Sub-Phanerozoic basement geology in the Watts, Mitishto and Hargrave rivers area, eastern Flin Flon belt, Manitoba

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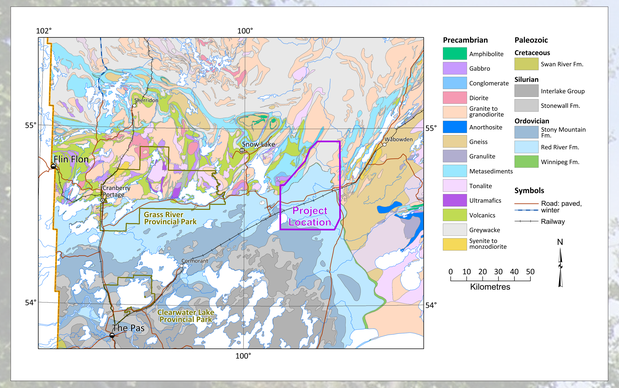

Figure 1: Geology of the Flin Flon belt in west-central Manitoba and the Watts, Mitishto and Hargrave rivers project location outlined in purple (see Figures 2-5). Note the extent of Phanerozoic cover rocks.

Introduction

The Manitoba Geological Survey (MGS) is in the process of updating the geological understanding of the Precambrian Flin Flon belt (FFB) where it extends to the south beneath Phanerozoic cover rocks in the Watts, Mitishto and Hargrave rivers area (see Project Location - Figure 1). Considering that the exposed portion of the belt is one of the most well-endowed volcanogenic massive-sulphide (VMS) camps in the world, the potential for numerous **world-class deposits beneath the thin Phanerozoic cover to the south** exists. To date, several sub-economic deposits have been discovered, but their position on current geological maps raises questions regarding our geological understanding of this region. New 1:50 000 scale geological maps are being developed from industry and government aeromagnetic, drillhole geochemistry and drillcore lithology data.

Objectives

- **Generate new geological maps of sub-Phanerozoic basement rocks.**
- **Evaluate the resource potential of the region (job creation through mining).**
- **Provide updated geological data for land-use planning (e.g. locating parks).**

Data and interpretation

The process of updating the sub-Phanerozoic geological map from the Watts, Mitishto and Hargrave rivers area includes:

Figure 2: Review the geological interpretation from NATMAP Shield Margin Project Working Group (1998), the simplicity of the map demonstrates the lack of knowledge for this area.

Figure 3: Max slope points are generated from total magnetic intensity data and help define magnetic trends, these can be compared with first vertical derivative or conductivity maps of the region.

Figure 4: Contacts and faults, which serve to define geological domains, are approximated from aeromagnetic and drillhole data.

Figure 5: New geological interpretation of the Watts, Mitishto and Hargrave rivers area

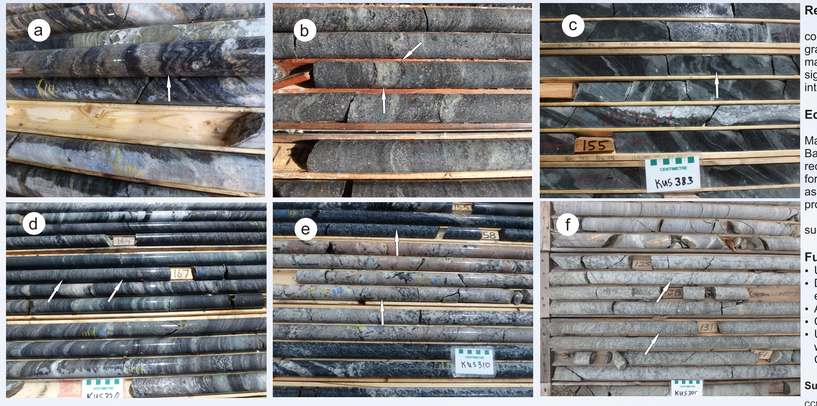

Figure 6: Select drillcore examples from the study area: a) dark, heavy mineral layers (arrow) highlight primary bedding in a quartz-feldspar sandstone, drillcore KUS378; b) biotite-garnet pelite with neosome (leucosome indicated by lower arrow and melanosome indicated by upper arrow) and paleosome, drillcore HAR070; c) layered amphibolite with calc-silicate layer (arrow), drillcore KUS383; d) light grey-green felsic rock with lapilli sized fragments (left arrow) and local clots of sillimanite (right arrow), drillcore KUS320; e) granodiorite (upper arrow) hosting significant interval of K-feldspar–rich pegmatite (graphic texture at lower arrow), drillcore KUS310; f) strongly magnetic, coarse-grained (lower arrow) to pegmatitic (upper arrow) gabbro, drillcore KUS301

Results

Drillcore observations confirm that a number of different rock types including metamorphosed sandstone and conglomerate, pelite and psammopelite, mafic to felsic volcanic rocks and a variety of intrusive rocks from granite to gabbro are present in the project area (Figure 5, 6a-f), many of which correspond to different total magnetic intensity domains (see Reid, 2018 for comprehensive description of rock types and aeromagnetic signatures). Trends in the aeromagnetic data indicate that these rocks are complexly folded (i.e. dome and basin interference pattern) and cut by regional faulting.

