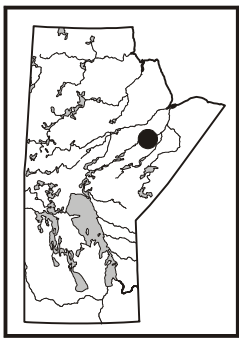
GS-12

THE FOX RIVER BELT PROJECT (PARTS OF NTS 53M/16 AND 53N/13)

by D.C. Peck, L. Hulbert[1], R.F.J. Scoates[2], E.C. Syme and P. Theyer



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SUMMARY

The Fox River Belt is a homoclinal, north-facing supracrustal sequence intruded, at two stratigraphic levels, by stratiform, layered ultramafic-mafic intrusions (the Fox River Sill and the Lower differentiated intrusions) (Scoates, 1981; 1990). The belt may have been thrust southward onto Archean basement gneisses of the northern Superior Province but, to date, there is no compelling evidence for structural imbrication within the belt. In comparison to other, lithologically similar segments of the Superior Boundary Zone, the Fox River Belt displays remarkably low metamorphic grades and limited structural complexity.

The Fox River Belt is the largest known continuous section of the ca. 1.9 Ga Superior Boundary Zone rifted margin sequence and is situated between the well documented Cape Smith Belt of northern Quebec and the Thompson Nickel Belt (TNB) in Manitoba. Despite containing a strikingly similar (and much less deformed) supracrustal sequence and a much larger volume of ultramafic-mafic intrusions (e.g., the Fox River Sill) than these two well known Ni mining districts, the Fox River Belt is not known to contain economic Ni deposits. However, in our opinion, the belt displays most of the critical geological attributes that are evident in the productive parts of the Superior Boundary Zone and, for this reason, we suggest that a major investgation of its potential to host both magmatic Ni sulphide deposits and disseminated, stratiform PGE deposits is warranted.

In cooperation with Falconbridge Limited, who currently hold the exploration rights to most of the belt, Manitoba Energy and Mines has launched a new geological program in the Fox River Belt. This program will gather new field and geochemical data to aid mineral exploration activities and as a basis for unraveling the history of sedimentation, volcanism and plutonism within this large, important segment of the Superior Boundary Zone.

INTRODUCTION

The new exploration-supportive geological program focusing on the Fox River Belt (Fig. GS-12-1) commenced in February 1999. This program is being undertaken at this time to complement an ongoing Ni-Cu-PGE exploration in the Fox River Belt (Falconbridge Limited) and because of the availability of a wide range of new geological data for other parts of the Superior Boundary Zone (see Peck, GS-3, this volume).

In the fall of last year, Falconbridge Limited secured two large Special Exploration Permits covering most of the known extent of the Fox River Belt. Subsequently, they reached an option agreement with Mr. B. Dunlop providing Falconbridge with the right to explore a smaller Special Exploration Permit that Mr. Dunlop had previously taken out over a portion of the west-central part of the Fox River Belt. Currently, a Memorandum of Understanding is being developed between Manitoba Energy and Mines, the Geological Survey of Canada and Falconbridge Limited. This agreement stipulates the terms for a lithogeochemical investigation of archival drill core and surface outcrop samples collected by previous workers and housed at the Manitoba Energy and Mines' rock storage facilities in Winnipeg. Following a one year confidentiality period, the results of this study will be made available to the public. Most of the geochemical investigations planned have been completed.

GEOLOGY OF THE FOX RIVER BELT

Scoates (1981, 1990) provides comprehensive geological descriptions of the Fox River Belt, including a 1:50 000 scale map of the

[1] ~~Mineral Resources Division, Geo~~logical Survey of Canada, 615 Booth Street, Ottawa, Ontario K1A 0E9
[2] Consultant, 509 Windermere Avenue, Ottawa, Ontario K2A 2W3

