36. Preliminary Results from Detailed Geological Mapping of Syenite-Associated Gold Mineralization Along the Lincoln–Nipissing Fault, Larder Lake, Ontario

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INTRODUCTION

This report summarizes the first summer of field work, conducted in Skead Township, as part of Metal Earth’s Larder Lake transect. Data collected will be used in the senior author’s MSc thesis. This work is part of the multiyear Metal Earth project carried out by MERC (Mineral Exploration Research Centre, Laurentian University, Sudbury).

Detailed geological mapping was conducted on composite intrusive bodies that are associated with gold prospects along the Lincoln–Nipissing shear zone in Skead Township, approximately 11 km south of Larder Lake. As a field term, these intrusive stocks are considered here to be syenitic in affinity. The main objectives of this study are to document the intrusive rocks, with a focus on the petrogenesis of the intrusions, the linkage between the intrusions and the gold mineralization, and how both these events fit into the geologic evolution of Skead Township. Mapping of the intrusions focussed on the compositional domains and the alteration overprint, as well as fracture and vein orientation and densities. Further work will characterize the metal and geochemical signature of the hydrothermal overprint of the gold prospects, for comparison with intrusion-related deposits elsewhere.

REGIONAL GEOLOGY

This project is located in the southern Abitibi greenstone belt. This area encompasses approximately 300 km², from Matachewan in Ontario to Val d’Or in Quebec. The southern Abitibi greenstone belt is characterized by several volcanic assemblages (or episodes) referred to as the Pacaud, Deloro, Stoughton–Roquemaure, Kidd–Munro, Tisdale and Blake River groups (Ayer and Calhoun 2005; Thurston et al. 2008). These units were intruded by granitoid stocks, followed by deposition of 2 types of successor basins—the turbidite-dominated Porcupine assemblage (2690–2685 Ma) and the clastic-dominated Timiskaming Group (2679–2669 Ma). These basins are spatially associated with the major regional structures, including the Porcupine–Destor and Larder–Cadillac deformation zones (Frieman et al. 2017).
GEOLOGY OF SKEAD TOWNSHIP

The geology in the study area is dominated by ultramafic to intermediate volcanic rocks of the Larder Lake assemblage (Figure 36.1). These rocks are locally pillowed, and the ultramafic rocks commonly show well-preserved spinifex texture and polyhedral jointing. These older rocks are unconformably overlain by clastic sedimentary rocks of the Hearst assemblage, dominantly clast-supported conglomerates, sandstone and siltstone (Hewitt 1949, 1951; St-Jean, Hunt and Sherlock, this volume, Article 37). Intruded into the volcanic and sedimentary rocks are mafic to felsic stocks, which are focussed along and around the Lincoln–Nipissing shear zone. These intrusions likely have an alkali affinity, and are analogous to intrusions along the Larder–Cadillac deformation zone, such as the

![Map of geological distribution in Skead Township](image)

**Figure 36.1.** Regional geology in the area of this study (geology from Jackson 1995) showing the distribution of supracrustal assemblages in the general Larder Lake area and specifically in Skead Township. The blue polygons are lakes and the white polygons represent till. Also shown is the location of the town of Larder Lake and the Lincoln–Nipissing fault (solid red line across upper third of Skead Township). Universal Transverse Mercator (UTM) co-ordinates are provided using North American Datum 1983 (NAD83) in Zone 17N.
Murdock Creek pluton, south of Kirkland Lake (Rowins et al. 1993). These intrusive rocks are associated with gold prospects that occur as mineralized quartz veins and possibly as disseminated mineralization within the altered intrusive.

The Lincoln–Nipissing shear zone trends west-northwesterly through the north-central part of Skead Township. This shear zone is poorly exposed and is better seen as a pronounced magnetic feature on geophysical maps. Numerous mafic to felsic alkalic stocks and associated gold prospects are related to the shear zone and are the subject of this study. The Lincoln–Nipissing shear zone marks a break in stratigraphy. To the south of the shear zone (see Figure 36.1) is a uniform northwest-striking, northeast-younging volcanic succession, with the Pacaud assemblage (circa 2750 Ma; 2750–2735 Ma volcanic episode) at its base and the Skead and McElroy assemblages (circa 2700 Ma; 2704–2695 Ma volcanic episode or Blake River assemblage) at the top (Jackson 1995; Thurston et al. 2008). To the north of the shear zone are rocks of the older Larder Lake assemblage (circa 2705 Ma; 2710–2704 Ma volcanic episode, or Tisdale assemblage), which are unconformably overlain by clastic sedimentary rocks of the Hearst (>2700 Ma) and potentially Timiskaming (2677–2670 Ma) assemblages (Hewitt 1949, 1951; Jackson 1995; Thurston et al. 2008). In addition to the juxtaposition of strata of different ages, the style of deformation is different north of the shear zone, with complex fold geometries to the north that are not recognized south of the shear zone. This change in stratigraphy and structural framework at the Lincoln–Nipissing shear zone is poorly understood.

