An Evaluation
of
Mineral Potential
Indian Reservations In Manitoba

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Indian Affairs and
Northern Development

CANADA

Ministère des
Affaires indiennes et
du Nord canadien

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This report provides information from an evaluation of mineral potential made by a consultant for the Department of Indian Affairs and Northern Development. Should you be interested in taking up mining rights to an Indian reserve covered by this report, you may enquire from:

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by

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on behalf of

Indian Affairs Branch

Department of Indian Affairs and Northern Development

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APPENDIX (to copy #1 of this report only)

Copies of all available published and unpublished reports and maps covering Indian Reservations. These are grouped by reservations in accordance with the listings of references which introduce the discussions on individual reservations in the text.

IV

Summary and Conclusions

A preliminary study of the mineral potential of Indian Reservations in Manitoba has revealed certain areas with considerable potential and others with little or none. The reasons for rating particular reservations as good or poor are detailed throughout the text and the ratings are summarized in the table on Pages 59, 60 and 61, according to potential and probable product.

In very few cases is it possible to point to specific targets, even for those reservations with good ratings. Consequently, further investigation on the ground may be required. Where such is the case, this is suggested in the text. Similarly further data on some reservations may be available from private company files. Efforts should be made to obtain these. This applies particularly to areas covered by airborne geophysical surveys.

Of the reservations in the Precambrian, those showing the most promise for possible metallic deposits are listed below, not necessarily in order of merit. Suggestions for additional follow-up work are included for each of the selected reservations.

1. Nelson House - possible copper-zinc deposits
   - obtain airborne electromagnetic data from Company
   - detailed geological examination to delineate fold structure

2. Split Lake - possible nickel occurrences
   - detailed geological examination
   - ground geophysical surveys
   - consultation with INCO

3. Cross Lake - possible base metals
   - detailed geological study, decipher folds
   - geophysical surveys
   - area is rated higher than the small amount of previous work would indicate

4. Oxford Lake - possible base metals
   - check "A"-grade airborne electromagnetic anomalies shown on maps
   - detailed geological examination

5. Gods Lake - moderate-fair rating for gold only
   - geological examination

6. Island Lake - possible nickel
   - obtain airborne electromagnetic results from Company
   - ground geophysical surveys if warranted
   - detailed geological mapping

7. Hole River - possible nickel
   - check "A"-grade airborne electromagnetic anomalies shown on map

8. The Narrows, Lake St. Martin - possible copper mineralization
   - further geological study in co-operation with Manitoba Mines Branch

Of the reservations in the southern part of the province, the potential consists entirely in the field of industrial non-metallic minerals. Indian lands have a certain advantage over free-hold or provincial Crown lands here. Indian lands comprise a single large block as contrasted with smaller individual parcels held by free-holders and the province. This is a decided advantage when considering a possible industrial mineral operation which commonly requires fairly large mineral holdings.

Calcium limestone on provincial lands and on freehold property is not exceptionally plentiful, yet a continuing demand is assured. This places those reservations underlain by calcium limestone in a good position. Specifically the following reservations are singled out:

Ebb and Flow	(66A)
Swan Lake	(65C)
Dawson Bay	(65B)
Dog Creek	(46)

Aerial photographic examination should precede examination on the ground for suitable quarry sites.

Sandy Bay I.R. #5 is probably underlain by extensive beds of gypsum which, like calcium limestone, is not all that plentiful in western Canada, and for which demand will continue. Shallow drilling will be required to confirm quality and thickness of the gypsum beds. Other mineable gypsum may exist on the Rousseau River I.R. #2 and 2A.

Possibilities also exist for production of salt, silica sand, building stone and bentonite. Potential markets and feasibility of production should accompany evaluation of these materials.

In the case of industrial minerals it is recommended that full appraisal of potential deposits be made as early as possible. Results may be revealed to the Manitoba Mines Branch and to the Manitoba Department of Industry and Commerce with a view to promoting use of materials on Indian lands. Few industrial mineral operators have exploration teams and rely heavily on the provincial government agencies for advice. It is possible to cite two recent instances when companies might have been induced to utilize raw materials from Indian lands. A recently opened cement plant in Winnipeg required calcium limestone and gypsum for their operation, both of which could have been supplied from Indian reservations. Similarly, a chemical plant located near Brandon might have obtained required salt from wells on the Birdtail Reservation. Had that been the case, the plant itself would probably have been located nearby - an additional bonus to the residents of that area.

The concluding recommendation is that serious consideration be given to further revisions to the Indian Mining Regulations with the intention of making exploration of Indian lands more competetive with exploration on provincial Crown lands. Existing regulations favour exploration on provincial lands to the detriment of Indian lands. The rationale for this suggestion is developed towards the conclusion of this report.

INTRODUCTION

This report presents a discussion and evaluation of the mineral potential of Indian Reservations in Manitoba. It deals specifically with metallic and non-metallic minerals, exclusive of oil and gas and unconsolidated material (sand, gravel etc.) lying above bedrock. The study is based on the writer's personal knowledge of the geology and mineral potential of Manitoba and on both published and unpublished material which forms an appendix to the report.

In accordance with the terms of agreement, the report includes:

a) Known mineral occurrences on reservations, giving location, nature, distribution and economic development potential.

b) Geological evaluation of inferred mineral potential on Indian Reservations.

c) An inventory of published and unpublished technical data which will contribute toward present and future evaluation of individual reservations.

d) An appendix consisting of technical data relevant to the mineral potential of reservations.

The report presents in two separate parts:

1) The metallic and non-metallic potential of individual reservations in the Precambrian.

2) The potential for specific industrial minerals on certain reservations, underlain by Palaeozoic and younger rocks in southern Manitoba.

In each case, the relevant published and unpublished data are listed in the appropriate section for individual reservations.

Table 1 summarizes the potential of all reservations, for specific minerals, as poor, fair, moderate, or good.

The final sections of the report outline general exploration trends in Manitoba and suggest ways in which the mineral potential of Indian Reservations may be further investigated and mineral development realized.

SOURCES OF INFORMATION

The general geology and mineral deposits of Manitoba are summarized in:-

i) Geology and Mineral Resources of Manitoba, by J.F. Davies et. al. Man. Mines Branch, 1962.

ii) Geological Map of Manitoba, Man. Mines Branch, Map 65-1, 1965.

iii) Metallogenic Map of Manitoba, Man. Mines Branch, Map 66-2, 1966, with accompanying lists.

The above general report and maps and numerous published reports and maps on individual areas have been used extensively in preparing this study. Most of these are publications of the Manitoba Department of Mines and Natural

Resources and the Geological Survey of Canada. Aeromagnetic maps of the Geological Survey of Canada and the Manitoba Department of Mines and Natural Resources have also been consulted. Assessment work files covering the areas surrounding reservations have been examined. Open files of the Industrial Minerals section of the Manitoba Mines Branch have been referred to. Copies of all available published material and pertinent unpublished data are included in the appendix.

Finally, the writer has relied on his personal acquaintance with the geology, mineral industry and exploration activity in Manitoba.

GEOLOGY AND MINERAL RESOURCES OF MANITOBA

Geologically Manitoba may be divided into the Precambrian Shield, which underlies 3/5 of the province and Palaeozoic and younger rocks of south-western Manitoba. The Precambrian, in turn, consists of 2 parts: the Superior province forming the eastern part of the Shield and the Churchill province lying to the north-west of the Thompson nickel belt (see Map 66-2).

The Superior province consists of east-trending volcanic-sedimentary belts intruded by small bodies of mafic and ultramafic rocks and batholithic masses of granite, granodiorite and quartz diorite. K-Ar ages cluster around 2500 to 2600 M.Y., characteristic of the Kenoran orogeny.

The Churchill province consists largely of meta-sedimentary rocks, paragneisses and granite, all complexly folded and yielding metamorphic ages of about 1750 M.Y., characteristic of the Hudsonian orogeny.

