Preliminary results of bedrock mapping in the Wasekwan Lake area, Lynn Lake greenstone belt, northwestern Manitoba (Parts of NTS 64C10, 15)

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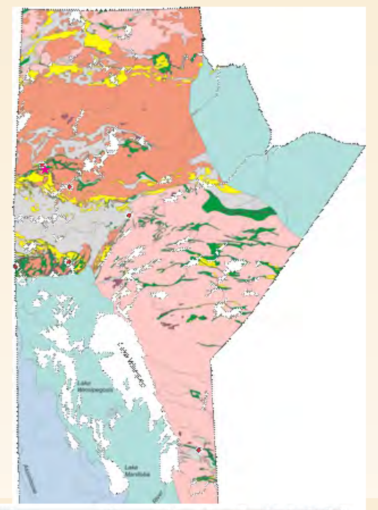


Abstract

In 2017, the Manitoba Geological Survey continued its bedrock mapping project in the Lynn Lake greenstone belt (Fig. 1), focussing on the Wasekwan area at 1:2 0000 scale, where the Burnt Timber Au deposit, Central Au showing, and Linkwood Au property are located (Fig. 2). Preliminary results of new mapping indicate that this area is dominantly underlain by massive to pillowed basalt, with minor basaltic andesite, dacite, rhyolite, and related volcaniclastic rocks, along with subordinate sedimentary rocks. The volcanic sequence is tholeiitic to calcalkaline, which is spatially and temporally associated with reworked volcaniclastic and epiclastic rocks and banded iron formation, suggesting that they may have deposited in a setting comparable to modern volcanic arcs or back-arc basins. These supracrustal rocks are intruded by three suites of granitoid intrusions, in addition to being overprinted by multiple phases of deformation and metamorphism.

The mapping suggests: 1) Au mineralization appears to be spatially associated with structural contacts between volcaniclastic rocks (unit 1), Fe-rich mafic volcanic rocks (unit 2) and sedimentary rocks (unit 3) that occur along, or adjacent to, the Johnson shear zone and associated structures, which may have created traps (structural and chemical) for Au-bearing fluids; 2) the presence of garnet-hornblende porphyroblasts well preserved in feldspathic greywacke (unit 3), that suggests it, together with the other supracrustal rocks, may have experienced middle-amphibolite facies metamorphism, although the presence of actinolite–tremolite and sodic plagioclase in mafic volcaniclastic rocks (unit 1) indicates that they have been subject to greenschist-facies retrograde overprint; 3) gabbroic intrusions of unit 4 may have potential to host magmatic Ni-Cu-Co-(Pt) mineralization but require further evaluation; and 4) some of the late granitic porphyry dikes (unit 7) contain higher Zr contents (i.e. higher temperatures) than other granitoids in units 5, and 6; these younger quartz-feldspar porphyritic rocks (~1815 Ma) are metaluminous and calcalkaline containing notable high Au up to 1.45 g/t, strongly suggesting that these late suite granitoids are of A-type and likely formed in an extensional setting due to orogen relaxation post to terrane collision. These porphyry dikes could serve an empirical guide to Au mineralization. 5) reduced I-type granitoid plutons (unit 6) need to be investigated for their potential linkage to Au mineralization.