Economic considerations

The Watts River base metal deposit in the north half of the study area, as interpreted by the NATMAP Shield Margin Project Working Group (1998), occurs within Burntwood group sedimentary rocks (Figure 2). However, Bailes (2015) interprets it to be a VMS deposit associated with felsic volcanic and sedimentary rocks. This work recognizes that additional volcanic rocks are present to the north, east and south broadening the search space for VMS deposits. Noteworthy is that pelite/psammopelite containing graphite and sulphides are commonly associated with minor felsic rocks that were too small to be represented as units on the map but maybe prospective enclaves folded within broader sedimentary rocks.

Ubiquitous pegmatites occur throughout the study area and present an opportunity to explore for rare-metals, such as tantalum and lithium (see Benn et al. 2018 poster).

Future work

- Use lithogeochemistry to determine the affinity and character of the volcanic and intrusive rocks.
- Develop schematic cross sections in conjunction with available seismic data (local 3D seismic) to help elucidate the tectonic history.
- Acquire U-Pb age of felsic volcanic rocks hosting the Watts River VMS deposit.
- Continue interpretation to the south and southwest under deeper cover.
- Use similar methodology and work flow to map the sub-Phanerozoic geology south of Flin Flon (a collaboration with the Saskatchewan Geological Survey and Geological Survey of Canada, this is part of the National Geological Surveys Committee pilot project for the next generation of collaborative projects in Canada).

Suggested references

Benn, D., Linnen, R.L., and Martins, T. 2018: Geology and bedrock mapping of the Wekusko Lake pegmatite field, central Manitoba, poster presentation CCMEC, Winnipeg, Manitoba

Bailes, A.H. 2015: Geological setting of the Watts River base metal massive sulphide deposit; HudBay Minerals Inc., unpublished internal geology report, 70 p.

NATMAP Shield Margin Project Working Group 1998: Geology, NATMAP Shield Margin Project area, Flin Flon belt, Manitoba/Saskatchewan; Geological Survey of Canada, Map 1968A, scale 1:100 000.

Reid, K.D. 2017: Sub-Phanerozoic basement geology south of Wekusko Lake, eastern Flin Flon belt, north-central Manitoba (parts of NTS 63J5, 12, 63K8, 9): insights from drillcore observations and whole-rock geochemistry of mafic rocks; in Report of Activities 2017, Manitoba Growth, Enterprise and Trade, Manitoba Geological Survey, p. 65-77.

Reid, K.D. 2018: Sub-Phanerozoic basement geology from drillcore observations in the Watts, Mitishto and Hargrave rivers area (parts of NTS 63J5, 6, 11, 12, 13, 14); in Report of Activities 2018, Manitoba Growth, Enterprise and Trade, Manitoba Geological Survey, p. 37-47.

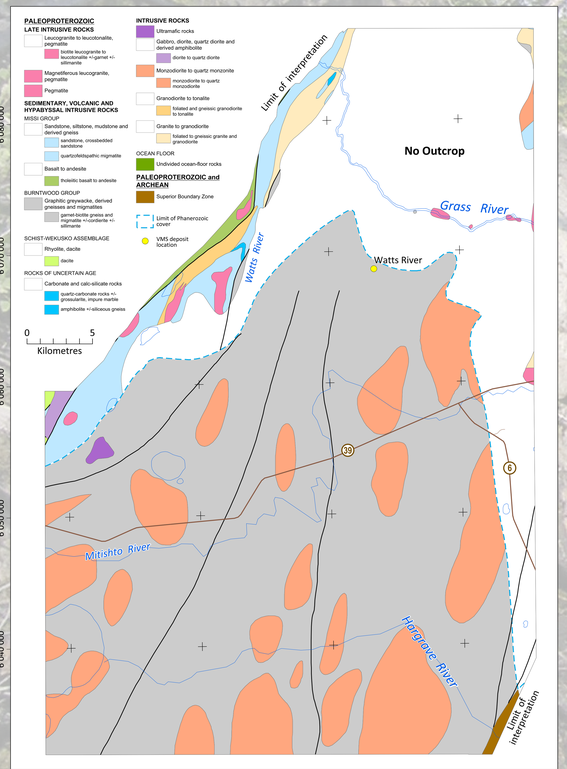

Figure 2: Sub-Phanerozoic geology of the study area from the NATMAP Shield Margin Project Working Group (1998). Note that only three rock type area observed in the sub-Phanerozoic portion: Burntwood group sediments, monzodiorite to quartz monzodiorite intrusives, ultramafic rocks and areas without outcrop and no geological interpretation.