It is possible that the rocks of the Churchill province were also subjected to the earlier Kenoran orogeny, as a "residual" age of 2670 M.Y. has been obtained from sedimentary rocks at Granville Lake, well within the Churchill block. Davies (1964) has suggested that the volcanic-sedimentary belts of the Lynn Lake district and the Flin Flon area are Superior remnants in the Churchill province and that the extensive mineralization in the areas may be related to the fact that these two belts have passed the through two separate orogenies.

The well-mineralized areas known in the Precambrian of Manitoba are:

a) Lynn Lake -- Copper-Nickel, Copper-Zinc, Gold
b) Flin Flon -- Copper-Zinc
c) Snow Lake -- Copper-Zinc, Gold, Lithium
d) Sherridon -- Copper-Zinc
e) Thompson -- Nickel
f) Oxford Lake -- Copper, Lead, Zinc
g) Gods Lake -- Gold
h) Island Lake -- Nickel, Gold
i) Rice Lake -- Gold
j) Winnipeg River -- Chromite, Copper-Nickel, Lithium

In a general sense the mineral areas of the Churchill province (Lynn Lake, Flin Flon, Snow Lake, Thompson) are characterized by base metals (copper, zinc, nickel) while volcanic-sedimentary belts of the Superior province are characterized by gold with apparently fewer base metals. Whether this distinction is well enough defined to guide exploration is debatable, as copper, nickel and chromium are all found within the Superior province of Manitoba.

South-western Manitoba is underlain by flat-lying Palaeozoic and Mesozoic Rocks. The Palaeozoic strata consist largely of limestones, dolomitic limestones and argillaceous limestones with extensive sections of evaporites (salt, gypsun and anhydrite). The Mesozoic rocks are largely siltstones and sandstones.

Mineral products occurring in Palaeozoic and younger strata include calcium limestones, silica sand, dolomitic limestones, potash, salt, gypsun and bentonite.

Indian Reservations in Manitoba are widely distributed throughout areas underlain by rocks of the Precambrian Superior and Churchill blocks and by both Palaeozoic and Mesozoic strata. Theoretically, therefore, potential for a wide variety of mineral products should exist.

It is unfortunate that apart from normal geological and airborne geophysical information, few specific data on actual mineral occurrences on reservations are available. Consequently, the appraisal has had to take as its starting point the known or inferred mineral potential of the areas surrounding the reservations. Consideration of correspondingly favourable lithology, stratigraphy and/or structure on the reservations proper permits extrapolation and inferences regarding the mineral potential thereon. However, it is only possible to suggest the potential in general terms ("good", "moderate" etc.) and even then considerable uncertainty may exist. In any case, only further geological examination or geophysical work would confirm the potential. Whether or not such work is warranted and methods of carrying it out are suggested in a later section.

INDIAN RESERVATIONS IN THE PRECAMBRIAN

The basis for determining the mineral potential of Indian Reservations in the Precambrian are:

i) Lithology: Volcanic-sedimentary belts are considered to be favourable for base metal and gold mineralization. The presence of mafic and ultramafic intrusions within these belts enhances the potential, as does the occurrence of small granitic stocks and porphyry dykes. Large areas of granitic rocks (granite, granodiorite, tonalite or quartz diorite) are generally unfavourable. However, existing geological maps may be misleading in some cases. Large areas of paragneiss (shown on older maps as granite) may be potential hosts for mineralization. Aeromagnetic data are useful in distinguishing true granitic intrusions from paragneiss and these maps have been checked in every case against existing geological maps.

ii) Structures: Major structures such as those shown on the metallogenic map of Manitoba (Map 66-2) are particularly favourable loci for mineralization. On a smaller scale, shear zones, faults and fold structures provide local structural controls for mineral deposits.

iii) Proximity to Known Mineral Deposits: Geological conditions on Indian Reservations, similar to those in nearby mineralized areas, are regarded as particularly favourable.

iv) Presence of Electromagnetic Conductors: Parts of Manitoba have been flown with electromagnetic equipment by companies holding airborne permits from the Manitoba Department of Mines and Natural Resources. Some of the resulting maps, which are required to be submitted to the Department, show electromagnetic data over reservations. Others do not. However, even in these instances it is probable that the companies have information covering the reservation; such information, not being over provincial Crown lands, need not have been submitted to the Department of Mines. Some maps, for example, show numerous conductors surrounding the reservation and are completely blank over the reservation itself. Such maps probably do not represent actual conditions on the Indian lands and allowance must be made for such a situation in evaluating their mineral potential.

v) Unusual Geological Conditions: All orebodies are, in a sense, geological anomalies, owing their presence to, in many cases, imperfectly understood geological conditions. Any areas displaying unusual complex geological history or anomalous geological conditions, therefore, offer potential for further investigation. As an example may be cited the existence of Precambrian granitic inliers with unusual clastic volcanic(?) rocks at Lake St. Martin, in an area of Palaeozoic limestones and evaporites.

The coincidence of several or all of the above factors, of course, provides for the greatest potential.

The following pages summarize the known geology and inferred mineral potential on individual reservations in the Precambrian of Manitoba.

Brochet I.R. 197

Location: 57° 55', 101° 35'

References: a) Geological Map, Brochet, N.R. Gadd, 1948. Geol. Surv. Canada, Map 1001 A, 1 inch to 4 miles, with marginal descriptive notes.

b) Aeromagnetic Map, Brochet, Geophysics paper 1057, 1 inch to 1 mile, 1961. Geol. Surv. Canada.

Discussion:

The reservation and the area surrounding it are underlain by granite and granite gneiss, containing a few remnants of paragneiss, orthogneiss and diorite. The small body of diorite and quartz diorite at the northern boundary of the reservation is clearly reflected on the aeromagnetic map. The magnetic pattern over the reservation and the surrounding area also reveals a geologic picture possibly more complex than that suggested by the reconnaissance geological map. However, no particular economic significance can be inferred from the available geological and geophysical data. No mineral occurrences are recorded either on or in the vicinity of the reservation. The lithology is not favourable and the structure is not encouraging. Consequently the mineral potential is regarded as poor.

Pukatawagan I.R. 198

Location: 55° 45', 101° 15'

References: a) Geological Map, Kississing, 1 inch to 4 miles, by J.M. Harrison, Map 970 A. Geol. Surv. Canada.

b) Aeromagnetic Map, Morin Lake, 1 inch to 1 mile, Geophysics paper 2553, Man. Dept. Mines and Geol. Surv. Canada.

c) Aeromagnetic Map, Llama Lake, 1 inch to 1 mile, Geophysics paper 2554, Man. Dept. Mines and Geol. Surv. Canada.

Discussion:

The geological map reveals that the Pukatawagan I.R. is entirely underlain by massive to gneissic granitic rocks. This is borne out by the flat, featureless, and uniform magnetic pattern over the area. No mineral occurrences are known in this area and both favourable lithology and structure are absent. The area is regarded as having little mineral potential.

Highrock I.R. 199

Location: 55° 52', 100° 30'

References: a) Geological Map, Kississing, 1 inch to 4 miles, J.M. Harrison, Map 970 A, Geol. Surv. Canada.

b) Aeromagnetic Map, Geophysics paper 2558, 1 inch to 1 mile, Man. Dept. Mines and Geol. Surv. Canada.

c) Aeromagnetic Map, Highrock, Geophysics paper 2562, 1 inch to 1 mile, Man. Dept. Mines and Geol. Surv. Canada.

Discussion:

Both the geological map and aeromagnetic expression indicate that the Highrock reserve is underlain by rocks similar to those at Pukatawagan. There is no indication of favourable lithology or structure and the area appears to be lacking in mineral potential.

Nelson House I.R. 170, 170 A, 170 B

Location: 55° 48', 98° 52'

References:
a) Geological Map 54-13, Nelson House, 1 inch to 4 miles, by H.A. Quinn. Geol. Surv. Canada, 1954.

b) Aeromagnetic Map, Nelson House, 1 inch to 1 mile, Geophysics paper 2586, Geol. Surv. Canada and Man. Dept. Mines, 1965.

c) Aeromagnetic Map, Wuskwatim Lake, 1 inch to 1 mile, Geophysics paper 2585, Geol. Surv. Canada and Man. Dept. Mines, 1965.

d) Airborne electromagnetic sheet, Mink 62 (sheet 10). Airborne permit # 37. Available from Man. Dept. Mines.

