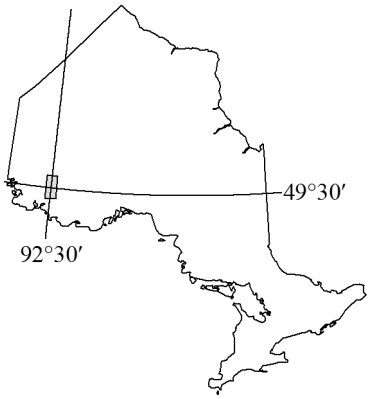
34. Preliminary Observations from Structural Mapping of Regional Deformation Zones in the Dryden–Stormy Lake Area of the Western Wabigoon Subprovince



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INTRODUCTION

This report summarizes preliminary results of investigations during the 2018 field season, which focussed on 2 crustal-scale deformation zones in the Dryden–Stormy Lake area of the western Wabigoon Subprovince: the Wabigoon and Manitou–Dinorwic deformation zones. These deformation zones represent major regional structures that accommodated significant strain during regional amalgamation. Thus, they are apparent on seismic sections and are potential hosts to orogenic gold mineralization. This work is part of the multi-year Metal Earth project carried out by MERC (Mineral Exploration Research Centre, Laurentian University, Sudbury), which aims to investigate why Archean greenstone belts in the Superior Province are variably endowed with precious and base metals.

REGIONAL GEOLOGY

The Wabigoon Subprovince is a structurally complex, 900 km long, 150 km wide granite-greenstone domain that has been divided into 3 parts: the western Wabigoon, the central Wabigoon and the eastern Wabigoon (Blackburn et al. 1991). This study is focussed on the western Wabigoon Subprovince, which consists of successions of mafic to intermediate metavolcanic rocks and related metasedimentary rocks, of age 2750–2715 Ma, that were intruded from 2750 to 2680 Ma by granodioritic to tonalitic plutonic rocks (Figure 34.1; Davis, Blackburn and Krogh 1982; Blackburn et al. 1991; Dostal, Mueller and Murphy 2004).

The northern portion of the study area displays a higher metamorphic grade (upper greenschist to lower amphibolite facies) than the southern area (lower to upper greenschist facies) (protolith names are being used for simplicity). The northern and southern areas of the western Wabigoon Subprovince are separated by the Wabigoon deformation zone (WDZ; *see* Figure 34.1). Lithologies north of the WDZ include the Brownridge, Thunder Lake and Zealand sedimentary rocks (2715–2710 Ma), as well as the Brownridge and Thunder River mafic volcanic rocks (2735–2730 Ma) (*see* Figure 34.1) (Davis and Trowell 1982; Davis, Sutcliffe and Trowell 1988; Beakhouse 2000). The sedimentary successions consist of greywacke and sandstone, with minor magnetite-bearing banded iron formation. The volcanic rocks primarily consist of pillowed to massive flows that are mafic in composition, with minor felsic flows. The southern portion of the study area is dominated by mafic to intermediate volcanic rocks of the Wabigoon volcanic succession, Pincher Lake group, Kawashegamuk group (~2745–2730 Ma) and Boyer Lake group (2725–2720 Ma) (Davis, Blackburn and Krogh 1982).

Summary of Field Work and Other Activities, 2018,
Ontario Geological Survey, Open File Report 6350, p.34-1 to 34-5.

