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Sub-Paleozoic geology of the Cormorant Lake map area, Manitoba
N.T.S. 63-K

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by

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DESCRIPTIVE NOTES

The geological interpretation presented is based on integration of drill hole, aeromagnetic, gradiometer, electromagnetic, and bedrock geological data, and as such, is not comparable to conventional 1:250,000 geological compilations. Ground truth information is limited to published geological mapping north of the Phanerozoic cover. Subsurface geological data was obtained from drill core in the public domain stored at The Pas, drill core from the Manitoba "Scout" drilling programs, and drill logs made available from confidential sources through the cooperation of industry. However, most of the drill hole information is from conductive horizons. Thus a disproportionate amount of lithological information has been derived from narrow linear units which, during mapping of exposed Shield areas, are generally recessive and thus are rarely mapped. The trends of electromagnetic conductors and magnetics as obtained from gradiometer and total-field data form the basis for the delineation of lithological contacts. The bedrock lithologies for much of the area are also based on magnetic signatures. At present, only one-third of the region has gradiometer coverage. The balance of the area is covered by total-field magnetics of 1962 vintage, which was flown at an acute angle to much of the regional bedrock grain (i.e., north-south oriented flight lines). The interpretation varies in quality as a result of not having a consistent geophysical base.

In excess of 1000 diamond drill logs were examined and summarized to provide ground truth. The number of data points per 15-minute quadrangle varied from 10 to 244. However, even within the quadrangle with the greatest drill density, there are units which are based strictly on aeromagnetic signature.

The geological interpretation was developed from a systematic and multiple review basis. A first-pass interpretation, at 1:50,000 scale, was based strictly on the magnetic signature. Subsequently, a drill hole lithology identification was then used to refine the geophysical interpretation.

Drill logs were summarized and re-interpreted several times in conjunction with the geophysical interpretations and drill core examinations. The resultant interpretation was then simplified and compiled at the 1:250,000 scale. In general, most volcanic units are based on drill hole information. Units having a significant felsic volcanic component generally have at least one drill hole to substantiate the interpretation. This same prerequisite applies to the metasedimentary units which are indicated to contain sulphide and/or graphite enriched horizons.

Drill holes which have intersected mafic intrusives were generally dependent upon the presence of conductive responses. Drill hole information pertaining to other lithologies is largely dependent on regional programs and the occasional drill hole which was targeted at surficial conductors or conductive responses associated with faulting.

The geophysical interpretive procedures rely on sufficient magnetic susceptibility contrast being present between units. Where insufficient contrast between units is present, interpreted faults were often utilized to delineate the boundary between different map units. The Phanerozoic cover rocks consist primarily of limestone and dolomite with extremely low magnetic susceptibilities, and thus have no significant masking or interference effect. The magnetic responses beneath thick Phanerozoic cover are similar to those which would have resulted by increasing the survey altitude.

The vertical gradiometer system is designed to map near-vertical contacts between magnetically contrasting units. Fault interpretations are based on the termination of linear magnetic trends and the alignment of linear magnetic depressions.

For the purposes of the 1:250,000 geological interpretation, sixteen lithological units are utilized in the legend. Intrusive rocks have not here been differentiated into pre- and post-Missi types. Such division may be feasible by applying age-dating procedures to drill core samples. Intrusives vary from ultramafic to felsic in composition. The latter could not be differentiated into more specific type without drill core confirmation. As most of the larger intrusives north of the Phanerozoic contact are of granodioritic composition, the majority of the larger felsic intrusives beneath the Phanerozoic cover have also been interpreted as granodiorite.

Mafic intrusives are not necessarily divisible among diorite, gabbro and ultramafic on the basis of magnetic signature alone. In general, the smaller bodies with very high magnetic relief were interpreted to be either gabbroic or ultramafic in composition. The region is dominated by a large, possibly multiple-phased felsic intrusive with dimensions of 60 x 25 km centered about Cormorant Lake

Missi sediments were identified only within sheet 63-K/13, here represented as a narrow, linear fault-controlled remnant. The possibility of Missi equivalent units within the metasedimentary gneisses is distinctly possible; however, no large areas of arkosic rocks have been identified to date.