Figure 36.2. Geological sketch of the Lincoln–Nipissing fault and study area, with locations of syenite-associated mineralized intrusions (yellow) and non-intrusion–related gold prospects in blue (geology from Poulsen 2017). The UTM co-ordinates are in NAD83, Zone 17N. The mafic volcanic rocks are shown in dark green; felsic to intermediate volcanic rocks are light green; Timiskaming metasedimentary rocks are grey; ultramafic intrusive rocks are brown; and the felsic intrusive rocks are pink. The dashed blue lines are faults; the dashed red lines are the boundaries of the study area.
GEOLOGY OF THE INTRUSIONS AND GOLD MINERALIZATION

The geology around the Lincoln–Nipissing shear zone within the study area, and the associated intrusive-related gold prospects, are shown on Figure 36.2. Two intrusive stocks were examined in this study, including the McGregor and the Wisconsin–Skead, the latter of which also contains the Lafond showing. All the intrusion-related showings examined during this study were well exposed by recent trenching. The intrusions have a small surface area. The McGregor composite stock is exposed in 2 trenches and is approximately 85 m long by 10 m wide in the north trench, and approximately 55 m long by 10 m wide in the south trench. The Wisconsin–Skead stock is exposed in 3 separate trenches. Together, the south, main and north trenches span an area roughly 400 m long by 170 m wide and are situated near the Lafond shaft of the historical Lafond showing.

There are 5 main compositional suites within the McGregor composite stock (Photos 36.1A, 36.1B and 36.1C): 1) a hornblende-rich gabbro; 2) quartz veined leucosyenite; 3) a fine-grained, red (likely hematite stained) syenite; 4) a pegmatitic gabbro with large amphibole phenocrysts; and 5) a brecciated gabbroic intrusive with finer grained gabbroic xenoliths.

At the main trench of the Wisconsin–Skead stock, there are 2 main rock types: a host rock of pillowed basalt, and intrusive rocks that are dominantly quartz-feldspar porphyry showing little compositional variation (Photo 36.1D). The composition of the rocks in the north and south trenches appears to be a quartz syenite.

Photo 36.1. Outcrop photos from the trenches on the McGregor and Wisconsin–Skead intrusions. A) View of the sharp, irregular contact between a syenite-associated intrusive and a gabbroic intrusive at the McGregor trench. B) A different syenite-associated intrusive in contact with the veined intrusive in Photo 36.1A. C) View of the gradational contact between an auriferous syenite-associated intrusive and a hornblende gabbroic intrusive at the McGregor trench. D) Example of a chloritized slickenside surface; these features are prevalent in the Wisconsin–Skead quartz-feldspar porphyry. The camera case is approximately 15 cm long by 5 cm wide; the notebook in Photo 36.1D is 19 cm long by 12 cm wide.
At the McGregor trench, crosscutting dikes range in composition from felsic to mafic. A mafic dike crosscuts the hornblende gabbro and another crosscuts the non-veined syenite intrusive. Within the pegmatitic gabbro, 2 lamprophyre dikes have intruded and crosscut each other. The felsic dike, in contrast, cuts the quartz-veined leucosyenite. At the Wisconsin–Skead trench, aplite dikes predate quartz veining.

The host rock to veining at the McGregor trench is the leucosyenite unit; the rocks with a more mafic composition do not host quartz veins, and any assays from these units are uniformly low. At the Wisconsin–Skead trenches, the host rock to veining is the quartz-feldspar porphyry unit. The quartz veins in this unit are either planar zones with sharp boundaries or irregular, wavy zones ranging in width from a couple of centimetres to more than a metre closer to the contact with the altered basalt unit. Ankerite is associated with these veins in both the intrusive rocks and the host pillowed basalts.

FUTURE WORK

Petrographic and lithogeochemical work will be completed on samples from the McGregor and Wisconsin–Skead intrusions, to examine the relationship of the compositional variation of the intrusions and their relationship to gold mineralization. A sample of quartz-feldspar porphyry was collected from the Wisconsin–Skead intrusion for geochronology work. The work that was begun in 2017 will be expanded in 2018 to additional intrusions along strike of the Lincoln–Nipissing shear zone.

RELEVANCE

The work carried out in the area of the Lincoln–Nipissing shear zone in the southern part of the Metal Earth Larder Lake transect provides an opportunity to examine the relationship between a cluster of gold prospects, an inferred fault zone and a chain of felsic to intermediate intrusive rocks (Poulsen 2017). By studying the syenite intrusions along the Lincoln–Nipissing shear zone, which is located south of the well-known Larder–Cadillac deformation zone, we can determine if there is a genetic link between gold deposition and porphyry intrusions (Cameron and Hattori 1987; Robert 2001) or if the intrusions behaved as a competent structural trap for later mineralization (Colvine 1989).

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