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SOUTHEAST QUARTER OF VERNEUIL TOWNSHIP

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SE - Verneuil Township

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CONTENTS

A. Introduction

During the summer of 1969 the 25 square miles of the SE - Verneuil township were mapped at scales from one inch equals 2000 feet to one inch equals one thousand feet, according to the complexity of the geology. This project is the eastern continuation of a program started by M. van de Walle (SW - Verneuil) in 1968.

Geographically located in the south central part of Québec, this area is bounded by longitudes 76°39'10'' and 76°45'30" W and latitudes 49°00'30" and 49°04'50" N. The center of the area is approximatively 15 miles east of the town Lebel sur Quévillon, which is on highway 58, 55 miles north of Senneterre.

Topographic base-maps at a scale of 1000 feet equal one inch were supplied by the Domtar Company of Canada (1/2 south Verneuil, 1966). The previous geological work by Longley (Grevet area, map 406, 1936) and the aeromagnetic map of the Geological Survey of Canada (Lac Quévillon, map 1434 G, 1965) were used for the area concerned with this work.

B.Morphology and Drainage

The investigated region is of low relief and is marked by a more or less flat country.It may be devided chiefly into two morphological zones:

1.In a wide northern and a small southern east-west belt, which are connected in the western part of the area;
2.And in a central east-west belt in the middle to south-eastern part of SE - Verneuil.

Morphologically these two belts contrast with one another.

The northern and southern belts together with the western part contain principally volcanic rocks and are mainly low, only numerous small rounded ridges and knolls are rising from the flat country.Swamps and muskegs are common and beside some outcrops the bedrocks are covered by glacial till.In a large part of this area extensive forests still remain,chiefly consisting of spruce and fir.

The central belt (south-eastern and middle part of SE - Verneuil),on the contrary,is characterized by almost continuous series of ridges.Here the relief is something higher than in marginal belts;elevation differences of more than 100 m within a horizontal distance of 1 km are frequent.The central belt consists predominantely of granite and besides that of volcanics.Rocky ridges more often occur and the vegetation especially of the granite is characterized by white birch.

The drainage of the area is westwards to the Bell river by way of the Kiask river (south) and Wilson river (north). There are four small lakes in the mapped region,all situated in the "Wilson-granite" of the middle-east part of SE - Verneuil.

C.General Geology

Except the alluvions and pleistocene glacial débris (boulder,clay.gravel and sand) all the rocks occuring in SE - Verneuil are precambrian in age.Most of them belong to the Archean while younger diabase dikes are thought to be proterozoic.Volcanic rocks and their associated intrusives cover most of the area and they are locally interbedded with metasediments.An E-W elongated granitic intrusion covers the south-eastern part of the area.The archean rocks generally trend in a E-W direction and dip steep to the north.

Extrusiv volcanics and their closely related basic to intermediate intrusives are thought to belong to the same period of magmatic activity.It is the common belief that the younger "granitic assemblage" originated from the same magma-sources.

Petrographically the volcanic rocks fall within the greenschist-facies (H.G.F.WINKLER 1967),except those south of the Kiask river which belong to the almandin - amphibolite facies partially.It is to be found that shifting of material during this low - grade metamorphism took place only over some 50 cm.

I.Volcanic and related volcano - sedimentary rocks

1.Basic to intermediate volcanic rocks

Basic to intermediate volcanic rocks cover nearly 3/4 of the mapped area and are termed as "andesites" because of their main mafic constituents,hornblende and biotite,the chemism of the relictic calcic plagioclase phenocrysts (An_{30-10}) and their less abundant quartz-volume in contrast to the acid volcanics.They fall together with the whole sequence within the greenschist or,less commonly,the amphibolitic facies of metamorphism.Petrographically the andesitic volcanics are similar to the associated gabbro - diorite and are thought to derive from the same magma source as the basic to intermediate intrusives.

Generally the weathered face of the usually medium (1 to 5 mm) to fine grained andesites is of light green colour while the fresh fracture is dark to middle green.

The andesitic volcanics generally form thick flows or intrusion like plugs and dikes.They have been devided by textural and structural matters into :

1.porphyritic andesite

2.amygdaloidal "

3.pillowed "

4.undifferentiated andesite

In this succession the andesites will be described in the following section.

1.1.Porphyritic andesite

Porphyritic lavas are the most widespread.The central part of the thick lava flow may be just as coarse grained as the average dioritic intrusion.In this case it is difficult to distinguish between extrusive and intrusive rocks only by coarseness.

Their middle to dark greenish-grey or green colour in a fresh fracture is caused by their high contents of small hornblende needles and chlorite,light green parts are enriched by epidote.Macroscopically all of them are carrying in more or less uniform distribution phenocrysts of plagioclase (Ø chiefly about 0.5 cm) and sometimes mafic phenocrysts (altered hornblende).Foliation often is poorly developed. The usually hard compact rock mainly has an irregular fracture with a rough face.Microscopically the main mafic component is hornblende,biotite seldom as a minor component (less than 10 vol-%) appears.Petrographically the metamorphic porphyritic andesite could be classed by the major constituents as :
epidote - plagioclase - hornblende -,quartz - plagioclase - clinozoisite - hornblende -,sphene - hornblende - plagioclase -, hornblende - epidote - rocks.
If they are more deformed by tectonic forces they are enriched by syntectonic chlorite :
epidote - quartz - chlorite -schists with biotite;
carbonate - epidote/clinozoisite - plagioclase - chlorite - schists.
In all porphyritic andesites carbonate,clinozoisite,partly the quartz and albite are products of altered formerly calcic plagioclase.

Beneath the microscope:

Thin sections: L-69-122b,L-69-127,L-69-204,L-69-103,L-69-2, L-69-89,L-69-261,D-69-62,D-69-28,D-69-56,D-69-85, D-69-35,M-69-500,A-69-707.

Texture:

There are wide textural variations.Porphyritic texture always is present marked by plagioclase phenocrysts which are sometimes accompanied by mafic phenocrysts (altered hornblende). The texture may become heteroblastic by hornblende megablasts. Hornblende and plagioclase locally occur in ophitic intergrowth.Foliation mainly in the margins of thick lava-flows is developed by subparallel,synmetamorphic hornblende-needles.

Mineral contents:

Hornblende (25-80 vol.-%),plagioclase (10-60 %) An_{10-20}, quartz (5-20 %),biotite (0-5 %) indicating progressive metamorphism,sphene usually 5 % or occasionally up to 15 %. The deuteric products of calcic plagioclase can become major constituents : epidote/clinozoisite (up to 50 %),calcite (15 %),sericite (up to 10 %),partly the quartz is to be counted to these products.

Accessories: Iron ore and limonite,Ti-oxids,chlorite.

In lavas with good synmetamorphic deformation the main constituent becomes chlorite (30-45 vol.-%) emplacing the hornblende.

1.2.Amygdaloidal lava

In amygdaloidal lavas little vesicles (Ø usually less than 1 cm) may subsequently be filled with secondary minerals, such as chlorite,calcite,quartz or albite.These lavas are part of thick flows and often occur in connection with pillow lavas.They locally seem to form the top of those thick lava-flows("vesicular tops").The fresh colour of the hand specimen varies from dark black-green to grey-green,the weathered face mostly is light green and soft Schistosity macroscopically and microscopically seldom is developed.

Beneath the microscope:
Thin section: L-69-51
Texture:
Less abundant parallel alignment of hornblende.Little hornblende-needles and chlorite are felt-like grown through eachother.
Mineral contents:
Hornblende (80 vol.-%),epidote/clinozoisite (10 %),calcite, pyritidioblasts and chlorite are minor constituents.
Accessories : sphene.

Petrographically this metamorphosed rock could be named as epidote/clinozoisite - hornblende - greenstone (amphibolite).

