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THE LAC DORÉ VANADIUM PROJECT: FIRST PRELIMINARY ECONOMIC ASSESSMENT

CHIBOUGAMAU, QUÉBEC, CANADA
NI 43-101 TECHNICAL REPORT

Presented to

VANADIUMCORP RESOURCE INC.

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Ville de Saguenay

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ABBREVIATION LEGEND

AA:	Atomic absorption
asl:	Above sea level
AMV:	Ammonium metavanadate
CANMET:	Canada Centre for Mineral and Energy Technology
BOF:	Basic oxygen furnace
Capex:	Capital expenditures
CEAQ-TJCM:	Centre d'Étude Appliquée sur le Quaternaire
CEO:	Chief executive officer
CFILNQ:	Chemin de fer d'intérêt local du Nord du Québec
CIM:	Canadian Institute of Mining and Metallurgy
CMB:	Crushing-Milling-Beneficiation
CNESST:	Commission des normes, de l'équité, de la santé et de la sécurité du travail
COMEX:	Comité d'examen des répercussions sur l'environnement et le milieu social
COMEV:	Comité d'évaluation des répercussions sur l'environnement et le milieu social
COREM:	Consortium de Recherche Minérale
COX and NOX:	Carbon oxides and nitrogen oxides
CRM:	Centre de Recherches Minérales
CRIQ:	Centre de Recherche Industrielles du Québec
DIRR:	Discounted internal rate of return
DMS:	Dense media separator
DNPV:	Discounted net present value
DGPS:	Differential global positioning system
DPV:	Dépot préliminaire (report type)
DTT:	Davis Tube Test
EBITDA:	Earning before interest, taxes, discount and amortization
EM:	Electromagnetic
EPCM:	Engineering, procurement and construction management
FOB:	Free on board
GPS:	Global Positioning System
GVWR:	Gross vehicule weigth rating
HBI:	Hot briquetted iron
HSLA	High strength – Low alloy
ICP-OES	Inducted coupled plasma-optical emission spectrometry
ICP-AES:	Inducted coupled plasma-atomic emission spectrometry
IRR:	Internal rate of return
IRM:	Internal reference material
IRSID:	Institut de recherche sidérurgique

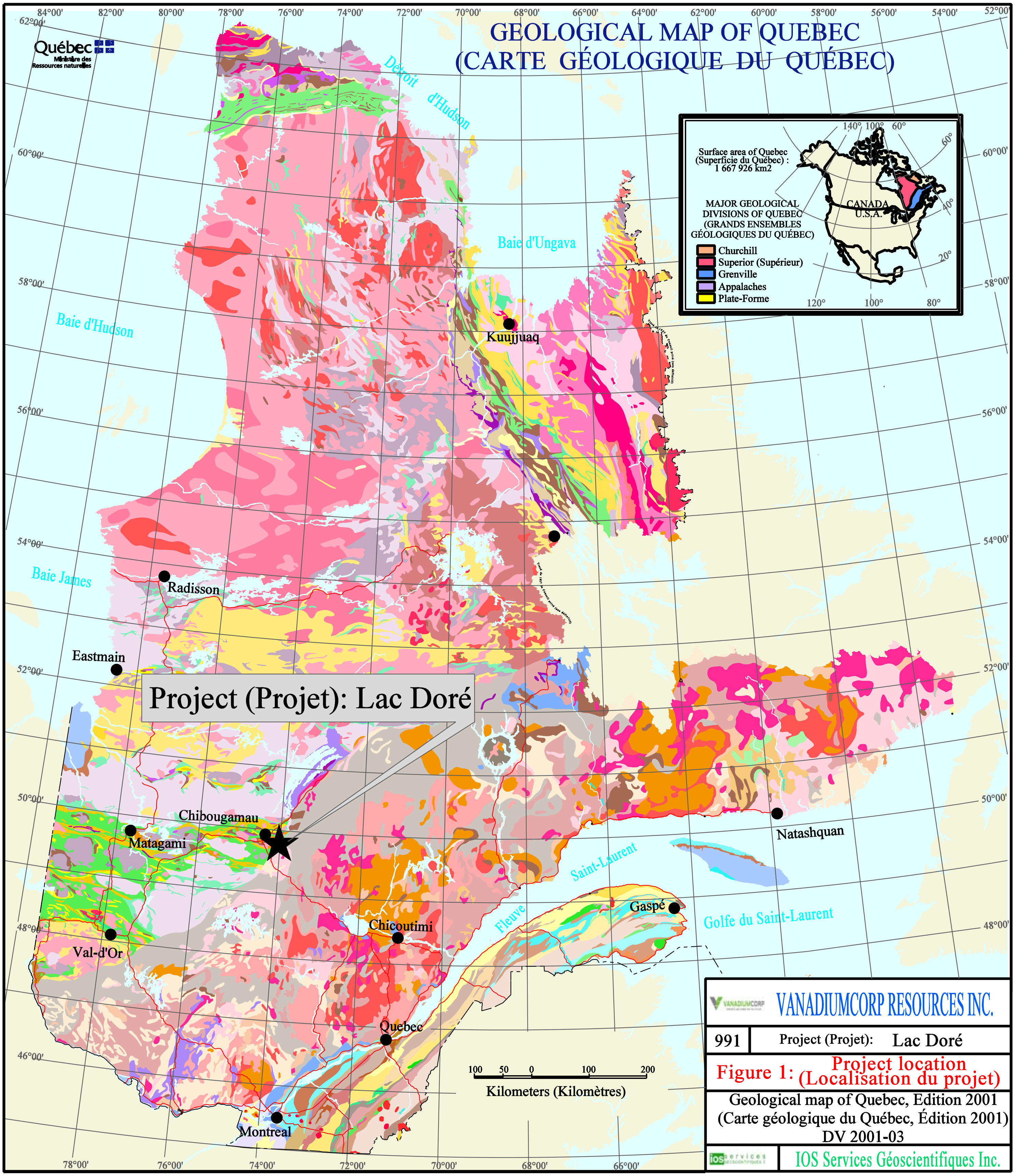
LIMS:	Laboratory internal management system
LIMS:	Low intensity magnetic separator
MAPAQ:	Ministère de l'Agriculture, des Pêcheries et de l'Alimentation
MDDELCC:	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques
MERN:	Ministère de l'Énergie et des ressources
MERNQ:	Ministère de l'Énergie et des Ressources naturelles du Québec, p. 24
MBJ:	James Bay Municipality
MIRR:	Modified internal rate of return
MKBY:	McKenzie Bay Resources
MM:	Mémoire (report collection)
MRC:	Municipalité régionale de conté
MRN:	Ministère des richesses naturelles
MRNQ:	Ministère des ressources naturelles du Québec
NI-43-101:	National Instrument 43-101
NPV:	Net present value
NTS:	National topographic system
OCR:	Optical character recognition
Opex:	Operation expenditures
PEA:	Preliminary economic assessment
PRC:	People's Republic of China
PST+GST:	Provincial sales tax and good and services tax
QAQC:	Quality analysis and quality control
QIT:	Québec Iron and Titanium
RP:	Preliminary report
RQD:	Republic of South Africa
RTIT:	Rio Tinto Iron and Titanium
SAG:	Semi autogenuous
SEDAR:	Système électronique de données, d'analyse et de recherche
SOQUEM:	Société québécoise d'exploration minière
UTM:	Universal Traverse Mercator
VRB:	VanadiumCorp Resource Inc.
VRB:	Vanadium redox battery
VTM:	Vanadiferous titanomagnetite
WHIMS:	Wet high intensity magnetic separator
XRF:	X-ray fluorescence spectrometry

ITEM 1: SUMMARY

VanadiumCorp Resource is a Canadian junior mining company based in Vancouver and listed on TSX-V (VRB). The current report, on the Lac Doré Vanadium Project, is prepared in support of the news release of the first preliminary economic assessment of the project by VanadiumCorp Resource Inc., under s.43(1)(j) of NI-43-101. The assessment was prepared in form F-1 of National Instrument 43-101 ("NI 43-101") of the Canadian Securities Administrators. The authors are all considered as *qualified persons* in their respective field of expertise, and independent of VanadiumCorp Resource Inc. according to NI-43-101 definitions.

A preliminary economic assessment is conceptual in nature, and aims to evaluate the plausibility of the technical choices related to a project and to predict their economic outcomes. It is not a comprehensive study, and solely aims to orientate the future investment into its development, and to provide guidance to identify the most severe issues to be resolved. It is based on approximate evaluation and partially tested assumption. In the scope of the current Lac Doré vanadium project, the current study is to validate the reasonableness of raising capital to complete the resource definition, to initiate the environmental impact study, and to conduct a pilot plant testing of the metallurgical process currently being developed by VanadiumCorp Resource Inc. Since the Lac Doré vanadium project deals with industrial commodities, for which few examples of successful development are available, it is considered that a preliminary economic assessment is required to test the economic plausibility before tinvesting in costly resource definition.

The Lac Doré Vanadium Project is a vanadium mining project under development covering a group of mineral properties owned 100% by VanadiumCorp Resource Inc. (hereafter “VanadiumCorp” or “VRB”) in the Chibougamau area, Province of Quebec (***figure 1***). The project development has a protracted history. Mineralization was initially discovered in 1956, and underwent economic evaluation at least 6 times since its discovery. The current report aims to evaluate the economics of developing the project to produce vanadiferous titanomagnetite concentrate, to be sold or used for its processing. A metallurgical and chemical process is currently being developed in partnership by VanadiumCorp Resource Inc. and Electrochem Technologies and Materials Inc. (hereafter “Electrochem” with the possibility to produce vanadium chemicals, copperas (ferrous sulphate heptahydrate) and titanium-rich products. Economic assessment of the conventional salt roasting of titanomagnetite to produce of vanadium pentoxide, which was the initial scope of the project, is demonstrated as not sufficiently attractive economically, and has been disregarded in the current study. Similarly, the option of smelting the titanomagnetite into iron or steel and processing the



VANADIUMCORP RESOURCES INC.

991	Project (Projet): Lac Doré

Figure 1: Project location (Localisation du projet)

Geological map of Quebec, Edition 2001
(Carte géologique du Québec, Édition 2001)
DV 2001-03

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slag for titanium and vanadium recovery, either through moderate or intensive smelting, was disregarded based on its elevated capital requirements and the saturated North American steel market. This decision lead VanadiumCorp to change its business strategy into developing its own vanadium recovery process. It should be kept in mind that the production of titanomagnetite contemplated would be captive of the markets created by the electrometallurgical process, and that the outcome of the current mining project directly depends on the success of the aforementioned process development.

The resource estimation of the project is currently based on historic data only. Additional systematic drilling is required to improve their classficiation , which drilling should be initiated at the earliest convenience.

The project aims to produce an average of 100 tonnes per hour of titanomagnetite concentrate, or 876,000 tonnes per year, a throughput similar to what was initially considered for alkali roasting. Such production would equate to approximately 8000 tonnes of vanadium pentoxide per year (17 million pounds), or approximately 10% of the current world consumption. Such vanadium production is not considered as sufficient to destabilize the market. The patented processes currently under development will also produce approximately 500,000 tonnes per year of electrolytic iron from the copperas, either as plates, flakes or powder. Electrolytic iron, or ferrite, is dominantly used for electric transformer manufacturing and sintered steel by automotive industry. The market is limited but with a value more than US $2000 per tonne. However, electrolytic iron can be beneficially used as feed for steel manufacturing, in replacement of pig iron or scrap metal. This market is extremely large compared to the actual project, and a price of US $600 per tonne can be expected. Since the process currently being operated in closed circuit with minimal acid consumption and low energy consumption, it is anticipated it could operate at competitive cost in these markets. Since the process is under development, it is decided to separate the mining project from the refining. It has been assumed the vanadiferous titanomagnetite being sold at a price of US $100 per ton, a price comparable to those of similar commodities (ie: ilmenite).

The current economic assessment draws on previously calculated resource (Girard and D'Amours, 2016), established at 99.1 million tonnes of inferred resource grading 26.3% vanadiferous titanomagnetite, itself grading 1.08% V_2O_5. These resources were calculated using the forecasted economics of alkali roasting operation producing vanadium pentoxide only to be sold at a market price of US$5.50/lbs. The current economic model is limited to a production life of 20 years, requiring only 62 million tonnes of the known resources.

Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as MineralReserves and therefore do not have demonstrated economic viability.

VanadiumCorp Resource Inc., exploring in the Chibougamau area in the last 12 years, has undergone a series of corporate name changes, with no material changes in ownership of the Lac Dore Vanadium Project, throughout its history from Novawest Resources Inc. to Apella Resources Inc. to PacificOre Mining Corp. and finally to VanadiumCorp Resource Inc. This report will reference VanadiumCorp with respect to all previous work done by these related companies. In 2007, VanadiumCorp acquired the property through conventional field staking, after the land was accidentally allowed to lapse by the former owner of the deposit.

The current report draws upon a former report disclosing the first resource estimate conducted on behalf of the current property owner, effective April 10, 2015, duly filed on Sedar. The first author, who supervised most of the field work carried-out under McKenzie Bay Resources, former owner of the deposit, has reviewed all geological data related to the deposit conducted by former management of VanadiumCorp, all contracts and agreements made by VanadiumCorp relating to this property, conducted a thorough review of the historical metallurgical work, and conducted the economic assessment. He reviewed calculations of the other authors to the limits of his technical capabilities. The second author (E. Larouche, P. Eng) is employee of the first author, and responsible for the evaluation of the construction and operating cost of the infrastructure of the project, as listed in Items 18 and 21, plus excerpts in item 1. . Mr Larouche has worked in numerous mining operations in his career and has significant experience pertaining to private engineering practices. The third author (J. Lapointe, P. Eng) mandate is to provide a first design for the beneficiation circuit as well as for equipment and processing costs estimates, as stated in items 17 and 21, plus excerpts in item 1. Mr Lapointe worked as a process engineer for 15 years in various mines in the Chibougamau area, prior to establishing Metchib Inc, a metallurgical laboratory and pilot plant testing facilities. The fourth author (C. D’Amours, P. Geo) is responsible for updating the resource estimate described in item 14. Mr D’Amours has about 19 years of experience in resources estimation, either in large corporations or as consultant through Géopointcom. Mining cost, included in item 16, were provided as a quote from Dynamitage TCG Inc, a reputed mine and quarry contractor (Dionne et Vachon, 2016), and revised by the first author. Finally, the market study provided in item 19 has been prepared by Mr. Terry Perles, a reputed metal broker and Advisory Board member of VanadiumCorp, so the liability for this section is taken by the first author.

A non-current bankable feasibility study was completed on a project of bringing the Lac Doré deposit into production in 2002 by SNC-Lavalin on behalf of the former owner. This study included a non-current mineral resource estimate. Furthermore, a non-current prefeasibility study was completed on the deposit in 2000 by Cambior, which study included another non-current mineral resource estimate. Since the author was involved in these studies, the current report draws upon certain aspects of these former non-current studies.

The first author has long been involved with the **Lac Doré** Vanadium Project, having worked on it intermittently since 1997 and has extensive knowledge on most of the technical aspects related to geology, metallurgy, environment and industrial applications. He was involved as independent Qualified Person on the project since its beginning with McKenzie Bay Resources 20 years ago, supervising the field work and serving as client advisor during the preparation of the feasibility study. He conducted various mandates for Cambior in 1999, was a technical consultant for BlackRock Metals Inc for a short period, and is now involved as Qualified Person for VanadiumCorp.

The **Lac Doré** Vanadium Project is located 30 km southeast of the town of Chibougamau, central Québec. The project includes two properties which cover an area of 52.86 km^2 and consists of 114 map designated cells.

Since its acquisition in 2007 by VanadiumCorp, a limited amount of exploration work was conducted on the project, including:

- Three ground magnetometric surveys, encompassing almost completely the current properties.
- Stripping and surface sampling on **Lac Doré North** property in 2008, which were recently remapped.
- A 10 hole exploration drilling program on **Lac Doré North** in 2009.
- A brief channel sampling program on **Lac Doré** in 2012 aiming to duplicate former McKenzie Bay Resources samples, the results of which are not available.
- A 4 holes confirmation drilling program in 2013 on **Lac Doré**, aiming to duplicate historical drill holes.
- A field verification and surveying of historical drill holes location in fall 2015.

The **Lac Doré** vanadium deposit has a protracted exploration history, spanning more than 60 years. It was evaluated by drilling or trenching on nine occasions through time, by the various past and present owners, although not in a systematic manner. It is still considered as insufficiently drilled by the authors. Results are of variable quality, but parts are sufficiently accurate to be incorporated into a resource estimation limited to inferred resources, assuming sufficient care and precaution. A total of 54 holes and trenches are available on the property totalling 15,006 metres, which are unevenly distributed, including some segments traversing onto adjacent properties:

- 1958: Jalore Mining, 5 holes for 773.38 metres
- 1970: MRN, 1 hole for 183.49 metres
- 1973: MRN, 9 holes for 914.99 metres
- 1979: SOQUEM, 19 holes for 3425.85 metres
- 1997: McKenzie Bay Resources, 27 trenches for 7225.21 metres
- 2001: McKenzie Bay Resources, 3 holes for 438 metres
- 2002: McKenzie Bay Resources, 3 holes for 450 metres
- 2009: VanadiumCorp Resource, 10 holes for 995.65 metres
- 2013: VanadiumCorp Resource, 4 holes for 600 metres

The current VanadiumCorp **Lac Doré** property encompasses the former Eastern and part of the former Western deposits (Kish, 1971), previously focused on by SOQUEM and subsequently by McKenzie Bay Resources. The **Lac Doré North** property encompasses part of the Northeast Extension as formerly defined by McKenzie Bay Resources. Through time, historical resource estimates were calculated on the Eastern and Western deposit, successively by the Québec department of Natural Resources (Assad 1968, Kish 1971, Avramtche 1975, SOQUEM (Dion, 1980)), LMBDS-Sidam on behalf of SOQUEM (LMBDS 1981), IOS on behalf of McKenzie Bay Resources (Tremblay *et al.,* 1998), Cambior (Crépeau, 2000) and finally SNC-Lavalin on behalf of McKenzie Bay Resources (2002). **All these previous resource estimates are considered as non-current and therefore historical in nature** and will not be discussed in detail. A mining reserve was calculated by SNC-Lavalin in 2002 on behalf of McKenzie Bay Resources, which is also considered as historical and non-current by the authors.

The current resource estimation (Girard and D'Amours 2015) is based on historical drilling and trenching, with the exception of four confirmation holes drilled in 2013 by VanadiumCorp. All relevant data were captured into a database under the authors' supervision, and thoroughly tested using redundancy, various statistics and closure tests. Head grade (core) and titanomagnetite concentrate (Davis tube) assays conducted since McKenzie Bay program in 1997 included the insertion of the same certified reference material, providing a fair confidence on their precision and accuracy. Assays conducted prior to McKenzie Bay, thus including MRN1970, MRN1974 and SOQUEM 1980 were not as well controlled, and an uncertainty remains in regard of their accuracy. These historic results shall be considered as potentially discrepant, either overestimated or underestimated by up to 5% relative. This issue is raised both in regards to head grade analysis as well as titanomagnetite concentrate grade. No correction was applied to the data. It is worth noting that these historic assays represent the bulk of the data available from drilling.

Grades were calculated based on titanomagnetite abundance as obtained from Davis tube testing, and the vanadium assaying of these titanomagnetite concentrates. Davis tube testing was conducted through time using slightly different grinding parameters. For example, the MRN-1974 samples were ground at 80% - 325 mesh, while the Cambior 1999 tests were conducted at 80% - 100 mesh. Fineness of the grinding influence titanomagnetite liberation: coarser is the material, more abundant are ilmenite and silicates, larger is the concentrate and lower is its vanadium grade. However, the overall vanadium recovery is almost similar, and all tests were used without applying corrections.

Systematic density measurements were available only from Cambior 1999 re-assaying of McKenzie Bay Resources 1997 trench samples. About 20% of the measurements were discrepant and discarded. The measured densities were equated to the iron plus titanium grade of the samples, and this equation is used for the computation of density estimation on every head grade sample.

Drill hole locations were systematically verified in the field by the author's crew to the extent of feasibility, and collar locations were measured with the use of a DGPS wherever available, providing a precision of a few tens of centimetres. Where collars were not found, evidence of the drilling pads was found in most locations, which enabled a precision on locations within 5 metres. Down hole measurements were taken from historic logs, most of them made with acid test, lacking azimuth measurements.

The block model and resources were calculated by C. D'Amours (OGQ n^{o} 226), based on the data provided by R. Girard (OGQ n^{o} 521) (Girard and D'Amours, 2015). The resources were calculated using the Davis tube tests results to evaluate the abundance of titanomagnetite, and vanadium grades of the titanomagnetite concentrate. This is in contrast with all previous historic estimations, which used the head grade assays, to which an overall recovery factor was applied. Parameters used for the current estimation were as follow:

- From section 6+50 East to section 24+50 East, for a total deposit length of 1.8 km.
- Maximum depth of 200 metres from surface.
- Pit slope: 50^{o}.
- Cut-off titanomagnetite abundance of 15%.
- Easting: 257 cells, 10 m each.
- Northing: 117 cells, 10 m each.
- Elevation: 230 metres, 32 cells 11.9 metres each.
- Ordinary Kriging.

- Search radius: 200 metres, 10-25 composite samples.
- Grade of unsampled interval: 0%.
- Specific gravity calculated from Fe_2O_3+TiO_2+V_2O_5, 5% trimming.
- Omnidirectional variograms.
- Minimum profit required: 25%.
- Mining cost: $1.80/metric tonne.
- Beneficiation cost: $2.50/metric tonne.
- Roasting cost: $40/metric tonne of titanomagnetite.
- Market value: US $5.50 per pound of V_2O_5.
- Hydrometallurgical recovery: 95%.

Results of the resource estimates were exclusively classified as inferred:

- Inferred resource tonnage: 99,104,000 metric tonnes.
- Waste tonnage: 165,690,000 metric tonnes.
- Titanomagnetite content: 26,067,000 metric tonnes or 26.3%.
- Vanadium grade in titanomagnetite: 1.08% V_2O_5.
- Total vanadium in titanomagnetite concentrate: 282,370 metric tonnes V_2O_5.

Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves and therefore do not demonstrate economic viability.

The resource model estimated in 2015 was used for the current PEA, and is considered compatible with the production model change. A recalculation was not required as current resources are classified as inferred only. Systematic drilling is next requirement to improve their classification:

- Resources are considered as “Inferred”, the least accurate category, due to the irregular drilling pattern, the analytical inconsistencies and the historic nature of the available information.
- Current inferred resources of 99.1 mt stand in excess compared to the current project requirements of 63.6 mt.
- The economics of the proposed process introduce less constrains than the previous salt-roasting.
- Future economics of the project is expected to be less sensitive to the vanadium grade in the titanomagnetite, since electrolyte would be a co-product to iron.
- Sensitivity analysis of the project economics indicates the limited impact of pit-ratio and grade variations to the overall profitability.

Since only about 64.2% of the resources are required for the project life, pit depth was raised to 120 metres, (level 380) for the resource model, using a waste to mineralization ratio at 1.34 and titanomagnetite abundance at 26.61% with a vanadium grade of 1.08% V_2O_5 in titanomagnetite, or 0.43% in the mineralization. Changes in VTM abundance and vanadium grades of the resources are noted as consistent with figures relating to the current resources.

Historically, a large amount of metallurgical testing was conducted on the Lac Doré mineralization. These included both bench scale and multiple pilot plant tests of titanomagnetite beneficiation, including the grindability and energy consumption, titanomagnetite concentration by magnetic separation, as well as pelletization. Vanadium and iron production was tested through two main processes, smelting and alkali roasting. Smelting, either by intensive or moderate fusion, requires the smelting of the ore in an arc furnace to produce steel or pig iron and a vanadium-titanium slag. Such smelting was tested on a pilot scale both in CANMET and QIT facilities in 1977-1978. The second route involves the production of vanadium chemicals only, while iron and titanium remain in calcine waste. It involves roasting of the titanomagnetite in presence of soda ash in order to produce a leachable sodium vanadate, which can be refined by conventional hydrometallurgy. This process was thoroughly tested in a pilot plant in Lakefield Research facilities in 2001 (Molnar *et al.*, 2002). Successful tests were made for the production of pure vanadium chemicals for the production of electrolyte. However, although claimed as being at the scale of a pilot plant, the purification of the liquor was of limited volume. Both routes, smelting and roasting, have amply been demonstrated as technically feasible.

Economics of both smelting and roasting for the Lac Doré Vanadium Project were evaluated in significant detail by the first author, who concluded their lack of economic attractiveness. Rate of returns for roasting was anaemicwhen compared to the magnitude of the required investments to operate in Canada compared to less stringent jurisdictions. As reference point, none of the recent (last 40 years) projects involving salt roasting were financially successful on the long run, and only two remain currently in operation (Rhovan in South Africa and Largo in Brazil, while Vametco in South-Africa may be repurposed for primary production). The smelting option, which currently accounts for 73% of the world production, is hampered by its large construction cost, the structural weakness of the steel market, its technical complexity and its feeble economic outcomes. Consequently, almost every steel and vanadium smelting plan using intensive smelting in the world is currently troubled if not shut down, and no moderate fusion smelter have been constructed. Canadian smelters were contacted for toll smelting of the Lac Doré VTM, and offers were deferred. The problems of the smelting route relates to the vanadium market structure, which is dependent on steel consumption and production. As 73% of the world vanadium production comes as by-product of steel, vanadium pricing is regularly affected by dumping which in turn causes disruptions in primary production. Consequently, the VTM alkali roasting option for vanadium pentoxide production as well as the moderate or intensive smelting options for the production of iron, steel and vanadium pentoxide were disregarded by the current economic study.

In December 2016, VanadiumCorp initiated a partnership with Electrochem Technologies & Material Inc. (Montréal, Québec) to assess the metallurgical and chemical processing of the vanadiferous titanomagnetite from Lac Doré at Electrochem's facilities in Boucherville, Québec. The technology was first tested at the bench scale and then at prototype scale. The first test successfully produced a vanadium-rich solution while all the iron values were recovered as copperas (ferrous sulphate heptahydrate) along with titania-rich and silica by-products. The patent pending technology (US Provisional Patent Application US 62/463,411) is jointly owned by VanadiumCorp Resource Inc. (50%) and Electrochem Technologies & Materials Inc. (50%). Furthermore, the technology can be fully integrated vertically using the Canadian Patent 2,717,887 C issued to Electrochem Technologies & Materials Inc. for electrowinning metallic iron from copperas and regenerating sulfuric acid. The electrochemical process is convincing, producing 99.9% pure electrolytic iron and a vanadyl sulfate liquor. The process was evaluated by the first author, and, despite his initial scepticism, considered as technically realistic and promising, although not ready to be included in a preliminary economic assessment. Furthermore, concerns about the confidentiality of the process were raised, and it was considered strategic not to disclose details at the current level of development.

Consequently, the production model of the current PEA was adapted to the production of vanadiferous titanomagnetite concentrates only, which would be sold at realistic price to metallurgical processing plants. Specifications of the VTM concentrate are as follow:

- < 2% silica
- < 1% lime
- >85% -70 µm
- <1% moisture
- <0.2% metallic iron
- Insensitive to sulphur
- Technically insensitive to TiO_2, V_2O_3 and Cr_2O_3 abundance, although these may cause premiums or discounts on VTM price.

Nominal capacity of the project was selected at 100 tonnes of VTM per hour, or 876,000 tonnes per year. It would represent the equivalent of 16 million pounds of V_2O_5, plus approximately 500,000 tonnes of electrolytic iron and approximately 80,000 tonnes of titania-rich products. Such capacity matches the maximum capacity achievable with a roasting kiln in the conventional salt roasting route, or to the consumption of a single submerged arc furnace fed with pre-reduced metalized VTM (Midrex process). However, the proposed integrated metallurgical and electrochemical processes would require building an electrowinning facility about twice as large as the largest currently existing facility in the world, which is operated for copper cathode production.

Aside from the currently contemplated market, VTM concentrate is a commodity used for niche markets, and is not widely traded. Contrarily to titanium-free magnetite, VTM is mined in only a few locations in the world as feed for vertically integrated vanadium-steel smelters without being traded. Only limited comparatives are available to establish its market pricing:

- Ilmenite as for iron-titanium smelting or titanium pigment industry: US$100/tonne
- Micronized (-325 mesh) titanomagnetite for copperas production or as fillers for dense media separation (DMS) plants (US$200/tonne)
- Iron ore (magnetite): US$80/tonne

Ilmenite production is considered as the most realistic analogy, being mined in similar amount with similar process, to be used as feed for smelters located in industrialized countries. Micronized titanomagnetite for DMS plants is considered as a too small of a niche market, while iron ore it typically produced in much larger operations leading to significant scale saving. Consequently, the economic model is elaborated using a VTM selling price of US$100 per tonne, delivered (FOB) in a railcar in Chibougamau. Credits for vanadium content were not considered in pricing.

Since the main commodity targeted by VanadiumCorp, and the main justification of the project, is production of vanadium flow battery electrolyte, and since this niche market is dedicated to rapidly evolving technologies, the first author capped the life of the project to 20 years.

Mining is planned as open pit operation, with a linear pit of approximately 1800 metres in length, up to of 400 metres in width, and a maximum depth of 120 metres. Using a waste ratio of 1.34 and an average titanomagnetite grade of 26.6%, a mining rate of 7.6 million tonnes per year is calculated, for a mill feed of 3.25 million tonnes per years.

Mining operation can be contracted to a specialized mining contractor on a per tonne basis. A mining cost of 3.69$ per tonne was quoted for the operation, all inclusive of blasting, handling, hauling and maintaining, which was taken as such and not negotiated. Using such scenario, no capital investment is required for the mining operations, aside of pit preparation and support infrastructure (garages, etc.).

The deposit being located on a hillcrest, outlet of the pit is planned as being toward the lowlands to the north-west, through an existing gully between Eastern and Western deposits. That should minimize ramps and benches. Both waste rocks pads and tailing ponds are to be built on the flank of the hill, minimizing infrastructure costs and maintenance. Since only inferred resources are currently available, it is currently premature to elaborate a detailed mining plan.

Crushing, milling and beneficiation circuit was designed for an overall throughput of 100 tons of VTM per hour, for a construction cost of $131 million. It includes:

- a primary 500 tph cone crusher with screen classification;
- a secondary 300 tph gyratory crusher;
- a 500 tph primary dry magnetic separator;
- a 3.6 MW primary grinding circuit and screen classification;
- a LIMS rougher;
- a 3.5 MW secondary fine grinding circuit with cyclone classification;
- 3 stages LIMS cleaner circuit;
- a belt filter and a 100 tph dryer.

Operating cost of the mill is estimated at 29.75 $/tonne of VTM, including:

- Power consumption of 273 kWh/tonne.
- Power draw of 31.3 MW.
- Water consumption of 0.6 m^3 per tonne of VTM.
- 4.1 kg of milling media per tonne of VTM.
- 20 grams of flocculants per tonne of tails.
- 80 employees.

The following infrastructure will be required, for a construction cost of $89 million:

- Upgrading and maintaining a 35 kilometres long access gravel road.
- Construction of a 32 kilometres long 161 kV power line, plus sub-stations.
- A 21 hectare waste rock pad.
- A 19 hectare tailing and polishing pond.
- Water and sewage treatment plants.
- Total of 62,000 square feet of building.
- A 23,000 square feet VTM storage dome.
- 1.7 kilometres of rail spur, plus loading facility.

VTM will require to be trucked to a rail spur to be constructed near the former Gagnon Mill siding of the Cran division of the Canadian National Railway. Trucking is expected to be contracted out, at an estimated cost of 3.67$ per tonnes of VTM, to be conducted by

70 tonnes off-road covered hopper semi-trailer, of similar GVWR as those used by local forest industry.

Infrastructure maintenance and operation were included in milling and trucking operating cost. Estimation do not takes into account the eventual construction of adjacent BlackRock Metals mine. In such event, infrastructure cost and maintenance, such as road, rail and power line, could be shared.

Social and environment impacts were briefly evaluated. The following parameters should be considered:

- Former McKenzie Bay Resources and BlackRock Metals environmental assessment study did not indicated the presence of specifically sensitive habitat or ecosystem.
- Open pit operation, so a rehabilitation cost to be provisioned shoud be minimal.
- Forests were dominantly harvested in the last 40 years, and are not of present economic or recreational values.
- No major water plant is to be affected by the operation. Only lake Laugon, which is devoid of significant fish population, will be hampered. However, the Villefagnant stream is located to the north-west of the operation, which drains into Armitage and Doré lakes. Precautions in regard of spills and dam burst will be required.
- Tailings as well as waste rocks were tested as not being significantly acid generating. No lining of the pad or other precautions should be required. Since no acid should be generated, metal leaching should be minimal.
- The mine site is remotely located, away from any habitations. Noise, vibration and dust should not be of concern.
- No chemical aside of tail flocculants are used in the process. The entirety of the used water can be recycled, including steam from the dryer.
- No effluent is expected from the mill.
- Gas emission is limited to COX and NOX from internal combustion engines and blasting. Electric vehicle fleet can be considered, but was not here included.
- The project is located near the water crest between James Bay and St-Lawrence River drainage. This water crest also represents the limit between two jurisdictions, ruled by two different permitting regimes: the James Bay and Northern Québec agreement to the northwest, and the *Bureau des audiences publiques en environnement* to the south. The project and its entire infrastructure should be located and restricted on the north-west side of this water crest, in order to lay within the James Bay area.
- This area is regulated by the James Bay and Northern Québec agreement, binding the Cree Nation and the Québec government. The project is located

within Category III lands, meaning that the Cree relinquished their exclusive cynegetic and halieutic rights. However, the project will have to be accepted by the joint Cree-Provincial-Federal COMEX and COMEV committees for its approval.

- Chibougamau is a former mining town and the population is acquainted to mining activity and quite receptive to projects. Social acceptability should not pose issues.
- The project is located within Ouje-Bougoumou Cree traditional lands and trap lines, although some ambiguity remains in regard of claims from Mistissini community. Discussions with these communities are recommended in the short term. It is expected that these communities will likely be receptive to the project, if the project respect their expectation in regard of local benefits. The following requests are to be expected: Labour employment ratios, contracting preferences, business opportunities including participation in the project, and possibly a "royalty".
- Heavy traffic, about 40 truck-loads per day, is to be expected on service road, which is currently used by locals for recreational activities as well as forestry activities.
- Railway traffic will increase by about 28 car loads per day, or one block-train every two days. Such traffic will benefit other local industry by justifying the maintenance of the railway. No capacity issue is forecast as long as destination is not Grande-Baie seaport in Saguenay, even if the BlackRock Metals project goes into production.
- About 120 workers will be required to support the operation, which can all be drawn from local white and native communities.
- About $7 million per year will be paid as post-taxes wages to local worker, plus ancillary spending in local shops and business.
- About $12 million per year will be paid as taxes (municipal, provincial and federal) once initial investment is amortized, plus about $3.7 million dollars per year as income taxes on worker wages, plus $7.6 million for power consumption.
- Over its 20 years, it is calculated that the project will generates about $377 million in overall revenues for the governments in the course of the project life, and approximately $308 million in local salaries and local business.
- No royalties to native communities was included in the current study, since such numbers are not publicly available. Unverified information points toward a payment of 6-8% of the net pre-tax profits.
- The two chemical and electrochemical processes currently tested by Electrochem Technologies & Materials Inc. on behalf of VanadiumCorp would be the cleanest process for the production of vanadium chemical as well as for production of pure iron for the steel industry. As the process does not involve

pyrometallurgy and carbon reduction, it will generate almost no greenhouse gas emission as well as very little residues. The chemical and electrowinning plants can be built almost anywhere in North America, including adjacent to mining site, as long as sufficient and affordable electrical power and railway access is available.

Using the 100 tph VTM production scenario and a selling price of US$100 per tonne of VTM concentrate, a project life of 20 years and 100% equity financing, the project is valuated after taxes as follow:

IRR: 15.42%
NPV: $814 million
DNPV: $139 million at 10% discount and 2% inflation rate
Operating ratio: 2.30
Capital expenditures: $344 million

Discount rate of 10% is used, as being 5% above the usual mortgage interest from leading banks.

Taxes, removed from NPV, include the Provincial mining tax, the Provincial and Federal income taxes, the municipal estate taxes, and the various environmental taxes. Most of these taxes have variable rates depending on various parameters, which were taken into account in the model. Courtesy payments and royalties to first nations are not included.

Sensitivity analysis suggests the project resilience to most influential factors:

- Resources were calculated for a maximum pit depth of 100 m., 110 m., 120 m. and 200 metres. A quite linear relation is noted between pit depth, available inferred resources and pit ratio. VTM abundance and V_2O_5 are rather insensitive to pit depth.
- The effect of pit ratio upon the economic model is tested from 0.8 to 1.67, with the base case at 1.34. The worst case scenario, a 1.67 pit ratio equivalent to the one obtained from mining completely the resources, would reduce the IRR at 14.3%, still to be considered attractive. This analysis suggests that the project can withstand errors on assumptions made for the pit ratio..
- Variation of VTM abundance is tested from 20% to 35%, although apparently not very sensitive in regard of resources. Using base case scenario regarding stripping ratio, a drop to 22% VTM grade is needed to cause the IRR to fall below 10%.
- Mining and milling operation costs, on “a per tonne” basis, were fluctuated from -30% to +30%. Their combined increases of +30% drops IRR to 13.2%, maintaining attractive economics and suggestive of resilience to operating cost fluctuaitons.

- Capital requirements were fluctuated from -30% to +50%, in which the worst scenario decrease IRR to 9.8%, indicating resilience to construction overrun.
- Selling price of VTM is the most influential parameter of the economic model. While base case scenario is US$100/tonne, the price cannot be reduced below US$83.50/tonne in order to maintain IRR above 10%. Further reduction in price render the project unattractive, while negative cash flows start being generated at price below US$62/tonne.
- Fluctuations of currency exchange rates has a complex effect, most operating cost being in Canadian dollars while selling price is stated in American dollars. From a base case scenario with a ratio CAD/USD at 0.75, IRR drops to 7.9% at parity between both currencies.
- The effect of the production rate of VTM is complex to model, as it is impacted differently on both operating cost, capital requirement, and mining life (assuming 99.1 mt of resources). Scaling effects were approximated from 17 tonnes per hour to 300 tonnes per hour, and suggest that IRR is best between 75 and 160 tonnes per hour, the 100 tonnes scenario being near optimal. The model takes into account the maximum availability of 99.1 mt of resources, and approximately compensate for pit ratio variation with required resources. Optimal rates of returns are obtained at 120 tonnes per hour of VTM.
- Effects on IRR on equity financing using various equity-debt ratios were calculated. Such effects are sensitive to interest rates on mortgage, which was tested as well. Effects are negligible up to 40% debt financing, above which the model become very sensitive to interest rates. A turning point is reach at about 18% interest, below which it is beneficial to finance as much as possible as debt.

Considering the aforementioned economic model, the project is sufficiently realistic to justify the completion of a feasibility study, and it is recommended to VanadiumCorp Resource to proceed with the following, to be completed within 2 years:

- Initiate a drilling program of 17,000 metres, at the anticipated cost of $5 million, to properly define mineral resources to a depth of 120 metres, with a sufficient definition to obtain a minimum of 65 million tonnes of indicated and measured resources.
- Pursue the development of the two metallurgical and electrometallurgical processes for the production of vanadium chemicals and electrolytic iron, including a pilot plant testing of 20 tonnes of VTM. A budget of $2 million must be allocated.
- Initiate the environmental and social impact assessment as soon as possible, and initiate discussion with local and native communities. A budget of $7.5 million must be anticipated up until permitting.

- Once the aforementioned being completed, initiate a feasibility study of the project including the vanadium electrolyte and electrolytic iron production scenarios. A cost of $5.5 million must be anticipated.

ITEM 2: INTRODUCTION

VanadiumCorp commissioned IOS Services Geoscientifiques ('IOS') to complete a Preliminary Economic Assessment (PEA) based on a model of vanadiferous titanomagnetite production to be disclosed into an independent Technical Report ('the report') in compliance with NI 43-101, form F-1, for their **Lac Doré** Vanadium Project ***(figure 1)*** and to coordinate the involvement of the various specialists required to complete the report. The report is a requirement according to 4.2j-i of the NI 43-101 rules and policies, following the disclosure of preliminary economic assessment in a press-release dated November 15, 2017.

Initial discussions with VanadiumCorp regarding the mandate to conduct such a preliminary economic assessment began in October 2015. The mandate evolved through time from an integrated model including mining, beneficiation, alkali roasting and hydrometallurgical recovery of high purity vandium chemical, to vanadium recovery by moderate smelting and slag roasting, to electrochemical vanadium recovery, and ultimately to the sole production of vanadiferous tianomagnetite concentrate. This last consideration encompasses the results that were delivered on November, 2017, and comprise this report.

AUTHORSHIP

Responsibility for compilation and assembly of this report is taken by Mr. Girard, P.Geo., CEO and general manager of IOS, assisted by his company's clerical and technical support staff charged with specific tasks. Mr. Girard subsequently engaged Mr. Éric Larouche, Mr. Jonathan Lapointe, and Mr. Christian D'Amours for their respective specialties in contributing to the PEA. Mr. Larouche has worked in numerous mining operations in his career and has extensive experience pertaining to private engineering practices. Mr. Lapointe worked as a process engineer for 15 years in various mines in the Chibougamau area prior to establishing Metchib Inc, which encompasses a metallurgical laboratory and pilot plant testing facilities. Mr D'Amours has 19 years of experience in resource estimation, either in large corporations or as a consultant through Géopointcom.

