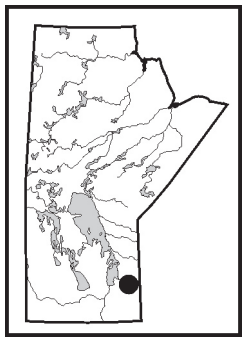
GS-17 Geology, structure and mineralization of the Ore Fault property, Bird River greenstone belt, southeastern Manitoba (parts of NTS 52L5NE and 52L6NW)

by L.A. Murphy[1] and P. Theyer



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Summary

The Ore Fault property is a mineral occurrence in a faulted and deformed sulphide-bearing segment of the Bird River Sill, which forms part of the Neoarchean Bird River greenstone belt. This report describes a geological-mapping and mineral-deposit research project aimed at investigating the geology and mineralization in a deformed segment of the Bird River Sill and, in addition, the role that tectonism may have played in the mobilization and redistribution of Ni, Cu and platinum group elements (PGE). This study is one of a number of projects, initiated in 2005 by the Manitoba Geological Survey (MGS), that address the geology and mineralization of the Bird River greenstone belt by combining the resources of industry (Mustang Minerals Corp., North American Palladium Ltd., Gossan Resources Limited, Cabot Industries and Bird River Mines Inc.), the universities of Manitoba and Waterloo, and MGS to help stimulate mineral exploration and update the provincial geological database.

The lithology of two major outcrops and intervening exposures underlying the Ore Fault property was mapped at 1:200 scale, logged and sampled. In addition, all available drillcore was logged and representative samples taken. Selected samples will be chemically analyzed and petrographically examined.

Introduction

The Ore Fault mineral occurrence is located in southeastern Manitoba, 0.3 km south of Provincial Road 315 and 0.9 km east of the junction of Provincial Roads 314 and 315. It is thought to be a part of the Bird River Sill that was tectonically dislocated and translated into the overlying Bernic Lake Formation. It is underlain by metabasalt, feldspathic tuff, peridotite (intersected in drillhole only) and quartzite (Figure GS-17-1). Several northwest-trending faults intersect segments of mineralized basalt and, in turn, are truncated by an 8 m wide northeast-trending shear zone. The faults are mineralized with pyrrhotite and chalcopyrite, and the shear zone contains pyrrhotite and lesser chalcopyrite. Pyrrhotite, chalcopyrite and lesser pyrite were identified in drillholes 89-1, 89-2, 89-3, 89-11, 89-16 and 89-17. A peridotite, assumed to be a faulted segment of the Bird River Sill, was intersected in drillhole 89-17.

Previous work

Previous investigations include an M.Sc. thesis dealing with the geology and mineralogy of this property (Ritchie, 1971) and a geological report (Anderson, unpublished report prepared for Bird River Mines Ltd., 1997). Ritchie (1971) argued that the presence of Zn and Cu in the south outcrop and Ni and Cu in the north outcrop indicated a bimodal mineral distribution, where the products of two discrete mineralization events mixed after deposition.

Regional setting

The Bird River greenstone belt consists partially of supracrustal rocks, including bimodal metavolcanic sequences and platform-type metasedimentary sequences (Trueman, 1980). Part of the belt is intruded by the Bird River Sill, a thin, fault-disrupted, differentiated mafic-ultramafic intrusion with significant Ni-Cu, Cr and PGE mineralization. The Bird River greenstone belt hosts a range of mineral-deposit types. The Tanco mine is a significant resource of Ta and Cs in rare earth element–enriched granitic pegmatites (Černý et al., 1981). The Bird River Sill includes two past-producing Ni-Cu mines: Maskwa West and Dumbarton (Karup-Møller and Brummer, 1971; Coats et al., 1979).

The Bernic Lake Formation unconformably overlies the Neoarchean Bird River Sill (2745 ±3 Ma; Wang, 1993). The Bird River Sill extends over 20 km east-west along the southern margin of the older Lamprey Falls Formation (Černý et al., 1981). Granitic intrusions and numerous north- to northwest-trending faults have caused significant offset to the sill. The sill has been subjected to regional greenschist-facies metamorphism and localized amphibolite-facies contact metamorphism near younger granitoid plutons (Juhas, 1973).

Geology

The Ore Fault property consists of two major outcrops (northern and southern), approximately 60 m apart, as well as several intervening small exposures. (Figure GS-17-2a–c)

The southern outcrop contains both rust-stained and non-stained pillowed and massive basalt, tuff and quartzite. The northern outcrop consists of rust-stained massive basalt.