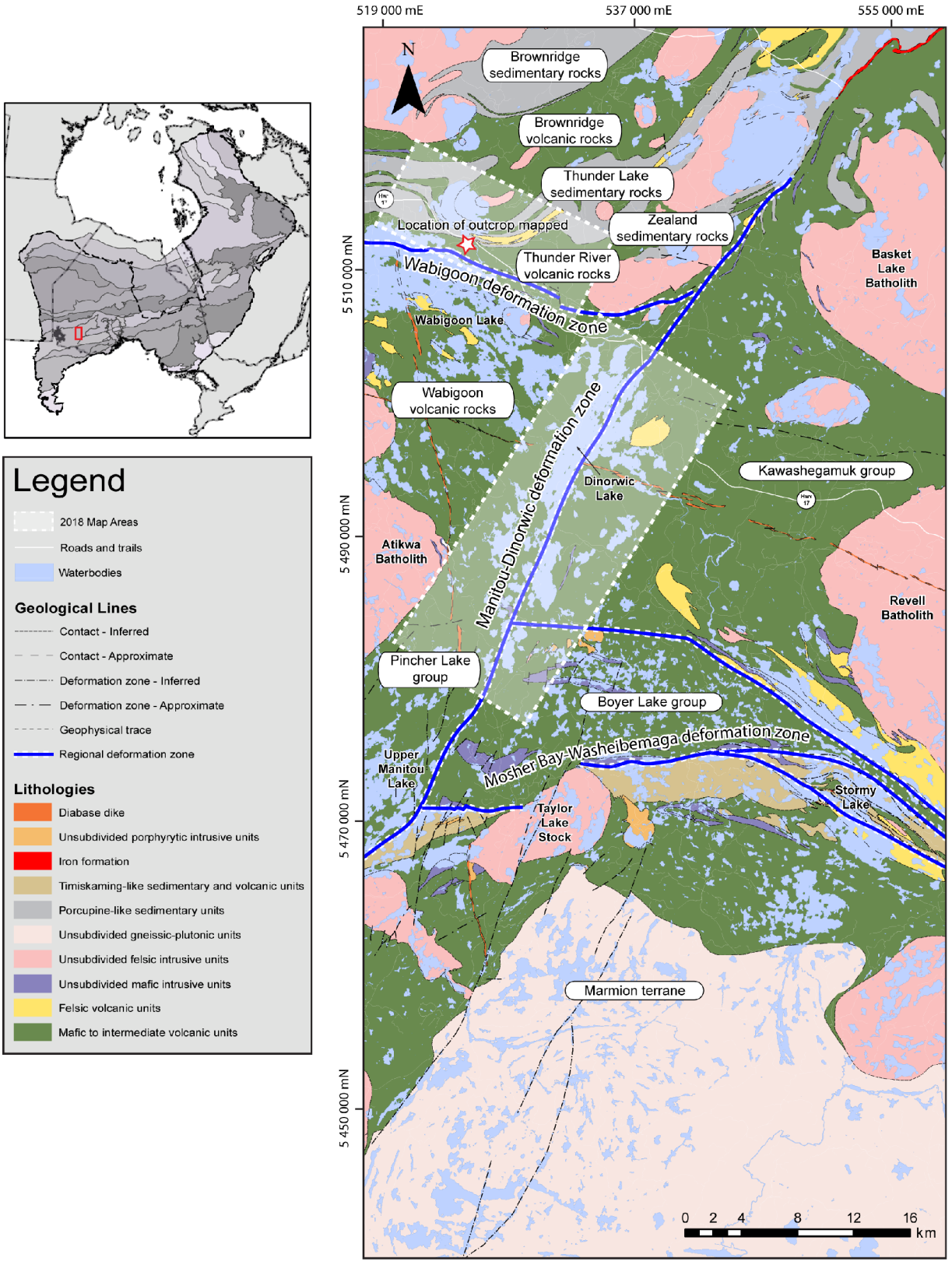

Figure 34.1. Geologic map of the Dryden–Stormy Lake study area, *modified from* Blackburn (1978). The upper-left inset shows the study area in the Superior Province. Universal Transverse Mercator (UTM) co-ordinates provided in North American Datum 1983 (NAD83), Zone 15N.

The Dryden–Stormy Lake area contains more than 200 gold occurrences and prospects, the majority of which are associated with structurally controlled quartz-carbonate veins (Parker 1989). Several past-producing gold mines are hosted by the Wabigoon deformation zone (WDZ) (~1000 ounces) and the Manitou–Dinorwic deformation zone (MDDZ) (~20 000 ounces; Parker 1989). Although variably endowed, both the WDZ and the MDDZ have a genetic and spatial relationship with gold occurrences in the study area. Thus, it is important to understand the structural and temporal settings of these regional deformation zones, to better constrain the Precambrian evolution and metallogeny of the western Wabigoon Subprovince, and to allow for comparison with better endowed deformation zones in other Precambrian subprovinces.

PRELIMINARY OBSERVATIONS

Field work during the 2018 season focussed on detailed geological mapping of the WDZ and the MDDZ, with an emphasis on the collection of new structural observations.