Discussion:

The Nelson House reservations are largely underlain by sedimentary gneiss and schist intruded by granite and granodiorite -- an assemblage of rocks typical of large parts of the Churchill geologic province. Canadian exploration geologists have been slow to recognize the mineral potential of large areas of paragneiss of the Churchill type, despite the fact that such deposits as the Cu - Zn orebodies at Sherridon, Manitoba and Manitowadge, Ontario occur in such rocks. Numerous similar deposits occur in Precambrian paragneisses of other continents, especially Scandinavia.

Notable exceptions to the reluctance of Canadian exploration Companies to prospect these types of rocks are Hudson Bay Exploration and Development Company and the Canadian Nickel Company; both have mounted several geophysical and drilling programmes in the vicinity of Nelson House.

Sulphide occurrences are widespread throughout the Nelson House map - area (Map 54-13). Most of these carry pyrite and/or pyrrhotite and some contain chalcopyrite and sphalerite. Little is known about the factors controlling their distribution, but it seems probable, by analogy with the Sherridon and Snow Lake areas, that they lie along particular folded stratigraphic horizons.

Exploration has been carried out by Hudson Bay over most of the area south of the Burntwood River. Of the numerous sulphide occurrences drilled, a moderate sized copper-zinc deposit has been outlined west of Wimapedi Lake-- in paragneiss. It is not known how much detailed exploration has been done in the area around Nelson House. However, it is noted that 2 sulphide occurrences, one containing copper, occur just outside the reservation area. It is also noted that an apparently favourable anticlinal fold structure occurs within sedimentary gneiss on reservations 170 A and 170 B.

The area around the reservation was flown by Canadian Nickel with airborne electromagnetic equipment and the results are shown on sheet 10, Mink 62 area. No results are shown over the reservations, but no doubt this was also flown and the results intentionally omitted. The presence of a few good electromagnetic responses (A2) is noted under Footprint Lake.

The mineral potential of the Nelson House reservations is worthy of investigation, but a high ratio of barren sulphide to economic sulphide is to be expected, as elsewhere in this area of Churchill gneisses.

Split Lake I.R. 171, 171 A, 171 B

Location: 56° 12', 96° 10'

References:

a) Geological Map 10-1956, Split Lake, 1 inch to 4 miles, R. Mulligan, 1955. Geol. Surv. Canada.

b) Assean - Split Lake area, A.S. Dawson, Man. Mines Branch Report 39-1, 1941.

c) Geology of the Waskaiowaka Lake area, J.C. Gill, Man. Mines Branch pub. 50-5, 1951.

d) Preliminary Map, Split Lake, 1 inch to ½ mile, I. Haugh and W. Gibbins, Man. Mines Branch.

e) Aeromagnetic Map, Split Lake, 1 inch to 1 mile, Geophysics paper 2443. Geol. Surv. Canada, 1963.

f) Aeromagnetic Map, Crying Lake, 1 inch to 1 mile, Geophysics paper 2444. Geol. Surv. Canada, 1963.

g) Prospectors Airways Co. Ltd.-Assessment report filed with Man. Mines Branch. Ted claims 16 to 21 and Row claims 1 to 15. SE8-64A.

Discussion:

Dawson (1941), Gill (1951) and Mulligan (1955) all show the areas of Reservations 171 and 171 A to be underlain by hornblende - feldspar gneiss, mafic gneiss or diorite gneiss. Most of Reservation 171 B is shown as underlain by sedimentary rocks of the Assean Lake Series (or Group). More recent work (Haugh and Gibbins) has revealed that this area of Reservation 171 B is one of intense faulting which is related to the Churchill - Superior boundary and that the so-called sedimentary rocks, in this area at least, are actually mylonites and not Assean Lake sediments as known around Mystery Lake and Thompson.

Split Lake and Assean Lake lie along the northeast extension of the Thompson nickel belt which in turn is situated along the northwest side of a broad gneissic zone marking the boundary between the Churchill and Superior geologic provinces. The precise position of the boundary is a matter of controversy, various interpretations being dependent on which feature one chooses as defining the boundary (degree of metamorphism, structural trends, lithology, faulting, gravity pattern, magnetic trends, zone of Alpine-type serpentinite lenses).

It is reasonably certain that the intense shear zone and well-defined linear feature passing through Assean Lake is continuous with a wide zone of faulting extending southwest throuth the Thompson - Moak Lake area to Setting Lake (see Metallogenic Map of Manitoba). The strong southeast-trending fault zone following the Landing (Aiken) River apparently branches off the Assean Lake fault just west of Assean Lake. Haugh defines the rocks at Split Lake lying in the wedge-shaped area between these two fault zones as "mixed gneisses mostly produced by granitization of gabbroic material.............abundant mafic inclusions...........some larger remnant bodies of gabbro cut by granitic veins...........".

In view of its relationship to the major Thompson structure and the strong structural displacements, Split Lake presents an interesting situation for possible mineral occurrences. Limited work to date, it must be admitted, has provided little encouragement in the search for nickel deposits such as those which occur in the Thompson area. Ultramafic intrusions with which such deposits are associated are not abundant in the Split Lake area. However, some nickel occurrences have been reported from the area and further study is probably warranted.

An electromagnetic and magnetometer survey by Rio Canadian Explorations (Doug claims, NE1-64A) was carried out at Split Lake immediately south of the west boundary of Reservation 171. A coincident electromagnetic and magnetic anomaly was drilled, but no mineralization was encountered. The same Company carried out further geophysical work and drilled one hole on the Hal claims (SW1-64A) situated at the entrance of the Nelson River into Split Lake. The hole is reported to have intersected 2 graphitic breccia zones carrying minor sulphides with nickel values up to 0.20% across 5 feet of core.

The most interesting mineral occurrence at Split Lake occurs on I.R. 171 on the lakeshore just north of the former Ted 17 claim (see appended extract from assessment work file SE8-64A, Row and Ted claims, Prospectors Airways). Massive and disseminated sulphides, principally pyrrohotite, in a gabbro dyke gave 1.32% Ni and 0.53% Cu in a representative chip sample across 8 feet.

In view of the outstanding structural situation and the indications of at least some base metal mineralization the Split Lake area, including the reservations merits more attention than it has yet received. Detailed geological examination and/or geophysical surveys are suggested.

Cross Lake I.R. 19, 19A, 19B, 19C, 19D

Location: 54° 35', 97°52'

References: a) Cross Lake Map area, C.K. Bell, Geol. Surv. Canada paper 61-22 with Map 32-1961 at 1 inch to 4 miles, 1961.

b) Geology of the Cross Lake area, D.H. Rousell, Man. Mines Branch 62-4 with Map 62-4 at 1 inch to 1 mile.

c) Aeromagnetic Map, Cross Lake, 1 inch to 1 mile, Geophysics paper 2597, Man. Dept. Mines and Geol. Surv. Canada.

Discussion:

The Cross Lake area lies in the western part of the Superior geological province, immediately east of the gneissic belt separating the Superior and Churchill provinces. The area is underlain by volcanic and sedimentary rocks of the Cross Lake group (Archaean) and gneisses derived from them during the Hudsonian orogeny (Proterozoic). Lithologically the region is typical of the numerous mineralized volcanic-sedimentary belts of the Superior province.

Structurally the area is dominated by two major synclines, one trending northeast and the other southeast. The area between the two synclines is occupied in part by the reservations and consist of a series of closely spaced subsidiary folded anticlines and synclines.

The reservations proper are underlain by hornblende schist and garnet-diopside schist derived from basaltic rocks and by arkose and conglomerate and by large areas of granitic gneisses and migmatite derived from the volcanic-sedimentary rocks and granite. The rocks underlying Reservations 19 and 19A are folded into a westerly plunging anticline. Reservation 19D lies on the west limb of this anticline. In addition on all of the reservations the smaller folds (some may be cross-folds) are present.