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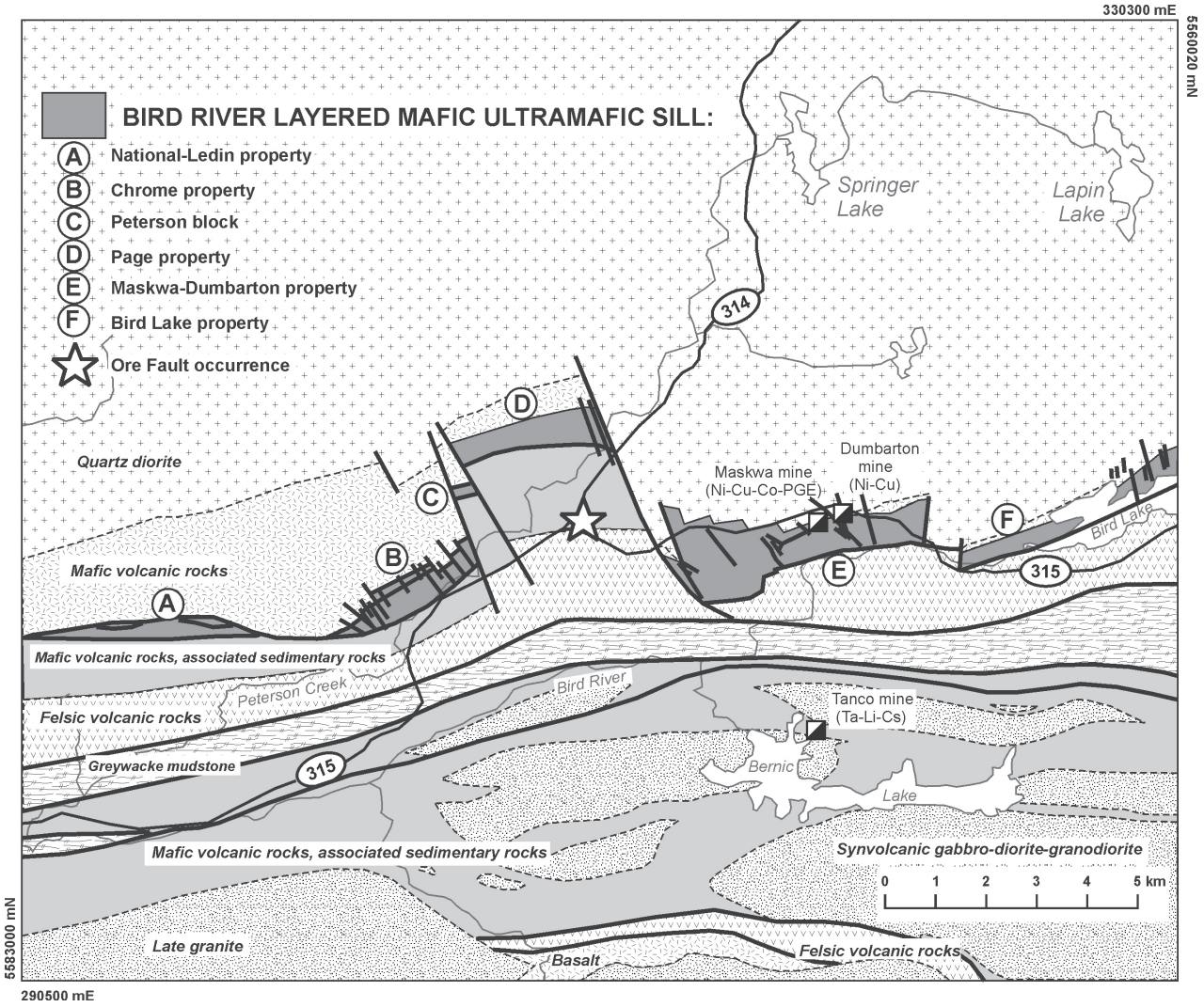

Figure GS-17-1: *Generalized geology of the Bird River greenstone belt, showing the location of the Bird River Sill and the Ore Fault mineral occurrence.*

Basalt

Basalt is the dominant rock type at the Ore Fault property. Most basalt outcrops are massive flows; however, minor pillowed flows occur in the southern outcrop. Intensely sheared basalt envelopes boudins in the southern outcrop. Pyrrhotite and chalcopyrite occur as veinlets, blebs and clots within the basalt. The northern outcrop consists of rust-stained basalt characterized by a west-trending foliation. Three different textures can be identified based on the size and shape of amphibole crystals: a) very fine grained; b) medium grained with blocky crystals up to 1 mm long; and c) coarse grained with acicular amphibole crystals up to 2 mm long that locally form aggregates up to 5 mm in size.