1.3.Pillowed lava

Pillowed lavas are well exposed in the middle and northern part of the mapped area.The pillows in general are elongated parallel to the bedding.In the NW - corner,in contrary, pillows are showing a long axis opposite to the bedding caused by shearing parallel to the contact of the"granite of boulder"(SW - Verneuil).Top and bottom of the pillows often are marked by a convexly curved surface,a downward pointing depression and a concentration of small amygdales at the summit of the pillows.

Locally pillowless lava formes the upper parts of a shallow basic to intermediate intrusive body.Amygdales may be more abundant at the top of the pillowed flows.

Normally the fresh pillow-lava is dark green with a light green soft weathered face.Sometimes the center of a pillow is white to greenish-white weathered while the marginal zones are light green in weathering as well as the andesitic groundmass surrounding the pillows.

Beneath the microscope:
Thin sections: a. D-69-60
b. D-69-59

a.White weathered center.

Texture:
Composed: 1.Amygdaloidal by ovoid vesicles filled with quartz mainly;2.Intergranular relict texture;3.Granoblastic alteration by metamorphic processes.

Mineral contents:
Quartz (20 vol.-%),epidote/clinozoisite (20 %),hornblende (15 - 25 %),chlorite (5 - 10 %),sphene with ilmenite - core. Most of these may represent devitrified groundmass.

b.Light green weathered matrix.

Texture:
1.Amygdaloidal by vesicles filled with quartz,epidote and chlorite;2.Porphyritic by phenocrysts of plagioclase;3. Altered hyalopilitic texture.

Mineral contents:
Plagioclase (20 vol.-%),quartz (10 %),epidote/clinozoisite (30 %),hornblende (20 %),chlorite (10 %),titanit with (5 %) ilmenite core,biotite (5 - 10 %),pyritidioblasts,iron hydroxid.

The white weathered core of those pillows is enriched by quartz and may be chemically more siliceous than the intermediate to basic margins.These pillow-lavas often grade into lavas with pyroclastic - like structure characterized by white weathered fragments developed in a light green matrix.

Beneath the microscope:
Thin sections: L-69-6,L-69-99,L-69-109.
Microscopically the normal pillowed lava is composed as following:
Hornblende (30 - 50 vol.-%),plagioclase (10 - 30 %),epidote/

clinozoisite (25 - 35%),quartz (5 - 20 %),chlorite (15 %), sphene (less than 5 %),calcite (5 %),actinolite (partly up to 10 %).

The former plagioclase completely is altered to albite, quartz,epidote,clinozoisite and calcite.

1.4.Undifferentiated lava

All lava flows with almost completely obliterated structures fall within this rocktype.They may include porphyritic, amygdaloid,and pillowed andesite too,which often are strongly foliated or sheared so that no relict structure is to be found.

Beneath the microscope:
Thin section: L-69-137
Texture:
Good foliation;actinolitic hornblende and chlorite are subparallel orientated and are surrounding predeformative hornblende crystals which are deformed to flat lenses.
Mineral contents:
Predeformative hornblende (60 vol.-%),syndeformative hornblende (10 %),chlorite (25 %).
Accessories:Pyrite,sphene,Fe-hydroxid,sericite,muscowite.

Postdeformative pyrite - idioblasts in certain parts of a lavaflow could make up nearly 10 vol.-%.

These lavaflows may range in chemical composition from basalt to andesite.There was no criterium found neither in field nor in laboratory which made sense to classify these altered lavas.

2.Intermediate to basic pyroclastics.

The intermediate to basic pyroclastic rocks chiefly consist of banded tuff and tuff with obliterated structure, less abundant of crystal tuff.Lithic tuffs are rare.

The banded tuffs are well exposed north of the "Wilson-granite" in the East of the mapped area.The banded structure is caused by rhythmic alteration of light green and dark green weathered beds of an average thickness of about one to three inches.

Beneath the microscope:
Thin section: L-69-136a
Texture:
Irregular texture predominates.Foliation seldom occurs.
Mineral contents:
Usually great variety.In this case: Actinolitic hornblende (35 Vol.-%), epidote/less clinozoisite(45%), granular quartz-albite(10%), sphene with ilmenite core(5%), pyrite-idioblasts locally become 5%.

The light green weathered layers of the laminated tuff and the light coloured fragments of the lithic tuff are enriched in epidote (up to 80 vol.-%).In places chlorite is predominant and is seen to be gradually replaced by hornblende needles.

These banded tuffs remind of the laminated tuff of the iron formation near Michelin, on road 58 to Chibougamau (kind information given by Dr.G.Duquette).

By contact-metamorphism which may be superposed the regional metamorphism the laminated tuff is grading into amphibolite.

Beneath the microscope hornblende makes up nearly 80 vol.-%. (L-69-8b;L-69-7a).

A part of the andesitic rocks is thought to be tuffs with obliterated structure.They are characterized by a quartzitic habitus (sand-like grain and platy cleavage) and by a commonly high feldspar contents.The hand specimens are greyish green coloured and rusty weathering is widespread. Microscopically they are to differ from metasediments because of abundant albite,chlorite or hornblende, and the always present sphene.

Beneath the microscope:
Thin sections: D-69-41;D-69-50;L-69-300
Texture:
Foliation is more or less clearly developed by the sub-parallel orientation of chlorite,actinolitic hornblende or sericite.A younger foliation may cross the main schistosity indicated by biotite crystals (slaty cleavage).
Mineral contents:
Actinolitic hornblende,if present,(25-35 vol.-%),granular albite (10-35%) and quartz(15-20%),biotite (5-15%),deuteric products of original calcic plagioclase: Calcite (5-25%), epidote/clinozoisite (5-15%).Sphene (5%) always is present. Chlorite sometimes becomes major component (up to 30%), usually 5-10%.
Accessories are:Pyrite,limonite,zonar zoisite.

These tuffs slowly may grade into tuffaceous metasediments or amphibolites.

Especially south of Kiask river crystal tuffs form thin layers and lenses (up to 10 feet in thickness) inbetween amphibolitic andesites.These dark green coloured rocks in places are well foliated and are characterized by large, tabular phenocrysts of plagioclase (2cm in length). Sedimentary bands free of crystals are interbedded.Locally Fe-rich carbonate layers (siderite) accompany the crystal tuff.

Beneath the microscope:
Thin section: D-69-4
Mineral contents:
Plagioclase phenocrysts(35 vol.-%),chlorite(25%),quartz(5), albite (5%),calcite(5-10%),epidote/clinozoisite(partly up to 30%),sphene (maximum 5%).

3. Intermediate to acid volcanic rocks.

Mainly in the NW and the W part of the central belt of SE-Verneuil these rocks are of importance.They seldom form thick lavaflows,more often pyroclastic rocks, and are interbedded in the andesitic volcanic rock sequence.Together with the andesites they are thought to belong to the same period of magmatic activity.By regional metamorphism & therewith connected tectonic movement they were after consolidation mineralogical and mechanical deformed.

Megascopically the acid volcanics are to be distinguished from andesites because of their white to greenish white weathered face and their grey to greenish grey fresh colour. Microscopically these volcanics contain a higher modal quartz volume than the andesites.

According to the dominant phenocrysts they are in field separable into:

a. Porphyritic dacite

b. Porphyritic hornblende dacite

c. Porphyritic quartz dacite

In all varieties schistosity is poorly developed.

3.1 Porphyritic dacite

Outcrops of porphyritic dacite were observed especially in the central belt of the mapped area,W of the "Wilson granite".Here these effusive volcanics occur in large lenses and thick lavaflows in regions with various pyroclastic rocks of mostly acid composition.In contrary, in the SE corner porphyritic dacite forms layers(about 10 feet in thickness) inbetween a sequence of andesites and related andesitic volcano-sedimentary rocks.These layers are partly well foliated,carry in places abundant magnetite- and pyrite-idioblasts, and are macroscopically difficult to distinguish from quarzites if fine grained.