Rousell (1965) has interpreted the structure of the areas as being due to two periods of folding--the first, vertical uplift (slip folds) to produce what now appears as cross folds and second, horizontal compression to produce the major northeast and southeast-trending synclines and anticlines. This interpretation is in accord with geochronological data which indicate two periods of folding in the Cross Lake area (the Kenoran and Hudsonian).

The rocks of the area are all strongly foliated and the foliation generally is parallel to the bedding and primary layering. Faults are reported to be uncommon (Rousell, 1965, p.48). Most of the deformation probably has been accommodated by the development of strong foliation which provide, just as well as do faults, suitable openings for the emplacement of mineral deposits.

Rousell reports that "sulphide minerals occur within shear zones oriented parallel to the foliation of the country rock. Shear zones are most common in the basalts, less common in the sedimentary rocks and least common in rocks of the gneiss complex" (Rousell, 1965, p.56). Pyrite is the most common sulphide but pyrrhotite, chalcopyrite, sphalerite and arsenopyrite are present, commonly as disseminated grains. Gold has also been reported. Beryl and spodumene are present in some pegmatites. Many of the recorded mineral occurrences are situated close to the reservation area. These have been marked on Rousell's map (62-4).

Data on the known occurrences are fragmentary, but it appears that those known to date are rather small. Probably typical of those investigated is the "Christy #1" showing which was examined by Noranda Exploration Company. The assessment file states ".........well-mineralized shear showing pyrrhotite pyrite with slight sphalerite and chalcopyrite...... 8' total width". However, an electromagnetic survey failed to trace any continuity to the showing. (Assessment file SW12-63I, Christy 1 to 10, Noranda Exploration, Manitoba Mines Branch)

The available government reports provide little information on the mineral potential of Cross Lake and it appears from the small amount of assessment data on file that little intensive exploration has been carried out in this area.

It is probable that the Cross Lake area merits further investigation for base metals. The reasons for this opinion are:

1) favourable lithology
2) suitable structures, extensive folding and widespread foliation
3) Proximity to the Churchill-Superior boundary and passage of the area through two orogenies.
4) Presence of at least some copper and zinc mineralization.

Considerable importance is attached to the fact that the area borders the Superior-Churchill boundary and the fact that the area has suffered two orogenies. Base metal mineralization in Manitoba appears to be concentrated in those areas where Archaean rocks have been subjected to both the Kenoran and Hudsonian orogenies.

Consequently, although the mineral potential of Cross Lake cannot be assessed in specific positive terms, it certainly warrants further investigation.

Norway House I.R. 17

Location: 54° 00', 97° 45'

References: a) Cross Lake Map Area (Report and Map 32-1961) C.K. Bell, Geol. Surv. Canada paper 61-22, 1962.

b) Geological Map 424A, Norway House, 1 inch to 4 miles, A.W. Johnson, Geol. Surv. Canada, 1938.

c) Aeromagnetic Map, Pine Creek, 1 inch to 1 mile, Geophysics paper 2595, Geol. Surv. Canada and Man. Dept. Mines, 1965.

Discussion:

The entire reservation area is underlain by granodiorite gneiss and related rocks. No mineral occurrences have been recorded within the reservation or surrounding area. No lithologic, stratigraphic or structural features suitable for the occurrence of mineral deposits have been outlined in this region and the mineral potential is consequently considered low.

Oxford Lake I.R. 24

Location: 54° 52', 95° 20'

References:

a) Geological Map, Oxford House, 1 inch to 4 miles, J.F. Wright, H.A. Quinn, compiled by K.L. Currie, Geol. Surv. Canada, Map 21-1961, 1961.

b) Geology of the Oxford House-Knee Lake area, G.S. Barry. Includes Map 58-3a at 1 inch to 1 mile, Man. Mines Branch, Pub. 58-3, 1959.

c) Aeromagnetic Map, Oxford House, 1 inch to 1 mile, Geophysics Paper 4064. Geol. Surv. Canada and Man. Dept. Mines, 1966.

d) Geology of the Western Oxford Lake - Carghill Island area, G.S. Barry, Man. Mines Branch, Pub. 59-2, 1960.

e) Airborne electromagnetic maps, Wolf 24, Wolf 10, Airborne permit #19, Man. Mines Branch.

Discussion:

Oxford Lake Reservation is underlain by a belt of volcanic and sedimentary rocks more than 60 miles in length and approximately 15 miles wide at its widest point (Barry, 1959, p.9). It is thus part of one of the largest volcanic-sedimentary belts of the Superior province in Manitoba and extends intermittently from longitude 97°00' W to the Manitoba, Ontario boundary.

At Oxford Lake the belt consists of the lower, Hayes River volcanic group (massive and pillowed andesite dacite, basalt and volcanic breccia) and the upper, Oxford group (greywacke, sub-greywacke, conglomerate). These are all intruded by small sill-like bodies of gabbroic rocks and by large masses of granitic rocks and associated granitic gneisses.

Rock exposures on the reservations are not abundant except along the shoreline and details of the structure are imperfectly known. However, between Jackson Bay, at the south end of the reservation, and Oxford House settlement the Hayes River and Oxford groups appear to occupy a major synclinal fold.

Barry (1959, p.34 and Map 58-3a) indicates a fault trending northeast past Eight-mile Point and through the reservation just north of Oxford House settlement. He suggests that this may be an extension of a major fault zone through Hyers Island to the west (Barry, 1960). Map 58-3a by Barry also shows several smaller faults cutting Hayes River and Oxford rocks in the southern part of the reservation.

No mineral showings have been recorded either on the reservation proper or in its immediate vicinity. However, this may be due in part to lack of extensive rock exposure. In any case several occurrences of base metals are known in the area to the west (Barry, 1960, pp. 29-35). These consist mainly of sericitic and carbonate shear zones carrying pyrite, chalcopyrite, sphalerite and galena in varying portions. Some are dominantly copper-zinc showings, others lead-zinc-(Silver) showings. Some trenching and diamond drilling has been done on these deposits, but they have not been extensively investigated.

East of the reservation Barry (1959, pp. 36, 37) reports several sulphide occurrences and one gold occurrence at Long Island on Knee Lake.

The deposits both east and west of the reservation lie along the same general stratigraphic zone and structural belt as that which underlies the reservation itself. Similar types of base metal mineralization could occur on Reservation 24. Probably electromagnetic surveys would be required to detect such deposits.

It may be remarked here that compared to other volcanic-sedimentary belts in the Superior geologic province this one (including Knee Lake and Gods Lake) has received relatively little intensive prospecting for base metals. Early prospecting (1930 to 1950) was largely for gold. Following the advent of airborne geophysical methods a large area, including Oxford Lake, Gods Lake and Island Lake, was flown by the Canadian Nickel Company in the late 1950's and early 1960's. Practically the entire area was covered with the airborne magnetic method and selected portions with airborne electromagnetic equipment. Ground geophysical follow-up and some drilling was done but as few claims were ever staked, little of this work was filed for assessment purposes.

The airborne electromagnetic maps covering the reservation show a zone of "A"-grade responses at Oxford House settlement, probably due to bedrock conductors.

Considering that the area of interest to Canadian Nickel covered about 25,000 square miles, it is doubtful that their investigation could be considered any more than reconnaissance in nature. Consequently it is concluded that the whole area, including the Oxford Lake Reservation #24 and Gods Lake Reservation #23 (discussed below) warrant further exploration; not only for base metals, but also for gold.

Gods Lake I.R. 23

Location: 54° 30', 94° 37'

References:

a) Geological Map, Oxford House, 1 inch to 4 miles, by J.F. Wright and H.A. Quinn, compiled by K.L. Currie. Geol. Surv. Canada Map 21-1961, 1961.

b) Geology of the Gods Narrows area, by G.S. Barry. Includes Map 60-1 at 1 inch to 1 mile. Man. Mines Branch pub. 60-1, 1961.

c) Aeromagnetic Map, Gods Lake, 1 inch to 1 mile. Geophysics paper 4026. Geol. Surv. Canada and Man. Dept. Mines, 1966.

d) Aeromagnetic Map, Vermilyea Lake, 1 inch to 1 mile. Geophysics paper 4044. Geol. Surv. Canada and Man. Dept. Mines, 1966.

e) Company airborne electromagnetic sheets Wolf 4, sheets 2 and 3. Airborne permit #23. Available from Manitoba Mines Branch.