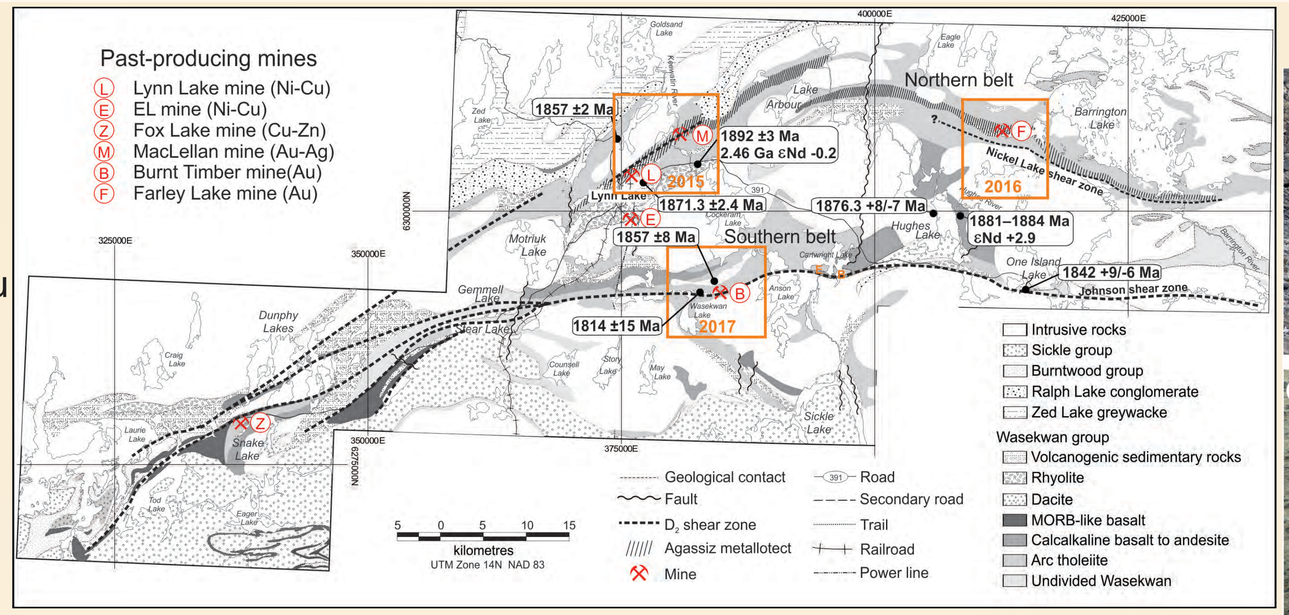


Fig. 1 Regional geology map of the Lynn Lake greenstone belt.

