GEOLOGICAL SURVEY OF CANADA COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

The Timmins map area of about 186 000 km² in Ontario and Quebec south of James Bay, includes parts of the Precambrian Superior and Southern provinces of the Canadian Shield, and the Phanerozoic Moose River Basin. The Canadian Shield, the peneplaned Abitibi Upland, has low relief and extensive cover of Pleistocene till and lacustrine deposits. Flat-lying Phanerozoic strata of the Moose River Basin form the southern part of the Hudson Bay Lowland, an area of bog and swamp poorly drained by river systems incised in thick Pleistocene glaciogenic deposits.

The Superior Province contains the Wawa and Abitibi volcano-plutonic subprovinces, the Quetico, Opatica, Nemiscau and Pontiac metasedimentary subprovinces, and the Kapuskasing Structural Zone of granulite facies gneiss. Metavolcanic and plutonic rocks north of Hearst and in the Partridge River area, Ontario, and along the Nottaway River, Quebec are probably part of the largely buried eastern extension of the volcano-plutonic Wabigoon Subprovince.

The Quetico, Nemiscau and Opatica subprovinces consist mainly of migmatitic paragneiss, tonalitic and granitic orthogneiss, minor mafic gneiss of volcanic origin and abundant biotite granite and peraluminous, palingenetic intrusions. Medium grade metasediments and metavolcanics in southern Quetico Subprovince have relatively well-preserved primary structures such as bedding and pillows. These subprovinces, their major lithological units and the internal gneissosity generally trend east-west.

Eastern Wawa Subprovince has several remnant greenstone belts (e.g. Michipicoten belt) but consists mainly of tonalitic gneiss with variable amounts of mafic and metasedimentary xenoliths of probable supracrustal origin. Gneiss and greenstone are intruded by foliated to massive quartz diorite to granite and syenite plutons with ages of 2677-2633 Ma. Polyphase deformation and diapirism formed domal structures with major culminations at approximately 30 km intervals. Metamorphic grade increases eastward from lower greenschist-amphibolite facies in the Michipicoten greenstone belt to upper amphibolite facies near the Kapuskasing Structural Zone.

Kapuskasing Structural Zone, characterized by northeast-trending, northwest-dipping granulite facies gneiss, a large layered gabbro-anorthosite complex, and positive gravity and magnetic anomalies, transects the east-west trends of adjacent subprovinces. It is bounded on the east by the west-dipping Ivanhoe Lake and Bad River faults and on the west, in part, by the Lepage and Saganash Lake faults. The zone represents the basal part of an oblique crustal section about 120 km wide, from low grade supracrustal rocks of the Michipicoten belt metamorphosed at depths of 5-10 km (2-3 kb), through amphibolite gneiss of eastern Wawa Subprovince formed at 15-20 km (4-6 kb), to granulite of the zone, subjected to pressures of 7-9 kb at depths of 30 km. This section was exposed by major displacement on a west-dipping thrust, of which the Ivanhoe and Bad River faults are remnants, followed by normal movements on subparallel faults, the Lepage and Saganash Lake structures, that broke the thrust sheet into several blocks similar to Laramide uplifts of the Rocky Mountains. Thrusting and uplift probably occurred in the Aphebian, possibly in response to collision along the boundary between the Superior and Churchill provinces. U-Pb zircon ages from various units within the Kapuskasing Zone are 2765-2611 Ma; metamorphic zircons systematically become younger eastward, from 2696 to 2611 Ma. Seismic refraction experiments indicate that Moho depth increases eastward from about 40 km beneath eastern Wawa Subprovince to over 44 km beneath the southern Kapuskasing Zone and decreases to about 35 km beneath western Abitibi Subprovince.

Abitibi Subprovince is dominated by the Abitibi greenstone belt which comprises several major volcanic megacycles each consisting of a lower komatiitic-tholeiitic sequence, a middle tholeiitic sequence and upper, diverse tholeiitic, calc-alkalic mafic to felsic sequences; locally a fourth, alkalic/shoshonitic division is present. The lower and middle sequences form extensive submarine lava plains, whereas the upper mixed sequences form central volcanic complexes of subaqueous and subaerial pyroclastics and flows. Turbiditic, volcanogenic wacke and conglomerate units are interstratified with and form aprons about the volcanic accumulations, notably the central complexes. Locally alluvial/fluvial sedimentary and alkalic/shoshonitic volcanic sequences unconformably overlie older volcanics. Sequences of this latter type, notably the Timiskaming Group, occur along major faults such as the Kirkland Lake-Cadillac Fault and may have been deposited in rift or pull-apart basins. Abitibi volcanic rocks have U-Pb zircon ages of 2730-2697 Ma; the age of Timiskaming Group volcanics is possibly about 2685 Ma.

Plutonic rocks include early, pre- to syn-kinematic, in part synvolcanic, gneissic and foliated quartz diorite, tonalite and granodiorite suites and younger, syn- to post-kinematic, foliated to massive granodiorite, granite and syenite suites. Ages of Abitibi plutonic rocks are 2718-2676 Ma; many late- to post-kinematic plutons have ages of about 2680 Ma, and constrain the last major deformation and metamorphism in this part of the Superior Province to 2700-2680 Ma.

Early ductile folding and faulting formed major east-west trending anticlinoria and synclinoria, complex interference folds and weakly deformed domains of various sizes, each with distinctive lithological and structural characteristics, and separated by narrow, linear high-strain zones and faults. Later deformation was increasingly brittle, culminating in large-scale transcurrent faulting, deposition of Timiskaming-type sequences, shearing, alteration and formation of gold-bearing quartz-carbonate vein systems.

Abitibi greenstone belt is primarily in low greenschist facies. Several large areas of subgreenschist (prehnite-pumpellyite) facies rocks are present but upper greenschist and amphibolite, or hornblende-hornfels facies are present only in relatively narrow aureoles about some intrusions.

Gravity data over part of Abitibi Subprovince indicate an average upper crustal density of 2.73g/cm³ corresponding to average tonalitic gneiss composition. Greenstone belts have been interpreted to extend down to about 5-8 km, and tabular granitoid batholiths are 3-6 km thick.

Northern Pontiac Subprovince consists mainly of turbiditic wacke with minor units of conglomerate and komatiitic-tholeiitic volcanics, metamorphosed to low and medium grade, and cut by granitic and syenitic plutons. Detrital zircons from Pontiac sediments have U-Pb ages of about 2713, 2920 and 3000 Ma. The grade of Barrovian-type metamorphism increases rapidly and uniformly southward from low greenschist to middle and upper amphibolite facies wherein approximately equal proportions of paragneiss and orthogneiss plus granitic, pegmatitic and syenitic dykes, sheets and plutons are present. Polyphase deformation formed east trending, south-verging isoclinal and recumbent folds and thrust faults.

In the northern extension of the Cobalt Embayment of the Southern Province, glaciogenic rocks of the Aphebian Gowganda Formation, Huron Supergroup, unconformably overlie Archean basement and occupy several narrow fiord-like, north-trending basins that may have been controlled by pre-existing faults. Superior Province is intruded by Aphebian and Helikian alkalic rock-carbonatite complexes, notably along the Kapuskasing Zone, and by several dyke swarms, including the Archean Matachewan and Hearst, the Aphebian Priessac, and the Helikian Sudbury and Abitibi swarms. Cretaceous(?) kimberlitic dykes intrude the northern Kapuskasing Zone.

Strata of the Moose River Basin are Ordovician to Cretaceous. The basin is bounded on the south by Precambrian rocks of the Fraserdale Arch, an east-northeast-trending tectonic element that underwent periodic vertical movements in the Paleozoic and Mesozoic which truncated strata by erosion and faulting.

Oldest strata are Late Ordovician, Gamachian(?) laminated dolostone with interbeds of feldspathic sandstone, shale and minor gypsum lenses of the Red Head Rapids Formation. The Fraserdale Arch shed terrigenous sediments into the basin producing channel fill deposits in tidal flat and supratidal carbonates.

Silurian, mid-to late Llandovery rocks disconformably succeed Ordovician strata and locally overlap the latter to lie on the Precambrian. They consist of thin to massive bedded, fossiliferous limestone of the Severn River Formation which locally contains thin lenses and interbeds of sandstone in the southeast part of the basin. Late Llandovery to Wenlock limestone and dolostone of the Ekwan River Formation overlie the Severn River and are succeeded by Silurian to Devonian, Ludlow to Gedinnian redbed shale, siltstone, sandstone, dolostone and minor gypsum of the Kenogami River Formation. Kenogami River strata conformably succeed the Ekwan River in the central part of the basin, but disconformably overlap the latter in the southern part of the basin and lie on the Precambrian. The Severn River, Ekwan River and Kenogami River formations are in fault contact with Precambrian rocks of the Fraserdale Arch.

Uplift of the arch in the Silurian, Wenlock and Devonian, Gedinnian, resulted in erosion of Paleozoic strata, and development of a broad highland of Precambrian basement above the floor of the Moose River Basin. This highland was a major continental source for Devonian, Siegenian and Emsian red and grey conglomerate, sandstone, siltstone and shale of the Sextant Formation which was deposited unconformably on Precambrian. Ordovician and Silurian rocks are intertongued with Emsian marine cherty limestone of the Stooping River Formation in the lower part of the basin. Reefal limestone of the Kwataboahegan Formation developed on the Stooping River, followed by gypsum, dolostone and breccia of the Moose River Formation. Uplift of the Fraserdale Arch occurred during Moose River deposition. Associated faulting triggered extensive salt dissolution, collapse and development of megabreccias at the same stratigraphic horizon as the Mackinac Breccia of northern Michigan. Limestone of the Murray Island Formation lies unconformably on the Moose River. Givetian rocks consist of fossiliferous limestone and shale of the Williams Island Formation, followed by Frasnian and Fammenian black petroliferous shale and minor limestone of the Long Rapids Formation.

Throughout the Siegenian Stage, seaways occupied similar channels onto the Hudson Platform from the central and eastern Arctic, spilling over the Fraserdale Arch in the late Emsian to connect with the St. Lawrence Platform, the latter connection being largely continuous until the end of the Devonian. Upper Devonian black shales of the basin are similar to equivalent rocks in the Great Lakes region and both were presumably derived from the Appalachian Orogen.

Renewed uplift of the Fraserdale Arch in the Jurassic and the Early Cretaceous provided a source for sand and clay of the Mituskwia beds and Mattagami Formation deposited along the southern margin of the Moose River Basin. Lamprophyre dykes and sills (K-Ar age of 128 Ma) that intruded Siegenian to Eifelian strata along the Abitibi River and presumably elsewhere in the basin were associated with Cretaceous movements of the arch.

The Timmins map area is an important mining region in Canada with major production of gold and base metals, chiefly from the Timmins, Kirkland Lake and Noranda areas of the Abitibi greenstone belt. The Moose River Basin has potential for oil, gas, lignite, lead and zinc, gypsum, limestone, clay and sand.

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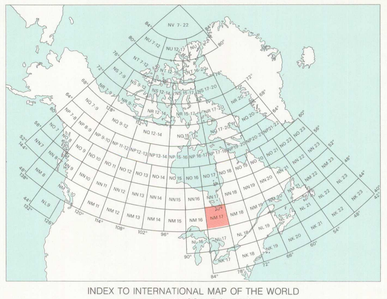

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GEOLOGY

TIMMINS

ONTARIO - QUÉBEC

GEOLOGICAL ATLAS, MAP NM-17-G

SHEET 1 OF 5

GENERAL CO-ORDINATOR: A.V. OKULITCH

Scale 1:1 000 000 - Échelle 1/1 000 000

Kilometres 25 0 25 50 75 Kilomètres

Lambert Conformal Conic Projection
Standard Parallels 48°40'N and 51°20'N

Base map at the same scale, published by Surveys and Mapping Branch in 1971, with names updated in 1982

Elevation in metres above sea level

This 1:1 000 000 scale map is part of the Geological Atlas of Canada and is plotted on the International Map of the World (IMW) base. Geology is one parameter being published in the National Earth Science Series

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LEGEND

PHANEROZOIC

MESOZOIC
CRETACEOUS
LOWER CRETACEOUS
Km *MATTAGAMI FORMATION*

PALEOZOIC
DEVONIAN
Ds *STOOPING RIVER, KWATABOHEGAN, MOOSE RIVER, MURRAY ISLAND, WILLIAMS ISLAND AND LONG RAPIDS FORMATIONS*

UPPER DEVONIAN
DLR *LONG RAPIDS FORMATION*

MIDDLE DEVONIAN
Dwi *WILLIAMS ISLAND FORMATION*
Dmi *MURRAY ISLAND FORMATION*
Dmr *MOOSE RIVER FORMATION*
Dk *KWATABOAHEGAN FORMATION*

LOWER DEVONIAN
Dsr *STOOPING RIVER FORMATION*
IDs *SEXTANT FORMATION*
Dkr *KENOGAMI RIVER FORMATION (upper member)*

SILURIAN AND DEVONIAN
UPPER SILURIAN AND LOWER DEVONIAN
SDkr *KENOGAMI RIVER FORMATION (middle member)*

SILURIAN
UPPER SILURIAN
Skr *KENOGAMI RIVER FORMATION (lower member)*

LOWER SILURIAN
Ser *EKWAN RIVER FORMATION*
Ssr *SEVERN RIVER FORMATION*

ORDOVICIAN
UPPER ORDOVICIAN
Ohrr *RED HEAD RAPIDS FORMATION*
Obcr *BAD CACHE RAPIDS GROUP*

PROTEROZOIC

HELIKIAN
NEOHELIKIAN
nHca *alkalic rock/carbonatite complexes*
nHayb *syenite/diorite/gabbro complexes*

APHEBIAN AND/OR HELIKIAN
NEOAPHEBIAN AND/OR PALEOHELIKIAN
Aca *alkalic rock/carbonatite complexes*

APHEBIAN
PALEOAPHEBIAN
Ac-G *HURON SUPERGROUP*
COBALT GROUP
GOWGANDA FORMATION

ARCHEAN

NEOARCHEAN
(relative ages uncertain)

MAINLY PRE- TO LATE-KINEMATIC

Ay, Aydi *syenite, quartz syenite, monzonite syenite/diorite/monzonite complexes*

Ag *granite, pegmatite, minor quartz syenite monzonite, granodiorite; in Quetico Subprovince includes inhomogenous and homogenous diatexitic bodies*

Agd *granodiorite, minor granite, syenite, monzonite, quartz diorite*

MAINLY PRE- TO SYNKINEMATIC

Aqd *tonalite, trondhjemite, quartz diorite*

Agx, Agp *xenolithic and agmatitic granitic rocks; variable mixtures of* Ag, Agd *and* Aqd *with* Avb, Ava, Anm *massive and foliated felsic plutonic rocks*

Aqdn *tonalitic, granodioritic and quartz dioritic orthogneiss, commonly with xenoliths, chiefly* Anm, *and intrusions of* Ag *and* Agd

Ang *xenolithic and layered granodioritic to dioritic orthogneiss and associated migmatitic rocks*

Angh *granulite facies xenolithic and layered granodioritic to dioritic orthogneiss*

Anm *dioritic, gabbroic and amphibolitic orthogneiss and associated migmatitic rocks*

Anmh *granulite facies dioritic, gabbroic and amphibolitic orthogneiss*

Anp *paragneiss and migmatitic paragneiss, commonly with abundant granitic and pegmatitic rocks*

Anph *granulite facies paragneiss and associated migmatitic rocks*

Aggn *unsubdivided felsic plutonic, gneissic and migmatitic rocks*

Ab *gabbro, diorite*
Aa *anorthosite, gabbro/anorthosite complexes*

Aub *ultramafic and lamprophyric intrusions*

Aif *iron formation, mainly oxide facies with lesser sulphide and carbonate facies*

Acg *fluvial and alluvial conglomerate, arkose, wacke, siltstone*

Aw *turbiditic wacke, siltstone, pelite, conglomerate; intercalated with volcanic rocks*

Avu *alkalic volcanic rocks, trachyte, trachy andesite, leucitite, mugearite, alkali basalt*

Ava *felsic, intermediate volcanic rocks; tholeiitic, calc-alkalic flows, pyroclastics, subvolcanic intrusions with intercalated volcanogenic sediments*

Avb *mafic, intermediate volcanic rocks; tholeiitic, calc-alkalic flows, pyroclastics, subvolcanic intrusions with intercalated volcanogenic sediments*

Avk *ultramafic volcanic rocks; komatiite, komatiitic basalt; related intrusions*

Areas with thick drift cover

Geological boundary (approximate assumed, facies)

Fault, displacement unknown (approximate, assumed)

Normal fault, solid circle on hanging wall (approximate, assumed)

Strike-slip fault (approximate)

Subsurface fault, displacement unknown (assumed)

Subsurface normal fault, solid circle on hanging wall (approximate)

Thrust fault, teeth on hanging wall (approximate, assumed)

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