Amisk group sediments and their metamorphic equivalent metasedimentary gneisses appear more prevalent beneath the Phanerozoic cover than throughout the Flin Flon region. Recognizable volcanics are present in the western part of the Cormorant Lake sheet and extend to the north shore of Goose Lake. Volcanics are also evident between Iskwasum Lake and Tramping Lake. The most discrete and best developed volcanic belts are located in the eastern portion of the area. These two felsic to intermediate belts are considered equivalent to those exposed at Snow Lake and may have similar economic potential.

The balance of the map-sheet has been interpreted to consist predominantly of metasedimentary gneisses and migmatitic rocks. As most industry geologists tend to utilize primary lithological terminology in their drill logs until amphibolite grade gneiss and migmatites develop, regional metamorphic zonations have not been determined at this time.

Almandine garnets were commonly observed in the metagreywackes and felsic gneisses. The gneisses between the eastern and western volcanic belts are considered to be primarily sedimentary in origin. The amphibolites in this area may represent original thin mafic volcanic flows.

Two distinctive areas can be outlined within the gneissic terrain. An area of high magnetic susceptibility in the Atik Lake region is identifiable over a 50 x 15 km area. Limited drill testing has established high-grade porphyroblastic biotite gneisses and migmatite of probable metagreywacke composition containing intercalated amphibolites and hornblende gneisses. Mafic intrusives are also indicated, although virtually none have been confirmed by diamond drilling. This belt is situated immediately southeast of the Namew Lake nickel/copper deposit.

A belt of felsic biotite gneisses extends from Namew Lake to Simonhouse Lake. Within the Goose Lake and Simonhouse Lake area, numerous formational sulphide horizons were interpreted by the gradiometer results and confirmed by drilling. The intervening lithology is interpreted as felsic to intermediate volcanic rocks. Further study may indicate that the intervening rocks are primarily sedimentary.

Structures identified by this study are comprised primarily of faults. Fold axes were interpreted within the area of gradiometer coverage at 1:50,000 scale but were not suitable for transfer to the 1:250,000 compilation. A major east-west cataclastic fault zone was identified along the Paleozoic margin from Athapapuskow Lake to Tramping Lake. This is both a strong and discrete gradiometer feature. Mapping in the 1940's in the Tramping Lake area confirmed faulting of this orientation. Drill hole data from Reed Lake also confirms the presence of a major cataclastic or mylonite zone. The presence of this structure along the Paleozoic margin precludes extension of many bedrock units from the exposed Shield southward beneath the Paleozoic cover. A parallel fault structure was identified along the south shore of Cormorant Lake. This feature, however, has not yet been confirmed by drilling.

The majority of the other identified faults exhibit north-northwest trends. Gradiometric survey coverage of the balance of the project area would result in an increase in the reliability and number of structures identified.

Base metals deposits of two types have been identified in the study area. Massive sulphide volcanogenic Cu/Zn (Au/Ag) deposits are the most common. The Coronation Mine (Saskatchewan) was situated right at the Phanerozoic margin. The Spruce Point deposit also is situated at the Phanerozoic margin at Reed Lake. Currently, there are no operating mines beneath the Paleozoic cover. The volcanic belts, which extend under the Paleozoic cover, have potential for hosting massive sulphide volcanogenic deposits. Based on this geological interpretation, the best potential is restricted to three very limited areas of volcanics, while the remainder of the map-sheet displays little potential for this type of deposit.

The discovery of the Namew nickel/copper (Pt group) deposit by Hudson Bay Mining & Smelting under Namew Lake is the most important published occurrence beneath the Phanerozoic cover. HBM+S has recently announced a decision to undertake an exploration decline. The ultramafic body associated with this deposit is not identifiable in the total-field magnetic maps currently available. However, if this feature is identifiable in the gradiometer coverage to be released this year, it could significantly assist in the exploration for additional deposits. To date, very few of the interpreted mafic intrusives beneath the Phanerozoic cover have been subjected to any drill tests.