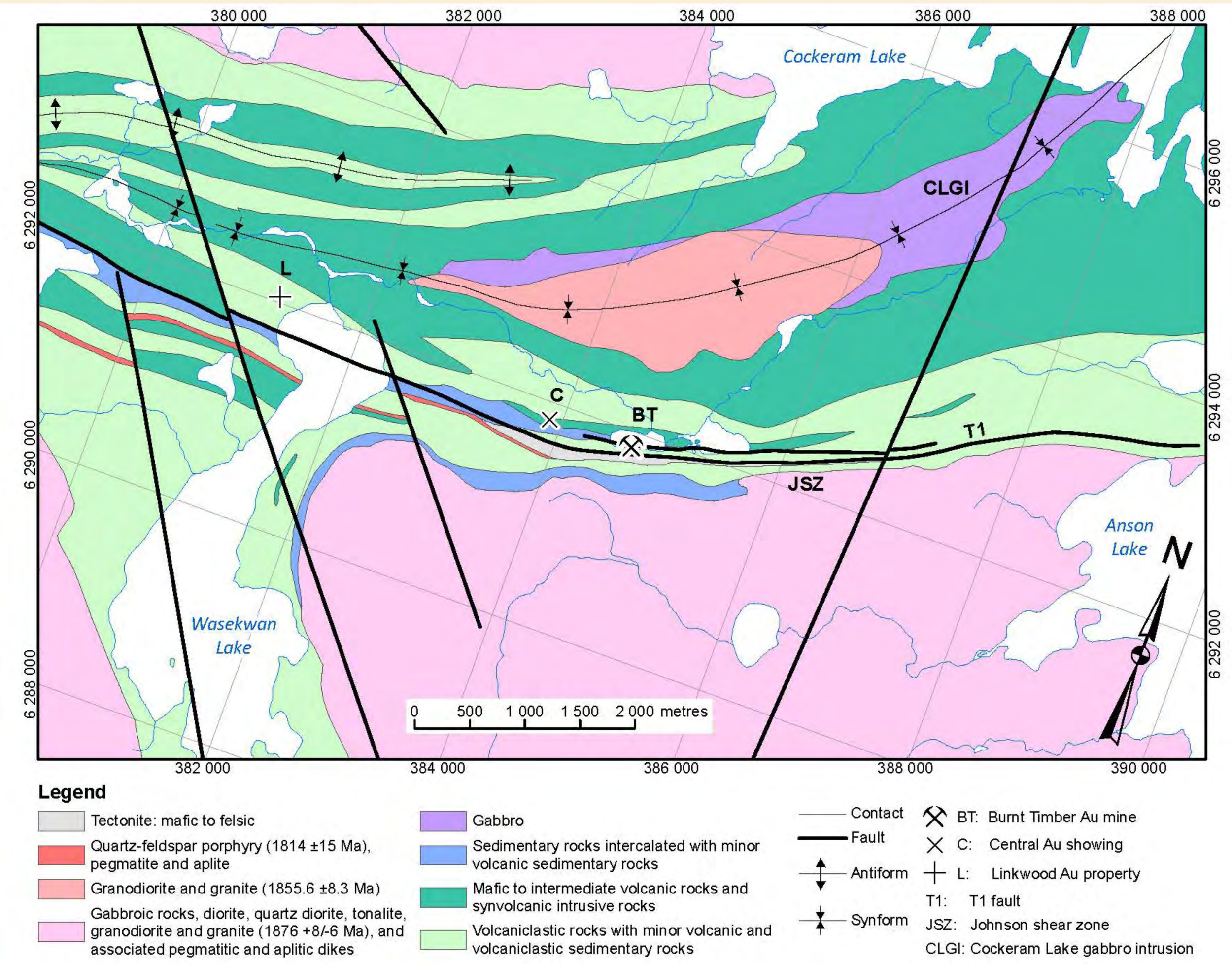
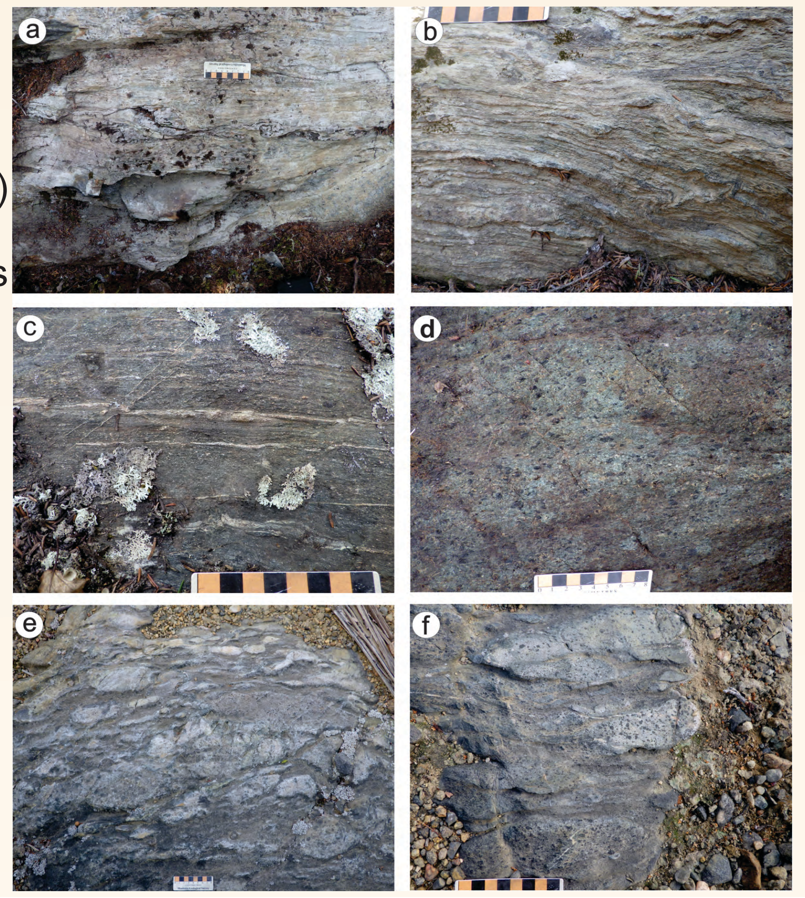
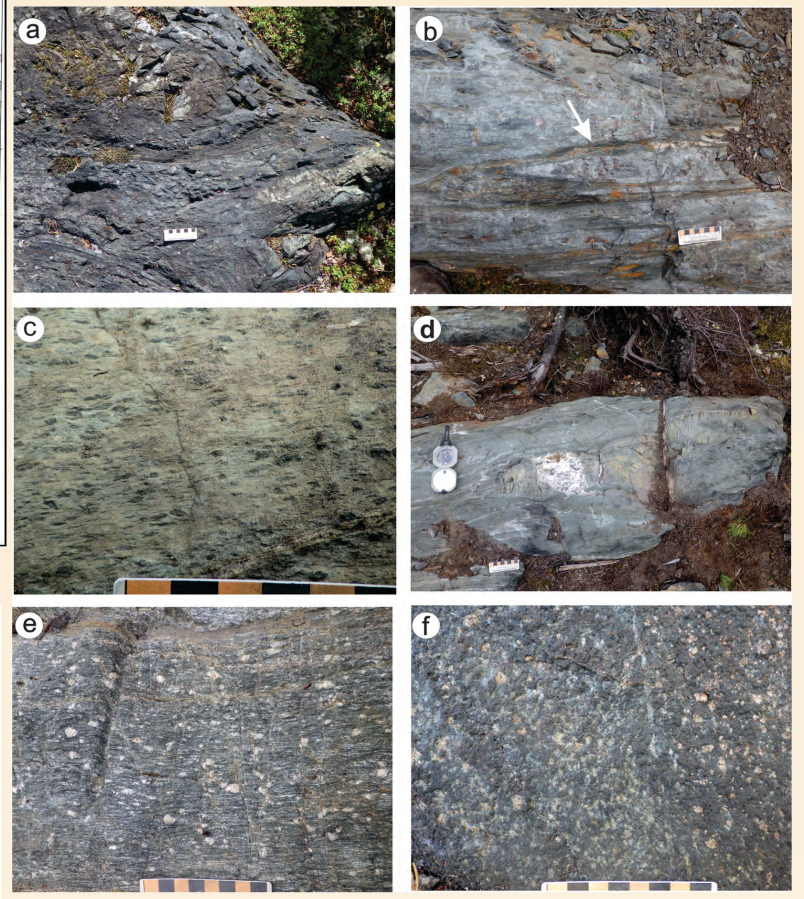


