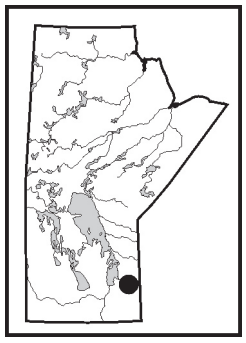
GS-15 Geological investigations of the Chrome property, Bird River Sill, southeastern Manitoba (NTS 52L5)

by C.A. Mealin[1]



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Summary

The Chrome property is located on part of the Bird River Sill, which is a differentiated mafic-ultramafic intrusion into the Bird River greenstone belt of southeastern Manitoba. The Bird River Sill is segmented into a number of fault blocks owing to displacement along north-northwest-trending faults.

Interest in the mineral potential of the Bird River Sill dates back to the discovery of Ni and Cu sulphides in the 1920s, chromite in the1940s and platinum group element (PGE) mineralization in the 1980s. This investigation aims to determine the nature and distribution of sulphides and of Ni-Cu and PGE mineralization in the sill.

The 2005 field season was devoted to geological mapping and sampling of the Chrome property. The western extent of the ultramafic unit was redefined after recognition of additional peridotite.

Introduction

The Chrome property, an approximately 2.9 km long by 150–700 m wide area, comprises one of the fault blocks of the Neoarchean Bird River Sill (2745 +/–3 Ma;Wang, 1993) that extends approximately east-west for over 20 km along the south margin of the older Lamprey Falls Formation and is unconformably overlain by the Bernic Lake Formation (Gilbert, GS-13, this volume; Figure GS-15-1).

The Bird River Sill is intruded into the Bird River greenstone belt, a 5–10 km wide by 55 km long, east-trending belt that extends from Lac du Bonnet in the west to the Manitoba-Ontario border in the east. The belt comprises a steeply dipping sequence of metavolcanic and metasedimentary rocks of the Rice Lake Group (Trueman, 1980).

The Bird River Sill is a differentiated and layered, mafic-ultramafic sill with a stratigraphically lower dunitic and peridotitic layer and an upper gabbroic and granophyric layer. Chromitite layers occur in the upper section of the ultramafic unit, below the contact with the gabbroic unit. The sill is metamorphosed to greenschist facies; localized amphibolite-facies contact metamorphism is restricted to rocks adjacent to granitic intrusions (Juhas, 1973). Primary textures are generally well preserved, although metamorphic minerals replace most of the original minerals (Theyer, 2002).

Tectonism, granitoid intrusions and faulting caused block faulting of the sill. Displacement and movements along north-northwest-trending and steeply dipping faults produced offsets of up to 1525 m (Bannatyne and Trueman, 1982).

Previous work

Interest in the mineral potential of the Bird River Sill dates back to the 1920s, with the discovery of Ni and Cu sulphides (Theyer, 1985). In 1941, chromite-bearing rocks were identified and exploration focused on chromite (Theyer, 1985). In 1982, systematic exploration for PGE was initiated, resulting in the identification of PGE in the sill (Theyer et al., 2001).

Starting in 1982, P. Theyer and assistants sawed three semicontinuous sampling sections (western, central and eastern cuts) across the Bird River Sill using portable rock saws (Figure GS-15-2). The western and eastern cuts crosscut the ultramafic portion and the central cut the gabbroic portion of the sill. These cuts provided a nearly continuous channel sample and cross-section of the sill. Detailed geochemical analyses led to the identification of two PGE- and sulphide-enriched layers within the ultramafic unit (Theyer, 1985). An additional PGE-bearing layer was identified by the Geological Survey of Canada in the following years (Scoates et al., 1989).

Platinum group elements are associated with the Ni-Cu sulphide mineralization, and PGE inclusions were shown to be present within chromite (Talkington et al., 1983). Theyer (1985) identified 13 magmatic cycles based on crystal morphology of olivine within the eastern and western cuts of the ultramafic portion of the sill.

