a. Although Eu is variably mobile, the remaining REEs are similar for samples from each area and show relatively flat profiles with enrichment in Th and slight to moderate negative Nb anomalies. Combined with the low ε_{Nd} values from two samples (+0.8 and –0.2 at 2.95 Ga), the data suggest some interaction with older felsic crust.

High-Th basaltic rocks occur within the Overload Bay formation and the basal Big Island composite assemblage. These mafic flows, mafic tuff, chlorite schist, and gabbro units, associated with the komatiitic rocks, are tholeiitic and typically contain 6–9 weight per cent MgO and 47–50 weight per cent SiO_2, although two samples are intermediate (4–5 weight per cent MgO; 60 weight per cent SiO_2). Mantle-normalized multi-element profiles (Fig. 4b) have flat to light-REE-enriched profiles with enrichment in Th and depletion

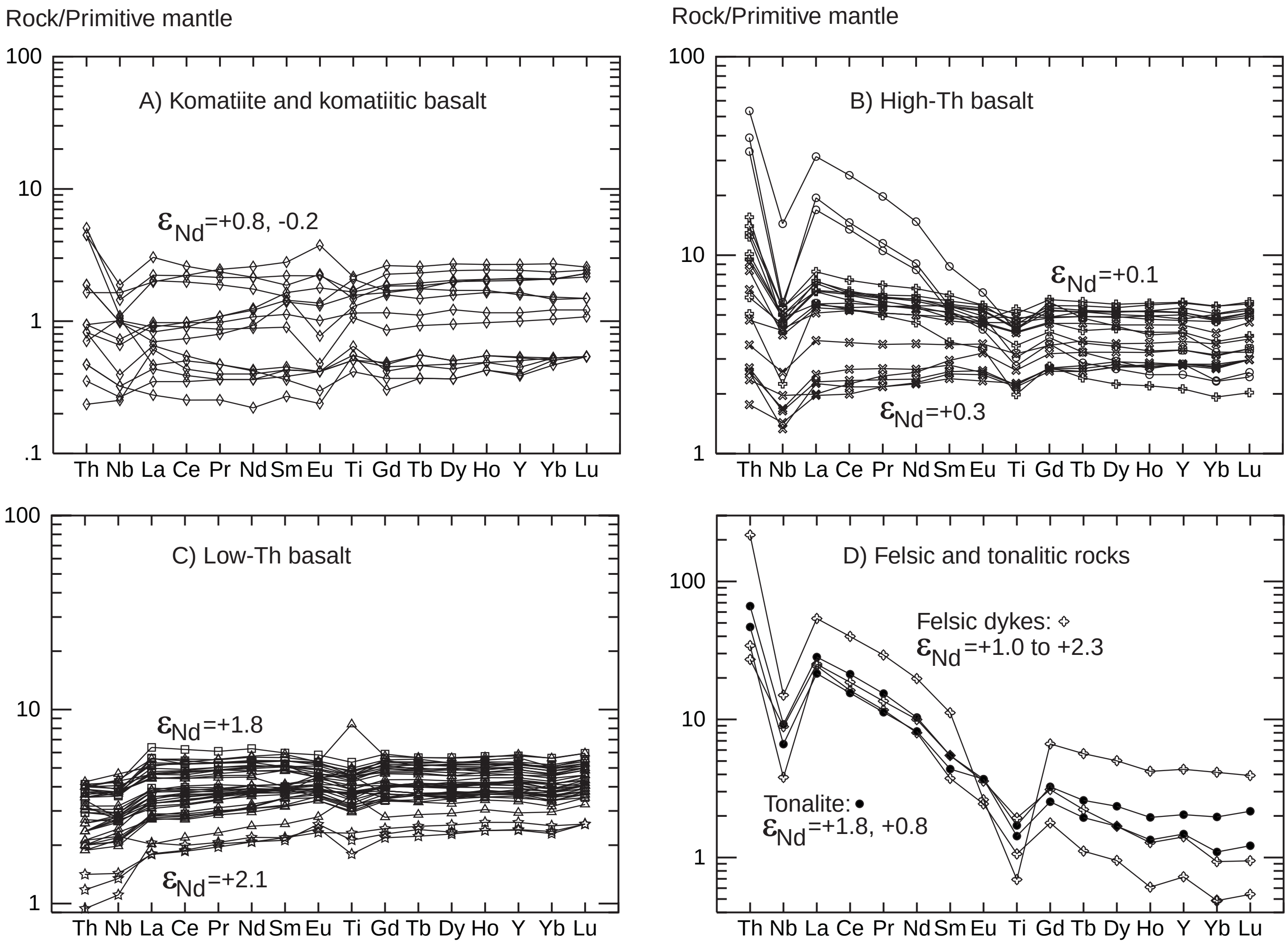

Figure 4. *Mantle-normalized multi-element profiles for* ***a)*** *komatiite* ***b)*** *high-Th basalt,* ***c)*** *low-Th basalt and* ***d)*** *felsic rock, of the Wallace Lake greenstone belt. Epsilon Nd values are also given for representative rocks from each group. The high-Th basalt units occur low in the volcanic sequence (Overload Bay formation and basal panel of the Big Island composite assemblage) and are associated with the komatiite units. The low-Th basalt units make up the rest of the Big Island composite assemblage.*

in Nb. Two samples have low ε_{Nd} values of +0.1 and +0.3 (at 2.95 Ga), indicating that these rocks have probably been contaminated by an older felsic crustal component. Both the komatiites and high-Th basaltic rocks from the Overload Bay formation and the basal Big Island composite assemblage may therefore have erupted through tonalitic basement.

