GM 42910

GEOLOGICAL SURVEY, G-D PROJECT

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ESSO MINERALS CANADA

G-D PROJECT:

GEOLOGICAL SURVEY

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INTRODUCTION

Location and Access

The G-D project is 75 km southwest of Chibougamau, Quebec and is centered at latitude 49°31'N and longitude 75°13'W (Figure 1). The G-D property comprises 238 claims covering an area of 3,699 ha in Guercheville, Drouet and Gradis Townships.

Access is provided by forestry roads. A main all-weather gravel road departs Highway 113 at km 317. A secondary road branches from the main gravel road 38 km south of the highway. The secondary road and subsidiary logging roads traverse the property.

History

Semi-detailed geological mapping in the G-D area was performed by Déland (1955) and Remick (1956, 1957). The area was covered in a regional reconnaissance geological survey carried out by Gobeil and Racicot (1982).

Mineral exploration in the area has been sporadic since the late 1940's. Gold exploration peaked in the late 1940's and 1950's. Base metal exploration was conducted in the 1960's and 1970's. A renewed search for gold commenced in the early 1980's. Significant previous exploration is summarized in Table 1.

Esso Resources Canada Limited acquired 203 claims in November, December, 1984. An additional 35 claims were staked in October, 1985. Claim status is presented in Appendix I.

1985 Exploration

Exploration during 1985 included detailed geological mapping. Control was provided by a grid which comprises 34 km of baseline and 270 km of cross lines. Previous work, including an airborne input electromagnetic and magnetic survey published by the Quebec government in 1982 (DP-927), was used to interpret lithology and contacts in areas of poor outcrop control. Geological data is presented on Dwg. Nos. 1,2,3 and 4.

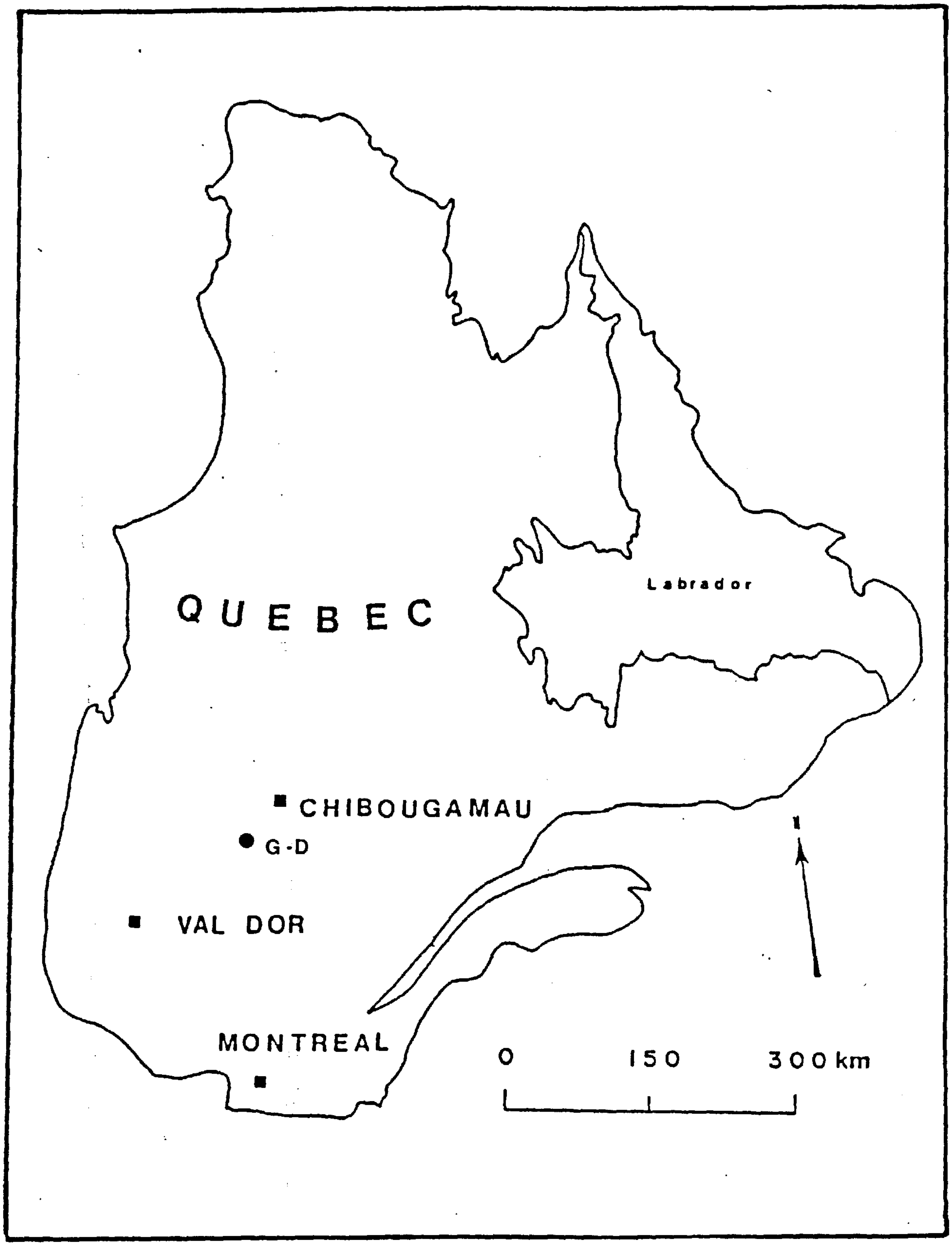


Figure 1: Location

TABLE 1

EXPLORATION HISTORY

	YEAR(S)	COMPANY	REFERENCE	LOCATION	TYPE OF WORK AND RESULTS
1.	1949	Consolidated Mining & Smelting Company of Canada	GM-475 Fiche de Gite 32G/11-15	4km SW of G-D property	Geology, diamond drilling (1219m in 12 holes): - up to 10.6 gm/t Au over 11.0 m, 38.5 gm/t Ag over 0.9m - Au concentration in folded, locally banded, siliceous pyritic bodies with high width/length ratio in small-scale southeasterly shear(s)
2.	1949	American Metals Company of Canada	GM-565 Fiches de Gite 32G/11-10, 11, 12	1.5km NW of (1)	Geology, rock sampling: - up to 31.9 gm/t Au in selected grab samples - Au in (a) siliceous pyritic pods in carbonate veins at 045° and 140°-160° crosscutting regional foliation; carbonate veins to 1.8m wide with local sphalerite concentrations (b) pyrite stringers in ESE shears that parallel regional foliation
3.	1959	Steerola Explorations Ltd.	GM-8044 Fiche de Gite 32G/11-16	N. shore Lac Mina, 1km W of G-D property	Geology, diamond drilling (457m in 7 holes): - up to 17.1 gm/t Au (?) in grab, up to 1.7 gm/t Au in partial drill results - chlorite-sericite-carbonate schist with graphite, pyrrhotite, pyrite, trace chalcopyrite
4.	1967, 1970	Serem Ltee.	GM-22539 -22586 -26435	N. part of G-D property	Diamond drilling (3,507m in 27 holes): - no significant Cu concentrations (up to 1.67% Cu over 0.25m) - up to 4.8 gm/t Au over 0.1m, numerous intersections of 0.3 - 1.0 gm/t Au - average Ag/Au ratio equals 6 - Au associated with concentrations of pyrrhotite, pyrite, chalcopyrite and locally graphite, commonly in carbonatized sections; local quartz-carbonate veining
5.	1976, 1977	Falconbridge Nickel Mines Ltd	GM-32827 -33449	E part of G-D & SE of G-D	HLEM, mag, geology, diamond drilling (349m in 7 holes): - SE trending conductors probably define bedding, foliation in bedrock strikes ESE - up to 0.26% Zn over 1.8m - up to 0.6 gm/t Au over 4.0m - Au in pyritic-graphitic zones locally with quartz-carbonate veins
6.	1981	A. Gobeil	Fiche de Gite 32G/11-18	central part of G-D (Victoria Diego Res. property)	Geology, sampling: - 5.4 gm/t Au in pyritic silicified zone (max 0.4m wide) in ESE shear
7.	1980-1983	SDBJ	GM-40470	same as (1), (2)	Surface & plugger sampling, extensive diamond drilling (drill results not published): - up to 1.54% Zn and 1.77 % Cu in near-surface samples