The larger mafic intrusives, especially in the Farewell Lake and Leak Lake areas, could be layered as they exhibit a similar gradiometer signature to the Reed Lake layered intrusive. The potential for concentrations of platinum group metals within this type of setting should be considered.

The relative attractiveness of this region for gold exploration has been enhanced by several recent discoveries to the north of the Phanerozoic contact. At present, no gold occurrences are known beneath the Phanerozoic cover. Nonetheless, publicly available assessment files indicate that numerous sulphide horizons tested by drilling have not been systematically analyzed for gold. Also, two geological settings with good potential for gold are in evidence. Volcanogenic exhalative horizons could host Nor Acme type deposits. Shear zones, especially at or near the contact with intrusive bodies, could host shear or vein type occurrences. The gold occurrences on Four Mile Island at Reed Lake may be of this latter classification. These occurrences are situated immediately north of the Phanerozoic contact in close proximity to the major east-west structure. This cataclastic or mylonite zone continues beneath the Phanerozoic in close proximity to a number of intrusive bodies. Another potentially attractive environment beneath the Phanerozoic cover is the well preserved thick regolith. Any gold deposits discovered beneath shallow Phanerozoic cover would likely be oxidized to a considerable depth and would thus be potentially leachable, thereby further enhancing the economics of low-grade deposits in this area.

Intrusive units have been subdivided in the legend into:

(1) granite, granite porphyry, quartz monzonite
(2) granodiorite
(3) diorite, quartz diorite
(4) gabbro, anorthositic gabbro diorite
(5) ultramafic pyroxinite, peridotite, hornblendite.

The identification of intrusive units beneath Phanerozoic cover is dependent as much on their configuration as on their magnetic response. These units often lack strong magnetic gradients or display a magnetic gradient which exhibits only subtle changes across strike. Intrusions are also characterized by the interruption of regional magnetic trends or grain and the presence of either high magnetic cores or rims. Within exposed Shield areas, large intrusive bodies are commonly zoned or multi-staged. These zonations or stages are not necessarily recognizable by the magnetics alone. Thus, the dominant composition of any intrusion may easily be misidentified on the basis of one or two drill holes.

1. Granite is generally characterized by a very flat magnetic gradient in small oval-shaped configurations that have low total-field magnetic responses. True granitic rocks constitute a low percentage of the total felsic intrusives in most Shield terrains. This is confirmed by bedrock mapping to the north of the map area. The areas mapped as (1) are, in part, based on the distribution of (1) identified to the north.

2. Granodiorite. Larger intrusive areas are generally of this composition. More complex gradiometer patterns suggestive of zonations and at times indicative of contaminated rims are also characteristic. Contacts are often not magnetically discrete and may be observed during field mapping as mixed border zones. The core areas are often similar in magnetic response to that displayed by (1) granite intrusives.

3. Diorite. Large diorite bodies are similar to granodiorite in their magnetic signature, with a common overall higher total-field magnetic response. The presence of very high magnetic and gradiometer responses are often indicative of differentiated gabbroic phases. Linear dioritic bodies often respond as positive linear gradient features that appear similar to formational sulphide and volcanic horizons. If airborne electromagnetic data is available, their corresponding lack of conductivity may be helpful in their identification.

4. Gabbro, Anorthositic Gabbro. A generally high total-field magnetic response is often characteristic . The gradiometry may display strong linear gradiometer contrasts. The Reed Lake intrusive has been recently identified as a layered intrusive. A series of bodies to the south and east of Reed Lake have been identified as gabbro on the basis of similar signature. A small oval-shaped body mapped on the north shore of Reed Lake (Stanton, 1945) within Township 65, Range 20 is mapped as a coarse-grained anorthositic gabbro. This body is characterized by a low total-field magnetic response with a negative gradiometer response. Other similar features have been identified regionally under overburden and/or

Paleozoic cover. Detailed re-mapping of this feature might provide the confidence for the identification of similar bodies beneath the Phanerozoic.