Usually white,tabular phenocrysts of plagioclase (about 1cm in length) give the white grey weathered surface of the porphyritic dacite a characteristic "knobby" appearance. In a section of a handspecimen the zoning of the plagioclase phenocrysts may be visible caused by selective weathering.

Beneath the Microscope

Thin sections: D-69-104,L-69-58,L-69-44,L-69-80

Texture:

Porphyritic by phenocrysts of plagioclase.Schistosity sometimes is developed by subparallel alignment of chlorite, biotite or sericite.

Mineral contents:

Plagioclase phenocrysts(15-40 vol.-%).Groundmass: Granular quartz (15-30%) together with albite (15-35%).Biotite,if present,10-20%.Minor components are: Chlorite(0-10%),sericite (0-15%),calcite(0-10%),sphene (5%), and pyrite(5%). Accessories: Epidote/clinozoisite(seldom up to 10%),magnetite, zircon,and actinolitic hornblende.

Garnet may occur as hypidiomorphic small crystal.The dominant plagioclase is albite as a result of altered calcic plagioclase.Plagioclase phenocrysts,originally zoned from calcic cores (oligoclase to andesine) to rims (albite) , are set in a fine grained matrix made chiefly up of granular quartz and albite(devitrified glass in places?).The synmetamorphic biotite always is showing the progressive regional metamorphism by beginning of growth.

3.2 Porphyritic hornblende dacite

Porphyritic hornblende dacite forms about 10 to 20 feet thick lavaflows and sills mainly in the NW of the area and is interbedded in acid and intermediate volcanic rocks. Macroscopically their weathered face is characterized by dark green spots (altered hornblende phenocrysts) - usually accompanied by white tabular plagioclase phenocrysts - in a light green to white green weathered matrix.

Beneath the microscope:

Thin sections: L-69-61,A-69-727

Texture:

Schistosity is not developed.Porphyritic because of mafic phenocrysts (altered hornblende) and occesionally altered plagioclase phenocrysts.

Mineral contents:
Mafic phenocrysts (up to 15 vol.-%),plagioclase phenocrysts (more than 5%).Granular quartz-albite matrix (20-40%) with chlorite(10-20%),calcite(5-15%),epidote/clinozoisite (5-25%), and biotite,if present, (up to 20%).
Accessories: Pyrite,limonite ,sphene,magnetite.

Epidote,clinozoisite,calcite,together with albite and partly the quartz are products of altered calcic plagioclase. The original glassy groundmass is devitrified by metamorphic process and consist mostly of an intimate granular mixture of quartz and albite.Mafic phenocrysts are completely replaced by chlorite,Fe-rich epidote,calcite and granular ore.

In places the sedimentary contact of lavaflow to tuff is well developed.The contact is free of vitrifaction.

3.3 Porphyritic quartz dacite

In the SE-corner of the mapped area the porphyritic quartz dacite occurs interbedded in andesitic volcanics,their related pyroclastic rocks,and slaty,C-rich metasediments usually as up to 20 feet thick layers.Macroscopically they are difficult to distinguish from quartzite and normal porpyritic dacite.Sometimes this light grey coloured rock carrys a gneissose structure and schistosity induces a more or less planar fissility.In places this acid volcanic rock-type may carry abundant pyrite and magnetite idioblasts, more often it is the country rock of sericite-quartzite-schist (acid tuff?) which is locally an orebed of economic interest because of Au-bearing pyrite (see page 42).

Microscopically the porphyritic quartz dacite usually is characterized by quartz phenocrysts (Ø up to 0.5cm) beside plagioclase phenocrysts.Therefore and because of the high contents of quartz in the groundmass this rock is termed as porphyritic quartz dacite.

Beneath the microscope:
Thin sections: L-69-296, L-69-60, L-69-55b, L-69-88, D-69-62
Texture:
Great variety.Always porphyritic by quartz and plagioclase phenocrysts.Sometimes schistosity occurs by subparallel sericite and biotite crystals.Partly the texture may be- come pyroclastic which may indicate a tuffaceous origin of some quartz dacite layers.
Mineral contents:
Quartz phenocrysts (5-10 vol.-%),plagioclase phenocrysts (15-40%) in a granular matrix of quartz(15-30%),albite (15-35%).Most dacites contain sericite(5-15%),chlorite (10%),and biotite(15-20%).Occasionally epidote,clinozoisite can become 10%, and Fe-rich carbonates 5-15%.
Accessories are sphene,pyrite- and magnetite-idioblasts, limonite,apatite.

The phenocrysts of quartz show corroded outlines and conchoidal fractures.Two generations of plagioclase are present: An older,saussuritized one and a younger consisting of clear albite.

4. Intermediate to acid pyroclastic rocks

4.1 Volcanic breccia

In the central belt of the mapped area an irregularly shaped breccia body lies within dacitic agglomerate.The breccia completely is composed of white weathered blocks of porphyritic dacite which may have been entirely solid when discharged.The fragments are chiefly sharply angular or less abundant rounded by assimilation and are measuring about eight to ten inches in diameter.They are packed very dense in a porphyritic matrix,often they are touching each-other.

Beneath the microscope: (L-69-268) : Texture and mineral contents of the fragments differs not from the normal porphyritic dacite.Biotite may be absent in cases.Carbonate always is present.
The groundmass between the components is just as porphyritic as the fragments by tabular plagioclase phenocrysts.

The breccia is thought to be the filling of a bocca-like opening (or a fissure vein),from which magmatic fragmental ejecta were emanated.

4.2 Agglomerate

Two types of intermediate to acid porphyritic agglomerates in field are to distinguish by the colour of the weathered faces of fragments and matrix:

a. Agglomerates with white grey components in a light green groundmass.

b. Agglomerates with light green andesitic bombs in a white grey ,dacitic-andesitic matrix.

The first type is the most widespread while the later only occurs in SW-Verneuil (mapped by M.v.d.Walle 1968).In the following the first type will be discussed.

Always components and groundmass are porphyritic by white weathered,tabular phenocrysts of plagioclase.In fresh fractures often it is impossible to see sharp outlines of fragments;both,matrix and inclusion,seem to consist of nearly the same mineral composition.

These agglomerates form thick lenses,irregularly shaped bodies,and thick layers between or nearby the porphyritic dacite.They are characteristically loaded with bombs of chiefly porphyritic quartz dacite measuring up to two feet in length;less abundant are bombs of porphyritic dacite without quartz phenocrysts.Occasionally other acid material was observed too,such as tuffs and tuffites.

All bombs are orientated with their long axis subparallel to the local schistosity and in places they are deformed to diskes by tectonic forces.

Beneath the microscope:

Thin sections: L-69-15,L-69-62e,L-69-12,L-69-13,L-69-243, D-69-90

Texture:

a.Bombs: Porphyritic by quartz and plagioclase phenocrysts. Schistosity is not as well as in the enveloping groundmass, but subparallel orientated biotite crystal occur locally.

b.Matrix:Same,but schistosity better is developed by biotite sericite or chlorite flakes.

Mineral contents:

There is no great difference in mineralogical composition between bombs and groundmass.Locally the bombs may be enriched in quartz while chlorite and calcite are abundant in the groundmass and occasionally garnet may be present.

Plagioclase phenocrysts (5-15 vol.-%), and quartz phenocrysts (5-10%) in a fine granular quartz-albite matrix (35-80%).Almost always biotite (10-20%),epidote/clinozoisite (5-10%), and pyrite,limonite(5%) are present.Sporadic occur carbonate (10-30%) and chlorite(5-40%).Garnet and apatite are rare.