REGIONAL GEOLOGY

The G-D prospect is located in the eastern part of the Abitibi greenstone belt. The main features of the Abitibi greenstone belt are summarized in Figure 2.

The Abitibi belt is approximately 700 km in length, and 200 km in width. It is the largest greenstone belt in the Superior Province. On the east it is bounded by the younger (950 MY) Grenville Province (Figure 2). The boundary between the two provinces is major tectonic zone called Grenville Front. It separates the low-grade metavolcanic rocks of the Superior Province from the high-grade gneisses of the Grenville Province (Allard, 1972). Allard (1976, 1978, 1981) has demonstrated that the rocks of the Abitibi belt in the Chibougamau District extend into Grenville Province. On the west, the Abitibi belt is bounded by the Kapuskasing structural zone (Figure 2). This zone is an elongate NE trending structurally discordant region of high-grade gneisses which is Proterozoic in age. To the north and south, the belt is bounded by high-grade gneisses which may represent older basement terrane (Dallmeyer, 1974; Racicot et al., 1984).

The Abitibi belt consists of a thick sequence of volcanic and sedimentary rocks which have been isoclinally folded into large scale anticlinoria and synclinoria, metamorhposed, and intruded by several large granitic batholiths.

Regional stratigraphic successions within the belt can be considered in terms of a large basin, with marginal (proximal) and interior (distal) facies (Goodwin, 1977). The marginal parts of the belt are characterized by large volcanic centres. The centres are composed of several shield-type volcanoes (Goodwin, 1977) comprised of lower dominantly tholeiitic parts, and upper calc-alkalic parts (Goodwin, 1972, 1977). The change in lithology from mafic to felsic is not abrupt, but takes place over a stratigraphic range of varying thickness by interlayering of flows of different compositions. Generally more than one mafic to felsic cycle makes up a succession (Ridler, 1970; Baragar, 1971; Allard et al., 1972; Goodwin, 1972, 1977), and the entire succession is generally conformable.

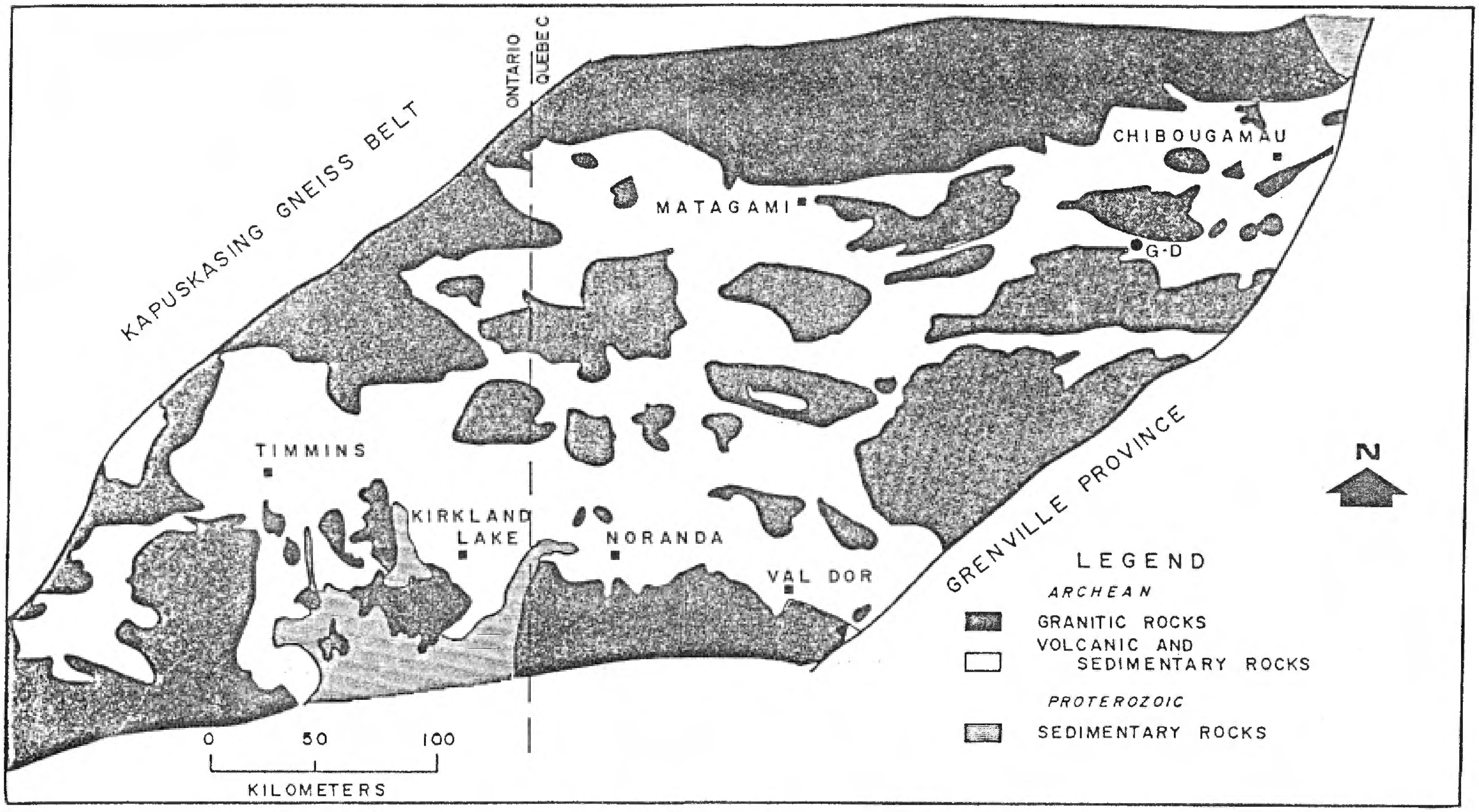


Figure 2 - General geology of the Abitibi greenstone belt.
(After Goodwin and Ridler, 1970; and Allard, 1976)

The mafic portions of the volcanic sequences are dominated by massive and pillowed flows which show evidence of having been deposited in a submarine environment. Mafic sills with compositions similar to their host rocks are generally abundant in the mafic part of the sequences (Baragar, 1971). In several volcanic centres large layered ultramafic to mafic complexes are present in the tholeiitic parts of the sequences. The calc-alkalic parts of the successions are composed mainly of intermediate to felsic flows, and small felsic intrusions (Baragar, 1971; Goodwin, 1972, 1977).