Fig. 2 Simplified geology of the Wasekwan Lake area, Lynn Lake greenstone belt (modified from PMAP 2017-3, Yang, X.M. and Beaumont-Smith, C.J., 2017).

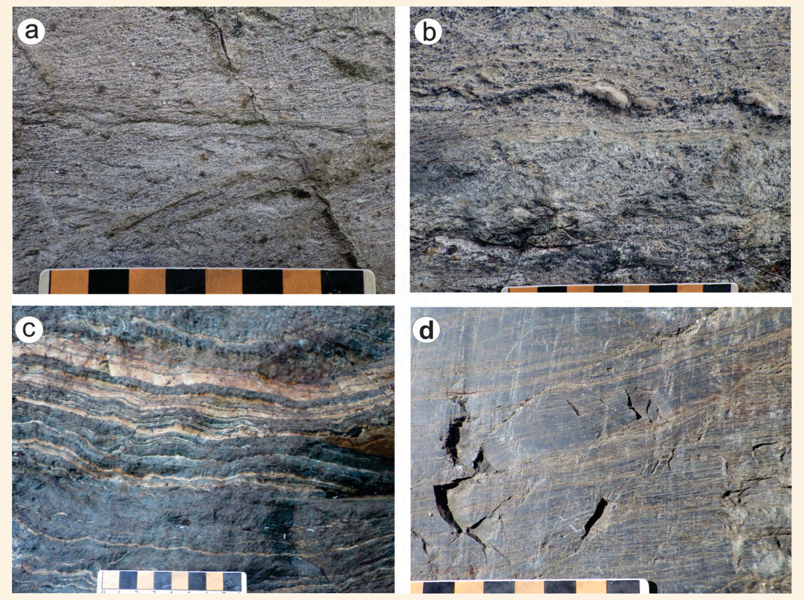


Unit 1: Volcaniclastic rocks with minor volcanic rocks and volcanic sedimentary rocks; a) strongly foliated felsic to intermediate volcanic rock; b) foliated and folded intermediate lappilli tuff and tuff; c) mafic to intermediate plagioclase crystal tuff and lapilli tuff with thin felsic bands and layerings; d) foliated lapilli tuff to tuff with amphibole (pseudomorph of clinopyroxene) and plagioclase crystal fragments in fine grained mafic matrix ; e) mafic tuff breccia and volcanic breccia with plagioclase- and amphibole-phyric basalt fragments and blocks in lapilli tuff to tuff matrix; f) plagioclase and amphibole-phyric basalt, and amphibole-phyric basalt fragments with epidote alteration in mafic tuff breccia, and some of the fragments are moderately to strongly.

