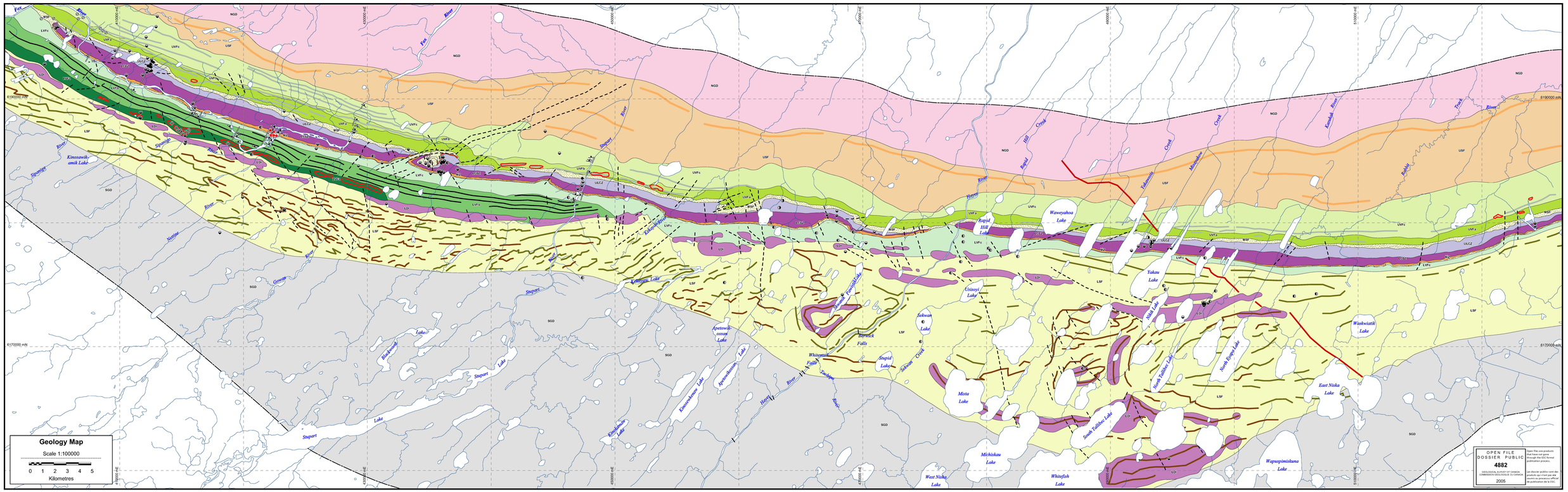

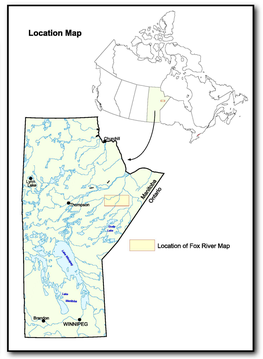

Geological Survey of Canada
Commission Géologique du Canada

GEOLOGY OF THE
Fox River Belt, Northern Manitoba

Open File 4882

(NTS sheets - 53 M9, M10, M15, M16, 53 N9-N16)

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Projection Details:
Universal Transverse Mercator
(NAD 83), Zone 15

Digital cartography
and map layout:
Paul Stacey, MapIT, Ottawa

Natural Resources Canada | Ressources naturelles Canada

Canada

Legend

Mesoproterozoic

Mafic Dyke
Late NW-SE trending mafic dyke (Mackenzie?)

Paleoproterozoic

NGD - Northern Gneiss Domain (undivided)
garnet-bearing, quartz-feldspar-biotite +/- hornblende gneiss and cataclastic and retrogressed equivalents; rocks resemble the greywacke- and mudstone-derived gneisses of the Burntwood River group.

USF - Upper Sedimentary Formation (undivided)
siltstone, argillite, shale, carbonaceous shale

UVF - Upper Volcanic Formation

UVFc - Upper Zone
siltstone, argillite, shale, carbonaceous shale breccia, minor pillow breccia, minor layered flows, interflow sulphide-bearing carbonaceous shale.

UVFb - Middle Zone
pillowed olivine clinopyroxenite and basalt, layered and massive komatiitic basalt, minor pillow breccia.

UVFa - Lower Zone
layered komatiitic basalt, massive and pillowed komatiitic basalt, minor massive basalt, interflow sulphide-bearing carbonaceous shale.

Fox River Sill

HRZ - Hybrid Roof Zone
gabbro, gabbronorite, quartz gabbro, granophyre-bearing gabbro, plagioclase-bearing websterite, serpentinized hertzolite, gabbroic pegmatite, granophyre and diverse quartz-rich rocks derived from melting of quartz-rich Middle sedimentary formation rocks.