The Wabigoon Deformation Zone

The Wabigoon deformation zone is an east-trending, high-strain, crustal-scale structure that juxtaposes the sedimentary and volcanic rocks north of the WDZ with the Wabigoon volcanic succession to the south (*see* Figure 34.1; Melling et al. 1988; Parker 1989; Blackburn et al. 1991). The WDZ is characterized by a penetrative east-trending subvertical foliation. Several progressive deformation events are recognized along the WDZ (Parker 1989; Beakhouse 2000). In order to better characterize the structural evolution along the WDZ, an approximately 270 m^2 outcrop that preserves key structural relationships was mapped at a scale of 1:200. Three deformation events were recorded at the outcrop:

- The D_{W1} event is characterized by mesoscopic to map-scale isoclinal F_{W1} folds, and subvertical S_{W1} foliation that is axial planar to the folds (270°/86°; defined by biotite and chlorite). This deformation is interpreted as an early contraction event.
- The D_{W2} event is characterized by abundant dextral shear sense indicators, such as asymmetric F_{W2} Z-folds and σ-clasts (Photo 34.1D). This deformation is attributed to reactivation of S_{W1} foliation and is associated with a weak S_{W2} foliation (230°/65°), and a moderately west-northwest–plunging L_{W2} lineation defined by aligned grains of biotite. This deformation is interpreted as a dextral compressive to strike-slip event.
- The D_{W3} event is characterized by local, centimetre-scale brittle sinistral faulting and a strong L_{W3} lineation, defined by aligned grains of biotite (foliation: 260°/88°; lineation: 40°/264°).

The Manitou–Dinorwic Deformation Zone

The Manitou–Dinorwic deformation zone (i.e., the Manitou Straits fault of Melling et al. (1988) and Blackburn et al. (1991)) is a northeast-southwest, high-strain, crustal-scale structure that juxtaposes the Kawashegamuk group, the Wabigoon succession, the Boyer Lake group and Pincher Lake group (*see* Figure 34.1). Volcanic flows with minor intermediate to felsic volcanic rocks (Photo 34.1A) are deformed by a penetrative northeast-trending subvertical foliation that extends across the mapped area, from Upper Manitou Lake through Dinorwic Lake (*see* Figure 34.1).

The D_{M1} event is characterized by metre- to kilometre-scale zones of subvertical, northeast-trending penetrative S_{M1} foliation (~045°/85°; defined by chlorite). The S_{M1} foliation is associated with a steeply plunging L_{M1} lineation (~75°/200°; defined by aligned grains of chlorite), along with abundant sinistral and dextral shear sense indicators on horizontal erosional surfaces (Photo 34.1C).

High-strain zones of the MDDZ display varying widths throughout the map area, ranging from metre- to kilometre-wide deformation corridors. The high-strain zones along the MDDZ are commonly spatially associated with a series of quartz, quartz-carbonate and quartz-tourmaline veins, and locally host up to 20% disseminated euhedral pyrite (visual estimation by area). Iron carbonate alteration is commonly observed in high-strain zones and is also spatially associated with disseminated pyrite (Photo 34.1B). At Dinorwic Lake, kilometre-wide regions of intensely sheared, variably silicified and sericitized volcanic rocks were observed. North of Dinorwic Lake, the east-trending S_{W1} foliation was overprinted by the northeast-trending S_{M1} foliation. This suggests that peak deformation (D_{M1}) along the MDDZ postdates major deformation (D_{W1}) along the WDZ.

FUTURE WORK

Preliminary work in the Dryden–Stormy Lake area focussed on mapping several key areas along the WDZ and MDDZ (*see* Figure 34.1). New geological maps will be produced for these areas, which will include structural synthesis. Additional work will include microstructural analysis of thin sections, as well as geochemical analysis of hand samples showing alteration and deformation. These results will be used to establish paragenetic relationships between deformation textures, and to contextualize known mineral occurrences. In addition, several samples were collected for U/Pb zircon geochronology analysis. The results of the analyses on these samples will be used to bracket the timing of deformation, and to constrain the relative age of supracrustal rocks proximal to the major deformation. The 2019 field season

