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PRELIMINARY REPORT, GEOLOGY OF THE CASTIGNON LAKE AREA, NEW QUEBEC TERRITORY

P.R. 571

GOUVERNEMENT DU QUÉBEC

DEPARTMENT OF NATURAL RESOURCES

Honorable PAUL-E. ALLARD, Minister

MINES BRANCH

GEOLOGICAL EXPLORATION SERVICE

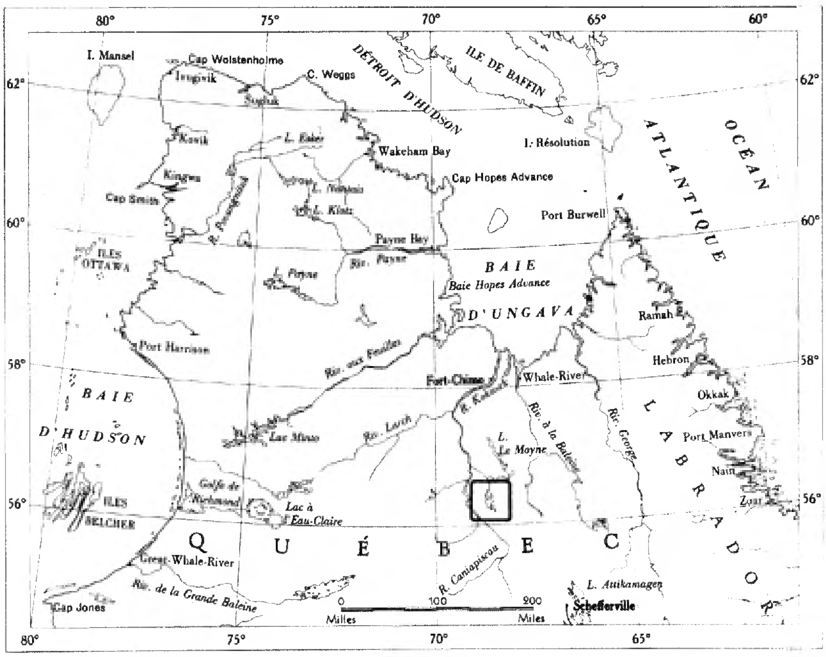
GEOLOGY of the CASTIGNON LAKE AREA

NEW QUEBEC TERRITORY

PRELIMINARY REPORT

by

Erich Dimroth



QUÉBEC

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INTRODUCTION

Location and Access

The Castignon Lake area is in central New-Quebec, 130 miles north of Schefferville and about 800 miles northeast from Quebec city. This area, which covers approximately 1,000 square miles, comprises three map-sheets: the Mistamisk Lake sheet, bounded by latitudes 56°15' and 56°30' and by longitudes 68°00' and 68°30'; the Brèche Lake sheet, between latitudes 56°15' and 56°30' and longitudes 68°30' and 69°00'; and the Lace Lake sheet, between latitudes 56°00' and 56°15' and longitudes 68°30' and 69°00'. The areas farther southeast were mapped previously by the writer (Romanet Lake area: 1964; Otelnuk* Lake area: 1965; Dunphy Lake area; 1967).

The name Chakonipau is used on maps of the topographical Survey of Canada in place of the name Castignon Lake used on the maps accompanying this report. This name (Chakonipau Lake) has now been retained for the eastern lake basin, whereas the name Castignon Lake now refers only to the lake basin west of longitude 68°33'. These changes were made after the accompanying maps had already been printed, and the reader is requested to take good note of them.

*The Toponymy Board writes Otelnuc with a "c", except Otelnuk Formation.

Access to the area is by airplane, and Schefferville is its principal air base. All the larger lakes within the area are accessible to float or ski-equipped planes. Canoe travel is practical only on the lakes. Travel on foot is generally easy.

Topography and Drainage

Two highlands (one in the west, the other in the east), dominating the wide basin between them, are the main topographic units of the area. The western highland is subdivided into several groups of hills: the hills west of Hématite lake (1990'), those west of Goethite lake (2,010', just outside the area), and those west of Lace lake (1,840'). These hills break off abruptly towards Cambrien lake (220') in the west, and the unbroken Labrador plateau begins on the other side of the lake. They slope gradually down towards the central lowland.

The central lowland is subdivided into several basins (de la Brèche Lake basin, Castignon Lake basin, Minowean Lake basin) by chains of smaller hills. The general level of the basins is between 650 and 800 feet, whereas the hills are between 1,000 and 1,300 feet high.

The eastern highland raises abruptly with a southwest-facing scarp from the lowland. Its general level is around 1,600 feet in the area, but it rises to 1,850 feet in the higher hills. The highest point of this highland, about 5 miles east of the area, is at an elevation of 2,400 feet. The Mistamisk Lake - Romanet Lake valley, trending southwest from Mistamisk lake, with a general level between 1,000 and 1,200 feet, subdivides the eastern highland into two inequal parts.

The area is part of the drainage basin of Ungava bay. Its westernmost portion drains into Ungava bay directly by way of Caniapiscau river, and the Castignon Lake basin, and the northeastern highland drains by way of Swampy Bay and Caniapiscau rivers.

Climate, Vegetation, Wildlife and Natural Resources

The climate of the area is sub-Arctic with long, cold, dry winters and short, cool commonly rainy summers. Temperatures in late June and early July generally range in the low forties and sixties, in late July and early August in the fifties and seventies, and in late August and early September in the forties and sixties or lower. Night frosts are common in June and again from mid-August, and some snow usually falls in the last days of August, or in early September. Very heavy rainfall is not common; nor are there many days without at least some drizzle.

The lower portions of the area are covered with sub-Arctic lichen woodland, whereas the higher portions are barren. The tree-line is about 1,700 feet in the southeast of the area and descends to approximately 1,500 feet in the northwest. Talus slopes and bouldery stretches, especially north and southwest of Castignon lake, are covered with extensive alder thickets.

Fire hazard is extreme in dry summers, and more than half the area has been burned. The area west and southwest of Castignon lake is part of a large burn, more than 30 years old, extending towards Caniapiscau river and beyond. A very large burn of recent date (1964) extends from Le Moyne lake, about 50 miles farther north, into the area east of Castignon lake and around the Mistamisk.

Bear, caribou, moose, wolf, fox, lynx, mink, otter, martin, beaver, muskrat, squirrel and porcupine were seen in the area during the field work relating to this report. Beavers are restricted to the lower portions of the area (below 1,200 feet). Partridge and ptarmigan (white partridge), as well as geese and ducks,are relatively abundant. Most lakes have a pair of loons, and a colony of sea-gulls. Hawk, bald eagle and horned owl were observed repeatedly, as well as a great number of species of smaller birds. Gray trout is common in the lakes, whereas pike and speckled trout are less common.

Hydro-electric energy is the only substantial natural resource of the area. Swampy Bay river drops about 270 feet between Otelnuc and Castignon lakes, just south of the area, and another 260 feet north of Minowean lake. A very large amount of hydro-electric energy is available at Eaton Canyon of Caniapiscau river, a few miles south of the area.

Field Work

Field work started on June 25th, 1966, and was completed on September 10. During that period a total of 800 square miles was covered by a 14-man party; the area mapped comprises the whole surface covered by Brèche Lake and Mistamisk Lake map-sheets and that portion of the Lace Lake map-sheet situated within the Labrador Trough. Considerable aerial photo interpretation was done before the start of the field season. Traverses were commonly spaced at 1/2-mile intervals, except for unusually complex sections, where they were spaced as closely as needed for exact mapping. The outcrops were located directly on RCAF aerial photographs on a scale of 2 inches to the mile, and were plotted on a base map on the same scale. The final map was drawn from this base map, and was rechecked against the aerial photographs.

Terminology

The work of the writer in the central segment of the Labrador Trough has now progressed to the point where it appears justified to introduce a formal terminology for the various formations and groups distinguished in this area. It is therefore suggested that private and public institutions follow the stratigraphical terminology of this report. All formations and subdivisions are described so that they can be readily recognized in the field, and their location of representative type sections will be quoted. The description of the type section has been omitted where it would duplicate the description of the formation, as in formations without significant facies change. Additional petrographic material is on deposit in the files of the Geological Exploration Service, and may be consulted on request.

GENERAL GEOLOGY

Introduction

The region offers a nearly complete cross-section through the Labrador Trough; the western boundary of the Trough enters the area at the southeastern corner of the Lace Lake sheet, from where it continues to the northwest and west-northwest, southwest of Lace lake and south of Pistolet lake. It crosses Cambrien lake at 56°10'. Farther north, it forms an irregular bulge to the west and re-enters the present area in the northwest corner of the Brèche Lake map-sheet. The eastern boundary of the Labrador Trough follows Wheeler river (Romanet Lake area), some 15 miles east of this area.

Table of Formations

Table 1:

<table>
<tr><td>PLEISTOCENE AND RECENT</td><td colspan="4">Moraine deposits, sand, gravel, peat</td></tr>
<tr><td colspan="5">UNCONFORMITY</td></tr>
<tr><td>?</td><td colspan="4">Carbonatite dikes and breccias</td></tr>
<tr><td colspan="5">INTRUSIVE CONTACTS</td></tr>
<tr><td rowspan="14">LOWER PROTEROZOIC</td><td rowspan="14">CANIAPISCAU SUPERGROUP</td><td colspan="2">Doublet (?) Group</td><td>Montagnais Group</td></tr>
<tr><td colspan="2">UNCONFORMITY (?)</td><td>INTRUSIVE CONTACTS</td></tr>
<tr><td rowspan="12">KNOB LAKE GROUP</td><td rowspan="3">FERRIMAN SUB-GROUP</td><td>Sokoman Formation</td></tr>
<tr><td>Ruth Formation</td></tr>
<tr><td>Wishart Formation</td></tr>
<tr><td colspan="2">UNCONFORMITY</td></tr>
<tr><td rowspan="3">SWAMPY BAY SUB-GROUP</td><td>Otelnuk Formation</td></tr>
<tr><td>Savigny Formation</td></tr>
<tr><td>Hautes Chutes Formation</td></tr>
<tr><td rowspan="3">PISTOLET SUB-GROUP</td><td>Uvé Formation</td></tr>
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<tr><td>Lace Lake Formation</td></tr>
<tr><td rowspan="2">SEWARD SUB-GROUP</td><td>Du Portage Formation - Dunphy Formation</td></tr>
<tr><td>Chakonipau Formation</td></tr>
<tr><td colspan="5">UNCONFORMITY</td></tr>
<tr><td>ARCHEAN</td><td colspan="2">ASHUANIPI COMPLEX</td><td colspan="2">WHEELER COMPLEX</td></tr>
</table>

The gneisses and granites framing the Labrador Trough east and west are the oldest rocks in the area. They are overlain by sedimentary and volcanic rocks of the Caniapiscau Supergroup.

Continental red beds (red arkoses and conglomerates of the Chakonipau Formation) are the oldest Caniapiscau rocks present in the region. These continental red beds are overlain by red siltstones, sandstones, calcareous sandstones, calcarenites and dolomites of the Du Portage and Dunphy Formations, which appear to be partly lacustrine, partly marine.

A sequence of marine dolomites, sandstones, quartzites, siltstones and shales (Pistolet Sub-group) follows. These rocks are developed in a marginal facies at Lace lake and south of Hématite lake, whereas they are developed in a deep-water facies in the center and east of the area. The sea deepened considerably after deposition of the dolomitic rocks of the Pistolet Sub-group, and an assembly of predominantly shaly rocks (Swampy Bay Sub-group) was deposited. First tectonic movements, producing local uplifts, faulting, and tilting, followed. The rocks of the Ferriman Sub-group (quartzites, siltstones, shales and ironstones) were laid down on an eroded and slightly folded terrain.

The deposition of these sedimentary rocks was accompanied by volcanism on a very minor scale; a major volcanic period, however, followed with the deposition of a thick sequence of basalts, (Doublet (?) Group) interlayered with thin beds of shale, graywacke and a little dolomite. During this period gabbros and diorites intruded the sedimentary rocks underlying the Doublet (?) Group. All these rocks were strongly folded and faulted in the Hudsonian Orogeny. The intensity of the folding generally increases from west to east, and the direction of movement is to the southwest. The rocks were also slightly metamorphosed and the degree of metamorphism increases from west to east.

ARCHEAN

Gneisses and granites exposed west of Lace lake (Lace Lake sheet) and northwest of Luche lake (Brèche Lake sheet) are the oldest rocks present in the area. These rocks are part of an Archean gneiss complex named Ashuanipi Complex west of Schefferville. They form the basement of the Caniapiscau Supergroup.