Two generations of plagioclase and quartz are common: Twinned,saussuritized plagioclase phenocrysts (oligoclase to albite) and clear albite in rims and intimate intergrowth with granular quartz.The quartz may occur as phenocryst with magmatic corrosions-phenomenons and as rind surrounding the phenocrysts.

In the groundmass carrying the large bombs locally appear crystalfragments and small lapilli together with abundant Fe-rich chlorite which may have replaced glassy substance. In places vesicular bombs are widespread,vesicular towards their tops.These agglomeratetypes are the result of rapid effervescence and sudden chilling of magma, such as may take place during explosive eruptions.

The agglomerates are the most voluminous and widespread of the acid pyroclastic deposits.

4.3 Tuff

Interbedded in acid agglomerates,dacitic lavaflows,and less often in the andesitic sequence are acid lapilli- and crystal-tuffs in the NW,the central part,and the SE of the mapped area.The average thickness of a tuffbed generally is measuring less than 20 feet.Usually they are fine grained and only get medium grained if abundant plagioclase fragments appear.Because of their white weathering they are well to distinguish from the green weathered andesitic tuffs.

Beneath the microscope:
Thin sections: L-69-1,L-69-201
Texture:
Pseudo-porphyritic by broken plagioclase crystals.Schistosity

always is developed by small flakes of chlorite and sericite. In the lithic tuff various fragments of intermediate to acid volcanic rocks predominate.

Mineral contents:

Plagioclase crystals in crystal tuff(5-25 vol.-%),ranging in composition from albite to oligoclase.Seldom large quartz crystals occur.These are situated in a granular matrix of quartz-albite(quartz 25%,albite 10-15%) together with chlorite (5),sericite (10-15), and carbonate(10-35%).Pyrite idioblasts may become 5%.

In the NW some acid tuff beds are characterized by emerald-green,strongly sheared inclusions (Fuchsite?).

Little basins (100 to 200 feet in diameter) where normal sedimentation was going on and pyroclastic ejecta were fallen in, may show a layered complex of tuffaceous sedimentary rocks and tuffs.In single layers graded bedding is to observe: The coarser materials passing upwards into finer material richer in quartz.Lateral transition often is developed.

In places foliation and a shaly cleavage is typical for the acid tuffs.Especially in the SE these tuffs are ranging into tuffites and macroscopically may be termed as sericite-quartz - schist.

Certain tufflayers are rich in Au-bearing pyrite.Although the mineralization is very poor they are thought to be eventually of economic interest as they are stratified deposits with quite a lateral continuation (1km).

II. Intrusive rocks

1. The basic to intermediate intrusive rocks

The greenstone assemblage contains beside effusive rocks and their related volcano-sedimentary rocks some amphibolitic intrusives ranging from gabbroic to dioritic in composition.Most of them form small intrusive bodies,such as sills and plugs,emplaced at shallow depths.

1.1 Meta-hornblende gabbro

Outcrops of coarse grained,hornblende-rich rocks are present at various places in the greenstone assemblage.Their weathered surface has a very characteristic "knobby" appearance due to big hornblende crystals.A megascopic foliation is not conspicuous.Some of these rocks are classed as meta-hornblende gabbros rather than diorites because of the former calcic natur of their feldspars,their low volume of quartz, and their color index.

Beneath the microscope:

Thin sections: D-69-71,D-69-66,D-69-74

Texture:

Usually an obvious preferred orientation of chlorite and actinolitic hornblende which defines a foliation.Premetamorphic hornblende-megablasts are surrounded by schistosity planes.

Mineral contents:

Chief mineral is brown or greenish brown hornblende (up to 50 vol.-%) occuring as large ophitic plates.As a result of low-grade metamorphism and the related deformation the feldspar is granulated and altered.Chlorite and actinolitic hornblende are widespread.Quartz occurs interstitially.

This hornblende gabbro has been formed by metamorphism without strong internal deformation - as for example in the inner parts of marginally deformed sills - to an amphibolite.It can hardly be distinguished with certainty from igneous diorite.

1.2 Diorite

The basic to intermediate rocks discussed under this terme are generally medium to coarse grained.Their colour indices are high as well as the volume-percentage of hornblende and plagioclase.Hand specimens are showing on the weathered face green spots (hornblende,chlorite) in a light green matrix (plagioclase mainly) in the quantity-proportion of about 50:50.Many of the darker "melanodiorites" with a high colour index could be chemically gabbroic.Because of their main constituents these low-grade metamorphosed diorites may range petrographically from: plagioclase - epidote/clino-zoisite - hornblende - to hornblende - chlorite - epidote/clinozoisite - rocks, depending on the grade of metamorphic alteration.In these metamorphosed intermediate to basic intrusive rocks there are blastoophitic and blasto-porphyric textures common that have clearly been inherited from a parent rock of igneous origin.

They form relatively small stocks,sills and bosses in the volcanic rock sequence.Some flow-like diorite intrusives were emplaced nearly stratabound between volcanic layers and are difficult to distinguish from coarse grained andesitic lava.

Beneath the microscope:

Thin sections: D-69-2,D-69-14,L-69-4,L-69-5,L-69-17-1, L-69-18-2,A-69-706,A-69-730-a.

Texture:

Subophitic:Large plates of greenish brown and brown hornblende are intergrown with plagioclase and partly are enveloping the feldspars.As a result of postconsolidation movement and metamorphism foliation is present marked by parallel aligned chlorite flakes.By these movements the predeformativ hornblende-megablasts are rotated.

Mineral contents:

Hornblende-megablasts (40 - 70 vol.-%) together with actinolitic hornblende,plagioclase (10-15%).Products of altered calcic plagioclase: Epidote/clinozoisite(10-40%),sericite (0-10%),calcite(0-5%),and partly quartz(5-10%).Chlorite (5-25%),biotite(0-5%), and Ti-minerals are minor constiuents. Accessories:Pyriteidioblasts,limonite,magnetite.

Partial replacement of hornblende by chlorite,calcite,sphene, biotite,and iron ore are the characteristic features of metamorphic alteration.Further alteration results in albitization and saussuritization of the original plagioclase. Xenomorphic quartz is always interstitial together with albite.

1.3 Quartz diorite

By the presence of abundant quartz and blue shiny quartz phenocrysts in diorites the terme quartz diorite is used. In field and in laboratory they are hardly to differ from thick andesitic lavaflows.These metamorphosed diorites may be called for their main mineral components:

Quartz - plagioclase - epidote/clinozoisite - hornblende - and quartz - epidote/clinozoisite - hornblende - plagioclase - rocks.Brown biotite starts to grow and sometimes may become abundant.

Beneath the microscope:

Thin sections: L-69-257,L-69-259

Texture:

Porphyritic by few corroded quartz phenocrysts.Foliation is indistinct marked by subparallel orientated chlorite flakes and secondary hornblende needles.Relict ophitic texture is locally maintained.

Mineral contents:

Similar to the diorite.There are two generations of hornblende :predeformative megablasts and syndeformative needles of actinolitic hornblende.Biotite appears as one of the last syncinematic minerals and forms still very small flakes.

The quartz-bearing diorite seems to be the top of a dioritic sill,which belongs to the same magmatic period as the surrounding effusive andesites.

1.4 Diabase dike

The youngest igneous rock in the mapped area is a medium to fine grained diabase which forms dikes cutting through intrusive and extrusive rocks. The main trend of the diabase dikes lies at 10-15° and 160-170°.Faults divide the dikes partly into pieces.Therefore often it is impossible to follow one dike in the direction of strike over a long distance in field.

In the dikes the grain size usually is greater than among the andesitic lavas and there is more tendency for development of ophitic and subophitic habits.Towards the center of a diabase dike the texture generally becomes coarser and more ophitic.The margins of the diabase dikes often are white in weathering.