Clastic and chemical sedimentary rocks are present in the stratigraphic successions in all of the volcanic centres. They characteristically occur in the upper part of the mafic to felsic cycles. The clastic sedimentary rocks consist of poorly sorted conglomerates, breccias, and coarse-grained turbidites, derived mainly from the volcanic rocks lower in the succession. They are spatially very closely associated with the calc-alkalic volcanic edifices, and grade into the volcanic rocks (Goodwin, 1972, 1977). The sedimentary sequences generally fine upwards and pass gradually into chert-rich oxide facies iron formation. Oxide facies iron formations occur as thick and extensive units which cap the different mafic to felsic cycles in the volcanic centres (Ridler, 1976; Goodwin, 1972, 1977).

As in the marginal parts of the belt, the stratigraphic successions in the interior are characterized by several mafic to felsic cycles with associated clastic and sedimentary rocks. However, in the interior parts of the belt, these cycles are composed mainly of tholeiitic mafic flows with coeval mafic intrusions and only insignificant amounts of calc-alkalic intermediate to felsic volcanics (Goodwin & Ridler, 1970; Descarreaux, 1973; Goodwin, 1977). The clastic sedimentary rocks which are found in upper part of the cycles consist of distal fine to medium grained turbidites. The mafic to felsic cycles are capped by thin discontinuous units of carbonate and sulphide facies iron formation. The changes in the nature of clastic and chemical sedimentary rocks is interpreted by Ridler (1976) and Goodwin (1977) as being indicative of a change in the paleoslope of the basin and depositional environment.

The volcanic rocks of the Abitibi belt have been intruded by several granitic batholiths and stocks. Most of these plutons are located in the interior of the belt, but several of the volcanic centres have also been intruded by granitic plutons. The granitic plutons can be subdivided into two groups: synkinematic tonalitic to dioritic plutons, and post-kinematic granite to granodiorite plutons. The rocks in the post-kinematic plutons are generally massive and usually more potassic than the rocks they intrude (Viljoen & Viljoen, 1969; Anhauser, 1973; Hickman & Lipple, 1975; and Glikson & Lambert 1976). These plutons are concordant on a regional scale and discordant on a local scale. Structural evidence from within the plutons and surrounding volcanics in indicative of a diapiric mode of emplacement (Drury, 1977; Goodwin & West, 1974).

Radiometric age dating of undeformed post-kinematic plutons within the Abitibi belt by Wanless and Loveridge (1972), Steiger and Wasserburg (1969), and Dallmeyer et al., (1975) suggests that many batholiths were emplaced during the period 2650-2700 M.A. Age dates from deformed ~~pre-or~~ synkinematic tonalitic-dioritic plutons by Krough and Davis (1971), Wanless et al., (1970) indicate a time of intrusion between 2780 M.A. and 2820 M.A. (Dallmeyer et al., 1975).

Metamorphism in the Abitibi belt is commonly of greenschist grade, and even as low as zeolite grade in a few localities (Jolly, 1974; Goodwin 1977; Dimroth et., 1982, 1983). However, close to the boundaries of the belt and adjacent to the granite-granodiorite stocks and batholiths the grade of metamorphism reaches amphibolite and hornblende hornfels, respectively(Dimroth et al., 1982, 1983). Age dates from pre-kinematic and post-kinematic granitic plutons suggest that Kenoran metamorphism must have occurred between 2650-2700 M.A. and 2780-2820 M.A. (Dallmeyer et al., 1975).

The main structural feature of the Abitibi belt is a series of large east-west trending isoclinal folds (Goodwin, 1977). In the Timmins and Chibougamau mining camps, north-south trending folds are also present (Allard et al., 1972; Davies, 1977; Karvinen, 1981; Daigneault & Allard, 1984). In the Chibougamau area north-south trending folds are older than east-west trending folds (Daigneault & Allard, 1983, 1984). Age relationships between the two generations of folds in the Timmins area are unclear at present. In addition, there has been some localized folding adjacent to some of the large granite-granodiorite batholiths. Another important feature of the Abitibi belt is the presence of large faults/shear zones in the marginal parts of the belt. The Porcupine-Destor fault in the Timmins camp, and the Cadillac-Larder Lake fault in the Val d'Or, Noranda, and Kirkland Lake camps have strike lengths in excess of 100 km. They developped as zones of normal faulting during accumulation of the supracrustal sequence. During the Kenoran orogeny they were transformed into zones of thrust faulting (Dimroth et al., 1982, 1983).

Information on the displacements along these major structures is lacking but it is believed to be on the order os several kilometers. Several generations of smaller faults and shear zones are common in all parts of the belt.

The evolution of the Abitibi belt during Archean time can be briefly summarized as follows: (1) volcanism and sedimentation on a pre-existing gneissic basement prior to 2780-2820 M.A. Intrusion of tonalitic-dioritic plutons into the volcanic and sedimentary rocks in the period 2780-2830 M.A.; (2) metamorphism and deformation during the Kenoran orogeny in the period 2650-2700 M.A. to 2780-2820 M.A.; (3) intrusion of post-kinematic potassic plutons at 2650-2700 M.A. The rocks along the western margin of the Abitibi belt were deformed during the formation of the Kapuskasing structural zone in the Hudsonian orogenic event (1800 M.A.). The rocks along the eastern boundary of the belt were deformed during the Grenville orogeny (950 M.A.).

GEOLOGY OF THE CHIBOUGAMAU DISTRICT

The Chibougamau district is situated in the extreme northeastern part of the Abitibi greenstone belt (Figure 2). Supracrustal rocks in the area have been divided into two groups: the Roy Group, and the Opemiska Group. The distribution of the different stratigraphic units in the district is shown in Figure 3 .