Discussion:

The Gods Lake Reservation is largely underlain by greywacke and arkoses of the Hayes River group which extend southeastward from the Oxford Lake area, discussed above. These are intruded by a large porphyry or felsite sill and by a large batholithic mass of gneissoid tonalite and granodiorite.

The Gods Lake area has been known primarily as a gold-producing area. God's Lake Gold Mine, situated on Elk Island, operated from 1935 to 1943 and produced bullion valued at $5,925,844.00 from 524,000 tons of ore. Jowsey Island Gold Mine, on Jowsey Island, outlined a small ore shoot with values up to 0.47 oz./ton gold across 5.5 feet and for a length of 113 feet.

Gold-bearing quartz veins in the Gods Lake region occur along favourable structural horizons; for example at the Gods Lake Mine the ore occurred in a quartz vein within a tuff horizon in contact with a diorite sill. At Jowsey Island it was in a sheared, fractured and silicified quartz porphyry dyke and in silicified andesite. Common sulphides were pyrite, arsenopyrite, chalcopyrite, pyrrhotite, sphalerite and galena. Most workers in the area have stated or implied a genetic relationship between the gold-bearing quartz veins and porphyry dykes - both in turn being related to bodies of "quartz-eye granite".

In the vicinity of I.R. 23 Barry (1961, p. 28 and Map 60-1) notes three mineral occurrences marked 1, 2 and 3 on Map 60-1. One is an occurrence of arsenopyrite in a quartz vein occupying fractures in a feldspar porphyry dyke. A channel sample is reported to have assayed a trace in gold. Number two is a small iron-formation. Three is a shear zone in a gabbro dyke containing small quartz stringers and disseminated pyrrhotite with minor chalcopyrite and pyrite. Some of the quartz veins in the area north of I.R.23 (localities 4 and 9) contained molybdenite.

The mineral potential of the Gods Lake I.R. 23 cannot be regarded as encouraging and consists primarily in the possibility of discovering gold-bearing quartz veins. The Company airborne electromagnetic sheets show little of interest in regard to conductors either on or near the reservation area. It is noted again, however, that there is no assurance that the electromagnetic results have been included on that portion of the map covering the reservation.

Even the potential for gold is doubtful. The required structural conditions may be absent in the fine-grained clastic sediments and schist that underlies the reservation. The one possible exception is in or along the contact of the felsite sill described by Barry (1961, p.15) as being in part a felsite breccia and possibly formed by injection of felsite into a breccia zone in schist. Although the rock is classified as younger than the pre-Oxford porphyry with which gold is presumed to be associated, it is probably, nevertheless, worthwhile to investigate this felsite further.

Island Lake I.R. 22, 22A

Location: 53° 52', 94° 40' and 53° 52' and 95° 00'

References:
a) Geological Map 26-1960, Island Lake, by H.A. Quinn. Geol. Surv. Canada, 1960.
b) Geology of the Island Lake - York Lake area, by J.D. Godard. Man. Mines Branch pub. 59-3, 1963. Includes Map 59-3a at 1 inch to 1 mile.
c) Aeromagnetic Map Island Lake, 1 inch to 1 mile. Geophysics paper 4041. Geol. Surv. Canada and Man. Dept. Mines.
d) Company airborne electromagnetic sheets Wolf 4 and 5 and Wolf 9 and 10. Available from Man. Mines Branch.

Discussion:

The Island Lake area in the vicinity of I.R. 22 and 22 A is underlain by volcanic and sedimentary rocks of the Hayes River group and by conglomerate of the Island Lake series all intruded by batholithic masses of granite, granodiorite and tonalite. Small lenticular bodies of mafic and ultramafic rocks intrude the Hayes River and Island Lake series and are probably older than the granitic rocks. The ultramafic intrusions, with which nickel is associated in this area, occur along an extensively faulted zone that extends from Stevenson Lake eastward through Island Lake to the Ontario boundary. This is not a single fault but rather a zone of faulting, details of which are shown, in the Island Lake area, on Map 59-3a (Godard, 1963). One branch of this fault zone trends southeast immediately south of I.R. 22A.

I.R. 22A is underlain by greywacke, argillite, and derived schist of the Hayes River group, by conglomerate of the Island Lake series, and by granite, granodiorite and tonalite intrusive into these rocks. I.R. 22 is entirely underlain by granitic rocks.

Godard (1963, p. 37) reports that sulphides are widely distributed in volcanic rocks and sediments of the Hayes River group and that pyritized shear zones are numerous, especially in the volcanic rocks. Chalcopyrite and pyrrhotite are present locally in these sulphide zones, but the gold content is low. Godard shows one such sulphide occurrence on the shoreline marking the southern boundary of I.R. 22A.

Quartz veins are abundant in Hayes River rocks. Most are barren but some carry considerable pyrite and carbonate and gold. Development work has been done on two gold properties east of the reservation area.

East of Linklater Island the highly sheared serpentinized peridotite contains pyrrhotite, pyrite, pentlandite, millerite, chalcopyrite and magnetite. Quinn (1960) reports that drilling by the Canadian Nickel Company outlined an extensive low-grade copper-nickel orebody.

It was noted above that a strong fault zone passes just south of Reservation 22A. The peridotite containing the copper-nickel deposit drilled by Canadian Nickel occurs along this zone through Linklater Island to the northwest. Just southeast of the reservation and along the lakeshore two other small ultramafic bodies occur (see Map 26-1960 by Quinn and 59-3A by Godard). All of them show up as small elliptical magnetic "highs" on the aeromagnetic map (4041). Quinn also shows an ultramafic body on the south edge of the Reservation 22A, on a small point about 1 mile due south of Garden Hill settlement. This is not indicated by Godard nor does the magnetic low there indicate its presence. Nevertheless, its presence or absence should be checked.

In view of the widespread sulphide mineralization, proximity of Reservation 22A to a pervasive zone of shearing and possibility of serpentinite intrusions on or near the reservation, it is considered that the mineral potential of I.R. 22A warrants careful investigation. It is realized that the airborne electromagnetic maps show little of interest in the vicinity of Reservation 22A. However, it is probable that not all of the electromagnetic responses have been placed on the map; for example no responses are shown over or near Linklater Island where the previously mentioned copper-nickel orebody had been outlined. On the other hand, lack of electromagnetic response may be due to the fact that sulphides are disseminated or at least not closely enough connected to act as a conductor.

The rocks exposed on Reservation 22 apparently have little potential and investigation should be confined to Reservation 22A, especially the southern part.

Berens River I.R. 13 and Pigeon River I.R. 13A

Location: East shore of Lake Winnipeg at latitude 52°20' and 52°15'.

References:

a) Geological Map, Berens River (West Half) 1 inch to 4 miles, by A.W. Johnson. Geol. Surv. Canada, Map 427A, 1938.

b) Geological Map, Berens River (East Half) 1 inch to 4 miles, by A.W. Johnson. Geol. Surv. Canada, Map 426A, 1938.

c) Aeromagnetic Map, 17-mile Lake, 1 inch to 1 mile. Geophysics paper 4126. Geol. Surv. Canada and Man. Dept. Mines, 1966.

Discussion:

Only reconnaissance geological data are available for this area. Indications are that the rocks are entirely granitic, containing in places remnants of gneiss. If this is correct, the mineral potential must be considered as low.

Little Grand Rapids I.R. 14

Location: $52^{\circ}00'$, $95^{\circ}25'$

References:

a) Geological Map, Deer Lake (West Half), 1 inch to 4 miles, by A.W. Johnson, Geol. Surv. Canada, Map 425A, 1938.

b) Geological Map, Carroll Lake (West Half), 1 inch to 4 miles, by A.W. Johnson. Geol. Surv. Canada, Map 428A, 1938.

c) Aeromagnetic Map, Family Lake, 1 inch to 1 mile. Geophysics paper 4050. Geol. Surv. Canada and Man. Dept. Mines, 1966.

d) Aeromagnetic Map, Fishing Lake, 1 inch to 1 mile, Geophysics paper 4053. Geol. Surv. Canada and Man. Dept. Mines, 1966.