Basalt in the southern outcrop is characterized by colour and texture variations. The pillowed basalt at the north end of the outcrop is generally dark green to light grey and the fresh surface is dark green. Cores within the pillows are light green. The basalt is poorly mineralized and very fine grained with a poorly defined foliation. Further south, the outcrop contains rusty-weathering basalt, partly covered by rubble. Toward the east side of the southern outcrop, the basalt is deformed in a major shear zone that contains large (>1 m) boudins. Weathered surfaces of the boudins are bleached light green to grey, whereas the fresh surfaces are a slightly darker grey. In places, the basalt is very fine grained and intensely foliated, almost a mylonite. Pyrrhotite occurs as veinlets and fracture fillings.

Feldspathic tuff

Feldspathic tuff is second in abundance only to basalt in the centre and west side of the southern outcrop of the Ore Fault property and in the intervening small exposures. It is in contact with the basalt and contains trace amounts of fracture-bound sulphides. The weathered surface is medium grey and the fresh surface is nearly black (Figure GS-17-3). The rock locally contains 2–25 cm

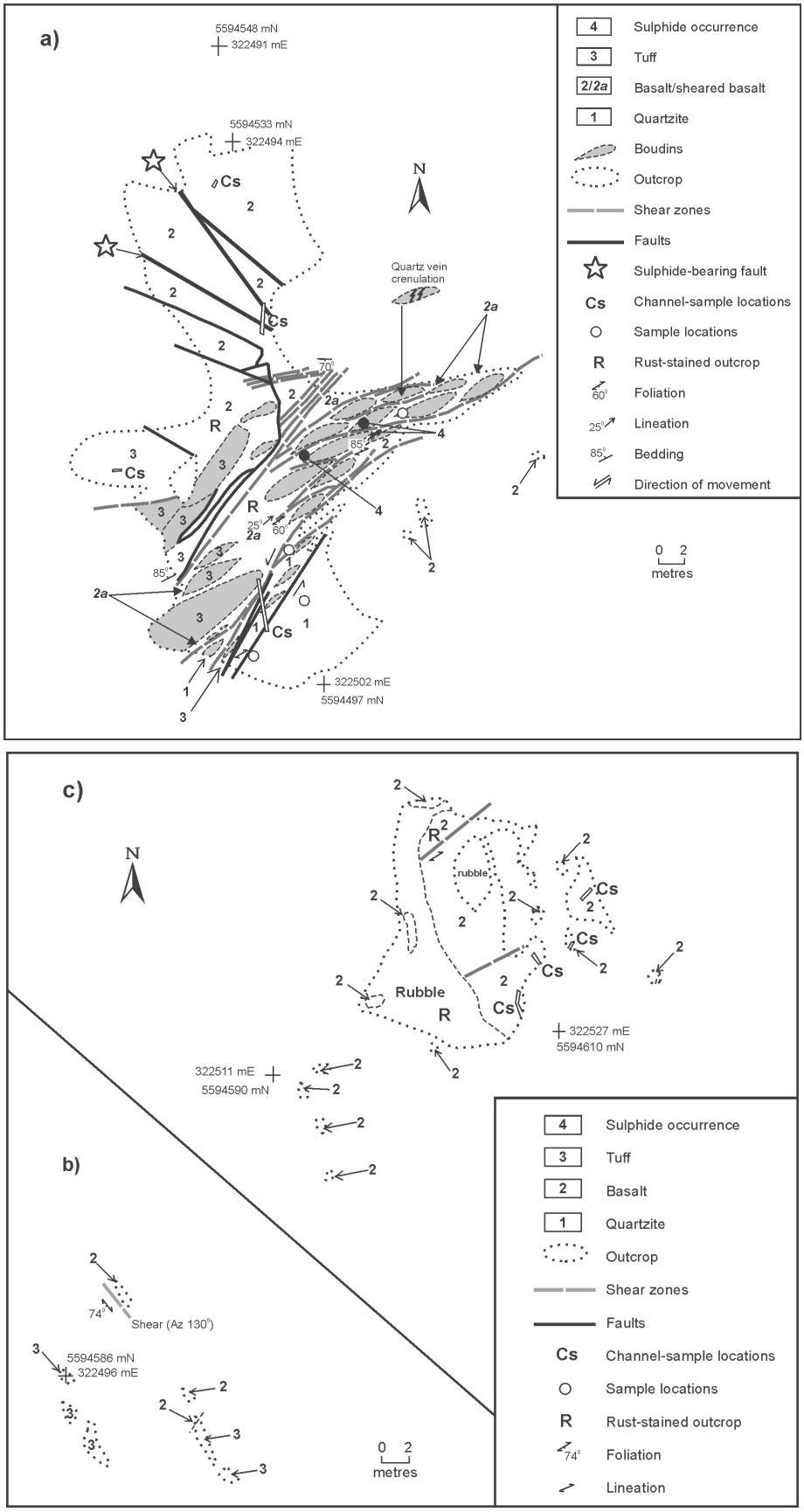

Figure GS-17-2: *Geology of the Ore Fault mineral occurrence:* ***a)*** *southern outcrop;* ***b)*** *central outcrop; and* ***c)*** *northern outcrop.*

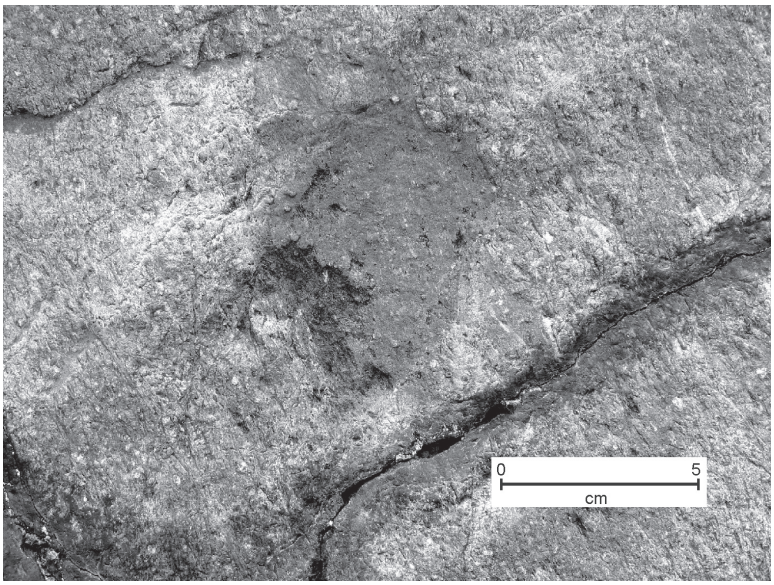

Figure GS-17-3: *Mafic inclusion in garnet- and feldspar-bearing tuff, southern outcrop, Ore Fault property. Maximum dimension of inclusion is 4.5 cm.*

