Canada
Department of Mines
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GEOLOGICAL SURVEY
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LEGEND

LATE PRECAMBRIAN

KEWEENAWAN

8 — *Diabase sills*

ANIMIKIE

7 — ROVE FORMATION *(shaly sediments)*

6 — GUNFLINT FORMATION *(iron formation, shaly sediments, basic lavas, basal conglomerate (Kakabeka formation.)*

TIMISKAMIAN

ALGOMAN BATHOLITHIC INTRUSIVES

5 — *Granite, granite-gneiss, etc., microcline granite (5a); oligoclase granite and granodiorite (5b). The greater part of the batholithic intrusives is presumably Algoman, but at several localities an older granite (Laurentian) is known, which may occur elsewhere*

SEDIMENTS

4 — *Seine (4a); Steeprock, sediments and volcanics (4b); Windigokan, sediments and some volcanics (4c); Mesabi (4d). All the named assemblages are not known to be of the same age; some at least are younger than Laurentian intrusives and none is known to be younger than Algoman intrusives. Some of the unnamed sedimentary assemblages (4) may be older than a considerable part of the volcanics (Keewatin) and not be correctly included here*

PRE-TIMISKAMIAN

LAURENTIAN BATHOLITHIC INTRUSIVES

3 — *Granite, granite-gneiss, etc. Laurentian granites are known to occur at the few localities indicated but are probably more widespread. They are younger than nearby volcanics but older than adjacent sediments*

VOLCANIC COMPLEX (KEEWATIN)

2 — *A schist complex essentially of volcanic origin but containing minor amounts of sediments, including iron formation, in places considerable volumes of undifferentiated sediments may be present.*

COUCHICHING

1 — *Mica schist, paragneiss, slate, greywacke, impure quartzite*

Iron formation. (differentiated in places from Early Precambrian strata)

Geological boundary

Mining Division boundary

Mining Recording Office

Road; trail, portage

PRINCIPAL MINERAL OCCURRENCES

×Ag	Silver
×Au	Gold
×Be	Beryl
×Co	Cobalt
×Cu	Copper
×Fe	Iron
×Mo	Molybdenum *(molybdenite)*
×Ni	Nickel
×Pb	Lead
×S	Sulphur *(pyrite)*
×T	Talc or Soapstone
×V	Vanadium

SOURCES OF INFORMATION

Geology compiled by T. L. Tanton. *From surveys by the* Geological Survey, *and the* Ontario Department of Mines.

PHYSICAL FEATURES

This area, which is in the southwest part of the Canadian or Precambrian Shield, is from 1000 to 1900 feet above sea level and averages about 1400 feet. The greater part, underlain by early Precambrian formations, is characterized by a monotonous succession of rocky, hummocky hills and ridges, rarely over 300 feet high, and a scanty soil-sheet consisting mainly of glacial drift, mostly collected in the low ground. In the northern and southwestern parts extensive and comparatively thick deposits of sand and clay cover all but the higher parts of the rock floor. In the southeast part, underlain by late Precambrian rocks, there are high tablelands, with rocky cliffs up to 400 feet high along their northwesterly sides, that slope gently toward the southeast; and smaller rocky mesas detached by erosion from the main tablelands. Sand and gravel plains occur in the lowlands of this part.

In the greater part of the area the scarcity of drift and unevenness of the rock floor has produced a myriad of ponds and lakes of the most diverse size and shape. These spill from one to another by short streams in which rapids and falls up to 50 feet in height are common. These conditions and the fairly steady annual flow are well suited for power development. Where the drift mantle is thicker there are extensive muskegs, fewer lakes, and streams of more constant widths and courses, and with few rock outcrops except at falls and rapids.

Canoe travel, which governs the prospecting season, usually lasts from early in May until mid-October. Game and fish are fairly plentiful. Except in fire-swept parts there is plenty of timber for camping, prospecting and mining purposes.

GENERAL GEOLOGY

The solid rocks comprise two major groups separated by a profound unconformity. The EARLY PRECAMBRIAN consists of more or less highly metamorphosed and folded strata, and batholithic intrusives of granite and related rocks. The LATE PRECAMBRIAN consists of slightly altered and nearly flat-lying sediments, basic lavas and diabase intrusives.

The COUCHICHING in Rainy Lake basin consists of steeply folded, banded mica schists, locally garnetiferous; paragneisses; and at places less highly metamorphosed sediments recognizable as slate, greywacke and impure quartzite. This essentially sedimentary group is overlain by Keewatin volcanics without pronounced unconformity; it is overlain unconformably by the Seine series; and it is intruded by all granites and related igneous rocks that have been found in contact with it. Areas other than those in Rainy Lake basin that are shown as Couchiching are underlain by highly metamorphosed sedimentary rocks that seem to be older than Keewatin volcanics.