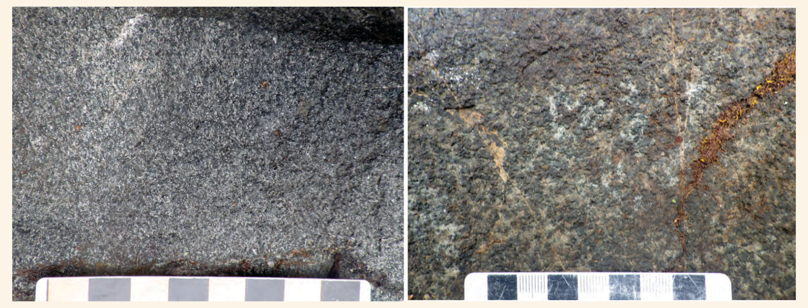
Field photographs of map units 1 to 8



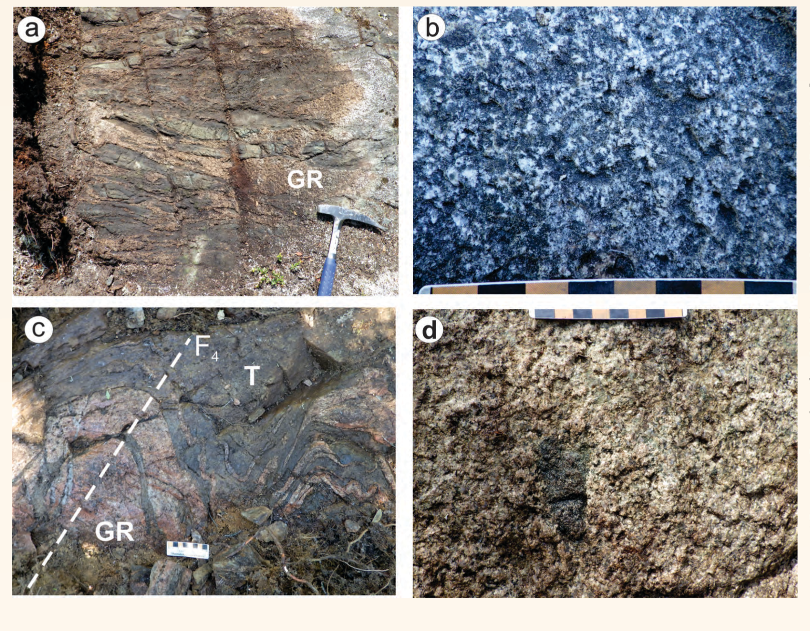
Unit 2: Mafic to intermediate volcanic rocks and synvolcanic intrusive rocks; a) pillow basalt with well preserved hyaloclastite selvage up to 5 cm thick and quartz±carbonate amygdules concentrated on top of the pillow; b) strongly deformed and foliated pillow basalt with recognizable hyaloclastite selvages; c) foliated amphibole-phyric basaltic andesite; d) very fine grained, foliated, aphyric basalt with epidotic altered domain; e) strongly foliated synvolcanic plagioclase-phyric gabbroic rock (diabase) in which equant plagioclase phenocrysts (up to 1.2 cm) in a fine-grained groundmass of plagioclase, amphibole, and chlorite; f) synvolcanic, weakly to moderately deformed gabbro (intruding foliated plagioclase-phyric basalt).



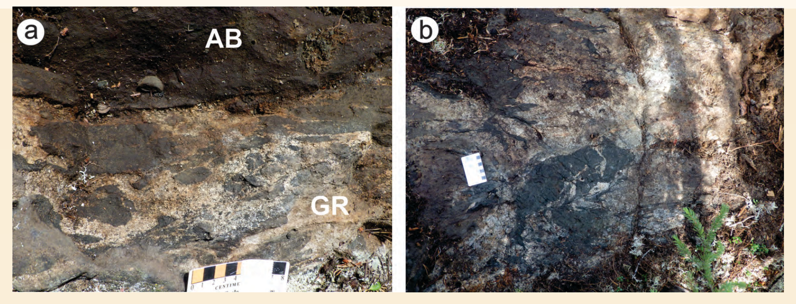
Unit 3: Sedimentary rocks intercalated with minor volcanic sedimentary rocks; a) quartz feldspathic greywacke containing dark pink garnet and hornblende porphyroblasts; b) arenite with hornblende and garnet porphyroblasts; c) thinly bedded argillite and mudstone dominated by mafic materials; d) banded iron formation consisting of alternating laminae of very fine grained magnetite, biotite-rich domains and chert, with bedding transposed by S2 foliation.



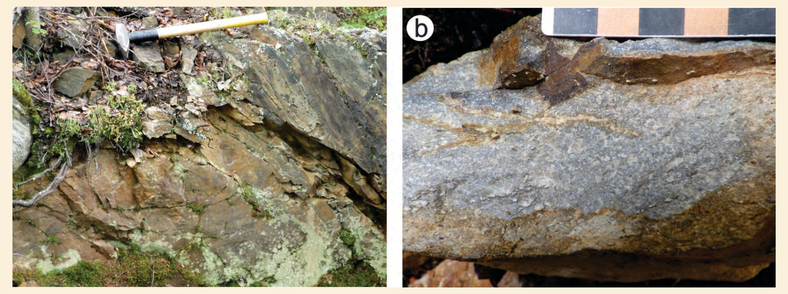
Unit 4: Pre-Sickle intrusive suite - Gabbro; a) weakly foliated, massive, medium-grained, equigranular gabbro; b) medium- to coarse-grained gabbro with disseminated pyrrhotite.