A gneiss complex largely composed of rocks of similar chemical composition is east of Wheeler river, where it forms the eastern frame of the Labrador Trough (Romanet Lake area; Dimroth, 1964). This complex, which will be referred to as the Wheeler Complex, contains a few rocks (amphibolites, quartz-sericite gneisses) which correlate probably with some rocks of the Caniapiscau Supergroup. The bulk of the gneisses, however, is older and underlies the Caniapiscau. The basement rocks have been involved in the Hudsonian Orogeny and have been remetamorphosed.

Ashuanipi Complex

Only a few outcrops of the Ashuanipi Complex were examined in the field. They consist of a biotite-hornblende gneiss west of Lace lake, and of a coarse-grained granite and granite porphyry at Luche lake.

The biotite-hornblende gneiss is gray; it is medium grained and quite heterogeneous. A variety of granodioritic bulk composition with lenses and schlieren of amphibolitic or of biotite-rich material is most common. Glacial boulders of more basic material were also observed. The gneiss is composed of quartz, plagioclase, some microcline, partly chloritized biotite, and amphibole. It has a granoblastic texture.

The granite is pink on the fresh and weathered surface. It is coarse grained (grain size 5 mm.) and consists of quartz, microcline, plagioclase and biotite. The granite has a well-developed hypidiomorphic-granular texture. The granite porphyry appears to fill small dikes in the granite. It contains 1-cm.-long tabular phenocrysts of microcline and plagioclase in a dark groundmass composed of quartz, microcline, plagioclase and biotite. The groundmass has an aplitic texture. Granite and granite porphyry are post-tectonic in relation to the (Archean) Keuoran Orogeny, and have been sheared during the folding of the Labrador Trough rocks.

Wheeler Complex

The rocks of the Wheeler complex have been described in the report on the Romanet Lake area (Dimroth, 1964).

CANIAPISCAU SUPERGROUP

KNOB LAKE GROUP

Seward Sub-group

Red beds - arkoses, conglomerates, arkosic sandstones, calcarenites and dolomites - are the oldest Caniapiscau rocks occurring in the area. Most of these red beds were laid down in a continental basin, and only the highest stratigraphic levels of the red sequence seem to be deposited in a marine or lacustrine environment. The red beds are thus sharply distinguished by lithology and origin from the clearly marine shales, dolomites and sandstones overlying them. They were therefore included into one unit. Similar red beds have been mapped as "Seward Formation" in the south of the Labrador Trough (Frarey and Duffell, 1964) and it is proposed to extend this name to include the red beds in the present area.

The Seward Sub-group has been subdivided into two formations:

1. The Chakonipau Formation typically composed of red arkoses, conglomerates and some fine-grained sandstones;

2. The Du Portage Formation composed of red sandstones, pink calcarenites, and pink stromatolitic dolomites. This formation also includes some green sandstones.

A third formation, occurring northeast of Otelnuc lake (Mistamisk Lake area) and continuing to the southeast, where it trends into the Otelnuc and Dunphy Lake areas, was correlated with the Du Portage Formation; this is the Dunphy Dolomite, a pink stromatolitic dolomite.

Chakonipau Formation 3,000 + feet

The term Chakonipau Formation is proposed for a sequence of red arkoses, arkosic conglomerates and of fine-grained arkosic sandstone, locally including pink calcarenites and dolomites. The best section through this formation is exposed at Prospecteurs lake (Mistamisk Lake sheet). Other good sections are east of Chakonipau lake at latitude 56°17', longitude 68°25' (Mistamisk Lake sheet); at latitude 56°12', longitude 68°27' (Otelnuc Lake area); and in the points south of Castignon lake (Lace Lake sheet). These sections make it possible to construct a detailed stratigraphical column in the type area (Table 2). The section at latitude 56°17', longitude 68°25' may serve as type. Similar red beds are also exposed east of Otelnuc lake in the Mistamisk Lake sheet and Otelnuc Lake area, and at the western margin of the Labrador Trough (north of Luche lake in the Brèche Lake sheet, and west of Cambrien lake). Rapid facies changes, however, prohibit a detailed correlation of the sequences exposed at these localities with the type section.

The Chakonipau Formation has been subdivided into three members at the type locality: a lower very fine-grained arkose (Member 1), a thick arkosic conglomerate (Member 2), and, at the top of the sequence, a member composed of interbedded arkose, arkosic conglomerate and fine-grained arkose.

Member 1 is a uniform, dark red very fine grained arkose, locally mottled with white spots. It is well banded commonly flaggy, with small-scale crossbedding in places. The sandstone is composed of quartz, feldspar (microcline and plagioclase) and a few andesite fragments, strongly compacted, and cemented by a hematite-rich groundmass.

Members 2 and 3 are largely conglomeratic. The middle member (Member 2) is a boulder conglomerate south of latitude 56°15', where it commonly includes fragments of up to 1 foot in diameter. Farther north, the size of the fragments decreases rapidly and medium- to coarse-grained arkoses are interbedded with the conglomerate. Member 3 is a sequence of alternating fine-grained arkose, of medium- and coarse-grained arkoses, and of pebble conglomerates. This member also contains some beds of calcarenites and of a pink stromatolitic limestone in higher stratigraphic levels. A bed of fine-grained arkose is locally at the contact of Members 2 and 3 and facilitates their mapping at localities where the grain size of the conglomerates of Member 2 is not distinctive.

The very fine grained arkoses of Member 3 are entirely analogous to those of Member 1. The medium- and coarse-grained arkoses are pink and commonly crossbedded; they consist of quartz, feldspar, and andesite fragments. The conglomerates are pink and coarsely bedded and are composed of fragments of biotite or hornblende gneiss, of granite, and of

Table 2 - Typical Sections of the Chakonipau Formation

Prospecteurs lake		East shore of (Chakonipau) lake lat. 56°17'		East shore of (Chakonipau) lake lat. 56°12'	
1,000'	m) medium-grained pink arkose, pebble conglomerate, some dark red very fine grained sandstone	300'	e) medium-grained pink arkose	1,800'	a) pink arkose, pebble conglomerate and dark red very fine grained arkose. Some pink calcarenite in highest levels.
		900'	d) pebble conglomerate interbedded with arkose as in c) and with a little dark red very fine grained arkose		
	l) medium-grained pink arkose				
1,000'	k) same as m)	800'	c) medium-grained arkose		
	i) same as l)				
300'	h) dark red very fine grained arkose				
	g) pebble and boulder conglomerate	700'	b) pebble and boulder conglomerate	500'	b) boulder conglomerate
	f) same as h) (local)				
1,200'	e) same as g)				
	d) same as h) (local)				
	c) same as g)				
400'	b) same as m)				
600'	a) same as h)	500'	a) dark red fine-grained arkose, commonly with white spots	700'	a) dark red very fine grained arkose
	base unknown		base unknown		base unknown

andesite, set in an arkosic groundmass. Quartz pebble conglomerates, containing up to 50% vein quartz fragments, were locally observed in higher levels of Member 3.

A white or light pink, medium-grained, arkosic sandstone underlies the area north of Luche lake. This sandstone appears to overlie the Pre-Caniapiscau basement unconformably. Rocks of the Wishart Formation unconformably overlie the sandstone, which also appears to be older than the rocks of the Pistolet Sub-group exposed south of Luche lake. The sandstone is, therefore, correlated with the Chakonipau Formation.

A sequence of arkoses, arkosic sandstones and conglomerates with much calcarenite and some pink stromatolitic dolomite is poorly exposed east of Otelnuc lake. It was impossible to construct a stratigraphical section through this sequence. It is similar in character to the upper member of the typical Chakonipau Formation, however, with a distinct predominance of calcarenites.

The calcarenites occurring in this sequence are commonly very coarse grained pink, soft rocks. They contain up to 1-inch-large fragments of pink dolomite, and of gneiss in an arkosic groundmass cemented by dolomite. The Chakonipau Formation is also present in the Otelnuc Lake, Dunphy Lake and Romanet Lake areas, mapped in previous summers. It corresponds to Formation 6, Group B, of the Otelnuc Lake area (Map unit 7). The metamorphosed quartzites exposed at Larabel lake, as well as the flaggy red sandstones occurring in the south-center of the Dunphy Lake area (Map unit 1), correspond to the Chakonipau Formation. The arkoses and conglomerates exposed between Bertin and Romanet lakes finally represent this unit in the Romanet Lake area.

Du Portage Formation 1,000 + feet

The Du Portage Formation is a sequence of fine-grained red sandstones, with some coarser pink sandstone, pink calcareous sandstone, white quartzite, pink calcarenite and pink salmon-colored stromatolitic dolomite. The Du Portage Formation is typically developed in the Castignon Lake basin, where it is well exposed between Du Portage and the eastern part of Chakonipau lakes. A section at latitude 56°20', between du Portage lake and Chakonipau lake, may serve as type of this formation. A similar sequence, undoubtedly correlating with the Du Portage Formation, is exposed at the southwestern margin of the Labrador Trough.

The lower contact of the Du Portage Formation is well exposed east of Chakonipau lake at latitude 56°18', longitude 68°28'. This contact is gradational. The upper contact of the formation, also gradational, is exposed west of du Portage lake at latitude 56°07', longitude 68°27'. The main body of the formation consists of dark red very fine grained arkosic sandstones. These sandstones are at many places interlayered with pink calcarenite and pink, brown-weathering dolomitic sandstones. Pink medium-grained arkosic sandstones are less common. These medium-grained sandstones have recrystallized at a few localities to a white quartzite, light pink on the fresh surface,some following purple cross-laminations. A few 30-foot beds of pink stromatolitic dolomite and calcarenite can be mapped and are characteristic.

The Du Portage Formation overlies the Pre-Caniapiscau basement at the southwestern margin of the Labrador Trough, where the Chakonipau Formation is absent. The sequence is poorly exposed. The rocks appear to be coarser grained than those in the type area; medium- and coarse-grained red calcareous sandstones are exposed at the points and islands of de la Concession lake. Similar calcareous sandstones are exposed at Lace lake and south of Pistolet lake. An outcrop of pink stromatolitic dolomite was observed north of Lace lake, and boulders suggest that fine-grained red sandstones also participate in the sequence.

The Du Portage Formation corresponds to Formation 1, Group A, of the Otelnuc Lake area.

Dunphy Dolomite 1,000 + feet

The Dunphy Dolomite occurs only in the south-center of the Mistamisk Lake area from where it trends south-east. The type section is at latitude 56°07', longitude 68°00' (Otelnuc Lake area) north of Dunphy river. It is a pink stromatolitic dolomite with thin beds of red, very fine grained arkosic sandstone, and locally contains pockets of pink medium-grained arkosic sandstone and calcarenite. The Dunphy Dolomite appears to become sandy to the southwest, especially in the center of the Otelnuc Lake area.

The Dunphy Dolomite appears to overlie the Chakonipau Formation. Lithological similarities suggest that it correlates with the Du Portage Formation. It corresponds to Formation 7, Group B, of the Otelnuc Lake area, and to the Dunphy dolomite of the Dunphy Lake area.

PISTOLET SUB-GROUP

An argillitic, calcareous, and sandy sequence, very complex stratigraphically, overlies the rocks of the Seward Sub-group. This sequence is well exposed at Pistolet lake, and it is proposed that the sequence be named Pistolet Sub-group.

The Pistolet Sub-group is very heterogeneous and is composed of shales, argillites, siltstones, quartzites, sandstones, calcarenites and dolomites. It is distinguished from the Seward Sub-group below by its clearly marine character, by the presence of much shale, and by the general lack of red colors of the rocks and from the overlying Swampy Bay Sub-group by the presence of some dolomitic material in all the formations and in most of their members. The Pistolet Sub-group has been subdivided into three units:

1. The Lace Lake Formation at the base, composed of green and gray, locally also red shales, argillites and siltstones, with beds of gray, brown-weathering dolomite.

2. The Alder Formation, grading from massive gray stromatolitic dolomites through calcarenites and dolomitic sandstones into white quartzites.

3. The Uvé Formation, characterized by a chocolate-brown or buff-weathering dolomite.

Lace Lake Formation   900 + feet

The Lace Lake Formation, adapted from Perrault (1955) is the lowermost stratigraphic unit of the Pistolet Sub-group. It consists mainly of green or gray siltstone, argillite, and shale, containing beds, between 2 inches and 20 feet thick, or brown-weathering dolomite, of shaly dolomite or of dolomitic sandstone. Locally, red siltstones, sandstones, argillites and orange-colored dolomites occur. The formation overlies the calcareous sandstones of the Du Portage Formation.

The best section through the Lace Lake Formation is exposed east of Lace lake, where the sequence described on table 3 is exposed. This may be defined as type section.

