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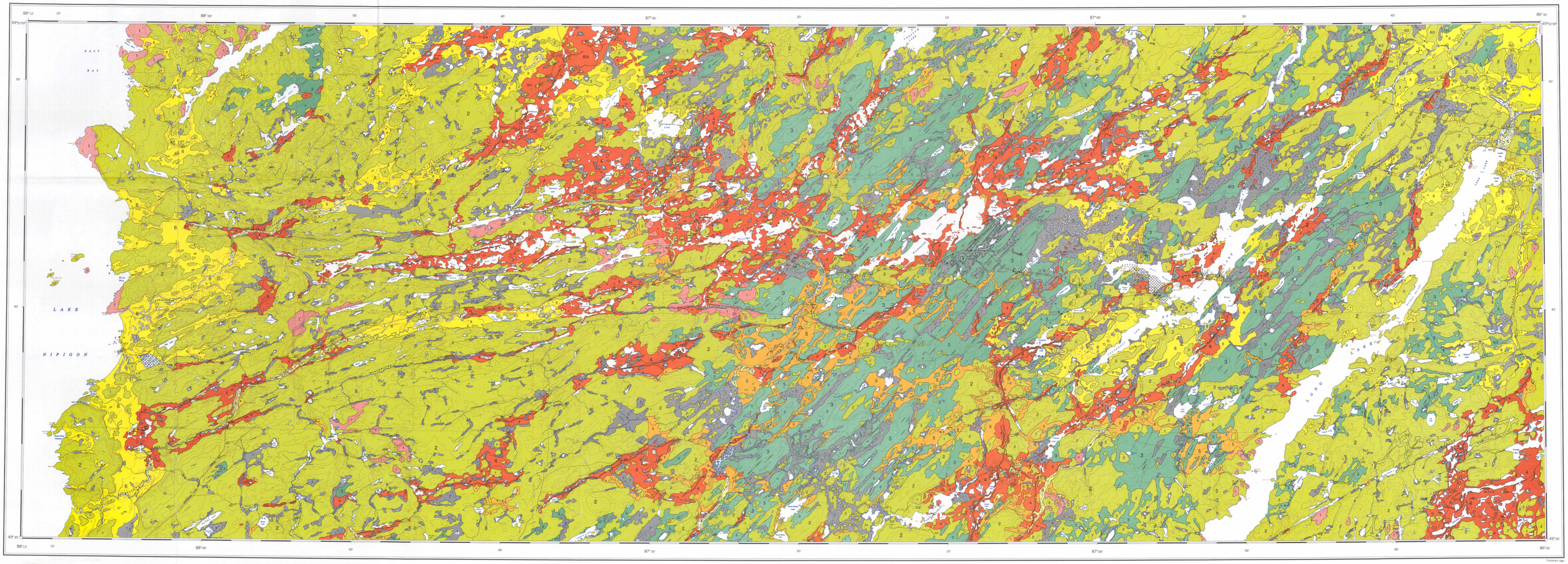

Energy, Mines and Resources Canada
Ministry of Northern Development and Mines
Ontario
Énergie, Mines et Ressources Canada
Ministère du Développement du Nord et des Mines

GEOLOGICAL SURVEY OF CANADA MAP 1768A
ONTARIO GEOLOGICAL SURVEY MAP 2535
SURFICIAL GEOLOGY

BEARDMORE-GERALDTON
ONTARIO

Scale 1:100 000 - Échelle 1/100 000
Kilometres
Universal Transverse Mercator Projection
Projection transverse universelle de Mercator
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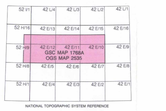

LEGEND

Note: compound unit: for example, 4/3 indicates a veneer of less than 1 m of unit 4 overlying unit 3; colour based on underlying unit

SURFICIAL DEPOSITS
QUATERNARY

POSTGLACIAL ENVIRONMENT

8 — ***ALLUVIAL DEPOSITS:*** *gravelly sand, sand, silt, organic detritus; 1-3 m thick; deposited on floodplains by existing streams*