Low-Th basaltic rocks make up the rest of the Big Island composite assemblage and occur above the komatiite–high-Th basaltic horizons. They are tholeiitic and contain 5–9 weight per cent MgO and typically 47–52 weight per cent SiO_2. Mantle-normalized multi-element profiles (Fig. 4c) differ from those of the high-Th basalt units in that these rocks are depleted in Th and Nb and have flat to slightly depleted light-REE profiles. They also have higher ε_{Nd} values of +2.1 and +1.8 (at 2.95 Ga). The combined trace-element and isotope data indicate that these rocks have not interacted with older felsic crust, and are hence more likely to have formed in an oceanic environment. The rocks are less depleted than modern mid-ocean ridge basalt, but are geochemically similar to rocks developed in modern oceanic plateaus and therefore they may represent a dismembered fragment of an oceanic plateau.

Various felsic dykes cut the sedimentary package and the mafic to ultramafic volcanic rocks. Some of these, along with a sample of tonalite intruding the Conley Formation, and a tonalitic clast from the basal tonalite conglomerate, have been analyzed for geochemistry and Nd isotopes (Fig. 4d). The dykes contain 65–72 weight per cent SiO_2, and the tonalites, 70–71 weight per cent SiO_2. The rocks are all strongly light REE and Th enriched, and strongly depleted in Nb and the heavy REEs. The age of each of these rocks is unknown, but ε_{Nd} values have been calculated at 2.92 Ga for the dykes and at 3.0 Ga for the tonalites. The ε_{Nd} values range from +0.8 to +2.3; the broad range may indicate that felsic magmatism in the belt stemmed from a combination of crustal and mantle sources. Significantly, the tonalite clast has the lowest ε_{Nd} value and its model age (T_{DM}) is 3090 Ma, indicating that rocks older than those dated in the vicinity (3.00 Ga; Turek and Weber, 1994) may be present in the source region. A felsic dyke cutting the Twin Bays komatiite unit also has a low ε_{Nd} value (+1.0) and an old model age (T_{DM}=3011 Ma), which suggests that the basal panel of the Big Island composite assemblage may also be Mesoarchean.