The authors, by virtue of their education, experience and professional association, are considered QPs as defined in the NI 43-101 and are members in good standing of appropriate professional institutions and/or associations. Author responsibilities for specific report Items are listed below:

Author	Company	Report Items
Rejean Girard, P.Geo.	IOS Services Geoscientifiques	1,2,3,4,5,6,7,8,9,10,11,12,13, 15,16,19,20,22,23,24,25.26.27
Éric Larouche, P.Eng.	IOS Services Geoscientifiques	1, 18, 21
Jonathan Lapointe, P.Eng.	Services Métallurgiques Metchib Inc.	1,17, 21
Christian D'Amours, P.Geo.	Géopointcom Inc.	1,14

The report is based on publicly available information, including scientific reports, government databases and exploration assessment files, as well as proprietary datasets and on the first-hand knowledge of the deposit. It represents an opinion based on professional judgement and reasonable care. The conclusions are consistent with the level of details and accuracy needed for a preliminary economic assessment, in perspective of the level of decision and the related risk to be taken to advance the project to prefeasibility and to complete resource definition. The current conclusions and estimates are not suitable to support a decision in regard of construction or production. Conclusions are based on the information available at the time of writing, which are not sufficiently detailed to provide accurate predictions, notably in regard of resources.

The authors authorize VanadiumCorp to file the report with the *Autorité des marchés financiers du Québec*, the *Ontario Securities Commission*, the *British Columbia Securities Commission*, the *Toronto Stock Exchange* and SEDAR. They authorize this report to be released into the public domain, and allow the use of excerpts by third parties so long as such excerpts do not alter the meaning of the content of this report.

The report presents the current status and all available information on the property for the purposes of making unbiased information available to shareholder's or potential investor's.

SOURCES OF INFORMATION

The geoscientific information used in the preparation of this report was extracted from various government reports, predominantly from the *Ministère de l'Énergie et des Ressources naturelles du Québec (MERNQ)*, internal and consultant reports, corporate documents, from former SOQUEM archives, various documents obtained from McKenzie Bay Resources, and from public reports and data produced by IOS under the author's supervision on behalf of McKenzie Bay Resources and VanadiumCorp Resource. All geological data available to VanadiumCorp were provided to the author, in various formats. All of the available data was reviewed by the first author. Metallurgical data were reviewed in detailed by Mr. Todd Richardson, professional chemical engineer with extensive expertise in vanadium processing. Aspect related to crushing, milling and beneficiation were further reviewed by Mr. Lapointe, co-author of the report. Most information released in the present report is publicly available, although some reports related to metallurgy are proprietary and confidential.

Archives of SOQUEM, including the work conducted by the former *Ministère des Mines du Québec,* were retrieved by the author in 1997, while he was acting on behalf of McKenzie Bay Resources. All geological information from McKenzie Bay Resources was collected by the author's team, and is considered as reliable. Information obtained from VanadiumCorp and its precursor was checked in detail from original documents and drill cores, if available, or conducted by the author's crew.

All agreements and contracts related to the project, exclusive of those related to strategic alliance made with third parties in regard of sales of product or strategic alliances, were provided by VanadiumCorp. Agreements relating to former ownership of the deposits were provided to the author by respective parties through time, reviewed in detail, and are now considered obsolete. The good standing of claims was verified with the *"Service des titres miniers"* from *"Ministère de l'Énergie et des Ressources naturelles du Québec"* (MERNQ) on December 12th, 2017.

The underlying data supporting the statements made in this report have been verified for accuracy and completeness by the first author. No meaningful errors or omissions were noted or are to be expected, within the limitation stated in the report. The first author has personally evaluated the validity of the available sources of information, including those archived and/or listed in the *References* section, as well as unpublished information acquired or archived by IOS.

The first author and his firm have been intermittently involved with this property on behalf of previous owners since 1997. It is the first involvement of Mr. Lapointe, Mr. Larouche and Mr. Vachon as well as Ms. Paquette, and the second involvement of Mr. D'Amours and his firm with the project or the client.

PREVIOUS TECHNICAL REPORTS

The current preliminary economic assessment draws upon information described in the previously published resource estimates (Girard and D'Amours, 2015), dated on May 21st, 2015, available on Sedar, which resource estimates were as such for the purpose of the model invoked in the current assessment. The resource estimate draws itself upon information described in a previous report written by the first author on behalf of

VanadiumCorp Resource Inc., dated on June 18th 2014, and revised on November 25th 2014, available on Sedar.

No previous technical report was issued on behalf of VanadiumCorp's former management on the project.

MANDATORY FIELD VISIT

The last mandatory visit made by the first author,Mr. Lapointe and Ms. Paquette for the current report was on July 12, 2017 (***picture 1***). Most of work sites led by VanadiumCorp were visited, including stripping and drilling sites. The first author also has extensive knowledge of the regional geology and logistics pertaining to the project. Mr. D'Amours and Larouche did not visit the property.

Picture 1*: Picture of the first author (centre) and Mr. Jonathan Lapointe (left) taken during their mandatory field visit, standing on one of the McKenzie Bay trench.*

INDEPENDENCE

All of the individual authors, as well as the firms for who they work, are considered thoroughly independent of VanadiumCorp Resource according to the provision listed in the National Instrument 43-101, section 5.3.

The ***Lac Doré*** and ***Lac Doré North*** properties were acquired ("staked") by Novawest Resources, former name of VanadiumCorp Resource, in 2008 under the recommendation of Mr. Glen McCormick, a local prospector, without any involvement by the authors. The first author obtained various small mandates from VanadiumCorp Resource, mainly regarding claim maintenance and former NI-43-101 reports. The mandates obtained by the other authors were received from the first author on behalf of VanadiumCorp, which they obtained without solicitation. The ***Lac Doré North Extension*** property was acquired by VanadiumCorp under the first author recommendation in order to secure land for infrastructure.

UNITS OF MEASUREMENT

Unless otherwise specified, all units of measurement (distance, area, etc.) are metric, with the exception of "tons"[1] and "miles"[2] and all monetary units are expressed in actual Canadian dollars. See ***table of content*** at the beginning of report for a list of abbreviations.

Units:

A:	Acre
Ha:	Hectare
tph:	Tonnes per hour
tpd:	Tonnes per day
tpy:	Tonnes per year
kV:	Kilovolt
kWh/tonne:	Kilowatt-hours per tonnes
MW:	Megawatt
Kg:	Kilogram
Km:	Kilometre
M:	Metre
µm:	Micrometre
km^2:	Square kilometre
masl:	Metres above mean sea level
T:	Metric tonnes (1000 kg or 2200 pounds)
Kt:	Kilotonnes
$:	Canadian dollar
US$:	United States dollar
ppm:	Parts per million
% V_2O_5:	Weight percent vanadium pentoxide

***Table 1**: Glossary of units of measurement.*

[1] "Tonne" refers to metric tonne (1000 kg or 2200 lbs) and is used throughout the text and calculation. Commodity price are usually stated as "ton" referring to imperial short ton (2000 lbs), and converted into tonne in the current report.

[2] "Miles" are still in use by railroad industry to indicates distances or position along tracks, and correspond 5280 feet or approximately to 1.6 Km.

ITEM 3: RELIANCE ON OTHER EXPERTS

The authors have relied on technical data from government publications, assessment files and previous work conducted by prior operators for some sections of this report. Critical components include historical assessment reports of the property, internal company reports and government (Québec and Canada) publications and websites. Mineral resource estimates included in this report are based on historical data publicly available as assessment files, plus a limited amount of data supplied by VanadiumCorp and by IOS Services Geoscientifiques Inc. Information in regard of cost estimates, consumable and equipment costs were obtained from various provider's websites, discussions or quotes.

Economics of vanadium production from VTM mining and alkali roasting with the use of a conventional rotary kiln was evaluated with the help of Mr. Todd Richardson. Mr Richardson is the chief Technical Advisor for VanadiumCorp, and thus not considered as independant from VanadiumCorp. He previously worked as general manager at Windimurra (Midwest Vanadium Pty Ltd) and at the Evraz Stratcor facility (Hot Springs, Arkensas). The authors have reviewed the private and public data and believe them to be accurate and reliable in their collection, disclosure and analysis of results and therefore can be relied upon and used for project evaluation. In cases of uncertainty, the authors have qualified that information with accompanying clarification and explanation.

Mining cost estimates were provided by Mr. Bernard Vachon, in the form of a quote from Dynamitage TCG Inc, a reputed mine and quarry contractor (Dionne et Vachon, 2016), and revised by the first author. Finally, a market study provided in item 19 was prepared by M. Terry Perles, a reputed metal broker and Advisory Board member of VanadiumCorp; liability for this section is accepted by the senior author.

Recommendations in regards to permitting, environmental and social impacts (Item 20) were provided by Ms Sylvie Paquette, biologist and eco-consultant at IOS Services Géoscientifiques Inc under the supervision of the Mr.Girard.

The authors, not experts in legal matters, are required by NI 43-101 to include a description of the property title, terms of legal agreements and related information found in Item 4 of the report. The authors have relied on property agreement information provided by VanadiumCorp. Claim status information was obtained from *Gestim*, the on-line registry of the Quebec's Department of Natural Resources, which is considered as of legal value. A review of the claim title information was conducted by the authors on December 12th, 2017. This report was prepared on the understanding that the property is, or will be, lawfully accessible for evaluation, development, mining and processing.

ITEM 4: PROPERTY LOCATION AND DESCRIPTION

CLAIM LIST

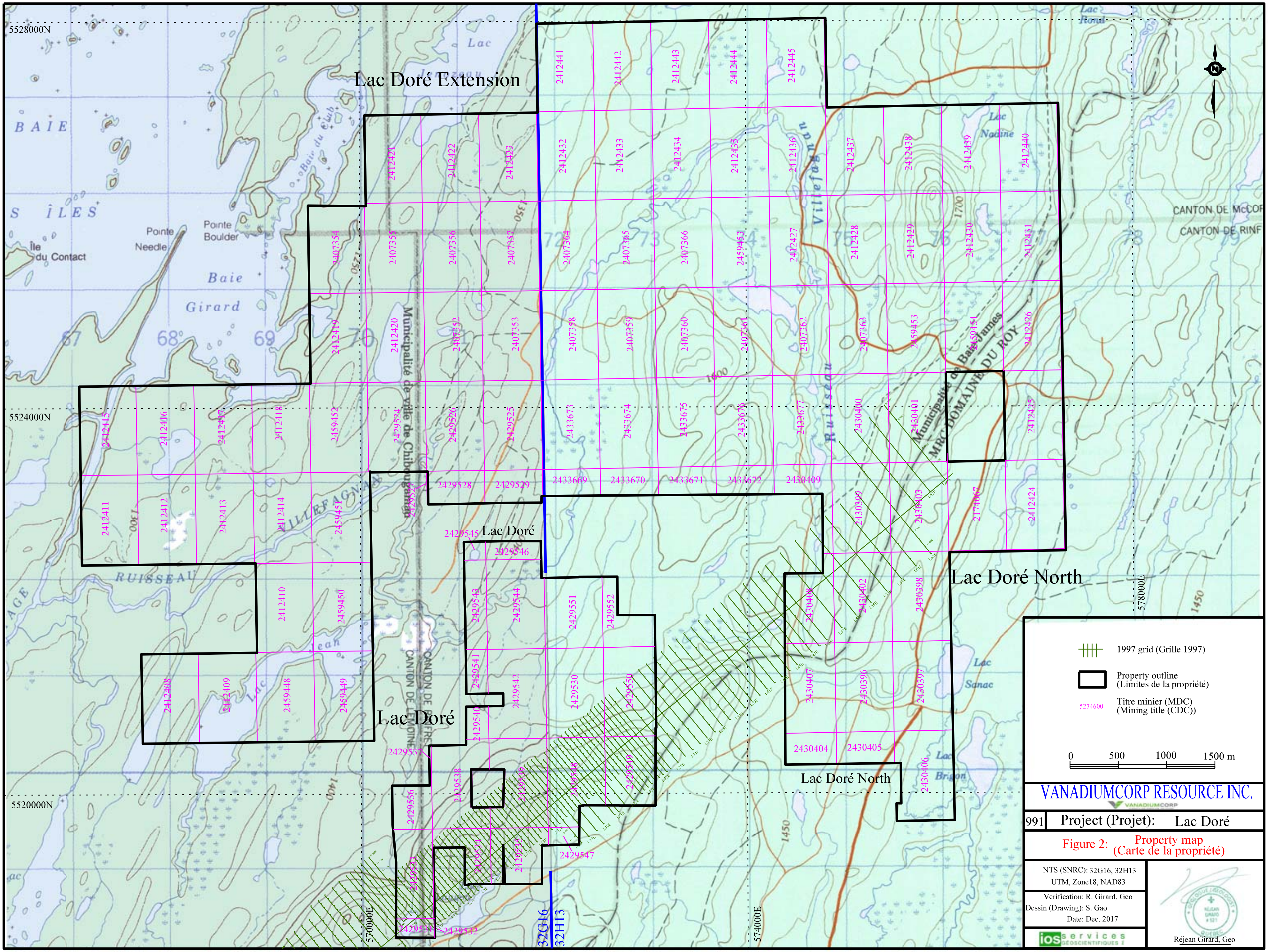
The claim list was downloaded by the author from the *MERNQ* on-line registry, on December 12th 2017. This list is provided in ***appendix 1***, along with assessment credits and obligations. All the titles are duly registered under the name of VanadiumCorp Resource (Intervenant #93181). A claims map is provided in ***figure 2***.

The three administratively distinct properties, **Lac Doré**, **Lac Doré North** and **Lac Doré North Extension**, consist of 114 map designated cells, mostly 55.5 hectares each. Map designated cells *"CDC"* are mining titles which are designated on map through the Gestim web-based system, according to a pre-established grid measuring 30 seconds of longitude by 30 seconds of latitude.

The properties used to include 81 conventional claims posted in the field. These were converted into map designated cells by the Minister in July 2015 (*Renvois au Ministre,* dossier 32-9502 to 32-9510*)*. For such, where former posted claims represented only a portion of the pre-established grid, the area of the cell was divided according to the outlined agreed between owners VanadiumCorp and its neighbour (BlackRock Metals). These outlines are currently irrevocable, defined by longitude-latitude coordinates, converted from UTM measurement obtained from GPS survey or land surveyor measurement. Posts are still visible in the field, but are obsolete and without any legal value. Original posted claims were acquired in numerous phases by VanadiumCorp, starting in 2007 and ending in fall 2014. In the course of the conversion process, anniversary dates and assessment credits were reset by the Minister. Posted claims are remnants from the former mining regime, all of which being currently converted into map designated cells in the area. No claim boundary conflict is possible anymore.

AREA AND EXTENT

The project covers two discontinuous groups of claims, **Lac Doré** to the southwest and **Lac Doré North** plus **Lac Doré North Extension** to the east and north. These two blocks are separated by a one kilometre gap to the east and 400 metres to the north of Lac Doré. They comprise a total of 114 titles for 5,286.69 hectares (52.86 km^2 or 13,064 acres). Of these, 23 former posted claims, for 648.82 ha, are attributed to **Lac Doré** property, 15 titles are attributed to **Lac Doré North** for 701.9 ha, and 76 map designated cell totalling 3935.93 ha belonging to **Lac Doré North** Extension as provision for infrastructure. These claims extend over 4.5 kilometres along a northeast-southwest axis



Lac Doré Extension
Lac Doré
Lac Doré North
Lac Doré North
Lac Doré
5528000N
5524000N
5520000N
570000E
574000E
578000E
32G16
32H13
BAIE
S ÎLES
Pointe Needle
Pointe Boulder
Île du Contact
Baie Girard
Baie du Club
Lac Nadine
Lac Sanac
Lac Brigon
Lac Rond
Ruisseau Villefagnan
RUISSEAU
Municipalité de ville de Chibougamau
Municipalité de Baie-James
MRC DOMAINE DU ROY
CANTON DE McCOR
CANTON DE RINF
CANTON DE LEMOINE
CANTON DE RINFRET
1997 grid (Grille 1997)
Property outline (Limites de la propriété)
5274600 Titre minier (MDC) (Mining title (CDC))
0 500 1000 1500 m
VANADIUMCORP RESOURCE INC.
991 Project (Projet): Lac Doré
Figure 2: Property map (Carte de la propriété)
NTS (SNRC): 32G16, 32H13
UTM, Zone18, NAD83
Verification: R. Girard, Geo
Dessin (Drawing): S. Gao
Date: Dec. 2017
IOS services géoscientifiques
Réjean Girard, Geo

of the mineralized zone, encompassing part of the former Western deposit, the entire Eastern deposit and part of the North-Eastern deposits.

LOCATION

The **Lac Doré** property is located in Lemoine and Rinfret townships, straddling NTS map-sheets 32G/16 (Chibougamau) and 32H/13 (Lac Mitshisso), about 30 km southeast of the town of Chibougamau (Québec) and 50 km by road (***figure 1***). Its boundaries are latitudes 49°48'54" and 49°54'00" North and longitudes 73°55'29" and 74°04'00" West WGS-84 (UTM-X: 567053 to 577250, UTM-Y: 5518521 to 5528013, NAD-83).

CLAIM STATUS

Claims are valid until their renewal anniversary, the next group being on April 20th, 2018. ***Table 2*** provides the anniversary dates, required credits and renewal fees. A total of $458,043.37 in assessment credits is currently available, although not evenly distributed. Renewal fees are of $6,650 per two years period, plus management cost.

Exploration titles in Québec are required to be renewed every two years, sixty days prior to their anniversary or up to their anniversary with a penalty. A renewal fee is needed at each renewal. Renewal also requires assessment credits accumulated from exploration expenditures. The management rules of assessment credits are complex. There are currently ample credits to renew **Lac Doré** and **Lac Doré North** properties, but not sufficient credits are available for renewal of **Lac Doré North**.

Property	Titles	Surface	Available Credit	Required Credit	Renewal Fee	Next renewal
Total	114	4,842.64 ha	$458,043.37	$19,402.50	$6,648.54	Sept. 21, 2016
Lac Doré	23	648.82 ha	$451,172.72	$19,402.5	$1,129.50	June 23, 2018
LD North	15	701.94 ha	$126 579.05	$15,502.50	$867.39	April 20, 2018
LDN Ext	76	3,935.93 ha	$5,353.16	$56,095.00	$4,651.60	July 15 2018

***Table 2**: Claim status and expenses.*

STAKING HISTORY

The first claims on ***Lac Doré North*** property were acquired by post staking in 2007, to cover the North-Eastern Extension of the deposit. The rest of the claims within **Lac Doré** and **Lac Doré North** properties were acquired between 2007-2008, when the claims were alloewed to lapse by McKenzie Bay Resources. The **Lac Doré North Extension** was acquired in 2014-2015, under the recommendation of the first author, in order to accommodate eventual infrastructure.

CLAIM IRREVOCABILITY

Lac Doré and ***Lac Doré North*** properties are made of map designated cells, the validity of which cannot be challenged by a third party, and are irrevocable by law, as long as renewal obligations are fulfilled by the owner. Claim posts, still visible in the field, are obsolete and of no legal value.

SURVEYING

As properties are map designated, their boundaries are defined by coordinate, and no land surveying is needed to certify their validity and field location.

EMBEDDED CLAIMS

Two adjacent isolated cells, belonging to BlackRock Metals (CDC-2427688 and CDC-2427689) are enclaved within ***Lac Doré*** property, close to its South-Western end and are due for renewal on March 30th, 2019.

An isolated cell (CDC 2429553) belonging to VanadiumCorp lies within BlackRock Metals property, very close to their Armitage deposit. This cell, to be renewed on February 25, 2020, is excluded from statistics of the project.

RELATION TO ADJACENT BLACKROCK METALS PROPERTIES

The **Lac Doré** property is totally surrounded by BlackRock Metals claims. To the North and Northwest, only a narrow strip (400 metres) of claims belonging to BlackRock Metals separates it from the ***Lac Doré North*** property. To the Southwest, the limit of **Lac Doré** property is very close (100-120 metres, corresponding to the irregular claim 5277107) to the outline of the mining lease acquired by BlackRock Metals, covering their South-western deposit.

The western border of **Lac Doré** property is interlocked with BlackRock Metals property. These imbrications are straddling the Western deposit and are a clear hindrance to its development. BlackRock Metals CDC-2430231 is an irregular cell which protrudes into the VanadiumCorp property, covering a 400 metres stretch of the Western deposit and precluding the inclusion of about half the deposit into resource definition. Cell CDC-2430231 is an irregular cell with a thin sliver wedged within VanadiumCorp cell CDC-2429535, which is a hindrance for VanadiumCorp pit design. Finally, CDC-2430235 and

2430236 form another embayment within VanadiumCorp located north of the Western deposit, which is not a hindrance. Any potnetial agreement to be made between VanadiumCorp and BlackRock to regularize the claim boundary will have to comply with the pre-established 30 second of arc cell grid.

BlackRock Metals owns a large continuous property, encompassing a long stretch of the titanomagnetite bearing layers. The property extends for about 14 kilometres to the southwest of VanadiumCorp, including the South-western deposit, Armitage deposit, and a thin layer extending close to the Corner Bay mine. BlackRock Metals property also includes a 2 kilometres long stretch of the North-eastern Deposit, separating the **Lac Doré** and **Lac Doré North** properties.

HISTORY OF THE PAST AND PRESENT PROPERTIES

Historical claims over the Lac Doré vanadium deposit and its extensions have a long and protracted history spanning half a century, with numerous interwoven liens, involving 13 different companies, entities or individuals, and more than 30 transactions. A review was offered in Girard (2014).

The initial Lac Doré property was first staked in 1966 on behalf of the Québec Government. These 21 "K" posted claims, 16 hectares each, encompassed the East and West deposit. On July 6th 1977, the ownership of the claims was transferred to SOQUEM, a mineral exploration Crown corporation. In 1997, the property was granted for option to McKenzie Bay Resources, and completely sold to this group in 1998. In 1999, the project was granted for option to Cambior Inc., who relinquished the option in 2000. In 2002, claims ownership was passed to Lac Doré Mining Inc., a fully owned subsidiary of McKenzie Bay International. These claims were accidentally allowed to lapse in 2007, making ownership and all liens obsolete. The land became available for staking.

In 2008, Lac Doré Mining Inc. sold their remaining properties as well as all their intellectual properties to BlackRock Metals Historical core drilled within actual VanadiumCorp properties is currently stored by BlackRock Metals and it is unclear if VanadiumCorp has any right over this core.

STATUS OF EXPLORATION EXPENDITURES

Until now, with the exception of the acquisition and claim management costs, total exploration expenditures incurred on the properties by VanadiumCorp is estimated by the first author to be less than $1 million.

REMAINING ENCUMBRANCES

To the first author's best knowledge, all encumbrances accrued from Lac Doré Mining and previous owners are currently obsolete, due to the expiry of the claims and legitimate staking by VanadiumCorp. No liens or royalties are reported by VanadiumCorp administration, and no hypothec was recorded at *Régistre des hypothèques du Québec*. An independent verification of all the potential encumbrances was not performed and as such, this report does not represent a legal title opinion in this regards.

To the first author's best knowledge; there is no legal issue to VanadiumCorp which could lead to sequestration of the property.

RIGHT OF ACCESS

The properties straddle territories of the Chibougamau municipality, the James Bay municipality (MBJ) and the Domaine-du-Roy regional municipality (MRC). This partition implies that these various jurisdictions will need to be addressed regarding the issuance of permits, according to their respective regulations.

The deposits straddle the limits of the Chibougamau municipality and the James Bay municipality. Any infrastructure construction, such as camps, sewage, and roads, needs to be permitted by the respective municipal authorities in Chibougamau-Chapais, Matagami or St-Félicien.

About 20% of the claims of the **Lac Doré North** property are located to the south of the water crest dividing the James Bay and St-Lawrence watershed. The area southeast of the water crest is located in non-organized territories (*"Territoires non-organisés"*) managed by the Domaine-du-Roy regional municipality (*"MRC Domaine-du-Roy"*) in St-Félicien.

There is nothing preventing a VanadumCorp from accessing their properties. The only permitting required relates to regulations regarding logging activity and access to wet lands. Notice that different permits, and slightly different permitting procedures, are required for intervention in *James Bay* or *Domaine-du-Roy* jurisdictions. Roads leading to the properties are in the public domain with no access restrictions, although they are not regularily maintained.

As mineral right owner, VanadiumCorp does not hold any surface rights. However, since the property is located on public lands, the claims grant a right of first refusal to obtain such surface rights within the property when required.

The property is straddling hunting and fishing zones 17 and 28. Exclusivity is not granted to outfitters or to the First Nations. No outfitters' camp is known to the first author in the vicinity, and no hunting or fishing cabins were noted within the property.

VanadiumCorp does not retain any rights to hydraulic, forestry, cynegetic or halieutic resources. There are no rivers with hydraulic potential in excess of 225 kW within or near the property, to which restrictions could apply.

FIRST NATIONS

The area is located within the Eeyou Istchee-Baie James territory, regulated by the James Bay and Northern Québec Agreement *("Convention de la Baie James et du Nord Québecois")* as well as the subsequent *"Paix des Braves"* treaty between the Québec Government and the Cree Nation. It is indicated as "*Terres de Catégories III"*, and free of encumbrances relating to exploration activities. The deposit is located within traditional trap line n^{o} O59, belonging to Mr. Matthew Wapache Sr. from Ouje-Bougoumou, except for its north-eastern limit which lies in trap line n^{o} O57, belonging to Mr James B. Wapache from Ouje-Bougoumou. According to the "*Paix des Braves"* treaty, any intervention affecting traditional activities, such as logging, needs approval from the trap line tallymen.

About 20% of the claims of the **Lac Doré North** property are located to the south of the water crest dividing the James Bay and St-Lawrence watershed. The area southeast of the water crest is located in non-organized territories (*"Territoires non-organisés"*) managed by the Domaine-du-Roy regional municipality (*"MRC Domaine-du-Roy"*) in St-Félicien. This area is not included in the James Bay and Northern Québec Agreement, and therefore falls under the general regulation of the *Ministère de l'Énergie des Ressources naturelles du Québec* relating to forestry and mining, and under the general regulations of the *Ministère du développement durable, de l'environnement et de la lute au changements climatiques du Québec* (MDDELCC) pertaining to environmental issues. This area lies within the Nitassinan, the traditional Innu (*"Montagnais"*) territory. A treaty, named the "*Approche commune"* is currently under negotiation between the Innus, the Québec and the Canadian governments.

VanadiumCorp is required to inform and consult with the First Nation communities as well as with the local tallymen (i.e., Mrs. Wapache) concerning any planned exploration work, in order to minimize interference with traditional trapping, hunting and fishing activities. In the event of the construction of the mine, the project will be submitted to approbation by First Nations. The Cree Nations are generally receptive to similar business opportunity.

LEASES

There is currently no surface lease or private land within the perimeter of the properties. No "*bail non-exclusif sur les ressources de surface"*, or lease for sand and gravel, is currently valid within the property, although gravel pits are present. No mining lease or any other lease in regards to mineral resources was ever active within the property. No evidence of any undeclared mineral exploitation or squatters was noted by the author.

PERMITTING

With respect to the exploration work, permitting is required for:

- The right to establish a temporary exploration camp within the property is granted by the mining law. However, permits are required for construction from the James Bay Municipality, MERN and MDDELCC. The camp must be compliant with the MDDELCC regulations, CNESST regulations and MAPAQ regulations.
- Logging is required in order to access drill site and clear drill pads, which needs to be requested from the forestry department of the *Ministère de l'Énergie et des Ressources naturelles du Québec*. For such, the Minister must obtain approval from the Tallymen, according to the "*Paix des Braves"* and if one considers that less than 90% of the forest within the trap lines were harvested, no difficulty is expected.
- Trenching in excess of 50 square metres requires a special permit from the Environment ministry (*MDDELCC*), and a rehabilitation plan may be requested.
- Extraction of more than 50 tonnes of rock from a claim requires a special permit from the Natural Resources Department. Although no difficulty is expected, there may be a request for a restoration plan.
- Permission to drill on lakes is requested from Environment Canada. No difficulty is expected.

A complete review of the requirements in regard of permitting for the development of the project is offered in ***Item 20***.

ENVIRONMENTAL LIABILITIES

To the first author’s best knowledge, there are two known environmental liabilities left by McKenzie Bay Resources. These liabilities are not legally transferable to VanadiumCorp, although a proactive attitude is expected. The first one is the reclamation plan in regard of stripping done in 1997. A set of 36 trenches, for a total length of 8538 metres, of which 32 are located on the actual ***Lac Doré*** property, were dug on the deposit. Since this stripping exceeded the 10,000 cubic metres limit, McKenzie Bay Resources was requested to file a reclamation plan in order to obtain its permit. According to this plan, McKenzie Bay Resources had to backfill any digging in excess of 1 metre depth, and to replace top soil upon it. Second, McKenzie Bay Resources had the liability in regard of a surface lease for its Laugon Lake camp. Thus, they were expected to clean the site, remove septic tanks and reclaim any soil contaminated by hydrocarbons. The camp site was cleaned by BlackRock Metals, with the exception of the septic tank removal and contaminated soil remediation. The cost of the trenches rehabilitation was estimated in 1997 at $18,510, or $35,000 in today's dollars.

ENVIRONMENTAL RESTRICTIONS

There is no sensitive breeding or spawning habitat known to the first author or reported in the former McKenzie Bay Resources environmental assessment study. There is no area where mining activity is restricted in the vicinity of the project, the nearest ones being the urbanized part of the town of Chibougamau and the *"Catégorie I"* land from Ouje-Bougoumou and Mistassini.

The Ashuapmushuan wildlife reserve *"Réserve Faunique de Ashuapmushuan"* is located about 20 kilometres to the south of the property, while the Assinica, and Albanel-Mistassini-and-Waconichi-Lakes wildlife reserves *"Réserve faunique d'Assinica et des Lacs-Albanel-Mistassini-et-Waconichi"*) is located about 40 kilometres to the north. There is no severe restriction with respect to exploration activities related to these wildlife reserves which could affect the project. A series of wildlife habitats (*"Refuges biologiques"*) are withdrawn from mineral exploration about 11 kilometres to the northwest, which should not be considered as a hindrance.

Any mining or industrial activities conducted near a tributary to Chibougamau Lake, such as near the Armitage Lake, may face opposition from native communities or environmentalists.

HISTORIC ENVIRONMENTAL IMPACT STUDY

In 2002, McKenzie Bay International, the parent company of McKenzie Bay resources, commissioned Groupe-Conseil ENTRACO Inc. ("*ENTRACO*") to perform an environmental assessment. This assessment included numerous aspects, among which a social and economic assessment, ecotoxicity, and baseline survey, with respect to surface water quality, biological sensitivity, and more for the area covering the main deposit as well as the surrounding area affected by infrastructure. No natural contamination by vanadium was detected. This element is considered to be sequestered in minerals and practically insoluble in water, does not significantly bioaccumulate and is of low ecotoxicity. Some aspects of this study, especially those related to the access corridor, were included in BlackRock Metals environmental study, and covered by their authorization certificate granted by the *MDDELCC.* It should be considered that this impact study predates the *“Paix des Braves*” treaty, and that numerous aspects of the social impacts on First Nations are potentially obsolete. A detailed review is offered in Item 20.

The adjacent project currently under development by BlackRock Metals obtained its certificate of authorization “*CA*” from the MDDELCC. The certificate authorized the construction of a “12,000 tonnes per day mining operation”, a mill, a rail spur to the project, plus all required infrastructure. The project scale was downsized since then, but the certificate is still valid for the aforementioned volume. As the effects of subsequent project are additive, BlackRock Metals certificate may impair the authorization of VanadiumCorp certificate if cumulate emission exceeds regulation, regardless if BlackRock project is developed or not.

There is no exceptional environmental restriction attached to the territory of the **Lac Doré** Vanadium Project. Only the usual *MDDELCC* rules and items included in the James Bay and Northern Québec Agreement apply. Within the James Bay territory, a mining project approval protocol is established, under the joint Provincial-Federal-Cree *Comev* (*Comité* d’évaluation) and *Comex (Comité d’examen des repercussions sur l’environnement et le milieu social)* reviewing committees.

The author did not observe any exceptional ecosystems within the property, such as a full-grown ancestral forest or white cedar strands.

ADEQUACY OF SIZE

The property of the ***Lac Doré*** Vanadium Project is of adequate size for an eventual mining operation. Additional ground was acquired to the north in this respect, separated from the deposit by a single claim-wide strip belonging to BlackRock Metals that does not preclude access.

ITEM 5: ACCESSIBILITY AND PHYSIOGRAPHY

PHYSIOGRAPHY

The ***Lac Doré*** deposit is located on a north-easterly trending hill culminating at an elevation of 530 metres, limiting the Lac Doré lowlands to the north which have an elevation of 410 metres. A relief, reaching 120 metres, is therefore present at the site. The mineralized zone extends parallel to the stratigraphy, as expressed by the crest of the elongated hill *(**pictures 2, 3**)*.

The property is located along the line of height of land between the St-Lawrence River to the South and James Bay to the North. Drainage to the north of the water crest flows toward Chibougamau Lake, via Villefagnan and Armitage rivers. Drainage to the south of watershed flows toward Lac St-Jean, by way of the Boisvert River. No large lake is present on the property, the largest being Laugon Lake to the Southwest. The property is well drained, with limited bogs and swamps on its southern limit.

Picture 2: *View from the East deposit looking north. In the distance we can see hills behind the town of Chibougamau, with the Chibougamau Lake just in front. The former Campbell mine shaft used to be visible from this location.*

***Picture 3**: View of logging road taken in 1997 along the crest where the East and West deposits are located. Outcrops of anorthosite are visible on both sides. The area was logged about 30 years ago.*

VEGETATION

The property is covered by immature second growth taiga forest, dominated by black spruce (*Picea mariana*) and poplar (*Poplar Trembuloides)*. Vast strands of alders (*Alnus incana)*, white willows (*salix sp.)* and birches (*Betula paperyfera)* cover areas with poor drainage, such as southeast of the deposit. Heaths (*Ericaceae*) are diverse and locally abundant. Most of the property was logged and reforested in the last 3 decades.

FAUNA

Large mammals are limited to moose and occasional wolf and black bear. Reindeer *(caribou forestier, a threatened species)* or white-tail deer *(chevreuil)* are not reported. Hares, ptarmigans, grouses, foxes and beavers are commons. Fishes are dominated by trout, bass and pikes.

CLIMATE

A cold continental climate prevails in the Chibougamau area. It is characterized by warm summers (15 ^{o}C July average) and cold winters (-20 ^{o}C January average). Average annual precipitations are in the order 919 mm of water, with prevailing winds from the West. Snow is present typically from late October to early May.

ACCESS

The property is accessible from the paved highway n° 167 between Chibougamau and St-Félicien (Lac St-Jean). At kilometre 197 or 200, access is provided by the forestry road n° 210 (known as "*Chemin de la mine Lemoine*" or "*Chemin Gagnon Frères*"). A network of poorly maintained forestry roads accesses the property at different locations from forestry road n° 210. Some upgrading or maintenance will be needed on these roads for proper regular access. A distance of about 85 kilometres by road separates the centre of the property from the town of Chibougamau. The property can also be reached from the north by way of another poorly maintained gravel road (locally known as Cigam road).

The former Lac Audet railroad siding of Canadian National Railways' Chibougamau-St-Félicien line is located about 40 kilometres from the property, near the junction between highway n° 167 and forestry road n° 210. A seaport is available at La Baie (Port-Alfred), 400 kilometres southeast along the railroad. A commercial airport is located between the towns of Chibougamau and Chapais, about 85 kilometres from the property. Additionnaly, a private helicopter base is operated in Chibougamau.

Most of the property is within the range of cellular phone towers.

SERVICES

Chibougamau-Chapais municipalities are both former copper and gold mining centres and have a combined population of 11,000 residents, plus the Cree communities of Mistissini and Ouje-Bougoumou with a population of about 3000 residents each. Besides mining, the local economy is based on forestry and the service industry. Social, educational, commercial, medical and industrial services, as well as a helicopter base, airport and seaplane base are available at the town site, as well as forestry and mining offices of the *Ministère de l'Énergie et des Ressources naturelles du Québec*.

Chibougamau is a former mining community, abundant and skilled manpower as well as equipment is available, and it is well served by heavy equipment service and maintenance providers.

INFRASTRUCTURE

No infrastructure except for the poorly maintained logging roads is present within the property. No infrastructure was left on Lemoine mine site after its reclamation. No infrastructure was left at the Gagnon Frères sawmill and Audet Lake siding. No infrastructure has yet been built on BlackRock Metals mining lease.

The property lies about 40 kilometres from paved highway n° 167. Daily buses and road carrier trucking are available in Chibougamau towards Lac St-Jean as well as towards Abitibi. The Canadian National Railway line (*Chemin de fer d'intérêt local du nord du Québec or CFILNQ)* and the Hydro-Québec 161 kV power line are located along the Highway n° 167. Bi-weekly railroad freight service is currently available, linking to the North American rail network, although the traffic density is low and track limited to 25 mph and 167,000 lbs loads. Loading facilities are available in Chibougamau. Water is plentiful.

There is no mining infrastructure currently available within the **Lac Doré** properties Permitting for Infrastructure construction for the BlackRock Metals project, including a rail spur, a 161 kV power transmission line and a road, were granted, while approval of their mining license is pending.

ITEM 6: EXPLORATION HISTORY

The ***Lac Doré*** vanadium deposit has sustained a protracted exploration history, spanning almost 60 years (***picture 4***). The amount of data available to the authors is immense. Over 200 studies and reports, filling a complete bookshelf cabinet, both confidential and available to public, dealing with geology, assaying, metallurgy, market and technico-economic issues are available to the authors. Therefore, the review of historical work will freely encompass both the main deposit and its extension as covered by the current project and all references will not be necessarily described in detail. A peculiarity is the limited amount of drilling conducted on the deposits compared to the extensive metallurgical testing.

According to tradition, each of the succeeding owners or operators started their work with geological mapping and ground magnetometry. The largest effort in this regard was conducted by McKenzie Bay Resources in 1997 on the main deposit, and subsequent years for its extensions. The details available from this effort supersede the work by previous owners, except in regard of drilling. These previous campaigns will not be described in detail here.

ASSESSMENT AND GOVERNMENT WORK

The property being located in the vicinity of a historic mining district, abundant government and academic literature is available. More than 400 government and university reports and maps are available for NTS 32G/16 and 32H/13 map-sheets, plus more than 2000 assessment files submitted by exploration companies. A thorough review of all literature is not considered relevant to the current report, only those are dealing directly with the current project were reviewed. The most relevant governmental work is considered to be those of Allard (Allard, 1967a, 1970, 1981; Allard and Caty, 1969) who mapped and described the magnetite series of the Lac Doré anorthositic complex, and from which Dr. Allard predicted the vanadium occurrence. A regional compilation of the geology of the Complex was prepared by Daigneault and Allard (1990).

***Picture 4**: Historic picture of Dr. Gilles Allard (centre, with glasses) and his crew mapping the vicinities of Lac Doré in the 1970's.*

EARLY EXPLORATION WORK

In 1948, Dominion Gulf discovered the magnetite deposit as a regional anomaly on an aeromagnetic survey (GM 1028; Jerkins, 1955). It is reported (Drury, 1959) that they conducted field work from 1954 to 1956, including geological mapping, trenching, sampling and some geophysics.

From 1957 to 1959, Trepan Mining Corporation Ltd. explored the aeromagnetic anomaly for its iron ore potential. Trepan Mining conducted geological mapping, a ground magnetometer survey and three diamond drill holes. Drill holes location are not available, although they are suspected to be near the former forestry road leading to Armitage Lake. Vanadium was not assayed (Derby, 1957; Bischoff, 1959; GM 06482). These drill holes, being located outside the current property, will not be discussed.

Subsequent exploration work by Jalore Mining (a subsidiary of Jones and Laughlin Steel Company from Pittsburgh) and by Continental Ore Company included a "dip-needle" (ground magnetic) survey, six diamond drill holes and some metallurgical testing on a 1000 tonnes bulk sample (Gabrielson et *al*., 1971; Assad 1958; Drury, 1959; Dubuc 1959; Allen 1958; Jerkins 1955; Oliver 1958; Assad 1956; Penstone 1956). The property was relinquished due to the high titanium content of magnetite, which renders it unsuitable for iron smelting with conventional blast furnace. The core was not assayed for vanadium by Jalore Mining, but was subsequently by the *Ministère des Richesses Naturelles* in 1970. This work is considered as of little use. The first author searched extensively in 1997 to locate this core without success. However, it was apparently found by Cambior (Crépeaux, 2000). Since the Cambior technical team was dismantled, the author has not been able to locate this core. The cores from these six drill holes are considered as lost.

WORK CONDUCTED BY THE "MINISTÈRE DES RICHESSES NATURELLES DU QUÉBEC"

The vanadium content of the titanomagnetite layers was indicated by Dr. Gilles O. Allard (1967a, 1967b), at that time working for the Quebec Department of Natural Resources, currently the *Ministère de l'Énergie et des Resource naturelles*. The deposit was then staked on behalf of the Crown. From 1966 to 1975, the following work was completed:

- Geological mapping (Assad, 1968; Gobeil, 1976).
- Line cutting and surveying (Gobeil, 1976).
- Ground magnetometric survey.
- Bulk sampling.
- 13 exploratory diamond drill holes (Assad, 1968; Avramtchev, 1975), of which two are on the Southwest deposit (BlackRock project).
- Numerous metallurgical tests, both for alkali roasting and steel-slag smelting.
    - Cloutier *et al*., 1971;
    - Castonguay, 1975a, 1975b;
    - Boulay and Rubenicek, 1969;
    - Assad, 1967, 1968;
    - Canmet, 1976;
    - CRM, 1979;
    - QIT, 1978;
    - CRIQ, Union Carbide, IRSID (France), Ontario Research Foundation.
- Preliminary resource estimates (Assad, 1968; Kish, 1971; Cloutier et *al*., 1971; Avramtchev, 1975).

Geological mapping and ground magnetic surveys conducted by the *Ministère des Richesses Naturelles du Québec (MRNQ, currently MERNQ)* are considered as being superseded by the more detailed McKenzie Bay Resources surveys (Tremblay et *al*, 1998).

Obsolete resources estimations were first calculated first by Assad (1968) and then by Kish (1971) and Avramtchev (1975). These estimates are non-current and considered of minimal use, and as such will not be discussed.

The dollar value of geological and metallurgical work carried out by the government has not been accurately assessed, but can be estimated at more than $5 million in 2017 adjusted dollar value.

WORK CONDUCTED BY SOQUEM

The ***Lac Doré Vanadium Project*** was transferred to SOQUEM, a Québec crown corporation, in 1977. This corporation did some geological work until 1979 and a non-current resource was recalculated, SOQUEM then carried out additional metallurgical testing until 1980. In 1981, SOQUEM abandoned the development program due to a weakening of vanadium market.