Table 3 - Type Section of the Lace Lake Formation

		feet
Member 5*		100
	Interbedded red sandstone, siltstone, and quartzite with pink chert, beds of orange-colored dolomite and with red chert pebble layers.	
Member 4		200
	Gray laminated argillite with a few 2- to 3-inch beds of gray, brown-weathering silty limestone and some 2- to 6-foot beds of green siltstone.	
Member 3		285
	5) green, locally green and pink laminated siltstone grading into 4	50
	4) same siltstone with 2-inch to 6-foot beds of gray, brown-weathering cross-bedded calcareous sandstone, or limestone	60
	3) gray, laminated argillite with a few 2- to 6-foot beds of green siltstone and fine-grained sandstone	150
	2) red siltstone	10
	1) red medium-grained sandstone	15
Member 2		190
	4) green laminated siltstone	6
	3) gray argillite; some 2- to 4-inch beds of gray laminated limestone and 1-foot to 2-inch beds of green, laminated siltstone	30
	2) laminated gray limestone	5
	1) same as 4, but with more argillite	150
	(base not exposed)	

*This member was formerly included with correlates of the Alder Formation (Otelnuc Lake area, Formation 3, Member 1a).

Twenty feet of green, green and red siltstone underlies this sequence at Concession lake. Similar red siltstones are exposed at the base of the section in the Lace Lake gully. These siltstones makes up Member 1.

The Lace lake is not exposed south of Pistolet lake, where boulders suggest that it is essentially composed of green siltstones and gray argillites. Only the uppermost part of the formation is exposed north of Roussenet lake and shows more or less the typical development. It contains more and more green, and gray siltstone, between Trident and Castignon lakes, where the interbeds of dolomite are exceptionally thick and numerous.

The Lace Lake Formation is developed in basin facies north and northwest of Castignon lake, where it is composed of gray quartzose shales with rare beds and lenses of brown-weathering argillaceous dolomite.

A thick formation of gray, green, and locally purple siltstones and argillites and of gray shales exposed east of du Portage lake (Mistamisk Lake sheet) was tentatively correlated with the Lace Lake Formation. This formation is in fault contact with the Doublet (?) Group. The rocks are similar to those in the higher portions of a sequence exposed in the same tectonic zone northeast of Dunphy lake (Dimroth, 1966: calcargillitic sequence), where they overlie a more typically developed series of siltstones and argillites with dolomite interbeds.

The following rock units of the Otelnuc Lake and Dunphy Lake areas apparently correlate with the Lace Lake Formation:

Otelnuc Lake area:	Group A, Formation 2
	Group A, Formation 3, Member 1a
	Group C, Formation 8
Dunphy Lake area:	Calcargillitic sequence north of Dunphy lake. Green argillites and siltstones at Duchény lake.

<u>Alder Formation</u>

The Alder Formation has been defined at the south bay of Chakonipau lake, where an excellent section through the

Table 4

SW. OTELNUC LAKE (Otelnuc Lake area)		S. and SW. CASTIGNON LAKE		MINOWEAN LAKE		DU CHAMBON LAKE	
graphitic slate (Hautes Chutes Form.)		graphitic slate (Hautes Chutes Form.)		?		graphitic slate and gray slate and siltstone with dolomite layers	
buff weathering dolomite white quartzite beds locally	300'	buff or brown weathering dolomite	300'	?buff-weathering dolomite	300'	brown weathering dolomite	0-130'
						dolomitic sandstone	0-30'
						white quartzite	0-30'
black chert	6'	gray siltstone with dolomite beds	300'	gray argillites and siltstones with dolomite interbeds(?)	?	gray slate with dolomite beds	0-30'
gray argillite	200'						
massive stromatolitic dolomite towards N. some quartzite interbeds	500'	interlayered sequence of stromatolitic dolomite and dolomitic sandstone	700'	dolomitic sandstone	800'	interlayered sequence of stromatolitic dolomite and dolomitic sandstone	300'
				interbedded dolomitic sandstone and white quartzite	400'		
		dolomitic sandstone locally white quartzite locally interbeds of red and green, or of gray siltstone and argillite	700'			dolomitic sandstone	100'
				white quartzite	500'	white quartzite	
greenish gray siltstones and shales, locally beds of shaly dolomite		NW. Castignon lake: gray siltstones and shales with some beds of shaly dolomite	ca. 1000'	gray siltstone and shale with beds of shaly dolomite	700'	?	
?		Du Portage Formation		Du Portage Formation		?	

Pistolet Sub-group

PISTOLET LAKE		LACE LAKE		SW. HEMATITE LAKE		
graphitic slate (Hautes Chutes Form.)		Wishart Quartzite		?		overlying rock
		UNCONFORMITY				
buff dolomite with black chert nodules	300'	missing	200'	gray shale and siltstone with lenses of dolomite	500'	upper member
dolomitic sandstone	30'					Uvé Formation
red and green siltstone and shale with 3-30-foot beds of dolomite	200'	gray siltstone with a 30-foot bed of dolomite		brown-weathering dolomite (local)	0-200'	lower member
				gray siltstone and shale	100'	
gray stromatolitic dolomite	200'	gray stromatolitic dolomite + calcarenite	100'	green, red and gray siltstone and argillite, with beds of purple sandstone, white quartzite and dolomitic sandstone	500'	Alder Formation
calcarenite, dolomitic sandstone		calcarenite + dolomitic sandstone	150'			
		white quartzite				
(shale and siltstone(?))	50'	red and green shale and siltstone with dolomite beds and pink chert		white quartzite	100'	
dolomitic sandstone, calcarenite	300'	dolomitic sandstone and calcarenite	150'	arkose and conglomerate	200'	
		white quartzite				
				UNCONFORMITY		
Lace Lake Formation not exposed		See detailed section p. 14	900'	Lace Lake Formation missing		Lace Lake Formation
Du Portage Formation		Du Portage Formation		granite		underlying rock

formation is exposed at Alder hill (latitude 56°16', longitude 58°27'). This section (Table 5) has the advantage of containing all the rock types present in the formation elsewhere.

The Alder Formation is subject to extreme facies variation and grades from a purely dolomitic facies into a purely sandy facies and even into a facies composed essentially of red siltstones and shales. These facies variations are best described by tables of representative stratigraphical sections (Table 4)

The lower and upper contacts of the Alder Formation are well defined, and follow from the sections described in Tables 4 and 5. The relations in the area southwest of Hématite lake, however, are more complex and demand a more detailed description.

At Hématite lake a thin layer (200 feet) of pink arkose and conglomerate overlies the basement granite. A white quartzite (ca. 100 feet) follows and is overlain by a sequence of red and green slates, argillites and siltstones including many layers of purple sandstone and white quartzite. The highest of these quartzite beds tends to be slightly dolomitic and grades into the dolomitic sandstone and calcarenite with gray dolomite lenses exposed southeast of Hématite lake. Gray shales and argillites with dolomite layers overlie this dolomitic quartzite bed and are followed by lenses of the chocolate-brown dolomite which is characteristic of the Uvé Formation.

The lower part of this sequence was correlated with the Alder Formation, because of the presence of white quartzite and especially because of the presence of the dolomitic sandstone and calcarenite southeast of Hématite lake. This member is in fact quite characteristic. The red shales, argillites and siltstones, which constitute the major part of the formation at this locality, are similar to the interlayers which are here and there present west of Castignon lake. The lower contact of the Alder Formation was therefore assumed to be at the unconformity between the conglomerate and arkose. The upper contact was supposed to be on top of the highest bed of quartzite, or, if this bed was not present or not mappable, at the contact between the red and gray slates and argillite.

Formation 9, Member 1, of the Otelnuc Lake area, corresponds stratigraphically to the Alder Formation.

Uvé Formation

The highest formation of the Pistolet Sub-group, has been defined at Etang Uvé, close to the type locality of the Alder Formation. Its contacts are best exposed south of Etang Uvé. The Uvé is not subject to the strong facies differentiation which affects the Alder Formation, and an abnormal facies is present only at Hématite lake. The Uvé conformably overlies the Alder Formation, and is conformably overlain by the Hautes Chutes Formation. It may be subdivided into two members (Table 5):

1. A lower member composed of argillites, shales and siltstones, commonly gray, but locally red and green, interlayered with beds of dolomite and locally of dolomitic sandstone.

2. An upper member composed of a massive, gray, chocolate-brown weathering dolomite, locally of light gray, buff-weathering dolomite. This member contains beds of dolomitic sandstone and white quartzite at a few localities.

The dolomite beds of the lower member are commonly thin - less than 6 feet in thickness. At some localities, however, one or several of the beds may be up to 50 feet thick; in this case they are easily confounded with the upper member of the formation. This is especially the case near Hématite lake, where a dolomitic bed, nearly at the base of the formation, is remarkably thick, whereas the upper member is altogether absent.

The siltstones, argillites and shales of the lower member of the Uvé Formation are similar to those of the Lace Lake Formation. They are commonly gray; red and green varieties occur, especially in the southwest of the area. The dolomites of the lower member are indistinguishable from those of the upper member.

The main dolomite occurs in two varieties: a non-recrystallized variety, aphanitic, dark gray on the fresh surface, and chocolate-brown weathering; and a recrystallized variety, light gray or yellow-gray on the fresh surface and buff, locally also light grayish brown weathering. The recrystallized facies always contains irregular blebs or lenses of black chert and is commonly fractured and brecciated.

Table 5 - Type Section of Alder and Uvé Formations

200' 20'	black, graphitic slate black, graphitic chert	Hautes Chutes Formation	
200'	gray, brown-weathering, locally coarsely stromatolitic, commonly massive dolomite	Upper member	UVÉ FORMATION
50'	red and green argillite and siltstone, with some 4" - 6' beds of gray, brown-weathering dolomitic sandstone	Lower member	
30'	gray, brown-weathering dolomite, massive slightly sandy at base		
100'	red and green argillite and siltstone with some 4" - 6' beds of gray, brown-weathering dolomite or dolomitic sandstone		
20'	brown-weathering, coarse-grained dolomitic sandstone	Upper member	ALDER FORMATION
200'- 500'	gray, light gray weathering stromatolitic dolomite alternating with beds of brown-weathering dolomitic sandstone		
1,000'	mostly gray, white weathering, massive quartzite; some 20'-30' beds of dark gray, brown-weathering, crossbedded dolomitic sandstones; few 5'-20' beds of gray argillite	Lower member	
	fault contact		

The non-recrystallized dolomite never contains chert. The recrystallized dolomite is massive and structureless, save for a tectonic brecciation. The non-recrystallized dolomite is massive, stromatolitic or brecciated. The stromatolites of this dolomite are rather large - with diameters of 1 foot or more - and are not preserved by chert laminae as are those of the Alder Formation. The brecciated variety is composed of intraclasts - commonly parts of stromatolites - embedded in an aphanitic groundmass (micrite).

The Uvé Formation is also present in the Otelnuc Lake area, where Members 2 and 3 of Formation 9, Group B, correspond to the Uvé.

SWAMPY BAY SUB-GROUP

The term Swampy Bay Sub-group is proposed for a sequence of pelitic sediments, free of dolomite, overlying the Uvé Formation. The Wishart Quartzite unconformably overlies the rocks of the Swampy Bay Sub-group in the present area. The name "Swampy Bay Sub-group" is derived from Swampy Bay river, which follows for a long distance a depression underlain by rocks of this unit.

The Swampy Bay Sub-group has been subdivided into two formations within the area:

1. The Hautes Chutes Formation, composed of graphitic slate;

2. The Savigny Formation, composed of well-bedded gray slates and, in subordinate quantity, of a graphitic graywacke.

   A third formation, which occurs only in the Otelnuc Lake area, has been tentatively included within this group;

   The Otelnuk Formation, a flysch-type slate graywacke sequence.

Contacts between the Otelnuk and the Wishart Formations were not observed and it is not impossible that the Otelnuk is younger than the Ferriman Sub-group, as has been previously assumed.

Hautes Chutes Slate 300 ± feet.

The Hautes Chutes Slate is well exposed only at three localities, all in the Otelnuc Lake area:

1. at the Hautes Chutes of Swampy Bay river (latitude 56°11', longitude 68°20'); this is the type locality;

2 and 3. east and west of the South bay of Chakonipau lake.

Within the present area outcrops of the Hautes Chutes Slate were observed at several localities south and west of Castignon lake. Fragments of graphitic slates, definitely of local origin, indicate the presence of this formation at other localities.

The contacts between the Uvé and the Hautes Chutes Formations were studied in the outcrops at the South bay of Chakonipau lake, where about 20 feet of black chert overlies the Uvé Dolomite. Graphitic slates follow and form the main body of the Formation.

The Hautes Chutes Formation corresponds to Formation 10, Member 1, Group B, of the Otelnuc Lake area.