long, angular and rounded, dark grey volcanic clasts characterized by detrital feldspar or garnet porphyroblasts up to 3 mm in size. The hostrock and clasts are oriented 070°/50°S. The tuff contains angular to rounded blue quartz up to 2 mm, plagioclase up to 1 mm and possible detrital feldspar or garnets up to 5 mm in a very fine grained matrix.

Quartzite

On the east side of the southern outcrop, massive quartzite is in sharp contact (oriented 040°) with the basalt along the south side of the shear zone. The weathered surface is light grey and the fresh surface is dark grey. The quartzite contains white and blue quartz crystals, ranging from 1 to 4 mm in size, within a dark grey matrix. Some amphibole minerals occur in millimetre-size veinlets. The quartzite contains pyrrhotite in the vicinity of the shear zone; however, it is barren at a distance exceeding 2 m from the shear zone.

Structure

All rock units have been deformed by faults and/or shear zones. In the northern outcrop, the basalt contains two shear zones that strike 060–070° and dip 80°N. The basalt-tuff contact strikes 045° and dips nearly vertically. The basalt unit in the southern outcrop is transected by several well-defined faults that strike 310–330° and dip steeply southward. Centrally located in the southern outcrop is a 1 m wide shear that truncates the faults and is oriented 085°/70°S. This extends to an 8 m wide shear zone that contains large (metre-scale) boudins within basalt, tuff and small fragments of quartzite. Crenulated quartz veins, 1–5 cm in width, occur in the basalt. The shear strikes 050°, dips 60°S and contains a mineral lineation plunging 25°E. The westernmost fault strikes 040° along a 1 m wide contact between the quartzite and the 8 m wide shear at the southern end of the exposure. The sense of movement within the shear plane is northeast, as indicated by stretched quartzite with sigmoidal shapes trapped in the 1 m interval.