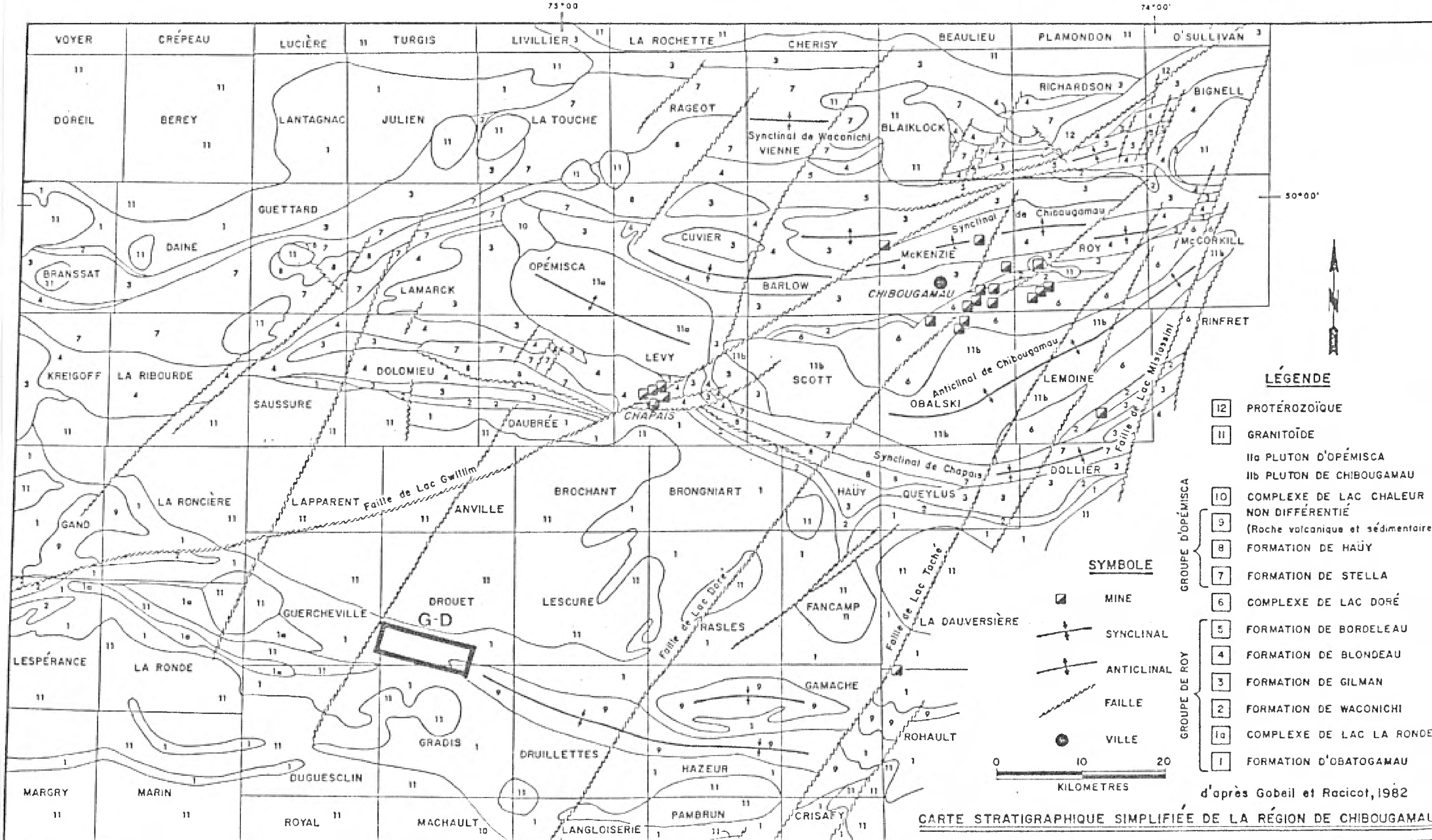
SUPRACRUSTAL ROCKS

Roy Group

The Roy Group is comprised of two mafic to felsic volcanic cycles. The lowermost unit of the first volcanic cycle is the Obatogamau Formation. This formation is extensive and has been traced westward from the Grenville front for over 100 km. It consists of 3,000 metres of pillowed basalts and numerous gabbro sills. The basalts are plagioclase phyric at many localities. Felsic to intermediate tuffs and breccias constitute a very small portion of the formation. The extent of the formation and the nature of the flows are indicative of a submarine lava plain environment (Allard et al, 1984).

Rocks of the Obatogamau Formation are overlain by those of the Waconichi Formation. It is less than 1,000 metres thick and is comprised of porphyritic soda-rhyolites, felsic tuff breccias, a few lenses of basaltic flows and tuffs, hyaloclastites and iron formation. The distribution of the various lithologies is indicative of widespread felsic volcanism localized in many small submarine eruptive centers. The small volcanic edifices are locally capped by a carbonate and/or sulfide facies iron formation (Lac Sauvage Iron Formation).

Rocks of the first volcanic cycle are conformably overlain by the pillowed basalts and comagmatic gabbro sills of the Gilman Formation. It has a maximum thickness of 3,600 metres in the central part of the Chibougamau district and thins all directions away from the center. The nature and distribution of the different flow units are similar to those of large central shield volcanic complexes (Allard et al, 1984).



CARTE STRATIGRAPHIQUE SIMPLIFIÉE DE LA RÉGION DE CHIBOUGAMAU

FIGURE Nº 3

The Blondeau Formation is the upper part of the second volcanic cycle. Rocks of this formation conformably overlie those of the Gilman Formation. It is approximately 1,000 meters thick and consists of variolitic basalts, rhyolitic flows, felsic tuffs and breccias, cherty and graphitic tuffs and argillites, and volcanogenic sandstones and greywacke. Relationships among the different facies are interpreted by Dimroth et al (1982) and Archer (1984) as the result of volcanism creating emerging volcanic islands and concurrent erosion and sedimentation in adjacent sedimentary basins.

The Bordeleau Formation as defined by Caty (1979) is restricted to the Waconichi syncline north of Chibougamau. It is comprised of volcanogenic sandstones. Mueller et al (1984) interpret this formation to be part of the Chebistuan/Stella Formation. The inferred environment of deposition is fault bounded basins adjacent to emerging volcanic islands.

Opemiska Group

The contact between rocks of the Roy Group and those of the Opemiska Group ranges from a conformable transitional contact to a profound unconformity (Allard et al, 1984). Cimon (1976) subdivided rocks of the Opemiska Group into the Stella and Haüy Formations. At the type localities in the Chapais syncline the Stella Formation is comprised of a basal polymictic conglomerate succeeded upward by an interlayered sequence of feldspathic sandstones and argillites. The overlying Haüy Formation consists of an intercalated sequence of feldspathic sandstones, argillites, and porphyritic potassic andesites.

On the basis of sedimentological and volcanological studies, Dimroth et al (1982) suggest that rocks of these formations should be considered as a single unit. Paleogeographic reconstruction of the sedimentary basins represented by rocks of this group indicate contemporaneous subaerial volcanism, rapid erosion, and sedimentation in adjacent fault bounded basins.

MAFIC INTRUSIONS

Supracrustal rocks in the Chibougamau district have been intruded by several concordant mafic layered complexes. The Doré Lake Complex has been emplaced into the upper part of the Waconichi Formation. The Chaleur Lake Complex is intrusive into rocks of the Gilman and Blondeau Formation whereas the Opawica River Complex has been intruded into rocks of the Obatogamau Formation. These intrusions are characterized by a suite of rock types and primary structures are similar to those found in other well studied layered intrusions such as the Bushveld and Skaergaard Complexes (Allard et al, 1984).

The Cummings Complex has been implaced into rocks of the Blondeau Formation. It is comprised of three sills which have been traced westward from the Grenville front for over 160 km. The three sills always occupy the same relative stratigraphic positions. The lowermost Roberge sill consists of dunite and peridotite. The Ventures sill which occupies a slightly higher stratigraphic position is composed of gabbro. The stratigraphically highest Bourbeau sill is comprised of leucogabbro and quartz ferrodiorite. Each of the three sills is differentiated and the three sills together form a larger differentiated unit (Allard et al, 1984).

GRANITIC ROCKS

The greenstone belt in the Chibougamau district is bordered to the north and south by granitic plutons and gneisses. Within the greenstone belt Racicot et al (1984) have subdivided felsic intrusions into four categories; remobilized basement domes, pre-kinematic intrusions, syn-kinematic intrusions, and post-kinematic intrusions.

Basement domes such as the Lapparent Massif are composed of migmatized tonalite-diorite gneiss that has been intruded by two generations of mafic dykes and subjected to at least three major deformation events. Pre-kinematic plutons ie the Chibougamau Pluton are composite intrusions of tonalitic to dioritic composition. Syn-kinematic plutons occur in two distinct tectonic settings and show two distinct petrographic suites.