Savigny Slate 2,000 ± feet

The Savigny Slate overlies the Hautes Chutes Formation, into which it seems to grade. This formation is well exposed in the Savigny Lake basin (Brèche Lake sheet) at Hautes Chutes of Swampy Bay river (Otelnuc Lake area) and farther south in the valley of the Swampy Bay river. Good outcrops along the western and eastern shore of Savigny lake may serve as type. The Savigny Slate is over 2,000 feet thick in the Savigny Lake basin; its thickness is approximately 1,200 feet in the Otelnuc Lake area.

This formation consists of gray, well-bedded slates, dark gray on the fresh surface, and somewhat lighter gray weathering. The bedding is very regular. Graded bedding was locally observed, whereas flaser-bedding seems to be rare. The beds are from 1 mm. to 1 cm. thick; 1- or 2-inch-thick beds of a graphitic limestone were observed at Hautes Chutes, but they do not appear to be common.

Graphitic graywackes occur in the Savigny Slate west of Savigny and du Camp lakes. This graywacke is composed of rounded quartz grains and a little feldspar, less than 2 mm. in diameter, set in a groundmass of graphitic shale. The beds are 2 to 4 inches thick. The graphitic graywackes alternate with normal gray shales. Graded bedding is fairly common in these rocks.

The Savigny Slate corresponds to Formation 10, Member 2, Group B, of the Otelnuc Lake area.

Otelnuk Formation 3,000 + feet

The Otelnuk Formation, a flysch-type slate-graywacke sequence, appears to overlie the Savigny Slate west of Otelnuc lake. Both formations seem to be in gradational contact. The Otelnuk Formation is well exposed northwest of Otelnuc lake. It does not occur in the area covered by this report. It has been described as Formation 11, Group B, in the preliminary report on the Otelnuc Lake area. The outcrops at the shoreline of Otelnuc lake and at some small lakes between latitude 56°09' and 56°12', and between longitudes 68°15' and 68°17' may serve as type for this formation. For descriptions of the rocks exposed at these localities see Dimroth, 1965.

FERRIMAN SUB-GROUP

In the present area the Wishart, Ruth and Sokoman Formations behave as one unit: they unconformably overlie the rocks of the Seward, Pistolet, or Swampy Bay Sub-groups or even the Pre-Caniapiscau gneisses. They occur everywhere together and commonly form relatively large structural blocks.

It is therefore practical to include the Wishart, Ruth and Sokoman Formations into one unit, for which it is proposed to revive the term "Ferriman" originally including the three formations at Schefferville (table 6).

Wishart Quartzite

The Wishart Quartzite is predominantly composed of gray, medium- or coarse-grained sandstones, and subordinate pebble conglomerate; locally it includes some gray argillites. The Wishart unconformably overlies the rocks of the Seward, Pistolet, or Swampy Bay Sub-groups, or the Pre-Caniapiscau basement.

The Wishart Quartzite is, on the whole, well exposed. The best outcrops are south of Goethite lake, where a complete stratigraphic section is exposed. In this section the Wishart is subdivided into three members: a lower gray sandstone (20 feet), a dolomitic sandstone (15 feet), and an upper gray sandstone (30 feet). These three units are not sharply bounded. It is not known whether this subdivision extends also to the southern occurrence of the Wishart Formation, where outcrop is not complete. In the northern occurrence of the Wishart, between Girafe and Luche lakes, only lenses of dolomitic sandstone occur, and the upper member contains much argillite.

The dominant rock type of the Wishart Quartzite is a medium- or coarse-grained, dark gray sandstone composed of quartz and feldspar; shale fragments also occur in the sandstone, especially where the Wishart overlies shales. A dark gray weathering, somewhat calcareous sandstone, also medium- or coarse-grained, containing round grains of a chloritic material (glauconite?) was observed at some localities.

The dolomitic sandstones are dark gray and weather brown. They are medium grained and are composed of quartz and feldspar cemented by dolomite and quartz. The dolomitic cement is quite irregularly distributed, and these rocks show therefore an irregular weathering pattern on the exposed surface.

The pebble conglomerates, which commonly occur at the base of the formation, are similar to the coarse-grained sandstones, but contain quartz and feldspar pebbles and rock fragments of up to 1 cm. in diameter. Laminated gray argillites with a well-developed bedding parallel cleavage occur interbedded with medium-grained sandstones in the northwestern corner of the Brèche Lake area.

The Wishart was not recognized as a separate formation in the Otelnuc Lake area (Dimroth, 1965), where it is poorly exposed, and where it overlies lithologically similar dolomitic sandstones of the Alder Formation. The upper part of what had previously been mapped as Formation 3, Member 2, Group A, should be included with the Wishart Quartzite. Previous correlations of white quartzites, arkoses, and dolomitic quartzites overlying gneisses in the northeast of the Dunphy

Table 6 - FERRIMAN SUB-GROUP

HĒMATITE LAKE		GOETHITE LAKE		LACE LAKE		
?		?		?		overlying rock
jaspilite	300'	upper jaspilite	50'	upper silicate-carbonate iron-formation	200'	SOKOMAN FORMATION
		lower silicate-carbonate iron-formation	60'	upper jaspilite	200'	
		lower jaspilite	100'	lower silicate-carbonate iron-formation	150'	
				lower jaspilite	150'	
iron siltstone	150'	siltstone	35'	siltstone	100'	RUTH FORMATION
iron slate	50'	slate	20'	slate?		
black chert jaspilite	6'-20'	black chert jaspilite	20'	black chert		
gray sandstone argillite interbeds	100'	gray sandstone, in part very coarse	80'	gray sandstone, in part very coarse	100'	WISHART FORMATION
UNCONFORMITY						
Pre-Caniapiscau Chakonipau Formation Pistolet Sub-group		Savigny Formation		Alder Formation		underlying rock

Lake area with the Wishart Quartzite were based on the assumption that only one quartzite horizon existed in the area, and are therefore incorrect. These rocks appear to be part of the Pistolet Sub-group.

Ruth Formation

The Ruth Formation is composed of iron-bearing shales, argillites and siltstones. It overlies the Wishart Quartzite conformably and is conformably below the Sokoman Iron-formation.

The Ruth has been subdivided into a lower iron shale and an upper iron siltstone in the northern portion of the area, where it is relatively thick (200'). A 6- to 20-foot thick bed of black chert and jaspilite or both are present a few feet from the base of the formation. This bed is commonly well exposed and therefore valuable for mapping.

In the area around Goethite and Roussenet lakes, the Ruth consists of gray shales below, grading upwards into gray siltstone. Again a 10-foot bed of black chert or jaspilite is present about 5 feet above the base of the formation. This bed, however, cannot be used for mapping purposes south of Roussenet lake, where black chert occurs also in the Wishart Quartzite and higher up in the Ruth Formation.

The iron slate which composes the lower member of the Ruth Formation in the Hematite Lake area is a dark gray, brown weathering rock. It weathers into thin, irregular shards about 2 inches across and half a centimeter thick which form large talus slopes below the cliffs of this rock. The iron siltstone is dark gray, in places greenish gray, and weathers brown. It is intensely fractured and these fractures are stained bluish black by manganese-rich weathering solutions. The iron siltstones are well laminated. Cross laminations are common and permit top-determinations. The rock does not fracture parallel to the bedding and is hard and massive.

At Goethite and Roussenet Lakes more normal shales and siltstones occur instead of iron slate and iron siltstone. The shales, which form the lower portion of the formation, are gray and well laminated. They contain a well-developed fissility parallel to the bedding and, in some places, a tectonically induced cleavage. The siltstones are dark gray and weather brown. They are laminated or massive, the more massive varieties prevailing higher up in the sequence. Cross-laminations were observed. The siltstones do not have a fissility; they are massive and hard rocks.

The Ruth Formation correlates with Formation 4, Group A, of the Otelnuc Lake area.

Sokoman Formation

The Sokoman Formation is a layer of iron-formation, predominantly jaspilite but including some silicate-carbonate iron-formation. It overlies the Ruth Formation concordantly with gradational contact. The top of the Sokoman Formation was nowhere observed.

In the southern portion of the area the Sokoman is subdivided into four members:

4. upper silicate-carbonate iron-formation
3. upper jaspilite
2. lower silicate-carbonate iron-formation
1. lower jaspilite

No such subdivision was recognized in the northern portion of the region.

The lower contacts of the Sokoman Formation were observed at many localities southwest of Hématite lake, where a 30-foot-thick sequence of interbedded jasper (individual beds 1" thick) and iron siltstone occurs. The lower contact of the Sokoman is sharp at Goethite lake and east of Lace lake.

Banded jaspilite, composed of homogeneous bands of brick-red jasper, is relatively rare within the area. More common is a fragmental facies, where red jasper granules, oölites, or, less commonly, pisolites occur in a black cherty groundmass. Larger fragments of jasper are common in this intraclastic facies and may form discs up to 10 cm. long and 2 cm. thick. Syn-sedimentary breccias, where sharp edged fragments of homogeneous jasper are embedded in a fragmental groundmass, were observed at some localities. The jasper commonly contains some carbonate (siderite or dolomite), which either forms the cores of pisolites and oölites or which occurs as dispersed crystals in the groundmass. Interbedded carbonate layers and fragmental jaspilite occur extensively in the area west of Hématite lake.

The silicate carbonate iron-formation comprises iron slates and iron siltstones, as they occur in the Ruth Formation. Black chert, containing some minnesotaite and some siderite, was found only at a few localities, and seems to become more prominent in the south of the area and especially in the Otelnuc Lake area. Much of the silicate-carbonate iron-formation of the Sokoman is fragmental and contains small and large fragments of the silicate-carbonate iron-formation set in a groundmass of more or less the same composition. The fragmental nature of these rocks is not readily visible; the fresh surface of the fragments and of the groundmass has virtually the same color, and commonly only a certain heterogeneity of the rocks is visible when they are weathered. The sedimentary structures of these rocks can be seen to advantage only in large thin-sections.

DOUBLET(?) GROUP

A group of metamorphosed basalt flows alternating with sedimentary rocks underlies most of the eastern portion of the area. These rocks were correlated with the Doublet Group of the southern Labrador Trough. The Doublet(?) Group is over 10,000 feet thick.

Farther west a group of metamorphosed gabbro sills and dikes intrudes rocks of the Caniapiscau Supergroup. These sills correspond to the "Wakuach sills" of the Montagnais Group (Frarey and Duffell, 1964). Most of the gabbros, unfortunately, are very similar to the metabasalts, and both rocks are commonly indistinguishable in hand specimen or thin-section. The distinction between metabasalts and metagabbros is therefore based exclusively on the geological criteria stated below.

The metabasalt sequence is astonishingly regular; individual flows are between about 50 and 400 feet thick, and continue for many miles without significant changes of thickness or facies. The contacts between the basalts and the underlying sediments are grossly concordant; effects of erosion of the sediments by the overlying basalt flow, however, are commonly visible on close inspection. The upper contacts of the basalts, rarely exposed, are everywhere concordant. Contact metamorphic effects of the basalts upon the underlying sediments are small. Eruptive rhythms are present, especially in the areas farther east, where one or two thin flows (50-100 feet thick) are commonly overlain by a very thick flow (300 feet or more).

Some of the basalt flows show pillow structures, or vesicular flow tops; these flows are undoubtedly extrusive. It seems to be clear from these criteria that the whole basalt sequence is geologically uniform; if some of the units are extrusive, then the whole sequence probably has the same origin.

The metagabbros on the other hand form commonly much thicker and much more irregular units. Grossly concordant sills are most common. Some of these are composite; others are split up into several branches. A few dikes are sharply discordant. The gabbros are much more strongly differentiated than the basalts, and contain pegmatitic schlieren near the top of the sills. Locally, these pegmatitic schlieren grade into a coarse quartz-gabbro. Thick gabbro sills produce pronounced contact-metamorphic effects in the sediments below and above. There seems to be little doubt that this sequence is intrusive.

Metabasalts

All flows of metabasalts have a fine-grained contact facies, and the grain sizes gradually increase towards their centers. The contact facies is commonly only a few tens of feet thick. Some flows are fine grained throughout. Pillows occur only in these fine-grained flows, whereas vesicular flow-tops were also observed on top of medium- or coarse-grained flows.

The metabasalts are homogeneous rocks. Fine-grained varieties are dark greenish gray and weather dark green, less commonly pale green. Medium- and coarse-grained varieties consist of black amphibole and green, white-weathering plagioclase. Ophitic textures are common in coarser varieties.

The lowermost basalt flows east of Otelnuc lake are strongly sheared.

