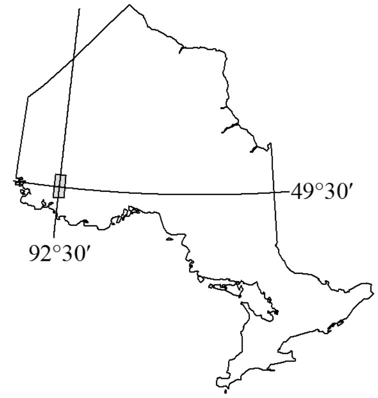
35. Preliminary Results from Detailed Geological Mapping of the Lost Lake Area in the Western Wabigoon Subprovince, Ontario



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INTRODUCTION

This report summarizes preliminary observations from field work in the western Wabigoon Subprovince during the summer of 2018 as part of Metal Earth's Dryden–Stormy Lake transect. This work is part of the Metal Earth research initiative being carried out by MERC (Mineral Exploration Research Centre, Laurentian University, Sudbury). Through this project, the authors seek to characterize the geodynamic evolution of the western Wabigoon Subprovince in order to better understand the metallogenetic evolution of the region.

The primary goals of this study are to constrain the significance of plutonic activity to the geodynamic evolution of the western Wabigoon Subprovince, and to investigate the role of plutonism in mineralizing systems. This will be accomplished through new bedrock mapping and geochemical and petrographic analyses as part of a two-year MSc thesis project. Initial work is focussed on areas with known gold occurrences, such as the Lost Lake area (Figure 35.1). Lithologic mapping will be used to constrain the extent and intensity of alteration, the relationship between hydrothermal fluids and mineralization, and the structural evolution. Based on this work, a model will be developed for the style of mineralization. The model will be used to compare and contrast with similar areas in the region and with other greenstone belts in the Superior Province.

REGIONAL GEOLOGY

The western Wabigoon Subprovince is a volcano-sedimentary-plutonic domain situated in the western portion of the Superior Province (*see* Figure 35.1; Beakhouse et al. 1996). This portion of the Wabigoon Subprovince comprises mafic volcanic successions (2750–2715 Ma), turbiditic successions (2715–2710 Ma), and fluvio-deltaic successions (2703–2696 Ma) (Beakhouse et al. 1996; Dostal, Mueller and Murphy 2004; Davis et al. 2005; Corcoran and Mueller 2007). The mafic units are generally dominated by laterally extensive mafic metavolcanic rocks overlain by laterally diverse mafic to felsic sequences and minor metasedimentary rocks. Large batholiths in the region, including the Revell, Atikwa and Basket Lake batholiths, are predominantly tonalite to granodiorite in composition and flank the margins of the study area (*see* Figure 35.1). Smaller stocks, including the Taylor Lake stock, Thundercloud porphyry, and other smaller felsic porphyries, are predominantly dioritic, granitic or syenitic in composition. The larger plutonic complexes are synvolcanic, whereas the smaller stocks are syn- to post-tectonic. The western Wabigoon Subprovince is transected by a series of deformation zones that exhibit variable kinematics and juxtapose volcanic sequences of contrasting ages. These include the Manitou–Dinorwic deformation zone, the Mosher Bay–Washeibemaga deformation zone, the Bending Lake deformation zone and the Lost Lake deformation zone (*see* Figure 35.1). Greenschist-facies metamorphic assemblages

Summary of Field Work and Other Activities, 2018,
Ontario Geological Survey, Open File Report 6350, p.35-1 to 35-5.