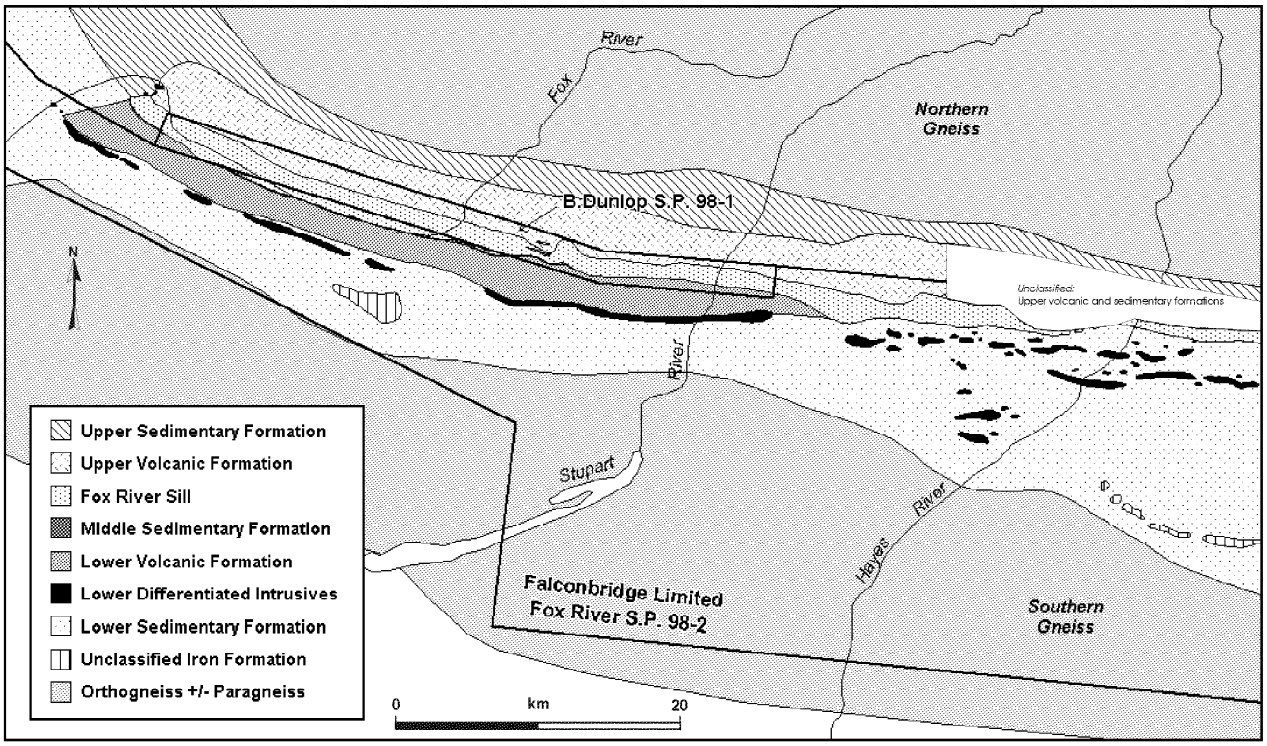

Figure GS-12-1: Major geological features of the exposed (western) part of the Fox River Belt (modified from Scoates, 1981; digital compilation by Falconbridge Limited, Winnipeg).

western part of the belt and a review of exploration and previous mapping. The following geological summary is based on these accounts and provides a background for ongoing investigations of sulphide mineralization in the Fox River Sill (Peck et al., GS-13, this volume) and volcanological studies in the Fox River Belt (Syme et al., GS-14, this volume).

The Paleoproterozoic Fox River Belt is a ca. 250 km long and 10 to 15 km wide, east-striking, north-dipping and north-facing supracrustal succession containing both the conformable, ca. 2 km thick Fox River Sill and a series of smaller, stratiform, sill-like ultramafic-mafic intrusions (Lower differentiated intrusions) (Fig. GS-12-1). Across the belt, metamorphic grades increase systematically from prehnite-pumpellyite facies in the north to greenschist facies in the south. No evidence has been found for major folding or faulting. Minor structures observed to date include discontinuous shear and brittle deformation zones that are typically parallel to bedding and flow contacts. To the south, the Fox River Belt is in contact (possibly faulted) with intermediate gneisses and granodiorite, both assumed to be of Archean age and recording at least one episode of amphibolite facies metamorphism. The contact between the Fox River Belt and paragneisses of presumed Proterozoic age that occur to the north is not exposed.

The supracrustal sequence within the Fox River Belt comprises two komatiitic basalt - basalt formations (Lower and Upper volcanic formations) and three sedimentary formations (Lower, Middle and Upper sedimentary formations). The Lower and Upper volcanic formations comprise multiple <10 to >30 m thick massive, pillowed and compound flow units that lack significant amounts of interflow sedimentary rocks. Detailed volcanological descriptions of measured sections obtained from both of these formations are given in Scoates (1981) and Syme et al. (GS-14, this volume).

The three sedimentary sequences recognized within the Fox River Belt are poorly exposed and have only rarely been intersected by drilling. Based on limited available data, they appear to comprise abundant, thin-bedded, fine-grained clastic sedimentary rocks (distal marine or lacustrine facies; mudstone, argillite, pyritic argillite and siltstone) and subordinate amounts of chemical sedimentary rocks (starved basin marine or lacustrine facies; sulphide and oxide facies banded iron formation and subordinate dolomitic limestone).