Sedimentary Rocks Interbedded with Basalts

Sedimentary rocks are here and there exposed at the base of the basalt cliffs, and it is probable that a thin bed of sediments is everywhere present at the base of these scarps. Gray and graphitic slates are the most common rock type. The slates grade into black quartzites composed of 1 mm. grains of quartz set in a slate groundmass. Buff-weathering dolomite beds occur locally.

Spotted slates, containing prismatic porphyroblasts of sericitized and chloritized andalusite and cordierite, were observed at several localities near Mistamisk lake.

MONTAGNAIS GROUP

Metagabbros of the Montagnais Group intrude, as sills and locally as dikes, the rocks of the Seward, Pistolet and possibly also of the Swampy Bay Sub-groups in the zone between Minowean and Otelnuc lakes.

Most of the metagabbro bodies appear to be roughly concordant. Slight discordancy of the contacts, however, was locally observed, e.g. northeast of Minowean lake. Some of the smaller metagabbros are sharply discordant dikes, as, for instance, the dike north of Esker lake.

Two macroscopically different types of metagabbro can be distinguished; most common is a relatively dark type, being dark green on the fresh surface and composed of hornblende, epidotized plagioclase, some chlorite, a little quartz, titanomagnetite, and rare relicts of pyroxene. Another type is light green, and has a fattish luster on the surface. The composition of this variety, occurring mainly at Minowean lake, is similar to the normal metagabbros.

NON-CORRELATED FORMATIONS OF THE CANIAPISCAU

A few formations mapped were not correlated with the formations described above. These are:

a) rocks overlying the Pistolet Sub-group northeast of du Chambon lake but distinguished in facies from the rocks of the Swampy Bay Sub-group.

b) basic volcanic rocks forming isolated bodies in the area southwest of Hématite lake.

Slate and Siltstone with Dolomite Beds[(1)]

A sequence of gray slates and siltstones with a few 1-foot-thick dolomite beds overlies the Uvé Formation north of du Chambon lake. This sequence has no similarity with the Hautes Chutes Formation, which overlies the Uvé south of Castignon lake.

Nodular Quartzite[(2)]

A slightly dolomitic quartzite with nodular structure overlies the slate and siltstone described above. This quartzite is gray and weathers light gray. The nodular structure is produced by the uneven distribution of the dolomitic cement in the rock. The nodular quartzite overlies the slate and siltstone with dolomite beds described above.

A number of outcrops of dolomitic quartzite, white quartzite and slightly dolomitic quartzite occurring south of Mistamisk and du Chambon lakes have been included with this nodular quartzite. The quartzites occur in a fault zone; they are commonly strongly brecciated and altered. Their stratigraphical position is unknown; they may well belong to several formations.

Bedded Dolomite with Beds of Purple Slate[(3)]

A well-bedded gray dolomite occurs at Romanet river and southeast of du Chambon lake. The beds of dolomite

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(1) Further work in the Romanet lake area has shown that the slate and siltstone with dolomite beds of Plissé lake grades into black graphitic slates east of du Chambon lake. The same horizon contains black quartzites at Duvic bay of Romanet lake. It will be united into one formation with the nodular quartzite described below under the name "Du Chambon Formation".

(2) Further work in the Romanet Lake area has shown that the nodular quartzite overlies the slate and siltstone described above. The quartzites south of du Chambon lake belong to various formations. The quartzite southeast of du Chambon lake is arkosic and is part of the Chakonipau Formation thrust over the nodular quartzite and the slates described above.

(3) Further work in the Romanet Lake area has shown that this dolomite correlates with the Dunphy dolomite. It is indeed identical to the dolomite exposed south of Ronsin lake (Romanet Lake area).

are more than 1 foot thick and are separated by 1- or 2-inch-thick beds of purplish gray slate. This dolomite has not been observed at localities where its structural relationships are clear; its age is therefore unknown. The formation may correlate with the dolomite exposed south of Ronsin lake (Romanet Lake area), in which case it would be quite low in the sequence.

Basic Volcanics (Lapilli tuffs)(4)

A few small bodies of a basic volcanic exhibiting a particular "pea-structure" have been observed west of Hématite lake. The rock is composed of small pea-sized rounded bodies cemented by calcite. The cores of the bodies are made up of unoriented sericite, chlorite, carbonate and opaques, and are surrounded by a thin rim of fibrous chlorite. These rocks appear to be slightly metamorphosed lapilli tuffs.

Metagabbro

Bodies of a metagabbro with red-brown plagioclase were observed southwest of Hématite lake. The gabbros are similar in composition to those of the Montagnais but contain plagioclase containing inclusions of hematite dust in zonal arrangement.

POST-CANIAPISCAU

Carbonatites

Undeformed volcanic breccias and related intrusive dikes occur west of Castignon lake. These breccias and dike rocks deserve a detailed description.

The volcanic breccia forms diatremes with irregular outlines in the hills south and southeast of Hématite lake. The contacts between the breccia and its country rock

(4) Further work has shown that south of Hématite lake similar rocks having a more massive texture are intrusive and are associated with the carbonatites described below.

are sharp. Only a few contacts were observed; they are steep or vertical. The breccia dips below the country rock at one locality between Hématite and Girafe lakes. The country rock may be folded and brecciated at the contact; in most cases, however, the country rock is not strongly deformed.

The breccia occurs in plugs and short discontinuous dikes in the area west of de la Brèche lake. The contacts of the dikes and plugs are steep. The country rock of the breccia is commonly brecciated and forms an aggregate of disoriented blocks. A large slab of the iron-formation occurs in this "wall-rock breccia" west of de la Brèche lake, and rests now in stratigraphically foreign surroundings.

The carbonatite occurs in continuous dikes, between 1 foot and 100 feet thick, in the area around Savigny lake and farther south. Some of these dikes were traced for several miles. Wall-rock brecciation is absent, and the proportion of fragments enclosed in the carbonatite decreases southward. Carbonatization of the wall-rock at the contact with the carbonatite dikes was observed repeatedly.

The fragments of the breccia range in size from 1 mm. to one yard. Fragments of 1 inch in their larger diameter are most common. Most of the fragments are derived from the country rock. Some larger fragments are derived from the overlying rocks (now eroded). Many small quartz and feldspar fragments appear to be derived from the Pre-Caniapiscau basement.

A very fine-grained porphyritic facies, and a granular-panxenomorphic facies of the carbonatite can be distinguished petrographically. The porphyritic facies consists of phenocrysts of partly chloritized biotite (up to 1 mm. long) and of carbonate (up to 3 mm. in diameter). These phenocrysts are set in a brown cryptocrystalline groundmass composed of carbonate, serpentine, and opaque minerals. A fluidal texture is commonly visible.

The panxenomorphic-granular facies consists commonly of somewhat larger grains of biotite and carbonate set in a fine-grained groundmass of carbonate and serpentine, very little quartz, and about 5% opaque minerals. The larger grains are not well idiomorphic, but may be distinguished from the groundmass because they do not include ore minerals. Some apatite is also present.

The grain size of the carbonatites increases generally to the north, and the porphyritic facies was not observed in the diatreme breccias. The silicate content also decreases from south to north. The diatreme breccia locally contains carbonate crystals of 1 cm. in diameter or more.

The carbonatites show no sign of later deformation; they are not sheared or folded, and the dikes follow the cleavage of the slates. These rocks are therefore Post-Hudsonian.

It is assumed that the diatremes, plugs, short dikes, and long dikes represent different levels of one and the same volcanic suite. The diatremes are surficial; the plugs, and short dikes expose still a very high level of the explosive volcanoes, and the continuous dikes are probably feeders of the diatremes. The whole area was apparently tilted after these volcanic rocks formed.

CORRELATIONS

The correlations between the present area and the southern Labrador Trough seem to be fairly well established, whereas the correlations to the north are tentative at present (Table 7).

The rocks of the Seward Sub-group east of Otelnuc lake continue into the red beds exposed east of Wakuach lake (Baragar, 1963) which correspond to the Seward Formation of the southeastern Labrador Trough.

The rocks of the Swampy Bay Sub-group trend to the southeast into the Wakuach Lake map-area. Rock types characteristic of the Hautes Chutes and Savigny Formations were observed by Baragar (oral communication, 1966) in rocks plunging below the Denault Dolomite and,therefore, undoubtedly correlating with the Attikamagen Formation. Calcareous rocks occurring at Wakuach lake plunge below these argillitic sediments. These calcareous rocks probably correspond to the rocks of the Pistolet Sub-group.

The correlation of the Wishart, Ruth and Sokoman Formations with those of Schefferville appears to be clear.

Table 7 - Tentative Correlations in the Caniapiscau Supergroup

<table>
<tr><th rowspan="2">South
(Frarey and Duffell)
1963</th><th rowspan="2">Center
(this report)</th><th colspan="3">North</th></tr>
<tr><th>West
(Berard)
1966</th><th colspan="2">East
(Sauvé and Bergeron)
1966</th></tr>
<tr><td colspan="2">?</td><td colspan="3">Thévenet Formation</td></tr>
<tr><td>Doublet Group</td><td>? Doublet(?) Group</td><td colspan="3">Hellancourt Formation</td></tr>
<tr><td>Menikek Formation</td><td>?</td><td>Larch River Formation
Abner Dolomite
Chioak Formation
Dragon Formation</td><td>upper phyllite</td><td rowspan="4">Baby Formation</td></tr>
<tr><td colspan="2">Sokoman Formation</td><td>Fenimore Formation</td><td>iron-bearing member</td></tr>
<tr><td colspan="2">Ruth Formation</td><td>Lower Schists</td><td>lower phyllite</td></tr>
<tr><td colspan="2">Wishart Formation</td><td>Allison Quartzite
Lower Dolomite</td><td>Harveng dolomitic schist</td></tr>
<tr><td colspan="5">UNCONFORMITY</td></tr>
<tr><td>Denault Formation</td><td></td><td colspan="3" rowspan="7">Pre-Caniapiscau</td></tr>
<tr><td>Attikamagen Formation</td><td>Otelnuk Formation
Savigny Formation
Hautes Chutes Formation</td></tr>
<tr><td rowspan="2"></td><td>Uvé Formation
Alder Formation</td></tr>
<tr><td>Lace Lake Formation</td></tr>
<tr><td rowspan="2">Seward Formation</td><td>Du Portage F. Dunphy</td></tr>
<tr><td>Chakonipau Formation</td></tr>
<tr><td colspan="2">UNCONFORMITY</td></tr>
<tr><td colspan="5">Pre-Caniapiscau</td></tr>
</table>

The stratigraphical position of the metabasalts is still uncertain. The basaltic rocks in this area were correlated with the Doublet Group, but may as well correlate with basaltic rocks mapped by Baragar east of Wakuach lake and plunging below (parts of ?) the Attikamagen Formation. Such a correlation, however, would introduce large complications in the interpretation of the geological relations farther north, because the metabasalts of this area probably correspond to the Hellancourt Volcanics.

The correlations to the north also seem to be relatively clear in the western half of the Labrador geosyncline. The descriptions of Bergeron (1954) and Bérard (1965) show clearly that the Wishart, Ruth and Sokoman Formations continue northwards as far as Leaf bay without appreciable facies changes. The "lower dolomite", mentioned by Gastil et al. (1960) and by Bérard (1965), is only locally present and seems to correlate with the calcareous sandstones of the Wishart Quartzite rather than with a formation below the unconformity. The formations overlying the Sokoman (Fennimore) ironstone (Chioak, Abner, upper iron-formation, Larch Formation) are not present in this area.

The correlations in the eastern portion of the Labrador geosyncline are more problematic. Only the Hellancourt Formation of Sauvé and Bergeron (1965) appears to continue into the present area and corresponds to the Doublet(?) Metabasalts. The correlations between the eastern and western portion of the northern Labrador Trough follow Sauvé and Bergeron (1965).

STRUCTURAL GEOLOGY

The area is within the Castignon Lake - Romanet Lake cross-zone of the Labrador orogen, where the regular arrangement of north-northwest-trending litho-structural units prevailing farther south and north is interrupted, and where an irregular block structure is present instead. From a structural point of view the area can be subdivided as follows:

1. Western zone:
   a) Hématite Lake synclinorium
   b) Luche Lake - Girafe Lake belt
   c) Savigny Lake basin and its southern foreland
   d) Nona Lake thrust zone and Otelnuc basin

2. Central zone:

   Castignon anticlinorium

3. Eastern zone:

   a) Dunphy River zone and Mistamisk - Préville block
   b) Mistamisk - Romanet anticlinorium

Western Zone

Hématite Lake Synclinorium

The Hématite Lake synclinorium is made up essentially of competent rocks of the Ferriman Sub-group overlying gneisses and red beds. The over-all structure is a synclinorium, complicated by a number of synclines trending north, and overturned to the west. The anticlines between the synclines are very sharp and a small thrust fault is commonly present in these anticlines. Flat overthrusts, generally trending eastwest,repeat the Ferriman Sub-group at least three times in the area between Hématite and Girafe lakes. The southern boundary of the Hématite Lake synclinorium, which follows the depression between Hématite and Luche lakes, may also be a thrust fault.