Structural history of the Wallace Lake belt

Four sets of structures are recognized in the Wallace Lake belt, designated D_1–D_4. D_1 is characterized by tight folds and associated layer-parallel shear zones. D_2 is responsible for close and reclined northwest- and west-trending folds. D_3 is a dextral shearing event associated with east-northeast-trending folds. D_4 produced S-shaped kink bands, localized within older high-strain zones. Due to their increasing intensity and interference patterns, the different events will be presented from latest to earliest, as they were analyzed in the field.

D_4

Effects of the fourth deformation are restricted to fissile high-strain zones developed during earlier deformation events. This deformation is characterized by north-northwest-trending ‘S’ kink bands that rarely form conjugate sets. This deformation is associated with a locally developed, 5–10 cm spaced cleavage with pronounced (70°), convergent fanning.

D_3

D_3 formed the dominant fabric elements in the Siderock Lake assemblage, whereas it is only locally developed in arkosic units of the Conley Formation, particularly in southwestern Wallace Lake. At the greenstone-belt scale, this dextral shear deformation produced outcrop- and map-scale folds and axial-planar shear zones. The east-northeast-trending folds of S_2 (Fig. 5) have conical geometry. In the Siderock Lake assemblage, a previously highly strained unit, these folds are characteristically tight (Fig. 5), whereas in the more competent units of the Conley Formation, they are open. A variably developed S_3 cleavage (schistosity and spaced cleavage) trends east-northeast, and a well developed east-northeast-trending L_3 mineral-elongation lineation plunges moderately, parallel to F_3 fold hinges. In the Wallace Lake and Big Island composite assemblages, F_3 long limbs typically trend easterly, whereas short limbs trend generally northwest (Fig. 1).

D_2

Effects of the second deformation event are present throughout the belt, and together with D_1 structures, produce the map-scale interference pattern in northwestern Wallace Lake. Such interference patterns are also seen at outcrop scale (Fig. 6). This deformation forms a convergently fanning (20°), 2–3 mm spaced axial-planar cleavage in hinges of tight and reclined F_2 folds. The S_2 cleavage and associated folds trend easterly on long limbs and generally northwesterly on the short limbs of F_3 folds.

D_1

D_1 deformation is most pervasive and intense. Very tight, moderately plunging F_1 folds, a well developed penetrative S_1 foliation, and a moderately plunging L_1 mineral lineation characterize this deformation. Discernable on the map only by opposed structural facings, the F_1 folds are more evident in cross-section (Fig. 7). Many map-scale and layer-parallel shear zones can be attributed to this deformation event, but the Gatlan shear zone (Sasseville and Tomlinson, 1999) is the only example of a D_1 axial-planar shear zone observed in the Wallace Lake greenstone belt. The tectonic contacts between the Wallace Lake, Big Island composite, and Siderock Lake assemblages are attributed to D_1 layer-parallel shear zones.

D_1/D_2 interference patterns

F_1 and F_2 folds dominate the deformation history of the Wallace Lake greenstone belt. The folds produce interference patterns at both map and outcrop scale (Fig. 1, 6). Structural analysis of an outcrop-scale interference pattern (Fig. 6) guides interpretation at the map scale of an interference

Figure 5. *Third-generation chevron-type fold, Siderock Lake.*

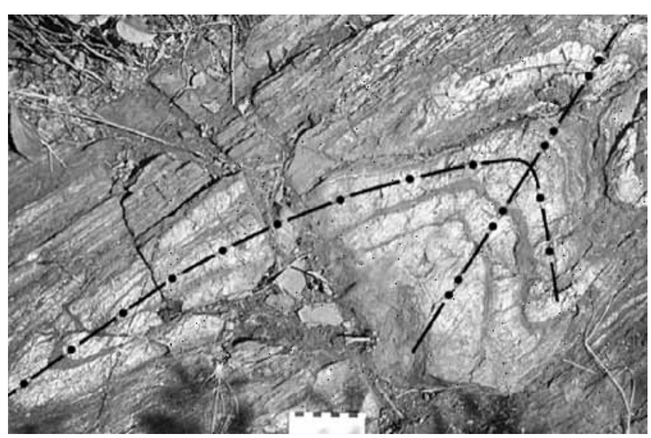

Figure 6. *First (single-dotted line) and second (double-dotted line) fold interference pattern.*

