Report of Activities 2003
Published by:
Manitoba Industry, Economic Development and Mines
Manitoba Geological Survey, 2003.

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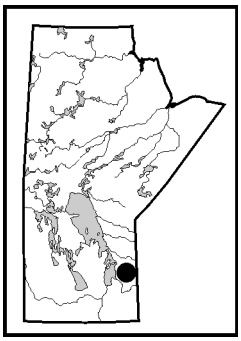
GS-25 Platinum group element investigations in the Mayville igneous complex, southeastern Manitoba (NTS 52L12)

by P. Theyer



Theyer, P. 2003: Platinum group element investigations in the Mayville igneous complex, southeastern Manitoba: (NTS 52L12); *in* Report of Activities 2003, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 196–199.

Summary

The Mayville intrusion (MI) is a layered mafic-ultramafic sill within the northern flank of the Bird River greenstone belt of the western Superior Province in Manitoba. The sill is north facing, steeply dipping, and approximately 10 km long and 1 km wide. The MI is subdivided into an upper, primarily anorthositic to leucogabbroic member (ALZ) and a lower member, the heterolithic breccia zone (HBZ). The HBZ is a complex heterolithic composite of anorthositic and leucogabbroic blocks and boulders, up to house size, that are presumed to be fragments from the overlying ALZ. The HBZ blocks and boulders have been entrained, intruded, partially eroded and digested by multiple ultramafic to mafic magma pulses.

Sulphide mineralization occurs in three different forms in the Mayville intrusion, discriminated on the basis of its age relative to the host rock and the composition of the contained sulphides. The chemistry of the three types of sulphide mineralization, including sulphur isotope composition, is being investigated, with the objective of determining the source of the mineralization and providing new techniques for platinum group element (PGE) exploration in the sill.

Introduction

The Mayville intrusion (MI) is a layered mafic-ultramafic intrusion, approximately 10 km long and 1 km wide, located in the northern part of the Archean Bird River greenstone belt approximately 145 km northeast of Winnipeg (Fig. GS-25-1). Macek (1985) first mapped the MI; however, its regional extent is estimated based on its magnetic signature, as neither upper nor lower contact is exposed. More recent mapping and investigation were undertaken by Peck and Theyer (1998) and Peck et al. (1999). Peck et al. (1999) subdivided the MI into a lower 100 to 300 m thick heterolithic breccia zone (HBZ) and an overlying anorthositic to leucogabbroic zone (ALZ).

Metamorphism in the Mayville intrusion and host volcanic rocks attained upper greenschist to lower amphibolite grade. Although hydrous alteration is widespread and especially intense near shear zones, primary igneous textures in the intrusion are generally well preserved.

Sulphide mineralization in the Mayville intrusion, which consists of chalcopyrite, pyrrhotite, pentlandite and ubiquitous pyrite, is more abundant toward the base of the intrusion (Mackie, 2003). Oxide mineralization (chromite, magnetite-bearing chromite, ilmenite) is abundant and, in certain peridotite bodies, occurs concentrated into chromitite bands. Platinum group elements are erratically associated with sulphides, principally disseminated and blebby pyrrhotite and chalcopyrite, that are present in all rock types throughout the lower part of the intrusion.

The aim of this study of the Mayville intrusion is to understand

- the configuration and intrusive history of the magma chamber;
- the nature and timing of sulphide introduction and/or exsolution, based partly on the relative age of the immediate host rock;
- the isotopic sulphide composition (i.e., mantle, crust or contaminated composition); and
- the role and relative importance of the diverse sulphide species and chromite species in concentrating PGE.

A number of recently created exposures in the Mayville intrusion facilitated these investigations, which include two recently completed B.Sc. theses (R. Hiebert and R. Mackie, University of Manitoba) undertaken in conjunction with this project. These studies focused on the chromites and sulphides in the Mayville intrusion, with the aim of discriminating those sulphides and/or oxides potentially associated with PGE mineralization. The objective was to provide an effective tool for further PGE exploration of this large mafic-ultramafic igneous complex.