7 — ***ORGANIC DEPOSITS:*** *peat, muck; 1-2 m thick; deposited in poorly drained depressions where lack of aeration prevents decomposition of organic matter*

PROGLACIAL AND GLACIAL ENVIRONMENTS

GLACIOFLUVIAL AND GLACIOLACUSTRINE DEPOSITS: *sand and gravel, minor silt and clay; 1-75 m thick; deposited by glacial meltwater*

6 — ***Subaqueous outwash and associated glaciolacustrine sediment:*** *rippled silty fine to very fine sand, silt and minor clay as thin interbeds; 1-75 m thick; sheet sands in topographic lows, commonly reworked into dunes; deposited in glacial lakes by sediment-laden meltwater turbidity currents derived from the ice margin*

5 — ***Outwash:*** *sand and gravelly sand; 1-10 m thick; generally planar surface; deposited by meltwater beyond the ice margin but in the beds of braided streams and in shallow, restricted portions of glacial lakes*

4 — ***Ice contact glaciofluvial sediments:*** *sand and gravel; 1-30 m thick; occurs in belts with single or multiple ridges, kames, and kettle holes; deposited by melt-water in contact with glacial ice*

3 — ***GLACIAL DEPOSITS:*** *gravelly, sandy to silty matrix-supported diamictons; 1-60 m thick; dominantly massive silty diamictons beneath sliding glacial ice*

2 — ***Thin till and other discontinuous drift (bedrock-drift complex):*** *gravelly silty sand diamicton overlying locally derived debris caused in the northeastern portion of the map area where thin exotic till occurs, thin sand and gravel in areas adjacent to glaciofluvial and glaciolacustrine deposits; < 1 m thick; 15 to 75% bedrock outcrop; largely locally derived sandy till deposited beneath and by sliding glacial ice as well as colluvium*

BEDROCK
PRECAMBRIAN

1 — ***METASEDIMENTARY, METAVOLCANIC, AND INTRUSIVE ROCKS:*** *> 75% bedrock outcrop; generally unweathered; glacially scoured irregular surface in areas of Archean granitic, metasedimentary and metavolcanic rocks; subcrop ridges formed by Proterozoic diabase occur near Lake Nipigon; includes patches of thin drift*

Geological boundary
Small bedrock outcrop
Drumlin
Glacial striae
Crossing striae (1 = oldest)
Ice contact face
Esker
Kettle holes
Abandoned channel
Intermediate shoreline feature
Stabilized eolian forms (large dunes)
Gravel pit
Mine
Overburden drill hole site A ●
Mine waste

Geology by F.J. Kristjansson, Ontario Geological Survey, and L.H. Thorlelton, Geological Survey of Canada, 1986-1989

Geological cartography by the Geological Survey of Canada

Any revisions or additional information known to the user would be welcomed by the Geological Survey of Canada and the Ontario Geological Survey

Base map assembled by Geological Survey of Canada from maps published at 1: 50 000 scale by the Surveys and Mapping Branch in 1979

Copies of the topographical editions covering this map area may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, Ontario, K1A 0E9

Mean magnetic declination 1991, 4°30' W, increasing 5.3 annually. Readings vary from 3°19' W in SW corner to 5°32' W in the NE corner of the map

Elevations in feet above mean sea level; contour interval 50 feet

DESCRIPTIVE NOTES

The Beardmore-Geraldton area is one of several areas in which geological surveys designed to stimulate further growth in Ontario's mining industry were initiated as part of the Canada-Ontario Mineral Development Agreement (1985-1990). A program of glacial geological research was carried out in this area, as a joint effort by the Geological Survey of Canada and the Ontario Geological Survey, in order to aid in the sampling in mineral exploration (e.g., Coker and DiLabio, 1989), and to obtain information required for engineering and environmental management. The research program was meant to determine the distribution, stratigraphy, sedimentology, composition, and source of glacial sediments in the area.