Beneath the microscope:

Thin sections: L-69-130a,M-69-517

Texture:

Crystals of hornblende partly enveloping some feldspar and partly interstitial between them (subophitic;intergranular).

Mineral contents:

Hornblende (40 vol.-%) and plagioclase (30-50%).Secondary minerals are epidote/clinozoisite (10%),carbonate(5%), and some quartz(5-10%).Small amounts of sericite and biotite may be present.Pyriteidioblasts and sphene are accessories.

The original plagioclase was oligoclase ,now altered to albite and saussuritic products.

2. Acid intrusive rocks

2.1 Rhyolite

Small acid intrusive bodies,emplaced at shallow depths,are observed in the W and E of the north part of the investigated region.This usually fine grained rocktype in field is characterized by a white grey to white brownish weathered, hard face and a light grey fresh colour,a typical "glassy" fracturing, and hardness caused by a high contents of quartz chiefly as a component of the groundmass.In places the texture may become porphyritic by white,tabular plagioclase phenocrysts.Their hand specimens show a great likeness to those of aplitic and porphyritic dikes.

The rhyolites, particularly those found in the East, carry abundant basic inclusions.These are amphibolitized fragments of the andesitic wallrocks. Because of the outlines of outcrops this rhyolite more seems to be a conduit situated on a tectonical structure,such as a fault, feeding flows higher up in the sequence.In the W these inclusions are nearly completely assimilated by the rhyoltic intrusion and occur shadow-like.

Beneath the microscope:
Thin sections: D-69-70,L-69-154
Texture:
Porphyritic by plagioclase and some quartz phenocrysts. Foliation may be present,shown by subparallel sericite and biotite flakes.
Mineral contents:
Plagioclase phenocrysts (15-20 vol.-%),quartz phenocrysts, if present,(up to 5%) in a granular matrix of quartz (25-40%), albite(20-25%) with biotite (5-10%) and sericite(5-15%). Occasionally chlorite(5-10%),epidote/clinozoisite(10%), sphene with ilmenite core(5%) and chloritoid(5%) are minor constituents.
Accessories:pyrite,limonite.

The partly saussuritized plagioclase may range in composition from oligoclase to albite.Quartz phenocrysts are showing corroded outlines.
The originally glassy groundmass is devitrify by metamorphism.Their dominant mafic mineral tend to be biotite which starts to grow indicating progressiv metamorphism.

Beneath the microscope there is no great difference between the rhyolite and the dacite.The rhyolite is thought to belong genetically to the same magmatic activity as the andesites and dacites.

2.2 Granite

There are two isolated occurences of granites in the mapped area.

The largest granitic intrusion, the "Wilson granite", forms a tongue-like,irregular shaped body in the south-east and is a part of the big granite masses of the Wilson township east of Verneuil.Megascopically the medium grained,fresh granite is of light-to-middle grey colour with a light-to-white weathered surface.

Beneath the microscope:

Thin sections: L-69-11,L-69-37.

Texture:

Hypidiomorphic granular - granitic texture.Idio- and hypidiomorphic crystals of plagioclase and biotite with xenomorphic,granoblastic quartz occupying irregular spaces between the other constituents.

Mineral contents:

The chief constituents are plagioclase (50 - 60 vol.-%) quartz (15 - 25 %) and biotite (10 - 15 %).Minor components are titan-minerals (up to 5 vol.-%) and the products of saussuritized plagioclase : epidote/clinozoisite (up to 10 %),sericite (5 %),and carbonates (5 %).Accessory minerals always present in the granite includes zircon,chlorite, pyrite,and limonite.Sporadic accessories are apatite, magnetite.

The dominant plagioclase is albite-oligoclase showing two generations; older idio- to hypidiomorphic crystals with complex twinning (Carlsbad,albite,pericline) and younger, xenomorphic clear albite.

Likewise two generations of biotite exist,the earlier in large flakes partly replaced by chlorite and the last sometimes tends to be orientated subparallel to a certain direction.

The central part of this large granite pluton exhibits little or no structure,but towards the margins linear orientation of minerals becomes locally increasingly pronounced.The mineral content,also,could change and the normal granite may range to hornblende - granite (5 vol.-% actinolitic hornblende).Granites that contain hornblende are probably produced by assimilation of andesitic wall rocks.

Beneath the microscope:
Thin section : L-69-10
Texture:
Gneissoid,characterized by lenticular parts of relict granitic texture,surrounded by comminuted debris.

The nearly structureless core of the granite intrusion seemes to be surrounded by a belt marked by microshearing and granulation.These mylonitized border rocks were produced partly by tectonic forces following complete solidification,partly while the pluton was still ascending.

Near the margins the inclusions of the wall rocks often become abundant.Especially on the northern border of the granite to the andesitic volcanic wall rocks the intrusive-contact is sometimes well developed.The volcanic inclusions still retain the volcanic texture and structure.Most of them are characterized by an earlier metamorphic texture. The granite as well as the volcanic xenoliths has been affected by contamination process.The contaminated granite may become dioritic.
Besides that the contact of granite to wall rocks often is of tectonical nature.

A marginal aureole of contact metamorphism has been superposed upon the earlier metamorphism of the invaded volcanics, but is only locally to distinguish from the low-grade regional metamorphism of the wall rocks.

A small part of the "Holmes granite",south of Verneuil township,continues northwards into the investigated area. The observed foliation is due to subparallel orientated granulation planes and is less obvious than in typical gneissoid rocks.Macroscopically there is no difference in mineral contents to the Wilson granite.They both are thought to derive from the same parential magma.

2.3 Quartz porphyry

In the northern part of SE - Verneuil,south of Wilson river,lies a small quartz porphyry intrusion of nearly circular outlines and a diameter of over 2000 feet.The average mineral composition is that of normal granite (thin section L-69-123).The onliest contrast is that most specimen contain corroded phenocrysts of blue-shiny quartz (Ø about 0.5 cm) and that minor accessories,such as apatite,and zircon are less abundant.

Besides a few shear-zones the core of the quartz porphyry is free of tectonic deformation while in the margins somewhat irregular foliation could be present.The "schistosity" is rather poorly developed.

2.4 Dikes,veins

2.4.1 Aplites,porphyritic dikes

The volcanic sequence together with its related intrusive rocks are cut by light coloured dikes originating from the granitic intrusives.Numerous occurrences were seen in the andesitic volcanics near the contact of granitic masses.Some of these rocks,the aplites,are characterized by an even grain size that rarely exceeds 2 mm and by allotriomorphic - granular texture.In handspecimen they appear "sugary".Texturally contrasted with these are porphyritic dikes carrying plagioclase phenocrysts in a fine - grained quartz - rich matrix.The weathering of both types is light-grey to white,on joints rusty colour may occur.

Most dikes are only a few feet or even yards in width and may occupy sharply defined fractures with sharp outlines.The direction of the strike varies,but there are maxima obvious : trends of 60°-75°,90°-120° and 180°-15° predominate and a small maximium at 140°-160° is present.

Beneath the microscope:
Thin sections : L-69-9,L-69-130-8,L-69-7,L-69-134 b,
L-69-154,L-69-159.

Texture:
The aplites are of xenomorphic granular texture.In porphyritic dikes the texture becomes porphyritic by plagioclase phenocrysts.Foliation locally appears caused by subparallel orientated biotite,sericite,or chlorite.

Mineral contents:
Plagioclase (25-40 vol.-%),quartz (20 - 45 %),biotite (10 - 20 %).Deuteric minerals as epidote/clinozoisite (5 - 10 %),carbonate (5 - 15 %),and serizite often are present.

In places hornblende occurs (up to 5 %).Sphene,pyrite and chlorite are widespread.
Accessories are zoisite and zircon (enveloped in biotite).