Luche Lake - Girafe Lake Belt

This is a 2-mile-wide belt composed mainly of rocks of the Pistolet Sub-group extending in northeast direction between Luche and Girafe lakes. It is structurally very complex. The main folds trend to the northeast and are overturned to the south. These folds have been refolded around axes plunging to the north.

Savigny Lake Basin

The Savigny Lake basin is made up essentially of slates of the Swampy Bay Sub-group. The rocks are tightly folded around axes plunging north and south respectively north-northwest and east-southeast. Concertina folds are developed in the slates. The folds are open in the overlying rocks of the Ferriman Sub-group and have been preserved in the doubly plunging Goethite Lake basin.

The rocks of the Pistolet Sub-group in the southern foreland of the Savigny Lake basin are simply tilted and dip flatly to the northeast. An east-west-trending anticline is present in this foreland northeast of Lace lake and in a small east-west syncline east of Lace lake.

Nona Lake Thrust Zone and Otelnuc Synclinorium

The rocks of the Pistolet Sub-group are thrust for a considerable distance over the iron-formation below at and west of Nona lake. The overthrust itself has been folded. The iron-formation below the overthrust has been partly sheared off the base and forms recumbent folds with nearly horizontal axial planes in the area northeast of Roussenet lake. The Nona Lake thrust ends in a zone of complicated imbricate structures southwest of Trident lake.

A small area in the northeast of the Lace Lake sheet is underlain by rocks of the Swampy Bay Sub-group and is a part of the western appendix of the Otelnuc synclinorium.

Central Zone

Castignon Anticlinorium

The Castignon anticlinorium plunges to the north. It is therefore bounded by a thrust fault south of Castignon lake, whereas stratigraphic contacts separate all formations and northwest of Castignon lake. Folds are generally open in the Chakonipau Formation and tight in the rocks higher up stratigraphically, except for the area around Minowean lake, where the extreme thickness of the Alder sandstone and quartzites enforced an open folding. Folds trend north-south in the western portion of the Castignon anticlinorium, and northwest in the area northwest of Otelnuc lake.

Eastern Zone

Dunphy River Zone

The Dunphy River zone comprises the area underlain by metabasalts extending between Otelnuc and Mistamisk lake. The Dunphy River zone appears to be bounded by a major thrust fault in the southwest, such as can be shown by the relations at Dunphy lake (Dunphy Lake area), and in the area east of Patu lake north of the present region. Another thrust fault, dipping steeply southwest, bounds the Dunphy River zone in the northeast (Bertin - du Chambon thrust).

The basalts of this unit show open folds. A major syncline trends northwest. A cross anticline trending east-northeast is present southwest of du Chambon lake. North-northeast-trending folds finally are outlined in this unit in the area southeast of du Chambon lake (Romanet Lake area).

Mistamisk - Preville Block

A small part of this unit - also composed of metabasalt- is in the northeast corner of the Mistamisk Lake sheet. This block is bounded by a major thrust fault (Romanet River thrust) in the south. It has the structure of a large anticline plunging northwest.

Mistamisk - Romanet Anticlinorium

A wedge-shaped anticlinorium, underlain by sharply folded sedimentary rocks, extends southeast of Mistamisk lake. The folds in this anticlinorium are complex. The double folds exposed at Plissé lake seem to have formed by interference of open north-northeast-trending folds, overturned to the west, and of isoclinal folds trending northwest and overturned to the southwest.

Pre-orogenic Structures

Studies of the stratigraphy and facies differentiation revealed an interference pattern of north-northwest-and east-trending zones of uplift and subsidence. These zones developed during the sedimentation. They are commonly bounded by syn-sedimentary faults, most of which have been re-activated during the Hudsonian Orogeny. The faults bounding the Luche Lake - Girafe Lake zone in the north and south, as well as the Castignon-Otelnuc fault system belong to these syn-sedimentary structures. The peculiar structural style of the area—irregular tectonic blocks instead of the regular, north-north-west-trending zones present elsewhere in the Trough - is due to the syn-sedimentary faults trending across the geosyncline.

ECONOMIC GEOLOGY

The area is of considerable economic interest and can be regarded as favourable ground for prospecting the following minerals: iron, copper, zinc, lead, uranium, thorium, columbium, rare earth minerals, graphite and pyrite. It is not favourable for prospecting nickel, chromium, and asbestos, which occur in other portions of the Labrador Trough.

Iron: Ironstones make up the Sokoman Formation, which underlies large portions of the following districts:

1. The zone between Hématite Lake and Luche Lake in the northwest of the Brèche Lake map-sheet.

2. The Goethite Lake basin in the southwest corner of the Brèche lake map-sheet.

3. The Roussenet Lake- Lace Lake zone in the southeast of the Lace Lake sheet.

Two types of ironstones occur in the Sokoman: silicate-carbonate ironstones composed of siderite, minnesotaite and quartz, and oxide ironstone, composed of hematite dust, and quartz. Both are primary sedimentary facies. The iron of the primary rocks is not recoverable from oxide ironstones because of the extremely fine grain size of primary hematite (<0.002 mm.) and from the silicate-carbonate ironstones because of their peculiar mineralogical character.

Ironstones, containing iron in recoverable form, developed by secondary processes from the primary sedimentary ironstones. Iron ores formed, therefore, in several periods. Three types of iron ore are developed in the Labrador Trough:

1. The unrecoverable hematite dust of the primary ironstones recrystallized during the diagenesis of the rocks. Hematite and magnetite grains of about 0.03 mm. in diameter formed this way. Migration of iron also took place and some diagenetically altered rocks were strongly enriched in iron, whereas others have been leached.

2. Subsequent metamorphism further increased the grain size of the hematite and magnetite in the northern part of the Labrador Trough, and in the Wabush-Gagnon area.

3. Secondary enrichment of iron by supergene solutions took place probably in Cretaceous time. The high grade "direct shipping" ore deposits of Schefferville were produced in this way.

Types 1 and 2 iron ores can be expected only in the oxide ironstones of the Sokoman Formation. Type 3 iron ores may be produced by alteration of all varieties of the Sokoman and may occur even in Ruth slates.

The Sokoman Formation has been prospected for high-grade ore. The Hématite Lake - Luche Lake zone was prospected by Fort Chimo Mines Ltd. before 1955, and has been mapped in reconnaissance style. The Goethite Lake basin and the Roussenet Lake - Lace Lake zone were prospected by Norancon Exploration Co. Inc. After a reconnaissance survey had been completed, detailed mapping was done on a scale of 1,000 feet equals 1 inch, and some trenching was done in 1953. As a result of these studies it can be stated with fair certainty that no high-grade direct-shipping ores are present in the area.

The iron contents of the primary oxide ironstones, on the other hand, are fairly high. Table 8 lists a number of analyses of grab samples from the Roussenet Lake - Lace Lake zone. Inspection of a number of thin-sections from the other portions of the Sokoman indicate that their iron contents are of the same order of magnitude. The writer believes that a fair proportion of the oxide ironstones of the Sokoman Formation contains approximately 30% iron, which is well within the range of beneficiating iron ores exploited elsewhere.

Table 8

Analyses of Oxide Ironstones

	1	2	3	4	5
Fe	32.6	27.9	29.14	32.88	54.56
Mn	2.79	3.16	3.48	2.24	0.51
Si	34.31	36.13	33.02	14.24	18.70
Al	n.d.*	n.d.	n.d.	n.d.	n.d.
P	0.056	0.049	0.053	0.049	0.034
S	n.d.	n.d.	n.d.	n.d.	n.d.

	6	7	8	9	10
Fe	27.31	39.23	53.12	50.07	44.68
Mn	4.63	0.50	1.04	0.08	0.39
Si	38.93	36.66	16.99	28.93	35.62
Al	0.24	0.07	0.19	0.14	0.15
P	0.007	0.013	0.009	0.013	0.010
S	0.07	0.01	0.03	0.006	0.007

It has been stated above that the iron of the primary oxide ironstones occurs as hematite dust (diameter below 0.002 mm.) included in microcrystalline quartz. This hematite dust is probably unrecoverable. Hematite and magnetite porphyroblasts about 0.03 mm. in diameter, developed during the diagenesis of the oxide ironstones. The intensity of the diagenetic alteration varies from place to place, and in some ironstones virtually all of the hematite has recrystallized. For example, this is the case in the area northeast of Veronot lake (Otelnuk Lake area, Dimroth 1965). Such recrystallized ironstones might be a source of beneficiating iron ore. It is therefore recommended that companies wishing to prospect for

*not determined

beneficiating iron ores study the local variation of the intensity of the diagenetic alterations of the oxide ironstones occurring in the Sokoman Formation.

Copper: two types of copper mineralization may be distinguished in the region:

1. Dispersed pyrite and minor chalcopyrite in metabasalts of the Doublet(?) Group, in sedimentary rocks interlayered with Doublet(?) metabasalts, and in consanguineous metagabbros.

2. Pyrite, chalcopyrite, chalcocite, and bornite in calcite veins, or quartz veins, or disseminated in brecciated or sheared rocks. The mineralization of this type occurs in all rock types and is structurally controlled. All occurrences are less than 1 mile from the boundaries between the structural blocks described above.

Very minor mineralization of Type 1 is visible at many localities on the area underlain by metabasalts and metagabbros and causes the elevated background values of copper and zinc in the geochemical samples (see below). The showings seen in the field were everywhere of exceedingly low grade and do not appear to be interesting economically.

Mineralization of Type 2 is more important and was observed in the following zones.

1. In the Otelnuc - Chakonipau zone following the southern contact of the red arkoses of the Chakonipau Formation. A minor copper showing was discovered in this zone in 1964 by the writer. The showing consists of pyrite and minor chalcopyrite and malachite in brecciated white quartzites of the Alder Formation close to a thrust fault. Relatively high copper assays were obtained from several river sediment samples from this zone.

2. Dunphy River zone. This zone follows the western boundary of the area underlain by basalt. In the area, it extends north-northwest from the northern bay of Otelnuc lake. Two showings of copper mineralization are within the area:

a) A small showing of chalcopyrite was found at latitude 56°24'-longitude 68°25', at the contact between a metagabbro sill and underlying arkoses of the Chakonipau Formation in 1966. Very high geochemical anomalies exist close to the showing.

b) A showing at latitude 56°16'-longitude 68°11', about 1 mile east of the north end of Otelnuc lake, was staked in 1962 by Mid-Chibougamau Mines Ltd. The showing consists of finely disseminated pyrite and traces of chalcopyrite in metagabbros (probably of Type 1), and of chalcocite, chalcopyrite in calcite veins, quartz veins and fractures in dolomite, and metagabbro. Some geological mapping, trenching and geophysical work were carried out on the property. The property has since been abandoned.
Several copper showings are known in the continuation of this zone in the Otelnuc Lake and Dunphy Lake areas.

3. Along the fault zones separating the Mistamisk-Romanet anticlinorium from the area underlain by metabasalts in the north and south. All the territory between both faults has been staked in 1962. Little work has been done in the Mistamisk Lake sheet, where exposure is poor, and all claims have since been abandoned. A mineralized outcrop, visited by the writer, is at latitude 56°23'-longitude 68°02', at Plissé lake, and shows gash veins of chalcopyrite in a greenstone. Strongly deformed quartzites, commonly with disseminated pyrite, occur south of du Chambon lake, and are probably mineralized here and there. Many showings were seen in the better exposed parts of this zone in the Romanet Lake area, particularly south and east of Bertin lake, south of Ronsin lake, between Ronsin and Romanet lakes, and along Romanet river.

Zinc, lead: A geochemical zinc anomaly was found by the writer in the area southeast of Chakonipau lake in 1964 at latitude 56°12'-longitude 68°26' (Otelnuc Lake area). Subsequent work, done by the Mines Branch, Department of Natural Resources, Quebec, confirmed the anomaly, and showed that it was due to sphalerite and galena in small cracks in stromatolitic dolomites of the Alder Formation. Similar geochemical zinc values were found also over dolomites of the Alder and Uvé dolomites in the present region.

Uranium, thorium: The areas underlain by the red beds of the Seward Sub-group and by the Wishart Quartzite deserve to be prospected for uranium and thorium. Two large claim groups, east and west of Chakonipau lake in the Chakonipau Formation, were staked in 1966 and are presently owned by Trough Iron Company Limited. The property does not contain possible iron ores, and the terrain was probably staked for possible Uranium mineralization. No trace of mineralization was seen by the writer.