- Exploration work:
  - Geological mapping: 1.1 km^2
  - Line cutting: 39.1 km
  - Magnetometer survey: 34.3 km Nolet, 1980
  - Gravity survey: 17.5 km Nole, 1980
  - 19 diamond drill holes: 3325 m Dion, 1980
  - Resource calculations Dion, 1980
  - Pit design, LMBDS-Sidam 1981

- Metallurgical tests:
  - Pellet testing: Fossen 1978
  - Ti-V recovery: Hatch, 1980; Rautaruukki, 1980; CRM, 1981

SOQUEM's expenditures on the project have not been disclosed, but its replacement value is evaluated to be at least $2 million dollars.

A non-current resource estimate was calculated by SOQUEM in 1980 (Dion, 1980) and again in 1981 along with a pit design (LMBDS-Sidam, 1981). These estimations are obsolete and as such will not be discussed in further detail.

From 1983 to 1989, the project was reviewed and evaluated by various groups on behalf of SOQUEM:

- 1983: CRM (Malensky and Castonguay, 1983)
- 1989: Hydro-Québec (1989)
- 1989: Société Générale de Financement (Vallée, 1989)
- 1989: Hatch & Associates (Lachapelle, 1989)

WORK CONDUCTED BY McKENZIE BAY RESOURCES LTD.

IOS, on behalf of McKenzie Bay Resources Ltd., conducted a large stripping and sampling program in 1997 over the Southwest, West and East deposits (Tremblay et *al.*, 1998). This campaign included the following:

- Line cutting, a ground magnetometer survey and detailed geological mapping over 70 line-km.
- Stripping and detailed mapping of 36 trenches for a cumulative length of 8650 metres *(**pictures 5** and **6**).*
- Sampling and assaying of 1734 samples (3 metres long) for a total of 4486.7 metres of diamond-saw cut channels.
- Structural mapping and analysis (Lamontagne, 1998; Tremblay et *al*., 1998)
- Analytical QAQC (Girard, 1997; Bédard and Girard, 1998)
- Ore microscopy and microprobe analysis (Lamontagne, 1998; Lamontagne and Lavoie, 1998; Bédard, 1998; Tremblay et *al*., 1998).
- Various markets, processing and economic review (Girard, 1997).
- No metallurgical testing was carried out on behalf of McKenzie Bay Resources within this program.

The 1997 work program, done on behalf of McKenzie Bay Resources, cost $1.5 million.

A non-current resource calculation was attempted by the first author, using assays from the trenching (Girard, 1997) and projecting downward. This estimation is obsolete and, as such, will not be discussed in further detail

***Picture 5**: Mechanized stripping done for McKenzie Bay Resources in 1997.*

***Picture 6**: Trench 19+50E on the East deposit, which was cleared and cleaned very wide to provide an impressive view of the mineralization. See the pick-up truck for scale.*

Between 1998 and 2001, various brief field programs were carried out by IOS on behalf of McKenzie Bay Resources over the Armitage and Northeast extensions, for the purpose of assessment credits. This work mostly encompassed the extension of the historical deposits, the Armitage extension toward the southwest. It is scattered in numerous partial reports and includes:

- 1998: Line cutting (14.8 km), ground magnetometer survey and geological mapping over the Armitage extension (Lamontagne, 1998).
- 1999: Stripping of two trenches on the Armitage extension (Boudreault, 2000).
- 1999: Line cutting (23.1 km), ground magnetometry, and geological mapping over the Northeast extension. This campaign also included detailed mapping of 5 trenches dug in 1997 (14+00W to 24+00W) over the Eastern deposit (Villeneuve, 1999).
- 2000: Line cutting (21.2 km), geological mapping and ground magnetometer survey over the south-western extremity of the Armitage extension (Boudreault, 2000). This campaign also included mapping, channel sampling (116.2 m) with diamond saw and assaying (59 samples) of the two trenches excavated in 1999.
- From 1997 to 1999, IOS conducted a series of ground magnetometer surveys covering the whole strike of the deposit. These surveys, made with analogical flux-gate magnetometer, were not properly levelled and must be used with care. They were helpful in selecting trenching and drilling sites. However, they are not reliable enough to make comparisons between the various parts of the deposit, model its geometry or to allow a reliable structural interpretation. The poor quality of these surveys led to the commissioning of the high resolution airborne survey by BlackRock Metals.

From 1998 to 2000, the following metallurgical tests were carried out for McKenzie Bay Resources by IOS:

- Review of the historical metallurgical tests (Girard, 1998).
- Crushing, work index and liberation of titanomagnetite (Lamontagne, 2000).
- Design of an optimum titanomagnetite recovery process with Davis tube for a routine separation protocol (Girard, 2000).
- Distribution of vanadium among oxide and silicates minerals (Girard, 2000).

In 2001, a drilling campaign was carried out by IOS on behalf of McKenzie Bay Resources (Huss, 2003). This campaign included 14 holes for a total 2187 metres of drilling, distributed as follow:

- Northeast extension: 7 holes 1016.7 metres
- Southwest deposit: 1 hole 153 metres
- Armitage extension: 6 holes 1017 metres

Of these holes, one is collared within the current ***Lac Doré North*** property, and two on ***Lac Doré*** property, for a total of 438 metres. Remaining holes are located outside the properties.

The overall value of the work conducted by McKenzie Bay Resources on the main deposits and their extensions is evaluated at 2 million dollars.

WORK CONDUCTED BY CAMBIOR INC.

Within their option agreement with McKenzie Bay Resources, Cambior (currently IMAGOLD Corporation) completed a non-current in-house pre-feasibility study (Crépeau, 2000), which included:

- Preliminary resource calculations and pit design.
- Market study for vanadium pentoxide and ferrovanadium (Taylor, 1998 in Service Technique 1999).
- Financial analysis (Services Techniques, 1999).

Subsequently, the following work was carried out, until financial difficulties forced Cambior to withdraw from the project:

- Detailed geological re-mapping of all trenches and re-logging of the core, including a due diligence and liability assessment (Magnan, 1999 in Service Technique 1999).
- Davis tube testing (contracted to IOS, Villeneuve, 1999) and titanomagnetite concentrate assaying, as well as titanomagnetite content measurement using a *"Satmagan".*
- Preliminary environmental assessment, contracted to *Entraco Groupe-Conseil* (Entraco, 1999).
- Very thorough analytical testing to corroborate accuracy of assays and grade assessment (Crépeau, 2000). This verification confirmed the extent of the quality and robustness of available analyses.

Cambior calculated a resource estimate on the East and West deposits. This resource predates the implementation of NI 43-101 regulations, and cannot be considered as current (Crépeau, 2000). Parts of the calculation were made available to the authors. Cambior invested about $340,000 in the project.

SNC-LAVALIN FEASIBILITY STUDY

On April 11th, 2001, McKenzie Bay Resources., in collaboration with SOQUEM, commissioned a bankable feasibility study to the mining group of SNC-Lavalin Inc., dated October 11th, 2002. Only fragments of this study are publicly available:

- (http://www.sec.gov/Archives/edgar/data/1144216/000109181802000450/ex99-02.txt),
- https://docs.google.com/file/d/0BxmBLfd5ee8sSDdtc2NWaDljUU0/preview
- (http://yahoo.brand.edgaronline.com/EFX_dll/EDGARpro.dll?FetchFilingHtmlSection1?SectionI D=2946136-56955-64407&SessionID=nHLt6vAzUL35qD7).

This study is **not considered current** by the authors**,** and will not be discussed in detail. This study cost in excess of $4.5 million, funded predominantly by public grants and was co-directed by Mr. Serge Nantel from SOQUEM and Mr. Michel Grégoire from SNC-Lavalin as project managers. The first author was involved as client representative on the advisory board until April 2002. This study included:

- Diligent review of geological data and grade assessment (Lafleur, 2002).
- Three confirmation drill holes (450 metres in total) plus a small bulk sample, under IOS supervision (Boudreault, 2002).
- Non-current reserve calculation using Whittle's 4-D block model, pit design and mining plan.
- Detailed ore petrography and mineral analysis, (Girard, 2002).
- Ore beneficiation process design, bench scale and pilot plant testing in Lakefield Research facilities.
- Pilot plant scale alkali roasting in Krupp Polysius facilities, followed by calcine leaching in Lakefield Research facilities.
- Hydrometallurgical process and bench scale testing.
- Infrastructure design, including utilities, tailing and calcine ponds, communication systems, automation, buildings, etc.
- Market study for the production of vanadium redox battery electrolyte by Secor Inc.
- Operating and construction cost estimate and financial analysis.
- Environmental study, compliant with COMEX-COMEV regulations by Entraco Groupe-Conseil Inc. (Archambault, 2002).
- Preliminary pit scope design and Geotechnical investigation.

The non-current mineral resource and mining reserve estimates offered by SNC-Lavalin were intended to be compliant with CIM Guidelines, and are provided here only because they are the last ones reported in the literature by previous owners. They are not considered as adequate by the author to be reported as current resources and must not be relied upon.

The resource calculation included the same dataset used in previous estimations by Cambior, plus three confirmation holes ***(table 3)***. The project aimed only at vanadium production with the used of alkali roasting process, and thus estimation targeted dominantly the P2 unit. The estimation is based on head grade analysis, so did not use the titanomagnetite concentrates from Davis tube testing for the resource calculation. Titanomagnetite abundance was calculated based upon various assumptions, such as simplified normative calculation, in regard of which the current first author is in disagreement. Variograms analysis indicated that grades can be extrapolated up to 125 metres laterally and 30 metres across strike. The resource calculations were used for the Whittle-4D mining plan.

Resources, all categories and deposit included, were calculated by stratigraphic units at:

Unit	Volume	Tonnage	Titanomagnetite	Ilmenite	%V_2O_5
P1	13,702,000 m^3	43,388 Kt	21.5%	7.2%	0.32%
P2	46,882,000 m^3	161,095 Kt	28.8%	14.3%	0.40%
P3	11,404,000 m^3	38,846 Kt	27.3%	12.6%	0.18%
Total	71,988,000 m^3	243,329 Kt	19.0%	8.8%	0.24%

***Table 3**: **Non-current** historic indicated plus measured resources estimated by stratigraphic units issued by SNC-Lavalin in 2002. Notice the discrepancy between titanomagnetite abundance in the various stratigraphic units and the overall abundance, reported here exactly as stated in the report.*

Non-current mineable reserves, all categories and using a cut-off head grade of 0.29% V_2O_5, stand at ***(table 4)***:

Deposit	Ore tonnage	%V_2O_5Grade	Waste tonnage	Pit Ratio
East	100,568,700	0.42%	56,785,900	0.56
Southwest	40,106,900	0.48%	16,744,600	0.41
West	29,448,100	0.38%	13,390,400	0.45
Total	170,123,700	0.43%	86,920,900	0.51

***Table 4**: **Non-current** historic "mineable" reserve calculated by SNC-Lavalin in 2002.*

These overall results are similar to previous estimates conducted by Cambior and IOS. SNC-Lavalin did not discriminate between *"measured"* and *"indicated"* resources, a CIM

Guidelines non-compliant practice, and the status of these same resources contrasts with Cambior's opinion who classified their own estimations as *"inferred"* only, although estimated from the same dataset.

The SNC-Lavalin historical estimate encompasses the South-western and Western deposit, which VanadiumCorp does not hold in their entirety.

WORK CONDUCTED BY LAC DORÉ MINING

Since completion of the feasibility study by SNC-Lavalin and until their agreement with BlackRock Metals, very limited work was conducted on the property by McKenzie Bay Resources and subsequently Lac Doré Mining, a fully owned subsidiary. The author was informed that hydrometallurgical processes were tested further at SGS-Lakefield Research Limited, under the supervision of Mr. Jan Mraček, who passed away in 2005. To the first author' knowledge, no cohesive report was issued and very little of his work should be considered recoverable.

WORK CONDUCTED BY BLACKROCK METALS

BlackRock Metals, who acquired the remaining assets from Lac Doré Mining in 2008, conducted the following work over the portion of the deposit currently owned by VanadiumCorp, which was either conducted or supervised by IOS:

- Securing the historic core and cleaning the former McKenzie Bay Resources camp site at Laugon Lake (located on current VanadiumCorp property). The historic core included the SOQUEM and MRNQ drill core from the East and West deposits as well as McKenzie Bay Resources holes on north-eastern and Armitage extension.
- High resolution airborne magnetometer and topographic survey over the entire length of the deposits (Largeault et *al*., 2008). The survey did encompass the East and West deposits, currently belonging to VanadiumCorp, although data from this portion was never provided by Novatem to BlackRock Metals. However, this part of the survey, carried because of flight logistics constrains, was made available by the Novatem to the first author, who was supervising the work, and will be presented in subsequent sections. This survey replicates with better accuracy the former ground magnetometer survey.

OTHER KNOWN MINERAL OCCURRENCE

No other mineral occurrence of economic significance is known within the property boundaries. Some apatite concentrations are reported in the upper stratigraphic unit "P4" of the magnetite sequence, which are not volumetrically significant.

A small occurrence of gem quality vanadiferous titanite is reported within (or very near) the property, in the valley between Laugon and Coco lakes. The value of this has not been addressed, the occurrence never been properly located, and it shoull be considered for the purpose of this report only as a mere curiosity.

VALIDITY OF THE VARIOUS SURVEYS AND INDEPENDENCE OF THE CONTRACTORS

The *Ministère des Richesses Naturelles* carried out all the work over the deposit using its own staff. There is no reason to doubt the integrity and independence of these authors, although some of them might not have been sufficiently trained for the type of work they conducted.

SOQUEM carried out their various surveys using their own staff, which work was conducted according to the industry standard of the time.

The work carried out on behalf of McKenzie Bay Resources was completed by the author's crews. The geologists in charge of the various programs were experienced and the work conducted according to quality procedures of the time. An exception is the set of ground magnetometric surveys which was not conducted by properly trained staff, and thus is of dubious quality. IOS was a thoroughly independent firm from McKenzie Bay Resources.

Part of the work conducted for McKenzie Bay Resources was conducted by Glen McCormick Exploration Ltd., who accepted shares in lieu of payment. This contractor is therefore not considered as independent.

The work conducted by Cambior was of proper quality, with the exception of the geological re-mapping of the trenches and density measurements. The authors have no reason to suspect any bias of execution.

The quality of work conducted by SNC-Lavalin cannot be addressed. The authors do not have the expertise to evaluate all engineering aspects. SNC-Lavalin is reputed to be independent from SOQUEM and from McKenzie Bay Resources.

DETAILS ON HISTORICAL DRILLING

The historical drilling is the most valuable set of information currently available, far more valuable from its mere abundance than drilling and sampling done by VanadiumCorp. This information is the basis for the calculation of the current resource estimate (Girard et D'Amours, 2015). Therefore, a thorough review of this data is presented in ***Item 10*** for the drilling, ***Item 11*** for the sampling procedure, and ***Item 12*** for the assaying procedure and quality controls. This historical data will be presented along with VanadiumCorp drilling.

ITEM 7: GEOLOGICAL SETTING AND MINERALIZATION

REGIONAL GEOLOGY

The **Lac Doré** deposit is hosted in the Lac Doré Anorthositic Complex, dated at 2.728 Ga. This Archean complex is at the core of the Eastern end of the Northern domain of the Abitibi Greenstone Belt, Abitibi sub-Province, and Superior Province in the Canadian Shield. The regional stratigraphy is dominantly East-West trending, South or North verging depending on the side of the anticline, with a metamorphic facies grading southward from green schist to amphibolites (Chown et *al*., 1992).

The volcano-sedimentary sequence in the Chibougamau area is shaped like an East-West trending anticlinorium, both flanks of which represent a mirror stratigraphy *(**figure 3**)*. The core of the anticlinorium is occupied by the Chibougamau pluton, the emplacement of which has resulted in tilting the enclosing volcanic pile into an upright position symmetrically on both sides. The stratigraphy is comprised of the volcanic Roy Group, and overlying volcano-sedimentary Opemisca Group. The Roy Group consists of two volcanic cycles, with the basaltic Obatogamau Formation and felsic volcanoclastic Waconichi Formation (2.728 Ga) in the lower part, and the basaltic Gilman Formation and felsic volcanoclastic Blondeau Formation in the upper cycle, capped by the volcano-sedimentary Bordeleau Formation. The Opemica Group is known to occur only on the south limb of the anticlinorium, including the epiclastite dominated Chebistuan, Stella and Haüy Formations.

The lower cycle Waconichi Formation is truncated by the near conformable Lac Doré Anorthositic Complex, itself truncated by the Chibougamau tonalitic pluton (2.718 Ga). Some other minor late intrusions are reported.

The rocks are affected by multiple deformation events, including regional dome-and-basin type folding and associated shearing. A dense network of late faults dissects the area, dominantly northeast trending. These faults are either associated with or reactivated by the Grenvillian event, the main expression of which being the Grenville Front to the Southeast.

Most of the mines from the Chibougamau camp are shear hosted within the Lac Doré anorthosite, typically associated with fault intersections. Over 44 million tonnes of gold-copper ore have been extracted to date. The only significant exception is the small base metals bearing volcanogenic massive sulphides, such as the Lemoine Mine, hosted in the Waconichi Formation.

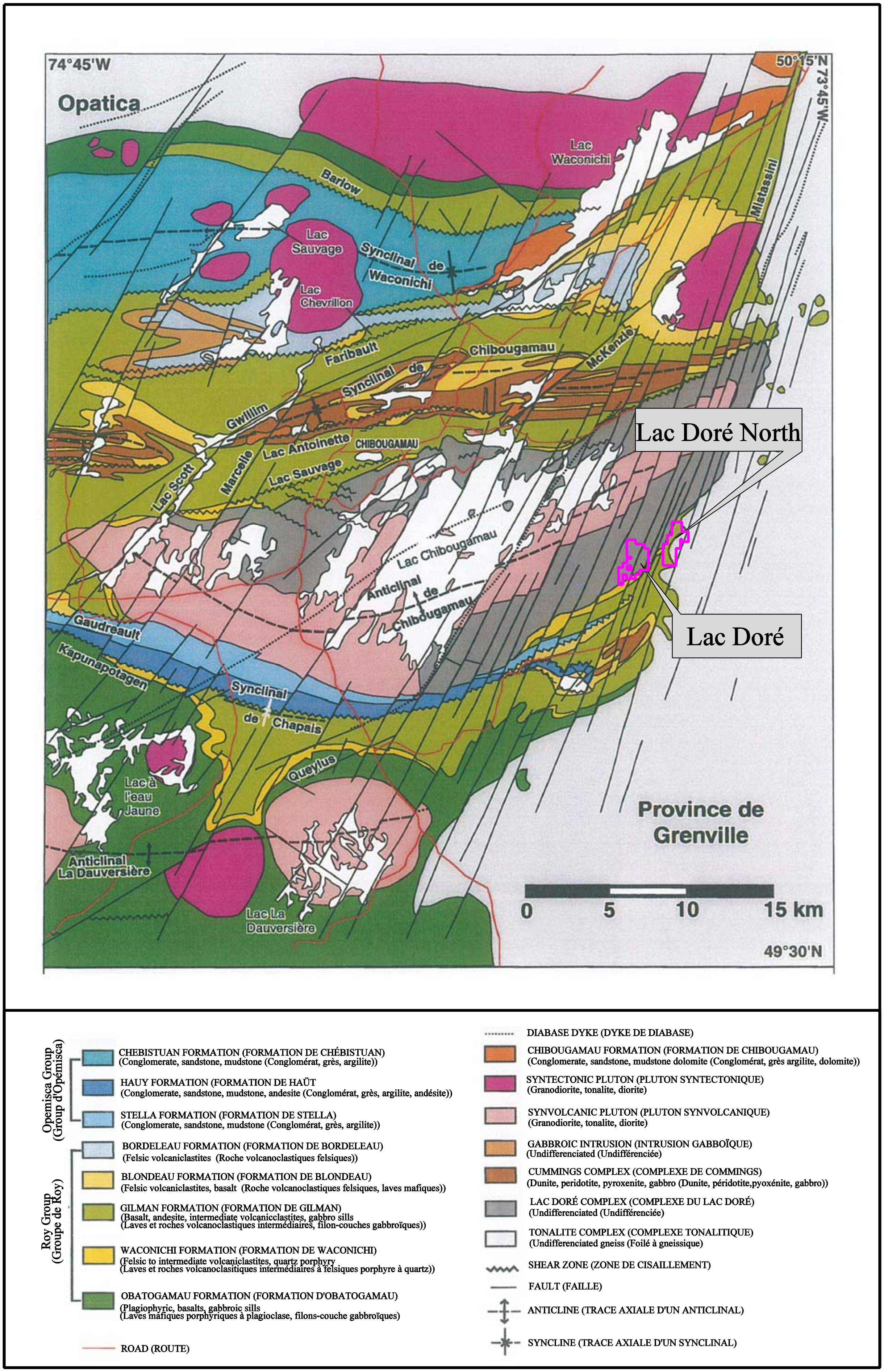


Figure 3: Geology of Chibougamau region, Quebec (after Daigneault et Allard 1996)

LOCAL GEOLOGY

The Lac Doré Complex is a lopolith, a sub-tabular intrusive body of mafic to anorthositic composition, strongly differentiated near its top. The lopolith is emplaced within the Waconichi Formation, a felsic volcanic and sedimentary pile, and folded along by the regional anticlinorium. The deposit is hosted in a homoclinal sequence of magnetite bearing layers within the South flank of the Lac Doré Anorthositic Complex. Top of stratigraphy is to the south.

According to Allard (1967), the Lac Doré Complex is divided in four major units. From top to bottom they are:

- The border zone (top, South-East);
- The granophyre;
- The layered zone;
- The Anorthositic zone (base, North-West).

The layered zone hosts the vanadiferous titanomagnetite deposit, while the anorthosite and the granophyre host most of copper-gold mineralization of the mining camp (outside the current project).

The anorthosite zone (approximately 3660 m in observed thickness) is composed of anorthosite, gabbro and titanomagnetite-bearing gabbro, plus some minor pyroxenite. The titanomagnetite abundance as well as the vanadium content increase in the upper 150 metres of the unit, toward the layered zone.

The layered zone, which hosts the vanadiferous titanomagnetite deposit, consists up of 450 to 900 metres of rhythmically layered beds rich in pyroxene, titanomagnetite plus ilmenite, intercalated with layers of anorthositic gabbro. The vanadium mineralization is located in the lowermost part, namely the P1, P2 and P3 units. Vanadium strongly partitions into magnetite, and thus into the first titanomagnetite layers. Abundance of titanomagnetite decrease upward (Allard, 1967).

The vanadium-bearing magnetite deposit is described by Allard (1967) as:

> *"… an alternation of layers of solid titaniferous magnetite, magnetite rich gabbro, magnetite rich pyroxenite, gabbro and anorthositic gabbro. The solid magnetite layers range from a fraction of an inch to four feet. The magnetite band is everywhere at the same stratigraphic horizon, but each magnetite layer is discontinuous and exhibits marked changes in thickness and character along strike …"*

Minor vanadium-bearing titanomagnetite layered series are reported on the north flank of the complex, near Magnetite Bay.

GEOLOGY OF THE DEPOSIT

The deposit was mapped both by MRNQ and SOQUEM geologists. It was at that time covered by forest and overburden with only about 1% outcrop. Since McKenzie Bay Resources stripping program and the recent logging activity, outcrops are more abundant and allow a better understanding of the geology as presented at ***figures 4A*** and ***B***.

Dr. Allard's stratigraphy (P1-A1-P2-A2-P3) was partly revised by the author based on this mapping (Tremblay, 1998). Local stratigraphy is presently defined as follow, from bottom (North) to top (South), and more recently refined by Arguin (2017) (***figure 5***):

- Footwall anorthosite, free of magnetite.
- P0: Anorthosite with small scattered beds of magnetite *(**picture 11**)*.
- P1: Anorthosite with abundant and thick beds of magnetite *(**picture 10**).*
- P2: Magnetite and layered gabbros, main ore body *(**pictures 7** and **8**).*
- P3: Magnetite-ilmenite bearing pyroxenite *(**picture 9**).*
- Hanging wall, mainly gabbro and pyroxenite.

Lenses of anorthosite, metres to tens of metres in thickness, are intercalated within the above units, which were considered as stratigraphic units by Allard (1967).

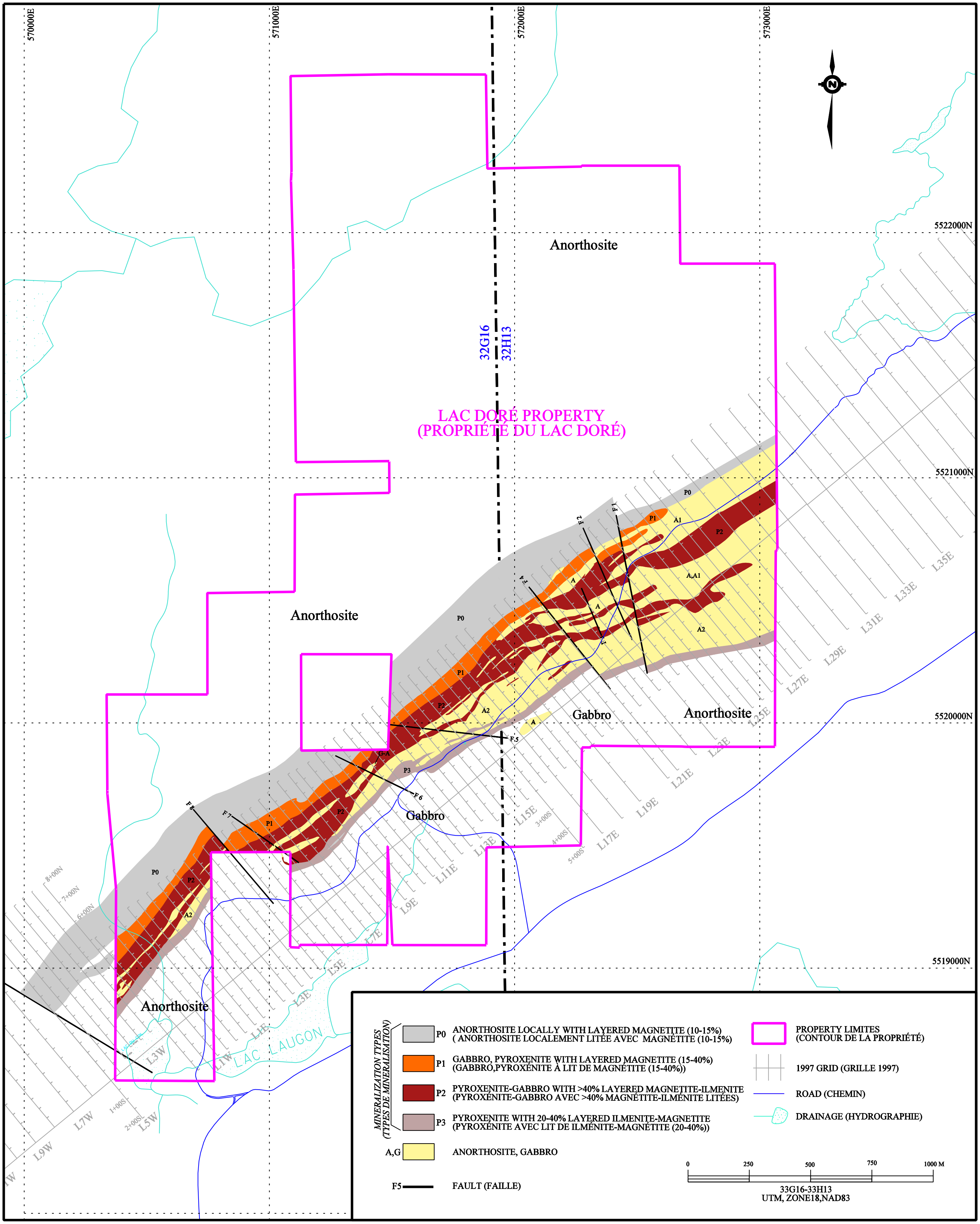


Figure 4a: Geology of LAC Doré property (Géologie de la propriété du Lac Doré)

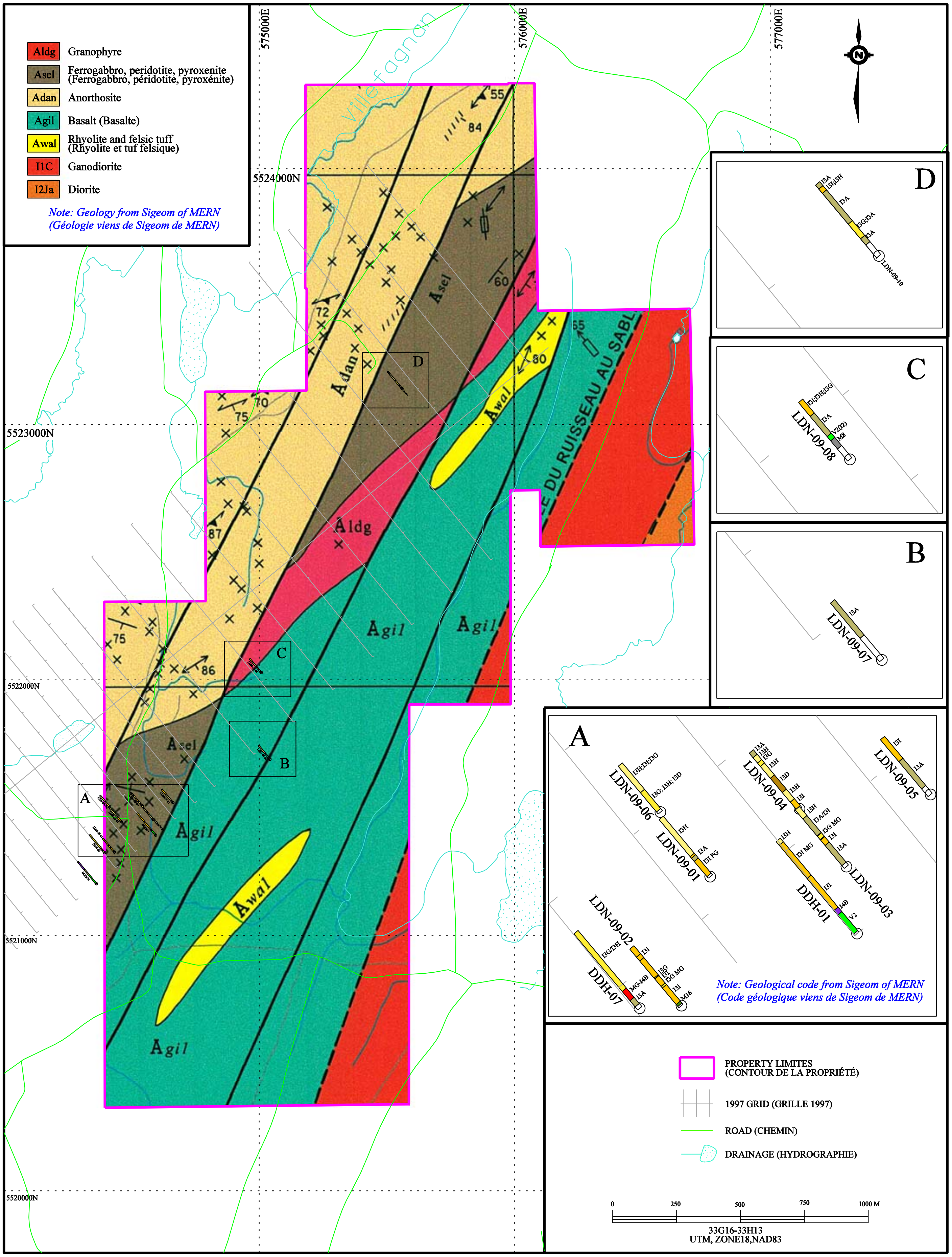


Figure 4b: Geology, Lac Doré North Property (Géologie, propriété Lac Doré North)

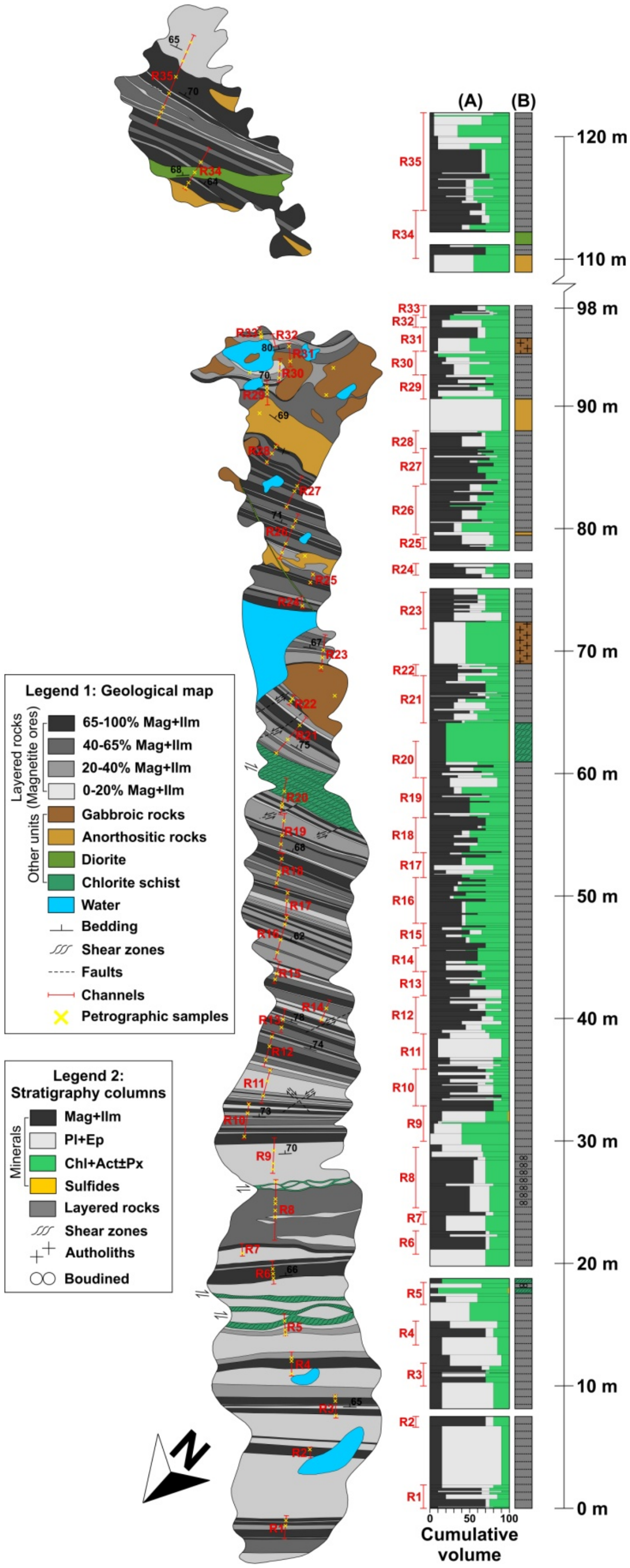


***Figure 5**: Detailed mapping of the trench 19+50E, which shows the complicated layering across the deposit (grey shades), plus the presence of a few pods of barren anorthosite (brown) and late dykes and schistose shear zones (Arguin, 2017). Visual estimation of the modal abundance of titanomagnetite, plagioclase and ferromagnesian minerals is indicated as bars, and shows the increase in chlorite and amphiboles toward the top of the sequence. Notice north toward the bottom of the figure in order to presents the stratigraphy in upright position.*

***Picture 7**: View of the layered magnetite series from P2 unit in trench 19+50 East. Notice the small anorthosite dyke in the lower right.*

***Picture 8**: View of the layered magnetite bearing anorthositic gabbro from P2 unit. Notice the cross-bedding, indicative of magmatic unconformity.*

Picture 9*: View of the layered gabbro with a magnetite band from P3 unit.*

Picture 10*: View of a magnetite band in the layered anorthosite from P1 unit.*

Picture 11*: View of thin magnetite layers within anorthosite, typical of P0 unit. Picture taken on a stripping located on Lac Doré North property.*

The stratigraphy is more or less continuous along strike for the whole deposit, from the south-western tip of the Armitage extension to the North-eastern end, where it is truncated by the Mistassini Fault (Grenville Front). However, thicknesses are variable and complexities locally abundant.

The East and West deposits were reported as a bulge on P2, distinctly visible on the aeromagnetic survey. The presence of this prominent magnetic anomaly attracted exploration activity. Exploration work neglected the extensions of the deposit except for the limited efforts by McKenzie Bay Resources in the 1998-2000 periods, until recent work by BlackRock Metals over Armitage extension.

All the various mineralized bodies, from Armitage to Northeast, correspond to a package of horizons steeply dipping toward the southeast. These horizons extend, almost continuously, for 17 kilometres in length, as expressed by the ground magnetometer survey and BlackRock aeromagnetic survey. The various mineralized bodies, or extensions, were named on historical basis, being separated only by late faults, topographic features or claim boundaries. However, the overall mineralized body is uninterrupted. For example, the East and West deposits are separated by a valley related to a small cross-fault with minimal displacement. The West and Southwest deposits are offset by the Coil Lake cross-fault corresponding to a second valley, and are separated by a narrow stretch of lower grade material. The East and West bodies bulge to a thickness of 100 to 150 metres, reaching locally up to 200 metres. The Southeast body is narrower at 100 metres in thickness, locally injected of abundant anorthosite sills devoid of magnetite. The Armitage extension is continuous over more than 12 kilometres with 50-100 metres in thickness. Toward the Northeast, the geology and stratigraphy is more difficult to decipher, being offset by late faulting related to the Grenville Front.

The vanadium grade decreases progressively towards the stratigraphic top of the layered series as one proceeds south-eastward. This is related to the early partition of vanadium in the magnetite which progressively depleted the magma during magmatic differentiation. Also, in the gabbroic and pyroxenitic top layers, the remaining vanadium is scavenged by ferromagnesian minerals, and not amenable for metallurgical recovery. Therefore, layers above P3 are not considered as part of the deposit. Nelsonite horizons, made of ilmenite and apatite, are reported in the upper series and the over incumbent granophyre, which shoull be just considered as curiosities.

Inversely, as one proceeds toward the base of the layers, north-westward, the grade of vanadium in the magnetite increases to a level which may be sufficient to justify mining of isolated magnetite bands within the anorthosite, such as P0. Only very preliminary results are available on this aspect.

GEOCHEMISTRY

The vanadium hosted in magnetite and ilmenite is relatively refractory. It is not expected to be liberated from the host minerals and to yield any geochemical anomaly in the secondary environment. Furthermore, vanadium is a ubiquitous element, present in trace amount in any type of rock, thus having little contrast with the deposit. Exploration geochemistry is therefore not considered as relevant.

A regional geochemical survey of lake bottom sediment, conducted by the MRNQ in 2007 and 2011, covers the area, which is of little use for the project.

GEOPHYSICS

As the vanadium is contained in the magnetite, the mineralization is readily visible on aeromagnetic survey. The 17 kilometres long anomaly associated with the deposit is outstanding on the regional map. Ground magnetic surveys were carried out by the Gulf Mineral, Trepan Mining and Jalore in the 1950's, using a dip-needle compass, as well as by *Ministères des Richesses Naturelles* (Kish, 1971), SOQUEM (Nolet, 1980), and McKenzie Bay Resources (Tremblay et *al*., 1998; Boudreault, 2000; Girard, 2001; Villeneuve, 1999). These surveys were carried out with an analog flux-gate instrument, which measures only the vertical component of the total field. Flux-gate was the standard instrument in the time of MRN and SOQUEM, and was chosen by IOS for the McKenzie Bay Resources survey for being less sensitive to lateral gradient and saturation than then available neutron precession units. The various surveys conducted for McKenzie Bay Resources are noisy, with numerous levelling discrepancies. For these reasons, the author recommended to BlackRock Metals in 2007 to commission a low-altitude high density airborne magnetic survey covering the entire area. This last airborne survey encompassed, for logistical reasons, a large part of VanadiumCorp **Lac Doré** and **Lac Doré North** properties (***figures 6A 6B,*** and *7*). It can be noted right away from this survey that the Eastern deposit has a significantly larger magnetic signature than the others.

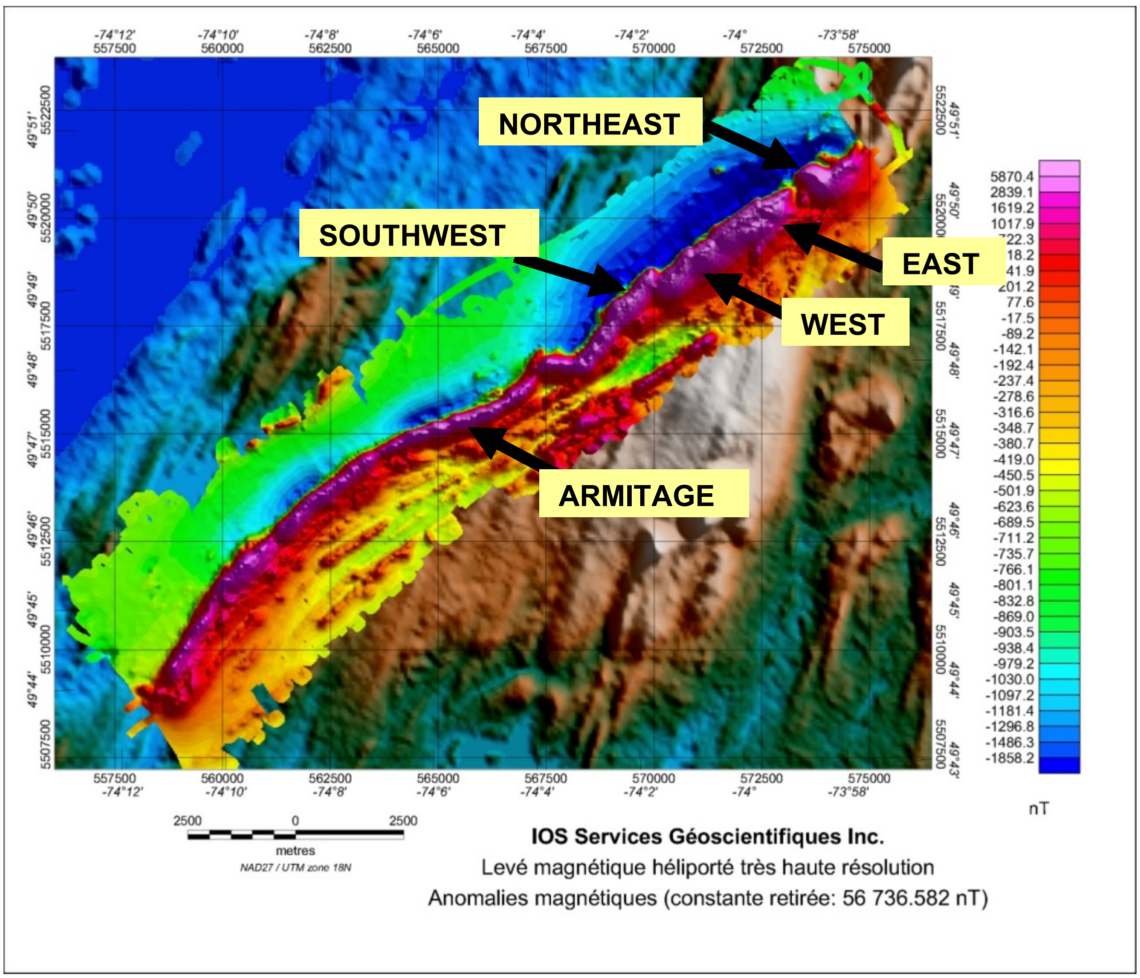


***Figure 7**: High density aeromagnetic survey (bright colours) over the entire length of the deposit, as provided by NovaTEM Inc (*Largeault et *al*., 2008*). Dull colours in background are topography.*

No geophysical method allows detection or measurement of the vanadium itself.