2.4.2 Quartz veins

Quartz may form lenses and veins generally a few feet in width often with indefinite margins;some veins may range up to 30 feet in thickness.In the direction of strike several quartz lenses may occur at one tectonical structure all together more than 300 feet length.

The quartz develop from solutions of the magma that produced the granitic intrusive masses like the "Wilson granite".They mostly are situated on faults or shear-zones in the neighbourhood of the granitic bodies.Some of them are characterized by a poor mineralization (Cu-,Mo-,Fe-sulphides with small amounts of Au and Ag).

The quartz veins show 180°-20° and 80°-120° striking maxima which represent the same system as it may be observed in the trending of dikes.Small maxima (40°-50°, 140°-150°) correspondending to those of dikes are to be found.

III. Metasediments

The volcanic rocks are accompanied by quarzites and phyllitic or gneissic schists.They form inbetween the volcanic sequence beds or lenses.The rocks mostly are epizonal metamorphites,sometimes grade into mesozonal metamorphism.Some amphibolites are thought to be originally partly sediments.

The schists petrographically may be classed as biotite-quartz - plagioclase-,epidote - biotite - plagioclase - quartz -,hornblende - biotite - quartz-,biotite - hornblende-chlorite - plagioclase-,and epidote - quartz - carbonate - chlorite - schist.

Beneath the microscope:
Thin sections: D-69-38,L-69-14,D-69-43,L-69-292,L-69-94.
Texture:
Well foliated by subparallel orientated biotite,hornblende, and chlorite crystals.Fine alternating beds locally are observed.If tuffaceous beds are present they may be characterized by a few large plagioclase - crystalfragments.
Mineral contents:
Plagioclase (10 - 40 vol.-%),quartz (10 - 55 %),and biotite (15 - 25 %) are the major constituent minerals. Chlorite (5 - 30 %),epidote/clinozoisite (5 - 15 %), calcite (10 - 30 %),hornblende (5 - 20 %) may be in some varieties of importance.Pyrite,sphene,and allanite especially are accessories in tuffaceous sedimentary rocks.

A few metasediments are showing a gneissose-like structure. Partly these rocks are porphyritic acid volcanics but some may have been originally arkoses.
Their fresh colour range from grey to greyish green and their weathered face often is rusty coloured.They may show the tendency to break according to parallel planes (cleavage).

IV. Amphibolites

Amphibolites are widespread south of Kiask river.Mostly they derive from intermediate to volcanic rocks and their related tuffaceous sediments.But some are thought to have been originally sediments.

The dark green coloured amphibolites are showing schistosity which is due to parallel alignment of hornblende needles. They all are praducts of regional metamorphism which may be superposed a low-grade contact metamorphism near the granitic intrusive masses.

The amphibolites derived from pelitic rocks contain conspicuous biotite or muscovite and seldom they carry garnet.

Beneath the microscope:
Thin sections: L-69-114,M-69-159
Texture:
Fine alternation of beds.Some of them carry big plagioclase fragments as (tuffaceous material on certain layers).
Mineral contents:
Hornblende (40-70 vol.-%),plagioclase (10-15%),quartz (10-20%),carbonate,if present,(10-20%),biotite(5-30%).
Accessories:sphene,pyrite,limonite.

D. Structural Geology

I. Folding

In the most metamorphosed and by tectonical forces deformed rocks of the area, such as volcanic rocks and their related tuffaceous sedimentary rocks as well as the metasediments, bedding has survived metamorphism.Usually the foliation and cleavage has developed parallel to surfaces of bedding (bedding plane slip).In parts two or more intersecting sets of s-surfaces referable to different stages of rock deformation may be distinguished.

The trend of foliation and stratification of the sequence in general is E-W.This could be established after the tectonical analysis of the field-measurements of cleavage faces (see s-face pole diagrams 4 and 5).Usually there are variations from these general trends due to intrusions of granite as along the N- and S-border of the "Wilson granite" in the eastern part of the mapped area is to be seen.N of the granite the sequence strikes ENE-WSW, S of the granite ESE-WNW. In the NE-corner of the region a strong N-S directed shearing in the vincinity of the contacts of the "granite of boulder" (M.v.d.Walle 1968) lies over the E-W striking series.This shearing may be caused by later movements along the contact of granite to volcanic rocks (tectonically inhomogenuous plane).

Beside the intrusions folding is the reason for irregularities in strike and dip.The general dip is to the north, but sometimes to the south.The most notable example to this is to be found arround the "Wilson granite" in the eastern part of the investigated area where dips are N of the granite to the N and S of the granite partly to the S. This fact and the similar rocksequence with determined tops in the north and south of this granite make obviously sure that the granite intrusion is following an east-westerly anticline. Tops of the sequence indicated by the shapes of pillows are orientated to the north and as well to the south in many places of the mapped region. At least two big anticlines and one syncline are to be found in the investigated part of Verneuil township. In general it seems that major anticlinal zones are occupied by granitic intrusions.

Diagram 4: pole diagram of cleavage planes of the southern part. The diagram shows an obvious maximum of poles of the cleavage planes in the SW sector ($100^{o}-120^{o}$ / $75^{o}-85^{o}$N) and a smaller maximum in the SE sector ($70^{o}-80^{o}$ / $70^{o}-80^{o}$NW). The two cleavage pole maxima show the steep dipping flanks of isoclinal folds which were overturned to the S and SE. The trends of the major folds is about E-W to WNW-ESE and they plung about 10 to 20 degrees to the W and a few degrees to the E in places.

Diagram 5: pole diagram of cleavage faces of the northern part. Here two separated maxima ($80^{o}-90^{o}/70^{o}$-80NW and $60^{o}-70^{o}$/ $55^{o}-75^{o}$NW) occur, both showing similar to diagram 4 general E-W trending of cleavage planes and steep dipping to the N. It is the typical picture of an isoclinal folding with to the S or SE overturned folds. The E-W to ENE-WSW trending folds are dipping mainly to the W and less obvious to the E. The maximum at $60^{o}-70^{o}/55^{o}-75^{o}$NW may be caused by the "Wilson granite" which is responsible for the change in strike in the NW part of the area (from E-W into NE-SW).