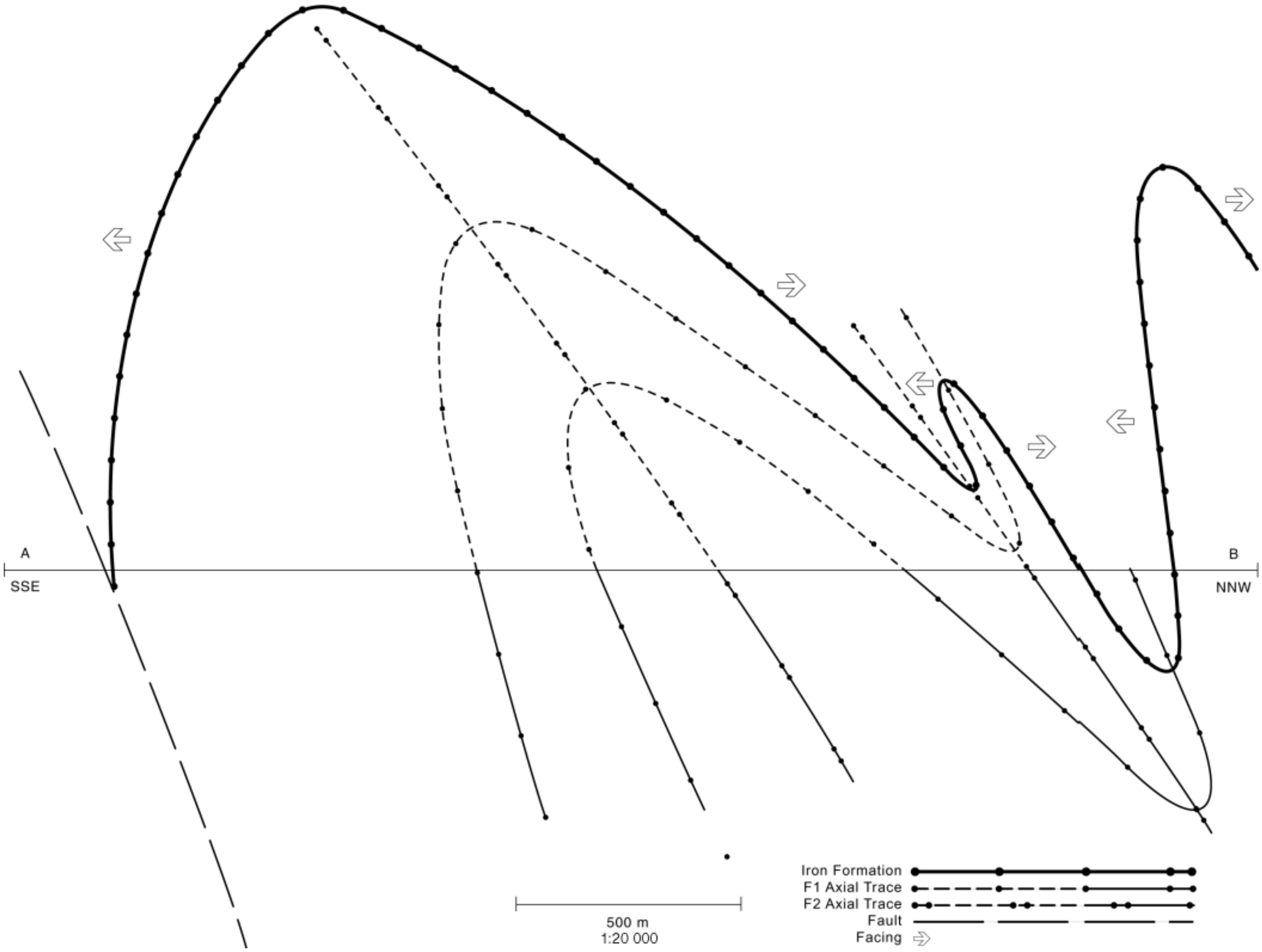

Figure 7. *Structural cross-section through the Conley Formation in southwestern Wallace Lake. Location of cross-section is shown in Figure 1.*

pattern of similar style. The interference pattern is coaxial, or type 3 (Ramsay and Huber, 1987), with an angle of 28° between the fold axis F_1 (B_1) and fold axis F_2 (B_2).

Mineral lineations were formed during D_1 and D_3. L_{m3} is parallel to F_3 hinges and plunges moderately to the east-northeast, whereas L_{m1} plunges moderately to steeply to the west-northwest and north.

CONCLUSIONS

D_1 shear zones separate the Wallace Lake assemblage, the Big Island composite assemblage, and the Siderock Lake assemblage; consisting of a platformal sedimentary sequence and ultramafic volcanics, a mafic-ultramafic volcanic package, and volcanogenic polymictic conglomerates, respectively. The age of the Conley Formation is bracketed between 2998 and 2920 Ma; however, the Big Island composite assemblage and Siderock Lake assemblage remain undated.

The Conley Formation represents a platformal sedimentary sequence capped by carbonate. The Overload Bay formation, a locally developed komatiitic unit, occurs above and includes banded iron-formation and pelagic sedimentary rocks. The Big Island composite assemblage is made up of three distinct panels composed from base to top of a mafic-ultramafic volcanic unit, equigranular gabbro unit, and pillowed basalt sequence. The panels are bounded by D1 high-strain zones, which include sheath folds.

The internal stratigraphy of the Siderock Lake assemblage remains similar to that previously described as the Siderock Lake Formation (Sasseville and Tomlinson, 1999).