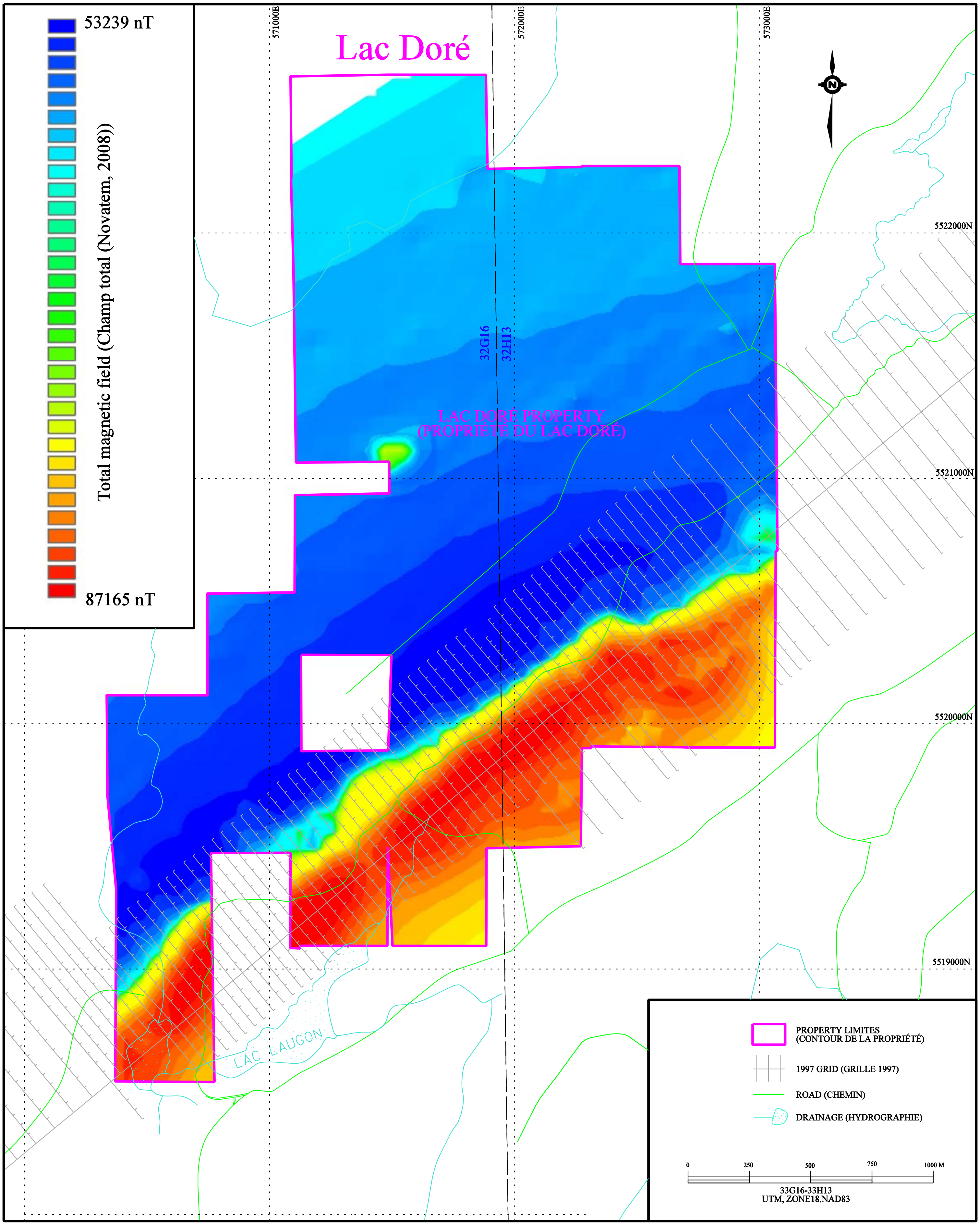


Figure 6a: Aeromagnetic survey, Lac Doré property (Levé aéromagnétique, propriété Lac Doré)

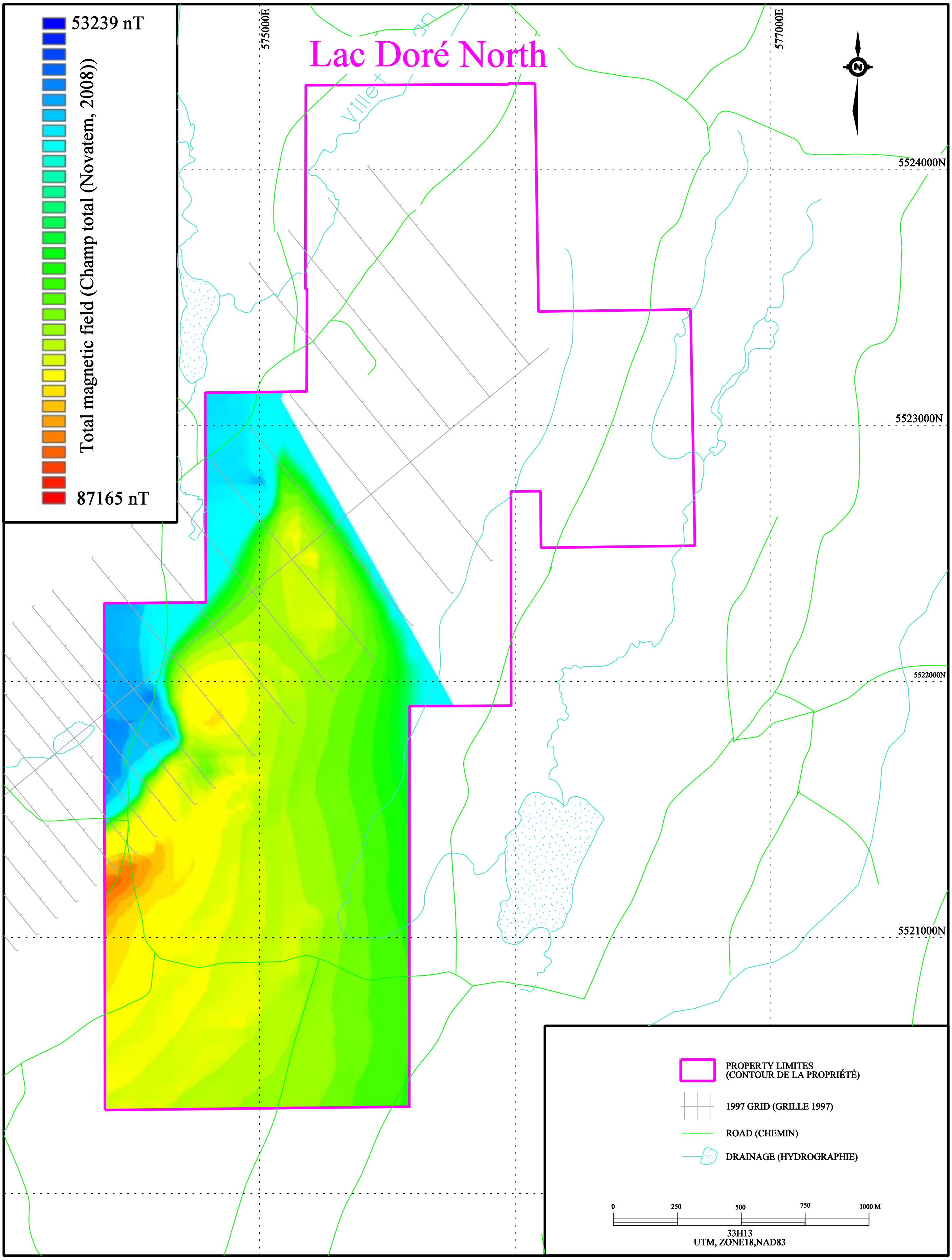


Figure 6b: Aeromagnetic survey, Lac Doré North property (Levé aéromagnétique, propriété Lac Doré North)

Electromagnetic and gravimetric (Nolet, 1980) surveys were carried-out by the *Ministère des Richesses Naturelles* and SOQUEM, without providing conclusive results. There is no need for testing other geophysical methods.

GLACIAL GEOLOGY

Glacial geology of Chibougamau area is dominantly covered by the Chibougamau Till (Martineau and Bouchard, 1984). This extensive till blanket is Winconsinian in age, and is reported to flow toward the Southwest in the area (see drumlin and elongated crest visible on ***figure 5***). The crest where the deposit is located is covered by a thin veneer of till, while periglacial sandy material dominates the plains to the North toward Lake Chibougamau. Fluvioglacial material is rare in the vicinity of the deposit.

MINERALIZATION

Vanadiferous mineralization at Lac Doré is composed of titanomagnetite and ilmenite, hosted in anorthosite, anorthositic gabbros and gabbros, within the layered series of the Lac Doré Complex. Magnetite and ilmenite, associated in various proportions depending on stratigraphy, are found either as massive beds, decimetres to metres thick, or as dissemination within anorthositic and gabbroic facies. Overall, the deposit contains about 30% magnetite, the main reservoir for vanadium, plus 10% ilmenite. Oxides are best described as orthocumulate phase in the massive beds, or intercumulate while disseminated in host rock. Typical abundances and vanadium grades for the various units as estimated from McKenzie Bay Resources channel samples (Tremblay et *al*., 1998) are provided in ***table 5***.

	Thickness as calculated from surface sampling	**V_2O_5**	**Fe_2O_3**	**TiO_2**	**% Mgt** from visual estimation
P0 *(base)*	32 m	0.194%	20.1%	1.74%	10%
P1	49 m	0.340%	41.5%	4.27%	15-30%
P2	97 m	0.486%	64.3%	9.20%	>40%
P3 *(summit)*	38 m	0.163%	48.6%	6.43%	20-30%
Total	216 m	0.353%	49.8%	6.49%	

Table 5*: Vanadium, iron and titanium grades in different facies.*

The magnetite bearing layers form a definite horizon which can be traced from the Grenville Front to the northeast, to the Lac Caché to the southwest, for a total stretch of 17 kilometres. Cross faults, with short displacement, are separating the East from the West deposits, as well as the West and South-West deposits. Magnetite beds are reported all along this horizon, with diverse abundance and thickness. The overall thickness of the sequence typically ranges between 60 to 100 metres, but increases to more than 200 metres in the East deposit. The aeromagnetic signature is very linear, suggesting a near perfect homoclinal sequence dipping steeply to the southeast. Although the overall mineralized envelope is fairly regular, detailed internal stratigraphy is complex, injected by dismembering anorthosite sills. Local tight folds and truncation of the stratigraphy are noted, and are interpreted as magmatic slumps.

PETROGRAPHY

Vanadium is hosted at 70-80% in magnetite (FeO-Fe_2O_3) and 10-15% in ilmenite (FeO-TiO_2). These two minerals are associated in a complex manner. Titanium is partitioned into hemoilmenite and ulvöspinel or titanomagnetite, which are co-precipitated from the magma, with granular relationship. Proportion of hemoilmenite and ulvöspinel is controlled by oxygen fugacity of the magma: more oxygen being available, more hemoilmenite being formed. The primary magmatic oxides typically have grain sizes of a fraction of a millimetre to a few millimetres. Titanomagnetite is a ferrous-ferric spinel (FeO-Fe_2O_3) which makes a discontinuous solid solution with ulvöspinel ($2FeO$-TiO_2) through a diadochic substitution at high temperature. At high temperature, this substitution can accommodate up to 20% TiO_2. No solid solution exists between ilmenite and titaniferous spinels. However, a complete solid solution exists between ilmenite and hematite at high temperature. At lower temperature, ulvöspinel is not stable and exsolves as ilmenite intergrowth in titaniferous magnetite. Titanomagnetite itself can accommodate up to a maximum of 4% TiO_2, the excess being exsolved as minute ilmenite intergrowths. Similarly, ilmenite ($FeTiO_3$) makes a complete solid solution with hematite (Fe_2O_3) at high temperature, and hemoilmenite may exsolves as ilmenite-hematite intergrowth at lower temperature. These various iron and titanium oxides react with iron-bearing silicates (pyroxene, etc.) during the course of metamorphism, making secondary magnetite, with or without titanium, with or without vanadium, plus panoply of vanadium-bearing ferromagnesian silicates. These secondary oxides are mainly developed in P2 and P3, considering the original abundance of ferromagnesian minerals (Arguin J.P., Ph D thesis in progress). Hematite is of very limited importance in Lac Doré ore, typically restricted to secondary minerals of metamorphic or alteration origin. Vanadium weakly substitutes in hematite.

Vanadium head grade is at its maximum in P2, in the middle of the layered series. However, vanadium grades in magnetite decrease systematically upward, while titanium head grade increases upward. Consequently, the best vanadium grades in magnetite concentrates are found in P0 and P1, while the bulk of the vanadium resources being hosted in P2. This is reflected in every former non-current resource assessments which targeted P2 only.

The Lac Doré mineralization typically consists of 80% magnetite and 20% granular ilmenite. The magnetite itself consists of 70-85% titaniferous magnetite with about 15-30% very minute intergrowths of ilmenite exsolution ***(figures 8a*** and ***8b)***, the proportions of which vary across stratigraphy. The presence of these ilmenite exsolutions within titanomagnetite makes this mineralization unsuitable for iron production from blast furnace, unless blended to decrease titanium level below tolerance threshold. Titanomagnetite typically grades about 1.8% V_2O_5, while the ilmenite typically grades 0.3% V_2O_5. The abundance of these ilmenite exsolutions in titanomagnetite causes dilution of the vanadium grade in the magnetic concentrate. Vanadium grades in titanomagnetite and ilmenite are rather constant in P0, P1 and P2, and drop drastically in P3. The difference in vanadium grade of the concentrates produced from P0, P1 and P2 reflects the abundance of ilmenite exsolutions within the titanomagnetite. For a typical sample from P2, it is calculated that 86% of the vanadium is hosted in titanomagnetite, 8% of vanadium is in ilmenite (exsolutions plus granular grains) and 5% is hosted in ferromagnesian minerals ***(table 6)***. Ilmenite can be process along with titanomagnetite if their concentrate is smelted for the production of iron and titanium slag. Otherwise, it is technically possible, although not economical, to process ilmenite along with magnetite by salt roasting to recover its vanadium content. However, recovering vanadium from ferromagnesian silicates is not technically feasible. Not processing ilmenite and ferromagnesian silicate explains the reported low vanadium recovery, tested at about 70-80% in historical beneficiation testing.

In oxide mineral, vanadium is present as sesquioxide V_2O_3 species, despite its grade being reported as pentoxide V_2O_5. The V_2O_3: V_2O_5 conversion factor is 1:1.21.

V_2O_5	P0	P1	P2	P3
Magnetite	1.78%	1.84%	1.74%	1.04%
Ilmenite	0.41%	0.41%	0.27%	0.15%
Magn. Conc.	1.6%	1.5%	1.3%	0.8%
Chlorite	-	-	0.1%	N/A
Amphibole	-	-	0.1%	N/A

Table 6*: Vanadium grade in wt% in different mineral species.*

Chromium is almost entirely partitioned into the titanomagnetite as chromite end-member. Inversely, manganese is partitioned into ilmenite as pyrophanite end-member. These are the only two contaminants known to be significantly abundant and currently documented in these oxides.

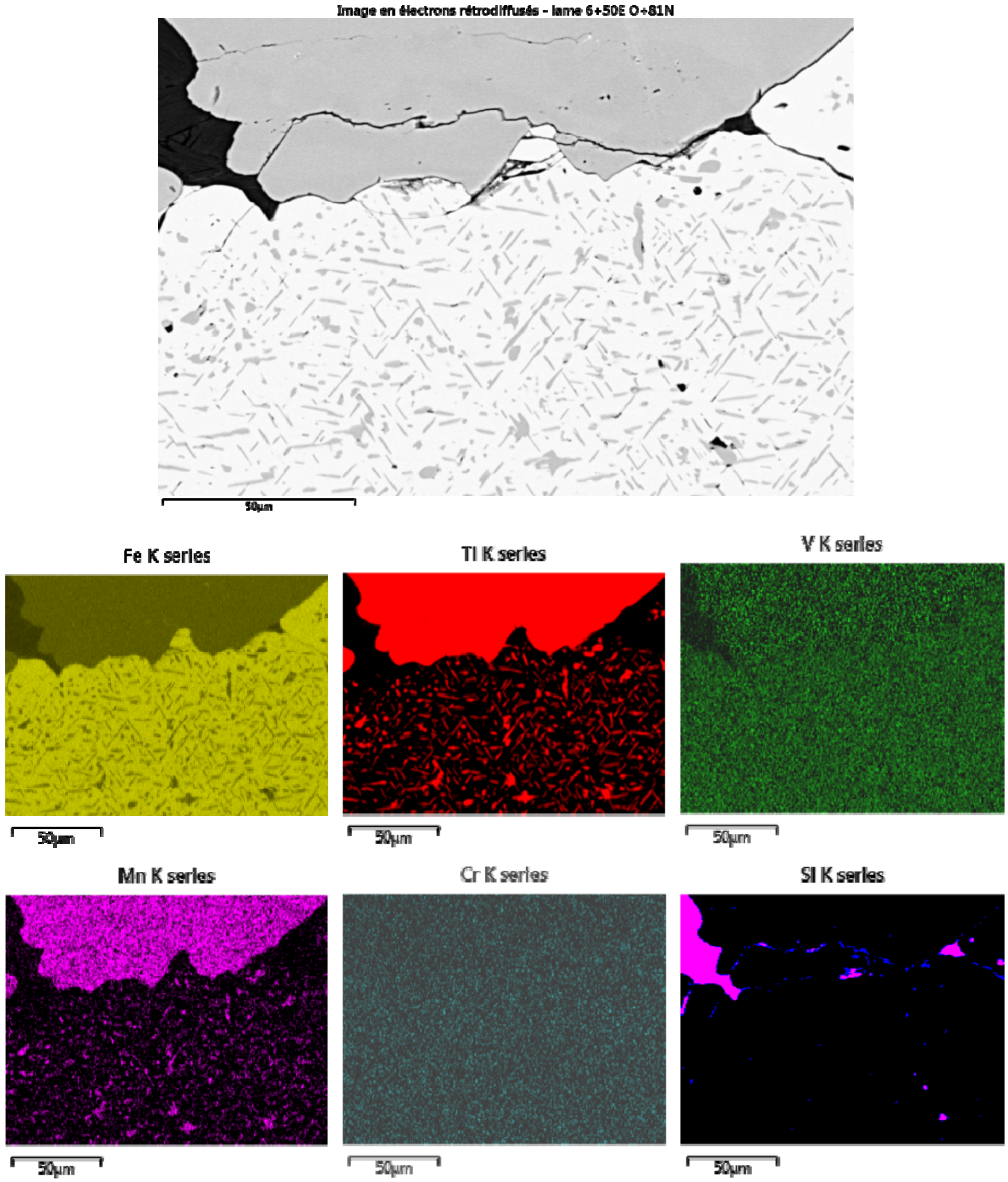


Figure 8A*: X-Ray map of a titanomagnetite and ilmenite grains from P2 horizon. Abundant ilmenite exsolutions, less than 10 µm across, are peppering the titanomagnetite (bottom), while no magnetite inclusion is present in granular ilmenite (top). A backscattered electron image (top, black and white) provide a clear view of the various minerals, while X-ray maps provide the distribution of each elements (colours). Image generated on IOS's scanning electron microscope.*

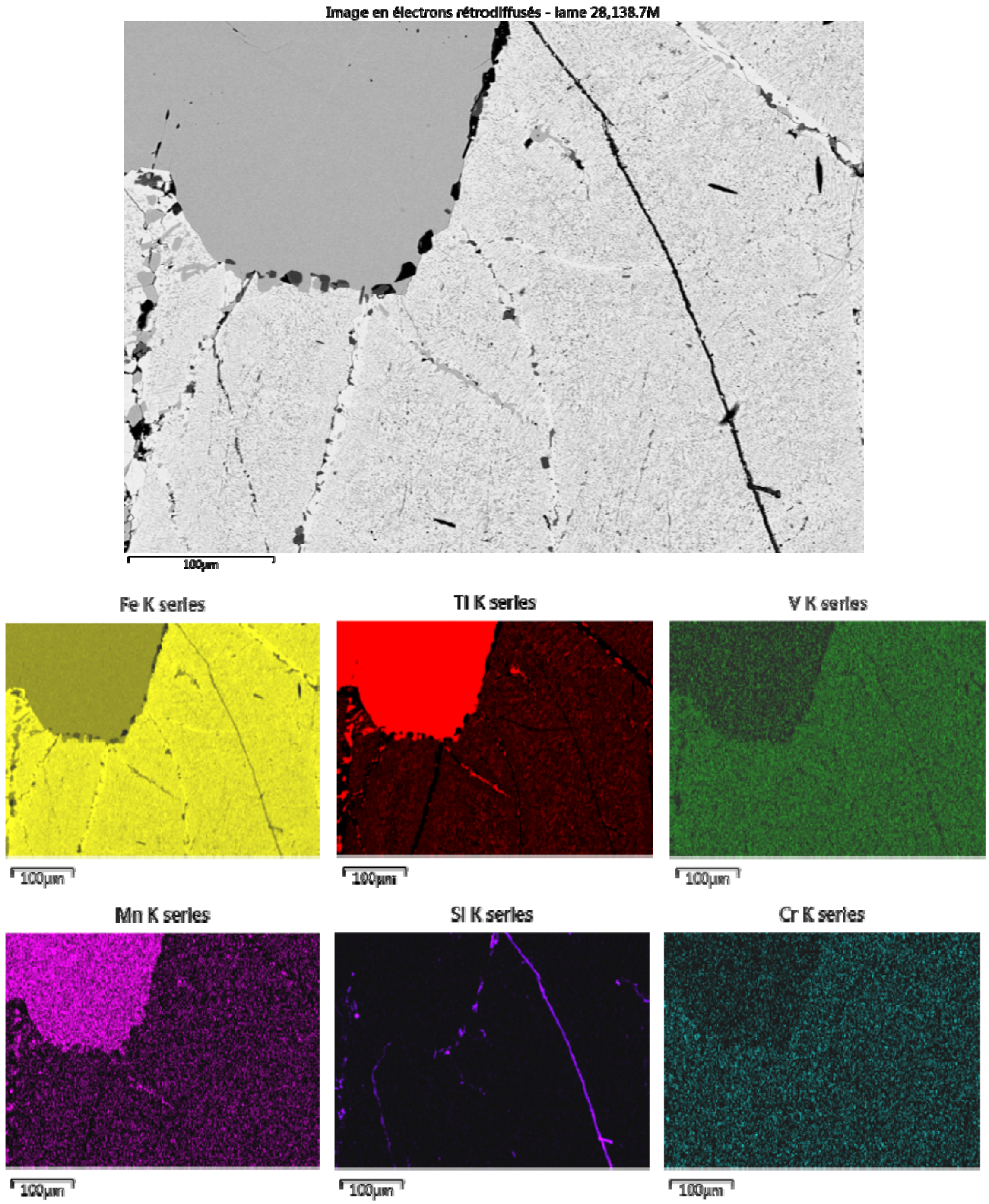


Figure 8B*: X-Ray map of a titanomagnetite and ilmenite grain from P2 horizon. Ilmenite exsolutions, less than 1 µm across, are at the limit of the image resolution. Difference in vanadium, chromium and manganese distribution between ilmenite and titanomagnetite are clearly visible on X-Ray maps. Image generated on IOS's scanning electron microscope.*

ITEM 8: DEPOSIT TYPES

In his discovery report, Allard (1967) made comparisons between the magnetite series of the Lac Doré Complex and the ones of the Bushveld Complex in South Africa. Similar series are also reported in the Skaergaard Complex in Greenland, the Muskox Complex in Nunavut, Panzhihua Complex in China and the Cullin Complex in the British Tertiary Province. Another Archean equivalent is the Bell River Complex in the Matagami area, Quebec, Canada, which hosts the Iron-T Vanadium Project owned by VanadiumCorp. Such differentiated mafic intrusions are rather common, and many of them contain vanadium-bearing magnetite series. More than 80% of the vanadium produced worldwide is from such occurrences, which also includes near to 100% of the primary vanadium production.

METALLOGENY

Vanadium is a ubiquitous element, reported at levels reaching hundreds of ppm in almost any kind of rock. Vanadium is a polyvalent transition metal, with valences between V^{+2} to V^{+5}, which is the controlling factor in its distribution. Vanadium is a constituent in rare minerals from supergene environments, representing strong oxidizing conditions and where vanadium is present as tetravalent vanadyl $(V^{+4}O)^{+2}$ or pentavalent vanadate radical $(V^{+5}O_4)^{-3}$ such as pentagonite, mounanaite, bannermanite and more than 200 exotic mineral species.

In reducing systems, V^{+2} has a chemical behaviour similar to iron in regards to most common ferromagnesian minerals, such as chlorite or pyroxene, where it substitutes into M^{+2} sites. Vanadium therefore does not tend to concentrate in a specific mineral in silicate dominated magmatic, hydrothermal or metamorphic systems. Inversely, under higher oxygen fugacity, vanadium in its V^{+3} state tends to substitute against Fe^{+3} in minerals such as magnetite (coulsonite or vuorelainenite are the vanadium end-member of the spinel family $(Fe\text{-}Mn)^{+2}V_2^{+3}O_4$) and hemo-ilmenite (karelianite V_2O_3 end-member as a diadochic substitution with $FeTiO_3$). Some other complex vanadium-titanium minerals are known, such as kyzylkumite and schreyerite, which are noted for reference only.

Massive iron oxide precipitation can occur in differentiating mafic magmatic systems, such as layered complexes. Triggering of this precipitation is apparently caused by silica saturation related to assimilation of the host rocks during migration and emplacement of the magma and by melting of the roof-rocks and the development of granophyre. Precipitation of these iron and titanium oxides may take on the form of rhythmically layered series such as in the Lac Doré Complex or in the Bushveld Complex, as pockets of massive oxide such as the "*pipes*" in the Bushveld Complex or the urbainite within the St-Urbain Anorthosite, or as broad horizons such as nelsonites (ilmenite-apatite-magnetite magmatic rocks typically associated with anorthosite) and cumberlandite (magnetite-ilmenite-olivine magmatic rocks typically associated with troctolite) deposits in the Lac St-Jean Anorthosite. In all cases, vanadium is preferentially partitioned into the first oxides to precipitate. Only magnetite layered series and magnetite pipes are economically mined as vanadium sources. Vanadium within ilmenite ore, such as from Lac Allard mine, is considered a contaminant in respect to titanium production. Vanadium-bearing titanomagnetite cannot be optically distinguished from vanadium-poor titanomagnetite on the basis of its appearance or physical characteristics, it necessitates assaying.

Given layered mafic complexesare large geological features, spanning tens to hundreds of square kilometres in area, they can host extremely large magnetite deposits. Such occurrences are easily identified in mineral exploration due to their prominent aeromagnetic signature. However, in most occurrences, layers are thin or the magnetite is disseminated, rendering mining of these deposits non-economical. The titanium content of such magnetite makes them not suitable for iron production through conventional blast furnace process, and no such smelting operation is known to the author in occidental countries.

ITEM 9: EXPLORATION

A large amount of exploration work was conducted on the East and West deposits by prior owners. The most detailed work, excluding drilling, was conducted by IOS on behalf of McKenzie Bay Resources, and are considered as superseding previous work done by SOQUEM or by the *Ministère des Richesses Naturelles*.

VanadiumCorp conducted two trenching programs, two limited drilling programs and three ground magnetometric surveys between 2007 and 2013, plus some road improvement and a GPS survey (Aurus, 2013). IOS conducted a field program on behalf of VanadiumCorp in fall 2014, which included a DGPS survey of drill collars, some verification and sampling of the 1997 trenches, re-mapping of the 2008 trenches and re-logging of the 2013 cores.

GROUND MAGNETOMETRIC SURVEYS

Three ground magnetometric surveys were conducted on behalf of VanadiumCorp, covering the **Lac Doré** (Tshimbalanga, 2009, 2012) and **Lac Doré North** (Tshimbalanga and Hubert, 2009) properties ***(table 7)***. All three surveys were conducted in a similar manner by Geosig Inc., from Québec City, meaning they can be merged. The surveys were conducted using 2 GSM-19WV Overhauser (neutron precession) magnetometers, a mobile and a stationary unit. Lines were spaced every 100 metres, oriented N315^o, plus a baseline and tie lines. The location of station was measured with handheld GPS devices. A base station was established and calibrated at 57,000 γ, providing an accuracy of 1 γ. Isopleth maps and profiles were provided. No vertical or horizontal gradient was measured or calculated, and no modelling was generated. Results from these surveys were concatenated and re-gridded as a single map (***figures 9A*** and ***9B***).

For the purpose of the ground magnetometric survey, the former McKenzie Bay's picketed line network was refreshed and surveyed (Aurus, 2013), although former line numbering was not respected.

Year	Property	Length	Line	Line-Spacing	Stations-Spacing
2009	Lac Doré	35 km	35	100 m	12.5 m
2009	Lac Doré North	66.7 km	38	50/100 m	12.5 m
2012	Lac Doré	45 km	53	50 m	12.5 m

Table 7*: Magnetometric Surveys.*

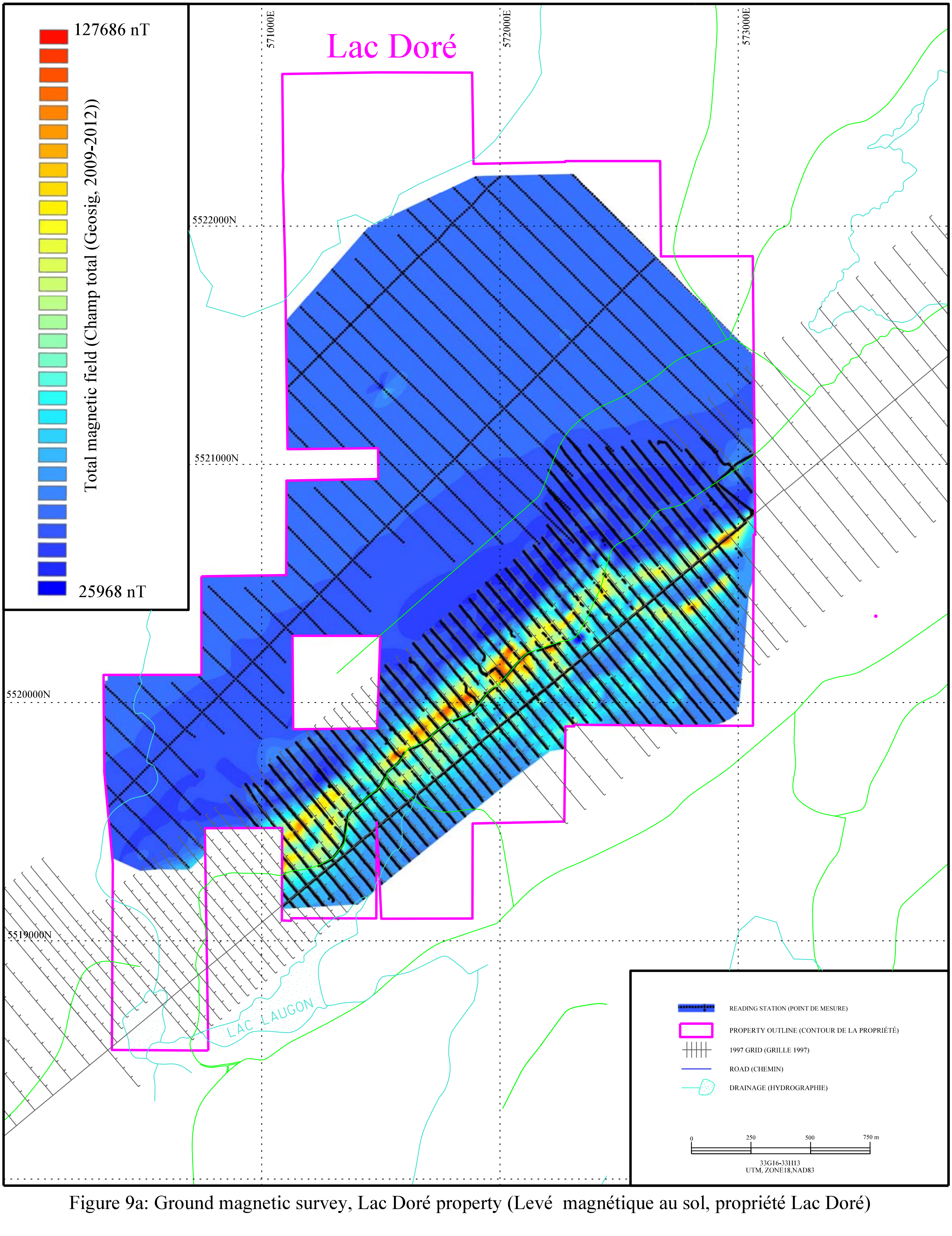


Figure 9a: Ground magnetic survey, Lac Doré property (Levé magnétique au sol, propriété Lac Doré)

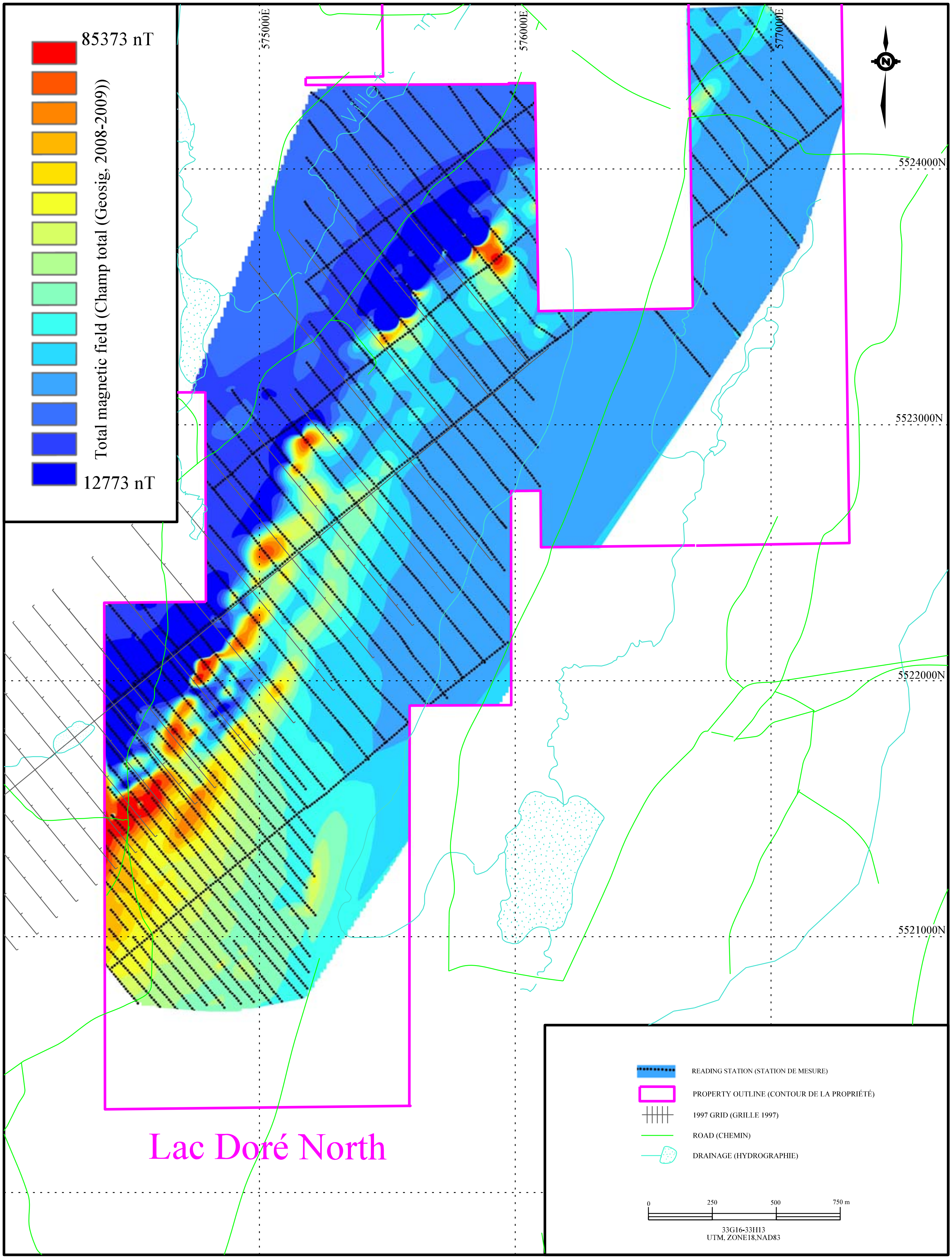


Figure 9b: Ground magnetic survey, Lac Doré North property (Levé magnétique au sol, propriété Lac Doré North)

2008 AND 2009 STRIPPING PROGRAM

Stripping programs were conducted by VanadiumCorp on the southwestern extremity of the **Lac Doré North** property in 2008 and 2009 (***picture 12***). The area targeted seems to coincide with the most intense ground magnetometric anomaly reported (Tshimbalanga and Hubert, 2009).

No report, sample location, maps, field notes or assay databases regarding this stripping was made available to the authors. For this reason, the stripping was re-mapped in the fall 2014 by IOS. Most sampling tags were still present, and assays available from certificates were relocated as possible (Block, 2015).

Picture 12*: View of the main stripping area excavated in 2008 on Lac Doré North property, as currently visible. Notice the massive magnetite layer (dark band) in the middle of the picture.*

2012: CHANNEL SAMPLING

Evidence of channel sampling conducted in the summer of 2012 on the McKenzie Bay trenches in **Lac Doré** property was noticed. No data or reports were made available to the authors, nor any report filed for assessment.

2014 PROGRAM

In the fall of 2014, a brief field program was conducted in preparation of the current resource estimate. It included:

- Locating the historic drill holes collars and surveying them with a DGPS.
- Mapping the 2008-2009 trenches.
- Verifying the current status of 1997 trenches and sampling any neglected intervals.
- Re-sampling and re-logging of 2013 drill core.

2015 PROGRAM

In the fall of 2015, a brief compilation program was conducted on CDC 2429553, which is embedded in BlackRock Metals' Armitage property, for the purpose of assessment filing (Joly, 2015). This brief work indicated that hole AE-24-02, drilled by BlackRock for the purpose of their resources definition, is collared within this claim.

2016 PROGRAM

In summer 2016, two short mapping programs were conducted. The first, for assessment filing purpose, includes a brief reconnaissance mapping in the Lac Doré Extension property, to the north of the deposit (Arguin, 2016). Only outcrops of granitic rocks of the Chibougamau Pluton were observed.

The second program consisted in a detail mapping of the Trench 19+50 east, which was widely excavated by McKenzie Bay Resources in 1997. This program is part of a doctoral study on mineral textural relationships and contaminant distributions (Arguin, in progress), this mapping included extensive petrography work (Arguin, 2016).

2017 PROGRAM

In summer 2017, a short sampling program was conducted on Trench 19+50, in complement of 2016 program (Arguin, 2017).

In autumn 2017, a short sampling program was conducted on CDC 2429553 (Joly and Glencross, 2017).

VALIDITY OF AVAILABLE SURVEYS

The ground magnetometric surveys were conducted according to the industry standards but are superseded by the BlackRock Metals high resolution helicopter-borne survey.

As no report, sample location, maps, field notes or assay database regarding the stripping conducted by VanadiumCorp was filed with the government or made available to the authors, the validity of the trenching programs will not be commented on.

INDEPENDENCE OF CONTRACTORS

Geosig Inc. is a well established contractor, the independence and integrity of whom is not questioned.

The trenching program was conducted by Glen McCormick Exploration, which was likely not independent from VanadiumCorp.

The subsequent mapping and sampling programs were conducted by IOS, considered as an independent contractor from VanadiumCorp.

ITEM 10: DRILLING AND CHANNEL SAMPLING

VanadiumCorp completed only limited drilling to date. Ten (10) short exploration holes were drilled on the ***Lac Doré North*** property in 2009, and four (4) confirmation holes were drilled in 2013 on ***Lac Doré*** property. This is in contrast with the amount of historical drilling completed by previous owners, which was the basis for the current resource estimate. Due to the importance of these historic drill holes and their use in the resource estimate, they will be described in detail in the current section (***item 10***).

The location of trenches and drill holes from the **Lac Doré** vanadium project are summarized in ***figures 10A*** and ***10B***. The sampling and assaying procedures are provided in ***item 11***. The details of trenches and a collection of sections of drill hole were provided in Girard (2014) but are not considered relevant to the current report.