5. Ultramafics. This commonly forms an integral component of the layered gabbroic complexes and may be often identified by their higher total-field magnetic response.

6. MISSI Group. Currently, Missi Group sediments are limited to one small linear belt within the northwest section of 63-K/12. The identification of Missi equivalent sediments is based on regional metamorphic grade. Under low-grade regional metamorphic conditions, Missi is characterized by interstitial hematite and low total magnetic field response. Under high-grade regional metamorphic conditions, the hematite is recrystallized to magnetite, completely altering the magnetic signature of the rock.

AMISK Group Rocks.

7. Intermediate to mafic metavolcanics. Gradient responses from these rocks vary considerably. Specific mafic volcanic belts display extremely high total gradient constrasts such as at Athapapuskow Lake. This expression may be caused by numerous mafic intrusive sills. Detailed mapping in this region may assist in identifying the cause of the pattern. The general lack of a conductive response, in conjunction with this gradiometer pattern, may also be characteristic. Drill hole data from these units is sparse except within local areas that have intercalated graphitic and sulphide-rich horizons of exhalative and sedimentary origins.

8. Felsic to intermediate metavolcanics. The presence of numerous conductive zones and positive linear grandiometer features may be diagnostic. Correspondingly, felsic volcanic terrains which lack conductive responses would be very difficult to interpret. The presence of any significant

felsic volcanic material within a designated area has resulted in the placing of that area into map unit (8) as a consequence of its importance to the exploration for massive sulphide volcanogenic deposits. Most of this unit may still be intermediate to mafic in composition. However, due to the reliance on drill hole information, the percentage of felsic volcanics is upwardly biased in comparison to that identified by conventional mapping in a similar terrain.

9,10 Metagreywacke, meta-argillite. These units and their metamorphic equivalents appear more prevalent within the Cormorant Lake region than is evident immediately to the north. The more restricted distribution of volcanic rocks and the more widespread occurrence of greywacke-type sediments also appears to be confirmed by drill records. The presence of barren sulphide and graphitic horizons within this sequence has led to the drilling of a reasonable number of exploration holes.

Those metasedimentary units which lack conductive horizons are very difficult to identify with just the aeromagnetic data. Several units of this type are indicated in the interpretation. The largest of these is represented by the intervening area between the two north-south trending volcanic belts in the eastern portion of the study. Drill confirmation should be considered to ascertain the nature of this trend.

11. Sulphide facies iron formation; minor intercalated argillite and felsic to intermediate tuff. This unit is based on a distinctive gradiometer signature and the presence of conductive horizons, and is located primarily within and at the margins of the volcanic pile.

12. Oxide facies iron formation. The interpreted oxide and mixed oxide/sulphide facies iron formation horizons are very limited in distribution. Due to their distinctive magnetic character, the most pronounced one has been confirmed by drilling.

Other narrow iron formations may form a minor component within the sedimentary. stratigraphy. However, there is no potential for major iron formation units.

Metamorphic Units

It is unfortunate that metamorphic units have to be included in this interpretation, because the use of this nomenclature tends to obscure the overall regional distribution of lithologies and a genetic interpretation of the depositional history.

Metamorphic terminology is utilized only because insufficient information is currently available to identify the primarily volcanic from the primarily sedimentary nature of the metamorphic areas. It would also appear that the metamorphic units classify terrain that is analogous to the Kisseynew Gneisses north of the Amisk Group volcanic belt.

13. This unit is largely equivalent to Units 9 and 10. Further investigation may identify meta-arkosic areas equivalent to Missi sediments.

14. This appears to be a border phase to the larger batholithic intrusions.

15. These may represent metamorphosed Amisk Group volcanics; however, the lack of recognizable felsic volcanics suggests that these may be related to submarine basaltic flows that have been identified within the Nokomis Group rocks to the north.

16. This unit is restricted to an identified major mylonite zone accompanied by retrograde metamorphic effects. Other mylonite zones may be delineated by drill testing the magnetic structures or careful re-logging of the drill holes proximal to indicated regional magnetic structures.

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