Current investigations

Three different types of sulphide occurrence have been distinguished, based on the age of the host rock and the nature of the sulphides, during the current study of the Mayville intrusion. The oldest (first generation) of the sulphides consists of up to centimetre-size chalcopyrite and pyrrhotite blebs hosted in subrounded decimetre-size zones that can

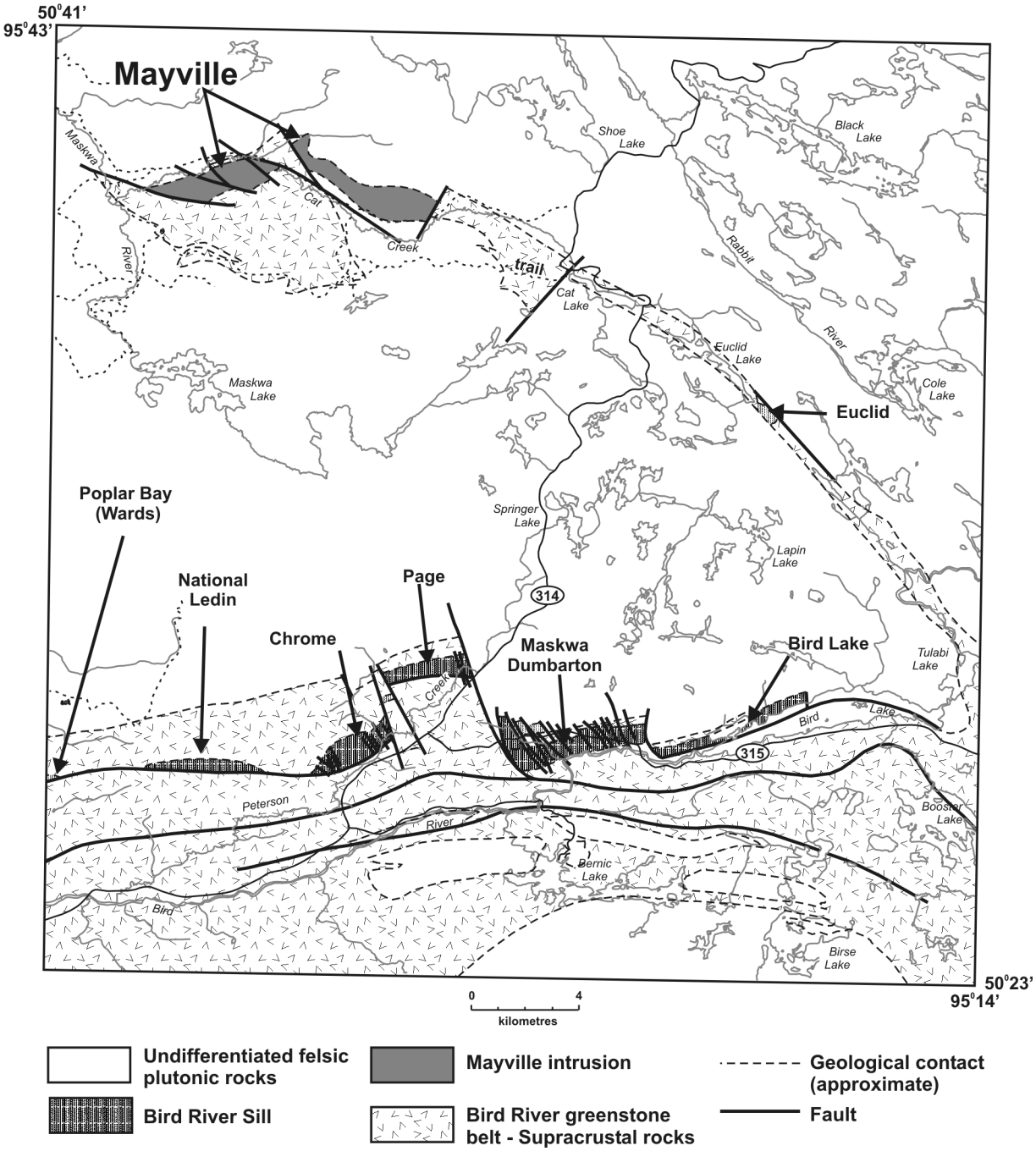


Figure GS-25-1: Schematic geology of the Bird River greenstone belt (simplified after Trueman, 1980).

be distinguished from the hostrock because they are subtly lighter in colour, weather with a smoother surface and concentrate sulphides in clusters. They are interpreted to be semidigested anorthosite boulders hosted by anorthositic gabbro masses (Fig. GS-25-2).