They occur either along the contact between basement and younger supracrustal rocks or in discreet masses with sub-circular outlines along major tectonic highs. Compositionably they belong either to a quartz monzonite or tonalite suite. There are pronounced contact metamorphic aureoles (associated with these intrusions) which are in part superimposed on fabrics developped in regional structural events. Post-kinematic plutons are granodioritic in composition. They are often prophyritic and exhibit compositional zoning rather than multiple intrusion. Adjacent wall rocks are locally deformed and extensive contact metamorphic aureoles superimposed on earlier fabrics are present around the plutons.

STRUCTURAL DEVELOPMENT

The Abitibi greenstone belt in the Chibougamau district has the form of a major synclinorium developed on basement granitic gneisses. Polyphase deformation has affected all the lithologies within the greenstone belt. The Chibougamau anticline is the central structure of the area, and is bordered to the south by the Chapais syncline and to the north by the Chibougamau syncline (Duquette, 1970). West of Chapais, the two synclines merge into a major synclinorium. Caty (1977) has identified the Waconichi anticline and syncline north of the Chibougamau syncline. South of the Chapais syncline Hébert (1980) has mapped the La Dauversière anticline.

Early north trending folds have been reported by Allard (1976), Durocher (1978), Hébert (1979) and Daigneault et al (1983, 1984). Sedimentary rocks of the Opemiska group have not been affected by the early north-south folding event. All supracrustal rocks have been affected by the regional east-west folding event.

On the basis of radiometric age dates, the regional east-west folding event and contemporaneous regional metamorphism occured between 2,650 and 2,820 MA (Dallmeyer et al, 1975).

Rocks in the Chibougamau district are transected by four major systems of faults: East-west striking faults are generally subparallel to lithological contacts, are up to 1 km wide and can be traced for several tens of kilometers along strike. Rocks within and adjacent to these faults are highly carbonatized. Charbonneau (1981), Allard (1982) and Daigneault et al (1983) mapped the Kapunapotagen fault in the Chapais syncline. It has been traced westward from the Grenville front for over 80 km. The nature of the fault and its sense of movement have not been established. The fault separates south facing sedimentary rocks of the Opemiska Group and north facing volcanic rocks of the Roy Group (Allard et al, 1984). The similar Faribault fault in the Chibougamau syncline separates north facing volcanic rocks of the Waconichi Formation and southward facing sedimentary rocks of the Bordeleau formation (Daigneault et al, 1983).

The Mistassini Lake, the Taché Lake, the Doré Lake-McKenzie Narrows, and the Gwillim Lake faults are major northeast striking faults, which have an apparent left lateral sense of movement. The fault zones are several hundred metres wide and are comprised of an anastomising network of faults and/or shear zones. On the basis of cross-cutting relationships, they are younger than E-W trending faults.

Where the Doré Lake - McKenzie Narrows fault transects the Doré Lake Complex, northwest striking faults and/or shears are common and in some cases host copper mineralization (Gobeil et al, 1984).

The area adjacent to the Grenville front is characterized by a series of closely spaced N-S to N20E striking faults. The spacing between faults increases westward away from the Grenville front. The faults are of a reverse nature and dips range from 50°SE at the front to vertical a few kilometers west of the Grenville front. The area adjacent to the front is also characterized by a higher metamorphic grade and Grenville style and age fabrics and structures superimposed on older fabrics and structures (Allard et al, 1984).

ORE DEPOSITS IN THE CHIBOUGAMAU DISTRICT

To date 25 ore deposits have been discovered in the Chibougamau district. Of these twenty five deposits, 18 are copper-gold fissure deposits, two are volcanogenic massive sulfide deposits and five are quartz vein type gold deposits. Seventeen of the copper-gold fissure deposits are situated in shear zones in the Anorthosite Zone of the Doré Lake Complex, and one deposit is localized in a border phase of the Chibougamau Pluton. The two massive sulfide deposits are situated in the felsic volcanic rocks of the Waconichi Formation. Several copper-zinc prospects occur in felsic volcanic rocks of the Blondeau Formation.

The gold deposits in the district are localized in or adjacent zones of intense hydrothermal alteration and deformation. They are structurally controlled, and occur in a variety of rock types and in different formations. In adddition, important deposits of vanadiferrous and titaniferous magnetite occur in the layered zone of the Doré Lake Complex (Allard, 1976).

PROPERTY GEOLOGY

The G-D property is underlain by a metavolcanic-metasedimentary sequence. The northern claim boundary in the western part of the property is 0.5 km from the Lapparent Massif. The eastern part of the Opawica River intrusive complex and the coincident Opawica River anticline are about 4 km southwest of G-D. Granitic plutons intrude the supracrustal rocks about 3 km south of the property. The above Archean rocks are cut by Proterozoic diabase dikes.

The stratigraphic succession in the northern part of the property faces south. Mafic flows and related mafic sills and plugs, and minor interbedded felsic pyroclastic and clastic sedimentary rocks overlie a unit comprised mainly of felsic pyroclastic and clastic sedimentary rocks with minor intercalated chemical sedimentary rocks, gabbro and mafic flows. These units are overlain by a thin horizon of mafic flows and gabbro. Synvolcanic feldspar and quartz-feldspar porphyry sills are common. Extensive feldspar phyric mafic flows and gabbro sills within the northern part of the property indicate that this sequence correlates with the Obatogamau Formation.

The southern part of the property is probably predominantly underlain by clastic and chemical sedimentary rocks. Although outcrop control is limited, this interpretation is supported by geological and geophysical data reported by previous operators within and near G-D (Table 1; M.E.R. DP-927). Compositionally and texturally immature clastic sedimentary rocks south of the eastern G-D claims probably reflect deposition within a fault-bounded basin and are tentatively assigned to the Opemiska Group (Gobeil and Racicot, 1983; Allard et al., 1984).

Quartz-feldspar porphyry plugs and dikes cut the stratigraphic sequence in the eastern part of the property. The contacts of these intrusive bodies are not defined. However, outcrop distribution and geophysical data indicate that they are localized along northeasterly trends. Sedimentological evidence supports the hypothesis that the quartz-feldspar porphyry bodies pre-date Opemiska Group ? sedimentary rocks.

Rocks in the northern part of the property are strongly deformed; primary structures are rarely discernible. Contacts are often sheared and it is difficult to trace individual depositional units along strike. In contrast, primary structures, such as bedding and pillow shapes, are generally well-preserved and zones of intense deformation are spatially restricted in and near the southern part of G-D.

Lithology

Mafic Metavolcanic Rocks

Massive and pillowed, fine-to-medium grained mafic flows are dark green or black and rarely gray. Feldspar phenocrysts, up to 4 cm long, are irregulary distributed and comprise up to 70% of the rock.

In the northern part of the map area, primary textures and structures are poorly preserved. Pillows are generally extremely flattened and locally rotated. Amygdules were recognized at only two localities.

In the area 3-5 km southwest of G-D, pillow breccia and flow top breccia, as well as massive and pillowed flow varieties, have been identified. Flows are commonly vesicular or amygdaloidal. Pillow shapes are generally well-preserved and indicate tops to the north.