1997 McKENZIE BAY RESOURCES TRENCHING

The 1997 trenching campaign carried out IOS on behalf of McKenzie Bay Resources provided quite systematic channel samples on more or less continuous section across the East and West deposits, on trenches spaced every 100 metres (Tremblay, 1998). A gap in the trenching pattern exists between 0+50E at the West end of the West deposit, and 2+00W due to topographic constraints. These trenches are quite systematic and continuous, being interrupted only on topographic accidents or to avoid to ripping out the road. Location of the trenches was established with the use of a magnetometer, to locate the limits of the mineralization. Land surveying was made in 1997 and recently reviewed (Aurus, 2013). Overburden was typically less than a metre thick. The quality of these trenches is sufficient to consider them as equivalent to horizontal drill holes for the purpose of the current resource estimate. Trenches within the actual VanadiumCorp's **Lac Doré** vanadium project are listed in ***table 8***.

It should be noted that segments of trenches 2+50E, 3+50E, 4+50E, 5+50E, 2+00W, 3+00W and 4+00W are partly located on BlackRock Metals property.

No trenching was undertaken on Northeast deposit by McKenzie Bay Resources.

Deposit	Line	Station from	Station to	Length (m)	Stratigraphy
East	24+50E	0+72S	3+66N	438	P0-P1-P2-P3
East	23+50E	0+00	3+40.5N	340.52	P0-P1-P2
East	22+50E	0+37S	3+38N	375	P0-P1-P2
East	21+50E	0+19N	2+66N	246.63	P2

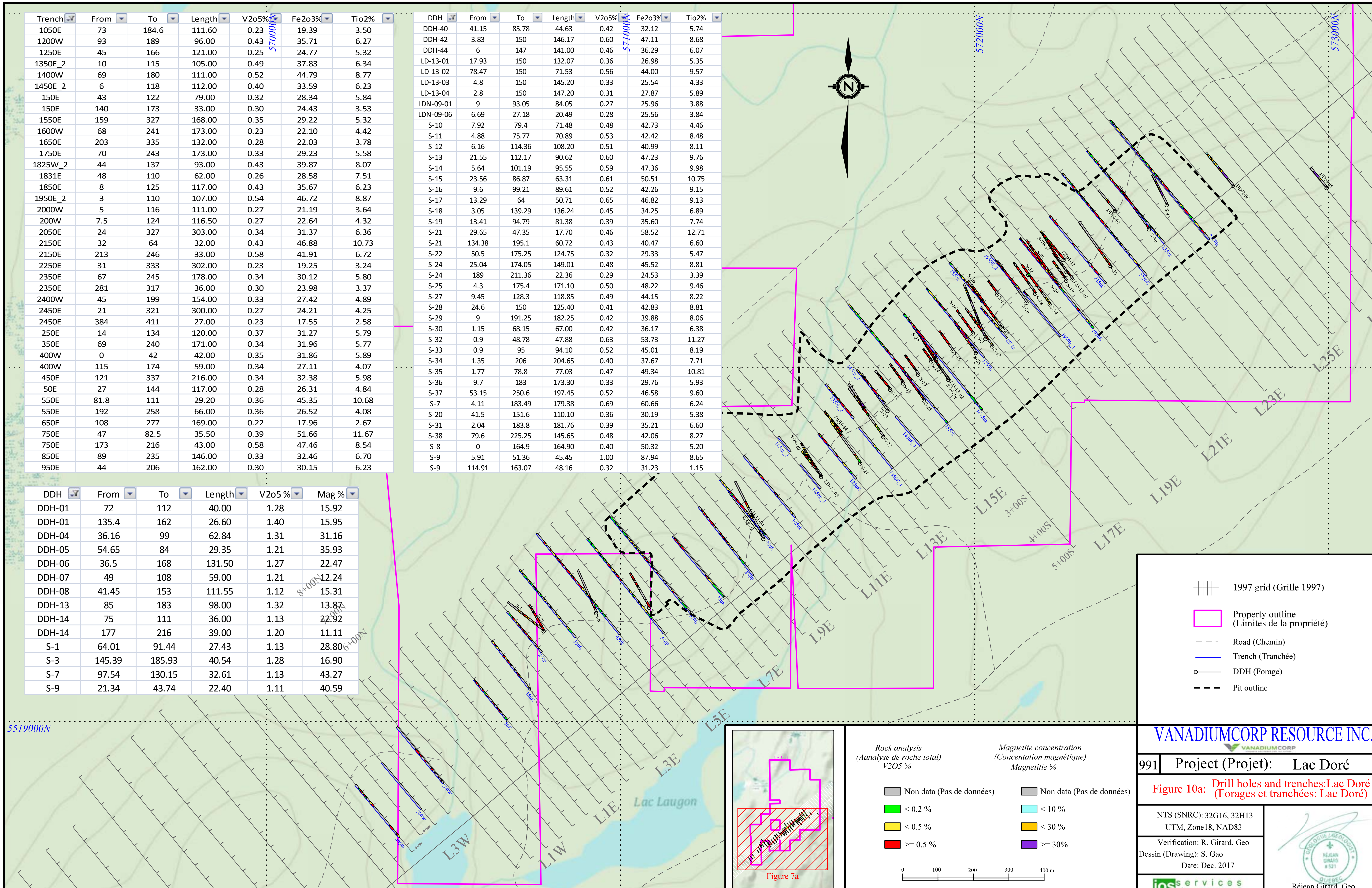
Deposit	Line	Station from	Station to	Length (m)	Stratigraphy
East	20+50E	0+57S	2+72N	328.97	P0-P1-P2-P3
East	19+50E	0+13S	1+52N	164.9	P2-P3
East	19+50E	1+60N	2+88N	128.26	P1-P2
East	18+50E	1+86N	3+41N	155	P0-P1-P2-P3
East	18+31E	0+75N	1+90N	115.22	P2-P3
East	18+25W	1+00N	1+46N	45.74	P2-P3
East	18+25W	2+50N	3+88N	138.22	P0-P1-P2
East	17+50E	0+74N	3+30N	255.8	P0-P1-P2
East	16+50E	0+38S	3+12N	349.76	P0-P1-P2-P3
East	15+50E	0+00	4+37N	437.24	P0-P1-P2-P3
East	14+50E	0+08S	1+00.5N	108.57	P3
East	14+50E	1+55N	2+77N	122.13	P1-P2
East	13+50E	0+15N	1+64N	148.93	P3
East	13+50E	1+79N	3+04N	124.6	P1-P2
East	12+50E	0+44N	2+10.5N	166.44	P2-P3
East	11+50E	0+87N	1+76.5N	89.51	P2-P3
East	11+50E	2+21N	2+75N	54.22	P1
West	10+50E	0+70N	2+96N	225.97	P1-P2-P3
West	9+50E	0+67N	2+85N	218	P1-P2-P3
West	8+50E	0+20N	2+67.5N	247.51	P1-P2-P3
West	7+50E	0+25N	2+50N	224.6	P1-P2-P3
West	6+50E	0+50N	2+35N	185	P0-P1-P2-P3
West	6+50E	2+65N	4+01.5N	136	P0-P1-P2-P3
West	5+50E	0+54N	1+15N	61	P3
West	5+50E	3+45N	3+98N	53	P0
West	4+50E	4+30N	4+99N	68.65	P0-P1
West	3+50E	3+85N	4+50N	65	P0-P1
West	2+50E	2+55N	3+85N	130	P0-P1-P2
West	1+50E	1+73N	3+47N	174.14	P1-P2-P3
West	0+50E	1+50N	2+97N	146.67	P1-P2-P3
West	2+00W	1+25N	3+32N	206.7	P1-P2
West	3+00W	1+09N	2+15N	171.67	P2
West	4+00W	0+84N	0+95N	11	P2

Table 8*: Location of the trenches made in 1997. Segments of these trenches belonging to BlackRock Metals were excluded.*

Trench	From	To	Length	V2o5%	Fe2o3%	Tio2%
1050E	73	184.6	111.60	0.23	19.39	3.50
1200W	93	189	96.00	0.43	35.71	6.27
1250E	45	166	121.00	0.25	24.77	5.32
1350E_2	10	115	105.00	0.49	37.83	6.34
1400W	69	180	111.00	0.52	44.79	8.77
1450E_2	6	118	112.00	0.40	33.59	6.23
150E	43	122	79.00	0.32	28.34	5.84
150E	140	173	33.00	0.30	24.43	3.53
1550E	159	327	168.00	0.35	29.22	5.32
1600W	68	241	173.00	0.23	22.10	4.42
1650E	203	335	132.00	0.28	22.03	3.78
1750E	70	243	173.00	0.33	29.23	5.58
1825W_2	44	137	93.00	0.43	39.87	8.07
1831E	48	110	62.00	0.26	28.58	7.51
1850E	8	125	117.00	0.43	35.67	6.23
1950E_2	3	110	107.00	0.54	46.72	8.87
2000W	5	116	111.00	0.27	21.19	3.64
200W	7.5	124	116.50	0.27	22.64	4.32
2050E	24	327	303.00	0.34	31.37	6.36
2150E	32	64	32.00	0.43	46.88	10.73
2150E	213	246	33.00	0.58	41.91	6.72
2250E	31	333	302.00	0.23	19.25	3.24
2350E	67	245	178.00	0.34	30.12	5.80
2350E	281	317	36.00	0.30	23.98	3.37
2400W	45	199	154.00	0.33	27.42	4.89
2450E	21	321	300.00	0.27	24.21	4.25
2450E	384	411	27.00	0.23	17.55	2.58
250E	14	134	120.00	0.37	31.27	5.79
350E	69	240	171.00	0.34	31.96	5.77
400W	0	42	42.00	0.35	31.86	5.89
400W	115	174	59.00	0.34	27.11	4.07
450E	121	337	216.00	0.34	32.38	5.98
50E	27	144	117.00	0.28	26.31	4.84
550E	81.8	111	29.20	0.36	45.35	10.68
550E	192	258	66.00	0.36	26.52	4.08
650E	108	277	169.00	0.22	17.96	2.67
750E	47	82.5	35.50	0.39	51.66	11.67
750E	173	216	43.00	0.58	47.46	8.54
850E	89	235	146.00	0.33	32.46	6.70
950E	44	206	162.00	0.30	30.15	6.23

DDH	From	To	Length	V2o5%	Fe2o3%	Tio2%
DDH-40	41.15	85.78	44.63	0.42	32.12	5.74
DDH-42	3.83	150	146.17	0.60	47.11	8.68
DDH-44	6	147	141.00	0.46	36.29	6.07
LD-13-01	17.93	150	132.07	0.36	26.98	5.35
LD-13-02	78.47	150	71.53	0.56	44.00	9.57
LD-13-03	4.8	150	145.20	0.33	25.54	4.33
LD-13-04	2.8	150	147.20	0.31	27.87	5.89
LDN-09-01	9	93.05	84.05	0.27	25.96	3.88
LDN-09-06	6.69	27.18	20.49	0.28	25.56	3.84
S-10	7.92	79.4	71.48	0.48	42.73	4.46
S-11	4.88	75.77	70.89	0.53	42.42	8.48
S-12	6.16	114.36	108.20	0.51	40.99	8.11
S-13	21.55	112.17	90.62	0.60	47.23	9.76
S-14	5.64	101.19	95.55	0.59	47.36	9.98
S-15	23.56	86.87	63.31	0.61	50.51	10.75
S-16	9.6	99.21	89.61	0.52	42.26	9.15
S-17	13.29	64	50.71	0.65	46.82	9.13
S-18	3.05	139.29	136.24	0.45	34.25	6.89
S-19	13.41	94.79	81.38	0.39	35.60	7.74
S-21	29.65	47.35	17.70	0.46	58.52	12.71
S-21	134.38	195.1	60.72	0.43	40.47	6.60
S-22	50.5	175.25	124.75	0.32	29.33	5.47
S-24	25.04	174.05	149.01	0.48	45.52	8.81
S-24	189	211.36	22.36	0.29	24.53	3.39
S-25	4.3	175.4	171.10	0.50	48.22	9.46
S-27	9.45	128.3	118.85	0.49	44.15	8.22
S-28	24.6	150	125.40	0.41	42.83	8.81
S-29	9	191.25	182.25	0.42	39.88	8.06
S-30	1.15	68.15	67.00	0.42	36.17	6.38
S-32	0.9	48.78	47.88	0.63	53.73	11.27
S-33	0.9	95	94.10	0.52	45.01	8.19
S-34	1.35	206	204.65	0.40	37.67	7.71
S-35	1.77	78.8	77.03	0.47	49.34	10.81
S-36	9.7	183	173.30	0.33	29.76	5.93
S-37	53.15	250.6	197.45	0.52	46.58	9.60
S-7	4.11	183.49	179.38	0.69	60.66	6.24
S-20	41.5	151.6	110.10	0.36	30.19	5.38
S-31	2.04	183.8	181.76	0.39	35.21	6.60
S-38	79.6	225.25	145.65	0.48	42.06	8.27
S-8	0	164.9	164.90	0.40	50.32	5.20
S-9	5.91	51.36	45.45	1.00	87.94	8.65
S-9	114.91	163.07	48.16	0.32	31.23	1.15

DDH	From	To	Length	V2o5 %	Mag %
DDH-01	72	112	40.00	1.28	15.92
DDH-01	135.4	162	26.60	1.40	15.95
DDH-04	36.16	99	62.84	1.31	31.16
DDH-05	54.65	84	29.35	1.21	35.93
DDH-06	36.5	168	131.50	1.27	22.47
DDH-07	49	108	59.00	1.21	12.24
DDH-08	41.45	153	111.55	1.12	15.31
DDH-13	85	183	98.00	1.32	13.87
DDH-14	75	111	36.00	1.13	22.92
DDH-14	177	216	39.00	1.20	11.11
S-1	64.01	91.44	27.43	1.13	28.80
S-3	145.39	185.93	40.54	1.28	16.90
S-7	97.54	130.15	32.61	1.13	43.27
S-9	21.34	43.74	22.40	1.11	40.59



VANADIUMCORP RESOURCE INC.

991 Project (Projet): Lac Doré

Figure 10a: Drill holes and trenches:Lac Doré (Forages et tranchées: Lac Doré)

NTS (SNRC): 32G16, 32H13
UTM, Zone18, NAD83

Verification: R. Girard, Geo
Dessin (Drawing): S. Gao
Date: Dec. 2017

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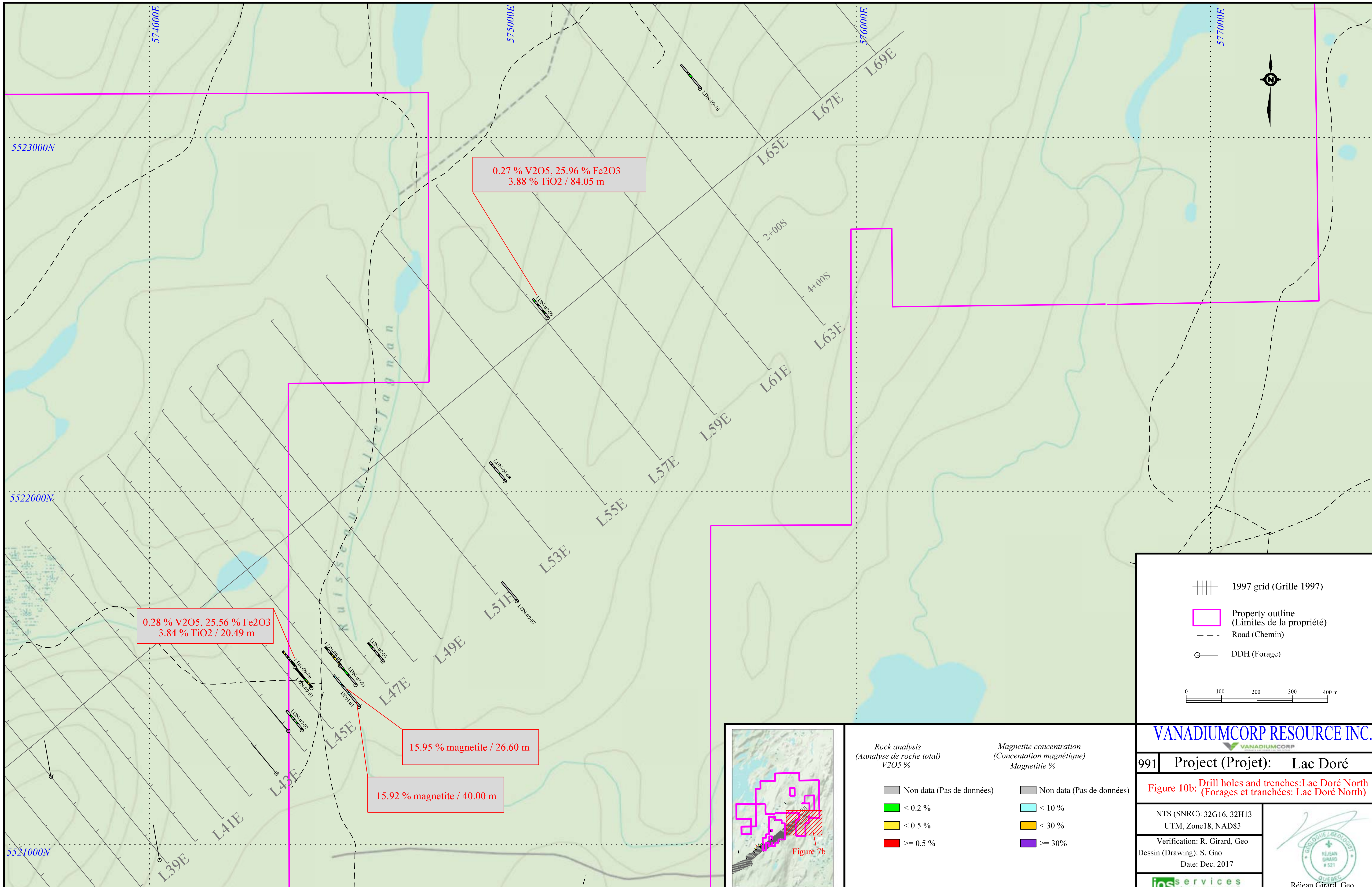
Réjean Girard, Geo



574000E
575000E
576000E
577000E
5523000N
5522000N
5521000N
0.27 % V2O5, 25.96 % Fe2O3
3.88 % TiO2 / 84.05 m
0.28 % V2O5, 25.56 % Fe2O3
3.84 % TiO2 / 20.49 m
15.95 % magnetite / 26.60 m
15.92 % magnetite / 40.00 m
L39E
L41E
L43E
L45E
L47E
L49E
L51E
L53E
L55E
L57E
L59E
L61E
L63E
L65E
L67E
L69E
2+00S
4+00S
1997 grid (Grille 1997)
Property outline
(Limites de la propriété)
Road (Chemin)
DDH (Forage)
0 100 200 300 400 m
Figure 7b
Rock analysis
(Aanalyse de roche total)
V2O5 %
Non data (Pas de données)
< 0.2 %
< 0.5 %
>= 0.5 %
Magnetite concentration
(Concentation magnétique)
Magnetitie %
Non data (Pas de données)
< 10 %
< 30 %
>= 30%
VANADIUMCORP RESOURCE INC.
991
Project (Projet): Lac Doré
Figure 10b: Drill holes and trenches:Lac Doré North
(Forages et tranchées: Lac Doré North)
NTS (SNRC): 32G16, 32H13
UTM, Zone18, NAD83
Verification: R. Girard, Geo
Dessin (Drawing): S. Gao
Date: Dec. 2017
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Réjean Girard, Geo

1958 DRILLING BY JALORE MINING LTD.

Six holes were drilled by Jalore Mining in 1958, 5 of which are within the main **Lac Doré** property. In the Jalore Mining report, hole's azimuth was indicated as S28°E in the old four-quadrant system, which must be translated as N152° in the more conventional single quadrant system. However, every subsequent report indicates them as towards northwest. Since drill collars are not available anymore, field verification is not possible. These holes are thus considered or oriented N308° to N339° so about 20° clockwise of the actual grid. The core was AX in diameter, and was splitted for sampling. Jalore Mining assayed the cores for iron and titanium in their private laboratory, and only the results indicated in the log are available. The cores were recovered by the MRN in 1970, quarter-splitted and submitted at *CRM* (*Centre de Recherches Minérales*, a former governmental metallurgy research facility, currently COREM) for vanadium assaying and for Davis tube test to concentrate magnetite (Kish, 1971; Castonguay, 1967). The cores were not preserved. The information obtained from these holes is of little use and not relevant to the current resource estimation.

1959 DRILLING BY TREPAN MINING

A series of five holes (T-1 to T-5) were drilled by Trepan Mining South-East of Armitage lake, on the Armitage deposit (BlackRock Metals) in 1959 (Bischoff, 1959). Being located outside the outline of VanadiumCorp properties, no attempt was made to evaluate them, and they were not included in the current resource estimation.

1970-1974 DRILLING BY THE QUÉBEC GOVERNMENT

Ten (10) of the 13 holes drilled by the *Ministère des Richesses Naturelles* are located within **Lac Doré** property, nine (9) of which are on the East deposit. Two (2) of the remaining holes are on the South-West deposit while the last two (2) are on the West deposit but outside VanadiumCorp properties (on BlackRock Metals property).

Four (4) holes were drilled in 1970 (DDH-07 to DDH-10), and logged by contract geologist of the MRN (Kish, 1971). Another nine (9) holes (DDH-11 to DDH-19) were drilled in 1974 (Avramtchev, 1975), from which only logs are available (***table 9***) without detailed report. The holes are oriented approximately parallel to current grid-lines, i.e. between N320° and N330°. The MRN grid was oriented with an east-west baseline and due north lines, which explains why holes are indicated to an angle to the lines in the logs. No evidence of this grid remains in the field. Casings were not left behind and old drill pads are not readily visible. However, evidences of the pads or access trails were recently located (Block, 2015). Logging and footage markings on these cores were not done in a conventional manner, without inserting marker blocks at the end of each tube.

Accurate metering and re-logging of these cores is not possible. Furthermore, significant handling and transport of the core boxes caused the split cores to shift and mix in the boxes. Finally, the cores resided for 20 years in the core-racks of Niobec Mine, near the tailing pond and are thus heavily contaminated with niobium-rich carbonatite dust. Cores are BQ in diameter and were sampled by half-splitting. Drill logs were obtained from assessment files, as conventional paper logs, which were captured into a Microsoft Office Excel spreadsheet by IOS in 1997, and converted to Geotic's database for the purpose of the current report. The cores are currently stored at a BlackRock Metals facility, but of little use due to their poor state of conservation.

The quality and level of detail of the logging by the MRN is adequate except for potential issues with depth measurement. There is no rock quality designation (RQD), density, photographs or other measurements available. Precision of the azimuth is uncertain, considering the magnetic deviation occurring on the deposit, and the absence of GPS devices which did not exist at that time. Orientation was probably made by aligning the rig with the lines, the quality of which cannot be verified. The plunge of the holes was measured with acid tests. Sampling procedures are not described nor is the chain of custody. Only Davis tube magnetite analyses are available for the 1970 holes conducted at CRM. Averages of head grade analysis are reported, but individual analyses were not disclosed. Holes drilled in 1974 have both head grade and magnetite concentrate assays.

The MRN holes are considered of sufficient reliability for the current calculation of inferred resources. However, they should be excluded from any subsequent calculations of the indicated resource.

Owner	Line	Station	Note	UTMX-83	UTMY-83	UTMZ	Précision XY
Apella Resources Inc.	20+83E	0+88N	DGPS-2014-Collar	572276.951	5520245.674	505.35	1
Apella Resources Inc.	16+31E	0+92N	DGPS-2014-Collar	571924.704	5519963.991	499.822	1
Apella Resources Inc.	12+26E	1+11N	DGPS-2014-Collar	571565.328	5519689.772	497.671	1
Apella Resources Inc.	9+45E	1+00N	DGPS-2014-Collar	571395.498	5519531.445	513.247	1
Apella Resources Inc.	45+30E	3+74S	DGPS-2014-Collar	574456.718	5521443.34	461.374	1
Apella Resources Inc.	44+32.6E	4+50S	DGPS-2014-Collar	574427.135	5521324.953	459.034	1
Apella Resources Inc..	46+31.4E	4+46S	DGPS-2014-Collar	574581.287	5521451.879	454.796	1
Apella Resources Inc.	46+31.4E	3+78S	DGPS-2014-Collar	574537.359	5521503.952	457.972	1
Apella Resources Inc.	47+32.7E	4+44.5S	DGPS-2014-Collar	574658.156	5521515.61	457.655	1
Apella Resources Inc.	45+30E	3+00S	DGPS-2014-Collar	574412.741	5521500.6	458.99	1
Apella Resources Inc.	51+34.7E	5+58S	DGPS-2014-Collar	575039.042	5521685.824	474.514	1
Apella Resources Inc.	53+22.5E	2+70.5S	DGPS-2014-Collar	575003.942	5522066.281	464.567	1

Owner	Line	Station	Note	UTMX-83	UTMY-83	UTMZ	Précision XY
Apella Resources Inc.	57+07E	0+10N	GPS-2014-PAD	575127	5522491	466	5
Apella Resources Inc.	64+51E	2+40N	DGPS-2014-Collar	575536.566	5523137.464	486.576	1
Jalore Mining	25+00E	2+40N	Not located				
Jalore Mining	39+96.96E	1+78N	Not located				
Jalore Mining	46+30.94E	1+81N	Not located				
Jalore Mining	36+30.94E	2+20. N	Not located				
Jalore Mining	31+82E	1+86N	Not located				
McKenzie Bay Ressources ltd	46+00E	5+00S	GPS-2014-PAD	574593	5521388	448	3
McKenzie Bay Ressources ltd	28+00E	1+75S	GPS-2014-PAD	572986	5520499	527	5
McKenzie Bay Ressources ltd	26+00E	0+00	GPS-2014-PAD	572714	5520513	503	5
McKenzie Bay Ressources ltd	44+00E	4+25S	GPS-2014-PAD	574392	5521318	457	10
McKenzie Bay Ressources ltd	23+00E	1+60N	GPS-2014-PAD	572396	5520439	487	10
McKenzie Bay Ressources ltd	21+00E	1+50N	GPS-2014-PAD	572251	5520300	494	10
McKenzie Bay Ressources ltd	13+00E	1+70N	GPS-2014-PAD	571622	5519813	497	10
MERN	36+92.15E	2+19.42N	GPS-2014-PAD	571762	5519934	-	10
MERN	37+32.72E	2+12.58N	GPS-2014-PAD	571799	5519951	-	10
MERN	37+81.94E	2+07.09N	GPS-2014-PAD	571841	5519976	-	10
MERN	38+35.16E	2+13.6N	GPS-2014-PAD	571878	5520013	-	10
MERN	39+0.43E	2+5.82N	GPS-2014-PAD	571948	5520062	485	10
MERN	39+74.95E	2+11.27N	GPS-2014-PAD	571996	5520093	486	10
MERN	40+96.02E	2+59.23N	GPS-2014-PAD	572064	5520202	486	10
MERN	41+74.14E	1+97.18N	DGPS-1997-Pad	572177.46	5520217.64	493.78	3
MERN	42+75.36E	1+68.81N	GPS-2014-PAD	572268	5520244	495	10
MERN	25+00E	2+40.37N	Not located				
SOQUEM	35+00E	1+00N	GPS-2014-PAD	571688	5519724	487	10
SOQUEM	36+00E	1+25N	DGPS-1997-Pad	571748.56	5519812.24	503.53	3
SOQUEM	36+50E	1+75N	GPS-2014-PAD	571753	5519877	485	5
SOQUEM	40+50E	1+80.5N	DGPS-1997-Pad	572124.86	5520145.34	498.35	5
SOQUEM	37+50E	1+41N	DGPS-2014-Collar	571851.264	5519897.838	498.718	1
SOQUEM	41+50E	1+93N	Calculated from grid	572152.96	5520192.14	495.3	15
SOQUEM	38+50E	2+11N	GPS-2014-PAD	571878	5520022	485	10
SOQUEM	39+50E	1+61N	GPS-2014-PAD	571998	5520035	492	5
SOQUEM	42+50E	1+75N	Calculated from grid	572244.46	5520237.34	493.78	15
SOQUEM	40+50E	2+69N	GPS-2014-PAD	572021	5520179	487	10
SOQUEM	42+00E	2+50N	DGPS-2014-Collar	572146.338	5520252.115	497.514	1

Owner	Line	Station	Note	UTMX-83	UTMY-83	UTMZ	Précision XY
SOQUEM	42+50E	2+62N	Calculated from grid	572193.26	5520308.34	481.58	15
SOQUEM	42+00E	1+50N	DGPS-1997-Pad	572218.16	5520187.14	499.87	5
SOQUEM	40+50E	1+50N	DGPS-1997-collet	572388.36	5520296.34	496.21	3
SOQUEM	45+50E	1+50N	DGPS-2014-Collet	572487.544	5520381.272	504.867	1
SOQUEM	40+00E	1+50N	DGPS-2014-Collar	572044.598	5520050.242	495.055	1
SOQUEM	34+00E	1+50N	DGPS-2014-Collar	571565.418	5519689.618	497.632	1
SOQUEM	43+00E	1+75N	Calculated from grid	572265.7	5520278.7	493	15
SOQUEM	38+50E	1+50N	DGPS-2014-Collar	571924.697	5519963.96	499.824	1
McKenzie Bay (Trench)	10+50E	0+70N	Calculated DGPS 1997	571498.06	5519584.14	502.62	5
McKenzie Bay (Trench)	11+50E	0+87N	Calculated DGPS 1997	571569.46	5519667.03	496.82	5
McKenzie Bay (Trench)	11+50	2+21N	Calculated DGPS 1997	571484.76	5519770.04	496.82	5
McKenzie Bay (Trench)	12+50E	0+44N	Calculated DGPS 1997	571669.46	5519693.44	499.87	5
McKenzie Bay (Trench)	13+50E	0+15N	Calculated DGPS 1997	571772.66	5519723.34	509.02	5
McKenzie Bay (Trench)	13+50E	1+79N	Calculated DGPS 1997	571662.46	5519863.94	501.4	5
McKenzie Bay (Trench)	14+50E	0+08S	Calculated DGPS 1997	571851.86	5519786.44	510.54	5
McKenzie Bay (Trench)	14+50E	1+55N	Calculated DGPS 1997	571750.76	5519906.44	502.62	5
McKenzie Bay (Trench)	1+50E	1+73N	Calculated DGPS 1997	570748.76	5519097.74	502.31	5
McKenzie Bay (Trench)	15+50E	0+00	Calculated DGPS 1997	571927.66	5519850.64	509.02	5
McKenzie Bay (Trench)	16+50E	0+38S	Calculated DGPS 1997	572025.76	5519887.84	510.54	5
McKenzie Bay (Trench)	17+50E	0+74N	Calculated DGPS 1997	572032.46	5520034.94	504.44	5
McKenzie Bay (Trench)	18+31E	0+75N	Calculated DGPS 1997	572095.56	5520090.54	501.4	5
McKenzie Bay (Trench)	18+50E	1+86N	Calculated DGPS 1997	572033.56	5520185.84	495.91	5
McKenzie Bay (Trench)	19+50E	0+13S	Calculated DGPS 1997	572247.96	5520095.84	505.97	5
McKenzie Bay (Trench)	19+50E	1+60N	Calculated DGPS 1997	572131.76	5520227.04	493.78	5
McKenzie Bay (Trench)	2+00W	1+25N	Calculated DGPS 1997	570504.46	5518832.74	481.58	5
McKenzie Bay (Trench)	20+50E	0+57S	Calculated DGPS 1997	572339.96	5520118.44	509.02	5
McKenzie Bay (Trench)	21+50E	0+19N	Calculated DGPS 1997	572374.96	5520245.24	495.3	5
McKenzie Bay (Trench)	22+50E	0+37S	Calculated DGPS 1997	572490.56	5520267.04	501.4	5
McKenzie Bay (Trench)	23+50E	0+00	Calculated DGPS 1997	572540.46	5520358.34	501.4	5
McKenzie Bay (Trench)	24+50E	0+72S	Calculated DGPS 1997	572667.46	5520368.94	509.02	5
McKenzie Bay (Trench)	2+50E	2+35N	Calculated DGPS 1997	570781.46	5519203.34	504.44	5
McKenzie Bay (Trench)	3+00W	1+09N	Calculated DGPS 1997	570440.76	5518760.24	484.02	5
McKenzie Bay (Trench)	3+50E	2+04N	Calculated DGPS 1997	570877.06	5519245.64	513.59	5
McKenzie Bay (Trench)	4+50E	1+30N	Calculated DGPS 1997	571002.06	5519254.14	524.26	5
McKenzie Bay (Trench)	0+50E	1+50N	Calculated DGPS 1997	570683.66	5519012.04	493.78	5

Owner	Line	Station	Note	UTMX-83	UTMY-83	UTMZ	Précision XY
McKenzie Bay (Trench)	5+50E	0+54N	Calculated DGPS 1997	571126.76	5519256.24	524.26	5
McKenzie Bay (Trench)	6+50E	0+50N	Calculated DGPS 1997	571201.86	5519314.14	521.21	5
McKenzie Bay (Trench)	7+50E	0+25N	Calculated DGPS 1997	571295.86	5519359.14	519.68	5
McKenzie Bay (Trench)	8+50E	0+20N	Calculated DGPS 1997	571379.26	5519420.34	505.97	5
McKenzie Bay (Trench)	9+50E	0+67N	Calculated DGPS 1997	571423.96	5519521.94	507.49	5

***Table 9**: List of drill holes and their collar location with accuracy.*

1979 DRILLING BY SOQUEM

In 1979, SOQUEM conducted the first resource definition with a 19 hole drill program, for 3325 metres, over the Eastern deposit (Dion, 1980) (***table 9***). Holes were spaced between 50 to 100 metres along sections, with sections every 100-200 metres. Holes were oriented parallel to the sections (N324°) plunging toward the north east. Collars were located by grid coordinates, but the grid was surveyed by a land surveyor, providing accurate relative location. However, the grid position was anchored on a local datum (E40+00.23, S0+25.07) no longer available. Some collars as well as most drilling pads were recently located and measured with a DGPS (Block, 2015). Drill cores are BQ in diameter, with near perfect recovery. Orientation of the holes was apparently based on grid lines, while the plunge was measured with acid tests. Sampling proceeded by splitting the cores and combining pieces typically of 3 metres in length. The cores were stored at Niobec mines until it was recovered by McKenzie Bay Resources in 1997. It is currently stored as BlackRock Metals facility in Chibougamau. The access to the cores was declined by BlackRock Metals. However, due to the numerous manipulations and transportation of cores, their integrity is uncertain. Assaying of headgrade was conducted by Chimitec (Québec City) while magnetite concentration using Davis tube was conducted by CRM on composite samples.

Results from SOQUEM drilling are considered as sufficiently reliable to be included in the current inferred resource estimation. However, it is uncertain if those results are reliable enough to be included in a subsequent resource category upgrade, mainly because of uncertainties related to assaying.

2001 EXPLORATION DRILLING BY McKENZIE BAY RESOURCES

In 2001, McKenzie Bay Resources conducted an exploration drilling campaign outside of the East and West deposits (Huss, 2003), for a total of 2187 metres (***table 9***). Of the 14 holes, one (DDH-01) is located on **Lac Doré North** property, while two (DDH-5 and DDH-6) are within **Lac Doré** property. The remaining 11 holes are collared on

BlackRock property. This drilling was conducted by L. Huss, professional geologist, under the author's supervision and is compliant with industry standards.

Holes were located to intersect the ground magnetometric anomaly, oriented parallel to the grid, and located according to grid pickets. They were NQ in diameter, and deviation of plunge was measured with acid tests, which precluded the measurement of downhole azimuth. Accurate collar locations were recently measured by DGPS for most holes. The cores are currently stored in BlackRock Metals facility, the access to which was declined to the author.

Only Davis tube magnetite concentrates were analyzed, without head grade analysis. Rejects were not preserved, so head grade analysis is not possible anymore. Samples were typically 3 metres in length, for a total of 497 samples. However, due to budgetary constraints, samples were not assayed until 2003, under the Cambior Option. They were then concatenated into 197 samples, typically 9 metres in length. Of these, 166 were selected for Davis tube testing and assaying of the magnetite concentrate.

The 2001 holes of McKenzie Bay Resources were not included in the current resource estimate, being located outside the East and West deposits. However, their quality is considered sufficient for an eventual inclusion.

2002 CONFIRMATION DRILLING BY SNC-LAVALIN

Under the supervision of SNC-Lavalin, and as part of their due diligence on the resources of the deposits, IOS conducted a three hole drill program, aiming to certify former SOQUEM and MRN results on the Eastern deposit (Boudreault, 2002) (***table 9***). These holes were not duplicates of former holes, as they test surface results obtained from trenching. The program was directed by Mr. Alexandre Boudreault, junior engineer, under the supervision of the first author during fall 2002. Holes were NQ in diameter, and located according to line pickets. Dips were measured with clinometer at collar, and by acid tests at depth, and thus which did not included the measurement of downhole azimuth.

The cores were logged according to industry standards and the information was recorded on a Microsoft Excel spreadsheet. However, these data were stored on floppy disk which is now corrupted and on backup-tapes which cannot be read by modern computers, which means they were not available in numerical format and need to be recaptured. RQD were measured, and were the only ones over the entire project. Sampling was done with a core splitter, for a total of 107 samples, plus QAQC materials. The cores are currently stored in a BlackRock facility, the access of which was declined to the author.

Additionally to these three drill holes, trench 11+50E was resampled for a length of 15 metres. Sampling proceeded with a diamond rock saw, cutting a 5 centimetres wide strip beside the former samples, for a total of 15 samples.

Samples were crushed and prepared at *Consortium de recherché minérale (COREM*) for head grade analysis. Davis tube testing was not conducted. Material from these samples is no longer available, and cannot be tested for magnetic concentration. The log description and sampling procedure were adequate. SNC-Lavalin holes were included in the current resource estimate.

2009 VANADIUMCORP DRILLING

In 2009, VanadiumCorp (recorded, at that time, as Apella Resources in assessment filing registry) conducted a drilling program on their **Lac Doré North** property, for a total of 10 holes representing 1129.94 metres of coring (***picture 13, table 9***). The program was conducted by Mr. Roger Moar, P.Geo, under the supervision of Mr. Christian Derosier, P.Geo. No report was produced on this program, only drill logs were submitted for assessment files, and only the Geotic drilling database was made available to the authors. Drilling sites were visited by the first author in the course of his mandatory visits and seem properly located and oriented. Accurate coordinates of collars were recently measured by DGPS. Casings were left on a few of the holes and capped with aluminium plugs. A wooden peg was inserted in the hole where no casing was left.

Cores were HQ in diameter, and were stored in a previously rented facility in Chibougamau which is now closed. It was recovered by the IOS and moved to its facility in Saguenay. The cores were examined by Gennady Ivanov, P. Geo, and the log reviewed. The logs were of adequate quality and sufficiently detailed. A downhole survey was conducted by Flex-it device. However, since Flex-it measurements are based on magnetic anisotropy, downhole azimuth measurements are not reliable. RQD, density or magnetic susceptibility were not measured, nor were photographs taken.

Samples were taken with the use of a diamond saw, a total of 254 composite samples consisting of segments of up to 3 metres in length. It was noted that wall rock to the titanomagnetite rich layers were not sampled. Samples were crushed and pulverized at the *Centre d'Étude appliquée sur le quaternaire (CEAQ-TJCM),* in Chibougamau, and shipped for assay at ALS Minerals in Val-d'Or.

Most of the holes are located on the west side of the Lac Doré North property, aiming to test the large magnetic anomaly and the magnetite layers visible on their trenches. Four

holes were testing other targets further east. Surprisingly, these do not coincide with magnetic anomaly, and their purpose is uncertain.
The holes were located outside the East and West deposits, and thus were not included in the current resource estimate.

Picture 13: *View of the capped casing of hole LDN-09-01, drilled for VanadiumCorp in 2009 on Lac Doré North property.*

2013 VANADIUMCORP DRILLING

In 2013, VanadiumCorp conducted a short drilling program of four holes on their **Lac Doré** property representing 600 metres of coring (***picture 14***). These drill holes aimed to duplicate former SOQUEM holes, as shown in ***table 10***. It should be noted that these duplicate holes were shorter than the original holes, with slightly different orientation and plunge, and that they were collared up to 20 metres away from the reported position of the original holes. Confusion in the labelled hole numbers were noted by the author between LD-13-03 (not existing in the field) and LD-13-04B (as indicated on the peg). The provided database also indicates that LD-13-04 is a twin of DDH-71-02 which does not exist, and considered as S-58-02. Finally, discrepancy was noted for LD-13-03, which is indicated as on section 34+00 in the provided database, but section 33+00 on the map.

2013 Hole	Historic SOQUEM hole	Line	Station
LD-13-01	S-77-31	43+00E	1+75N
LD-13-02	S-77-38	38+50E	1+50N
LD-13-03	S-77-20	33+00E	1+50N
LD-13-04	S-58-02	35+00E	1+75N

***Table 10**: 2013 confirmation drill holes equivalents.*

Holes drilled in 2013 were HQ in diameter. They were reportedly located with the use of handheld GPS, with downhole survey made from acid tests. Collars were all visited by the first author, and their DGPS location measured (Block, 2015). They were originally described by Mr. Christian Derosier, P.Geo, using a Geotic database. They were recently re-logged due to some deficiencies (Ivanov, 2015), and detailed photographs taken. RQD, recoveries and magnetic susceptibility were measured along with fracture description. Density measurements are not available. Half core was sampled with the use of a diamond saw, and samples shipped to the CEAQ-TJCM facilities in Chibougamau, for a total of 122 samples representing 317.05 metres of core. Cores were stored in a warehouse in Chibougamau until it was recovered and transferred to IOS facility in Saguenay. Coarse rejects were recovered from CEAQ-TJCM, re-assayed at COREM and magnetite concentrated by Davis tube.