Discussion:

The area of the reservation, like those at Berens River and Pigeon River have only received reconnaissance mapping and is shown to be underlain by granitic rocks whose mineral potential is regarded as low.

Bloodvein I.R. 12

Location: $51^{\circ}45'$, $96^{\circ}40'$

References: Geological Map, Hecla (East Half), 1 inch to 4 miles, by A.W. Johnson. Geol. Surv. Canada, Map 429A, 1938.

Discussion: This area is underlain by granitic rocks with no apparent mineral potential.

Hole River I.R. 10

Location: 51°08', 96°15'

References:
a) Geological Map, Hecla (East Half), 1 inch to 4 miles, by A.W. Johnson. Geol. Surv. Canada, Map 429A, 1938.
b) Geology of the Manigotagan - Rice River area, J.F. Davies, Man. Mines Branch Pub. 50-2, 1951.
c) Geology of the English Brook area, G.A. Russell, Man. Mines Branch prelim. rept. 48-3, 1949.
d) Aeromagnetic sheet "Black #2" - unpublished data available from Man. Mines Branch open file.
e) Airborne electromagnetic sheets Wanipigow "R", Lynx Ext., sheets 13 and 15. Available from Manitoba Mines Branch.

Discussion:

The Hole River Reservation is shown as largely underlain by gabbro, peridotite and quartz diorite containing a few remnants of quartzite and arkose (see Map 50-2). The reservation lies near the west end of the Rice Lake volcanic-sedimentary gold-bearing belt of southeastern Manitoba. The gold occurrences are most widespread in the central and eastern part of the belt. Few gold-bearing quartz veins are known in the western section.

The basic and ultrabasic intrusions on the reservation and vicinity are of interest for their nickel potential. These intrusions are some of several which appear to occupy a more or less linear zone, possibly a fault, that extends from the Ontario boundary to the mouth of Hole River (where the reservation is situated) and that then swings northeast under Lake Winnipeg and parallel to its eastern shoreline. The expression of these intrusions is shown on the aeromagnetic sheet, Black #2. Some of these ultramafic rocks are nickel-bearing, for example at Clangula Lake, English Lake and north of Currie's Landing (Fox claims, see assessment file NE1-62P, Fox 1 to 63, International Base Metals).

The mafic and ultramafic rocks on Reservation 10 warrant careful investigation for its nickel potential. Particularly interesting in this respect is the zone of "A" electromagnetic anomalies extending from east of Clangula Lake westward onto the reservation (see airborne electromagnetic maps, Wanipigow "R", Lynx Extension).

Fort Alexander I.R. 3

Location: $50^{\circ}30'$, $96^{\circ}15'$

Discussion:

This reservation is largely underlain by glacian drift lying on probable granite and granite gneiss bedrock. It cannot be regarded as having any mineral potential.

Black River I.R. 9

Location: $50^{\circ}40'$, $96^{\circ}15'$

Discussion:

This reservation is underlain by granitic gneiss and as far as can be determined has no mineral potential.

Shoal Lake and Northwest Angle I.R.

34C, 37A, 37C, 39, 39A, 40

Location: Approx. 49°30' at Man., Ont. boundary

References:
a) Geology of the Rennie - West Hawk Lake area, by G.D. Springer. Man. Mines Branch pub. 50-6, 1952.
b) Aeromagnetic Map, Waugh, 1 inch to 1 mile. Geophysics paper 1191. Geol. Surv. of Canada and Man. Dept. Mines, 1967.
c) Aeromagnetic Map, Berry Point, 1 inch to 1 mile. Geophysics paper 1190. Geol. Surv. Canada and Man. Dept. Mines, 1967.

Discussion:

Geological data on all the reservations except 39A and 40 are fragmentary because of extensive drift cover in the southeastern corner of Manitoba. However, it is most probably that bedrock underlying I.R. 39, 37A, 34C and 39A is volcanic as exposed on the shore of Shoal Lake. The aeromagnetic pattern is indicative of volcanic rock.

Bedrock on Reservation 39A and 40 has been mapped as andesite and basalt with intercalated rhyolitic rocks (Springer, 1952).

Although numerous gold deposits have been investigated in the West Hawk Lake, Falcon Lake and Lake of the Woods areas surrounding the Shoal Lake reservations, none have proved to be of economic importance. The same may be said of occurrences of lithium, tungsten, nolybdenum and uranium. Similarly, there are many occurrences of barren sulphides (pyrite and pyrrhotite) in the volcanic and sedimentary rocks.

It is probable that sulphide occurrences and quartz veins are present in places on the reservation and although they are likely to prove uneconomic, their presence or absence and their nature should be determined.

Buffalo Point I.R. 36 and Reed River I.R. 36A

Location: Approx. 49°00' at Manitoba, Ontario boundary

Discussion:

Data on bedrock geology in this area are entirely lacking due to glacial cover. It is probable that the underlying bedrock is granitic with little or no mineral potential.

The Narrows, Lake St. Martin I.R. 49, 49A

Location: Twp. 32, Rge. 7 WPM.

References: a) Igneous Rocks in the Lake St. Martin area, by H.E. Hunter. Man. Mines Branch pub. 50-10, 1951.

b) Metallogenic Map of Manitoba, Man. Mines Branch Map 66-2, 1966.

c) Amygdoloid in Manitoba. Geol. Surv. Canada Sum. Rept. 1903, p. 9A, 1904.

Discussion:

An inlier of Precambrian granite and probable volcanic rocks is exposed at Lake St. Martin through the younger Ordovician and Silurian strata. The granitic rocks have been described by Hunter (1951) as microcline granite, biotite granite and oligoclase granite. The extrusive rocks as exposed on surface are remarkably fresh looking grey augite andesite and purplish grey vesicular porphyritic andesite containing carbonate-filled amygdules. Inclusions of granitic material in the volcanic rocks suggest that the latter may be younger than the granites. K-Ar age dates on the granite are 2385 M.Y. and on two samples of volcanic rock were 200 and 250 M.Y. The latter ages were whole rock determinations on crystalline material and may not be reliable.

The volcanic rocks are lacking in metamorphic alteration and are remarkably similar to Tertiary and younger rocks. They most probably are truly younger than the Precambrian granitic rock.

The occurrence of granite at Lake St. Martin represents a 700-foot topographic high on the Precambrian surface, a relief not characteristic of the Shield in Manitoba and possibly due to some unusual basement structure.

The volcanic rocks are interesting economically because of the reported occurrence of copper (Geol. Surv. Canada Sum. Rept. 1903, p. 9A). Analysis of ordinary volcanic material from Lake St. Martin assayed 490 ppm copper, which is several times the average for andesites.

Unfortunately outcrops are sparse and structural information is lacking. Uncertainty exists regarding the granite-volcanic relationship and present understanding of the nature and origin of the volcanic rock is inadequate. Recent drilling has revealed poorly consolidated fragmental volcanic looking rocks containing sections possibly representing granite inclusions. However, other interpretations are possible. Current studies being made by the Manitoba Mines Branch and the University of Manitoba should be followed closely.

The entire occurrence is unusual and may have economic importance.

Non-Metallic Minerals

Non-metallic mineral production in Manitoba consists of high-calcium limestone, silica sand, gypsum, bentonite, Tyndall limestone, and granite. In addition potential exists for production of potash and salt. All of these products occur in southern Manitoba underlain by Palaeozoic and Mesozoic rocks.

Industrial mineral production is much more sensitive than in metallic production to such factors as:

a. supply and demand, and market conditions

b. competition from other products

c. economic conditions generally

d. geographical location, transportation costs

e. physical nature of quarry or mine sites

f. volume of recoverable material

g. possibility or otherwise of obtaining mineral rights

Generally speaking industrial minerals are low-priced commodities that can be produced in volume at low cost. Commonly a large part of the total cost is in acquiring mineral rights, most of which are held by private landholders in the southern part of Manitoba. Another difficulty exists in acquiring sufficient acreage with sufficient volume of material. This frequently involves dealing with several holders of mineral rights each of whom may hold only a few hundred acres. This type of situation commonly makes it difficult or unprofitable to undertake an industrial mineral operation.