The VOLCANIC COMPLEX (KEEWATIN) is an assemblage of lava flows, chiefly of andesitic composition, and pyroclastic rocks, with some sediments, including banded iron formation. These rocks are more or less highly altered; large parts are schistose and, judging from the attitudes of the stratified members, the group has been highly folded. This dominantly volcanic assemblage is unconformably overlain by the Seine series and it has been invaded by both Laurentian and Algoman batholithic intrusives.

According to Lawson the Keewatin and Couchiching are series closely associated in time and form part of a major geological unit, called Ontarian, that antedates the Laurentian revolution. Miller and Knight call this unit the Logamian.

LAURENTIAN BATHOLITHIC INTRUSIVES. At several places, far apart, there is presumptive evidence of two periods of granitic invasion. It is commonly assumed that these two periods are everywhere the same two, and that during both there were mountain-building disturbances. The older of these periods has been designated the Laurentian revolution of interval, and the younger the Algoman. The Laurentian granitic rocks have been identified only where early Precambrian strata have been found unconformably on them, e.g., south of Mine Centre and on Steeprock lake. At such places they contain inclusions of schists and exhibit a variety of lithologically different phases, such as are common elsewhere in batholithic intrusives which may be either Algoman or Laurentian. Early Precambrian strata of post-Keewatin age contain granitic pebbles of various sorts that presumably came from Laurentian, and though its distribution is yet little known the Laurentian may be or may have been widespread.

SEDIMENTS. The Seine series consists of a basal conglomerate, quartzites, grits, greywackes, slates and phyllites. These rocks are highly metamorphosed and folded. They have been found unconformably overlying the Laurentian, Keewatin and Couchiching. The Steeprock series near Steeprock lake consists of a basal conglomerate and other sediments like those in the Seine series and also limestone, iron formation and lavas and pyroclastics. These rocks have been metamorphosed and folded, and they unconformably overlie the Laurentian, Keewatin and Couchiching. Other named assemblages shown by the same colour symbol on this map resemble the Seine or Steeprock series and are likewise not easily distinguished from the Keewatin, with which they are associated, and with which they were formerly grouped. Some of the unnamed assemblages (symbol 4), though resembling the Seine and Steeprock series, are not known to be younger than all of the volcanics in the Volcanic Complex.

The named assemblages are all believed to have formed in the interval between the Laurentian and the Algoman revolutions, but all are not known to be of precisely the same age. Miller and Knight named this interval, and the formations deposited during it, Timiskamian, although they also erroneously included some younger formations in their original citation of examples. The name is adopted here for the time and the formations deposited between the Laurentian and Algoman.

ALGOMAN BATHOLITHIC INTRUSIVES can be identified at a few places where they intrude Timiskamian strata. They are probably extensive because the Timiskamian seems everywhere to have been severely deformed. They include granites, gneisses and related rocks and also partly digested inclusions of older rocks. Zones of these inclusions up to a few miles in width are common at the margins of areas of older formations.

The ANIMIKIE series in the southeastern part of the map-area consists in ascending conformable order of the Kakabeka formation, up to 4 feet thick; the Gunflint formation more than 515 feet thick; and the Rove formation, more than 1300 feet thick. The Kakabeka is a conglomerate with locally interstratified layers of sandstone. The Gunflint is characterized by beds of iron formation with, at some horizons, intercalated beds of fragmental rocks resembling shales, and, locally, volcanic rocks. The Rove formation consists of shaly sediments. This series lies on a peneplanated erosion surface of early Precambrian rocks: it dips gently toward the southeast and is dislocated along numerous nearly vertical faults. The rocks have not been metamorphosed except within a few feet of some diabase intrusives. In Minnesota the Animikie contains extensive and rich deposits of iron ore; strata correlated with it occur south of Lake Superior and near Sudbury.

KEWEENAWAN diabase sills up to 250 feet thick intrude the Animikie. The diabase is fresh and more resistant to weathering than the sediments, consequently the sills form prominent caps on the eroded highlands of the area. They are about parallel to the bedding of the Animikie and have been faulted in the same way. Some of the faults are occupied by dykes of diabase, and others have been cemented by veins. The diabase intrusives are the youngest solid rock in the map-area. Similar intrusives, generally classified as Keweenawan, are widespread in the Canadian Shield, commonly as dykes and sills.

ECONOMIC GEOLOGY

The mineral occurrences shown by symbols provide clues for appraising the mineral potentialities of the formations in which they lie. The Couchiching strata are not known to contain valuable mineral deposits. Near batholithic intrusives they are apt to contain pegmatite dykes and quartz veins but no valuable mineral has been found in them except some molybdenite in one quartz vein at Bear Pass.