Felsic Metavolcanic Rocks

Felsic tuff, lapillituff and lapillistone are gray-to-pale green on fresh surface and weather white-to-buff. Coarse-grained pyroclastic rocks are monolithic and are comprised of quartz phyric fragments in a matrix of sericite, and feldspar and quartz crystals. Feldspar and quartz-feldspar crystal tuffs are common.

Many of the rocks which have been assigned a pyroclastic origin are largely replaced by sericite and carbonate. These felsic rocks may, in part, comprise felsic flows and/or synvolcanic intrusives. In the absence of primary textures and structures, positive genetic classification is not possible.

Clastic Metasedimentary Rocks

Wacke, feldspathic wacke, mudstone, lesser arkose and minor conglomerate are intercalated with metavolcanic rocks in the northern part of the property. Mudstones and arenites, and the matrix of conglomerates are largely replaced by chlorite and sericite; in the north-central part of the area, amphibole is a major constituent of these rocks. Accessory graphite, pyrite, pyrrhotite and trace chalcopyrite are common in wacke/mudstone sections. Felsic volcanic clasts and probable mafic volcanic/gabbro clasts are found in conglomerate. Felsic volcanic pebbles are extremely stretched and define long-to-short axes ratios of 10 to 20:1; mafic clasts are difficult to distinguish from matrix which is amphibole-chlorite rich. Deformation and metamorphism have extensively overprinted primary textures and structures in the northern portion of the map area. However, southerly tops are defined by graded arkosic beds in the extreme northwest corner of G-D claims.

South of the eastern part of the property, conglomerate, wacke, arkosic wacke, arkose and mudstone are compositionally and texturally immature. Matrix-supported, oligomictic conglomerate is comprised of angular-to-subrounded feldspar and quartz-feldspar phyric clasts in a quartzofeldspathic matrix. The striking similarity between conglomerate composition and nearby intrusive rocks indicate that the clastic sedimentary rocks may be derived from the feldspar and quartz-feldspar porphyry bodies.

Chemical Metasedimentary Rocks

Thin, discontinuous units of graphitic and/or pyritic, locally garnetiferous, chert are found within clastic sedimentary sequences in northwestern G-D. Minor amounts of amphibole-chlorite-garnet rock are intercalated with mafic flows and clastic metasedimentary rocks. This garnetiferous unit may have chemical sedimentary affinities; laminated siliceous rock is commonly associated with this rock type. Fine-to-medium euhedral magnetite is locally disseminated in the chert and amphibole-chlorite-garnet units.

Concentrations of sulphide minerals within clastic sedimentary successions may represent a chemical component of these rocks.

Mafic Intrusive Rocks

Gabbro is a major component of the stratigraphy. Gabbro generally exhibits a colour index of 60 to 80 and is commonly feldspar phyric. Leucogabbro and quartz gabbro are rare and are restricted to the thicker mafic intrusive units in and near G-D. On a large scale, the gabbro units are conformable; at an outcrop scale, cross-cutting relationships can be defined. Gabbro sills are generally lenticular. Contacts are commonly schistose and it is probable that many of the gabbro bodies have been structurally transposed into their present position.

A distinctive feldspar porphyry sill in the eastern part of G-D (L 148 E/3+00S area) is comprised of 80% white feldspar phenocrysts, up to 3 cm in diameter, in a fine-grained, medium green matrix. The rock is soft, epidote-rich and locally fuchsite-bearing. This unit may be related to mafic intrusive rocks described above.

Felsic Intrusive Rocks

Feldspar and quartz-feldspar porphyry cut metavolcanic, metasedimentary and gabbroic rocks in the eastern part of the map area. Porphyry is pale gray-to-white on fresh surface, weathers white, is fine-to-medium grained (1-5 mm) and is comprised mainly of feldspar with up to 25% quartz crystals. Matrix generally comprises less than 5% of the rock and, in addition to very fine quartzofeldspathic material, is composed mainly of sericite and minor chlorite. In places quartz crystals and crystal aggregates are coarser than feldspar and reach diameters of up to 8 mm. Porphyry dikes clearly cross-cut pillowed flows and gabbro; variably oriented zenoliths of country rock are common. Massive porphyry to the north is transitional to quartz-eye sericite schist towards the south.

Structure

At least three episodes of deformation are recorded in rocks in the G-D area. Direct evidence of a structural event preceeding these three episodes is not preserved at G-D. However, the nature of sedimentary rocks in the southeastern part of the area indicates that sedimentation may have been controlled by early wrench faults. These faults may have been re-activated as ductile shear zones and/or reverse faults during a second deformation. The second deformation imparted a penetrative east-west structural fabric. The third and fourth deformations are represented by brittle or ductile-brittle structures which have only locally disrupted the east-west fabric.

Taking into account the hypothesis that an early period of deformation affected the G-D area, structural features associated with subsequent deformations are described below.

Second Deformation (D_2)

Structural features that are considered to be a result of D_2 deformation include: flattened pillows and stretched pebbles; pervasive, subvertical, east-southeast striking cleavage; rotated foliated garnets; dextral, Z-asymetric minor folds; and ductile to ductile-brittle shears. Many of these features can be considered within the context of progressive development of a dextral shear system (McClay, 1984).

Discrete east-southeast shears in the northwestern part of the area are generally less than 5 m wide and display a well-developped cleavage parallel to their east-southeast strike. Subsidiary reidel (R) shears are commonly developped at an orientation 10-35° clockwise to the strike of the main shears. The R shears are anastomosing, commonly merge with the main fabric, and define lozenge-shaped domains within which rotation of fabrics indicates dextral displacement. In the eastern part of the property east-southeast shears are weakly developped in the northern part of the major outcrop area; synthetic R and P shears are oriented at about 20° clockwise and counterclockwise to the main east-southeast shear direction. In contrast, the southern 400 m of this outcrop area comprise intensely sheared rocks with local development of mylonite; previous fabrics have generally been rotated into a close-spaced 110° cleavage.

At least four stages of shear development can be identified in northwestern G-D. The first stage is represented by a strong cleavage and emplacement of quartz veinlets. This cleavage was imposed early in D_2 or possibly during D_1 deformation. At 71 + 67 E/3 + 00S, sericite-carbonate schist with cleavage-parallel quartz veinlets is interbanded with competent felsic tuff; the banding defines a small-scale, Z-shaped fold. Such dextral asymetric folds were identified at several localities; folds are open-to-isoclinal, exhibit wavelengths of 1 m to 10 m and have an average plunge of 25° westerly to west-northwesterly. Shallowly westerly plunging lineations are also defined by stretched pebbles in conglomerate at 71 + 50 E/1 + 40 N. Subhorizontal lineations are common to many shear zones.

The third stage is characterized by semi-brittle P shears and by centimeter-to-meter scale folds of dextral asymetry which locally are accompanied by axial planar cleavage. The P shears and cleavage are oriented at about 20° counterclockwise to the main shear direction and cut limbs and hinges of earlier folds. Axes of third stage folds exhibit variable, but generally shallow, plunges. P shears are commonly infilled with quartz veins and, at 72 + 20 E/2 + 30 S, by quartz-garnet veins. The third stage may represent a relaxation phase in shear zone development.

A late episode of shearing is evidenced by boudinaged quartz veins of the third stage. Quartz vein segments have sigmoidal shapes and are locally rotated towards the east-southeast plane of shearing. Sigmoidal shapes and transposition of vein segments define a dextral sense of shear.