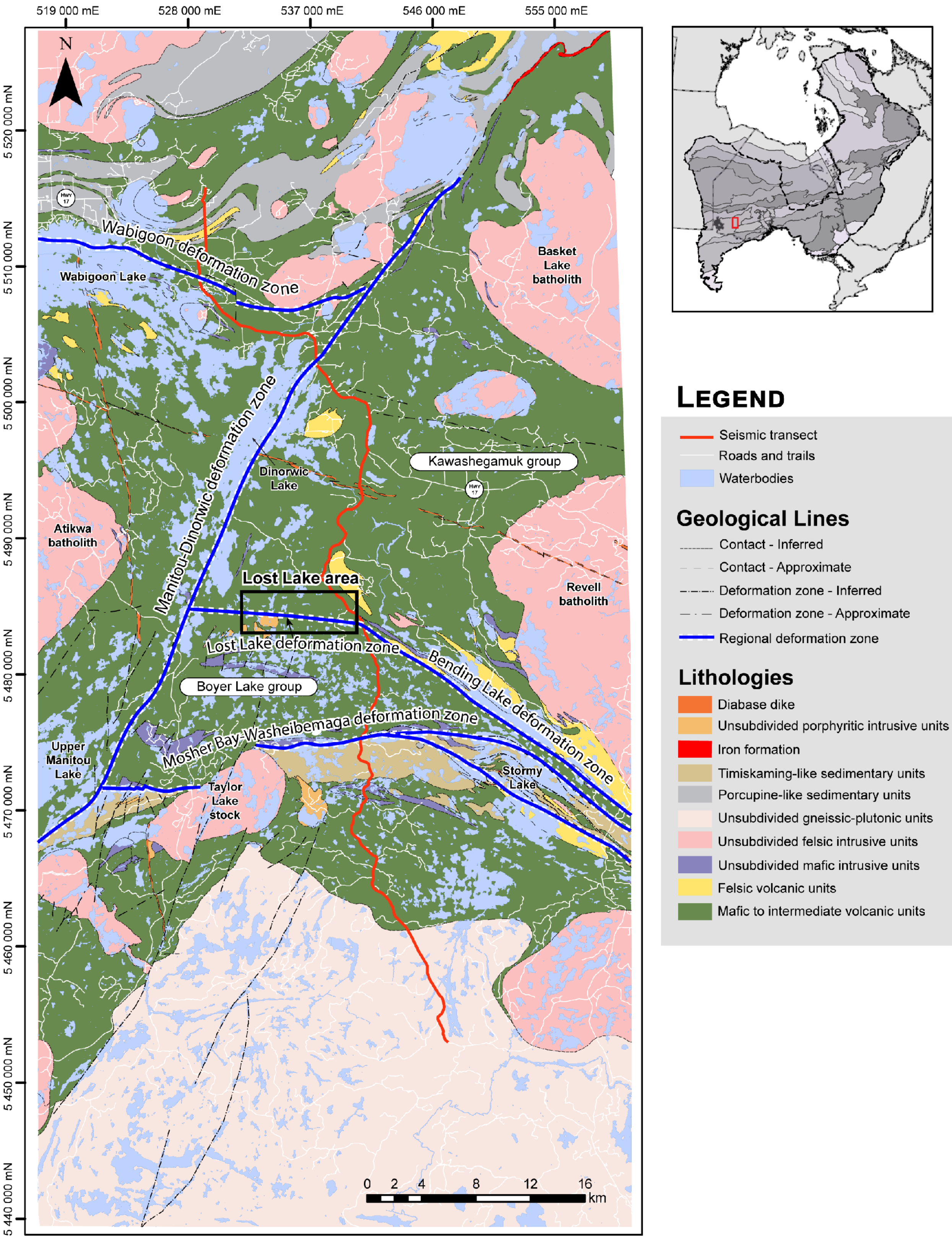

Figure 35.1. Geologic map of the Dryden–Stormy Lake area, with the location of the Lost Lake study area indicated by the black outlined area. Universal Transverse Mercator (UTM) co-ordinates are given in North American Datum 1983 (NAD83), Zone 15N. The inset in the top right shows the location of the Dryden–Stormy Lake area relative to the Superior Province.

characterize most of the region except for narrow amphibolite-grade zones that occur at the contact between the batholithic complexes and the volcanic successions (Blackburn et al. 1991; Beakhouse et al. 1996).

GEOLOGY OF THE LOST LAKE AREA

Supracrustal exposure in the Lost Lake area is dominated by mafic to intermediate metavolcanic rocks of the Boyer Lake group (*see* Figure 35.1; Melling et al. 1988; Blackburn et al. 1991). These volcanic sequences mainly consist of metres-thick massive to pillowed flows. The flows range from fine grained and aphanitic to plagioclase-phyric, variolitic and amygdaloidal. The volcanic sequence trends approximately east-to-west, faces south, and is upright within the study area. Pillows are bun-shaped to locally amoeboid, with well-preserved, thick selvages (Photo 35.1A). The volcanic rocks are intercalated with minor mafic to intermediate pyroclastic rocks. The pyroclastic unit consists of primarily mafic to intermediate flow breccias and felsic to intermediate lapillistones (Photo 35.1B). The Boyer Lake group is