The Lower differentiated intrusions are typically <1 to 20 km long and <500 m thick. They are extremely well differentiated (dunite to anorthosite) stratiform intrusions and were emplaced within the upper part of the Lower sedimentary formation (Fig. GS-12-1).

The Fox River Sill, with an age of 1883 +/- 1.5 Ma (Heaman et al., 1986), was emplaced within a relatively thin metasedimentary sequence (Middle sedimentary formation). It has an average true thickness of ca. 2 km, and has a strike length, based on the interpretation of airborne magnetic data (Scoates, 1990), of >250 km; its third dimension is at least several kilometres. These dimensions show the Fox River Sill to be one of the largest stratiform ultramafic-mafic intrusions on Earth (cf. Scoates, 1990). Gravity data support an interpretation that the sill widens at depth and dips moderately to steeply to the north (Scoates, 1990). The sill comprises four major sub-units, viz. (from base to top): 1) the Marginal Zone, a ca. 300 m thick sequence containing 3 cyclic units having a lower olivine-rich zone, a central pyroxene-rich zone and an upper plagioclase-rich zone; 2) the Lower Central Layered Zone, a ca. 1 km thick sequence comprising multiple, decametre-scale cyclic units containing a thick dunite-peridotite unit grading into an uppermost clinopyroxene-rich (+/- plagioclase) unit; 3) the Upper Central Layered Zone, a ca. 1 km thick sequence comprising at least 20 cyclic units containing variable proportions olivine and clinopyroxene +/- orthopyroxene +/- plagioclase; 4) The Hybrid Roof Zone, averaging 50 m in thickness and containing a variety of quartz and granophyre-bearing ultramafic to mafic rock types, xenoliths of the overlying Middle sedimentary formation rocks and derivative aplite and granophyre melt inclusions (Scoates, 1990).

PREVIOUS EXPLORATION

Most of the previous exploration in the belt was conducted by INCO Limited and focused on the potential for large massive Ni sulphide deposits at the base of the Fox River Sill ("Thompson-type" deposits). The earliest, major exploration was conducted by INCO Limited between the mid 1950s until the mid 1970s, and involved geophysical surveys (ground and airborne magnetic and electromagnetic) and diamond drilling. Also in the 1970s, Falconbridge explored the western end of the Fox River Belt for Ni sulphide deposits (Atkinson Lake area). In the mid to late 1980s, B.P. Minerals explored for platinum-group elements (PGE) in the Fox River Sill and completed a detailed airborne magnetic survey that covers a large portion of the Fox River Belt. In the early 1990s, Westminer Limited (currently Western Mining International Limited) completed a small drill program that tested coincident magnetic and electromagnetic anomalies in the western part of the Fox River Belt along the contact between the Lower volcanic formation and the Lower sedimentary formation.

OBJECTIVES AND APPROACH OF THE CURRENT STUDY

The principal objectives of our study are to expand the existing geochemical database (e.g., Scoates, 1981; 1990; Schwann, 1989; Naldrett et al., 1994; several INCO Limited, B.P. Minerals, Falconbridge Limited and Westminer Limited non-confidential assessment files) and the existing mapping (Scoates, 1981; 1990) for the Fox River Belt so that effective geochemical and geological exploration models for Ni-Cu-PGE deposits within the belt can be developed. To date, ca. 400 major, minor and trace element analyses, ca. 100 Au-Pt-Pd-S-Se analyses and ca. 30 S isotope analyses have been completed. These data will be available for public disclosure in late 2000. Approximately half of the new whole-rock geochemical data were from INCO Limited drill core samples and surface outcrop samples that were originally collected in the 1970s by R.F.J. Scoates and coworkers (Scoates, 1981; 1990). The remaining data is from samples collected by the authors from drill core donated to Manitoba Energy and Mines by WMC in February of this year.

In addition to the lithogeochemical studies, the authors, together with Falconbridge Limited geologists, completed a 1 week reconnaissance field program in July of this year. This program was undertaken to examine all of the major areas of known bedrock exposure in the belt, principally along the Fox and Stupart Rivers (Fig. GS-12-1), in support of follow-up exploration (Falconbridge Limited) and geological mapping and bedrock sampling (Manitoba Energy and Mines). The value of this program was enhanced by unusually low water levels (ca. 1 to 1.5 metres below normal levels) in all of the major river systems flowing through the Fox River Belt. Following the reconnaissance field program, detailed volcanological investigations were completed along the best exposed sections through the Lower and Upper Volcanic formations (see Syme et al., GS-14, this volume). In addition, a two week field program was undertaken in August to investigate the potential for PGE-Cu-Ni mineralization of the Marginal Zone of the Fox River Sill. This study mainly involved detailed mapping and sampling in the Great Falls area of the Fox River (Fig. GS-12-1).

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