Ultramafic volcanic sequences occur at three distinct stratigraphic levels in the Wallace Lake greenstone belt. The lowest forms isolated lenses within the Conley Formation, and is therefore bracketed between 2998 and 2920 Ma. Therefore, a correlation with the Garner Lake belt to the south does not seem warranted as proposed in the introduction. The second unit, the Overload Bay formation, with spinifex-textured flows, pillow basalt, and pyroclastic flows, occurs at the top of the Wallace Lake assemblage. The third ultramafic unit, at the base of the Big Island composite assemblage, displays similar characteristics to the Overload Bay formation, but no direct correlations can be established at this stage.

Geochemically, the ultramafic rocks of the Overload Bay formation are much higher in MgO content than those of the basal Big Island composite assemblage, but they are similar in terms of REE and HFSE characteristics. Thorium enrichment and slight Nb depletion combined with low ε_{Nd} values, suggest interaction with older felsic crust. Mafic rocks associated with the komatiite units (pillow lava, gabbro, and mafic tuff) are light REE and Th enriched, and also have low ε_{Nd} values suggesting that the volcanic rocks of the Overload Bay formation and the basal units of the Big Island composite assemblage were contaminated during eruption through a felsic basement. In contrast, the structurally higher part of the Big Island composite assemblage shows depletion in Th and flat to depleted light-REE profiles, which, combined with high ε_{Nd} values, indicates that these rocks are uncontaminated and may represent part of an oceanic plateau.

Structural analysis demonstrates that F_1-F_2 coaxial-fold interference patterns occur as dominant structures in northwest Wallace Lake, whereas D_3 deformation forms an intense, and dominant foliation in the Siderock Lake assemblage, but only open folds in the Wallace Lake assemblage.

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