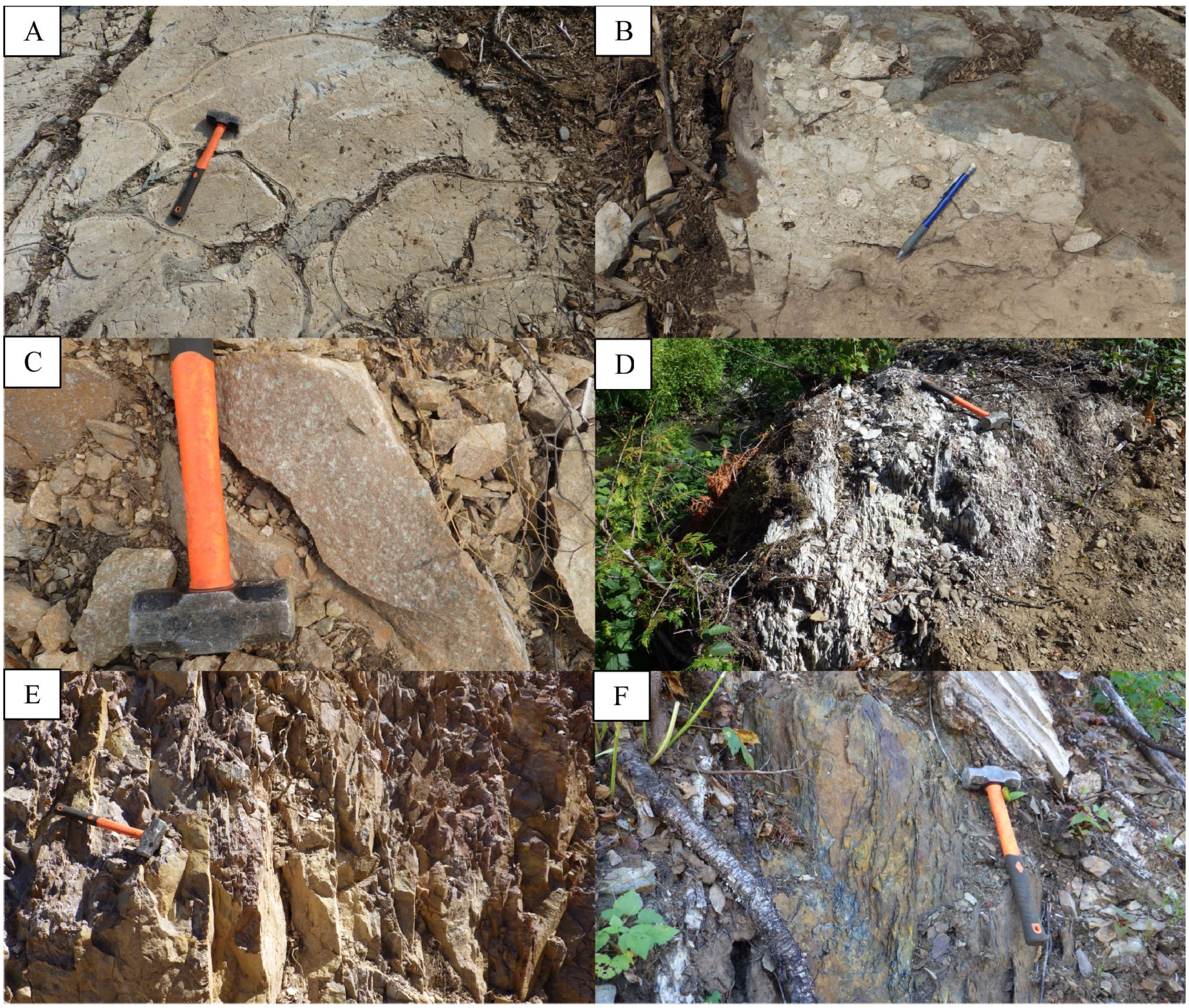

Photo 35.1. Outcrop photos from the Lost Lake area. **A**) South-younging pillow basalt of the Boyer Lake group. **B**) Intermediate lapillistone with clasts of intermediate and mafic volcanic rocks. **C**) Altered feldspar porphyry. Note the pink to red weathering and the silicification of both the phenocrysts and the matrix. **D**) Highly foliated quartz-feldspar porphyry near the shear zone in the west of the map area. Foliation is oriented 225/90. **E**) Variably oriented fracture sets in a strongly altered quartz-feldspar porphyry. **F**) Altered and metasomatized mafic volcanic with large clots of orange-brown iron-oxide minerals and showing high strain. The rock hammer is 41 cm long with the handle oriented north; the head of the hammer is 13 cm wide; and the pencil is 15 cm long.

intruded by feldspar- to quartz-feldspar–phyric felsic intrusions that locally display alteration (Photo 35.1C). These intrusions form metre-scale pod-like to dike-like bodies in the eastern portion of the study area, and a large (>1 km^2) stock in the western portion. Quartz and feldspar phenocrysts are 0.5 to 1 cm long, and the matrix is siliceous and aphanitic. Throughout the study area, the felsic intrusions weather to a distinct greenish cream to light purple. The contact with the volcanic rocks is sharp and variably oriented, and no chill margins were observed.