UCLZ - Upper Central Layered Zone
serpentinite, serpentinized plagioclase-bearing lherzolite-wehrlite, melatroctolite, serpentinized olivine melagabbronorite, plagioclase-bearing olivine websterite-clinopyroxenite, olivine gabbronorite-gabbro, minor quartz gabbro and granophyre-bearing gabbro, minor serpentinized dunite, some sulphide-bearing rocks and chromitiferous rocks; well developed repetitive cyclic units, cm-scale grain size graded layers locally developed.

LCLZ - Lower Central Layered Zone
serpentinite, serpentinized dunite, serpentinized wehrlite, minor herzolite, olivine clinopyroxenite, minor olivine gabbro-gabbronorite, minor chromitiferous dunite, and chromitite; well developed repetitive cyclic units, rhythmic layering locally developed.

MZ - Marginal Zone
serpentinized hornblende-bearing olivine melagabbronorite, serpentinized plagioclase- and hornblende-bearing herzolite-wehrlite, plagioclase-bearing olivine websterite-clinopyroxenite, olivine gabbronorite, minor gabbroic pegmatite, minor sulphide-bearing rocks; some repetitive cyclic units, rhythmic layering locally developed.

MSF - Middle Sedimentary Formation (undivided)
laminated quartz-rich siltstone, argillite, shale, feldspathic sandstone, quartzite, minor greywacke, minor calcareous rocks, included mafic-ultramafic intrusions; rocks adjacent to the base and roof of the Fox River Sill have been converted to hornfels.

LVF - Lower Volcanic Formation

LVFc - Upper Massive Zone
massive basalt, plagioclase-phyric basalt, intercalated pillowed basalt, some interflow sulphide-bearing carbonaceous shale.

LVFb - Middle Pillowed Zone
pillowed olivine clinopyroxenite and basalt, layered and massive komatiitic basalt.

LVFa - Lower Massive Zone
massive to massive komatiitic basalt flows, minor basalt, interflow sulphide-bearing carbonaceous shale.

LDI - Lower Differentiated Intrusions
marginal zone consists of a highly altered plagioclase-bearing olivine clinopyroxenite, the overlying peridotite zone consists of serpentinized plagioclase-bearing lherzolite and the upper portion of these intrusions consists of a clinopyroxenite zone, gabbro zone, and hybrid roof zone comprising plagioclase-bearing olivine websterite, olivine gabbronorite, quartz-bearing gabbronorite, granophyre-bearing gabbronorite.

LSF - Lower Sedimentary Formation (undivided)
siltstone, argillite, calcareous siltstone, silty limestone, dolomitic limestone, feldspathic sandstone, sandstone, shale, carbonaceous shale, specular hematite/ magnetite iron formation, and minor conglomerate; rocks adjacent the Lower differentiated intrusions are converted to hornfels.

Archean

SGD - Southern Gneiss Domain (undivided)
granite, augen granite, quartz-feldspar-biotite gneiss, amphibolite, migmatite.

Structure Symbols

- Bedding tops known (inclined, vertical, overturned)
- Inclined volcanic bedding (tops inferred from pillow structures)
- Igneous layering tops known (inclined)
- Cu-Ni-PGE Sulphide Occurrences

Topographic Symbols

- Lake, River, Rapids

Magnetic Trends and Anomalies

- **USF magnetic trend** prevalent magnetic trend or fabric in the Upper Sedimentary Formation
- **UVF magnetic high** distinctive magnetic highs associated with the Upper Volcanic Formation
- **UVF magnetic trend** prevalent magnetic trend or fabric in the Upper Volcanic Formation
- **LVF magnetic trend** prevalent magnetic trend or fabric in the Lower Volcanic Formation
- **LVF magnetic high** distinctive magnetic high associated with the Lower Volcanic Formation
- **LSF magnetic trend** prevalent magnetic trend or fabric in the Lower Sedimentary Formation
- **LSF iron formation** strong magnetic anomaly and trend associated with iron formation in the Lower Sedimentary Formation
- **Fault lines** undifferentiated
- **Limit of mapping and geological interpretation**

Diamond Drill Holes (# locations on map)

- Falconbridge Exploration Ltd. (33)
- Canadian Nickel Co. (101)
- BP Resources Canada (6)
- BP Selco Inc. (10)
- Westminer Canada (10)
- Sherritt Gordon Mines (8)

Geological Sections (Scoates et al., 1981)

1. 380 W section
2. Fox River South section
3. 208 W section
4. Fox River South section2
5. 462 W section
6. 32 E section
7. Camp Rapids section
8. Fox River South section 4
9. Great Falls Section
10. Fox River North section 1
11. Fox River North section 2
12. Fox River North section 3
13. 670 E section
14. 722 E section
15. Fox River South section
16. 1086 E section
17. Otter Falls section
18. Jackfish Falls section

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Explanatory Notes

MAP CONSTRUCTION

This map represents a new interpretation of the Geology of the Fox River Belt, Manitoba. It is based primarily on an aeromagnetic survey of the area flown by Fugro Airborne Surveys in 1999 for Falconbridge Limited. The survey line spacing was 250 m, and the nominal sensor elevation was 75 m above ground level for the magnetometer. Flaconbridge geological staff are acknowledged for discussions pertaining to the Fox River Belt geology in the early stages of the map production.