***Picture 14**: Picture of the author in 2015 at the collar of hole LD-13-04B, drilled in 2013 by VanadiumCorp.*

MINERALIZED INTERSECTIONS

Mineralized intersections were published officially only for the 2009 (November 30th, 2009 press release) and 2013 programs (April 2nd, 2013 press release). Neither SOQUEM nor McKenzie Bay Resources published their intersections or calculated them in their reports. Intersections were initially calculated by the Girard (2014), using uniform parameters and *"Explorpac"* (*Gemcom*) software provided on ***figures 10A*** and ***10B***. McKenzie Bay Resources channel samples were included as "*horizontal holes*", assuming unsampled interval as barren. Segments of holes or trenches outside the property (within BlackRock Metals property), naming trenches 3+50E, 4+50E, 5+50E and 6+50E, as well as for drill holes S1 and S7, were not excluded. Constraints used for the current resource estimate (Girard et D'Amours, 2015) were different. A 3-D projection of the drill holes shows the grade distribution in ***figure 11***.

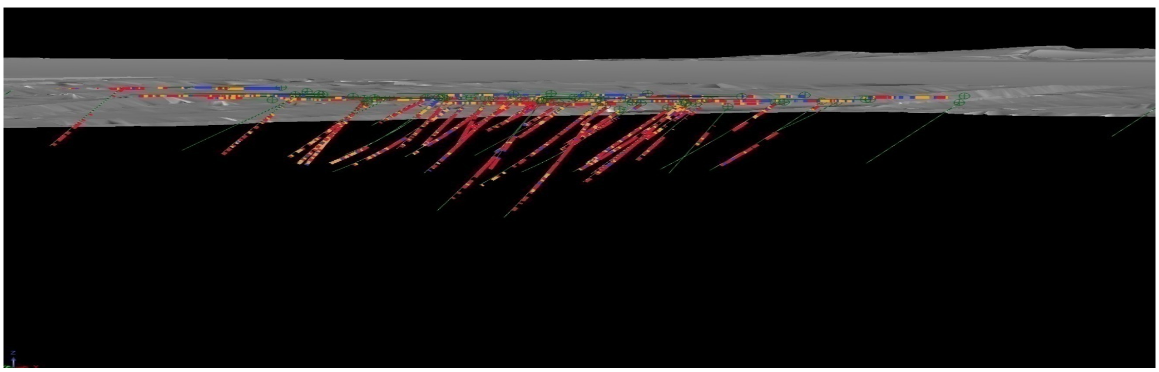


Figure 11*: 3-D projections of trenches and drill holes on East deposit, view from underneath the surface looking northward. Blue: 0.1-0.2% V_2O_5, Orange 0.2-0.5% V_2O_5, Red: >0.5% V_2O_5. Digital terrain model is from the aeromagnetic survey.*

DISCUSSION ABOUT DRILLING RESULTS

The VanadiumCorp Lac Doré properties include 54 drill holes, mostly from historic drill programs. The majority of these drill holes are located on **Lac Doré** property, specifically on the Eastern deposit. Of the 35 holes available on the Eastern deposit, 31 are considered as sufficiently documented and reliable to be used for the calculation of inferred resources. The remaining four (4) holes are not sufficiently documented to be incorporated into resource estimation. Drilling on the Western deposit is sparse with only four (4) holes, two of which being outside VanadiumCorp property, and two of which traversing through VanadiumCorp and BlackRock properties. Therefore, resources were not evaluated on the Western deposit. Similarly, 11 holes are within the Lac Doré North property, on the North-Eastern deposit, seven (7) of which within a tight cluster. These drill holes provide only a partial interpretation of this deposit, and an adequate estimation of the resources cannot be performed for the North-Eastern deposit.

Most of the holes are located within P2 unit, which is the dominant resource of titanomagnetite. Only a few intersections have passed through the entire stratigraphy of the magnetite layers, excluding the P0 which was not intersected by any drill holes. Discrimination of stratigraphy units has not been attempted for any drill holes except for the ones drilled in 2001 and 2002 by McKenzie Bay Resources. Distribution of stratigraphic units was extrapolated from the surface trenching only, where they were carefully mapped (Tremblay, 1998).

The irregular drilling pattern contrasts with the regular and thorough channel sampling conducted by McKenzie Bay Resources. Trenching results are considered of sufficient quality to be incorporated into resource estimation as horizontal drill holes. Such systematic trenching is not available on the North-Eastern deposit and trenches on Western deposit are too spaced apart to be of any use for resource calculation.

Drilling of the North-Eastern deposit suggests the deposit is affected by faulting related to the Grenville Front, which creates stacking and truncation of the stratigraphy, in stark contrast to Eastern and Western deposits. Detailed interpretation of the North-Eastern deposit has never been attempted. It seems that further to the East, the P2 unit disappears, leaving a thick non-economic P3 unit.

DRILL CORES STORAGE

The drill core from Trepan Mining and Jalore Mining are considered lost.

The drill cores from the *Ministère des Richesses Naturelles* was recovered by SOQUEM and stored at Niobec Mine storage facility. In 1997, the core, along with SOQUEM core, was recovered McKenzie Bay Resources and stored at Laugon Lake camp site. In 1999, core-racks were built at Laugon Lake, and the cores properly stored. However, it is unlikely that the integrity of this core was maintained through time.

The cores from the 2001 drill holes completed by McKenzie Bay Resources and SNC-Lavalin were stored at Laugon Lake camp site. From 2001 to recently, this storage facility was left unattended, and some cores were vandalized. Integrity of this core is likely to be partial.

In the summer 2008, the core stored at Laugon Lake was transferred in new core boxes with covers and strapped on palettes pending transfer to a secured BlackRock Metals facility. Access to the core was denied by BlackRock.

VanadiumCorp drill core is currently stored in racks in the IOS secured facility, located in Saguenay, QC.

ITEM 11: SAMPLING, SAMPLE PREPARATION, ANALYSIS AND SECURITY

McKENZIE BAY RESOURCES CHANNEL SAMPLING

All the channel sampling for McKenzie Bay Resources was completed by IOS using a uniform protocol. Channels of about 4 centimetres wide and deep were cut using diamond saws, parallel to trench axis. Samples are typically 3 metres in length, weighting 10-20 kg per sample. Aluminium tags were nailed on the rock for identification. Locations were chained from the line's pickets, and GPS location was not recorded. Sample length disregarded the geology, and was kept as constant as possible. Samples were chiseled out of the channels, bagged and shipped to Laboratoire S.L. (1997) or IOS facilities (1998) for crushing and grinding. No witness samples were kept, since trenches are readily accessible. Rejects from crushing were kept temporarily for eventual metallurgical processing but were finally discarded in 2002. A rigorous chain of custody was implemented by the IOS, due to stronger regulatory measures imposed in the aftermath of the Bre-X scandal.

The effect of weathering was tested upon a few samples, by collecting twin duplicates below the initial sample. No discrepancies were noted and no weathering is noticeable at the surface of the trenches (Tremblay et *al*., 1998), and the quality of sampling was considered adequate.

JALORE MINING AND TREPAN MINING CORE SAMPLING

No information is available on sampling procedure although the MRN resampled the core in 1971 and some magnetite concentrates were made (Castonguay, 1967).

MRN CORE SAMPLING

Core drilled by the MRN, BQ in size, was split with a standard core splitter and shipped to CRM for assaying. Details on sampling procedure are not available, and rejects were discarded. The first author noted that depth markers were not inserted in the boxes, neither was samples limits, implying that it would be impossible to properly quarter-split this core to replicate the assays.

SOQUEM CORE SAMPLING

Core drilled by SOQUEM, BQ in size, was split with a standard core splitter and shipped to Chimitec in Québec City for assaying. Detailed sampling procedure is available (Dion, 1980), and rejects were discarded. According to our 1997 observations, sampling was according to industry standards. Contrarily to MRN core, the depth markers were properly located. Various sections of the core were resampled by quarter-splitting (Bédard and Girard, 1998), and submitted to ALS Chemex for confirmation assays. However, due to the multiple manipulations on the core through time, pieces shifted in the boxes and exact position cannot be certified.

McKENZIE BAY RESOURCES CORE SAMPLING

The NQ core from the 2001 and 2002 McKenzie Bay Resources drill program was split in half on site using a regular hydraulic core splitter by IOS crew, following industry standards. The samples were bagged and shipped to IOS facility for crushing and pulverizing. This core is now apparently stored at BlackRock Metals facility and access was declined. A proper chain of custody was implemented for the two McKenzie Bay programs.

VANADIUMCORP CORE SAMPLING

The NQ core from the 2009 and 2013 drill programs was halved with a diamond saw in a facility rented in Chibougamau, by Glen McCormick Exploration staff, following industry standards. The samples were bagged and shipped to CEAQ-TJCM facilities for crushing and pulverizing. This core, the coarse crushing rejects as well as the pulps are now stored in IOS facility. Coarse rejects from 2013 program were used for re-assaying and Davis tube testing (Ivanov, 2015). No chain of custody was implemented by VanadiumCorp, while one was implemented in IOS facility.

SAMPLE SECURITY AND TAMPERING ISSUES

Historical drilling program were sampled either by government or a crown corporation representatives, and falsification of the samples is not considered a concern.

Since the 1997 trenching program of McKenzie Bay Resources was carried out just after the aftermath of the Bre-X scandal, much care was devoted to sample security. Samples were trucked by IOS employees to IOS or Laboratoires S.L. preparation facilities, and preparation done under IOS supervision (Bédard et Girard, 1998). Tampering issues were discussed but considered practically irrelevant (Girard, 1997), considering the heightened security, the size of the sample, the abundance of vanadium and its embedding in the magnetite structure. McKenzie Bay Resources representatives did not access the samples in the course of the programs.

Samples from VanadiumCorp drilling programs were collected by Mr. Glen McCormick, a local prospector and contractor, who was granted securities from the same company. Mr. McCormick or his employees are thus not considered independent. Tampering is not considered an issue.

HEAD GRADE ASSAYS AND QAQC

Core samples from the various drilling programs were assayed using different methods and laboratories (***table 11***). Vanadium is notorious for being difficult to assay, due to its low abundance, the signal of which is masked by the chromophoric nature of iron in optical spectrometry (atomic adsorption or ICP-OES), or the complex peak interferences in X-ray fluorescence. Jalore Mining and MRN did not report any quality control. SOQUEM conducted a proficiency test comparing the various laboratories, but did not inserted reference materials. Their assays are considered as internally consistent, but not necessarily accurate.

McKenzie Bay Resources implemented, in 1997, a proper quality control, including a proficiency test and the systematic insertion of certified as well as internal reference materials (Bédard et Girard, 1998). The protocol was respected by subsequent historic drilling programs. They also resampled former SOQUEM drill core in an effort to do a reconciliation of both sets of assays. Results were ambiguous, suggesting previous SOQUEM assays underestimated the vanadium by a fraction of a percent. However, due to the ambiguity, both Cambior (1999), SNC-Lavalin (Lafleur, 2002) and Girard and D'Amours (2015) decided NOT TO CORRECT SOQUEM assays and to use them as reported for resources estimation.

Program	Year	Samples	Laboratory	Method	Davis tube	Laboratory
Jalore	1953	361	Jalore		124	CRM
MRN	1971	122	CRM	XRF	109	CRM
MRN	1973	274	CRM	XRF	270	CRM
SOQUEM	1979	691	Chimitec	AA	150	CRM
MKBY	1997	1347	Chemex Lab	ICP-AES	481	IOS/COREM
MKBY	2001	497	Not assayed		166	IOS/COREM
MKBY	2002	107	Chemex Lab	ICP-AES	0	
Apella	2009	254	ALS-Chemex	ICP-AES	0	
PacOre	2013	210	COREM	XRF	109	IOS/COREM

Table 11*: Compilation of the head grade assays and Davis tube testing for the various programs. Numbers encompass the entire historic database, thus including some segments of core and channel samples located on BlackRock Metals property.*

Since resources used in the current study were calculated exclusively from Davis tube magnetite concentrate, not using core sample (head grade) assays, core sample assaying protocols will not be discussed. The reader is referred to Girard and D'Amours (2015) report for detailed accounts the methods used and results obtained for the various historic drilling or trenching programs.

DAVIS TUBE TESTING OF MRN AND SOQUEM SAMPLES

Davis tube testing is a standardized method for magnetite recovery, extensively used by the iron ore industry. By such, magnetite can be recovered from a finely pulverized material, with an excellent recovery and cleanliness. This method is reputed to emulate results from magnetite concentration circuits in mill. Almost all samples from the various drill and trench programs were tested, with the exception of the 2002 confirmation holes of McKenzie Bay Resources. The performance of Davis tube magnetic separation is sensitive to liberation, and therefore to the grain size distribution of the feed. As for head grade assays, magnetite concentrate assays are sensitive to analytical methods. Slightly different procedures were used for samples from MRN and SOQUEM and for subsequent samples from McKenzie Bay Resources and VanadiumCorp. A detailed account of procedures, results and quality controls was provided in Girard and D'Amours (2015).

Samples from MRN and SOQUEM drill holes were tested for their titanomagnetite content by Davis tube at the CRM. Tests were conducted, in most instances, on composite samples representing intervals up to 10 metres. Little details are available on settings; other than the testing was performed on material grinded with a dry ball mill until reaching 60% of the material passing through 200 mesh, using a 15 grams aliquot, 2 amperes and 10 minutes wash. A standardized protocol is expected. No grindability or liberation tests are available, which does not mean they were not conducted. Magnetite concentrates were assayed for iron, titanium and vanadium. No measurement of the remaining silica and lime is available, which require to be estimated from the non-closure to 100% (***figure 12***), suggesting an average of 7% silicates left along the titanomagnetite concentrate. Most of these tests were conducted as complete individual metallurgical test, providing head grade, concentrate and reject analyses, except for MRN samples where only 20% of samples were submitted to such metallurgical balance (Richard, 1975), allowing calculation of mass balances. Procedures between batches are considered as identical, although details cannot be assessed. Assaying of the concentrates was made by X-ray fluorescence (XRF) on borate glass bead by CRM. A limited number of samples (17) were reassayed in 1999 by CRM on behalf of Cambior, yielding a regression coefficient of 78%. No liberation or grindability study is available to support the results. No laboratory accreditation existed at the time of the programs.

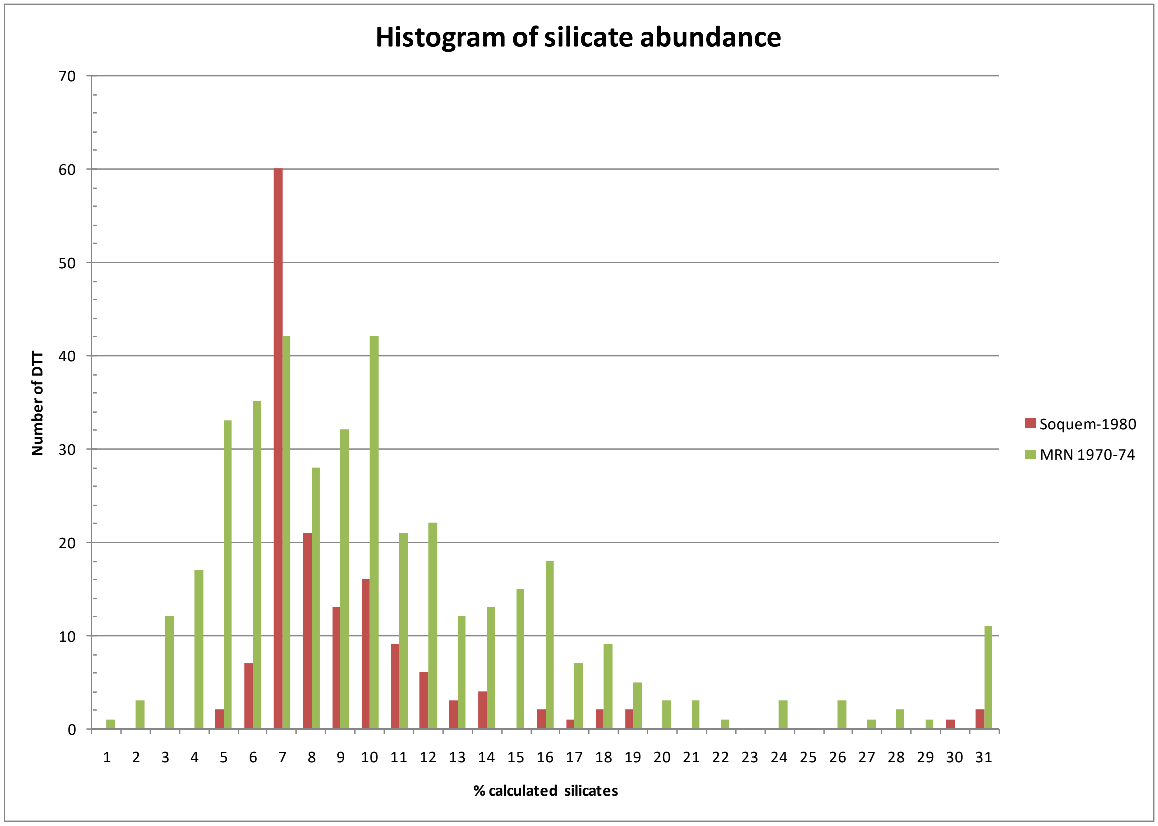


***Figure 12**: Distribution of silicates in titanomagnetite concentrates obtained from Davis tube testing (DTT), as calculated by the non-closure to 100% of the iron, titanium and vanadium assays. It can be noted that MRN-1970-74 and SOQUEM 1980 testing were not conducted according to the same procedure, the titanomagnetite from MRN concentrates being less liberated. The maximum silicate abundance is elevated, with a mode of 7%, suggesting about 4-5% silica.*

DAVIS TUBE TESTING OF McKENZIE BAY RESOURCES CHANNEL SAMPLES

In early 1999, IOS was mandated by McKenzie Bay Resources to initiate titanomagnetite concentration tests on their channel samples with the use of the Davis tube. An extensive series of tests were carried out to assess the grinding, concentration and assaying best protocol (Girard, 2000), the specifications of which was maintained for subsequent programs. Production of magnetite concentrates was contracted by Cambior later in 1999. Adjacent samples aliquots were typically concatenated by group of three, in order to represent intersection of about 6 to 9 metres. Proportions used for concatenation proceeded based on the number of samples only, which were not weighted according to sample length, according to Cambior's instruction. Of the 1347 samples, 481 titanomagnetite concentrates were made, of which 401 are from the East and West deposits. Sample's aliquots were milled at 100 µm (150 mesh), and titanomagnetite separated with the Davis tube according to a complex protocol and reprocessed until quality specifications were met, i.e. <4% silicates in the concentrate, <10% magnetite in the rejects, <5% losses, and >5 grams magnetite (Villeneuve, 2000). Concentrates and rejects were shipped to Cambior. Analyses were made at COREM using XRF on fused borate glass beads for the titanomagnetite concentrates and the non-magnetic rejects, as well as atomic absorption for vanadium but only in head grade. A subset of samples of titanomagnetite concentrates was also analysed by neutron activation by Activation Laboratories. Titanomagnetite concentrates were assayed for all major oxides, yielding an average of 1.95% SiO_2 and 0.32% CaO (***figure 13***). This average silica content is comparable with what is achieved by most vanadiferous titanomagnetite mines worldwide, but twice what was required and obtained from pilot plan magnetic separation of the Lac Doré material. Fineness of the grinding is suspected as the main cause of this discrepancy. No metallographic study has yet been conducted to assess the issue.

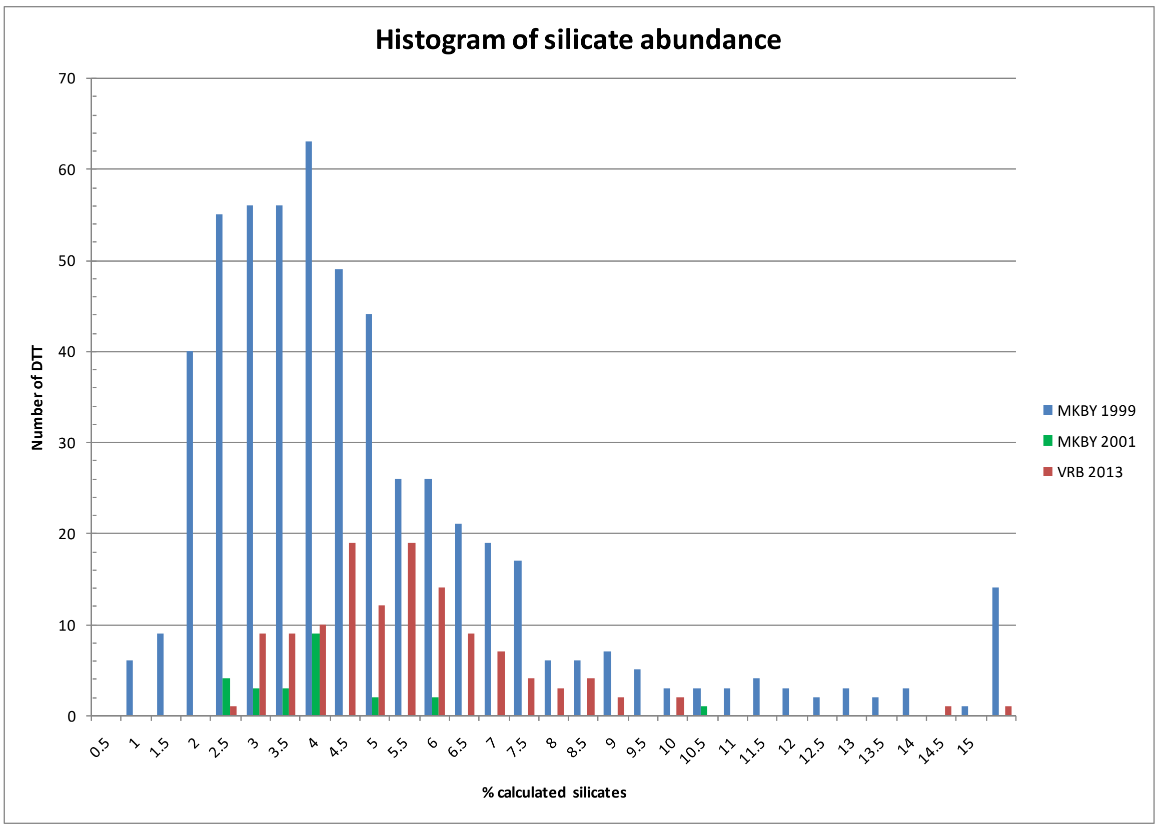


Figure 13*: Distribution of the calculated silicates retained in the magnetite concentrates after processing the samples by Davis tube. Magnetite concentrates were made by IOS for Cambior (1999), McKenzie Bay (2001) and VanadiumCorp (2013). The average 4.2% silicate content is in accordance with the silica analysis, and suggestive of liberation issues.*

The abundance of titanomagnetite was also measured in McKenzie Bay 1999 samples with the use of a magnetic susceptibilimeter, or "*Satmagan*", by COREM. Correlation between *Satmagan* and Davis tube testing is noisy and present a severe bias. These results were disregarded for the current study.

Since the non-magnetic fractions were submitted to analysis, a mineralurgical mass balance can be calculated. Theoretically, the amount of vanadium in the head sample should balance with the amount of vanadium in the magnetite concentrate plus the amount of vanadium in the non-magnetic rejects. Discrepancies are close to propagated analytical errors for both the composite samples assayed by XRF at ALS-Chemex and at COREM (***figure 14***) as well as the samples assayed at Actlabs by INAA. About 6% of composite samples are discrepant. Older CRM Davis tube tests indicate both concentrate, head grade and tails analysis, but it is uncertain if these were analyzed or calculated (Durocher, 1980), their mass balance being perfect.

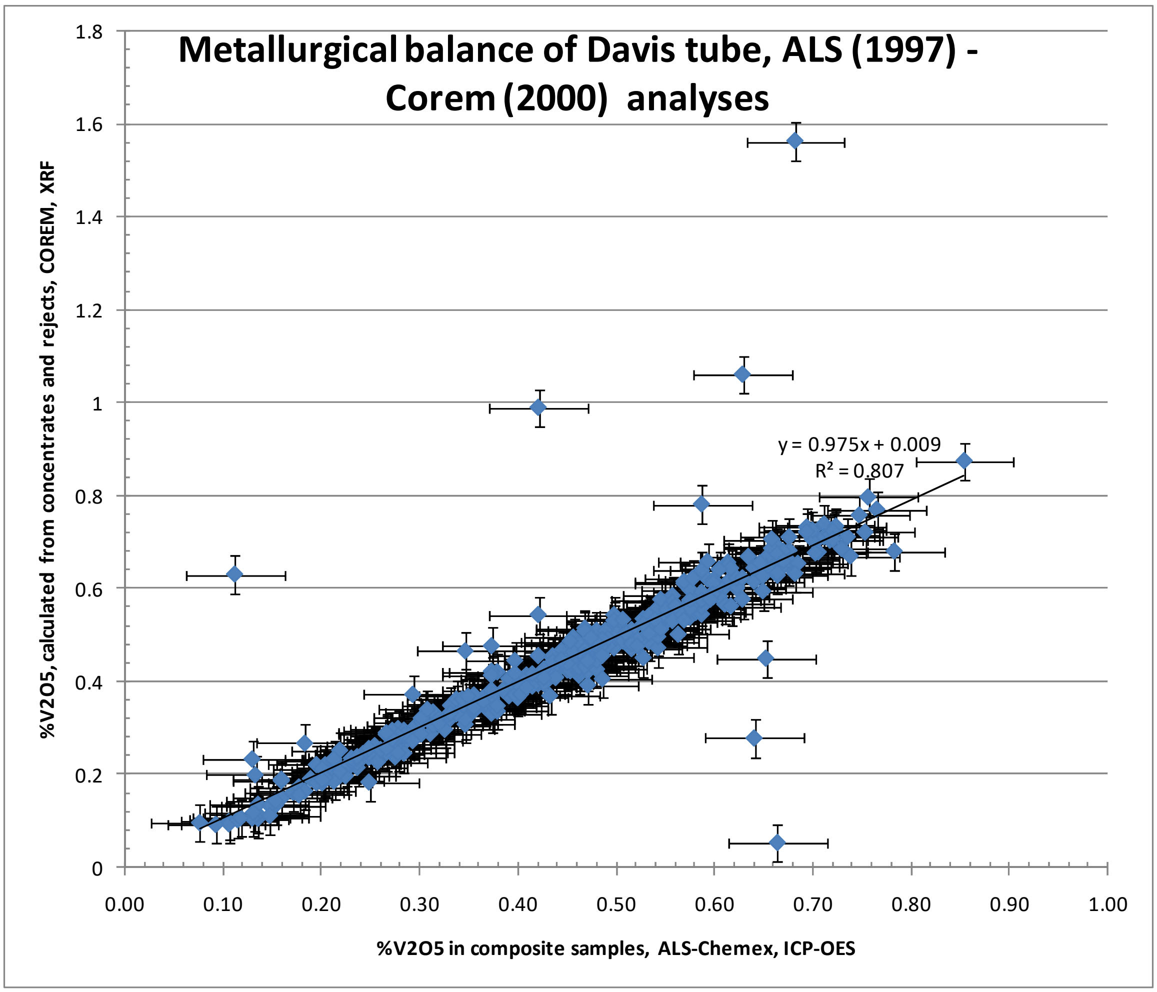


Figure 14: *Comparison of the vanadium metallurgical balance calculated from magnetite concentrates and rejects versus the composite sample head analyses. Results are*

within the propagated error of the analysis, which are estimated at 0.05% V_2O_5 for the composite samples and at 0.04% for the metallurgical balance calculated from concentrates and rejects. Note that 0.3% of test results are erratic.

A thorough quality control was implemented by Cambior for assays, either for magnetite concentrates, for head samples and for non-magnetic rejects (Crépeau, 2000). About 2% of samples were certified reference material, including the ones used by IOS to certify the head grade assays (SARM-12 at 0.093% V_2O_5 or 520 ppm V and JSS-831-1 at 0.535% V_2O_5 or 3000 ppm V), all results being within tolerance limits. Cambior also had three internal reference materials (*IRM*) manufactured at COREM, both head grade materials and titanomagnetite concentrates, from Lac Doré material and certified only for their vanadium content (MRI-99-08 at 1.18% V_2O_5, MRI-99-09 at 0.49% V_2O_5 and MRI-99-10 at 0.65% V_2O_5). Their internal reference material was inserted as to it represent about 10% of the population. Averages obtained from the assays of these IRM were slightly overestimated compared to certified value.

Finally, 95 analytical duplicates were assayed at COREM, with variation within tolerance.

Samples collected from McKenzie Bay Resources drill holes in 2002 were not submitted for Davis tube testing. Inversely, samples collected from McKenzie Bay Resources drill holes in 2001 were submitted for Davis tube testing in 2003, but were not for head grade analysis. Of these programs, only 26 concentrates were produced from drill holes located within VanadiumCorp properties, which were not included in the current resource estimate being located outside the East and West deposit.

IOS does not have laboratory certification. COREM was, at the time of the program, an ISO-9001 accredited facility. However, it did not have the ISO-17025 accreditation for vanadium assays. Quality control of Davis tube concentrate is a complex task, which was described in detail in former reports (Girard 2014, Girard and D'Amours, 2015).

DAVIS TUBE TESTING OF VANADIUMCORP CORE SAMPLES

Samples from 2009 drill cores were not tested for the magnetite content with a Davis tube.

Samples from the 2013 confirmation drill program were recently tested by Davis tube (Ivanov, 2015). The magnetic concentration of 109 of the 210 samples available was conducted by IOS, while analysis of the magnetite concentrates was conducted by COREM by mean of XRF on fused borate glass beads. Samples were not composite, but only samples with sufficient iron grades were processed.

A liberation study was conducted (***figure 15***), by pulverizing the material with laboratory rod mills for variable time ranging from 5 to 60 minutes. A efficient liberation was reached after 45 minutes milling for which the grain size of the particles reached 97.4% smaller than 75 microns. Not much improvement is observed by longer milling time in regard of titanomagnetite concentration giving a maximum of 63.59% Fe (Ivanov, 2015).

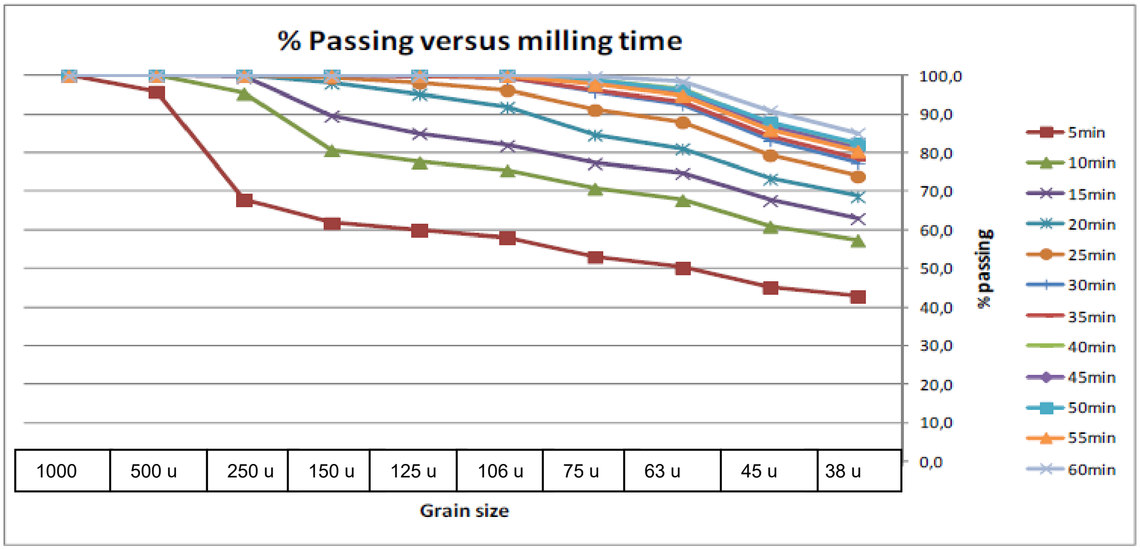


Figure 15*: Grindability curves obtained by the laboratory rod mills on VanadiumCorp samples. Davis tube testing of the material indicate that titanomagnetite purity reach a plateau after 45 minutes milling.*

Titanomagnetite was concentrated from samples ranging between 5 and 50 grams using 3200 gauss magnetic field, which is somewhat more intense than usually used. The concentrates contain an average of 1.7% SiO_2, which exceeds the purity of previous programs, but still fails to match the targeted level of a maximum of 1% SiO_2.

The author is confident on the quality of the 2014 analysis, and recommends this protocol being used for subsequent drilling programs.

DENSITY MEASUREMENTS

Accurate density measurement is essential for the calculation of resources in iron mineralization. Density may vary from 2.7 g/cm^3 in a barren silicate rock to 5.5 g/cm^3 in pure magnetite. Contained resource is a square function of the iron grade, this grade influencing both the amount of metal per tonne as well as the amount of tonnes per cubic metres. Experience of the first author with a different magnetite deposits indicated that using average density over the deposit instead of real measured density on every sample significantly underestimated the total resource.

No reliable density measurements were made by the MRN. All measurements reported by Kish (1971), Avramtchev (1975), Dion (1980) and Nolet (1980) used selected samples not corresponding to core intervals. Density measurements were made by SOQUEM, using a deficient protocol (Dion 1980), the detail of which is discussed in previous report (Girard and D'Amours, 2015).

Cambior measured the density of 1689 samples from 1997 McKenzie Bay Resources channel samples on crushed material (Crépeau, 2000). An aliquot of the crushed material was weighted and immerged in water in a graduated cylinder to calculate its volume. The comparison between the measured density and the iron plus titanium content indicates about 15% of the population being discrepant by more than 7% of a second order polynomial relation (Girard and D'Amours, 2015). If such discrepant measurements are considered as manipulation or typing errors and removed, the regression coefficient R^2 is improved to 93% (***figure 16***). Density is then calculated by the following equation, which is used for the current resource estimation:

$$SG = 0.0000677(Fe_2O_3 + TiO_2+V_2O_5)^2 + 0.009832(Fe_2O_3 + TiO_2+V_2O_5) + 2.78977841$$

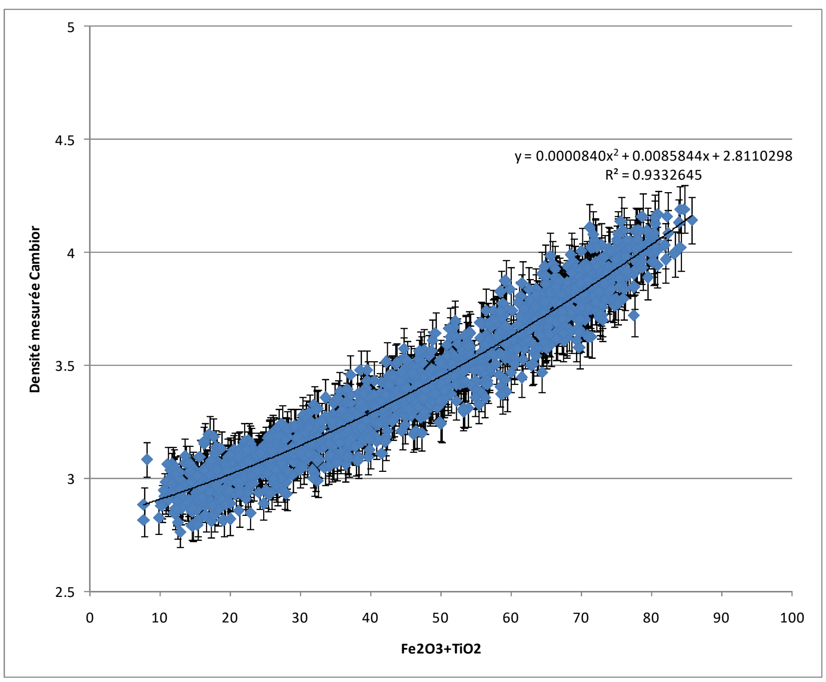


Figure 16*: Comparison of density measured by Cambior and iron plus titanium weight %. A regression coefficient R^2 of 93% if discrepant samples are removed and an equation can be drawn to calculate density. Error bars are calculated by propagating precision of the various measurements.*

ITEM 12: DATA VERIFICATION

Considering the project spans over 60 years of work, by numerous groups, with different goals and methods, and considering the very large and heterogeneous database involved, thorough data verification was completed to the best of the first author's capability, who takes liability for, and which is described in details in Girard and D'Amours (2015).

HISTORIC REPORTS

All of the over 200 historic reports relating to the deposit were read by the first author over time, and significant information, maps, drill holes and assays were captured into database and mining software. Most of these reports were handed to the author in 1997 by SOQUEM, and are available only as hard copies. No compilation database was transferred to the author by SOQUEM.

Most of the historic reports are old photocopies, some of them of poor quality, incomplete or with handwritten annotations. Part of the data is available only as handwritten datasheets. Significant data were typed by the author's assistant, or captured with optical character recognition (OCR) software (ReadIris Pro V. 12.5). Drill logs were typed and formatted into modern drill hole software (Geotic's Log format), although with some details willingly omitted.

McKENZIE BAY RESOURCES DATA

The first author supervised the data collection by his various field crews during the McKenzie Bay period, which was carried out according to the accepted industry practices of the time, except for the ground magnetometric survey. Data results as well as most metadata were reported in details (Tremblay et *al*., 1998; Huss, 2003; Boudreault, 2002). However, the original numerical data were stored on obsolete numerical format and significant portion of data required to be recaptured by OCR. Trenching data and plans were formatted to enable their use with Geotic' or Gemcom drill hole management software, trenches being considered as *"horizontal drill holes*", collared at their Southeast extremity.

CAMBIOR DATA

Relevant Cambior data were either retyped or captured by OCR, including metadata for the density measurements. Davis tube testing being conducted by IOS was available in numerical format.

VANADIUMCORP RESOURCE DATA

Only a negligible amount of data from the two trenching programs conducted under the previous management of VanadiumCorp was made available to the author. The trenches were remapped in late 2014, sampling sites and collars were measured with a DGPS and the certificates recalled from ALS Minerals (Block, 2015). Drill logs from 2009 were compared meticulously with the core, and considered of acceptable quality.

Drill cores from 2013 (Derosier, 2013) were re-logged (Ivanov, 2015) directly into Geotic' database. The sample's meterage were thoroughly checked, corrected if needed, and the sampling intervals completed. Collars were located in the field with the use of a DGPS (Block, 2015). Assaying results were numerically transferred into the database once QAQC approved.

DATABASE VALIDATION

Building a database from heterogeneous data in various states of quality raises issues with its reliability. Errors accumulate through the process, starting from errors within the typewriting of original reports and errors in capturing the data. Validation was a complex task, and details are provided in previous report (Girard and D'Amours, 2015).

Every critical data, such as assays and footages, was checked by the use of redundancy.

REMINISCENT ERRORS

Difficulties have arisen in verifying core assays from SOQUEM. Some drill logs photocopies were truncated, and typographic errors were relatively abundant. Some of the data was not indicated on the drill log, density measurement was handwritten on one of the copies of the certificates, and some assays from the same sample were scattered on many certificates. Furthermore, errors are suspected on certificates, which were typewritten as well. These errors were corrected to the best of the author capacity, and every certificate was checked.

Despite the efforts by Cambior to control the quality of historic data and assays, the data they generated contained abundant errors. These errors were corrected in the extent they were detected by the author.

Validation of drill holes location and orientation was done by plotting them and comparing with maps in original reports. Discrepancies were detected and corrected.

OVERALL CONSISTENCY OF ASSAY RESULTS

The quality of assays had always been a concern with the current project, mainly regarding their accuracy. Vanadium hosted in iron-titanium oxides is difficult to assay, and prone to analytical discrepancies. The first quality control including insertion of certified reference materials was implemented by McKenzie Bay Resources in 1997, and all datasets acquired since then are considered as being accurate and compatible with each other. However, the reconciliation of older analyses from MRN or SOQUEM has proven difficult, and uncertainties remain (Girard and D'Amours, 2015), as indicated by the various inter-laboratory crosschecks (***table 12***).

Program	*#Sample*	*Original laboratory*	*Cross-checked laboratory*	*Discrepancy*
SOQUEM	17	Chimitec (AA)	CRM (XRF)	+7.45%
SOQUEM	20	Chimitec (AA)	CRM (XRF)	+3.8%
SOQUEM	20	Chimitec (AA)	CRM (XRF, dup)	+4.7%
SOQUEM	151	Chimitec (AA, comp)	CRM (XRF)	+2.5%
Cambior	22	ALS (ICP-OES)	Actlab (INAA, 1999)	+5.7%
Cambior	48	ALS (ICP-OES)	Actlab (INAA, 2000)	-2.3%
Cambior	50	ALS (ICP-OES)	Corem (XRF)	+3.7%
VanadiumC.	122	ALS (ICP-OES)	Corem (XRF)	-9.8%
Cambior	17	CRM (XRF-DTT)	Corem (XRF)	-3.8%
Cambior	28	Corem (XRF-DDT)	Actlab (INAA)	-6.7%
Cambior	50	Corem (XRF-DDT)	Actlab (INAA)	-2.7%

Table 12*: Compilation of the discrepancies between head grade and titanomagnetite concentrate vanadium assays from various inter-laboratory cross-checks.*

The uncertainties on drill core head assays remain, and are expected to be in the range of plus or minus 5% of the reported grade. Correcting this issue is not possible since cores are no longer available in integrity. This accuracy issue with assaying is one of the prime reasons why the deposit must be drilled systematically in order to upgrade the category of resources.

DAVIS TUBE TESTING GENERALITIES

Davis tube testing is the industry standard protocol used to routinely measure the abundance of magnetite in iron ore. It is a wet high strength magnetic separation, operating up to 3000 gauss under water current to wash the non-magnetic fraction Davis tube testing is considered by metallurgists as a fair simulation of industrial wet magnetic separator. The quality of the magnetite concentrate depends on the quality of liberation of the magnetite grains, and thus to grain size and grinding process, as well as the settings of the various other parameters such as magnetic field strength and water current. Such settings are not disclosed in every report and no uniform procedure is recommended. Some laboratories use "standard" settings, while others will optimize them through a grinding test. Magnetite abundance obtained by Davis tube testing and its analyses can be used directly into resource estimation and block modelling, as done in the current resource estimate. A detailed account of the issues related to Davis tube testing was provided in previous report (Girard and D'Amours, 2015).