The Precambrian geology and gold mineralization of the Beardmore-Geraldton area have been described by Mason and McConnell (1963) and Mason and White (1966). The Wabigoon Subprovince of the Canadian Shield is subdivided in the study area into two greenstone belts; 1) the Schreiber-Hemlo Belt in the northwest and 2) the Beardmore-Geraldton Belt, which parallels and flanks Highway 11. The Onaman-Tashota Belt consists predominantly of intermediate to felsic volcanic rocks intruded by felsic plutonic bodies. The Beardmore-Geraldton Belt consists of a complex metasedimentary sequence interlayered with mafic to intermediate metavolcanic rocks. Between the greenstone belts and the Proterozoic carbonate rocks of the Hudson Bay Lowland 100 km to the northeast (Pattison, 1965; Heath, 1988; Fig. 1-5) is a terrain largely dominated by metasedimentary rocks in this area. Late Precambrian diabase dykes and, in the western portion of the study area, large tabular sills intrude the older rocks. Nineteen past-producing mines in the area yielded over four million ounces of gold and 300 000 ounces of silver (Mason and White, 1966). Copper, nickel, zinc, lead, molybdenum, and tungsten mineralization, as well as iron ore, are also present (Pye et al., 1966).

Field data were obtained from excavations, existing exposures, and drilling. Additional information was obtained from previous research (Dyke, 1965, 1967; Sado, 1975; Gartner, 1965a, b; Mollard and Mollard, 1981). Surficial geology was interpreted using aerial photography at a scale of 1:15 840. Results were first published at 1:100 000 scale by Kristjansson, Thorlelton, and Barnett (1990). Drift provenance was assessed using 10-15 kg till samples collected at surface and from drillholes.

Bedrock is in general well exposed and displays glacially streamlined forms. These features parallel the youngest set of striations, a radiating pattern ranging from about 250° at Beardmore, 230° at Geraldton, to 270° at Longlac. Rare occurrences of preserved older striations indicate a former ice flow direction of 210° at Beardmore and 190° at Geraldton. Veillette (1986) has reviewed evidence for an older west-southwestward ice flow which also may have influenced the Beardmore-Geraldton area.

Till is the most common surficial sediment in the area. The most distinctive feature of much of this till is its calcareous matrix below the 0.5 m thick A and B soil horizons and the abundance, particularly in the Hudson Bay Lowland, of Paleozoic carbonate rocks and Proterozoic metasediments derived from the Hudson Bay Lowland 200 km to the northeast (Pattison, 1965; Heath, 1988; Fig. 1-6). The presence of this fine-grained carbonate-rich till in the Lake Nipigon basin and in the Long Lake area to the east are attributed to: 1) a zone of vigorous ice flow or ice stream emanating from Hudson Bay; 2) the high susceptibility to erosion of Paleozoic carbonate rocks, 3) the low erodibility of Archean granites occurring between the greenstone belt and Paleozoic terrane, and 4) the short distance over which glacial ice flowed over greenstones prior to the deposition of till in the study area. The composition of exotic till grades to that of more locally derived thin till which occurs at the surface in the area around and northeast of Beardmore and in the subsurface in areas of thick till. Locally derived till contains abundant angular, foliated Archean metasedimentary and metavolcanic rock fragments. The till matrix is a function of these deposits, their massive and compact structure, and the presence of faceted and striated clasts as well as boulder pavements which have been interpreted as having been deposited by actively sliding ice (Kristjansson and Thorlelton, 1987; Hicock, 1988). Graded sediment flow diamictons derived from the ice surface overlie till in places.

Glacial meltwater deposited eskers, kames, and outwash as belts of sand and gravel crossing the area. Subaqueous outwash was deposited by continuously flowing, sediment-laden turbidity currents or underflows derived from the ice. These currents were driven by their density to the deepest parts of the shallow, short-lived proglacial lakes which covered part of the area. Whereas higher ground in the southern and north-central parts of the map area remained exposed, lower areas between Jellicoe and Lake Nipigon, as well as the Geraldton and Longlac areas, were inundated. The upper limit of inundation, which rises to the northeast due to postglacial isostatic rebound, varies from 320 m (1050') at Beardmore to 350 m (1150') at Longlac. Most of the area within these limits consisted of islands, so sediments influenced by inundation are rare. Sediments deposited in the Lake Nipigon basin are described by Antevs (1925) who was responsible for the lack of sand and clay considered typical of glaciolacustrine environments elsewhere.