In addition, a detailed helicopter based magnetic gradiometer survey, conducted for BP Selco Inc. in 1987, was employed for more detailed interpretation within the Fox River Sill and immediate surrounds. Regional Geological Survey of Canada aeromagnetic (800 m line spacing) and ground gravity geophysical data and imagery was also utilized in conjunction with these more detailed industry acquired geophysical data sets. LandSat 7 imagery (Canadian Centre For Remote Sensing GEOBASE) and a digital elevation model (DEM) based on NASA SRTM data was also implemented to illustrate the extensive Pleistocene glacial coverage and the limited topographic expression of the area. Manitoba Energy and Mines Map GR-81-1-1 " Geology Of The Western Part Of The Fox River Belt" by Scoates et al., 1981, and reports GR81-1 and GR82-3 provided the geological framework for interpreting the geology based on the geophysical coverage in an area. The study area contains virtually no outcrop exposure other than in limited river sections. Information from extensive exploration diamond drill hole intersections were also utilized to interpret the geology.

STRATIGRAPHIC RELATIONSHIPS (Taken from Scoates et al., 1981)

Supracrustal rocks of the Fox River Belt consist of two broadly similar successions of sedimentary, volcanic and intrusive rocks. The similarity of these successions could be explained by tectonic repetition. This would require the presence of a fault at or near the contact between Middle Sedimentary Formation and Lower Volcanic Formation rocks. This contact has not been observed and evidence for a fault in this area has not been found. The following discussion is considered relevant to the problem of possible large-scale tectonic repetition.

The Middle and Upper zones of the Upper Volcanic Formation have distinctly different thicknesses and possess substantially different proportions of pillowed and massive flows than the equivalent Lower Volcanic Formation zones. The differentiated intrusions are vastly different in size, the Fox River Sill being several times thicker than the Lower differentiated intrusions. The latter also lack the internal zones and repetitive cyclic units that characterize the Sill. The Lower Sedimentary Formation contains calcareous rocks near the contacts with some Lower differentiated intrusions, whereas calcareous rocks are rare in the Middle Sedimentary Formation. Such differences between the volcanic and sedimentary formations may be considered significant and consequently support the concept of simple succession of units.

The Fox River Sill is interpreted to represent the subvolcanic chamber from which the overlying lavas of the Upper Volcanic Formation were derived, and a similar relationship has been suggested relating the Lower differentiated intrusions and lavas of the Lower Volcanic Formation. Given this concept, large-scale tectonic repetition would be precluded because Upper massive zone rocks of the Lower Volcanic Formation were metamorphosed by intrusion of the Fox River Sill. Small-scale repetition within the volcanic formations and intrusions is unlikely because these major units display apparently uninterrupted progressive changes in composition. Thus, the continuity of the geology of the volcanic formations and intrusions suggests that, with the exceptions noted below, the Fox River Belt is structurally not complex.

The absence of major faults, parallel with the layering of units of the belt, cannot be unequivocally demonstrated, given the sparseness of outcrop. A fault is indicated between the Lower Sedimentary Formation and the Southern Gneiss Domain on the basis of deformation observed in drill core from the stratigraphically lowest part of the Fox River Belt. A fault is interpreted as separating Fox River Belt rocks from the Northern Gneiss Domain on the basis of the north-facing, homoclinal character of Fox River Belt rocks.

An apparent large-scale fold at the approximate mid-point of the Fox River Sill marks a slight change in direction of strike of the Sill and associated units. Relationships between the upper units of the Sill and Middle Sedimentary Formation rocks based on drill hole intersections are uncertain due to an absence of outcrop in this area.

POSITION OF GEOLOGICAL CONTACTS (Taken from Scoates et al., 1981)

Geological contacts have been located in the field in areas of outcrop, and by diamond drill hole intersections. Contacts have been extended in drift covered areas on the basis of changes in aeromagnetic signature. Many contacts extended in this manner coincide with sharp deflections of streams and river beds. This suggests that the coincidence of change in magnetic signature with deflections in the drainage pattern is significant, pinpointing the precise position of contacts between major geological units. Major contacts defined this way on the geological map are those between the Fox River Belt and the Southern and Northern Gneiss Domains, between sedimentary and volcanic formations and between differentiated intrusions and enclosing country rocks.