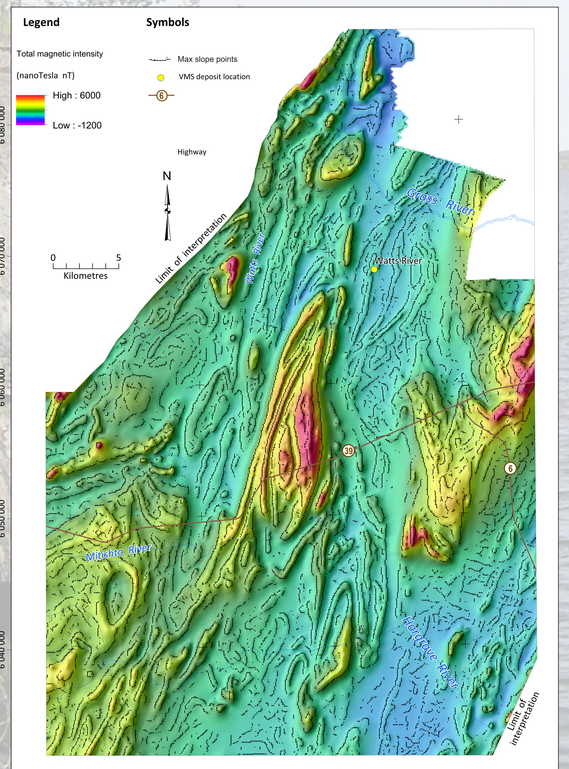

Figure 3: Total magnetic intensity map of the Watts, Mitishto and Hargrave rivers study area with a transparent hillshade illuminated from 290º and an inclination of 45º. Trends in the aeromagnetic data are re-enforced by peak/max slope points (derived from slope analysis in ArcMap and peak points selected in Geosoft).

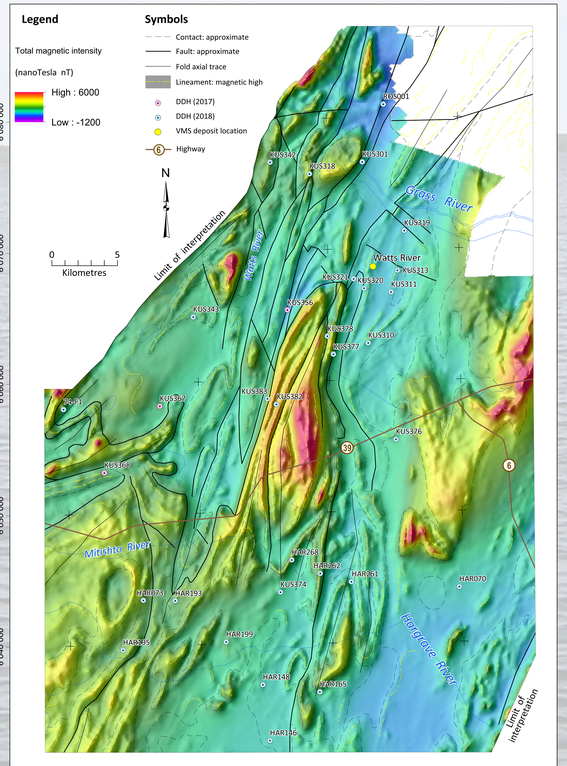

Figure 4: Total magnetic intensity map of the Watts, Mitishto and Hargrave rivers study area with a transparent hillshade illuminated from 290º and an inclination of 45º. Major faults, contacts and axial traces are shown along with prominent magnetic high lineaments. Re-examined drillcore locations are shown on the map, where possible these test magnetically distinct domains.

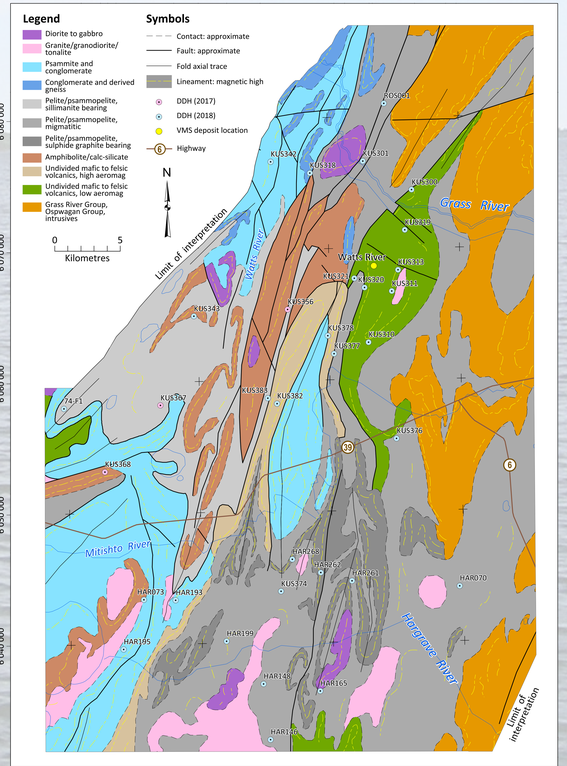

Figure 5: Simplified geological interpretation that incorporates aeromagnetic data and drillcore observations for the Watts, Mitishto and Hargrave rivers area.