The discrepancies which arose between MRN, SOQUEM and McKenzie Bay dataset are even more acute with regards to magnetite concentrates made by Davis tube testing than for headgrade assays. Each set of data were made according to different settings, especially with respect to grinding. Samples submitted by MRN to the CRM were grinded at 90% -325 mesh (<50 µm), SOQUEM samples were grinded at 85% -200 mesh (<75 µm), McKenzie Bay and Cambior samples were grinded at 85% - 100 mesh (<150 µm) and VanadiumCorp samples were grinded at 95% -200 mesh (<75 µm). Since these different grinding specifications affect the titanomagnetite liberation from silicates and ilmenite, vanadium grades and abundance of magnetite are not directly comparable, although it does not mean that they are inaccurate. To circumvent such issues, Cambior did normalize all test results to 90% magnetite, a correction which was not applied in the current resource estimate.

Statistical comparison (***table 13***) of the magnetite abundance or vanadium grade from the various series of Davis tube testing is not significant, considering they do not represent population from the same segments of the deposit. Thus, tests conducted for MRN, which represent almost uniquely samples from strongest magnetic anomalies, are enriched in magnetite, while samples from SOQUEM, which are dominantly cores from the P2 unit, are statistically enriched in Vanadium. Cambior (1999) samples are lower in magnetite since they tap into P1 and P0 units.

Batch	***Samples***	***%Magnetite***	***%V_2O_5***	***%Fe_2O_3***	***%TiO_2***
Total	*1262*	*32.5±16.2%*	*1.24±0.29%*	*87.4%*	*9.36%*
MRN-1970	*121*	*39.4±11.3%*	*1.05±0.21%*	*88.2%*	*8.50%*
MRN-1974	*274*	*39.1±17.7%*	*1.32±0.21%*	*86.17%*	*10.44%*
SOQUEM	*150*	*32.9±14.8%*	*1.44±0.24%*	*89.1%*	*8.22%*
Cambior-99	*556*	*28.8±15.1%*	*1.18±0.29%*	*87.5%*	*9.64%*
MKBY-2001	*26*	*21.1±15.2%*	*1.11±0.43%*	*84.0%*	*6.68%*
VRB-2014	*135*	*30.1±16.6%*	*1.25±0.32%*	*88.1%*	*8.53%*

Table 13*: Statistics on magnetite concentrate assays. See text for grinding parameters.*

The relation between the vanadium grades in the magnetite concentrate versus the abundance of magnetite is complex (***figure 17***). It is controlled by the provenance within the deposit, the abundance of magnetite of metamorphic origin, as well as the effect of dilution caused by the non-liberation of ilmenite and silica during the Davis tube testing. The discrepancies are readily visible, especially between the MRN-1970 and MRN-1974 batches, which represent samples from the same area of the deposits, processed by the same laboratory (CRM) apparently with the same methods. Similarly, a discrepancy is noted between SOQUEM-1980 samples which are from drilling mainly in P2 unit, and Cambior-1999, which is from McKenzie Bay surface samples which encompass P0, P1 and P2. Since McKenzie Bay samples encompass the entire stratigraphy, a larger scattering in vanadium grade as well as more abundant samples with low magnetite abundance is present compared to former SOQUEM and MRN samples. SOQUEM samples are distinctive by being more vanadium rich, a difference considered as the effect of finer grinding and better liberation as well as potential analytical discrepancies.

The discrepancies noted in vanadium grade of the magnetite concentrates are not as acute in the head sample vanadium grade (***figure 33***). On the vanadium grade versus magnetite abundance diagram, the trends defined by the various batches are coincident, with scattering towards lower grade due to the inclusion of P3 samples.

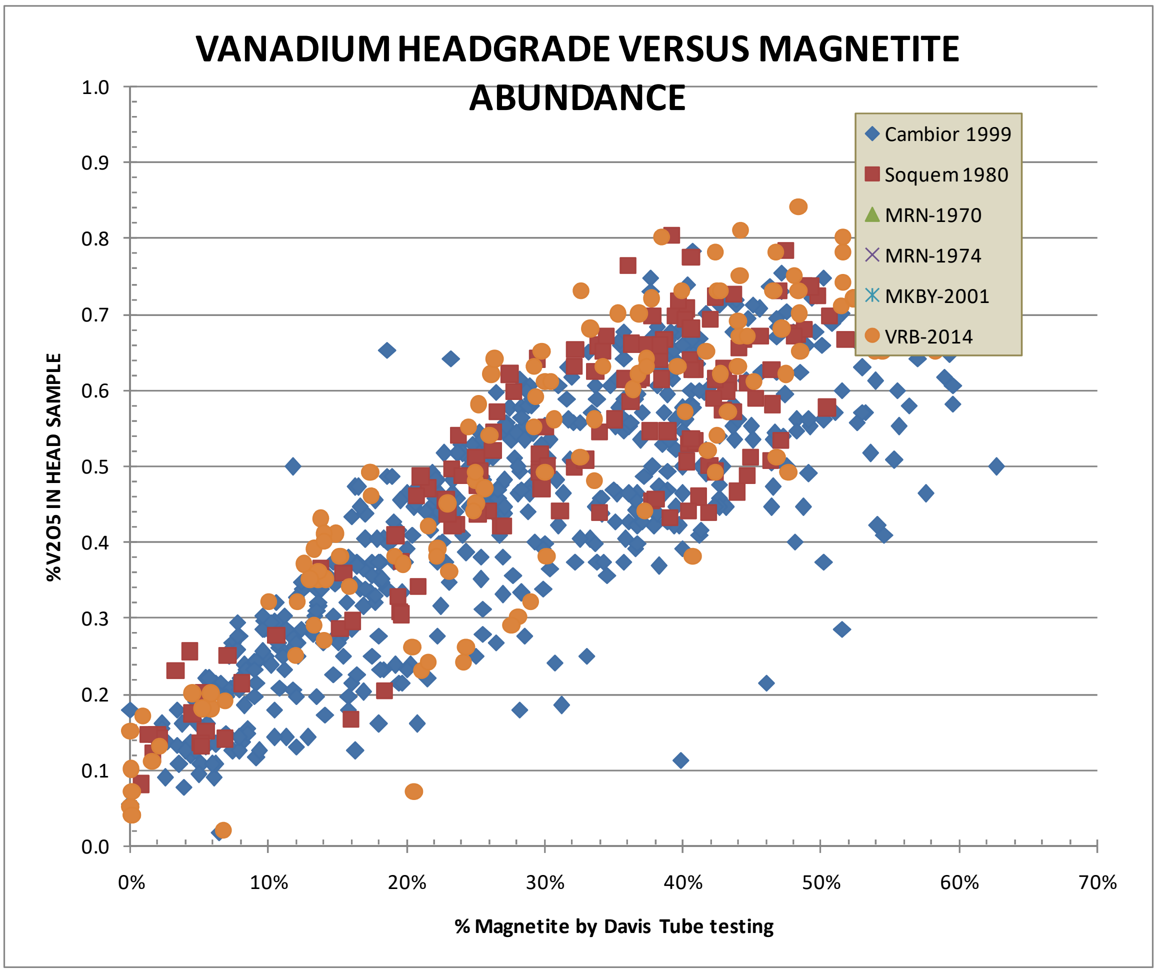


Figure 17*: Head sample vanadium grade versus the magnetite abundance as measured by DTT. Unlike for the vanadium grade of the magnetite concentrate, the various*

batches of samples fell on a dominant trend, with scattering towards low vanadium grade related to samples taken higher in the stratigraphic sequence. Note that head grade analyses are not available for MRN-1970 samples.

Vanadium recovery can be calculated for each test, which equals vanadium grades in magnetite multiplied by magnetite abundance, divided by vanadium head grade. This recovery represents the amount of vanadium extracted from the rock through beneficiation of magnetite, the rest of vanadium being hosted in silicate or liberated ilmenite. The recovery is dependent on magnetite abundance (***figure 18***), nearing 90% for magnetite-rich sample (>50% magnetite), and progressively dropping to 60% for samples containing less than 15% magnetite, and then tend to zero for magnetite-poor samples (<15% magnetite). Samples from MRN-1974, Cambior-1999 and those processes for VanadiumCorp in 2014 have concordant recovery/grade curves. However, samples from SOQUEM 1980 shows abnormally high recoveries, some even exceeding 100%. This suggests that the vanadium grade of the magnetite concentrate might be overestimated by about 10% or head grade underestimated by such amount.

The discrepancy between the concentrate grades obtained on SOQUEM drilling samples and the various other samples sets is of concern, since SOQUEM drilling dominates the current resource estimate. It was agreed by both authors (Girard and D'Amours, 2015) that no correction on the data would be applied to correct this issue and that the estimation must be based only on original assays without introducing further bias.

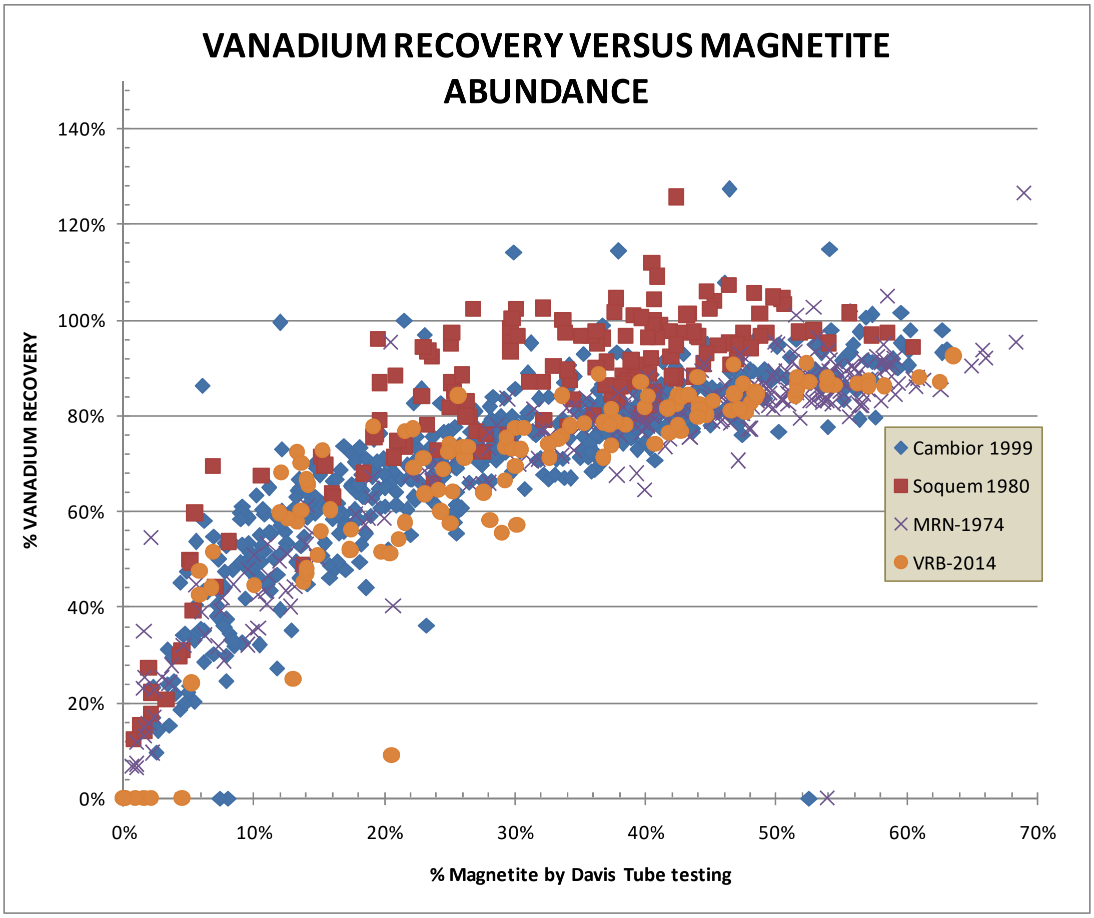


***Figure 18**: Recovery-grade curve for the various batches of Davis tube concentrates. Samples from MRN-1970 and MKBY-2001, lacking head grade analysis, are excluded. Samples from SOQUEM 1980 show abnormally high recoveries, which is suggestive of either overestimated vanadium grade of the magnetite concentrate or underestimated grade in the head sample.*

The vanadium grades obtained in the magnetite concentrate are a function of the effectiveness of eliminating minute intergrowths of ilmenite (Arguin, 2017). The finer is the comminution, the more efficient is the liberation and removal of gangue minerals and ilmenite intergrowths, but also lowers the overall vanadium recovery. Optimization of the grinding and beneficiation process was conducted historically in regards of vanadium recovery by conventional roasting or smelting, and thus requiring the most efficient ilmenite removal. However, since iron, titanium and vanadium are recovered by the contemplated electrowinning process, the ilmenite presence in the concentrate is expected to be less sensitive, and the optimisation of the beneficiation process should be made in this regard. To grind finer means cleaner titanomagnetite concentrates and lower reactant consumption (such as sulphuric acid being converted into gypsum), but also increased grinding costs and handling issues. Grinding cost is a square function of the fineness and represents the bulk of the beneficiation circuit operating costs. Conversely, less grinding means less beneficiation costs and a better recovery due to the recovery of more vanadium bearing ilmenite However, it also implies higher acid consumption.

Silicate minerals contaminating the magnetite concentrate are dominated by calcic plagioclase, epidote, chlorite and amphibole. During acid digestion, the silica goes into solution and needs to be precipitated from the pregnant liquor to forms silica gel, a valuable by-product. Second is the calcium from the plagioclase and epidote which reacts and precipitate as gypsum. Magnesium reacts to form soluble sulphates, which will require to be precipitated from the liquor. The effectiveness of the process in dealing with such contaminants is uncertain.

ITEM 13: MINERAL PROCESSING AND METALLURGICAL TESTS

The current section includes a thorough review of the metallurgical reports related to crushing, milling and beneficiation available on the project, written since early 1960' until 2017. Since VanadiumCorp selected an alternative electrochemical technology for vanadium extraction from the Lac Doré VTM, only the results relating to crushing, milling and to the titanomagnetite beneficiation are relevant for the current study. Remaining results in regard to the vanadium extraction and refining by conventional alkali roasting or by smelting were summarized in a separate 65 pages review remitted to VanadiumCorp (Girard, 2017) (***figure 19***). Overall, this review indicates that Lac Doré titanomagnetite behaves in a very similar manner as titanomagnetite exploited elsewhere in the world in regard of vanadium extraction, and that conventional processing routes were successfully applied to this material. The difficulties related to these more conventional processes relate to their economics, not to technical issuesDespite the quality and abundance of this metallurgical work, it is not considered relevant to the current project.

The review of historic metallurgical testing made by the first author (Girard, 2017) is the first comprehensive attempt to compile all aspects in a systematic manner to evaluate various options without preconceived process selection, such as McKenzie Bay feasibility study. As the reader may realize, historic testing is scattered in abundant reports, letters and memorandum which interweave the results from different processes and makes comprehension of the overall results difficult without achieving thorough reading of the complete literature. According to Mr. Todd Richardson, the Lac Doré deposit is currently the most thoroughly tested vanadium deposit in the world.

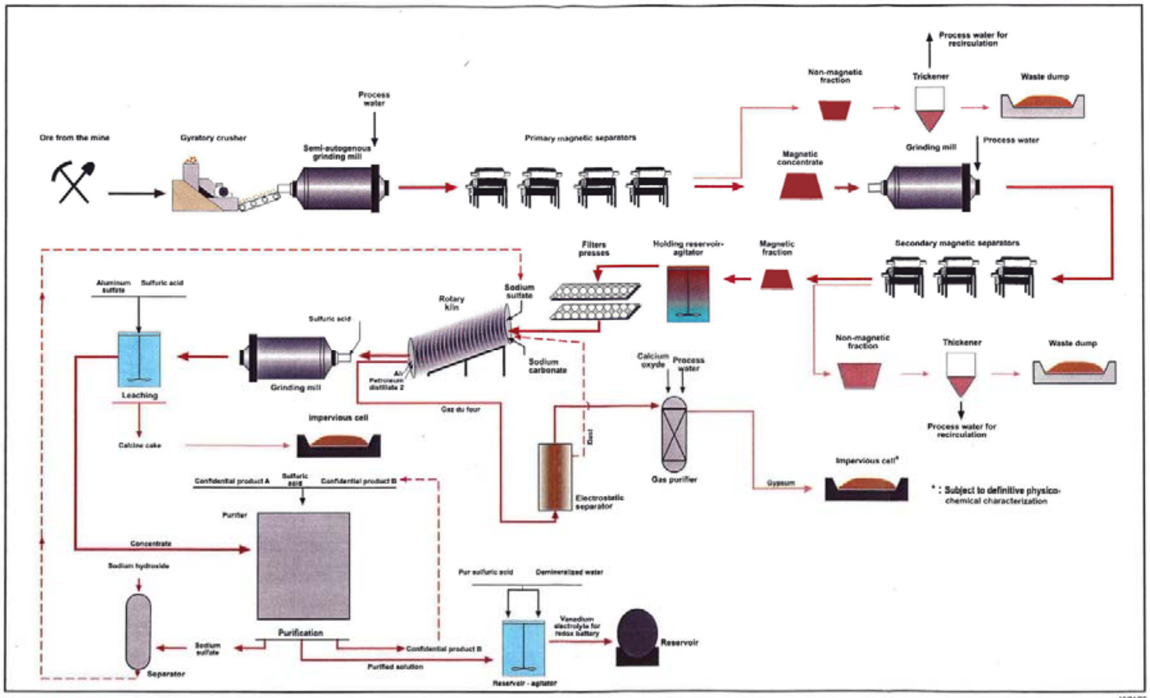


***Figure 19**: Conventional alkali roasting process for primary production of vanadium pentoxide or VRB Electrolyte as projected by McKenzie Bay Resources (Entraco, 2002).*

Titanomagnetite is notorious for being unsuitable for conventional iron production unless coupled with vanadium and titanium co-production. Steel or pig-iron production from titanomagnetite requires additional steps compared to conventional blast furnace and basic oxygen furnace, including smelting by direct reduction and arc furnacing. Conventional blast furnace smelting of titanomagnetite was attempted in the early 1900's for various titanomagnetite and ilmenite deposits located in Québec (St-Charles de Bourget, St-Urbain, Natashquan, etc.) without commercial success. It is currently used by a Chinese steelmaker, but no details are available to the author.

Since its discovery by Gulf Mineral in 1956, more attention was placed on the metallurgy of the Lac Doré magnetite mineralization than on the characterization of the deposit itself. Successively, Jones and Laughin Steel Company, Campbell-Chibougamau Mines, the Québec Departement of Natural Resources (*Ministère des Richesses Naturelles*), SOQUEM, McKenzie Bay Resources and BlackRock Metals did extensive work on metal recovery and various aspects of the metallurgy. Extraction of ferro alloying metals is usually more complex than for base or precious metals and requires metallurgical testing early in the exploration process. The overall profitability of a project, independent of its grade and resources, is usually dictated by the choice of the metallurgical process and the capital requirements attached to the selected process.

The development of the Lac Doré Vanadium Project systematically raised questions about the efficiency of the metallurgical process and the availability of the essential expertise. Extensive metallurgical testing on Lac Doré mineralization was carried out by past owners of the project, and indicates clearly the technical suitability of the mineralization for beneficiation, and the recoverability of vanadium by conventional alkali roasting as well as smelting processes. Both tested routes are commercially operated worldwide upon similar titanomagnetite resources for more than 50 years and are proven technologies. Laboratory and pilot plant tests on Lac Doré mineralization were carried out by various independent facilities, which indicated that the mineralization behaves similarly to other vanadiferous-titaniferous-magnetite deposits in production in South-Africa, China, Australia, Brazil and Russia. Concentrate grade and recovery were similarly consistent with global projects in productions when tested with either method. Overall metallurgical efficiency using conventional processes can thus be forecasted with acceptable certainty.

Titanomagnetite is the cleanest vanadium source material currently used and the one that requires the simplest metallurgical process. Vanadium used to be extracted out of shales (former Stratcor facility in Arkansas), of phosphorite (Idaho), of uranium ore (Colorado), of fly ashes (current Stratcor facility in Arkansas, former Carbovan Inc. facility, Fort McMurray), of bauxites, of non-titaniferous iron ore, or of clays. These sources are not utilized currently, aside from fly ashes, due to complex and expensive processes (Gupta and Krishnamurthy, 1992), and shall not be considered.

The largest amount of vanadium production is derived from titaniferous magnetite processing and accounts for over 80% of the world production. Secondary production, such as vanadium recovery from cokes, ashes and spent catalysts, provide a small percentage of the total supply. Processing of these secondary sources requires specialized processes which are dependent on the characteristics of the feed source. As such, they will not be compared to titaniferous magnetite extraction options. Co-production of vanadium and steel account for about 75% of the overall global vanadium supply, and is to be considered in this study. However, the economics of this process is based on steel with/without titanium dioxide production, and vanadium extraction has a minor impact on their economics.

All metallurgical tests conducted through time on the deposit were done on bulk samples taken from P2 Unit in the East Deposit. It was amply demonstrated that the mineralization from the East Deposit closely resembles that of the West Deposit, as well as the mineralization from BlackRock Southwest and Armitage Deposits. However, mineralization varies across stratigraphy, the effect of which has never been tested. Mineralization from Northeast Deposit may behave differently in the course of

beneficiation, due to metamorphic overprint responsible of sintering, grain coarsening and the presence of abundant secondary iron silicates such as chlorite and amphiboles.
The Lac Doré deposit is zoned across stratigraphy, both in grade and mineralogy. Beneficiation and metallurgical efficiency is thus expected to be dependent on the specific stratigraphic unit sampled (Arguin, 2017, also see discussion on Davis tube testing, Item 12). Conversely, the decision as to which unit is to be mined, and thus tested, is dependent on the process selected in the subsequent metallurgical processes, and which metals are to be recovered. Production of vanadium alone by alkali roasting requires high vanadium grade in the magnetite and may tolerate low magnetite abundance of the P1 and P0 units. Inversely, co-production of vanadium, iron and titanium via smelting or electrowinning is less sensitive to vanadium head grade but requires high magnetite content and may tolerate magnetite from the P3 unit. Furthermore, alkali roasting is sensitive to the abundance of silicates in the concentrate, which benefit from being below 1% SiO_2. Inversely, concentrate to be smelted will benefit from having some silicates, which would act as a flux lowering the smelting temperature and easing the slag viscosity. Effect of contaminant on electrowinning process is still to be documented. Therefore, the specification of the milling and beneficiation circuit is to be adjusted to the refining process.

BULK SAMPLES

The *Ministère des Richesses Naturelles du Québec* collected three successive bulk samples of 30, 200 and 600 tonnes in late 1960' and early 1970'. These samples were taken from the P2 magnetite-rich beds of the East Deposit. It is uncertain if these three bulk samples were taken at the same location, but evidence of blasting was found in only one location. These samples are likely biased toward a higher head grade than the average deposit. They were taken within the area of the initial pit designed for SOQUEM, the site still being visible in the field ***(picture 15)***.

Picture 15*: Sampling site for the 600 tonnes bulk sample collected by the Ministère des Richesses Naturelles du Québec in 1971.*

Picture 16*: Sampling site for the 50 tonnes bulk sample collected for SNC-Lavalin in 2001.*

A series of eight (8) small 1 tonne bulk samples were collected by McKenzie Bay Resources in 1997, from various stratigraphic units. Bench tests including grinding, energy consumption and magnetite concentration were carried out on one of these samples (T1) (Lamontagne, 1998). SNC-Lavalin also used these samples for preliminary beneficiation tests. These bulks samples are the only one taken from P0, P1 and P3, and it is uncertain if they were processed individually or if they were mixed to create composite samples.

A 50 tonnes sample was collected for SNC-Lavalin in 2001, which was used for the pilot plant testing carried out within the scope of the feasibility study. This sample was collected from the P2 horizon in Eastern Deposit, close to the former MRNQ site *(**picture 16**)*.

BENEFICIATION AND TITANOMAGNETITE CONCENTRATE QUALITY

The ***Lac Doré*** magnetite deposit has similar characteristics to other deposits currently in production in the world and the beneficiation process is well understood. Beneficiation is required to produce a pure titanomagnetite concentrate free from deleterious elements. Historic beneficiation design seeks to minimize silica, which cause a reduction of vanadium recovery and consumes reagents in the roasting step. Therefore, beneficiation design is typically an economic trade-off between grinding size and silicate liberation. A typical beneficiation circuit consists of crushing and grinding, scalping, regrinding followed by cascading magnetic separators. Various designs for Lac Doré were tested through time both at the laboratory and pilot plant scales. Reported results in the literature are sometimes confusing, since they do not always provide details of the tests. In most reported tests, specifications for technical grade vanadium production were apparently met or exceeded.

Davis tube testing performed in several historical reports show how vanadium grade in titanomagnetite concentrate is affected by grind size. While silica contamination is reduced by finer grinding, vanadium credits are lost by a more efficient ilmenite removal. These effects were never studied in detail at pilot scale, and no detailed liberation studies were conducted. Each of the beneficiation tests were conducted at a specific grinding size dictated by the subsequent flow sheet and the metallurgist’s experience, leading to slightly different results.

The efficiency of downstream vanadium refining is sensitive to the grinding and beneficiation process employed. Both with the roasting and smelting processes, the finer the magnetite concentrate is, the more dust is generated which increase loading in the kiln or furnace and results in lower overall vanadium recovery and extra capital costs for the project. This liberation size is critical to milling circuit design. If the required grinding size is too fine, a pelletizing or briquetting step may be required prior to roasting or smelting. Furthermore, grinding size may affect efficiency of the leaching and filtration circuit. The Lac Doré magnetite is not expected to be suitable for shaft or blast furnace without pelletization, but was considered acceptable for direct reduction smelting such as RTIT (QIT) process without pelletization and alkali roasting.

BENEFICIATION TEST CONDUCTED BY JALORE MINING LTD

Jalore Mining Ltd., a subsidiary of Jones and Laughlin Steel Co of Pittsburgh, reported a limited beneficiation test relating to the potential production of iron ore. They failed to produce a magnetite concentrate with titanium content low enough to be suitable as feed stock for their blast-furnace.

BENEFICIATION TEST CONDUCTED BY CAMPBELL-CHIBOUGAMAU MINES LTD

A 35 tonnes bulk sample, taken from the Campbell-Chibougamau deposit, was sent to CRM for magnetite concentration in 1966. The report is not available (Delisle, 1972). This deposit is located at the same stratigraphic level within the Lac Doré Complex, about 40 kilometres to the west. Vanadium grade of this titanomagnetite, 0.77% V_2O_5, is lower than P3 Unit, but its low titanium grade (0.54% TiO_2) is distinctive to the rest of the Complex. This material is, however, comparable to former Otanmäki mine in Finland, owned by Rautaruukki, meaning it could be smelted in conventional blast furnace according to their process, if pelletized.

FIRST CRM BENEFICIATION TEST, 1967

The first beneficiation test done on the ***Lac Doré*** mineralization was carried by the CRM on drill cores recovered from Jalore Mining drilling. At the time, four small samples representing 50 kilograms were selected by Dr. Gilles O. Allard and tested. Titanomagnetite concentration was done by Davis tube and Sala magnetic separator, on samples grinded at -325 mesh. Bench-scale alkali roasting tests were subsequently performed on these concentrates.

BENEFICIATION TEST BY IRSID, 1970

A pilot plant beneficiation test was performed by IRSID (*"Institut de recherche sidérurgique")* in Nancy, France in 1970, on behalf of the *Ministère des Richesses Naturelles* (Gerbe et *al*., 1970; Astier et *al*., 1970). It processed 5 samples of 4 tonnes each from the MRNQ bulk samples *(**table 14**)*. Autogenous grinding energy requirements were established at 8.15 to 12.7 kWh/t. A dry route test included primary grinding and low strength magnetic separation (usually referred as *"scalping"* by metallurgists). A subsequent wet route involved secondary grinding, magnetic separation and recycling. Ilmenite was concentrated using a high strength magnetic separator and gravity separator from rejects of primary magnetic separation (Astier and Boudier, 1969).

The results for the five samples are listed below. Some vanadium grades are low, probably as result of sampling parts of the P3 unit, vanadium distribution between units was not understood at that time. The material was not assayed for contaminants.

IRSID	Yellow	Red	Bleu	Brown	Green
Fe (Fe_3O_4)	85.3%	83.8%	82.3%	80.8%	81.7%
V (V_2O_5)	1.39%	1.26%	1.16%	0.87%	1.19%
TiO_2	9.5%	11.0%	12.4%	15.6%	12.1%

***Table 14**: Analysis of IRSID concentrates, labelled as colour in their report. Note that iron and vanadium were stated as metal, while grades seem to represent oxides.*

2nd BENEFICIATION TEST BY THE CRM

A second beneficiation test was carried in 1971 (Cloutier, 1971) by the CRM using aliquots of the same samples than IRSID tests. Conventional wet methods were used for comminution and separation, including multiple steps of crushing and grinding down to 270 mesh. Magnetic separation was done using a Sala separator and then a Davis tube. This work aimed mainly to establish the effect of grinding on titanomagnetite concentration.

BENEFICIATION TEST BY FOOTE MINERALS

Tests were carried on the Lac Doré mineralization by Foote Minerals for an American steel producer. Only a shipping statement is available at this point, no results were found.

3rd BENEFICIATION TEST BY CRM

A pilot plant concentration test (Delisle and Dessureaux, 1977) was done by the CRM (***table 15***). Two samples were extracted from two distinct trenches T-1 (45 tonnes) and T-3 (200 tonnes). Such large tonnage was needed for a subsequent smelting test. The rock was first crushed to -28 mesh and submitted to a first magnetic concentration step ("*scalping*"). Rejects were processed with Humphrey spirals for ilmenite recovery, which amounted to 3%. The concentrate was then ground to 90% at -325 mesh and submitted to a second magnetic separator. Grinding indexes were calculated at 12.7-13.0 kWh/t for the rock and 23.9-26.0 kWh/t for the magnetite concentrate.

Drums of this concentrate were submitted to various laboratories for pelletizing, roasting and smelting tests.

	1	2	3	4	5	6
Fe_{total}	65.9%	64.7%	64.1%	65.0%	64.37%	66.0%
FeO		32.5%	30.6%	n/a	32.25%	n/a
Fe_2O_3		n/a	57.7%	n/a	56.19%	--n/a
TiO_2	9.6%	8.0%	7.97%	7.5%	7.75%	0.54%
V_2O_5	1.46%	1.61%	1.48%	1.6%	1.56%	0.77%
SiO_2		1.20%	0.80%	1.0%	0.88%	2.8%
Al_2O_3		0.81%	0.67%	0.8%	0.78%	0.36%
MgO		0.24%	0.25%	0.24%	0.45%	3.86%
CaO		0.17%	0.15%	0.17%	0.14%	0.05%
P		0.0017%	--	--	--	0.01%
As		< 0.001%	--	--	--	--
Cr_2O_3		0.06%	0.13%	0.13%	0.12%	--
MnO		0.15%	0.20%	--	0.15%	--
Na_2O		0.07%	0.05%	--	--	--
K_2O		0.05%	--	--	--	--
S		0.02%	--	0.02%	--	0.02%
Ni		0.011%	--	--	--	0.06%

***Table 15**: Analysis of the magnetite concentrates from the 3rd CRM test. The various reported analyses were made by different laboratories on different aliquot from the same material.*

__1__: CRM pilot plan concentrate reported by CRM; __2__: CRM pilot plan concentrate analysed by Rautaruukki Oy; __3__: CRM pilot plan concentrate analyzed by Hatch & Associates; __4__: CRM pilot plan concentrate as mentioned in CIM Bulletin; __5__: CRM pilot plan concentrate used by QIT fusion.

Another pilot plant concentration test was planned in 1981, for 600 tonnes to be processed at CRM. This test was cancelled and the fate of the bulk sample is unknown (letter by Desrochers, 24 Feb 1981).

BENEFICIATION TEST DONE BY LAKEFIELD RESEARCH FOR SNC-LAVALIN

A pilot plant beneficiation test was commissioned to Lakefield Research in 2001 by SNC-Lavalin on behalf of McKenzie Bay International (https://docs.google.com/file/d/0BxmBLfd5ee8sSDdtc2NWaDljUU0/preview). This included the bench-scale processing of the eight bulk samples of 1 tonne collected in 1997 on behalf of McKenzie Bay Resources, plus the pilot plan processing of the 50 tonnes bulk sample collected in 2001. The test includes primary grinding, magnetite scalping at low magnetic intensity, secondary closed circuit regrinding and triple drum low intensity magnetic separation (***figure 20***). Results were apparently within specifications, yielding a magnetite concentrate with <1.2% SiO_2 and <1.2% V_2O_5, from a feed containing 0.47% V_2O_5 and 32% magnetite.

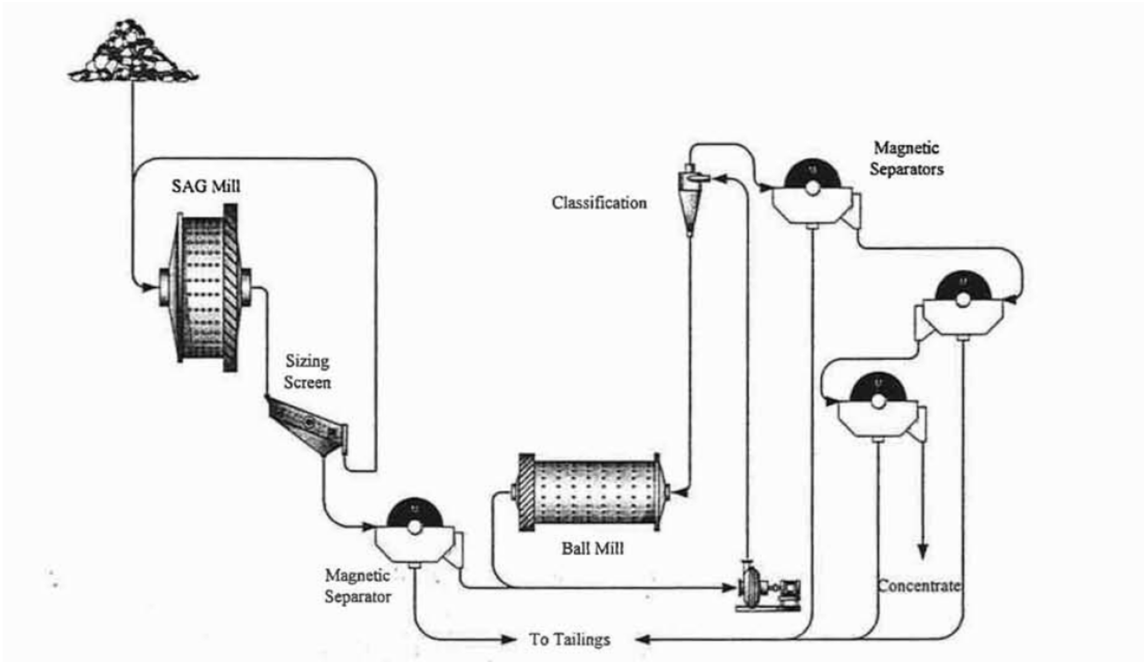


***Figure 20**: Magnetite beneficiation flow diagram, as reported by SNC 2002.*

TITANOMAGNETITE CONCENTRATION BY IOS IN 2017

Two titanomagnetite concentration tests were conducted by IOS in 2017 in order to provide material for the digestion test to be conducted by Electrochem Technologies and Materials in the development of their leaching and electrowinning process (Boivin et *al.*, 2017, Boivin et *al.*, in prep.), The first concentrate, for 25 kilograms, was prepared using composited pulps from 123 assays of 2013 drill holes. Titanomagnetite was recovered after multiple passes on a Sala drum magnetic separator, and assayed with a portable XRF spectrometer and XRF on press borate glass bead at COREM. Grain size curves were measured with a Fritsch laser dispersion grain sizer.

The second concentrate, for 25 kilograms, was prepared from coarse crushing leftover from the preparation of the same samples from 2013 drill core. The material was split in three lots, which were pulverized first with a porcelain disk mill (Bico), second with carbon steel mini rod mill, and third with a manganese steel mini rod mill. The test aimed to evaluate the metallic iron contamination, and its capacity to generate hydrogen during acid digestion. Magnetic separation was conducted with the use of a Sala drum magnetic separator, and assayed with a portable XRF spectrometer and XRF on press borate glass bead at COREM. Grain size curves were measured with a Fritsch laser dispersion grain sizer.

ILMENITE BENEFICIATION

Concentration of ilmenite in order to produce a valuable concentrate was discussed in the past (Castonguay, 1978), but only limited testing was completed in 1967 (Kish, Cloutier et Olivier, 1971). These test, conducted on the 35 tonnes bulk sample collected on P2 Unit, recovered 9.55% ilmenite, which graded 35.2% Fe (45.3% FeO, or nearly stoichiometric $FeTiO_3$), 45.9% TiO_2, 0.17% V_2O_5, and about 4.8% contaminant such as silica. A second set of results (Castonguay, 1977), indicated that reprocessing the tails from the magnetic separation with a spiral recovered 8.4% of ilmenite from the initial feed, representing 23.2% of the overall titanium and 3.4% of the overall vanadium. Such ilmenite is acceptable for the production of titanium dioxide only through sulphate route, or would require to be upgraded to synthetic rutile for the chloride route. Adding the ilmenite to the magnetite concentrate would increase the overall oxide weight recovery from 35.8% to 44.2%, and reduce its vanadium grade from 1.46% to 1.23%, for an overall vanadium recovery improvement from 79.4% to 82.6%. These numbers refer solely to the test conducted on the aforementioned bulk samples, and are not indicative for the overall deposit.

The author was indicated that ilmenite recovery tests were conducted by SGS-Lakefield on behalf of McKenzie Bay Resources in 1983, under the guidance of J. Marcek. Results were never concealed in a report.

Similar ilmenite concentration as by product was contemplated by Arianne Phosphate, out of their Lac à Paul apatite deposit, as well as by Mine Arnaud, from their Sept-îles apatite deposit. However, no significant market for such pulverulent ilmenite was identified, and the option was abandoned.

Separation of granular ilmenite is more challenging than magnetite, ilmenite being only slightly ferromagnetic. Magnetic separation thus yields an ilmenite concentrate contaminated by silicates from non-liberated magnetite. Subsequent gravity or flotation circuit are required to clean the ilmenite concentrate.

Ilmenite abundance is in the order of less than 20% of the magnetite abundance, but has never been accurately estimated for Lac Doré deposit.

CHEMICAL AND ELECTROCHEMICAL PROCESSES

A chemical process involving the digestion of the titanomagnetite into sulphuric acid has recently been developed by Electrochem Technologies and Materials Inc. ("Electrochem") at its facilities located in Boucherville Québec on behalf of VanadiumCorp. Construction of a plant for the processing of the VTM is not addressed in the current study, as too many design uncertainties being still pending. However, a brief description of the anticipated process is considered relevant, although aspects have to remain confidential.

The chemical process will be integrated vertically with Electrochem's patented electrowinning process allowing the production of pure electrolytic iron and vanadium electrolyte. The integrated process is divided into two distinct sections, with different intellectual property (IP) ownerships.

The first upstream chemical process, identified as the VanadiumCorp-Electrochem process in news releases, refers to the digestion of vanadiferous titanomagnetite into sulfuric acid, and leads to the production of or ferrous sulfate heptahydrate ($FeSO_4 \cdot 7H_2O$) also known as copperas in the trade, vanadyl sulphate (VOSO4) precursor to be used for the preparation of the vanadium electrolyte (VE), with silica and titania-rich as by-products. The chemical technology is patent pending (US Provisional Patent Applications 62/463,411 and 62/582,060), jointly owned by Electrochem Technologies and Materials Inc. (50%) and VanadiumCorp Resource Inc. (50%). It has recently been tested successfully on 25-kilograms batch of Lac Doré titanomagnetite as well as with titanomagnetite from other locations and other vanadiferous feed stocks originating from various sources.

Titanomagnetite is digested into hot concentrated (70-98%) sulfuric acid between 160^oC to 220^oC under atmospheric pressure. Sulphating reaction being exothermic, the system is autogenous and the first part of the process requires just a minimum of external heat to trigger the reaction. Iron, vanadium, titanium and other contaminants are converted to metal sulfates. The operating conditions are selected in order for some of the titanium to remains in the insoluble solid residues with silica and gypsum while the remaining will end up dissolved as titanium (III) and titanyl sulfates and later separated by selective precipitation and hydrolysis. The digestion process is rather different to what is used for the production of ferric sulphate requiring autoclave and oxygen under pressure.

Pure copperas or ferrous sulphate heptahydrate ($FeSO_4 \cdot 7H_2O$) is crystallized from the solution by vacuum evaporation, chilling and crystallization, leaving a titanium and vanadium-rich solution. The copperas crystals are recovered by centrifugation. After precipitating the titanium, the vanadium-rich pregnant solution, drained from the copperas mush, is purified to produce vanadyl sulfate, the precursor for VRB battery electrolyte.

The purity of the titanium dioxide rich by-product obtained is usually more than 95% TiO_2 with a good marketable value. Silica and gypsum could be eventually precipitated independently, both of commercial value. Although the process works in closed loop with about 90% efficiency, no information is available yet about contaminant build-up. Unreacted residues from the sulphuric acid digestion were examined under scanning electron microscope (SEM) by IOS, and consist mainly of unreacted coarser grains of titanomagnetite and silicate grains, which can be regrinded and recycled back into the digestion circuit (Tremblay and Girard, 2017).

Small pilot plant scale metallurgical testing of Lac Doré titanomagnetite concentrate is currently underway with a custom built digester unit and related processing equipment having a nameplate capacity of 300 kg of vanadiferous titanomagnetite concentrate per month.