Niobium, rare earth elements: These elements are in many instances concentrated in carbonatites. Two analyses of the Laboratories Services, Department of Natural Resources, gave 0.02% Nb and 0.00% rare earth elements in dike carbonatite, northeast of Savigny lake.

Graphite, pyrite: The graphite slates of the Hautes Chutes Formation contain layers very rich in graphite. Other layers of the formation contain a high percentage of pyrite porphyroblasts. Gossan on top of apparently highly pyritiferous slates was observed east of Veronot lake (Otelnuc Lake area), and north of Pistolet lake.

Geochemistry

Approximately 450 stream sediment samples were collected during the field work, and were later analysed for copper, zinc, lead, molybdenum, nickel and uranium. Most of the samples were rich in humus; all samples were taken at or a few inches below the surface of the streams. Only small streams were sampled.

The normal trace element contents of the stream sediment samples vary strongly and are different for terrains underlain by different rock types. Generally speaking, they are lowest in terrains underlain by the red arkoses of the Chakonipau Formation. They are higher in terrains underlain by marine non-calcareous sedimentary rocks and highest in areas underlain by dolomites, metabasalts, and metagabbros. The distribution of zinc and copper follows relatively well established rules and the zinc contents of the stream sediment samples are everywhere much higher than their copper content. Lead, nickel, and uranium are more erratically distributed. One of the gabbro sills, extending from the northern limit of the area at latitude 68°29' to the area 2½ miles north-northeast of Otelnuc lake, is anomalous in so far as the stream sediment samples collected in its zone of influence show an exceptionally high copper content and very low zinc values. Table 9 gives the variation of the normal trace element contents of stream sediment samples collected in areas underlain by various rock types.

A number of stream sediment samples yield anomalously high trace element contents. The highest copper values found were 3,000 p.p.m., the highest zinc anomaly was 2,500 p.p.m. and the highest nickel value is 1,200 p.p.m.

It has been postulated before (Dimroth, 1965), that the geochemical anomalies are bedrock controlled, and that they are due to mineralization. This hypothesis was confirmed by follow-up work, done by L. Kish (1967), in several anomalous zones of the Otelnuc Lake area. Mineralization was in all cases the source of the anomalies. It may be stressed here that minor mineralization, completely without economic significance, may cause relatively large geochemical anomalies.

The number of stream sediment samples collected in the present area is too small to permit an outline of anomalous zones. On the whole, however, there are, within the area, anomalies, which for geological reasons are thought to be favourable for mineralization, and in which showings of heavy metal mineralization are known. These zones have been outlined in the section on economic geology.

Table 9

Normal trace element contents of stream sediment samples.

	Areas underlain by red arkoses of the Chakonipau Formation		Areas underlain by slates, sandstones and quartzites	
	range	most common values	range	most common values
Cu	0-30	4-10	5-90	15-35
Zn	25-90	25-60	25-125	40-90

	Areas underlain by dolomitic rocks		Areas underlain by metabasalts and metagabbros	
	range	most common values	range	most common values
Cu	5-90	15-35	10-80	15-25
Zn	40-150	50-125	40-150	60-125

Results of analyses in p.p.m

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
1	P2804	16	90	6	0	25	12		
2	P2803	36	90	6	0	26	24		
3	P2802	10	60	6	0	15	2		
4	A1002	0	75	6	4	20	2		
5	P3102	24	110	36	0	3	1		
6	A1001	24	100	16	0.8	28	6		
7	P2801	0	90	16	0	33	2		
8	P3101	10	60	4	0	14	1		
9	P3105	6	60	4	-	12	2		
10	P3103	10	90	125	0	12	1		
11	P3104	6	25	6	0	6	1		
12	D2902	10	75	6	0	15	3		
13	D2804	44	75	16	0	26	2		
14	D2801	0	60	10	0	21	3		
15	P3001	6	40	16	0	7	1		
16	D2701	0	90	16	1	30	3		
17	A1301	10	90	4	0	30	4		
18	D2702	6	125	16	0	33	4		
19	P2901	24	125	6	0	28	2		
20	D2703	0	90	0	0	22	2		
21	D2704	0	60	16	0	13	2		
22	P2902	6	75	6	-	23	2		
23	A1101	16	40	16	0	-	-		
24	P2903	16	60	6	0	16	4		
25	A1102	10	60	6	0	-	-		
26	P2505	20	220	6	2	20	8		
27	P2504	0	60	8	0	7	2		
28	P2507	24	180	16	0.8	13	6		
29	D2303	20	75	0	0.8	6	2		
30	D2302	24	75	6	0	23	2		
31	P2506	40	220	24	0.8	25	2		
32	D2304	50	220	10	0.8	32	3		
33	D2305	24	125	6	0	32	-		
34	D2301	24	90	6	0.4	25	5		
35	P2508	20	125	4	0.4	28	10		
36	P2502	30	90	16	0	27	10		
37	P2503	24	75	16	0	18	10		
38	P2501	24	90	16	0	21	10		
39	D2502	16	40	10	0	12	2		
40	P2701	-	15	-	-	6	-		
41	D2501	20	60	0	0.4	16	20		

Results of analyses in p.p.m.

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
42	D2404	70	75	6	0	30	12		
43	D2403	70	250	0	8	112	24		
44	D2401	20	90	16	0	13	10		
45	A0901	24	500	24	0.4	23	12		
46	P2603	20	110	16	0.8	18	4		
47	P2601	16	90	4	1	15	12		
48	A0902	10	75	6	0	20	8		
49	A0903	36	90	8	2	60	10		
50	D2705	16	125	6	0	25	4		
51	D2706	6	60	4	0	13	2		
52	P2602	20	140	16	0.8	17	4		
53	D2707	0	60	4	1	13	12		
54	P3002	16	60	6	-	13	6		
55	P3003	4	50	6	-	11	2		
56	P3004	2	60	6	-	18	8		
57	D2901	4	40	4	0	5	1		
58	D2803	24	280	10	-	37	2		
59	D2802	24	90	16	0	17	-		
60	D3101	1	75	6	0	28	2		
61	D3102	50	50	4	0	11	6		
62	D3103	16	90	0	4	12	2		
63	D3104	0	60	16	0	12	8		
64	D3105	10	125	6	8	13	2		
65	P3305	40	60	8	0	12	8		
66	P3304	10	110	24	0	8	16		
67	P3303	2	40	0	0	3	1		
68	P3302	4	50	0	6	6	2		
69	P3301	4	50	0	0	3	1		
70	D3005	40	125	6	0	40	6		
71	D3004	16	50	10	0	0	4		
72	D3001	0	40	8	0	22	4		
73	P3201	4	50	6	0	-	-		
74	P3206	10	125	0	0	25	-		
75	D3002	40	90	8	0	33	4		
76	D3003	50	125	10	0	46	4		
77	G2004	24	250	0	10	40	2		
78	P3202	20	50	2	0	13	12		
79	P3203	0	60	16	0	7	1		
80	B2703	50	125	24	0	18	20		
81	B2704	70	110	16	0	28	20		
82	P3204	50	50	16	0	18	4		

Results of analyses in p.p.m

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
83	P3205	50	60	36	0	20	16		
84	A1507	0	90	30	0	18	8		
85	A1602	6	60	10	0	25	2		
86	A1601	16	40	10	0	18	6		
87	P3501	6	75	0	0	13	2		
88	P3606	10	90	8	0	13	1		
89	P3604	20	110	16	0	17	-		
90	P3605	50	300	16	0	50	4		
91	P3601	-	40	8	0	6	6		
92	P3602	40	90	24	0	12	8		
93	P3603	36	90	16	0	-	-		
94	W3000	20	50	16	0	10	28		
95	W3001	100	220	36	0	52	8		
96	B2702	16	50	16	0	250	-		
97	B2701	0	75	0	0	20	1		
98	G2001	30	100	20	0	35	2		
99	G2002	30	90	10	0	30	2		
100	G2003	36	90	24	0	20	4		
101	W2800	6	60	0	1	13	0		
102	W2801	36	75	6	0	32	12		
103	W2600	0	40	0	0	12	-		
104	A1202	24	125	20	1	23	-		
105	A1201	24	40	6	-	7	-		
106	P3006	4	60	4	0	13	6		
107	P3005	6	90	6	-	18	6		
108	A1302	24	50	2	0	20	4		
109	D2402	0	50	4	0	12	3		
110	W2101	50	60	16	0	18	-		
111	D2103	24	75	6	0	25	1		
112	D2104	6	40	0	0	3	16		
113	W2100	24	60	4	0	16	-		
114	W2102	0	40	4	0	0	-		
115	W2200	6	60	10	0	16	4		
116	W2500	16	75	36	0	-	-		
117	W2501	10	60	50	0	-	-		
118	D2003	36	75	16	0	32	6		
119	D2002	20	50	10	0	-	-		
120	G1901	6	50	24	0	8	1		
121	G1902	30	60	24	0	13	-		
122	G1903	36	40	16	0	16	1		
123	G2103	24	75	36	0	15	5		

Results of analyses in p.p.m.

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
124	G2101	30	60	16	0	30	-		
125	W1501	10	60	10	0	26	-		
126	W1500	24	180	40	0	32	-		
127	G2502	0	40	16	0	12	0.5		
128	G2201	40	50	60	-	6	8		
129	G2501	6	40	10	-	23	2		
130	W1701	6	60	10	0	22	-		
131	W1700	40	90	10	-	32	6		
132	D2001	36	90	30	0	18	2		
133	D2004	30	125	16	0	28	4		
134	B2001	16	90	30	0	-	-		
135	D1702	16	40	24	0	16	10		
136	D1703	16	40	16	0	18	8		
137	D1701	0	50	16	0	8	-		
138	P1706	6	60	20	0	13	6		
139	P1705	10	60	30	0	16	5		
140	P1704	0	40	10	0	15	6		
141	D2202	30	60	10	0	7	2		
142	P1703	24	90	16	0	16	12		
143	P1702	10	50	16	0	15	10		
144	P1701	6	125	16	0	11	-		
145	P1601	20	40	2	-	3	8		
146	P1602	6	50	4	0	0	-		
147	D1503	4	100	30	0	30	1		
148	D1502	4	90	6	0	32	3		
149	P1801	20	140	50	0	13	8		
150	P2101	36	40	0	0	5	24		
151	P1803	0	40	4	0	13	6		
152	D1601	4	40	20	0	7	-		
153	D1602	4	75	20	0	13	-		
154	W2301	10	110	20	0	18	2		
155	W2300	0	90	16	0	3	2		
156	P2402	20	75	10	0	20	2		
157	P2401	6	50	0	0	12	4		
158	A0501	20	140	0	2	-	-		
159	P2308	6	90	16	0	21	2		
160	P2201	30	90	10	0	35	2		
161	P2202	16	60	16	0	-	-		
162	P2203	16	60	6	-	-	-		
163	A0601	50	60	8	0	16	24		
164	P2301	0	90	4	0	50	2		

Results of analyses in p.p.m

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
165	W0601	24	60	8	0	50	6		
166	W0600	36	60	24	0	25	8		
167	W0400	80	90	6	0	50	2		
168	P2302	6	90	4	0	30	14		
169	P2303	-	40	0	0	18	14		
170	P2304	30	90	0	0	40	1		
171	P2305	100	75	24	0	8	-		
172	P2306	100	90	100	0	10	8		
173	P2307	10	75	16	0	-	-		
174	A0504	24	75	16	0	20	-		
175	A0503	24	90	40	0	24	-		
176	A0502	60	110	40	0	32	-		
177	P2403	10	60	24	0	15	3		
178	A0702	24	60	16	0.8	23	14		
179	A0701	20	40	16	0	20	5		
180	P2001	6	90	0	2	6	-		
181	P2002	30	125	0	0	33	-		
182	P2003	24	75	50	0	-	-		
183	P2004	20	125	16	0	12	18		
184	P2005	24	90	36	0	12	-		
185	P1802	0	40	6	0	11	-		
186	W0301	50	60	10	0	5	-		
187	W0302	6	40	8	0	-	-		
188	W0300	16	50	6	0	8	12		
189	D1501	0	60	16	0	10	-		
190	W1800	10	60	10	0	40	2		
191	P1502	0	60	6	0	6	6		
192	P1501	0	125	4	20	120	2		
193	P1503	0	75	24	0	12	4		
194	D1401	6	150	16	0	10	4		
195	D1403	24	60	0	0	40	6		
196	D1402	2	15	10	-	6	8		
197	P3401	10	25	4	0	6	16		
198	W0502	4	15	0	0	-	-		
199	B0601	24	60	8	0	22	-		
200	B0604	36	250	6	0.8	40	16		
201	B0602	10	90	16	0	25	-		
202	W0602	24	40	6	0	20	10		
203	B0603	50	125	20	0	30	14		
204	G0212	20	50	0	0	16	10		
205	B0501	6	40	8	0	-	-		

Results of analyses in p.p.m.