Objectives

The primary purpose of this investigation is to establish the controls on Ni-Cu-PGE mineralization within the Bird River Sill. This will be accomplished by reexamining the stratigraphy of the sill and attempting to recognize and map the lateral continuity of economically important horizons of the sill. Stratigraphic-sequence studies will be supplemented with modern trace-element analysis of the channel samples collected by Theyer in the early 1980s. It is expected that the trace-element studies will aid in

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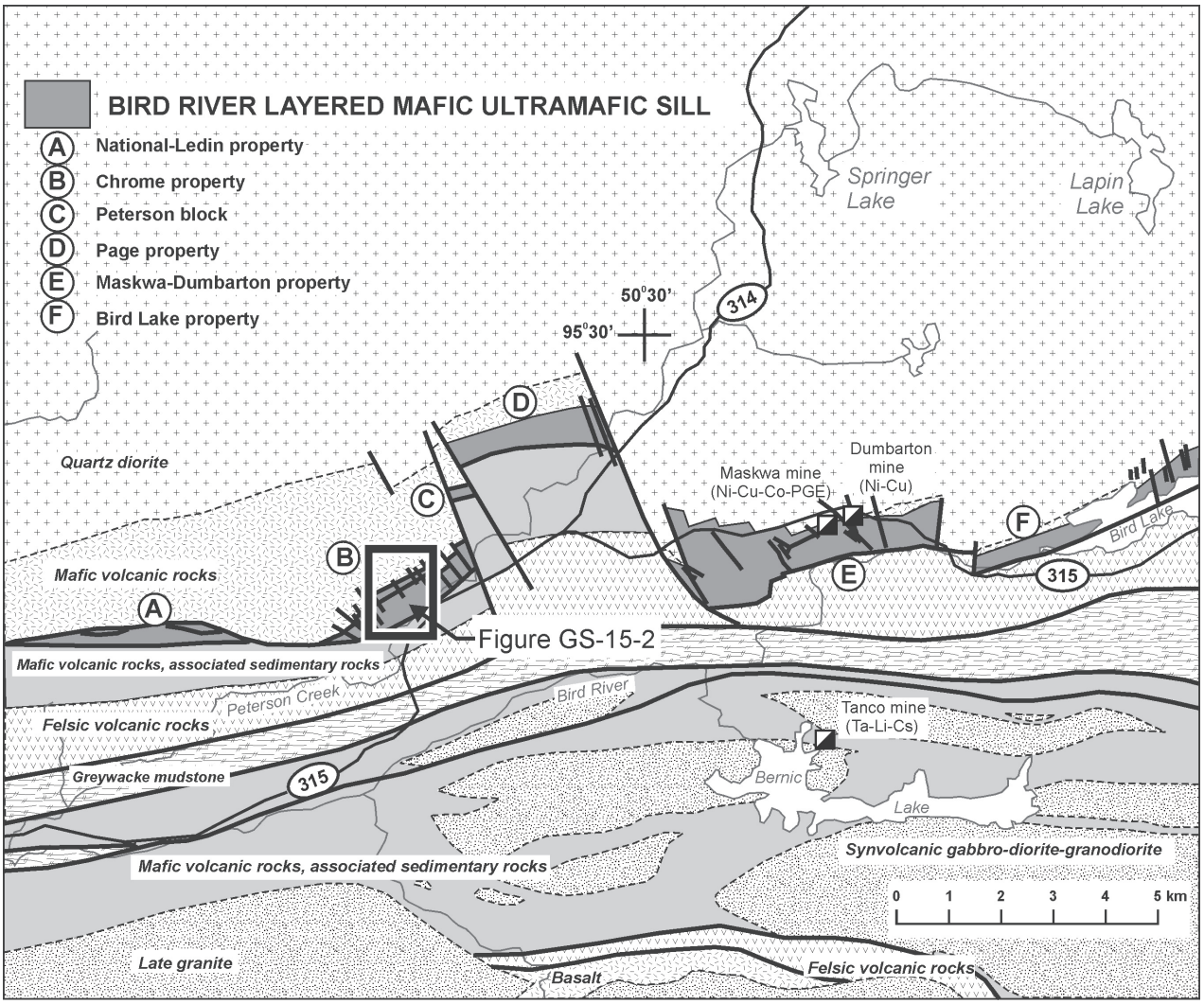

Figure GS-15-1: *Location of the Bird River Sill (*after *Theyer et al., 2001).*

defining cyclical injections of magma and the relationships of these injections to mineralization.