The second part of the electrochemical process, referred as the Electrochem's process, is fully owned by Electrochem Technologies and Materials Inc. and a memorandum of understanding was signed by VanadiumCorp to access and use the technology (VRB news release, February 9th, 2017). The process is patented worldwide, described in Canadian Patent 2,717,887C (Cardarelli, 2009). It refers to the electrowinning of copperas and other sulphate solutions containing mainly iron for producing pure electrolytic iron and/or iron-rich alloys and regenerating sulfuric acid (***figure 21***). Electrodeposited metallic iron is plated to the cathode as pure iron with a final purity exceeding 99.5 wt% Fe. Mildly concentrated sulphuric up to 30% H_2SO_4 and pure nascent oxygen gas are also produced in the anode compartment, using mixed metal oxides anodes. The divided electrolyser uses anion and cation exchange membranes, depending on the cell configuration (i.e.: two or three compartments). The regenerated sulfuric acid is further concentrated by thermal evaporation and recycled back to the digestion circuit. The faradic current efficiency of the cell is claimed at more than 95%, meaning electrical consumption for the electrowinning process is about 2.90 MWh per tonne of iron under certain conditions (see cited patent). This represents less than half the energy requirement of steel production at 6.38 MWh per tonne (Fruehan et *al*., 2000). The process was successfully applied at prototype and semi-pilot scale using copperas recovered from digestion of Lac Doré titanomagnetite.

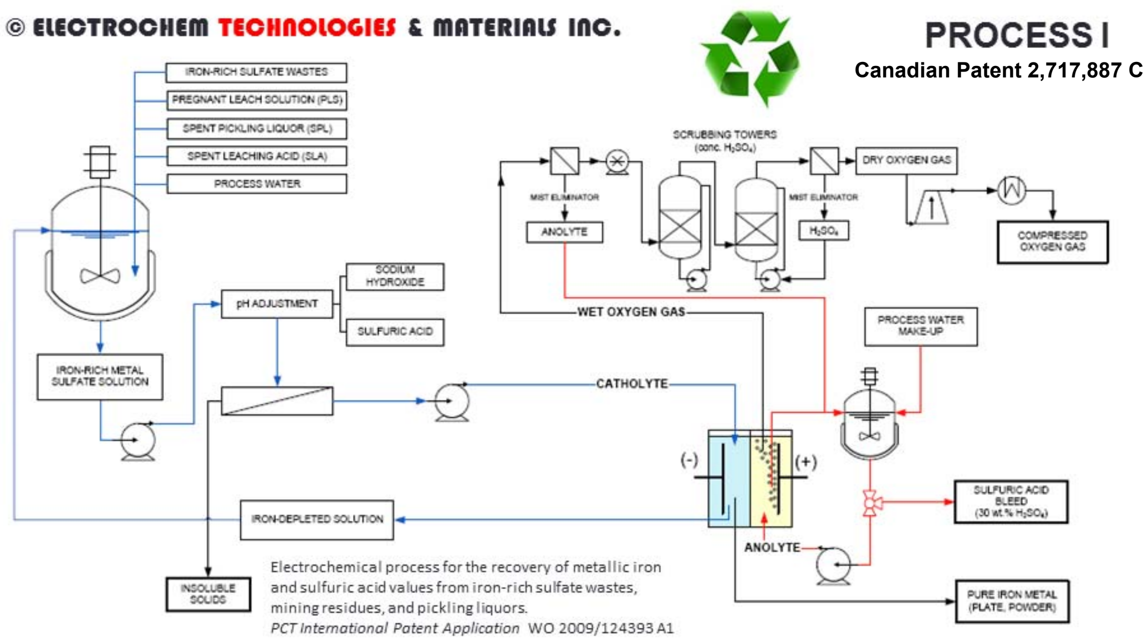


***Figure 21**: Electrochem process flow diagram from Canadian Patent 2,717,887C for the production of pure electrolytic iron and regeneration of sulfuric acid from copperas (ferrous sulfate heptahydrate).*

A summary of the two integrated technologies is depicted ***figure 22*** showing the electrowinning of iron and vanadium chemical production applied to Lac Dore titanomagnetite.

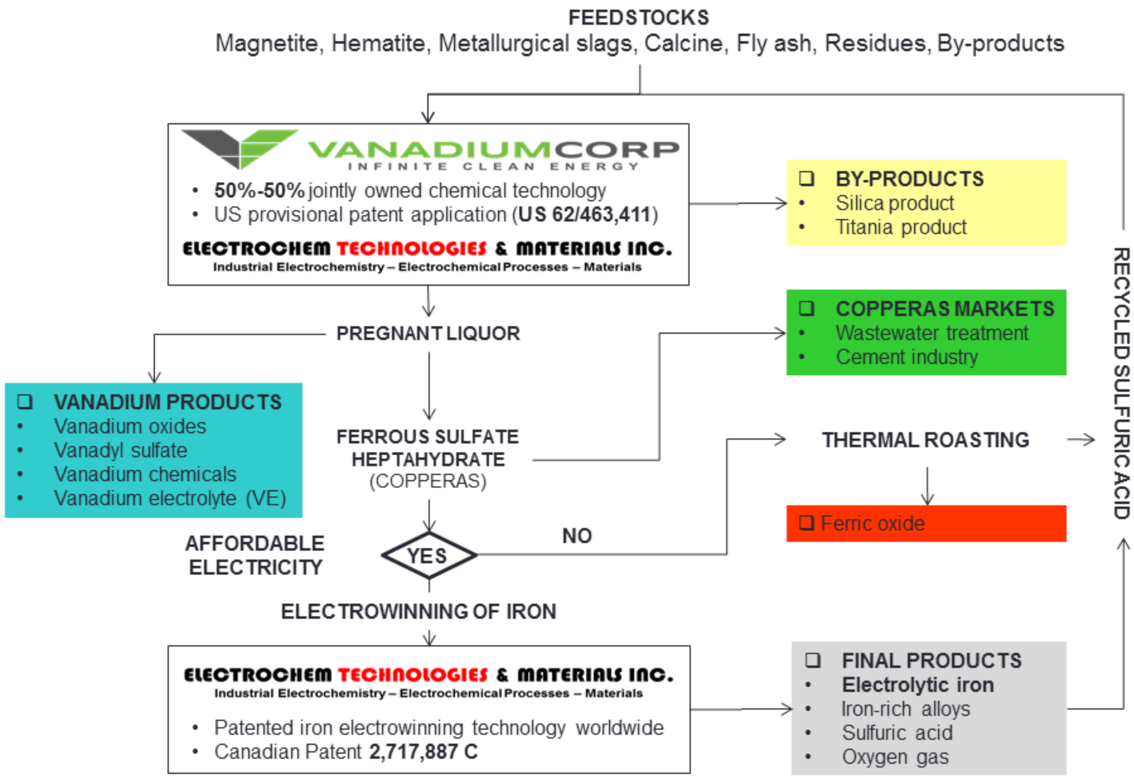


***Figure 22**: Schematic flow diagram of the two integrated VanadiumCorp-Electrochem and Electrochem processes, for the production of electrolytic iron, vanadium chemical and titania products from various feed stocks.*

Pure electrolytic iron is at least 99.5% pure, carbon-free ferrite (alpha-iron) with a body-centred cubic structure. Electrolytic iron compares with other form of high purity iron such as reduced iron, ingot iron, and carbonyl iron, (Cardarelli, F. 2008). It is carbon free, compared to other products that still contains up to 3 wt.% or more carbon. It can be produced as massive cathodes, scraped flakes or fine powder depending on the electrolyser configuration and the cathode current density. Industrial uses of electrolytic iron are multiple, mainly manufacturing the core of electrical transformer, as food additive and as metallic powder iron for sintered casted steel by the automotive industry. Electrolytic iron powder pricing is highly dependent on purity and fineness, but minimally sold at approximately twice the price of steel (>2,000 US$/tonne).

Oxygen is also produced, for about 25% the weight of iron, which is saleable co-product at about $40 per tonne.

The vanadium pregnant solution may also be process itself by electrowinning using Electrochem's process to produce iron-rich alloys at the cathode. This material can be used as master alloy in steel manufacturing process, in replacement of ferrovanadium.

Inversely, vanadium in the PSL, can be separated from other metals by solvent extraction, in order to obtain a pure vanadium electrolyte, a well established process.

Application of the technology to the vanadiferous titanomagnetite volume anticipated in the current project would lead to the production of approximately 500,000 tonnes per year of electrolytic iron, 80,000 tonnes of titania-rich product, 16,000,000 pounds of vanadium pentoxide equivalent, 16,000 tonnes of amorphous silica dust, 8,000 tonnes of gypsum and 125,000 tonnes of oxygen.

VANADIUM ELECTROLYTE

Production of vanadium-bearing electrolyte is currently perceived as the next big vanadium market. Vanadium redox flow batteries use vanadyl sulfate $VOSO_4$ as basis for their electrolyte. This compound is obtained by reaction of sulfuric acid with vanadium pentoxide followed by reduction. The production of the electrolyte requires a very low contaminant level in the soluble vanadium compound, notably for silica (<10 µg/l) and sodium (<100 µg/l), for an overall 99.99% $VOSO_4$ purity. Such contaminant level cannot be achieved by conventional hydrometallurgy, and requires the addition of a purification circuit. This purification is currently achieved through the addition of ion exchange resin or solvent extraction circuit prior to the AMV precipitation (Bradbury, 2002). Chemicals with such purity are currently produced in limited quantities by Stratcor (USA), AMG Vanadium (USA), Vanchem (South Africa) and Dalian Bolong (China). Details of the resins or solvents are not publicly available.

The purity of the electrolyte is required to ensure longevity of the ion exchange membranes of the batteries. Contaminants, notably silica, tend to cover the membrane, reducing its ionic permeability (***figure 23***). Accordingly, current density is reduced from 560 mA/cm^2 with pure electrolyte, to 280 mA/cm^2 with electrolyte made from unpurified liquor. This leads to membrane degradation and maintenance costs. By contrast, cycling the electrolyte through the membrane progressively removes its contaminants (Burch, 2015). On the other hand, traces of chromium Cr^{+3} in the anolyte are reported to enhance current density (Huang and *al*., USGS, 2012). Iron does not have a significant impact. Effects of contaminants on membrane longevity and performance are an active field of research (P. Mercier, National Research Council of Canada (NRC), personal communication, 2016). Contaminant distribution in titanomagnetite across Lac Doré deposit is currently under evaluation (J.-P. Arguin, PhD in progress, UQAC).

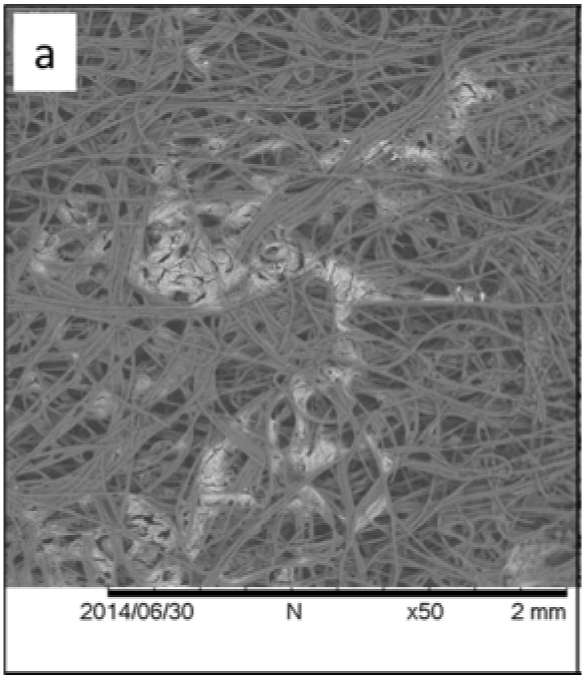
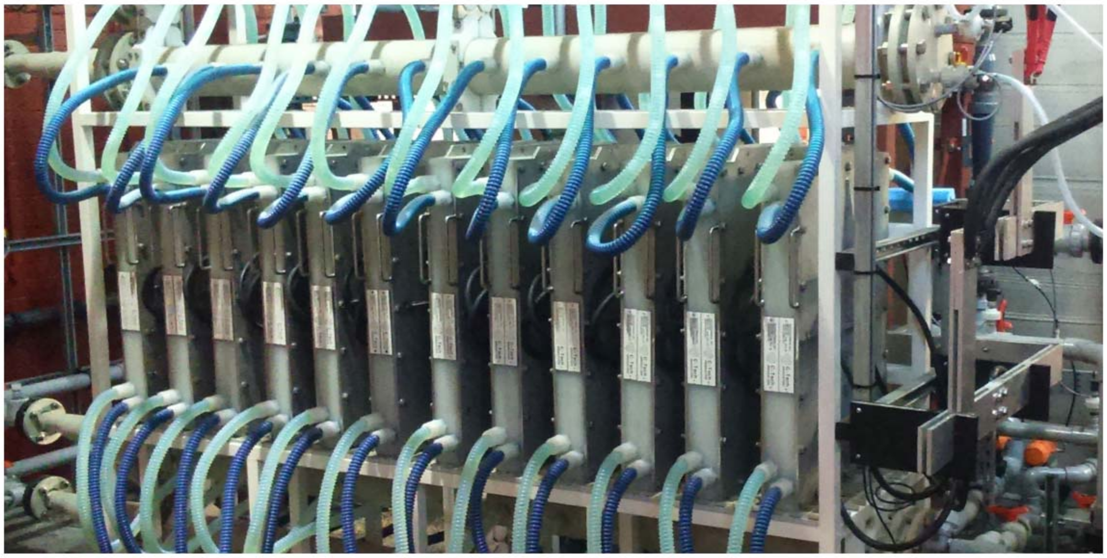


***Figure 23**: SEM image of silica precipitate on VRB membranes (Burch, 2015).*

Production of pure vanadyl sulfate has not been considered in historic work on Lac Doré titanomagnetite. Test work was conducted in this regard only by Lakefield Research on behalf of McKenzie Bay Resources in 2002, the result of which is not publicly available.

More recently, a vanadium liquor purification process based on electrodialysis was developed and commercialized by C-Tech Innovation, from Chester, UK (http://www.ctechinnovation.com/chemical-processing/vanadium-electrolyte-production/). Electrodialysis is a process similar to electrowinning, where the cathode and the anode are separated by series of anion and cation exchange membranes trapping the various metals (***figure 24***). The system is fed with impure vanadium liquor and efficiently separates the various cations. Industrial application is currently being tested by Australian Vanadium Limited. VanadiumCorp Resource recently entered into a memorandum of understanding with C-Tech Innovation for licensing the technology to the North-American market.



Production-scale vanadium electrolyte equipment

***Figure 24**: Production scale electro dialysis cells used for vanadium electrolyte purification (www.ctechinnovation.com).*

ITEM 14: MINERAL RESOURCES ESTIMATES

The current Preliminary Economic Study uses the resources calculated in a previous report (Girard and D'Amours, 2015), effective on June 2nd, 2015, without modification. The resource model used in 2015 is based on slightly different economic premises than the current economic study, in the sense that it included the effect of vanadium extraction by alkali roasting, while the current PEA is limited to the production of titanomagnetite, without considering the roasting. The current scenario is less restrictive than the one used in resource calculation, in the sense that the vanadium grade of the titanomagnetite is not considered. Only titanomagnetite abundance is affecting the current scenario. Since the model currently required is less restrictive, and that not all resources calculated in 2015 are required to sustain the mine life at the anticipated mining rate, and that considering that only inferred resources are currently available, it has not been considered that a thorough resource re-estimation was required, and that fluctuations are expected to be within the limits of the sensitivity analyses.

Christian D'Amours, P. Geo. (OGQ n° 226) from Geopointcom was contracted by VanadiumCorp to complete a Resource Estimate for the Lac Dore project. The resources were estimated by Christian D'Amours, P. Geo. who is a qualified person and independent of the issuer, based on the tests outlined in National Instrument 43-101. The current estimation is restricted to the Eastern deposit and the easternmost part of Western deposit as defined in historical reports, and does not encompass the main portion of Western or North-Eastern deposits.

The resource estimation work was performed from November 2014 to February 2015. The last drill hole included and considered is LD-13-04. This hole was drilled in March 2013. Since that time, no new information was added to the database. The Mineral Resource Estimates included in this report are based on data supplied by VanadiumCorp and IOS Services Géoscientifiques Inc. and validated by the author. The effective date for the resource estimate is June 2nd, 2015.

The main objective of this work was to publish the results of a mineral resource estimate needed to complete a preliminary economic assessment and evaluate the work required to upgrade confidence and resource categories.

The resource estimations are based on a scenario considering an open pit mining method (50° slope) up to a maximum depth of 200 m. Mineralized block selection is made in two steps. First, the abundance of magnetite (Davis tube magnetite concentrate) must be over 15%. Then, the amount of V_2O_5 measured in the magnetite concentrate must be over the cut-off limit. The cut-off limit is the breakeven point between cost and revenue for the specific cell. In this case, the cost for extracting V_2O_5 from magnetite bearing rocks varies in relation to the abundance of magnetite within the rock. Thus, the V_2O_5 cut-off cannot be a constant and is taken as a function of the magnetite abundance in the rock.

Mineral resources are not mineral reserves, not having demonstrated their economic viability.

Christian D'Amours was responsible for the 3D model and geostatistical analysis as well for resource estimation and classification.

METHODOLOGY

The Mineral resource estimate and geostatistical study detailed in this part of the report was performed using Isatis (V.14.02) software. The method involves a 3D block model of 10 m X 10 m X 11.9 m estimated by ordinary kriging (OK). Then an iterative procedure allowed for selecting cells and optimizing the pit design.

DRILL HOLE AND TRENCH SAMPLE DATABASE

The actual Geotic/MS Access diamond drill holes and trench database was setup and created by the author using all the data submitted. It contains 83 surface diamond drill holes and trenches, for 14,559 m of core (trenches are considered as core equivalent). A total of 2880 head grade samples were assayed for V_2O_5, Fe_2O_3 and TiO_2, while specific gravity (*SG*) was calculated according to the procedure described in *Item 12*. Almost all samples were also flagged with a lithological code. Most of the intervals previously assayed for head grade were tested for their magnetite content using a Davis tube magnetic separator, and the magnetite concentrate assayed for V_2O_5, Fe_2O_3 and TiO_2. Original sample limits were not systematically respected. Head grade samples were combined in longer intervals in most cases prior to the Davis tube process, to create composite samples. Thus, the database contains 3751 samples tested for magnetite content with the use of a Davis tube and assayed for TiO_2, Fe_2O_3 and V_2O_5 (hereafter referred as magnetite concentrates). This method allows measuring the V_2O_5 content within the magnetite concentrate with minimal contribution from other mineral phases. This magnetite concentration method is very similar to the method proposed for an eventual milling process. Thus the current estimate is based solely on results from the Davis tube testing, and any head grade estimate are based on cells selection from magnetite concentrates.

INTERPRETATION OF MINERALIZED ZONES

Interpretation and modeling of all lithological contact was performed in two phases using mostly rock code and the measure of Fe_2O_3 reported in head grade samples when available. The main difficulty here was to interpret and model a series of barren anorthosite sills and dykes within the P2 Unit.

First, the author used all trenching information combined with all available surface mapping information to create a consistent three dimensional lithological model fitted to the topographical information. At this point it is important to note that trenching was not systematically sampled. Un-sampled sections may either represent dykes or poorly mineralized rocks, typically a topographic high, or may represent sections where stripping was not possible, typically a depression or underneath the road. Both types of unsampled segments were managed differently, either attributed with a grade of 0% within mineralized rock, or a grade of 0% within barren anorthosite.

The next step consisted of adding all pertinent drill holes information to the previous surface model. In regard of drill holes, unsampled section, especially within the P2 Unit, were considered as an internal barren anorthosite sill or dyke.

In the cases of narrow intersections or inconsistencies with surrounding information, it was impossible to correlate all lithological variations. Hence, samples which clearly represent dykes were left within different lithological units. Inversely some mineralized units may be included inside barren unit. Such instances are not abundant and do not affect the quality of the estimation.

The final wireframe solid was created by digitizing interpretations onto 35 sections (spaced 50 m apart in the SW area and 25 m apart in the NE), and then using tie-lines to complete the wireframes (***figure 25***).

At this point, modelled lithologies were coded back to drill holes and trenching, allowing to match rock code for sample selection during the interpolation process.

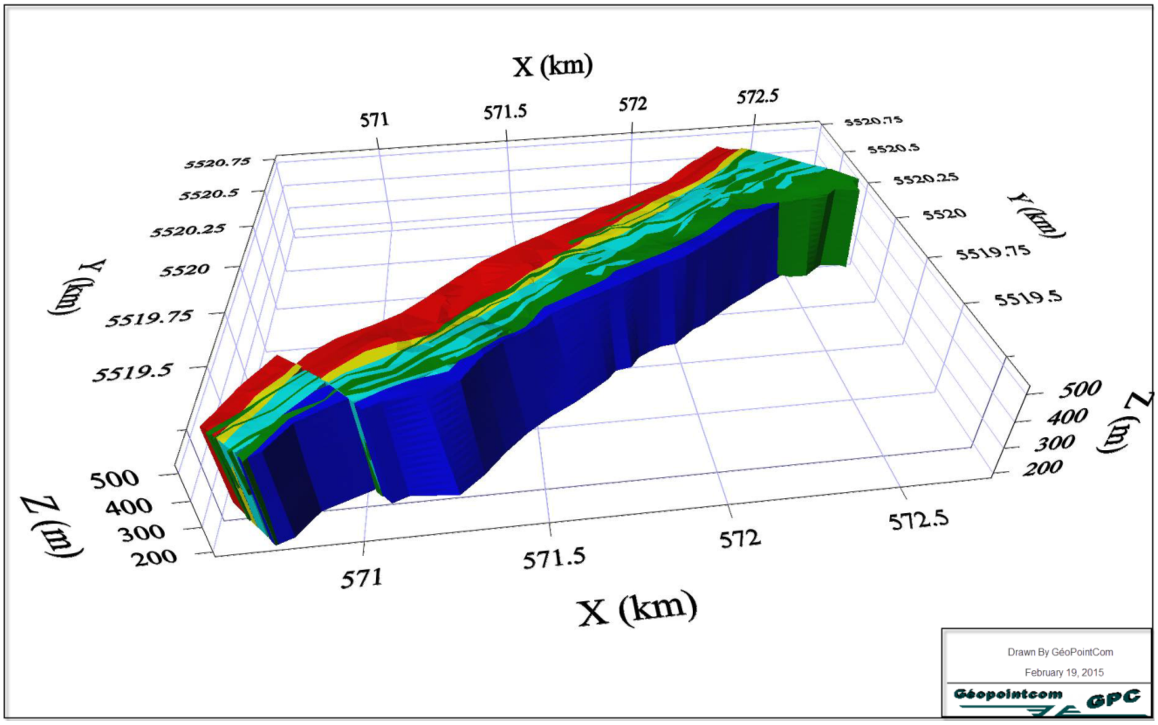


***Figure 25**: Wireframe solid model.*

COMPOSITING AND STATISTIC

The estimation method chosen requires that all samples represent the same volume of rock (same length). Compositing was processed using the SG calculated from each head grade sample but magnetite abundance and V_2O_5 grades were taken from the Davis tube samples. All samples were composited as close as possible to 3 metres within each lithological interval as previously defined from the 3D model. Within each lithological interval, remaining shorter mineralized intervals were redistributed over the whole composite. Thus the average length of all composites is 2.99 metres, the smallest composite is 1.77 metres and the longest 4.48 metres (***table 16***). While creating a composite, SG and magnetite abundance were weighted solely on core length while V_2O_5 was weighted both on core length and magnetite abundance.

Table 17 shows how the averages shift when extreme data are trimmed off. Trimming 5% means removing 2.5% from the highest value as well as 2.5% from the lowest value. The author used this table to select default specific gravity value based on lithological code where data are missing.

		Number of 0 value*	Number Over 0	Mean	Standard Deviation	Coefficient of Variation	Minimum	Maximum	10th Percentile	90th Percentile
SG	Dyke	0	1304	3.18	0.21	0.07	2.8	4.1	3.1	3.5
	P-0	0	172	3.12	0.18	0.06	2.9	3.9	3	3.4
	P-1	0	301	3.26	0.27	0.08	2.8	4	3	3.7
	P-2	0	1724	3.51	0.33	0.09	2.8	4.2	3.1	3.9
	P-3	0	250	3.25	0.21	0.07	2.8	3.9	3.1	3.5
Magnetite (%) Over 0	Dyke	1187	117	11.97	12.61	1.05	0.01	56.97	0.89	31.01
	P-0	132	40	6.11	4.94	0.81	0.09	18.7	0.38	11.9
	P-1	45	256	17.1	9.3	0.54	0.04	57.3	6.5	31.46
	P-2	130	1594	35.26	12.66	0.36	0.06	68.85	18.01	50.27
	P-3	136	114	14.44	10.55	0.73	0.45	41.12	2.93	31.63
V2O5 (%) Over 0	Dyke	1170	134	1.28	0.31	0.24	0.6	2.34	0.91	1.67
	P-0	132	40	1.38	0.17	0.13	0.82	1.67	1.17	1.66
	P-1	38	263	1.43	0.14	0.09	0.31	1.67	1.27	1.58
	P-2	133	1591	1.3	0.25	0.2	0.21	2.01	0.93	1.61
	P-3	139	111	0.66	0.19	0.29	0.34	1.3	0.42	0.99
Length of composite (m)		0	3751	2.99	0.12	0.04	1.77	4.48	2.89	3.08

* 0 values are absent date (not assayed) these where exclude from other statistics

***Table 16**: Basic statistics for composite used.*

Trimmed average for SG						
Percent trim	**5%**	**10%**	**15%**	**25%**	**35%**	**45%**
P-0	3.099	3.098	3.079	3.075	3.092	3.100
P-1	3.246	3.233	3.222	3.204	3.180	3.181
P-2	3.505	3.505	3.506	3.526	3.539	3.545
P-3	3.234	3.221	3.210	3.190	3.170	3.194
Dyke	3.150	3.124	3.106	3.100	3.100	3.100

***Table 17**: Trimmed average for SG (g/cm^3).*

The distribution of SG (***figure 26***) is indicative of the relevance of the lithological coding achieved from the lithological 3D model (very low IQR for barren dykes and P0). Barren anorthosite and P0 anorthositic units are well constrained with only few results over 3.2 g/cm^3. However the presence of some high values is probably due to some erratic mineralized intervals within barren units. P1 and P3 units are quite similar, their SG being confined between 3.1 and 3.4 g/cm^3. The bimodal distribution of P2 specific gravity shows the presence of some barren anorthosite samples within the unit.

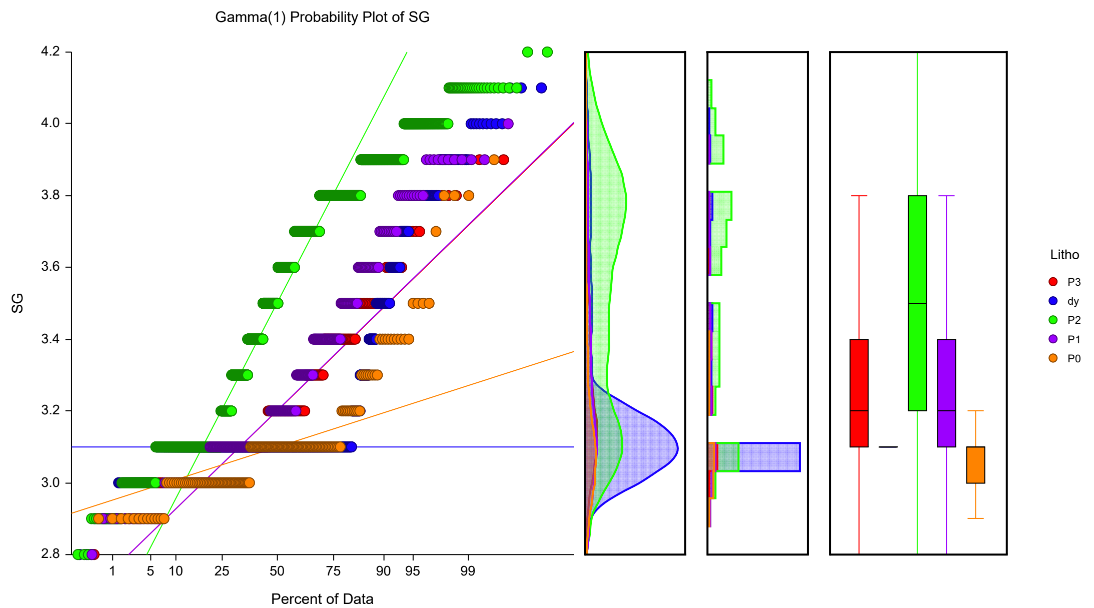


Figure 26*: Specific gravity probability plot and distribution per rock code.*

The V_2O_5 content of P1 and P2 units (***figure 27***) is very similar and distinctive from other units. Inversely, the amount of magnetite discriminates between P1, P2 and P3 units (***figure 28***).

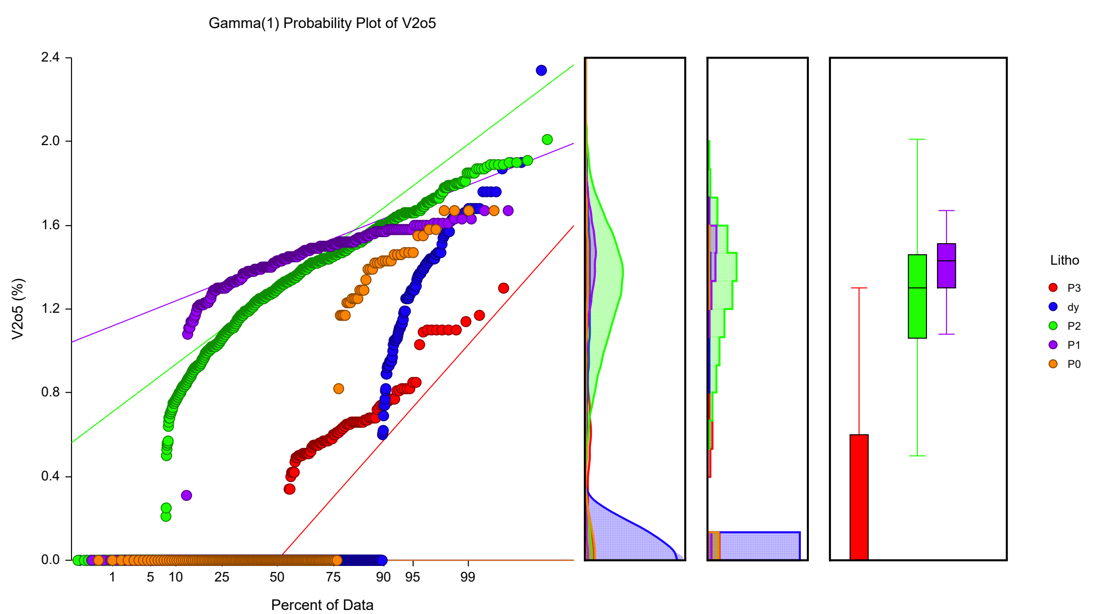


Figure 27*: V_2O_5 probability plot and distribution per rock code.*

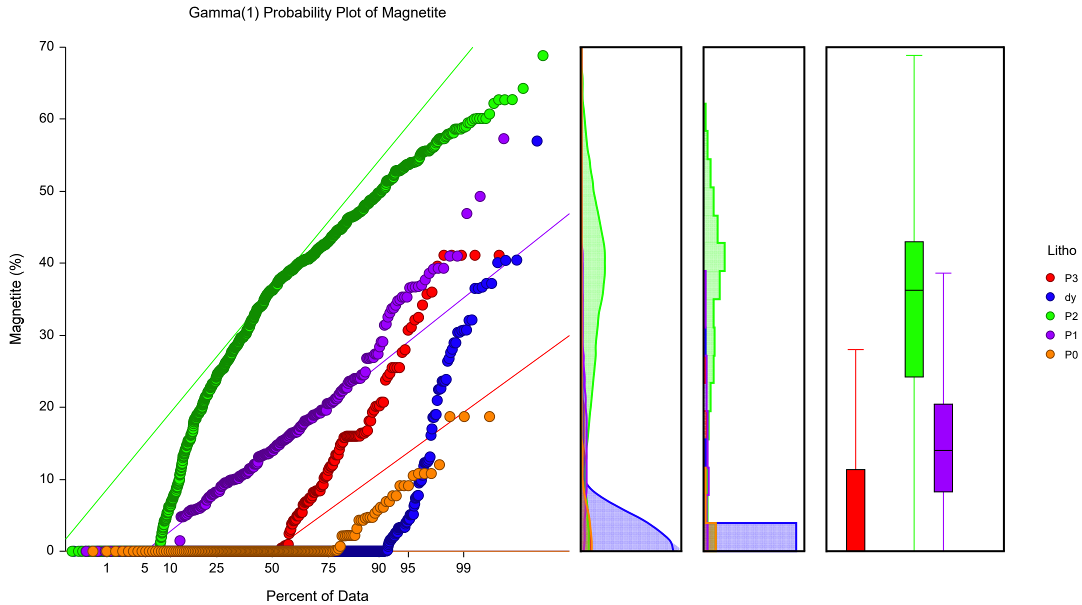


***Figure 28**: Magnetite (%) probability plot and distribution per rock code.*

VARIOGRAPHY

Variography was modeled using Isatis software. Because of the sampling density and stationary effect, only composites from the P2 unit were used. The author was unable to identify any consistent and relevant geometrical anisotropy. Therefore, the variogram model (***table 18***) was built on an experimental omnidirectional variogram (***figure 29***).

Model	Nugget effect	Spherical 1		spherical 2	
	sill γ	sill γ	range (m)	sill γ	range (m)
SG	0.05	0.04	70.7	0.01	400.9
V_2O_5	0.007	0.028	150.2	0.024	265.7
Magnetite (%)	96.6	27.0	75.1	44.3	511.6

***Table 18**: Model Variogram.*

$$\gamma(h) = C\left[\frac{3}{2}\left(\frac{\delta h}{a}\right) - \frac{1}{2}\left(\frac{\delta h}{a}\right)^3\right] \quad (h>a)$$

$$\gamma(h) = C \quad (h<a)$$

$\delta = 1$

Where "γ(h)" is the semi-variance, "h" is the lag distance, "a" is the range and "C" is the nugget effect.

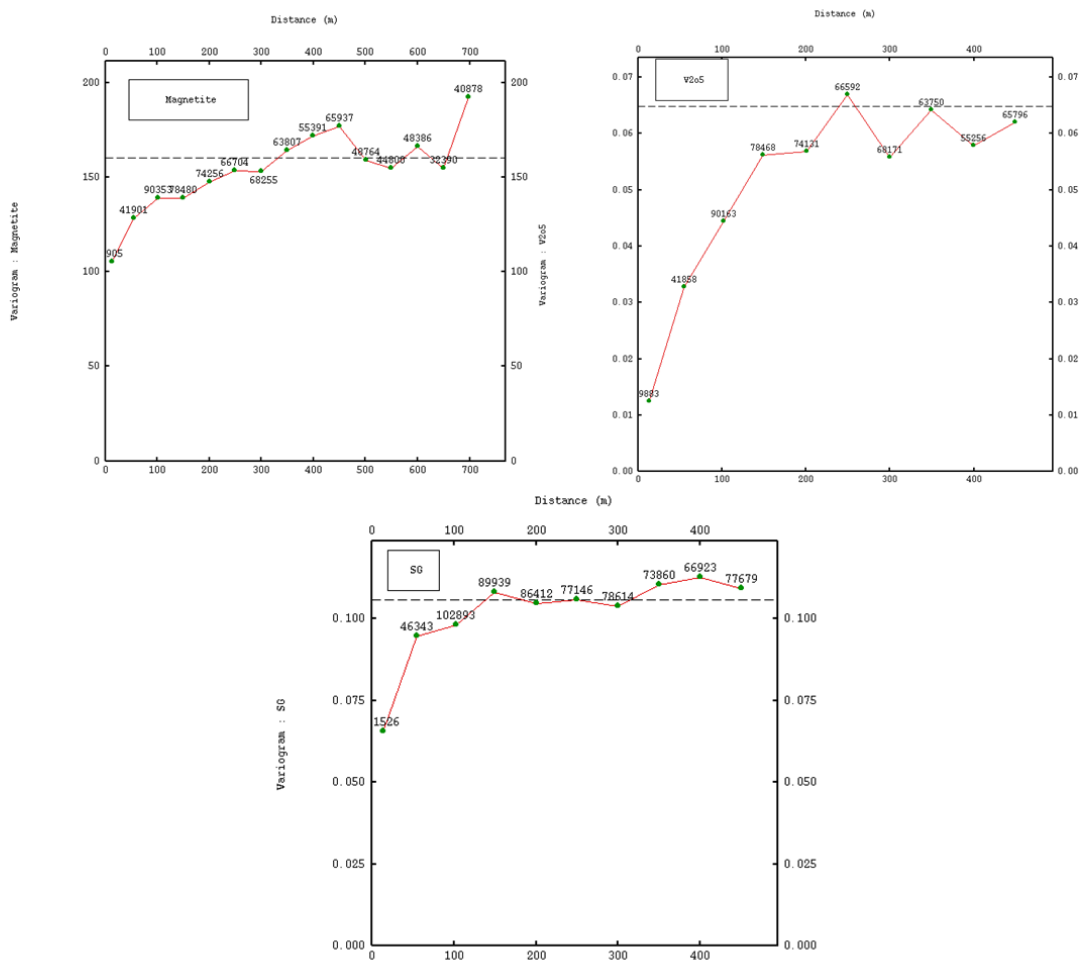


Figure 29: Experimental omnidirectional variograms.

BLOCK MODEL GEOMETRY

A block model was established encompassing the entire drilled area. Origins of the model are as follows (center of the front, bottom, left cell):

Easting: 571180 m E (257 cells x 10 m each)
Northing: 5518770 m N (117 cells x 10 m each)
Elevation: 230 m (32 cells x 11.9 m each)

The block model was rotated 39 degrees anticlockwise around the Z axes. The relative volume occupied by each rock unit within each cell was estimated using an array of 5 x 5 needles oriented parallel to the rotated Y axes of the block model.

ROCK DENSITY

For each cell, rock density was estimated from specific gravity by ordinary kriging (OK) using the model presented in ***table 18***. Neighboring was set to a minimum of 10 and a maximum of 25 composites within a search radius of 200 metres without any constraint regarding neither the hole names nor the octant distribution. The only constraint was matching rock code from cell to composite. When the search ellipsoid was unable to find the required minimum number of composites, default values were applied. The default value of 3.1 g/cm^3 was used for barren anorthosite and P0. The default density was set to 3.2 g/cm^3 for P1, and P3 units. When required, the default density for the rock code P3 was 3.2 g/cm^3 (***table 17***).

GRADE BLOCK MODEL

Abundance of magnetite (%) and vanadium grade (V_2O_5 %) of the concentrate where estimated in the same manner as for specific gravity but with correspondent spherical model (***table 18***). The author used the same neighboring strategies and the same search ellipsoid size. The only difference was in the case where the minimum number of composites could not be found, then the value was set to 0% magnetite and grade.

RESOURCE CATEGORIES

The resource classification definitions used for this report are those published by the Canadian Institute of Mining, Metallurgy and Petroleum in their document "CIM Definition Standards for Mineral Resources and Reserves" dated of November 27, 2010. The CIM definition is reproduced here.

Inferred Mineral Resource

An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes.

Due to the uncertainty that may be attached to Inferred Mineral Resources, it cannot be assumed that all or any part of an Inferred Mineral Resource will be upgraded to an Indicated or Measured Mineral Resource as a result of continued exploration. Confidence in the estimate is insufficient to allow the meaningful application of technical and economic parameters or to enable an evaluation of economic viability worthy of public disclosure. Inferred Mineral Resources must be excluded from estimates forming the basis of feasibility or other economic studies.

Indicated Mineral Resource

An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics, can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough for geological and grade continuity to be reasonably assumed.

Mineralization may be classified as an Indicated Mineral Resource by the qualified Person when the nature, quality, quantity and distribution of data are such as to allow confident interpretation of the geological framework and to reasonably assume the continuity of mineralization. The Qualified Person must recognize the importance of the Indicated Mineral Resource category to the advancement of the feasibility of the project. An Indicated Mineral Resource estimate is of sufficient quality to support a Preliminary Feasibility Study which can serve as the basis for major development decisions.

Measured Mineral Resource

A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application *of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough to confirm both geological and grade continuity.*

Mineralization or other natural material of economic interest may be classified as a Measured Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such that the tonnage and grade of the mineralization can be estimated to within close limits and that variation from the estimate would not significantly affect potential economic viability. This category requires a high level of confidence in, and understanding of, the geology and controls of the mineral deposit.

In the present case, variability and distribution (continuity) of the three dominant parameters (specific gravity, magnetite abundance and V_2O_5 of the magnetite concentrate) seem to be relatively simple, comprehensive and predictable (refer to variography). However, uncertainties related to the data are multiple:

- The paucity of drilling do not enable to build a reliable lithological model allowing to clearly identify and localise a barren dyke within a mineralized unit.
- Information is partly incomplete, built from various incongruent databases.
- Uncertainties remain regarding the accuracy and comparability of the assays as well as Davis tube test results from the various drilling programs.
- Most holes are poorly localised and lacking downhole surveying.
- Majority of drill holes and trenches have undescribed and unsampled intervals.

These limitations have a major impact on resource classification. As such, all resources estimated in the current report must be classified as inferred.

MINIMUM CUT-OFF VALUE

The cut-off value is defined as the breakeven point considering total potential cost and revenue generated by the operation. In the current estimation, potential milling and processing costs vary with the abundance of magnetite in the mineralization, since only magnetite concentrate needs to be processed by roasting. Since roasting capacity is the main constraint on production rates, the grade of the roasted concentrate has a major impact on potential revenues and cost. Thus, cut-off grade cannot be a simple uniformly applied grade, but requires calculation to be a function of magnetite abundance. ***Table 19*** show the calculated cut-off when considering certain financial parameters as constant. The retained scenario is US$5.50 per pound for V_2O_5 as indicated in Item 24.

The three year (April 2012-2015) average selling price of vanadium pentoxide on the European market is US$5.54 per pound for V_2O_5.

Production cost used the following parameters, as detailed in Item 25:

- Potential mining cost, including waste removal, based on similar operation: $1.80 per tonne.
- Potential milling and beneficiation cost, based on similar operation: $2.50 per tonne.
- This is based on a power consumption of 17 KwH/t at "L" rate. It includes cost for tailing management.
- Potential roasting and hydrometallurgy cost at $40/tonne of magnetite.
- Reactants are estimated at $21 per tonne of magnetite (soda ash and coal mainly, without salt recovery plant), to which manpower and calcine disposal need to be added.

V_2O_5 (within the concentrate) