The Geology of the South Half of Senneterre Township Abitibi-East County, Quebec

by

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INTRODUCTION

The field work covering the south half of Senneterre township was completed over several seasons of intermittent visits between 1964 and 1968 and again in 1975. Liberal use of company data was made including geophysical, geological and diamond drill results. This data was incorporated into the maps for a better coverage. Data particularly covering the Senneterre pluton, taken from an unpublished report of 1964 by G. Erdosh was used to complete the geology of the area. Marc Germain mapped most of the rocks in the area covered by the Dollard batholith.

This map project was undertaken following the discovery in 1962-63 of what was thought to be a major gold deposit. Subsequent work proved this to be exaggerated and interest in the area waned.

Location

The map-area is located in northwestern Quebec immediately south of the town of Senneterre which lies 260 miles (420 km.) northwest of Montreal. The centre of the area is at latitude 48°20' and at longitude 77°15'.

Access

The Bell River, which flows in a northerly direction, cuts through the west central part of the township.

Highway No. 113, Senneterre to Montreal, parallels the river on the

west side. A good gravel road, known as the Senneterre-Croinor road parallels the river on the east side. Another good gravel road known as the aeroport road cuts across the eastern part of the township. This road leads to the Senneterre aeroport on lots 46 and 47, range IV and to a small lake at the south end of lot 50, range III which is used as a water supply for the town of Senneterre. The extension of this road to the south along a sand and gravel esker leads to the former property of Transterre Exploration in lot 38, range I. A branch road continues to the southeast into the neighboring townships where it was used by lumber operators. There are numerous winter roads, trails and cut range lines rendering most parts readily accessible. The C.N. railway line from Val d'Or to Senneterre parallels highway No. 113 and the C.N. transcontinental line cuts across the northeast corner of the map-area.

Culture

A minor amount of farming is being done along both main roads on both sides of the Bell River. Dairy and beef farming are the main endeavours and hay is the main crop. Numerous farms have been abandoned and are being reclaimed by the forest. Lumbering took place in the past but the best stands of lumber have been harvested and any being cut now is on a very modest scale by some of the local farmers. A large peat bog covers lots 48 to 52 in range V and the south halves of lots 47 to 51 in range VI. The exploitation on a commercial basis of this bog was begun, in 1975, in range VI, by Toubex Incorporated of Senneterre.

Previous work

The area was covered by reconnaissance mapping by L.V. Bell and A.M. Bell in 1933. The map on a scale of 1 inch to 1 mile accompanies a report published in the Annual Report of the Quebec Bureau of Mines for 1933, part B. The area is included within compilation map no. 997A of the G.S.C. published in 1950. In 1948 the Geological Survey of Canada had the area flown magnetically and the results were published in 1952 on map No. 86G entitled "Senneterre".

In 1973 Questor Surveys flew the area electromagnetically by their "Input" method and the data was released by the Quebec Department of Natural Resources on maps No. D P 173.

PHYSIOGRAPHY

The south half of Senneterre township lies at the eastern extremity of the "clay belt" of northwestern Quebec. The west part of the map-area, which is relatively flat, is overlain by clays of the once extensive glacial lake Barlow-Objibway. Glacial eskers, one near the west side of Senneterre township is partly buried in the clay. Another one near the eastern side of the township is well exposed and forms a wide ridge readily seen on the air photos. The Senneterre air strip is built on the eastern esker.

The most prominent hills are along the northerly trending diabase dike in the central part of the township. The Senneterre radar station is built on this ridge just a few hundred feet north of the north limit of the map-area.

The northeastern corner of the map-area is underlain by the granitic rocks of the Dollard batholith. This is higher ground strewn with boulder and gravel ridges, and it covered the eastern limit of the former glacial lake Barlow-Objibway.

Outcrops are generally rare except along the Bell River, on and near the diabase dykes and over the Dollard batholith. Elsewhere outcrops are generally small, scattered, low-lying and moss covered.

Poorly drained areas, forming swamps, are located along the west side of the township, west of the partly buried western esker, and, near the eastern limit of the township, east of the large eastern esker. These swamps lie on the outwashed plains of the eskers.

GENERAL GEOLOGY

Chronostratigraphy

The consolidated rocks of the map-area consist entirely of Precambrian-age rocks made up of Early Precambrian (Archean) volcanic, sedimentary and intrusive rocks, cut by Late Precambrian (Proterozoic) diabase dykes. The unconsolidated material of Cenozoic-age consists of Pleistocene clays, sands and gravels of glacial origin, and, Holocene (Recent) lake, river and swamp deposits.

Lithostratigraphy

The area lies within the Superior Structural Province and belongs almost entirely to the Abitibi Supergroup and the Kinojevis Group which are characterized by their abundances of volcanic rocks.

STRATIGRAPHIC TABLE

Lithostratigraphic Units			Lithology	Chronostratigraphic Units		
Megagroup	Supergroup	Group		Era	Period	Epoch
Superior Structural Province			Recent swamp, lake & river deposits.	Cenozoic	Quaternary	Holocene
			Glacial clay, sand and gravel.			Pleistocene
	Abitibi	Kinojevis	Diabase dykes	Proterozoic (Late Precambrian)	Aphebian	
			Granite and granodiorite masses. Porphyry dykes and sills. Sills of gabbro-diorite, amphibolite and peridotite. Basalts, andesites, dacites, tuffs, agglomerates and related schists. Biotite, sericite and hornblende schists and gneisses of sedimentary origin, graphitic slates, argillites and sillstones (fine greywackes).	Archean (Early Precambrian)	Keewatin	

GENERAL GEOLOGY

Volcanic and sedimentary rocks

The oldest rocks, of sedimentary and volcanic origin, underlie the largest part of the map-area. They can be divided into two large units a northern one covering the central parts of ranges III to V, and, a southern one covering most of ranges I to II. With more data from neighboring townships these two units may be given subgroup names.

Northern unit

The northern unit, probably the oldest, is made up of sedimentary and pyroclastic rocks interlayered with both thin and thick flows of amphibolitized basaltic lavas. Some intermediate to siliceous lavas are present but these were more difficult to delimit from some of the light coloured sedimentary rocks. These rocks, because of their location between two large granitic masses have been highly metamorphosed into amphibolites, hornblende biotite garnet gneisses, and a variety of mafic and siliceous schists. But at some distances from the granite masses they assume their more normal low grade greenschist metamorphism.

The basaltic lavas and some associated gabbroic intrusions have been partly to completely recrystallized to amphibolites, in some cases losing their original identities but in other cases volcanic textures and structures are still preserved and the gabbroic nature of the intrusions are discernable from their massive appearance. Most of the gabbroic sills

can be delimited from magnetic data because of their higher content of magnetite.

The largest flows and beds of siliceous volcanic rocks are located in lot 31, range IV. The large lense-like mass, at least 300 feet wide, is made up of very light grey flows and tuffs. The lavas are rhyolitic and fairly massive but no volcanic textures or structures were noted except for a few possible amygdules. The tuffaceous phases are thin-bedded cherty and argillitic. No similar rocks were noted on the east side of the diabase dike. Material of similar composition are dikes of rhyolitic felsite which are probably related to the same magmatic activity that fed the siliceous extrusions. Two of these dikes were noted in the southwest corner of lot 32, range IV and 700 feet north of the latter. They are only a few feet thick.

The sedimentary rocks including much material of tuffaceous origin were the most highly metamorphosed. The original minerals were completely recrystallized to hornblende, biotite, actinolite, sericite and garnet and the cherty material recrystallized locally to quartz. The sedimentary rocks were mostly thin-bedded and the varying compositions of the individual beds were recrystallized into amphibole and black biotite-rich beds, into light brown mica-rich beds and into quartz-rich beds thereby keeping their bedded appearances. The original rocks were probably mudstones, siltstones, argillites, impure cherts,water-lain tuffs and minor agglomerates.

Sulphide iron formations made up of pyrite and pyrrhotite and locally

including graphite were noted in surface outcroppings and in diamond drill cores. They can be followed both magnetically and electromagnetically. Their trends are parallel to the strike of the sedimentary rocks. These iron formations are commonly found in the central part of range V but are strewn about elsewhere in the unit.

The south limit of this large unit contains in lots 21 to 29, range III, a series of lenticular magnetic anomalies. A few outcrops of amphibolite and gabbro on at least four of these confirm their mafic nature. They probably represent gabbroic feeders which pierced the top of the sedimentary rocks to supply the overlying basaltic lavas.

To the east, the southern limit of this large sedimentary and basaltic unit contains bead-like zones of aerial electromagnetic anomalies. (Q.D.N.R., 1973). These cross lots 34 to 42 in range III, lots 39 to 61 in range II, lots 56 to 62 in range I, and continue to the south-east into the neighboring townships. This six mile long zone in Senneterre township has no outcrops but was probed by five diamond drill holes by four different companies. These holes are located in lots 43, 52 and 57 in range II, and in lot 57, range I. The rocks cut were graphitic slates with or without barren sulphides, chlorite biotite hornblende schists of sedimentary or tuffaceous origin, and, some gabbros and basalts. The outline of the zone of anomalies was taken from the aerial map and for that reason it is shown on the geological map as a much wider unit than it actually is. Local ground surveys and the drilling indicated that the zone is made up of numerous lenses of graphitic slate with narrow basaltic flows and gabbroic sills within the sedimentary rocks.

Southern unit

The southern unit covers the west end of ranges I to V of the township and tapers off to the southeast corner of range I. Its northern limit runs diagonally across the map-area from the north end of lot 1, range V, to the south end of lot 62, range I.

The unit is made up almost exclusively of lavas with sill-like masses of mafic intrusions some of which could also be thick lava flows. Locally, minor tuffs and agglomerates may be found between some lava flows. In lots 51 to 53, range I, a zone at least 1400 feet wide of sedimentary and tuffaceous rocks was noted in drill holes.

These rocks strike southeasterly on the west side of Senneterre township and again near the east end in ranges I and II. But in the central part the strikes are nearly east-west. Dips are generally vertical but may vary to 80 degrees in either direction.

The outcrops in this unit are rare on the west side of the Bell river but are more common in the central parts of ranges I and II, east of the Adelphus river. Between the two rivers enough outcrops are scattered about to give a general idea of the make-up of the unit. At the east end the wide esker has completely masked the bed rock.

Numerous magnetic surveys have outlined lenticular zones, which, from a few outcrops and a fair amount of drilling, were confirmed to be gabbro-diorite sills. A sill up to 1200 feet wide located at the south end of lots 30 to 39, range I, deviates from the normal by being non-magnetic. These sills are probably feeders to the lavas.

The volcanic rocks are in large part flow brecciated lavas of basaltic composition but lesser amounts of andesitic to dacitic lavas are also present. Tuffs and agglomerates are relatively rare. The flow breccias can be confused with agglomerates. A close examination of outcrops can delineated pillowed forms as well as amygdules in both the fragments and the goundmass. The fragments generally weather to a lighter colour while the goundmass is darker green due to the preponderance of chlorite. Core from drill holes cutting these rocks show alternating relatively lighter and darker coloured bands which can appear to be tuffs. Tuffs and agglomerates are locally interbedded with the flow breccias but these are much less extensive in outcrop than the drill hole logging would indicate.

The lighter colour of the fragments can lead one to consider the rock to be a more siliceous composition than it actually is. The lighter colour is only relative, the fragments being fairly dark on a fresh surface. This may be due to higher contents of epidotes and carbonates. These minerals are calcium rich and chemical analysis of these rocks would place them in the basaltic clan. Erdosh (1964), in his unpublished report noted the high epidote content in hand specimens and also in thin section. Alsac (1974) following extensive geochemical analysis of volcanic rocks in the same sequence further west in Barraute township classified as basalts, rocks that were originally considered to be andesites. The massive interflows are dark fine-grained basalts and can be considered to be the massive equivalents of the brecciated flows.

The grade of metamorphism is low and belongs to the greenschist facies. Alteration is strong with the common alteration minerals of epidote, chlorite and carbonates. Erdosh (1964) also reported clinozoïsite and zoïsite from thin section work. Talc can be found in the mafic factions and sericite in the more siliceous factions.

INTRUSIVE ROCKS

The intrusive rocks of the south half of Senneterre township cover the whole spectrum from ultramafic to the more siliceous types. The granitic rocks are by far the most voluminous since they compose two large batholiths and a fair size pluton. The mafic intrusions are on the other hand closely related to the basaltic and andesitic vulcanism probably as sills and dykes feeding the latter.

Ultramafic to mafic intrusions are numerous and strewn about in the volcanic pile. They are generally lenticular and sill-like with strikes similar to those of the enclosing rocks. Ground magnetic surveys have outlined many of these bodies. Four of these, located at the south end of lot 3, range V, at the north end of lot 25, range II, in lots 57 to 58, range I and lots 51 to 53, range I, were shown by drilling to be caused by ultramafic rocks of peridotitic composition. A serpentinized peridotite was also noted in outcrop in lot 37, range V. Its outline is unknown since no magnetic data is available covering the north part of the range.

The other magnetic anomalies are related to gabbroïc rocks. They vary in composition from dark coarse-grained gabbros to medium-grained

lighter coloured gabbros, some diorites and in at least one case a quartz diorite sill. Gabbro is the main rock type and is probably related to the lavas possibly as feeders to the latter. Most of these have been confirmed by drilling or from outcrops. The untested anomalies which resemble the others are assumed to be similar and are thus shown on the map to be underlain by mafic intrusions. This does not rule out the possibility that some may also be thick massive basalt flows.

One large sill possibly as much as 1200 feet wide, is exposed at the south end of lots 30 to 39 in range I. It is, contrary to most other similar rocks, non magnetic.

Grain size varies from coarse to medium and the colour is various shades of grey. The feldspars are greyish and the amphiboles greenish grey to black.

One sill in lots 17 and 20, range I, is considered to be a quartz diorite. The sill is highly altered to a chlorite, sericite, quartz and carbonate rock with well disseminated pyrrhotite and local fine chalcopyrite grains. The rock kept its granular appearance. The magnetic high over this sill is due to the pyrrhotite and some magnetite. It may be related to the granodiorite -quartz diorite pluton a mile to the south in Tiblemont township which is also magnetic.

Quartz feldspar porphyries were noted in lot 27, lots 35 to 41, lots 43 and 44 all in range I and at the north end of lot 31 range III. These rocks of granodioritic composition are associated with gold metallization in range I. The quartz porphyries are made up of very light

white to buff coloured rocks. There is very little or no mafic mineral. The rock is hard, brittle and composed of quartz grains, altered feldspar, sericite, carbonate and locally minor pyrite.

Diorite porphyries, generally referred to as feldspar porphyries, were reported in drill cores as narrow dikes in numerous places. In outcrop these were labelled as diorite porphyries or feldspar porphyries. Whitish to slightly greyish feldspar phenocrysts are found in a dark greenish grey groundmass for the more mafic types but others can be found with lighter groundmasses.

Numerous dykes and sills cutting the metamorphosed pyroclastic, sedimentary and basaltic rocks in lots 28 to 38, range V, are made up of granodiorite. These vary is colour from light grey to fairly dark, the colour differences probably depend on the degree of assimilation of wall rocks. The magmatic activity feeding these is probably the same as that associated with the emplacement of the Senneterre pluton and the Dollard batholith. The area, about a mile and a half wide, lies between the pluton and the batholith. In the south half of range IV in the vicinity of the township centre line some narrow light-coloured rhyolite or felsite dykes were noted. These are fine-grained light grey rocks of rhyolitic composition. They crosscut lavas and tuffs and are probably feeders to minor siliceous vulcanism in that area.

The Senneterre pluton covers, in the southwestern quarter of the township, large parts of ranges IV and V, and, the north central part of range III. It also covers, outside the map-area, part of range VI, and

may join by a narrow neck another larger mass further north. At depth it probably joins the main Dollard batholith which lies a mile to the east.

The writer has seen few rocks of the Senneterre stock. The following data was taken from an unpublished 1964 report by G. Erdosh for the Quebec Department of Natural Resources.

The Senneterre pluton is five miles long in an east-west direction and about three miles wide. The southern contact from outcrops and geophysical data is relatively straight. The eastern contact is irregular with several tongues.

As the composition of the stock varies and exposures are relatively scarce, it was difficult to classify. The interior of the stock forms a negative relief, now covered with overburden, and it is well exposed only in a few rapids of the Bell River. Even here a great variation in composition, texture and color was observed within relatively short distances. Exposures are better near the margins but high contamination can be expected which may affect the composition.

Microscopic examination revealed that the few central outcrops and those along the eastern margin are granodioritic while the western and southwestern part is monzonitic and in places quartz monzonitic. The grain-size is relatively uniform, medium to coarse and the texture is granitic throughout. Color varies from light grey to slightly pink and locally darker. Quartz content ranges from less than 5 to 30 percent. Mafic minerals form very little to over 50 percent and they may consist

of only hornblende, only biotite or both. The composition of plagioclase varies around An_{35}. Potash feldspar may be orthoclase or microcline. Alteration, except for that of plagioclase, is slight. Some alteration products such as epidote, chlorite and sericite are always present. Albitization seems to be an important deuteric alteration affecting plagioclase and producing albite of about An_{10}. Zircon and/or apatite are ubiquitous accessory minerals.

Near the borders of the stock, assimilation of the wall rocks is shown by fairly numerous remnants of partly digested xenoliths, and by the considerable increase of mafic constituents.

A small pluton in lots 32 to 34 at the range IV-V line is about 2000 feet long in a northeasterly direction and it has a maximum width of 800 feet. The rock is a monzonite-syenite to quartz monzonite-granite mass probably related to the more siliceous phase of the Senneterre pluton which lies half a mile to the west. Similar rock was noted in one spot in the Dollard batholith five miles to the east.

The rock is medium grained, but some parts are fine grained felsitic. It contains very little mafic material, 10 percent or less of fine biotite, some epidote and variable amounts of quartz, hardly any quartz was present in some specimens. Two feldspars are present, one pinkish and the other whitish, but the pinkish orthoclase feldspar generally predominates. The rock as a whole has a very pinkish colour. The rock is almost identical to a specimen of the Senneterre pluton taken from an outcrop at the northwest end of lot 25, range IV. Another similar rock slightly less

pinkish and with a little more biotite was found in a sill of unknown width at the north end of lot 38 range V. This rock intrudes recrystallized tuffs. Narrow pink dykes and sills of similar composition are numerous for several hundreds of feet from the pluton.

The Dollard batholith covers several thousand square miles to the east and northeast of Senneterre township. In the map-area, the east parts of ranges IV and V are underlain by the contact area of the batholith.

The rocks encountered are mostly gneissic grey granodiorites and quartz diorites. These rocks vary considerably in texture and colour and are probably highly contaminated by the volcanics. Xenoliths of amphibolite, possibly recrystallized basalts, are numerous. The wall rock basalts and possibly associated gabbros are also recrystallized and amphibolitized. Some of the batholithic rocks near the contact are hornblende biotite diorites representing partly assimilated volcanics. The grain size varies considerably from coarse to fine. Gneissic textures are generally present and in many places are prominent. At the south end of lot 60, range V, a light pinkish coloured rock with only 2 percent biotite grades towards a quartz monzonite to true granite composition. This rock is similar to those found in lot 25, range V in the Senneterre pluton and in the small pluton in lots 32 to 34, range V.

Black biotite is the most common mafic mineral and is found in all samples. It varies from 2 to almost 50 percent of the rock. Hornblende is common near the contact and may be remnants of the assimilated material of the wall rocks, it tends at some distance to convert to biotite. Quartz

is present and may make up 10 to 30 percent of the rock. A few rocks, such as the hornblende biotite diorite in the contact area, are poor in quartz. Feldspars are greyish-white and appear to be altered particularly in the more gneissic samples. These are all plagioclases and only the sample from the south end of lot 60, range V has pinkish feldspar which may be a potassic variety.

Only the contact area of the batholith has been observed in Senneterre township and the batholithic rocks have been highly contamined by the neighboring volcanic rocks. The wall rocks, have also been affected by the batholith, the basalts and related gabbros having been recrystallized to amphibolites.

The north contact of the Tiblemont-Pascalis batholith cuts across the southwest corner of Senneterre township, diagonally across lots 1 to 5 in range I. A few small outcrops in lot 1 are made up of granodiorite or quartz diorite. Some other outcrops to the north are gabbros with basaltic inclusions and are probably a basic phase of the intrusion which is shown on Bell and Bell's 1933 map as diorite. These are probably assimilated volcanic rocks. Many of these were also noted in that part of the batholith that lies in Tiblemont township. All grades of assimilation were noted there.

A large Late Precambrian diabase dike cuts across the central part of the south half of the township from lots 19 and 20, range I, at the south end, to the north end of lot 35, range V. In the middle of range I and towards the north end of lot 31, range IV, smaller parallel dikes were

noted. In range III the main dike ends to continue in a parallel position a few hundred feet away. The highest outcrops in ranges III to V are located on these dikes.

The general strike of the main dike is N.25°E. but it is sinuous in outline. Width varies from less than 100 feet to a little over 300 feet. The smaller dikes are 50 to 100 feet wide and strike in a more northerly direction.

The dikes are irregularly and weakly magnetic. They can be picked up over outcrop areas and shallow overburden but appear to be too weak to be noted over deeper overburden.

The rock is a gabbro which varies in grain size from a fine-grained chilled edge to a coarser central part. The ophitic texture although present is not readily apparent but the rock because of its fresher appearance and its distinctive greyish colour and small rough pitted weathering can be distinghuished from the older gabbros with their dark green colorations.

G. Erdosh (1964) examined the rock microscopically and reported that the feldspar is labradorite with An_{70}. The pyroxenes, which constitue 60 to 70 percent of the rock, are augite and pigeonite. A little quartz is also present. About 5 percent magnetite was noted in the sections examined.

A large xenolith 10 by 30 feet and smaller ones made up of feldspar porphyry with inclusions of sedimentary rocks were noted on the east side

of the diabase dike at the north end of lot 32, range IV. These were undoubtably slabbed-off the wall rocks by the diabase magma. The curious phenomenon noted is the presence of five or six inclusions of diabase in the smaller xenoliths. A possible explanation is that the original sedimentary inclusions were punched out of the thin porphyry xenoliths and replaced by the diabase magma.

STRUCTURE

Strikes

The volcanic and sedimentary rocks of the south half of Senneterre township have a slightly south of east direction but at the west end the directions are southeasterly. A strong deviation in range IV and V at the township centre line forced the rocks into a north-south direction. This is due to the squeezing of the volcanic and sedimentary rocks between the Senneterre pluton and the Dollard batholith.

Dips

The volcanic and sedimentary rocks are standing up on edge, dips vary from a few tens of degrees on either side of the vertical. The flatest dips, approximately 60 degrees to the west, are found in the rocks lying between the Senneterre pluton and the Dollard batholith in the central part of ranges IV and V. Again these probably conform to the dips of these two large intrusions.

Stratigraphic tops and folding

The lack of a suitable number of top determinations renders difficult the definition of the major folding pattern. Until more data is available from surrounding areas the assumption is made that the major structure is anticlinal. It is postulated that the fold axis passes through the central part of the Senneterre pluton and through the volcanic and sedimentary rocks near the north end of lots 30 to 32 in range III. Poor outcropping to the east leaves the location of the extension of the fold axis conjectural. To the west lack of suitable top determinations and outcropping in Carpentier township and the need for detailed mapping in Courville township leaves the tracing of the fold axis through these areas uncertain.

In the south part of Senneterre township pillowed basaltic outcrops show in four places tops from the pillows which all face towards the south. These were noted on the map in lots 19 and 28 in range I and lots 39 and 41 in range II. So these rocks appear to lie on the south limb of an anticlinal fold whose axis lies to the north.

To the north the volcanic and sedimentary rocks have been too highly altered, sheared and metamorphosed to preserve structures and textures suitable for determinations. The rocks there were undoubtedly affected by the intrusions of the granitic rocks to a large degree. But drag folding which is fairly extensive in the thin bedded sedimentary rocks in the central part of range IV and V seems to indicate an anticlinal axis lying to the south. There, the rocks were severely squeezed between the Senneterre pluton and the Dollard batholith, so the observations may be of doubtful value.

It has been observed in mapping further to the west particularly in Dalquier township that diabase dikes end to continue in a parallel but offset position a few hundred feet away at fold axes. The offset of the main dike at the north end of range III in lots 29 to 31 may therefore indicate the location of a fold axis.

This location in range III and through the Senneterre pluton would line up with the Amos anticline further west. The mixed unit of volcanic and sedimentary rocks appears to be in the same stratigraphic horizon as that in which the Amos anticline is located in Barraute and possibly in Carpentier township.

Provisionally, considering the meagre and indirect evidence available, a major anticlinal fold axis is deemed to pass through the south part of Senneterre township. This anticline which appears to follow along in the same stratigraphic horizon as the Amos anticline to the west is considered to be an extension of the latter into the Senneterre area.

Faulting and shearing

No major through going shears or faults were noted. Most of these are local in nature and appear to be relatively short.

Shearing with associated drag folding is the most intense in the deformed sedimentary and tuffaceous rocks in the central parts of ranges IV and V. The basaltic lavas interbedded with these appear to be much less sheared and deformed. This is probably due to the homogeneous nature of the flows which responded to the shear stresses by massive amphiboli-

tization. The stresses were taken up mostly by the sedimentary rocks because of their weak bedding planes.

A strong east-west shear zone in range I, lots 35 to 39, is related to numerous sill-like porphyry intrusions in which gold is found. The strong shearing seems to be limited to the length in which the sills are multiple.

Cross faults were noted in numerous places but these are more apparent in the thin-bedded sedimentary and tuffaceous rocks. These have displacements of less than an inch to several feet. The scattering of moss covered outcrops and the glacial overburden cover may hide some stronger fault zones.

ECONOMIC GEOLOGY

Mineralization

Mineralization in the south half of Senneterre township is limited to gold, molybdenite and copper-zinc.

Gold mineralization is the most extensive and has attracted prospectors from the earliest days beginning with the passing through the area of the transcontinental railway in 1913. Numerous trenches were noted in outcrop areas wherever there are quartz veins or sulphide zones. Most of these were dug during the twenties and thirties. Few results concerning these endeavours are available but Bell and Bell's (1934) report does describe some.

Diamond drilling and geophysical surveying dates from the fifties to the present day. Gold and base metals were the favoured metals sought.

The writer is not aware that any gold assays of economic interest were had from the numerous sulphide zones. Gold seems to be found principally in or near porphyry dykes and sills and generally in the more siliceous of these, particularly the highly felsic quartz porphyries. Some gold has been found associated with the rocks of the Pascalis-Tiblemont batholith in the neighboring townships. This batholith cuts across the southwest corner of Senneterre township. Outcrops were found only in lot 1, range I. Quartz veinlets in a gabbroic rock related to the batholith were noted in the northermost outcrop. The veinlets also contained pyrite mineralization. A specimen sent in for assay returned 0.004 oz. gold per ton.

The search for base metals was carried out in most recent years by verifying geophysical anomalies. So far only barren pyrite and pyrrhotite lenses with or without graphite have been intersected in the drilling.

Molybdenite mineralization is associated with the activity related to the Dollard batholith. This mineral is found in quartz veins in the contact area of the batholith, within the granitic rocks or in the wall rocks within a mile of the contact.

Exploration projects

The following companies carried out work in the south half of the township on properties where some mineralization of minor interest was encountered.

The property of Candore Explorations Ltd., covered lots 43 to 46, renge I, Senneterre township. In 1964 Candore drilled 18 holes totalling 11,024 feet which included 2 joint holes with Northwest Canalask Mines totalling 1,722 feet. The Candore-Canalask holes were located along the northeast limit of Candore's property.

A cross-section of 10 holes in lot 43 cut a few gold values in or near porphyry dykes or sills. At the north end of the range, one hole cut a 1.3 foot section which returned 0.13 oz. gold per ton. In the central part of lot 43, of four holes drilled to follow a porphyry dyke, two holes cut 0.09 oz. across 1.3 foot and 0.12 oz. per ton across 0.5 foot. About 500 feet south of the above porphyry two of three holes in the same section cut in or near a porphyry dyke 0.13 oz. gold across 5.3 feet and 0.14 oz. across 1.6 foot. Gold would seem to be erratically distributed in or about porphyry intrusions.

Senneterre Goldfields Ltd., drilled 4 holes in lots 40 and 41, range I, Senneterre township in 1964. Gold tenors over narrow widths were cut near the edge of a quartz porphyry sill. The better values in ounces per ton across the following footages were: 0.175, 0.16 and 0.10 across 4.5 2.5 and 2.0 feet.

Transterre Explorations Ltd., held in the early sixties lots 29 to 39, range I, Senneterre township. At least one hundred holes were put down on this property. Eighty holes totalling approximately 40,000 feet were drilled by Transterre Explorations Ltd., in 1963-64 and 20 holes totalling 6,231 feet by Dubuisson Mines in 1944-45. No data is available concerning the latter company's results (Q.D.M., 1945-46).

A strong shear zone in volcanic rocks cuts across the property in an almost east-west direction. The volcanic rocks are made up of andesitic and dacitic lavas and some tuffs and agglomerates. The shear zone has been invaded by numerous quartz porphyry sills. The sills branch out and coalesce along the strike and down the dip, vary considerably in width but remain within the shear zone.

The quartz porphyry is made up of a very light white to buff coloured rock. There is very little or no mafic mineral. The rock is hard, brittle and composed of quartz, altered feldspar, sericite, carbonate and pyrite. In places pyrite constitutes less than one percent of the rock and is rarely more than five percent. It is found scattered as fine cubic crystals or small rarer blobs. The rock is fractured with fractures healed by quartz-carbonate stringers. The wall rocks near the sills are highly sheared, pyritized and silicified.

Gold is erratically distributed in the sills and neighboring wall rocks. The first 16 holes of Transterre Explorations Ltd., with the exception of holes 12 and 15 seemed to indicate a possible deposit of ore grade material. But subsequent drilling in the extensions of the zone and test holes in the same sections as the first 16 holes failed to confirm the earlier results and the possibility of a mineable deposit. Gold is present in the sills but is erratically distributed. In part it seems to favor some well silicified and pyritized parts of the sills neighboring iron-rich wall rocks.

No deposit of ore grade was delimited from this work. Ore grade material reported across fair widths in one hole would fail to be repeated in a neighboring hole in the same section or in a neighboring section.

J.J. Harris, now deceased, was the consulting geologist and general manager on the property of Transterre Explorations Ltd.

Newconex Canadian Exploration covered lots 14 to 28 in range I in 1964. Magnetic and electromagnetic surveys were completed over the entire property. Three drill holes were put down in lots 17, 20 and 27. The two first holes in lots 17 and 20 cut a magnetic anomaly caused by a quartz diorite sill. This rock is highly altered to a chlorite, sericite, carbonate rock with well disseminated pyrrhotite and local fine chalcopyrite grains. The rock kept its granular appearance. The wall rocks are highly sheared and altered volcanics, displaying an alternation of mafic and siliceous bands, made up of chlorite and sericite schists. Outcrops and trenches at the east end of lot 17 have exposed the quartz diorite. It is a grayish white weathering rock with shears and fractures. On a fresh surface the rock is medium gray. Sericite, some chlorite, iron bearing carbonates, quartz and carbonate stringers are the main minerals noted. Pyrite and pyrrhotite were noted in small quantities. J. Smith a prospector who has lived on the property for the last 40 years reports that he has found free gold in the quartz-carbonate stringers. A value of 0.61 oz. per ton in one assay was also reported. The drill holes failed to cut values of economic interest.

A porphyry sill at the north end of lot 27, range I is identical to the sills of Transterre located to the east. The rock is very light grey with quartz stringers and local pyrite mineralization. A few trenches put down by early prospectors were noted but the sampling results, if any was undertaken, are unknown. The sill intruded amygdular and flow

brecciated andesite-dacite. It strikes N.85°E. and dips almost vertically.

In the central part of lots 22 and 23, range II, trenching on the Fortin claims was undertaken in 1933 (Bell & Bell, 1934; Dresser & Denis, 1949) in a shear zone with a rusty band 20 to 50 feet wide. The zone, which strikes N.65°W., is silicified and mineralized with pyrite and some veinlets of sphalerite. A narrow vein in the west trench was reported by the prospector to carry gold but a sample by Bell & Bell (1934) gave only low values. The writer visited the showing in 1965 but the trenches were caved-in and heavy scrub brush had almost completely covered the old workings. Only a piece of pyritized sericite-chlorite schist was retrieved from a small exposure in one of the trenches.

Continental Exploration Ltd., in 1951, drilled 4 holes totalling 1,318 feet in the central part of lots 22 and 23, range II. Only low values in copper, zinc, silver and gold were reported.

In 1955-56 the property belonged to Italia Copper Mines. A limited amount of trenching and some pack-sack drill holes were put down in lot 15 range II. Some of the drilling was done in rock outcropping on the edge of the river. On both sides of the road in lot 15, range II, chalcopyrite and pyrite mineralization were noted in minute fractures in the volcanic rocks.

On the east side of the road along the north edge of the outcrop area chalcopyrite mineralization in stringers and blobs was noted in the chlorite schist in the contact zone of quartz veins. On the west side of the road at least two shear or fracture zones contained fine chalcopyrite mineralization

in minute fractures. Grab samples by the prospectors from a larger fracture ran as high as 0.8 and 1.2 percent copper. Chalcopyrite was noted only on freshly broken surfaces along with pyrite and some pyrrhotite. On weathered surfaces only minor gossan was noted. At the river edge chalcopyrite disseminated in the chlorite schist was seen in hand specimens. Chalcopyrite is disseminated in the shear and fracture zones but no concentration of economic interest was found.

The writer revisited the showing in lot 15, range II located on the east side of the road along the north edge of the outcrop area in 1965. The mineralized area 100 x 100 feet had just been bulldozed and final cleaning of the exposure was being done by prospector O. Thibault of Senneterre. The five parallel quartz veins exposed are very irregular, narrow and some coalesce at the west end. At one spot a blow-out up to 15 feet wide was formed. The veins generally strike east-west and are up to 100 feet long becoming veinlets at the east end where they dissipate themselves in the sheared basalt. Chalcopyrite and pyrite in blobs can be seen in the quartz veins and in the chlorite schist on the edge of the veins. The prospector claims that some of his samples ran as high as 0.16 and 0.34 ounce gold per ton. The writer sent in a sample with chalcopyrite for assay and got only 0.018 oz. gold per ton.

Consolidated Mogul Mines acquired the property in 1961. It covered lots 14 to 27 range II, the east half of lots 18 to 20 and the south half of lots 21 to 29, range III in Senneterre township. Magnetic and electromagnetic surveys were completed over the entire property and nine drill holes totalling 2,928 feet were put down. These holes were located in

lots 15 and 17, at the north end of lots 21 and 25 in range II, and, in lots 23 and 28, range III. The holes in range III, drilled to test electromagnetic anomalies, cut sedimentary rocks with interbeds of graphitic slate mineralized with pyrite and pyrrhotite. The other holes in range II tested magnetic anomalies. These cut gabbro-diorite sills in an environment of basalt-andesite lava flows. One hole in lot 25 cut a serpentinized peridotite sill. No values of economic interest were reported from this work.

Nisto Mines held in 1964-65 lots 20 to 34 in range II. A magnetic survey covered lots 27 to 34 and an electromagnetic survey covered lots 22 to 34. A diamond drill programme totalling 4,997 feet was completed in 11 holes. Two holes drilled to test a magnetic and an electromagnetic anomaly at the north end of lot 30 in range II cut basaltic lavas, gabbroic rock and graphitic slate containing pyrite and pyrrhotite mineralization. Very minor chalcopyrite was reported from the drill cores. One hole in the central part of lot 33 in range II cut a fairly massive gabbro intrusion. The remaining 8 holes were located at the south end of lots 21 to 30 in range II. They cut basaltic, andesitic to dacitic lavas and some tuffaceous rocks that were locally mineralized with pyrite and pyrrhotite. Values of economic interest were very low for gold, silver, nickel and copper.

Numerous companies and individual prospectors held ground at one time or another on ground covering lots 28 to 37, range V in Senneterre township.

Jubilee Iron Corporation in 1964-65 covered the property with magnetic, electromagnetic, and geological surveys. Two diamond drill holes, located

at the south end of lots 33 and 34, range V, cut the southeastern extensions of long pyrite and pyrrhotite zones. These zones begin at the north end of lot 28 and extend diagonally across range V to the south end of lot 35. These barren sulphide zones can be seen in pits, trenches and outcrops in numerous locations and were outlined geophysically by numerous surveys. The other rocks on the property are well bedded but highly metamorphosed sedimentary rocks which have also been considered to be water-lain tuffs.

Kennco Exploration also drilled a hole at the south end of lot 33, range V in 1959. Magnetic and electromagnetic surveys partly covered the property. The rocks cut in the hole were mostly sedimentary rocks with pyrite and pyrrhotite mineralization.

The Lavoie-Simard property, which comprised the north half of lots 32 to 37, range V and lots in range VI, contains a molybdenite showing located on the radar road at a point on lot line 35-36, 300 feet south of the range V line. Quartz veinlets in sheared sedimentary rocks are mineralized with molybdenite. One grab sample, taken in 1951 at the time of the radar construction, assayed 2.16 percent molybdenite. This showing is now within the perimeter of the radar property and is restricted to prospecting.

O. Thibault, a Senneterre prospector, held lots 28 to 31, range V, and undertook trenching on molybdenite mineralization in 1958, at the north end of lot 31 (Q.D.M., 1960). The mineralization is associated with pegmatitic quartz veins and veinlets 3 inches to 4 feet wide. Molybdenite can be found in the veins and in the sheared siliceous sedimentary rocks in the contact area. Streaks up to $\frac{1}{2}$ inch thick of molybdenite were noted in a zone two feet wide. The two zones of mineralization lie 500

and 750 feet south of the range line near the east side of lot 31, range V.

R. Thomas, another Senneterre prospector worked the same claims in the thirties for gold (Bell & Bell 1934) (Dresser & Denis 1949). Only low values were reported from the numerous quartz veins and barren sulphide zones.

Diamond drilling was completed on the following properties generally to test geophysical anomalies. No mineralization of economic interest was encountered.

Three drill holes totalling 792 feet were drilled in 1965 on the Simard claim near the south end of lot 42, range II.

The Berthiaume claims, covering lots 1 to 6, range IV and the north halves of lots 1 to 6, range III, were surveyed by magnetic and electromagnetic methods. The anomalies were tested by 3 holes totalling 1,771 feet. The work was carried out between 1959 and 1965.

Big Town Copper Mines Ltd., held lots 1 and 2 and the south halves of lots 3 and 4 in range V during the period 1959-65. Magnetic, electromagnetic and induced polarization surveys and two drill holes totalling 1,149 feet were completed. The holes were located at the south end of lot 2 and near the west limit of lot 1. Ultramafic rocks, possibly altered peridotites, were cut in one hole.

The Canadian Nickel Co., (Canico) drilled holes in the central parts of lots 43 and 52, range II, to test an extensive zone of aerial electromagnetic anomalies in 1967. These holes cut graphitic slates, schists of

sedimentary origin and some basaltic lavas or gabbroic intrusions.

Great Plains Development Co. Ltd., in 1974, drilled 2 holes at the south ends of lots 41 in ranges IV and V. These tested magnetic and electromagnetic anomalies. Graphitic slates with pyrite and pyrrhotite mineralization were cut in the holes. Two holes were also drilled near the central part of lot 29, range III. One of these cut pyrite and pyrrhotite mineralization. Magnetic and electromagnetic surveys covered the south quarters of lots 38 to 42, range IV the north quarters of lots 38 to 42, range III; the south quarters of lots 39 to 45, range V and the north quarters of lots 39 to 45, range IV; the central parts of lots 27 to 33, range III; the south quarters of lots 34 to 36, range V and the north halves of lots 34 to 37, range IV; the south quarters of lots 34 to 37, range III and the north quarters of lots 34 to 37, range II; the south quarters of lots 3 to 5, range II and the north quarters of lots 3 to 5, range I.