An additional goal of this study is to determine the role that crustal contamination may have played in the mineralization of the sill. Trace-element analysis will be supplemented with sulphur-isotope studies of the different types of mineralization identified in the sill and of iron formations within the underlying Bernic Lake Formation that may have been the source of crustal sulphur.

The third objective will be to determine the relationship between the gabbroic rocks of the Bird River Sill and the gabbroic intrusions identified within the Lamprey Falls Formation, north of the sill.

Current investigations

The summer 2005 field season focused on detailed mapping and sampling of the Chrome property. Grab samples were collected for base-metal and trace-element analysis.

The two PGE-enriched horizons of Theyer's western cut have been resampled for sulphur-isotope studies. The powders from the original analysis of samples from this cut will also be reanalyzed for trace elements.

Petrographic investigations on samples and thin sections from both eastern and western cuts, and of selected samples collected during 2005, are currently underway.

Mapping of the Chrome property

Geological mapping of the Chrome property was completed at 1:5000 scale (Mealin, 2005). The sill is divided into two units, the lower ultramafic unit and the upper gabbroic unit.

Ultramafic unit of the Bird River Sill

The ultramafic unit is composed of intensely serpentinized peridotite. Present in lesser amounts are layers of chromitite, dunite and pyroxenite. The chromitite layers, which occur within the stratigraphically higher portion of