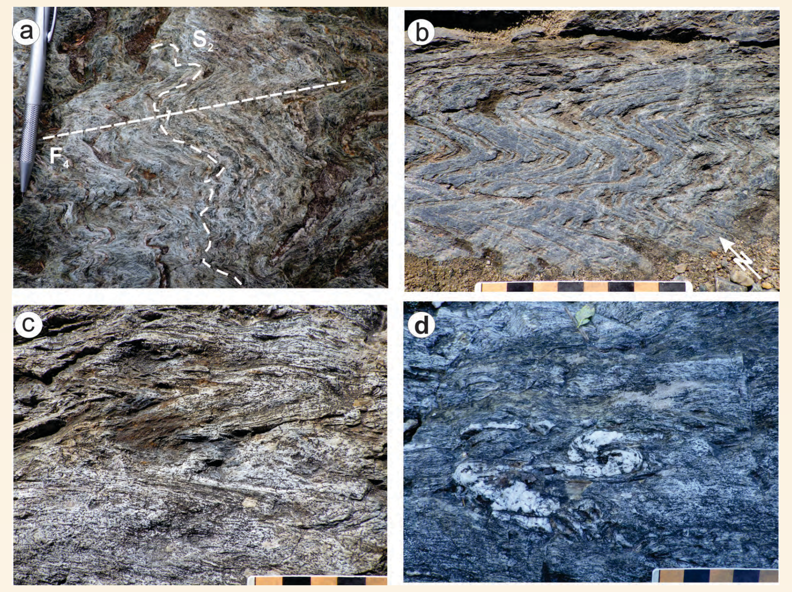
Unit 5: Pre-Sickle intrusive - Diorite, quartz diorite, tonalite, granodiorite, and granite; a) dikes of medium grained, porphyritic to equigranular granodiorite intruding unit 2 basalt at the contact zone; b) porphyritic quartz diorite; c) medium- to coarse-grained granite dikes cutting unit 1 intermediate tuff, which are folded by NE-trending F_4 fold; d) medium-grained tonalite with a mafic inclusion. Abbreviations: GR - granodiorite; T - mafic tuff.



Unit 6: Post-Sickle intrusive suite - Granotdiote and granite; a) medium-grained granodiorite as veins and veinlets cutting strongly foliated unit 2 basalt; b) medium-grained granodiorite with gabbroic inclusions. Abbreviations: AB - aphanitic basalt; GR - granodiorite.



Unit 7: Late intrusive suite - Quartz-feldspar porphyry (~1815 Ma), pegmatite and aplite; a) quartz-feldspar porphyry dike ~2.5 m wide, containing fine-grained pyrite disseminations, cutting unit 3 quartz feldspathic greywacke and unit 2 mafic volcanic rocks; b) enlarged view of the massive quartz-feldspar porphyry.



Unit 8: Teconite - mafic to felsic in composition; a) mafic tectonite showing S_2 foliation and associated quartz veins folded by F_4 folds; b) mafic tectonite folded by F_3 fold vertically plunging to the northwest within the Johnson shear zone; c) felsic to intermediate tectonite; d) sheared and rotated quartz boudins within S_2 foliation planes in mafic tectonite.

Geochemical characteristics of bedrocks in units 1 to 8: tectonic & mineral implications

Figure 3a shows the distribution of 108 samples collected from the map area, including 21 from this study; 84 from Beaumont-Smith (2008) and 3 from Zwanzig et al. (1999) on the TAS diagram.

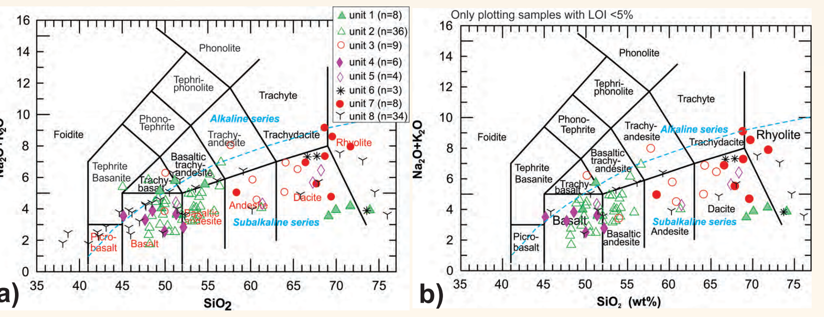


Fig. 3 Total alkalis vs. SiO_2 (wt%) diagram (Le Bas et al., 1986) for whole-rock samples from the map area (a); samples with LOI <5% (excluding 26 with LOI>5%) (b). Boundary of subalkaline and alkaline series from Irvine and Baragar (1971).