The Keewatin is the chief repository of the known mineral deposits. Those of iron, talc and soapstone have been derived from rocks originally forming part of this group; those of lead, copper, nickel, cobalt, vanadium and gold resulted from mineralizing processes that found in the Volcanic Complex conditions specially favourable for deposition.

The Laurentian batholithic intrusives as known do not contain any valuable mineral deposits, but molybdenite occurs south of Mine Centre in quartz pebbles of the Seine conglomerate. The molybdenite was probably derived from Laurentian intrusives.

The Timiskamian includes an iron formation that may yet be found to contain iron ore. As a repository for mineral deposits introduced by agencies operative during the Algoman it has potential economic interest equivalent to the Keewatin. Sulphide deposits and gold-bearing veins have been found in these strata.

The Algoman batholithic intrusives carry pegmatitic deposits in which beryl and molybdenite have been found, but otherwise are characteristically barren. A variety of small intrusions, notably of porphyry, granodiorite and diorite, that occur marginal to the major batholiths and are generally regarded as Algoman, contain veins and sulphide replacement bodies. These deposits usually occur at the borders of the intrusive and in the fractures and metamorphosed intruded rock adjacent. One or several of the following metals are known to occur thus in veins and replacement bodies: gold, copper, lead, cobalt, nickel and vanadium.

Animikie strata include a thickness of 800 feet or more of iron formation in the Gunflint formation. The latter is equivalent to the Biwabik formation in Minnesota that contains important bodies of iron ore. Veins mineralized with silver, lead and zinc occur in Animikie strata, and valuable concentrations of silver minerals have been found locally in veins near diabase intrusives.

Keweenawan intrusives are at some places cut by veins that contain local rich concentrations of silver.

The GOLD deposits occur characteristically in quartz veins that cement fractures in a composite assemblage of porphyry intrusives and the adjacent early Precambrian strata, which are altered to chlorite schist, sericite schist, ferruginous carbonate and highly silicious replacement bodies, ampholite, etc. The gold-bearing quartz veins were presumably deposited from hot solutions that were given off by the porphyry magma that is probably an offshoot from the great magma of the batholiths. The first solutions given off pervaded and altered the overlying rocks; those of a later stage, richer in gold and some other metallic constituents, may have collected under the frozen roof of the magma chamber and escaped into fractures in the overlying rock. Where granitic rocks are extensively exposed erosion must have removed much of the roof material and any veins that may have existed in it; small masses of granite and porphyry on the other hand indicate that erosion has left some of the cover over a batholith and that any mineralized veins will remain. Consequently the favourable areas for prospecting are around small intrusions of porphyry or granite, and less so near main batholithic masses.

Deposits of LEAD, COPPER, NICKEL and COBALT occur in veins and replacement bodies in Early Precambrian strata near the margins of porphyry or granitic intrusives. The largest of the known nickel occurrences, near the west end of Lower Shebandowan lake, are in sulphide replacement bodies that contain also copper, cobalt and platinum group metals.

Concentration of IRON minerals, of which the most abundant is magnetite, occur in iron formations in the Keewatin, some of the Timiskamian sedimentary series, and in the Gunflint formation of the Animikie series.

VANADIUM has been found in the titaniferous magnetite deposits along the northwest side of Bad Vermilion lake, near Mine Centre, in metamorphic rocks resultant from the interaction of batholithic intrusives and Keewatin iron formation.

SOAPSTONE in large and small masses has resulted from alteration of early Precambrian basic lavas near porphyry or granitic intrusives. Seams of talc occur in the soapstone deposits.

PYRITE occurs as replacement bodies in Keewatin banded iron formation and in masses of ferruginous carbonate that have replaced early Precambrian strata. The deposits are believed to originate from neighbouring intrusive rocks.

SILVER-bearing veins occur characteristically near Keweenawan intrusives, from which they originated. They occupy nearly vertical faults and cut formations of all ages involved in the faulting. The common vein minerals are calcite, barite, fluorite, white and amethystine quartz, together with galena, zinc blende, chalcopyrite and pyrite in varying proportions; pockets of native silver and argentite occur in cleavage cracks and small cavities among all of the other vein minerals. Such pockets, found just east of this map-area have yielded several thousand ounces of silver to the ton. They are regarded as secondary concentrations.

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MAP 266A

KENORA SHEET

ONTARIO

Scale, 506,880 or 1 inch to 8 Miles

Miles 0 4 8 16 24 32

Kilometres 0 10 20 30 40 50

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