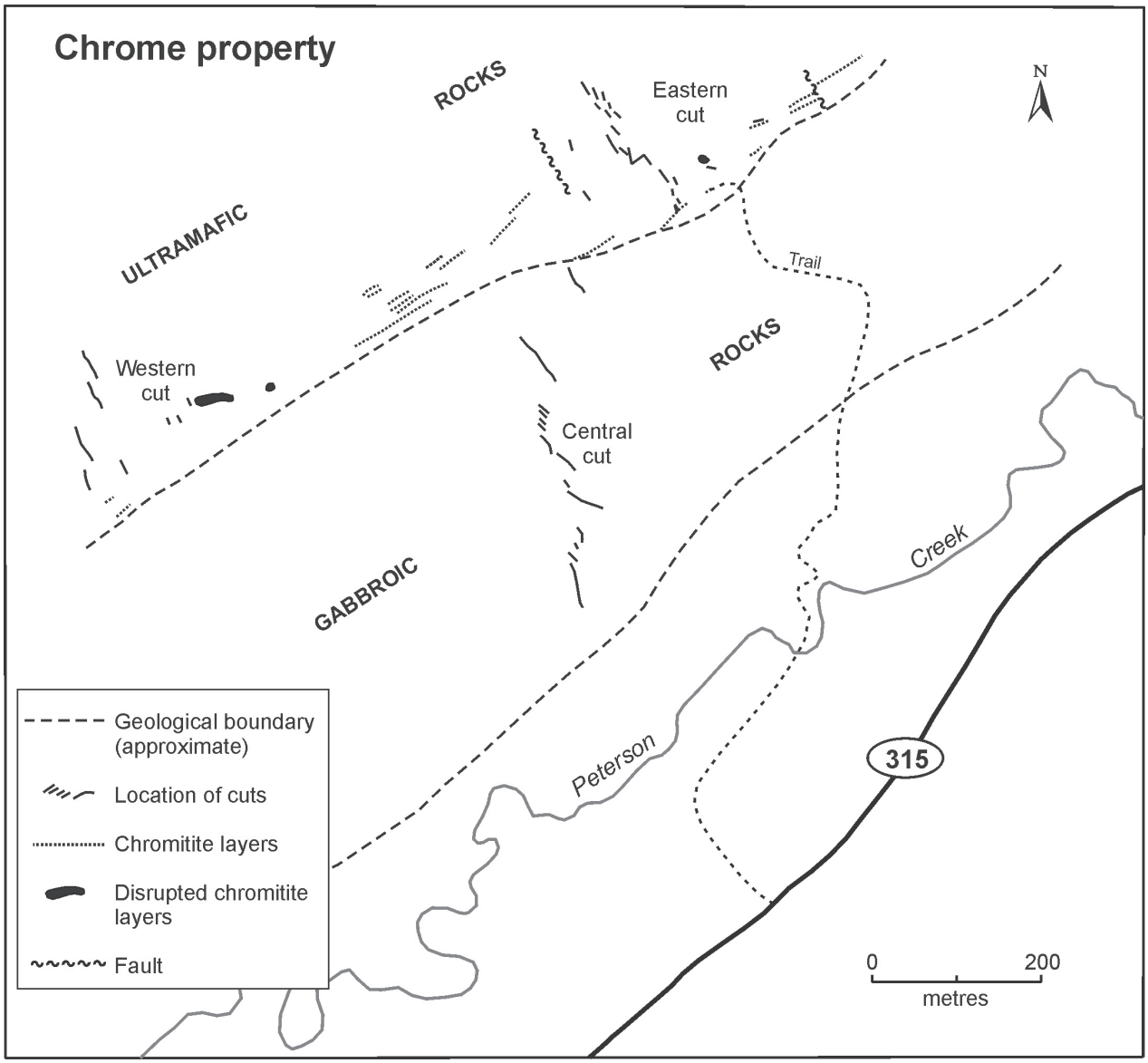

Figure GS-15-2: *Location of the cuts made by P. Theyer on the Chrome property, Bird River Sill (Theyer et al., 2001).*

the ultramafic unit, range from a few centimetres up to 30 cm in width and span a 60 m horizon near the contact with the upper gabbroic unit (Watson, 1982). Dunite is generally present, either hosting or close to the chromitite layers. Pyroxenite occurs at the lowermost stratigraphic position of the sill, between peridotite and the underlying pillowed basalt of the Lamprey Falls Formation. The pyroxenite locally exhibits a skeletal texture, contrasting with the smooth-weathering peridotite.

Sulphides within the ultramafic rocks include disseminated chalcopyrite, pyrite and pyrrhotite in amounts ranging from trace up to 5%. The highest sulphide concentration occurs within shear zones, implying tectonic remobilization of the sulphides.

The extent of the ultramafic unit on the west end of the Chrome property was expanded with the discovery of peridotite occurring between the gabbroic unit and underlying basalt of the Lamprey Falls Formation.

Mafic unit of the Bird River Sill

The mafic unit is composed of gabbro, hornblende-rich gabbro and leucogabbro. The gabbroic unit overlies the ultramafic unit throughout the Chrome property, except for a small section in the northeastern portion of the property where there is a direct contact between the gabbro and basalt.

Disseminated chalcopyrite, pyrite and pyrrhotite, ranging from trace amounts up to 5%, occur within the mafic unit.

Structure of the Bird River Sill

The Chrome property, as previously discussed, is one of the several segments of the Bird River Sill offset

by a number of north-northwest-trending faults. Numerous shear zones following the same general trend were observed throughout the property. A southwest-trending igneous layering was observed within the peridotite.

Future investigations

Future investigations will include geological mapping (1:5000 scale) of the Page property and the Peterson block. Previous work in the area of the Peterson block has delineated what is referred to as the Galaxy PGE occurrence (Theyer, 2002). This partly exposed, east-southeast-striking trench exposes fracture-controlled sulphide mineralization. The mineralization is hosted in intensely sheared peridotite located at or near the stratigraphic base of the ultramafic unit of the Bird River Sill (Theyer, 2002). This area will be of particular interest, as sulphide mineralization sampled elsewhere in the sill for sulphur-isotope analysis is not fracture controlled.

In addition to mapping the Page property and Peterson block, iron formations within the Bernic Lake Formation will be sampled for sulphur isotope analysis, to investigate the possibility that the iron formations were sources of crustal sulphur to the sill. The gabbroic intrusions within the Lamprey Falls Formation will be sampled for trace-element analysis, the results of which will be compared with the trace-element distribution in the mafic unit of the Bird River Sill.

Economic considerations

The Bird River Sill contains Ni, Cu, PGE and chromite mineralization. Understanding the controls of sulphide formation, distribution and deposition is crucial in the development of exploration strategies for the sill.

Acknowledgments

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