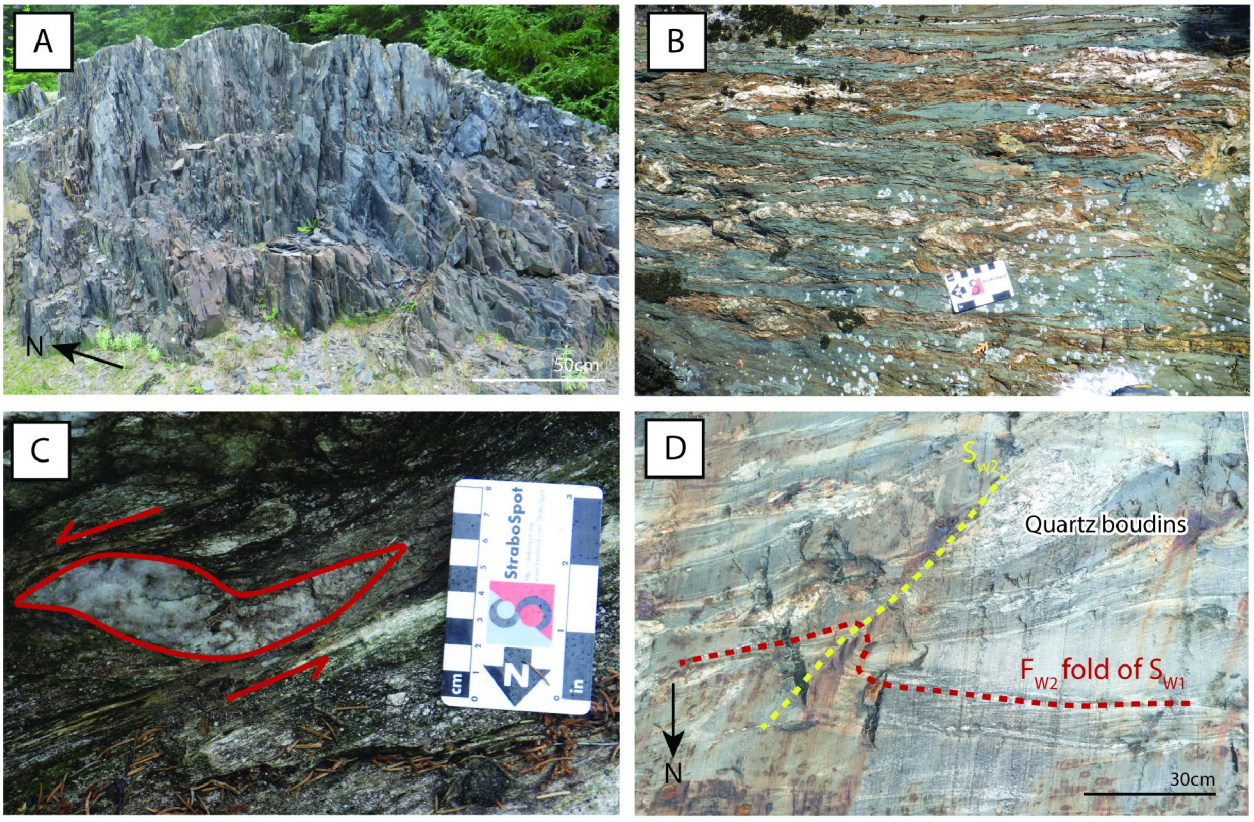

Photo 34.1. Representative outcrop photos from the Dryden–Stormy Lake field area. **A**) Strongly foliated volcanic rocks within the Manitou–Dinorwic deformation zone, south of Dinorwic Lake. **B**) Iron carbonate alteration in sheared volcanic flow within the Manitou–Dinorwic deformation zone, Dinorwic Lake. **C**) Sinistrally rotated quartz sigma (σ) clast in chloritic schist within the Manitou–Dinorwic deformation zone, protolith likely lapilli tuff, north of Dinorwic Lake. **D**) Deformed sedimentary rocks with boudinaged quartz veins that occur along the Wabigoon deformation zone.

will involve further mapping of the MDDZ, and will focus on the southern extent of the structure at Upper Manitou Lake. Other major deformation zones in the western Wabigoon Subprovince will also be investigated. Based on these results, a comparison to areas of well-documented orogenic gold mineralization, such as in the Abitibi Subprovince, will be conducted.

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