Postglacial sedimentation is limited to eolian reworking of subaqueous outwash sand, deposition of alluvium on the floodplains of rivers, and accumulation of peat in poorly drained depressions.

Efforts to use soil sampling and overburden drilling in mineral exploration must take into account the several environments of glacial sedimentation, variable distances and directions of glacial transport, and the effects of postglacial weathering. Locally derived till, an ideal sampling medium for geochemistry or mineral tracing (Closs and Sado, 1981; DiLabio, 1982; Thorlelton and Kristjansson, 1987, 1988), may be sampled at the surface in areas of thin till. This material is oxidized to a depth of typically 3 or 4 m, but locally to 10 m. In the Lake Nipigon basin, the oxidized zone is leached and trace metals redistributed, possibly into the fine-grained fraction of the oxidized till (Shilts, 1984). The geochemical characteristics of surface samples therefore differ from unweathered subjacent till which can be sampled by overburden drilling in areas of thick till. Calcareous, Paleozoic carbonate-bearing till should be examined for a local component, most readily recognized on the basis of angular, foliated metasedimentary and metavolcanic clasts in the pebble fraction, before analysis. Glaciofluvial sediments have a generally longer and more complex transport history than till, so this material is less desirable as a prospecting medium.

The most favourable aggregate sources are located in ice contact glaciofluvial sediments (Unit 4). Thin sand and gravel deposits will be found in areas of outwash (Unit 5).

ACKNOWLEDGMENTS

The participation of E.V. Sado, T.N. White, and S.P. Gaudino, Ontario Geological Survey, and T.A. Warman, Geological Survey of Canada as well as assistance by S. Stalvie and M. Coyne, Ontario Geological Survey, and S. Balzer, R. Dawson, M. Fingland, S. Fulton, A. Heath, P. Laudiz, S. Pelkey, and P. Rossi, Geological Survey of Canada are acknowledged with appreciation.

Figure 1. The pebble fraction of a Geraldton area till sample consists of Paleozoic carbonate rocks (left), metasedimentary and metavolcanic rocks dominated by rounded, unfoliated black greywacke (right), and granitic rocks (centre). The matrix of this till consists largely of calcareous silt. It would seem reasonable to suspect that the carbonate is derived from a nearby Paleozoic outlier and that all of the metasedimentary and metavolcanic material represents locally derived greenstone belt debris, but most of this material is actually derived from the Hudson Bay Lowland, more than 100 km to the northeast. Locally derived greenstone belt debris, such as angular, foliated metasedimentary and metavolcanic clasts, is a minor component of calcareous till near Geraldton, but is dominant in till near Beardmore

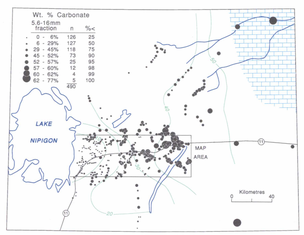

Figure 2. Paleozoic carbonate in the pebble fraction (5.6-16 mm) of surface till samples diminishes gradually from Hudson Bay Lowland Paleozoic terrane to Geraldton, hence long distance glacial transport, rather than erosion of a nearby Paleozoic outlier, was responsible for carbonate in Beardmore-Geraldton area till. The pebble fraction of till overlying the carbonate source in the Hudson Bay Lowland contains only about 60% carbonate due to the presence of metasedimentary and granitic erratics. Samples from the thin till of the Beardmore area are dominated by locally derived metasedimentary and metavolcanic rocks