All of the features described above are consistent with the hypothesis of progressive dextral shear. Additional evidence of dextral sense of shear is provided by small-scale structures that include rotated porphyroblasts and phenocrysts, and asymetric pressure shadows; foliated garnets are commonly rotated into sigmoidal shapes.

Third Deformation

This deformation is reflected in a conjugate set of subvertical, brittle to ductile-brittle shears/faults. Dextral shears have an average strike of 165°, while sinistral shears have an average strike of 060°. These shears are wide-spaced and are found throughout the property area. Pre-existing fabrics are rotated towards parallelism with the shears, and a weak S_3 cleavage is locally developped, in the vicinity of these structures. Maximum apparent horizontal displacement of 3 m was observed. Major northeast faults, such as those found elsewhere in the Chibougamau region, have not been identified at G-D property.

Fourth Deformation

The fourth deformation is marked by generally brittle structures which comprise fractures and kinks. Subvertical fractures are common: very limited apparent horizontal translation of both dextral and sinistral sense exists locally. Kinks exhibit both dextral and sinistral sense of displacement and are more common in less competent rocks. The average strike of fractures and kinks is 017°. These structures do not significantly disrupt previous structural fabrics and may, in part, be related to the Grenville Front.

CONCLUSIONS

The G-D property is predominantly underlain by Archean mafic flows, felsic pyroclastic deposits, clastic and chemical sedimentary rocks, gabbro sills and quartz-feldspar porphyry plugs. Quartz-feldspar porphyry cuts earlier volcanic, sedimentary and mafic intrusive units. Sedimentological data indicates that a clastic sedimentary sequence overlies earlier supracrustal rocks, including quartz-feldspar porphyry. The late sedimentary rocks may have been deposited in a basin bounded by faults of an early tectonic event.

A second period of deformation resulted in flattening of primary structures, generation of subvertical, east-southeast cleavage and probable transposition of lithological units. Progressive development of a dextral shear system is reflected in structures of the second deformation. Relative timing of at least four stages in evolution of this system have been established. In chronological order, the stages are: early flattening and/or shearing, folding, subsidiary P shear development and late shearing.

A third tectonic event is represented by a conjugate set of subvertical faults, shears and associated cleavage at 165° and 060°. Fractures and kinks with an average strike of 017° are assigned to a fourth phase of deformation. Structures of the third and fourth deformation have only locally disrupted the predominant east-southeast structural grain.

REFERENCES

Allard, G.O. 1972. Precambrian geology and mineral deposits of the Noranda-Val d'Or and Matagami-Chibougamau greenstone belts, Quebec. Guidebook for excursion A41-C41 of the International Geological Congress, Montreal.

_______ 1976a. A volcanogenic model for the ore deposits of the Chibougamau district. University of Georgia and Quebec Department of Natural Resources, C.I.M.M. Meeting.

_______ 1976b. Doré Lake Complex and its importance to Chibougamau geology and metallogeny. Ministère Rich. Nat., Qué., DP-368.

_______ 1978. Pétrologie et potentiel économique du prolongement du sillon de roches vertes de Chibougamau dans la province de Grenville. Ministère des Richesses Naturelles du Québec, DPV-604.

_______ 1981. Quart sud-ouest du Canton de Rinfret et partie du quart sud-est du canton de Lemoine. Relation avec le front de Grenville. Ministère de l'Energie et des Ressources du Québec, DPV-759.

_______ 1982. Géologie du quart nord-ouest du Canton de Haüy. Ministère Energie Ressources Qué., DPV-928.

Allard, G.O., Gobeil, A. 1984. General geology of the Chibougamau region. In Chibougamau Stratigraphy and Mineralization. Edited by T. Guha and E.H. Chown. CIM, Special Vol. 34. pp. 5-19.

Anhaeusser, C.R. 1973. The geology and geochemistry of the Archean granites and gneisses of the Johannesburg-Pretoria dome. Geol. Soc. of S. Africa, Special Publ., 3, pp. 361-386.

Archer, P. 1984. Interpretation of the volcano-sedimentary environment of the Archean Blondeau Formation, Barlow Lake section Chibougamau. In Chibougamau Stratigraphy and Mineralization. Edited by T. Guha and E.H. Chown. CIM, Special Vol. 34. pp. 92-106.

Baragar, W.R.A. 1971. Some physical and chemical aspects of Precambrian volcanic belts of the Canadian Shields. Canadian Contribution, 9, pp. 129-140.

Caty, J.L. 1977. Demie est du canton de Richardson. Ministère Rich. Nat., Qué., DPV-447.

_______ 1979. Demie ouest du Canton de Bignell. Ministère Rich. Nat., Qué., DPV-678.

Charbonneau, J.M. 1981. Cantons de Dolomieu (1/2E) et de Daubrée (1/4SW). Ministère Rich. Nat. Qué., DP-844.

Cimon, J. 1976. Géologie du canton de Queylus (NE), Abitibi-est. Ministère Rich. Nat. Qué., DPV-439.

Daigneault, R., Allard, G.O. 1983. Stratigraphie et structure de la région de Chibougamau. In Stratigraphie des ensembles volcano-sédimentaires archéens de l'Abitibi: Etat des connaissances. Ministère de l'Energie et des Ressources, DV-83-11, pp. 1-18.

_______ 1984. Evolution tectonique d'une portion du sillon de roches vertes de Chibougamau. In Chibougamau Stratigraphy and Mineralization. Edited by T. Guha and E.H. Chown. CIM, Special Vol. 34. pp. 212-228.

Dallmeyer, R.D. 1974. $^{40}Ar/^{39}Ar$ Incremental Release Ages of Biotite and Horneblende from Pre-Kenoran Gneisses between the Matagami-Chibougamau and Frotet-Troilus Greenstone Belts, Quebec. Canadian Journal of Earth Sciences, 11, pp. 1586-1593.

Dallmeyer, R.D., Maybin, A.H., Durocher, M.E. 1975. Timing of Kenoran Metamorphism in the Eastern Abitibi Greenstone Belt, Quebec: Evidence from $^{40}Ar/^{39}Ar$ Ages of Hornblende and biotite from Post-Kinematic Plutons. Canadian Journal of Earth Sciences, 12, pp. 1864-1873.

Déland, A.N. 1955. Rapport préliminaire sur la région de Gradis-Machault. Ministère des Mines, Québec, RP-312.

Descarreaux, J. 1973. A petrochemical study of the Abitibi volcanic belt and its bearing on the occurrences of massive sulphide ores. Can. Inst. Min. Metall. Bull., 66, pp. 61-69.

Dimroth, E., Imreh, L., Rocheleau, M., Goulet, N. 1982. Evolution of the south-central part of the Archean Abitibi Belt, Quebec. Part I: Stratigraphy and paleogeographic model. Canadian Journal of Earth Sciences, 19, pp. 1729-1758.

Dimroth, E., Imreh, L., Goulet, N., Rocheleau, M. 1983. Evolution of the south-central segment of the Archean Abitibi Belt, Quebec. Part II: Tectonic evolution and geomechanical model. Canadian Journal of Earth Sciences, 20, pp. 1355-1373.

Drury, S.A. 1977. Structures induced by granite diapirs in the Archean greenstone belt at Yellowknife, Canada: Implications for Archean Geotectonics. Journal of Geology, 85, pp. 345-358.