Indian reservations, which generally cover several square miles, if underlain by produceable industrial minerals, offer a much more attractive situation than dealing with private holders of individual small acreage. Furthermore, Provincial Crown acreage is limited and thus Indian reservations are at a distinct advantage.

Some reservations in southern Manitoba are or may be underlain by useful industrial minerals. Others have little or no potential. Consequently, only those reservations possibly underlain by non-metallic products are discussed below. The sequence will be in terms of products, rather than separate reservations.

High-Calcium Limestone

Ebb and Flow	52	Dawson Bay	65B
Pine Creek	66A	Dog Creek	46
Swan Lake	65C		

Location: West side of Lake Winnipegosis, east Side Lake Manitoba.

References:

a. Devonian Geology of Lake Manitoba - Lake Winnipegosis Area, by A.D. Baillie. Man. Mines Br. pub. 49-2 1951

b. Limestones of Canada; Their Occurrence and Characteristics pt. V, Western Canada. Mines and Geol. Bureau of Mines, Canada, Rept. 811 1944.

c. High-Calcium Limestone Deposits of Manitoba Unpublished summary by B.B. Bannatyne, Indust. Min. Geol., Man. Mines Branch.

Discussion

High-Calcium limestone used in the manufacture of Portland Cement, occurs in Devonian rocks of Manitoba, specifically in the Point Wilkins member of the Manitoba group, and in the Elm Point limestone.

The Steeprock quarry of the Canada Cement Company and the Spearhill quarry of the Winnipeg Supply and Fuel Company occur in the Point Wilkins member east of Lake Manitoba. The Mafeking quarry of the Saskatchewan Cement Company is in the Elm Point limestone west of the north end of Lake Winnipegosis.

Known occurrences of Calcium limestone in the Manitoba group are found in a belt from the north end of Lake Manitoba to Dawson Bay. The requirements for a suitable productive quarry are:

1. sufficiently large outcrop or subcrop area
2. sufficient thickness of Calcium limestone
3. high Calcium content - minimum 95% $Ca\ CO_3$
4. low magnesium content
5. uniformity in composition throughout quarry
6 reasonably short distance to market

Exposures of Calcium limestone are known on Ebb and Flow I-R 52 west of Ebb and Flow Lake (map 49-2). The extent and chemical composition are not known. High Calcium limestone also occurs on I.R. 65B at Whitehead Point on Dawson Bay, Lake Winnipegosis. The limestone is at least 10 feet thick and analy ses 96.37% $CaCO_3$, 0.78% $Mg\ CO_3$, 1.66 % SiO_2 (see attached summary by B.B. Bannatyne). Other areas where Calcium limestone may occur are on Pine Creek I.R. 66a, Swan Lake I.R. 65C and Dog Creek I.R. 46. No exposures are shown on geological map 49-2 but this is only a reconnaissance map and numerous exposures are now known elsewhere that do not appear on the map.

Ths possibility of developing quarry sites on any of the above reservations is worth investigating. Two cement plants in Manitoba and one in Saskatchewan depend on Manitoba Calcium limestone and these companies are constantly seeking suitable materials.

Silica Sand

(I.R. 4, Brokenhead, South end of Lake Winnipeg)

Reference: Unpublished notes by B.B. Bannatyne, Industrial Minerals Geologist Man. Mines Branch

Discussion

The outcrop and subcrop belt of the Winnipeg sandstone formation is shown on Figure 1 of Bannatyne's notes and in a general way on the Geological map of Manitoba, 65-1. This Ordovician formation passes just east of the Brokenhead reservation no. 4 (see map 65-1). In subsurface, interpretation and extrapolation of well data indicates that the Winnipeg formation should lie at a depth of about 50 feet and should have a thickness of about 120 feet under the reservation. The formation as exposed on Lake Winnipeg consists of a basal poorly consolidated sandstone and an overlying section of greenish shale with interbedded sand or sandstone, in turn containing many shaly partings. The high quality sand section, thus may lie at about 125 feet below the surface of the reservation.

Analyses of unwashed sand range from 95.5% to 98% SiO_2. Washed sand may be upgraded to 99.5% SiO_2. This material is suitable as a foundry sand and glass sand. A market exists in Western Canada for such silica sand as considerable material is still being imported. The balance of requirements are being provided by Selkirk Silica Co. Ltd. from a location on Black Island. Additional uses could be in the chemical industry.

Theoretcally at least it should be possible to produce sand from the subsurface. The material is unconsolidated and should be amenable to pumping after injection with water. This possibility is worth investigating but only after market studies have been made.

Rock Salt

(I.R. 57, Birdtail Creek, Tp 15, Rge 27 W.P.M.)

References: a. Potash, Rock Salt and Brines in Manitoba by B.B. Bannatyne, Man. Mines Branch pub. 59-1 1960

b. Evaluation of Rock Salt in the Prairie Evaporite Formation. Unpublished report by H.R. McCabe and B.B. Bannatyne, Man. Mines Branch.

Discussion

Thick deposits of rock salt overlain by beds of potash occur in the Devonian prairie evaporite formation of western Manitoba. Only a thin edge of potash occurs on the Birdtail reservation and the potash beds are interbedded with salt ("the mixed zone").

Below this mixed zone is a salt bed, intersected in two wells, with a thickness of 80 feet (well 10-8-15-27) and 85 feet (well 9-21-15-27) at depths of 3150 and 3075 feet respectively. If this thickness is uniform under the reservations the total tonnage is about 150,000,000 tons of rock salt.

This would be an ideal source for Na Cl produced by brining , for the mineral rights for a large area are vested in one body. Such production would be suitable for a chemical complex. Unfortunately Dryden Chemicals Limited have selected a site near Brandon using natural brines. However, future expansion of the western Canadian chemical industry may open the way for production from a source such as that underlying

I.R. no. 57. Advantages of such a location besides large volume controlled by a single agency include relatively shallow depth, proximity to a reliable water supply for bringing (Assiniboine River) proximity to rail transport (CNR) and proximity to natural gas supply (Trans-Canada Pipeline).

Bentonite

(I.R. no. 57, Birdtail, Twp. 15, Rge 27 W.P.M.)

Reference: Cretaceous Bentonite Deposits of Manitoba, by B.B. Bannatyne, Man. Mines Branch Pub. 62-5 1963

Discussion

Semi-swelling bentonite occurs in the Millwood beds of the Cretaceous Riding Mountain formation. Non-swelling bentonites occur in the Pembina member of the Vermilion River formation. The area of reservation no. 57 is underlain by the Riding Mountain formation and presents a potential source of partly swelling bentonite.

Bannatyne (1963, p.22) reports that the Millwood beds have a thickness of 350 feet in western Manitoba, near Millwood on the Assiniboine River. This compares with 80 feet in the Pembina valley to the southeast.

The Millwood beds consist of a greenish waxy bentonite shale which is best described as partly swelling. The bentonite will form a gel but not to the same extent nor with the same viscosity as true swelling bentonite. However, with the addition of small quantities of sodium carbonate, sodium is exchanged for Calcium and the material approaches Wyoming swelling bentonite in its capacity to form viscous gels. Possible uses are as oil well drilling fluids, bonding agent for pelletising iron ores, lightweight aggregate, and as a slurry spray for fire control.

Few data are available regarding the possible bentonite occurrences along the Assiniboine River at or near I.R. 57. Most work has been done in the thinner occurrences in the Pembina Valley area. Further work might be carried out in the Birdtail area, and it may be possible to engage the cooperation of the Manitoba Mines Branch in such work.

Gypsum

(Rousseau River I.R. 2, 2A, Tp.2 Rge. 2 and Tp. 3 Rge. 4 EPm Sandy Bay I.R. 5)

References: a. Gypsum-Anhydrite Deposits of Manitoba, by B.B. Bannatyne, Man. Mines. Br. Pub. 58-2, 1959

b. Jurassic Stratigraphy of Manitoba, by D.F. Stott, Man. Mines Branch Pub. 54-2

c. Log and location sketch of drill hole E110 Western Gypsum products Limited, Man. Mines Branch Files.