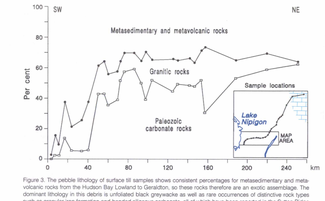

Figure 3. The pebble lithology of surface till samples shows consistent percentages for metasedimentary and metavolcanic rocks from the Hudson Bay Lowland to Geraldton, so these rock types therefore are an exotic assemblage. The dominant lithology in this area is unfoliated black greywacke as well as rare occurrences of distinctive rock types such as granular iron formation and banded siliceous carbonate, all of which have been reported in the Sutton Ridge (Bostock 1971) as well as in the Belcher Islands area. The content of metasedimentary and metavolcanic rocks in exotic Hudson Bay Lowland debris is consistently about two-thirds of the Paleozoic carbonate content. Percentages for metasedimentary and metavolcanic rocks that exceed this proportion, such as in the Beardmore area, therefore indicate debris derived from local greenstone belt sources

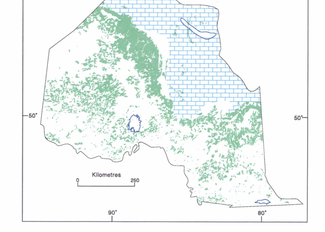

Figure 4. The outcrop pattern of till sufficiently thick to mask bedrock topography (green), as mapped by Sado and Carswell (1987), indicates that the Geraldton area, along with Pickle Lake, Hemlo, and Chapleau, are areas where plumes of Paleozoic carbonate-rich debris have been transported southwestward onto the shield by streams of vigorous glacial ice flow. Other areas of extensive thick till include 1) a zone of late glacial south-southeastward ice flow north of Timmins, 2) southwest of Proterozoic rocks in the Nipigon basin, and 3) the Fort Frances area, where ice flow turned southwestward from Manitoba Paleozoic terrane (Sado and Carswell, 1987). Hence thick till only occurs where easily eroded Proterozoic and Paleozoic rocks served as the source and distance of transport varied in response to the vigour of glacial processes

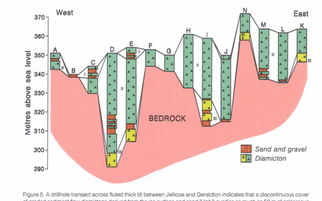

Figure 5. A drillhole transect across fluted thick till between Jellicoe and Geraldton indicates that a discontinuous cover of graded sediment flow diamictons derived from the ice surface and sand (Unit 5 overlies as much as 50 m of calcareous silty till (Unit 3) in which Paleozoic carbonate and Proterozoic metasediments derived from the Hudson Bay Lowland are more abundant than local debris. At five sites, locally derived till (Unit 3) with little or no exotic debris was encountered. Lenses of glaciofluvial sediment occur within the thick till sequence. Neither organic material nor weathering horizons were encountered.

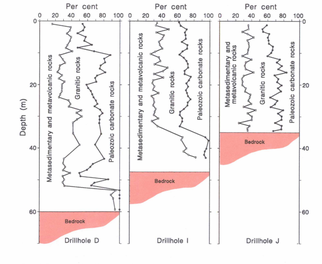

Figure 6. The lithology of pebbles screened from drillhole till samples indicates an abrupt transition from dominantly exotic to locally derived till in, for example, drillholes D and I. In drillhole D, the carbonate-rich till includes a zone (10-20 m) rich in granite derived from the area between the Beardmore-Geraldton greenstone belt and the Hudson Bay Lowland as well as a zone (25-40 m) enriched in metasedimentary and metavolcanic rocks. The additional material in the latter zone is interpreted as locally derived greenstone belt debris because percentages for this class exceed values encountered north of the greenstone belt and some of the observed clasts are similar to nearby bedrock. Thick carbonate-rich till at drillhole I has no similar zonation. Exotic debris is dominant, even at the bedrock surface, in drillhole J. Presence of up to 20% local debris deep in the sequence is indicated, however, by a near-constant percentage of metasedimentary and metavolcanic rocks as granite increases and carbonate decreases

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CANADA ONTARIO Mineral Development Agreement Accord de développement minéral

Contribution to Canada-Ontario 1985 Mineral Development Subsidiary Agreement under the Economic and Regional Development Agreement
Contribution à l'Entente auxiliaire Canada/Ontario sur l'exploitation minérale 1985 dans le cadre de l'Entente de développement économique et régional

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