References

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Scoates, R.F.J., 1990. The Fox River Sill, Northern Manitoba A Major Stratiform Intrusion. Manitoba Energy and Mines Geological Services, Geological Report GR82-3, 192 p.

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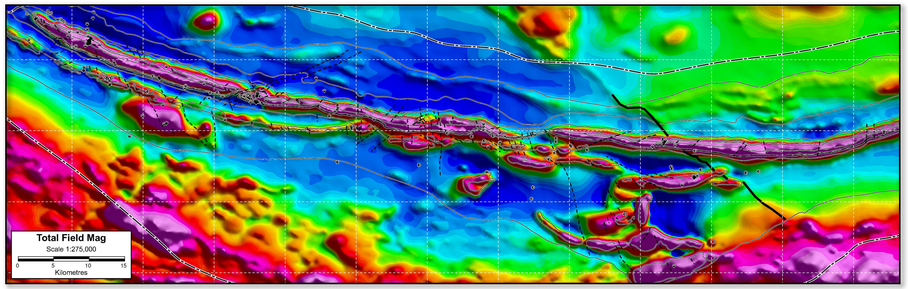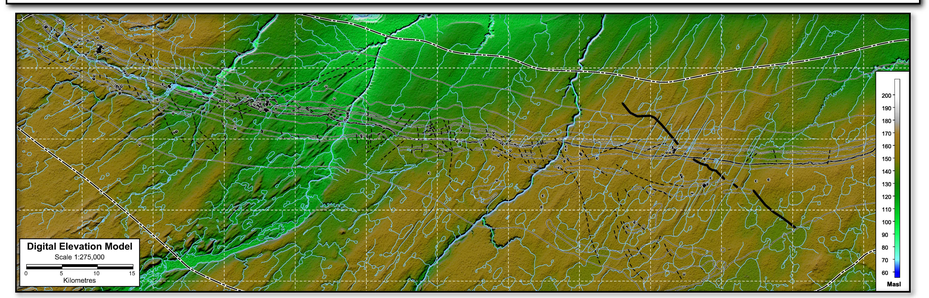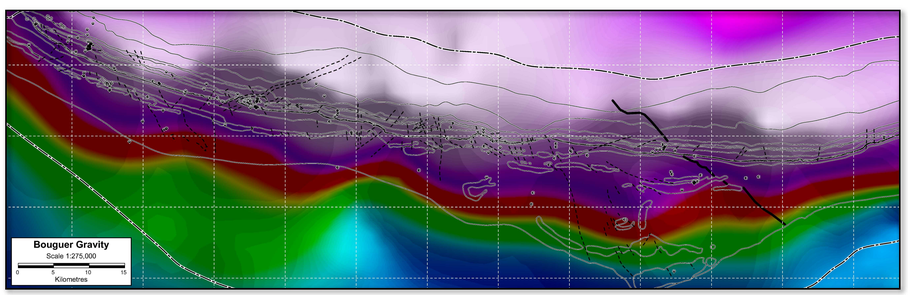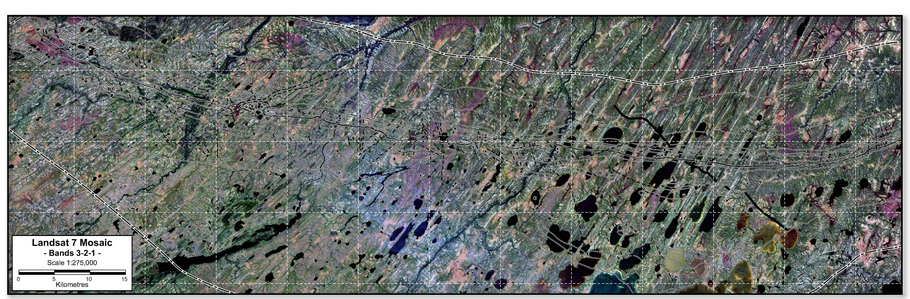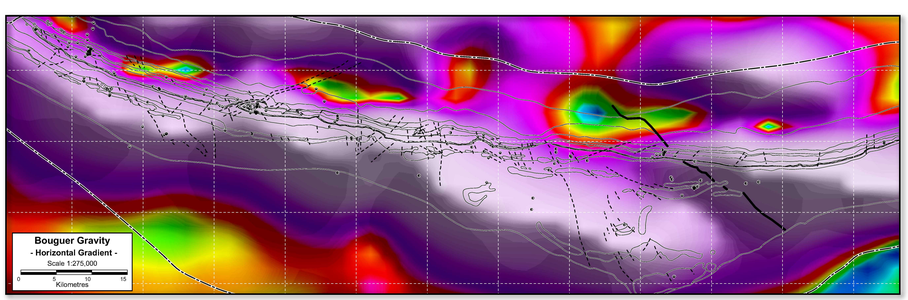
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