Discussion

The approximate distribution of the Jurassic Amaranth evaporites (gypsum and anhydrite) in Manitoba is shown on figures 2 and 3 of Bannatynes report. At the time the report was written gypsum was being produced at Amaranth. Since then new mines have been opened at Silver Plains (Twp. 6 Rge. 2 EPm) and west of Amaranth. The former mine sight at Amaranth has been closed. The Manitoba gypsum deposits are the only ones east of the foothills and no doubt will be called upon to supply gypsum for years to come. An excellent opportunity may exist to develop deposits on the Sandy Bay I.R. 5 and possibly on the Rousseau River reservations.

Although the Amaranth Evaporite formation is extensive enough, the thickness and purity of the beds vary considerably. A further problem arises with suitable mining sites as in many places water problems may be encountered.

The proximity of the former and present mines at and near Amaranth and the fact that the same beds probably underlie Sandy Bay reservation suggests the likelihood that a gypsum operation could easily be developed there. Preliminary shallow drilling would be necessary to confirm the presence of mineable thicknesses of good grade gypsum.

Data on the thickness and purity of the gypsum on the Rouseau River reservations are lacking. However results from holes in the general area, as reported by Bannatyne (1959, p.21) are as follows:

Sec.	Twp.	Rge.	Depth	Remarks
28	1	2W	190	30' mainly gypsum
4	3	5E	260	45' pure, not confirmed
33	2	5E	335	Gypsum stringers in shale
33	2	5E	301	Several thin beds
4	3	5E	300	Several beds, total 26.5'
27	3	3E	175	25' gypsum or anhydrite
36	4	2E	150	27' gypsum or anhydrite

A hole drilled by Western Gypsum at St. Jean Baptiste intersected 47 feet of interbedded gypsum, shale and limestone between 213 feet and 260 feet depths. None of these results are particularly encouraging at first glance. However, Bannatyne points out (personal communication) that the nature of the evaporites changes rapidly laterally. This is confirmed by the presence of the mine at Silver Plains (Tp 5, rge 2E). Thus, the possibility of finding commercial deposits on I.R. 2 and 2A are fair. One or two shallow drill holes would determine the potential there.

Tyndall Stone

(Fisher River I.R. 44, Twp 28, Rge 1 Epm)

Reference: Ordovician Geology of Lake Winnipeg and adjacent Areas, by A.D. Baillie, Man. Mines Branch pub. 51-6 1952.

Discussion

The Selkirk member of the Ordovician Red River formation is quarried at Garson, Manitoba and distributed as the well known Tyndall building stone. It is a yellowish grey to pale yellowish brown mottled dolomitic limestone.

Baillie (1952, p17) reports outcrops of mottled limestone south of Koostakak on Fisher River reservation 44 (see map 51-6 in Baillie's report). It is not known if the site is suitable for quarrying or whether markets will expand sufficiently to accommodate another operation. Water transportation from Fisher River via Lake Winnipeg to Winnipeg would be possible from June to October.

Summary of Mineral Potential

The following table lists the mineral potential of the reservations discussed above. By necessity the ratings are according to such imprecise terms as poor, fair, moderate, and good. In general "poor" may be equated with "nil". "Fair" implies some chance of mineral occurrence, and "moderate" somewhat better chance. In both cases further work in the area might well improve the rating and it is suggested future developments by companies in the surrounding areas be carefully followed. Those classed as having "good" or "moderate-good " warrant further investigation to confirm the immediate or early prospect for development.

I.R. No.	Product	Potential
13, 13a	-	Poor
12	-	Poor
4	Silica sand	moderate
36, 36A	-	poor
3	-	poor
10	nickel	fair-moderate
9	-	poor
14	-	poor
2, 2A	Gypsum	fair-moderate
51	-	poor
52	Ca. ls.	good
66A	Ca. ls.	moderate

5	Gypsum	good
65A	-	poor
65B	Ca. ls.	moderate
65C	Ca. ls.	fair
65F	-	poor
63A	-	poor
45	-	poor
50, 50A	-	poor
44	Tyndall Stone	moderate
43, 43A	-	poor
46	Ca. ls.	fair
49, 49A	base metals	fair
48	-	poor
1B, 1C	-	poor
23	gold, base metals	poor-fair
22	gold, nickel	fair-moderate
24	gold, base metals	fair-moderate
34C, 37C, 37A, 39, 40	gold, base metals	fair
171, 171A, 171B	base metals	moderate
19, 19A, 19B, 19C	base metals	moderate-good
17	-	poor
16	-	poor
57	rock salt	good
62	-	poor
61	-	poor

6	-	poor
59	-	poor
58	-	poor
67	-	poor
8	-	poor
7	-	poor
197	-	poor
32	-	poor
33	-	poor
199	-	poor
198	-	poor
31	-	poor
170, 170A, 170B	base metals	fair
21	-	poor

Exploration Methods and their Relevance to Indian Reservations

Methods of mineral exploration have changed radically in the last two decades, great reliance being placed on geophysical methods, especially airborne geophysical surveys either from fixed-wing aircraft or low-flying helicopters. Area selection, however, is based on geological factors and follow-up work on the ground combines both geological examinations and detailed ground geophysical surveys. This procedure in mineral exploration has been particularly prevalent in the Precambrian of Manitoba.

Generally the size of the area selected for the initial reconnaissance airborne geophysical survey measures tens, hundreds or thousands of square miles. Of the total area the average reservation would comprise only a few per cent or even just a fraction of one per cent. Areas covered in Manitoba by airborne geophysical surveys by companies are shown on Manitoba Department of Mines Index Maps 3, 4 and 5. The information submitted by companies who carried out this work is available to the public. As noted previously, information over the reservations may have been omitted from the geophysical sheets submitted to the Manitoba Department of Mines. For this reason the absence, for example, of electromagnetic anomalies over reservations need not be regarded as discouraging. However, it is recommended that the companies which did this work be approached and requested to turn over to the Indian Affairs Branch any information they may have covering the reservation areas. It is probable that most of the companies, desiring to maintain good public relations in a (potentially) sensitive area, will co-operate.

A further factor to consider is the fact that airborne surveys are not entirely definitive. Commonly weak conductors, which may represent potential ore, are missed. In other cases, strong conductors are too deep to be detected by airborne surveys, but show up on ground surveys.

Subsequent procedures, following evaluation of the airborne surveys in conjunction with geological data, usually consist of:

a) ground geophysical surveys to confirm and accurately locate the anomaly,
b) geological examination to determine a probable cause for the conductor (sulphides, graphite, wet shears and faults, overburden etc.),
c) diamond drilling if deemed necessary or advisable.

Because mineral exploration is now a large-scale, costly and complex exercise, as contrasted with the one-man prospecting of the past, it is suggested that exploration over Indian Reservations might best be undertaken as part of these larger exploration programmes. However, it is not suggested that conventional ground prospecting, possibly by trained Indian residents, be excluded.

On the other hand, it is assumed that neither the individual Indian bands nor the Indian Affairs Branch are in a position to directly investigate possible mineral occurrences beyond the preliminary stage. Consequently, it is both necessary and desirable to permit exploration by private companies. The apparent policy of the Indian Affairs Branch and the intent of the new Indian Mining Regulations are to encourage and facilitate such exploration by companies. The regulations do much toward this end, and are a considerable forward step, especially in view of the difficulties attendant to administration of Indian land resources. However, in spite of possible difficulties it suggested that further changes be considered.

In order to encourage exploration and development of mineral resources on Indian lands, it may be advisable that regulations and requirements be essentially equivalent to those in effect on provincial Crown lands. Any more restrictive or onerous requirements would only serve to inhibit mineral exploration on Indian lands which, as pointed out above, form only a small portion of the whole area generally covered by companies during their programmes.

It is further apparent that in a general and overall sense the mineral potential of the Indian lands is neither greater nor less than that of the surrounding provincial lands. If a compan ~ to choose which lands to explore, it will obviously choose those where acquisition of rights is the most straightforward and where regulations are such as to facilitate operations.