Pole-diagrams of cleavage planes (s-planes) of SE Verneuil

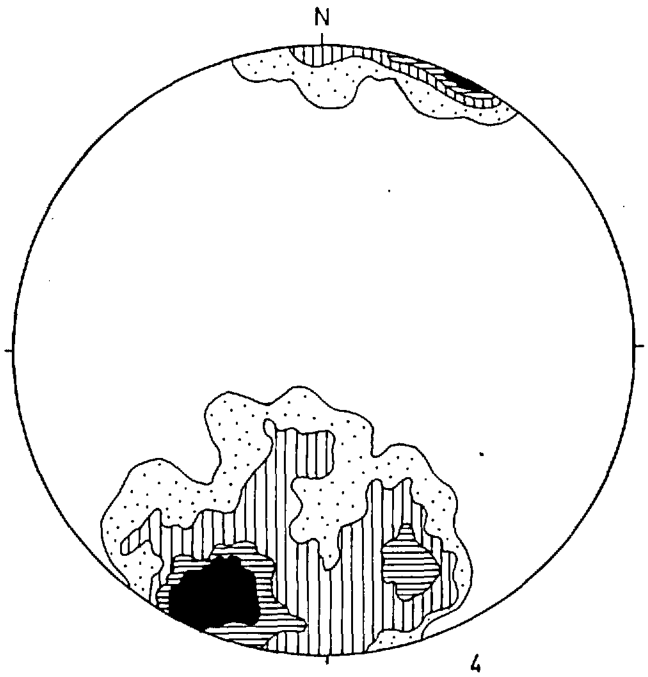


Diagram 4

164 s-poles

0 - 2%
2 - 6%
6 - 9%
9%

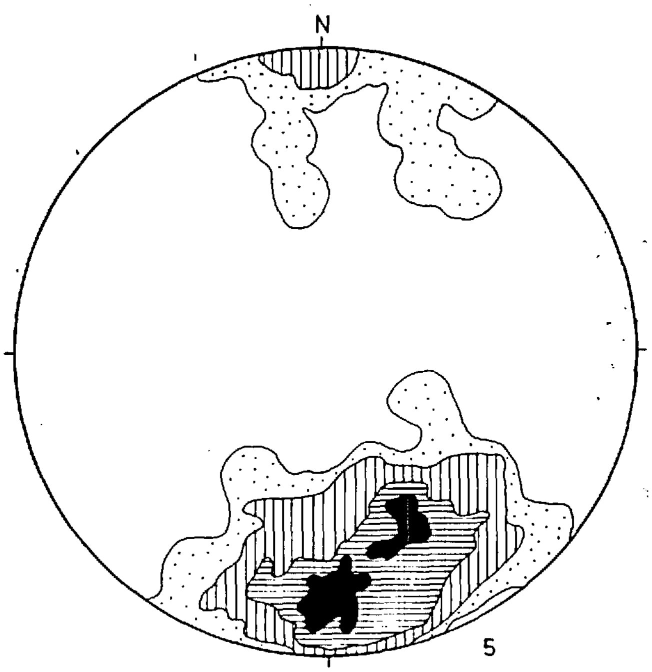


Diagram 5

181 s-poles

0 - 1.5%
1.5- 5.5%
5.5- 8.5%
8.5%

II. Tectonical aerial analysis (joints and faults)

Photogeological analysis and conventional geological field measurements have been used in order to clarify and describe the tectonics of the rock sequence in SE-Verneuil. A tectonical analysis of the lineaments was carried out by photogeological method.This tectonical investigation compared with field measurements has shown the obvious equality of results of aerial and field analysis.

In the mapped area aerial photographs make it possible to survey and analyze large and small lineaments (within 10m to kilometer dimensions) quicker than in field.The drainage and topography offer a much better clue to these structures than do the actual observations made in outcrops.The presented Phototectonical Map and the Phototectonical Diagrams are showing only vertical joints and faults that are formed where tectonical surfaces cut through bedrocks and volcanics. These vertical structures which are projected on the map form straight lines;the course of these lineaments remains unaffected by changes in topography.Of the large number of lineaments observed in the aerial photographs only a few could be definitely classified genetically as faults.The remaining tectonical structures could only be considered as joints or possible faults.

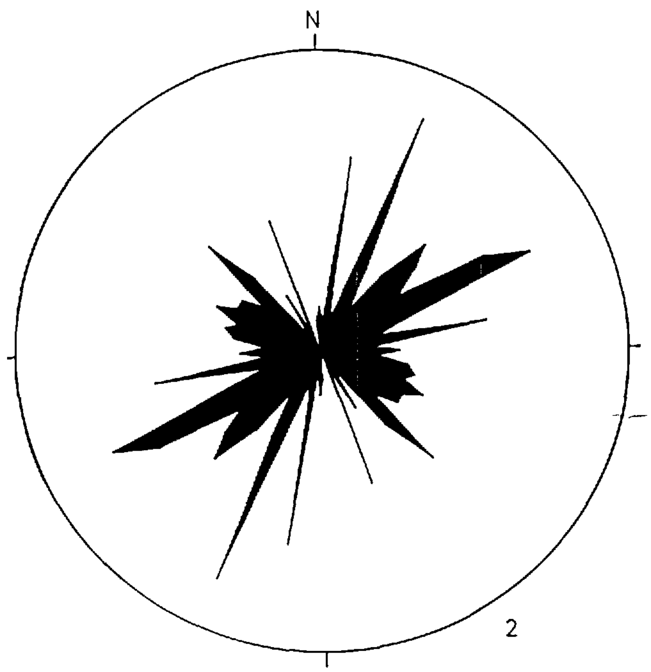
The measurements of joints and faults of SE-Verneuil which were determined by using aerial photographs ,have been entered in diagrams for the N and S half of the region and for the "Wilson granite" separately.For the evaluation of the measurements it was necessary to assign a value to each lineament according to its size. The individual lineaments were assigned values corresponding to the length over which they could be traced.If,for example, a lineament could be traced over 5cm in the map,it was considered as 5 individual measurements in the joint-fault diagram.

Aerial diagram 1: The NE and middle part of SE-Verneuil. Most lineaments are marked by the course of streams and small valleys.

The diagram has a total of eight maxima of which especially one is prominent.Between the strikes of 50° to 70° (an intervall of 20°) one large maximum is obvious.This maximum represent an extensive joint-fault set.These tectonic structures strike parallel with respect to the major folds and they correspond with the h0l plane of synclines and anticlines in the NE of the area.The large faults parallel to the contact of "Wilson granite" which are marked in the map lie within this maximum.

Between 135° and 160°,an intervall of 25°,a second large maximum may be interpreted.This joint-fault set forms a joint-fault system with a 10° to 20°striking set occuring in the NE sector of the diagram.These ruptures correspond to the SE and NE striking hk0 plane of the folds.

Two additional maxima,which strike 180° and 90°-120°degrees respectively,probably represent AC joints in the former case and h0l planes in the later case corresponding to the more E-W trending folds in the western part of the region.



Aerial diagram 2

190 joints & faults

Aerial diagram 2: "Wilson granite"

This large structurally homogenous area has similar maxima as the surrounding volcanic sequence.The granite intrusion is following an east-westerly striking anticline.The largest valleys within the granite however strike decidedly different (20° to 25°).These directions correspond with important joint and fault directions.

The NE (10° and 25°) and SE (100°-140°) maxima as well as the maxima at (40°-65°) and 160° are orientated symetrically to an abt. 70° trending deformation axis although the main fold axis is thought to trend about E-W in this part of the mapped area.

The small maximum of 80°-90° striking joint-fault set belong to the identical system which is to be observe in the other parts of the region.