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
206	B0502	6	90	10	0	27	-		
207	B0503	30	125	16	0	-	-		
208	B0505	24	90	10	0	30	6		
209	B0504	0	60	10	0	28	-		
210	W1400	4	60	10	0	35	-		
211	G0211	10	25	0	0	5	6		
212	P0303	30	90	16	0	32	10		
213	P0302	6	90	56	0	5	-		
214	B0302	0	40	36	0	-	-		
215	B0301	24	90	50	0.8	7	-		
216	B0303	4	90	40	0	-	-		
217	B0304	4	90	24	0	-	-		
218	P0301	24	90	56	0	10	16		
219	G0210	6	25	0	0	10	2		
220	B0201	24	50	16	0	6	-		
221	B0202	16	50	0	0	8	24		
222	B0204	40	90	8	0	8	-		
223	B0203	6	40	4	0	10	-		
224	B0205	30	25	16	0	3	-		
225	B0206	0	15	4	0	6	24		
226	P0205	0	60	10	0	0	12		
227	P0206	30	60	6	0	0	14		
228	P0201	6	125	0	0	6	-		
229	P0202	6	60	16	0	3	-		
230	G0101	0	25	24	0	-	-		
231	G0102	10	40	16	0	3	-		
232	P0203	0	15	0	20	0	-		
233	P0204	0	60	16	0	-	-		
234	W0700	20	15	6	0	-	-		
235	G0503	4	25	0	0	15	2		
236	G0103	6	40	36	0	5	28		
237	G0104	6	40	16	0	17	6		
238	G0501	6	50	6	0	15	1		
239	G0502	4	60	8	0	15	2		
240	P0602	16	60	16	0	8	4		
241	P0601	6	60	8	0	-	-		
242	W0202	0	40	16	0	5	12		
243	W0201	0	40	10	0	13	32		
244	W0204	0	50	0	0.8	3	-		
245	W0203	0	40	8	1	6	-		
246	W0206	0	25	4	0	3	-		

Results of analyses in p.p.m

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
247	D0207	4	40	20	0	-	-		
248	D0206	6	40	6	0	10	-		
249	D0201	24	90	16	0	10	-		
250	D0205	10	60	6	0	15	8		
251	D0202	20	40	8	0	-	-		
252	D0204	6	40	8	0	4	-		
253	P0102	4	15	0	2	0	-		
254	D0203	20	40	0	0	-	-		
255	P0103	20	125	24	0	12	-		
256	P0104	0	25	6	0	-	-		
257	P0101	4	60	6	0	15	8		
258	B0101	6	60	16	0	7	-		
259	B0102	0	25	6	0	3	-		
260	B0105	4	60	24	0	-	-		
261	B0104	0	25	4	0	8	-		
262	B0103	6	60	20	0	-	-		
263	D0502	10	60	24	0	17	4		
264	D0503	20	60	8	4	16	8		
265	D0505	36	60	24	0.8	60	-		
266	P0401	6	125	0	100	30	-		
267	P0402	6	60	10	0.8	3	-		
268	G0402	6	90	4	0.8	16	1		
269	G0307	10	125	6	0	6	-		
270	G0403	50	75	16	-	-	-		
271	P0404	16	90	10	0	23	1		
272	P0403	4	15	4	0.8	-	-		
273	P0405	20	90	6	2	21	16		
274	G0401	10	60	4	0.8	15	4		
275	D0501	24	90	6	0.8	20	12		
276	G0306	6	90	6	0	10	4		
277	G0301	20	60	0	0	16	8		
278	G0302	10	60	6	0	15	6		
279	G0305	20	40	0	0	10	2		
280	P0501	150	60	6	0	10	-		
281	P0506	100	15	0	0	5	6		
282	G0304	175	60	6	0	10	-		
283	G0303	100	50	0	0	13	8		
284	W0702	100	60	10	0	7	108		
285	D0801	30	125	6	0.8	28	6		
286	D0802	36	90	36	0	-	-		
287	D0803	80	60	6	0	10	32		

Results of analyses in p.p.m.

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
288	W0701	36	15	4	0	-	-		
289	G0209	60	60	6	0	13	32		
290	G0208	112	75	10	0	10	-		
291	G0207	3000	125	56	1	0	-		
292	G0205	180	125	36	0	12	-		
293	G0206	150	40	4	0	3	-		
294	B0402	80	90	6	2	12	-		
295	B0401	125	125	30	0	36	-		
296	W0500	24	125	10	2	15	20		
297	W0501	140	140	24	0	-	-		
298	G1402	36	250	6	0	28	-		
299	G1401	70	75	2	12	44	6		
300	G1601	24	220	10	4	18	5		
301	G1602	40	60	2	0	40	4		
302	G1603	50	90	0	1	30	6		
303	W0900	30	125	6	0	52	8		
304	B1201	24	250	4	1	35	2		
305	B1207	36	60	2	0	28	1		
306	B1206	20	110	2	0	20	2		
307	W1000	10	90	4	0	30	1		
308	B1205	36	140	16	0	40	0		
309	B1202	10	140	2	1	20	2		
310	B1203	6	25	6	0	-	-		
311	B1204	125	150	10	0	52	1		
312	G1003	76	360	6	1	80	6		
313	G1004	30	60	16	0	25	1		
314	G1001	24	900	0	0	-	-		
315	G1002	20	50	24	0	13	0.5		
316	G1101	140	75	4	0	-	-		
317	G1102	40	90	2	-	46	1		
318	G1202	20	250	0	1	32	2		
319	G0701	80	250	50	0	60	6		
320	G0702	24	90	0	0	15	4		
321	P1304	20	125	2	-	25	2		
322	P1303	30	250	4	1	44	2		
323	P1302	24	125	2	1	40	2		
324	P1301	6	60	4	0	15	2		
325	D0404	100	90	16	0.4	17	-		
326	D0901	60	250	20	0.8	25	12		
327	B0801	10	180	10	0.8	20	10		
328	B0804	24	250	6	0.8	3	6		

Results of analyses in p.p.m

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
329	B0802	16	125	10	4	16	10		
330	B0803	16	60	6	0	20	8		
331	P0504	120	90	8	0	46	6		
332	P0505	120	60	8	0	10	-		
333	D0702	20	60	4	0	21	8		
334	D0703	80	125	16	0	120	12		
335	D0601	30	60	10	0	30	12		
336	D0602	56	90	10	0	30	14		
337	D0604	60	125	8	0	8	16		
338	D0603	24	250	16	0.8	28	6		
339	B1002	10	40	16	0	-	6		
340	B1001	0	60	0	0	18	6		
341	B0901	50	90	8	0	23	12		
342	P1004	30	360	8	1	27	2		
343	P1003	30	125	6	0.8	30	1		
344	P1101	36	90	2	0	35	0.5		
345	P1004	160	40	2	0	6	2		
346	P1103	6	60	10	0	15	0.5		
347	P1102	6	125	0	1	18	0.5		
348	P1102	24	90	10	0.4	28	1		
349	P1001	20	90	6	0.4	30	1		
350	P0901	20	90	6	0	-	-		
351	P0702	16	125	24	0	25	2		
352	P0701	16	250	4	1	30	2		
353	P0503	40	90	8	0	22	6		
354	D0701	24	50	4	0	20	12		
355	D1205	40	110	16	0	23	2		
356	D1201	56	140	24	0	30	-		
357	D1105	24	40	4	0	13	7		
358	D1104	10	90	4	0	23	4		
359	D1102	70	60	36	0	52	12		
360	D1103	6	40	2	0	16	2		
361	D1202	24	125	2	12	36	8		
362	D1203	36	90	10	1	40	8		
363	D1101	80	40	10	0.8	200	80		
364	D1004	60	140	50	-	128	40		
365	D1204	50	125	2	2	50	8		
366	D1001	30	75	0	0.4	25	32		
367	D1002	30	140	6	0.8	36	14		
368	D1003	30	25	16	-	12	32		
369	P1202	30	180	0	20	42	8		

Results of analyses in p.p.m.

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
370	P1201	36	180	4	1	28	4		
371	P1305	250	110	36	0	10	32		
372	G1201	16	60	4	0	20	1		
373	B3703	10	90	0	2	52	1		
374	B3701	10	250	0	4	300	4		
375	G2701	0	50	4	1	8	4		
376	B3601	6	90	16	0.8	100	-		
377	B3602	0	40	8	0	-	-		
378	B3603	2	90	10	0.8	-	-		
379	B3604	6	360	8	4	260	2		
380	B3605	0	180	8	0	38	1		
381	P3702	6	125	0	14	18	-		
382	P3703	4	75	0	14	13	-		
383	P3704	6	40	6	1	-	-		
384	P3705	10	110	0	14	60	2		
385	P3708	10	110	0	14	38	2		
386	P3706	24	125	6	0	20	4		
387	P3707	20	60	0	70	38	-		
388	G2704	0	75	0	25	52	8		
389	G2703	0	90	0	14	40	6		
390	G2702	0	60	50	8	13	-		
391	G2705	0	60	0	6	52	22		
392	W3401	100	2500	0	0	1200	1		
393	W3400	24	500	0	1	320	2		
394	D1802	36	75	10	0	28	2		
395	D1801	36	90	50	-	18	4		
396	D1803	40	60	0	1	37	-		
397	D1903	30	560	16	0	16	1		
398	D1901	4	60	10	0	30	4		
399	W3401	10	90	0	10	20	-		
400	W3402	4	75	24	0	13	-		
401	D1902	24	125	10	0	32	2		
402	G2802	36	60	4	0	28	16		
403	G2801	6	60	0	0	16	1		
404	W3301	56	200	36	0	-	-		
405	W3303	36	140	0	1	112	10		
406	B4003	6	90	8	0	5	-		
407	G2901	6	50	10	0	4	-		
408	G3001	0	60	4	0	7	4		
409	D3204	16	140	6	0	-	-		
410	D3703	20	90	16	0	-	-		

Results of analyses in p.p.m

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
411	D3702	20	360	10	0	8	0		
412	B4101	16	40	8	0	10	-		
413	D3701	50	125	50	-	-	0		
414	B4501	10	90	30	0	8	-		
415	B4002	20	75	16	4	-	-		
416	B4004	24	220	0	0	120	1		
417	B3402	100	25	0	0	3	2		
418	P3403	16	25	6	0	6	16		
419	W3302	16	50	16	0	6	12		
420	W3300	16	60	36	0	-	-		
421	B4103	10	75	8	-	-	-		
422	B4102	8	60	6	0	6	2		
423	W3802	0	75	6	0	12	2		
424	W3803	6	40	16	0	11	-		
425	W3801	60	40	6	0	8	6		
426	P3904	0	25	6	0	6	1		
427	P3905	0	25	6	0	-	-		
428	P3903	40	40	4	0	15	16		
429	P3902	0	40	6	0	-	-		
430	P3901	20	60	16	0	12	1		
431	P3906	16	90	6	0	15	12		
432	W3800	0	40	10	0	-	-		
433	W3804	6	50	8	0	6	-		
434	P4001	36	40	0	0	-	-		
435	P4002	10	50	0	0	8	1		
436	A2102	60	75	6	0	4	14		
437	A2101	60	125	16	0	12	12		
438	W3904	100	50	0	0	6	-		
439	P4007	24	90	10	0	11	2		
440	W3902	24	60	6	0	-	8		
441	P4006	100	60	6	0	13	8		
442	P4001	60	50	0	0	12	-		
443	P4004	70	40	16	0	3	-		
444	P4003	20	40	8	0	-	-		
445	W3901	0	60	0	0	5	1		
446	B4301	10	60	4	0	-	-		
447	G2902	6	50	6	0	-	-		
448	P4101	175	75	36	0	7	-		
449	P3804	60	60	10	-	5	4		
450	P3803	500	40	50	0	8	-		
451	P3802	30	90	60	0	10	4		

Results of analyses in p.p.m.

Sample No. on the map	Code No. of sample in files of Dept.	Cu	Zn	Pb	Mo	Ni	U		
452	P3801	6	60	24	0	-	-		
453	P3805	152	75	10	0	7	-		
454	P4103	4	40	0	0	5	1		
455	P4104	6	40	0	0.8	3	-		
456	W4002	6	40	0	0	7	2		
457	P3701	16	250	0	0.8	120	-		
458	B3702	16	200	10	0	-	-		
459	W4001	6	60	2	0	3	12		
460	W4000	36	60	2	-	7	24		
461	W3900	24	125	24	0	5	-		
462	A2103	24	75	6	4	15	12		

A dash indicates the absence of determinations.

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