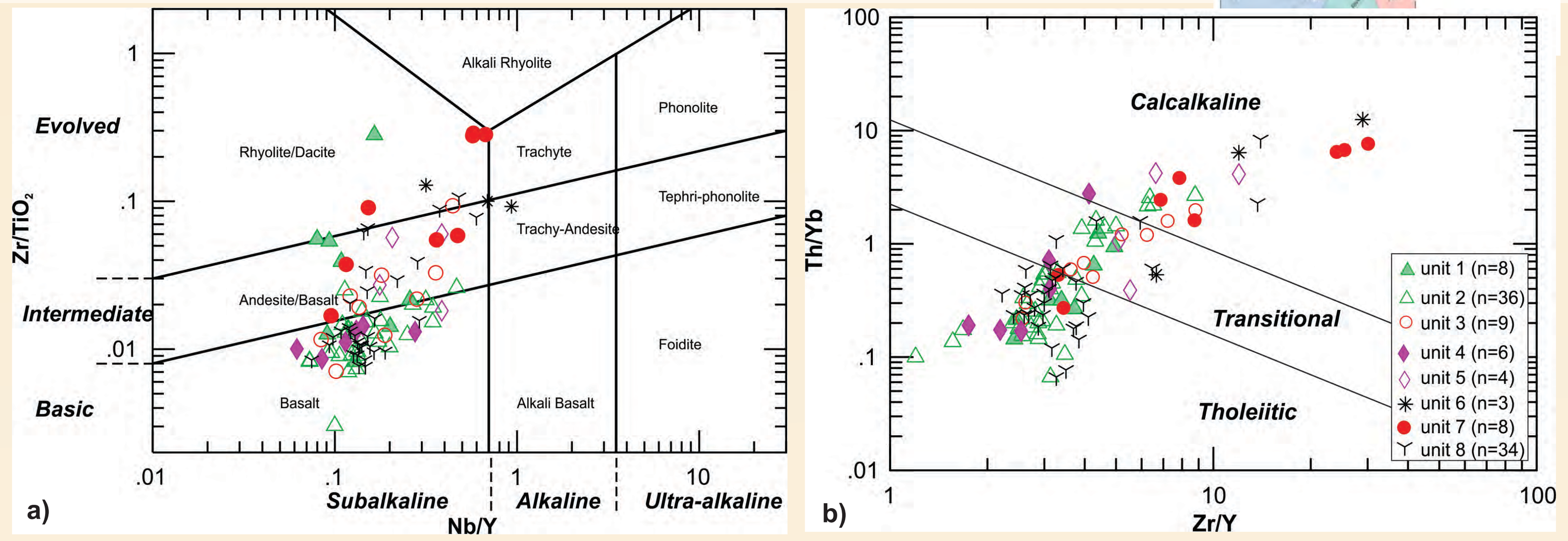


Fig. 4 Geochemical discrimination diagrams for samples from the Wasekwan Lake area: a) Zr/TiO_2 vs. Nb/Y plot (Pearce, 1996); b) Th/Yb vs. Zr/Y plot (Ross and Bedard, 2009).

Figs. 3, 4 and 5 indicate that the following key points.

1) Volcanic and volcaniclastic rocks of units 1 and 2 are dominantly tholeiitic, although some display calcalkaline affinities; they comprise a large compositional range of rocks from basalt, andesite, dacite to rhyolite, typical of those in volcanic arc to back arc setting.
2) Sedimentary rocks of unit 3 show some geochemical similarities to the volcanic and volcaniclastic rocks, suggesting that they are likely to derive from local provenance with similar compositions and deposited rapidly within an intra-arc basin.
3) Unit 4 gabbro is mainly tholeiitic, but some could be affected by crustal contamination as indicated by high Th/Yb ratio (Fig. 4b); this gabbro is geochemically similar to the Lynn Lake gabbro that hosts magmatic Ni-Cu deposits.
4) Ganitoid rocks in units 5, 6 and 7 are calcalkaline, and mainly metaluminous, typical I-type of volcanic arc origin. However, some of the unit 7 quartz-feldspar porphyries of the late intrusive suite show A-type granite signature (Fig. 5b).
5) Key HFSEs signatures are retained in tectonite of unit 8, although some samples are heavily altered (reflected by high LOI contents >5%).