The Lost Lake deformation zone is situated near the western extent of the Bending Lake deformation zone, a regional northwest-trending, dextral shear zone analogous to the Mosher Bay–Washeibemaga deformation zone (*see* Figure 35.1). It is still unknown whether the Lost Lake deformation zone is genetically related to the Bending Lake deformation zone or if this is a separate structure that parallels the Mosher Bay–Washeibemaga deformation zone. Preliminary mapping suggests that the Lost Lake deformation zone is a brittle–ductile shear zone that trends northeast and is metres to hundreds of metres wide. The Lost Lake deformation zone is characterized by a localized penetrative, steeply dipping foliation (Photo 35.1D) or spaced cleavage that trends northeast with subvertical lineations. The foliation is defined by hornblende, plagioclase, biotite, chlorite and muscovite, with lineations typically defined by mafic minerals in high-strain zones and slickenfibres in brittle fault zones. The Lost Lake area also contains abundant sets of variably oriented fractures that crosscut the foliation (Photo 35.1E). These fractures typically occur near the contact between volcanic rocks and the intrusive rocks, and are associated with pervasive alteration. Distal to the intrusions (metres to tens of metres away) the fractures are weakly developed and alteration is less pervasive. This association suggests the fractures and the intrusions are a major control on alteration within the area.

Both the volcanic and intrusive rocks are metamorphosed to greenschist facies and display varying alteration assemblages. The volcanic rocks that are metres to tens of metres away from the intrusions have well-preserved primary igneous textures, and alteration includes chloritization, epidotization and minor sericitization. Near the contact with the intrusions, primary textures and minerals are altered and replaced with various metasomatic phases. The alteration is typically characterized by silicification and carbonatization, with the formation of minor iron-oxide minerals and black tourmaline. The feldspar phenocrysts in the intrusions are typically the first to become replaced with silica and carbonate minerals, and further alteration results in the quartz phenocrysts becoming recrystallized and finer grained. At the most western extent of the mapped area, silicification is pervasive and primary textures are destroyed. The intrusive rocks are strongly silicified, the phenocrysts are entirely replaced with fine-grained silica and albite, and there are large clots of iron-oxide minerals and extensive iron staining. The volcanic rocks in this area are highly silicified, becoming locally graphitic and schistose, with large clots of iron-oxide minerals (Photo 35.1F). The mafic volcanic rocks locally contain 5 to 10% arsenopyrite and 1 to 5% pyrite, which is interpreted to be synvolcanic.

FUTURE WORK

Oriented samples collected from the Lost Lake area during the summer of 2018 will be used for petrographic and geochemical analyses. Thin sections will be utilized to characterize the paragenetic relationships, alteration assemblages and microstructural relationships. Whole-rock geochemical analyses will include a comparison of altered and unaltered intrusive rocks from the Lost Lake samples, as well as a broader comparison to other intrusive suites in the study region.

Initial investigations will be used to guide further detailed mapping and sample collection during the summer of 2019. Additionally, preliminary results from this study will be used to compare to other analogous areas in the western Wabigoon Subprovince, such as around the Thundercloud porphyry (*see* Figure 35.1), and to identify target areas for similar mineralization styles. Continued detailed mapping of the Lost Lake area will further constrain the geometry of the porphyritic intrusion, as well as the extent of the alteration halo and deformation.

RELEVANCE

Many gold occurrences in the western Wabigoon Subprovince are spatially associated with lithological contacts between units with contrasting ductility near high-strain regional structures (Parker 1989). This spatial association suggests that intrusive complexes may have controlled potential mineralization, and acted as rheological traps for mineralization and focussed hydrothermal fluid flow. Preliminary mapping of the Lost Lake area indicates the area shares many of these same characteristics, including widespread hydrothermal alteration, proximity to large-scale regional fault systems, and lithological contacts between brittle felsic porphyritic intrusions and ductile mafic volcanic rocks. The model developed for the Lost Lake area will help constrain exploration targeting in the western Wabigoon Subprovince near small felsic intrusions, and determine whether proximity to large regional structures is necessary for mineralization. Additionally, this model will be used to compare and contrast with models developed for gold deposits in the Abitibi Subprovince that are also spatially associated with small felsic intrusions, such as the one proposed by Robert (2001).

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