Aerial diagrams of joint-fault sets

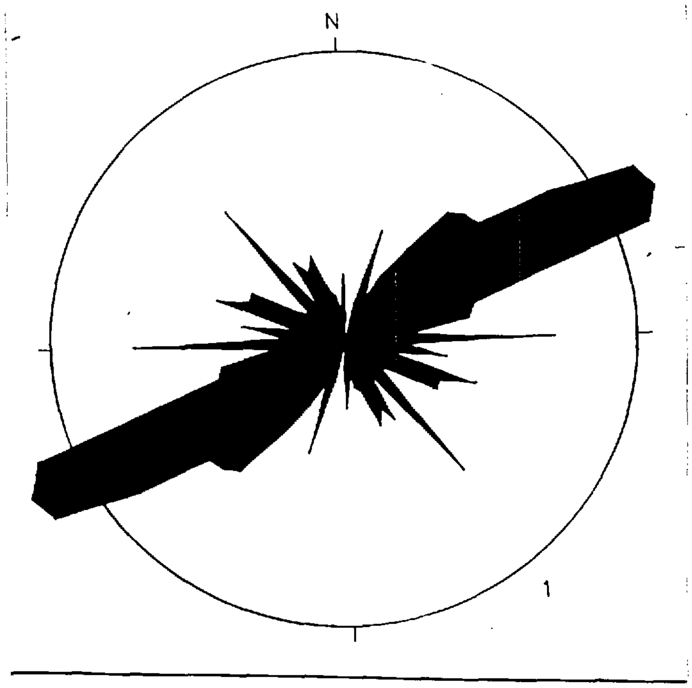


Diagram 1

271 joints & faults

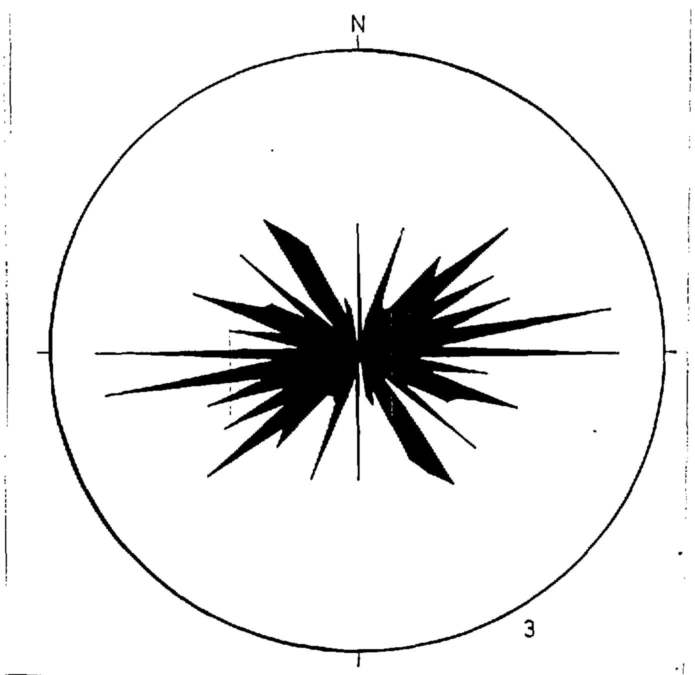


Diagram 3

222 joints & faults

Aerial diagram 3: South part of SE-Verneuil

The maxima of this diagram are partly orientated to an ESE trending deformation plan.The diagram shows NE (40^o-70^o) and SE (145^o-155^o) striking maxima which represent a joint-fault system diagonally with respect to the major folds in this part and they correspond to the SE and NE striking hkO plane of folds.The small 180^o striking maximum probably may show AC joints.

An other attitude of the major folds trending NE-SW occurs in this part.The rupture system with maxima at NNE (20^o) and ESE (100^o-130^o) may correspond to the hkO plane of the mentioned direction of fold axis.

The 80^o-90^o striking maximum consists of faults and large ruptures and may represent the hOl plane of the folds.

E. Economic Geology

The general succesion of strata in the present area can be compared with that of the southerly Val d'Or district. As result there seems to be in general the same sequence of "greenstone assemblage" with granitic intrusions.This serie is economically important in the Val d'Or region. For this reason the Québec Department of Natural Resources commenced a program of detailed geological mapping in 1968 and 1969 in Quévillon district.

In the investigated area two types of sulfide mineralizations could be distinguished:

a. Stratified orebeds

b. Ore on shear-zones and quartz veins

1. Stratified orebeds

The stratified sulfide occurences in Quévillon district seem up to today not of economic interest because of their smallness.They are to be found in dacitic tuffs as thin beds with pyrite mineralization (NW part) and in pillowed lava or dioritic intrusive rocks as irregularly orebodies with pyrite and chalcopyrite(NW and central part).In both cases Au occurs in chemical analysis.

Locally MoS_2-mineralization appears in pillowed andesite. MoS_2 is to be found together with quartz and epidote in the matrix between the pillows in not important concentrations.

In the SE of SE-Verneuil Au-bearing pyrite is a stratified conformable constituent of a 6 to 10 feet thick sericite-quartz - schist.This schist derive from an acid tuffaceous sedimentary rock as it could be established by microscopic investigations.This premetamorphically tuffite is accompanied by porphyritic andesite and rocks of gneissose structure. The later was identified beneath the microscope as porphyritic dacite and porphyritic quartz dacite.With some certainty it could be supposed that there is genetically a relationship between orebed and acid volcanic rocks.This orebed could be of economic interest.

There is no genetically relationship between these mineralizationes and the intrusions of granites in the vincinity. In comparison with the metamorphic and tectonic features in the area the statement is possible, that the substance of the ore-layers is in all cases of pre-orogenic age. It is presumed that they are of an exhalative-sedimentary origin. A low-thermal submarin inflow of substance is thought to have initiated external and internal synsedimentary chemical deposition of sulfides and quartz contemporanneously with the deposition of volcanics or argilaceous(less abundant) and quartz sediments. Syndiagenetic crystallization and, above all, metamorphic crystallization as well as local tectonic movement caused by blurring of primary fabrics and the local formation of discordant mineral accretions.

2. Mineralization on shear-zones and in quartz veins

The mineralization on shearing-zones and quartz veins seems to be the more economically important in the mapped area referring to the serious investigations made by companies. During the summer 1968 and 1969 considerable prospection was done in the eastern central belt of SE-Verneuil and several claims were staked. A complex sulfide mineralization occurs in quartz veins which are trending 30°-50° to NE, abt. 90° E-W, and 140°-150° to SE. (Compare chapter 2.42, page 31). Most of the quartz veins are situated on faults and large joints which probable may be faults. The assays of the milky, pyrite- and chalcopyrite-bearing quartz yielded traces of Mo, Au, Ag, W, Be, Pb, Zn. Native copper occurs in places.

The zones of shearing in the "greenstone assemblage" is mineralized with pyrite and chalcopyrite. In one case a cupriferous shearing-zone is 10 feet wide.

Considering that practically the most ore-bearing quartz veins and shearing-zones are situated in the vincinity of the granitic intrusions one can conclude with a faire degree of certitude, that a big part of the complex sulfide mineralization with milky quartz on lineaments is genetically related to the granitic intrusions.

Gold and copper associated with silicified rocks have been known to occur in the SE-Verneuil township since 1936. Serious investigations have followed:

1950

Labontè mining corporation

Location: Southeastern part of SE-Verneuil at the southern contact of granitic intrusion and volcanic rocks.

Geology: Silicified and altered shearing-zone.

Mineralization: Gold, chalcopyrite, pyrite.

1967

The White River Exploration Limited

Location: Southeastern part of SE-Verneuil at the southern contact of granitic and volcanic rocks.

Geology: Silified rocks, sericitic schists, porphyritic diorite.

Mineralization: Gold, chalcopyrite, pyrite.

1968

Beehler Corporation

Location: East-central part of SE-Verneuil

Geology: Quartz vein

Mineralization: Gold,chalcopyrite,pyrite,molybdenite,native copper.

1968 - 1969

New Jersey Zinc Exploration Company Limited (Canada)

Location: Central part of the SE-Verneuil township;group of 60 claims).

Geology: Quartz veins,shearing-zones,rhyolite,andesite.

Mineralization: Gold,chalcopyrite,pyrite,molybdenite,silver.

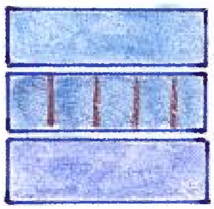
L E G E N D

Volcanic rocks

V6 ◘	Porphyritic andesite
V6 ϕ	Pillowed andesite
V6	Undifferentiated andesite
V4 ◘	Porphyritic dacite
V4	Porphyritic hornblende dacite
V4	Porphyritic quartz dacite
V10	Agglomerat
	Breccia
V9	Acid Tuff
V9 ~	Intermediate laminated tuff
V9	Intermediate crystaltuff
V9	Intermediate undifferentiated tuff

Intrusive rocks

IV2	Rhyolite
IG	Granite ;contact breccia
IQ	Quartz porphyry
IA;Q	Aplites,porphyritic dikes ; quartz veins
3G	Meta-hornblende gabbro
2D	Diorite
2DQ	Quartz diorite
4	Diabasedike



M8

Metasediments

Undifferentiated metasediments

Gneissose metasediments

Amphibolites

Symbols

Sand, gravel deposits

Geological boundary

Strike and dip

Faults, shear-zones (located, assumed)

Outcrops

Swamps

Wagon road

Road, second class

Mineralization