Drill logs

A total of 670.6 m of drillcore from holes 89-1, 89-2, 89-3, 89-11, 89-16 and 89-17 was logged and samples were collected for thin-section and geochemical analysis. Results of these investigations were not available at the time of writing.

The stratigraphy underlying the Ore Fault property is a structurally repeated sequence of predominantly mafic basaltic units that grade progressively into greywacke, then quartz-feldspar porphyry and then back to the basalt. Some contacts between the units are sharply defined, indicating a sudden change in the volcanic environment, whereas other contacts are transitional over several metres. An ultramafic zone approximately 12 m wide was identified in drillhole 89-17.

Mineralization

The northern outcrop is stained with rust, a clear indication of the presence of sulphide mineralization. The basalt contains pyrrhotite and chalcopyrite in disseminated clusters and in small fracture-filling veinlets. Concentrations of massive sulphides are found in association with quartz veins in the shear zones. Outcrop observations at the southern exposure indicate that pyrrhotite and chalcopyrite from the basaltic rocks were mobilized into the southeast-trending faults, and then further concentrated into a large, 8 m wide shear zone trending perpendicular to the faults. The shear zones contain a concentration of fine-grained pyrrhotite. Samples from channel cuts in the shear zones contain up to 50% pyrrhotite and lesser chalcopyrite in association with quartz veins and basalt.

Investigations of the drillcore indicate that the ultramafic and mafic rocks are sulphide rich. Pyrrhotite and chalcopyrite occur as disseminated grains and in discrete patches and clots, as well as in veinlets. Table GS-17-1 provides the widths of the mineralized zones and the hostrock found in each drillhole.

Discussion

The Ore Fault property is considered to be a faulted portion of the Bird River Sill. Most of the rocks underlying this occurrence are of volcanic origin; however, a source of sedimentary rocks was proximal. The tuff contains detrital feldspar or porphyroblastic garnets; fragments of mafic material in the tuff also contain detrital feldspar or porphyroblastic garnets with similar orientations. A large shear zone is orientated perpendicular to the trend of the Bird River greenstone belt. It has concentrated remobilized sulphides, along with metre-scale boudins of basalt and tuff; sulphide-bearing mafic and ultramafic units underlie the surface exposure. Small pieces of quartzite were deformed during movement of the shear, indicating that the unit was tectonically introduced. Further investigation of the geochemistry and petrology of the Ore Fault property is required to understand its relationship to the tectonics that deformed the Bird River Sill and its importance in the formation of this mineralization.

Economic considerations

The study of sulphide deposition, distribution and remobilization in tectonically highly stressed environments, such as that of the Ore Fault property, are expected to aid exploration for Ni, Cu and PGE in this and other tectonically stressed portions of the Bird River Sill.

Acknowledgments

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Table GS-17-1: Summary of mineralized intervals in drillholes from the Ore Fault property.

Drillhole	Lithology	Sulphide concentration	Total width (m)
89-1	Basalt	<20% pyrrhotite; <5% chalcopyrite	10.3
89-2	Basalt	<2% pyrrhotite; < 5% chalcopyrite	16
89-2	Basalt	Massive pyrrhotite interval	1
89-3	Basalt	<3% pyrrhotite; ~1% chalcopyrite	18.8
89-3	Basalt	Massive pyrrhotite interval	0.1
89-11	Basalt	<5% pyrrhotite	12
89-11	Basalt	Massive pyrrhotite interval	1
89-16	Basalt	Mostly <2% pyrrhotite, in places <15% pyrrhotite; < 5% cpy	60
89-16	Basalt	Massive pyrrhotite interval	0.2
89-17	Ultramafic	~3% pyrrhotite; 1% chalcopyrite	12
89-17	Basalt	Mostly <5% pyrrhotite, in places <10% pyrrhotite; ~1% chalcopyrite	86
89-17	Quartz veins	Mostly 10–20% pyrrhotite, <50% pyrrhotite in places in 1–2 cm veins	0.6