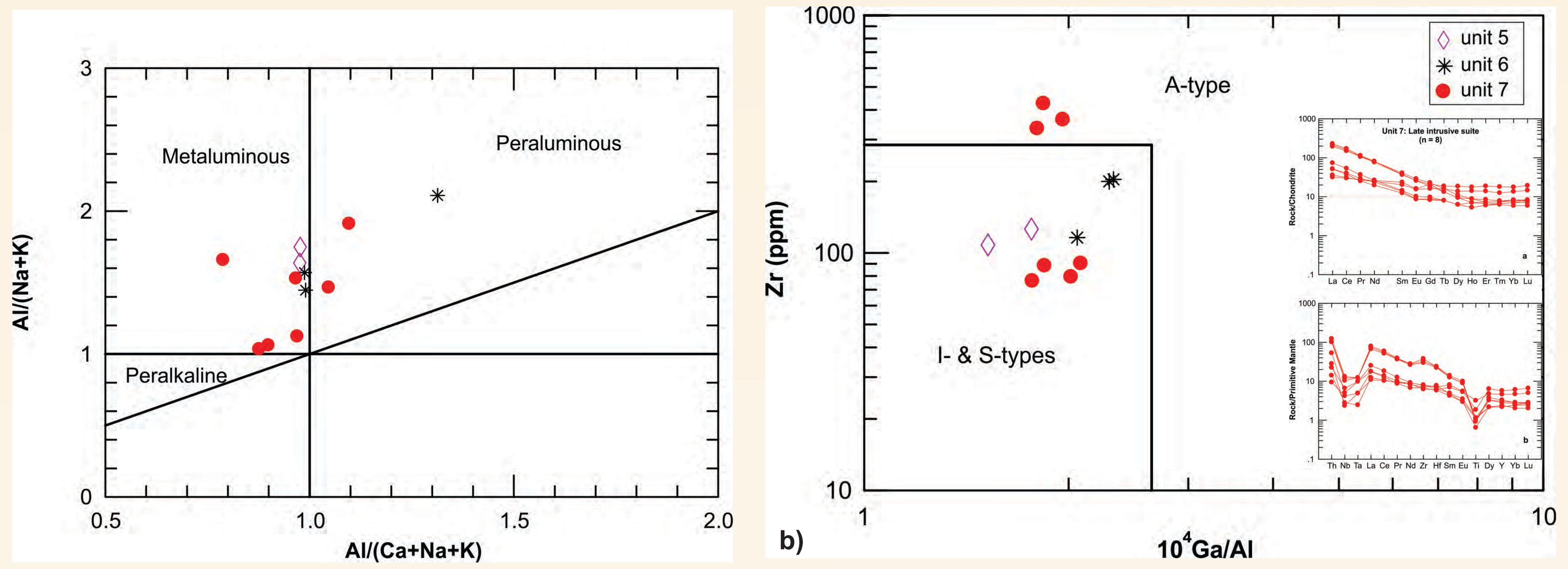


Fig. 5 Geochemical discrimination diagrams for granitic samples of units 5, 6, and 7 from the Wasekwan Lake area: a) molar Al/(N+K) vs. Al/(Ca+Na+K) (Maniar and Piccoli, 1989); b) Zr (ppm) vs. 10^4Ga/Al plot (Whalen et al., 1987).

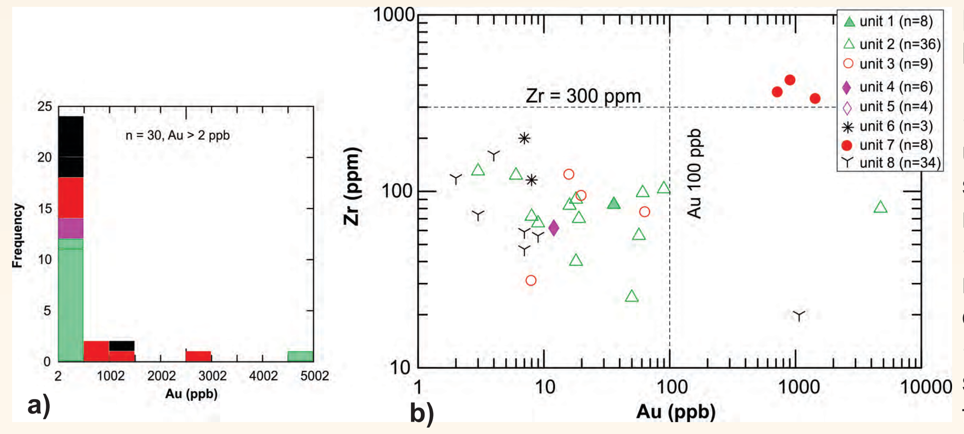


Fig. 6 Samples with Au contents > 2 ppb; a) Au histogram; b) plot of Zr (ppm) vs. Au (ppb).

- Three quartz-feldspar porphyry samples in unit 7 have high Au and high Zr contents, suggesting late high temperature granitic magmas are favourable for Au mineralization;
- These granitic rocks with high Na_2O/K_2O ratios are calcalkaline, and metaluminois, and of A-type;
- They may have formed in an extensional setting related to orogen relaxation post to terrane collision (see the inset spiderogram in Fig. 5b indicating two distinct groups).

Acknowledgments
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References cited in this poster are available from the Xue-Ming (Eric) Yang (eric.yang@gov.mb.ca) upon request.