Duquette, G. 1970. Archean stratigraphy and ore relationships in the Chibougamau district. Ministère Rich. Nat. Qué., Special Paper 8.

Durocher, M.E. 1978. Géologie du canton d'Opémisca et le quart nord-ouest du canton de Cuvier, Abitibi-est. Ministère Rich. Nat. Qué., internal file report.

Glickson, A.Y., Lambert, I.B. 1976. Vertical Zonation and Petrogenesis of the early Precambrian crust in Western Australia. Tectone physics, 30, pp. 55-89.

Gobeil, A., Racicot, D. 1982. Géologie de la région des lacs Caopatina et des Vents. Ministère de l'Energie et des Ressources, Québec, carte manuscrite avec notes marginales, DP 82-18.

Gobeil, A., Racicot, D. 1984. Chibougamau, histoire et minéralization. In Chibougamau Stratigraphy and Mineralization. Edited by T. Guha and E.H. Chown. CIM, Special Vol. 34. pp. 261-270.

Goodwin, A.M., Ridler, R.H. 1970. The Abitibi orogenic belt. In Symposium on basins and geosynclines of the Canadian Shield. Edited by A.J. Baer. Geol. Survey of Canada, Paper 70-40, pp. 1-30.

Goodwin, A.M. 1972. The Superior Province. In Variations in tectonic styles in Canada. Edited by R.A. Price and R.J.W. Douglass. Geol. Ass. Can., Spec. Paper 11, pp. 527-623.

Goodwin, A.M., West, G.F. 1974. The Superior Geotraverse project. Geoscience Canada, 1, pp. 21-29.

Goodwin, A.M. 1977. Archean volcanism in Superior Province Canadian Shield. In Volcanic regimes in Canada. Geol. Ass. Can., Spec. Paper 16, pp. 205-241.

Hébert, C. 1979. Demie sud du canton de Haüy. Ministère Rich. Nat. Qué., DPV-653.

_______ 1980 La Dauversière (SW) et Rohault (NW). Ministère Énergie Ressources Qué., DPV-723.

Hickman, A.H., Lipple, S.L. 1975. Precambrian structural geology of part of the Pilbara region. Geol. Surv. Western Australia, Ann. Rept. for 1974, pp. 68-73.

Jolly, W.T. 1974. Regional metamorphic zonation as an aid in the study of Archean terrains: Abitibi region, Ontario. Canadian Mineralogist, 12, pp. 499-508.

Karvinen, W.O. 1981. Geology and evidence of gold deposits, Timmins Area, Ontario. In Genesis of Archean, Volcanic hosted Gold Deposits. Edited by E.G. Pye and R.G. Roberts. Ont. Geol. Survey, Misc. Paper 97, pp. 29-46.

Krogh, T.E., Davis, G.L. 1971. Zircon U-Pb ages of Archean metavolcanic rocks in the Canadian Shield. Geophys. Lab. Ann. Rept. 1970-71, pp. 241-242.

Mueller, W., Dimroth, E. 1984. Sedimentology and depositional history of the Blondeau and Chebistuan Formation in the Waconichi syncline, Chibougamau. In Chibougamau Stratigraphy and Mineralization. Edited by T. Guha and E.H. Chown. CIM, Special Vol. 34. pp. 137-152.

McClay, K.R. 1984. Mapping Geological Structures, Short Course No. 2 (Part I). Geol. Assoc. Can., Cordilleran Section.

Racicot, D., Chown, E.H., Hanel, T. 1984. Plutons of the Chibougamau-Desmaraisville belt: a preliminary survey. In Chibougamau Stratigraphy and Mineralization. Edited by T. Guha and E.H. Chown. CIM, Special vol. 34. pp. 178-197.

Remick, J.H. 1956. Rapport préliminaire sur la région d'Anville-Drouet. Ministère des Mines, Québec, RP-322.

_______ 1957. Rapport préliminaire sur la région de Guercheville-Lapparent. Ministère des Mines, Québec, RP-343.

Ridler, R.H. 1970. Relationship of mineralization to volcanic stratigraphy in the Kirkland-Larder area, Ontario. Geological Association of Canada, Proceedings, 21, pp. 33-42.

_______ 1976. Regional metallogeny and volcanic stratigraphy of the Superior Province. In report of activities, Part A. Geol. Survey of Canada, Paper 76-1A, pp. 399-405.

Steiger, R.H., Wasserburg, G.J. 1969. Comparative U-Th-Pb systematics in 2.7 x 10^9 yr. plutons of different geological histories. Geochimica et Cosmochimica Acta, 33, pp. 1213-1232.

Viljoen, M.J., Viljoen, R.P. 1969. An introduction to the geology of the Barberton granite-greenstone terrain. Geol. Soc. of S. Africa, Spec. Publ., 2, pp. 9-27.

Wanless, R.K., Stevens, R.D., Loveridge, W.D. 1970. Anomalous parent-daughter isotopic relationship in rocks adjacent to the Grenville Front near Chibougamau, Quebec. Eclogae Geol. Helv., 63, pp. 345-364.

Wanless, R.K., Loveridge, W.D. 1972. Rubidium-strontium isochron age studies, Rep. 1. Geol. Surv. Can. Paper 72-23.

APPENDIX I

CLAIM STATUS

LICENCE NO.	CLAIMS	EXPIRY DATE*	LICENCE NO.	CLAIMS	EXPIRY DATE*
424684	1-5	Nov 22/86	424711	1-5	Nov 29/86
424685	1-5	Nov 23/86	424712	1-5	Nov 30/86
424686	1-5	Nov 24/86	424713	1-5	Dec 01/86
424687	1-5	Nov 25/86	424714	1-5	Nov 22/86
424688	1-5	Nov 26/86	424715	1-5	Nov 23/86
424689	1-5	Dec 20/86	424716	1-5	Nov 24/86
424690	1-5	Dec 21/86	424717	1-5	Nov 25/86
424691	1-5	Dec 22/86	424718	1-5	Nov 26/86
424692	1-5	Dec 23/86	424719	1-5	Nov 27/86
424693	1-5	Dec 24/86	424720	1-5	Nov 28/86
424694	1-5	Nov 22/86	424721	1-5	Nov 29/86
424695	1-5	Nov 23/86	424722	1-5	Nov 30/86
424696	1-5	Nov 24/86	424723	1-5	Dec 01/86
424697	1-5	Nov 25/86	426542	1-5	Dec 20/86
424698	1-5	Nov 26/86	426543	1-5	Dec 21/86
424699	1-5	Nov 27/86	426544	1-5	Dec 22/86
424700	1-5	Nov 28/86	426545	1-5	Dec 23/86
424701	1	Nov 29/86	436411	1-5	Oct 09/86
424704	1-5	Nov 22/86	436412	1-5	Oct 10/86
424705	1-3	Nov 23/86	436413	1-5	Oct 11/86
424706	1-5	Nov 24/86	436414	1-5	Oct 12/86
424707	1-5	Nov 25/86	436415	1-5	Oct 09/86
424708	1-5	Nov 26/86	436416	1-5	Oct 10/86
424709	1,2,4,5	Nov 27/86	436417	1-5	Oct 11/86
424710	1-5	Nov 28/86			

* The expiry dates of claims with licence numbers prefixed by 424 and 426 will be effective after acceptance of $109,135.82 of work covered by this report. An excess work credit $93,440.82 should remain.