The second generation of sulphides consists of decimetre thick, stratiform and stratigraphically controlled pyrrhotite-enriched layers exposed for tens of metres along strike in pyroxenite. These layers are draped over an anorthosite boulder and, for this reason, are considered to represent a generation of sulphides younger than the anorthosite masses.

Included in the youngest, third generation of sulphides are those mobilized during late deuteric alteration. These are typically emplaced at or near shear zones and/or in the vicinity of deuterically altered rock. They form in association with areally extensive biotite-sericite-chlorite-amphibole alteration zones.

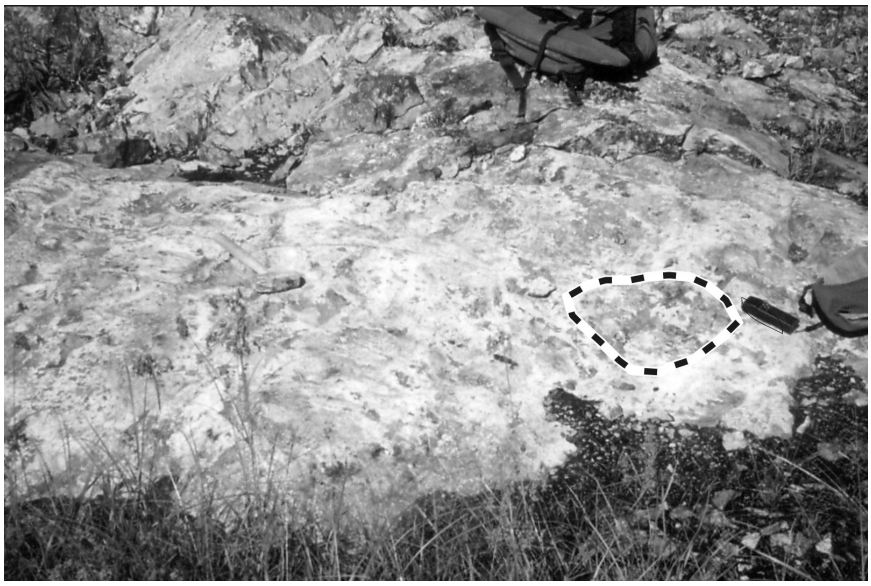


Figure GS-25-2: Anorthositic gabbro hosting sulphide-bearing semi-digested boulders (boulder outlined for better visibility).

Future activities

The chemical composition of the collected samples, including sulphur isotopes, will be determined. These data are expected to clarify the nature and provenance of the sulphides, in particular the ratio of magmatic versus crustal sulphides. They will also help establish possible links to the deposition of PGE, including the timing of sulphide injection or immiscibility and concentration of PGE.

In conjunction with detailed mapping, these data will provide an understanding of the dynamics and configuration of the magma chamber, and will be critical in aiding future exploration efforts on this and other properties with comparable mineralization.

Economic considerations

The Mayville intrusion (MI), located in the northern flank of the Bird River greenstone belt in southeastern Manitoba, is a proven repository of platinum group elements (PGE). The PGE mineralization has geological characteristics that identify it as 'contact type' (Peck et. al., 2001). Contact-type PGE mineralization is characterized by the occurrence of sulphide-bearing igneous breccia with substantial associated PGE resources. Several contact-type PGE deposits in the Sudbury Basin (Ontario) are currently being intensively explored for their economic potential. The Lac des Isles contact-type PGE deposit near Thunder Bay (Ontario) is currently mined. The aim of the present investigations of the MI is a better understanding of the magma chamber's configuration, the emplacement history and the provenance, composition and emplacement history of the sulphides. The expected findings will help to direct further PGE exploration in this intrusion, aiming at eventually converting it into a producing mine.

Acknowledgments

The author would like to express his appreciation to Falconbridge Limited and Exploratus Ltd. for allowing access to their data. R. Hiebert and R. Mackie shared their insights into the geology of the area during field trips and discussions. J. Dowd provided able and enthusiastic field assistance.

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