Ghislau Mining Corporation covered lots 51 to 54 in range I, in 1964. A magnetometer survey located an anomaly crossing the property. Four drill holes totalling 3,734 feet were completed to test the anomalous zone which turned out to be an ultramafic sill and some gabbro dykes. The other rocks were argillites, greywackes, some tuffs and minor basalt and amphibolite.

Quebec Explorers held the east end of lots 11 to 13, range II in 1961. A magnetometer survey outlined a sill-like intrusion which was tested by a drill hole at the east end of lot 11. The rock cut was gabbro.

A vertical drill hole for water was put down 280 feet in lot 8 range II by the Department of Colonization on the east side of the road. The hole cut basaltic lavas.

Another vertical drill hole was put down 200 feet at the east end of lot 11, range I for cottage water by M. Goyette. The rocks cut were basalts.

Union Minière Exploration and Mining Corporation Ltd., (Umex) held in 1969 the north halves of lots 55 to 58, range I, in Senneterre township. Magnetometer and electromagnetic surveys partly covered the ground. A drill hole, approximately 1800 feet south of lot post 57 and 58, range I, cut mica schists of sedimentary origin, and graphitic slates with pyrite and pyrrhotite mineralization.

Sullico Mines covered approximately the same ground in 1966 with magnetic and electromagnetic surveys. A hole was drilled 1350 feet south and 100 feet west of lot post 57-58 in range I. It cut biotite, sericite and chlorite schists of sedimentary origin, graphitic slate and the south edge of a gabbro and altered peridotite sill.

The following companies carried out geophysical surveys on their properties without reporting any further work.

Central Manitoba Mines Ltd., in 1964, covered magnetically lots 1 to 6, range I; lots 1 to 4, range II; and, lot 1 and the south halves of lots 2 to 5, range III.

Jubilee Iron Corporation Ltd., in 1964, covered magnetically the following properties excluding those mentioned previously; lots 28 to 33,

range V; lots 27 to 40, range IV; lots 17 to 38, range III; lots 7 to 13 range I; lots 5 to 7, range II and lots 6 and 8, range III; and lots 54 to 58, range III.

The Mackay D.S. Claims were flown in 1958 by an airborne electromagnetic survey which encompassed lots 34 to 44 in ranges II, III and IV.

White Star Copper Mines Ltd., held in 1965 lots 37 to 40, range II. Magnetic and electromagnetic surveys were conducted over the claims.

The H. Bush showing, located in the centre of lot 62, range III, near the east limit of the township, was uncovered in 1933 (Bell & Bell, 1934). Here some mineralization occurs along an acidic dyke, two to eight feet in width, which intrudes amphibolitic basalt in a north-south direction. Irregular lenses of mineralized quartz are found along either side of the dyke. Along the west side, such lenses have a varying width of two to six feet, while on the east, quartz lenses with accompanying silicification and intervening country rock occur through a zone having a maximum width of 15 feet. These veins are exposed for some 180 feet. Although the quartz is well mineralized with chalcopyrite and some pyrite, gold values appear to be low.

Molybdenite mineralization can be seen at the north edge of a large outcrop area covering the south end of lot 61 range IV. The discovery is imputed to the prospector H. Gilligan in the early forties. Fine molybdenite with some pyrite can be found in two en échelon shear zones intruded by quartz veins. The zones strike east-west with dips of about 60° to the south.

Two trenches were made along the edge of the outcrop area in the two shear zones. The eastern rock trench was opened for a length of 20 feet with both ends covered by overburden. The shear there has a width of 7 feet. It shows numerous quartz veins and veinlets parallel to the shearing. There are also a few quartz blobs. The western trench is offset 15 feet to the south and continues in a westerly direction for 50 feet, and, 20 feet beyond the end, another pit also shows the quartz-molybdenite bearing shear zone to be present. A width of 10 feet can be seen in one spot with the north side covered with overburden.

Molybdenite and pyrite mineralization can be found with the quartz in most places in the shear zones. The molybdenite is fine grained and found disseminated or in streaks and blobs. The average grade for the deposit would be low. Because of the poorness of the exposures and the fineness of the mineralization a visual estimate of the grade was impossible. Some grab samples would run well over one percent molybdenite.

McKinney Gold Mines Ltd., in 1964, covered by magnetometer survey the south halves of lots 57 to 62, in range IV. Three holes totalling 1504 feet were drilled at the south end of lots 58 and 59. The rocks cut were amphibolitized basalts intruded by siliceous and diorite porphyry dykes. The hole in lot 59 cut a three foot siliceous porphyry dyke mineralized with fine pyrite and a little fine molybdenite.

Molybdenite mineralization was also noted in lots 31, 35 and 36, range V and it is described under the Lavoie-Simard property and under O. Thibault in this report.

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TABLEAU STRATIGRAPHIQUE

Unités lithostratigraphiques			Lithologie	Unités chronostratigraphiques		
Mégagroupe	Supergroupe	Groupe		Ere	Période	Epoque
Province structurale de Supérieur			Dépôts récents de lac, rivière et marais.	Cénozoïque	Quaternaire	Holocène
			Argile, sable et gravier glaciaire.			Pléistocene
	Abitibi	Kinojevis	Dikes de diabase	Protérozoïque (Précambrien Postérieur)	Aphébienne	
			Masses de granite et de granodiorite. Filon-couches et dikes de porphyres. Filon-couches de gabbro-diorite, d'amphibolite et de péridotite. Basaltes, andésites, dacites, tufs, agglomérats et schistes reliés. Schistes et gneisses à séricite, à biotite, et à hornblende d'origine sédimentaire, schistes argileux graphiteux, argilites et grauwackes.	Archéenne (Précambrien Antérieur)	Keewatienne	

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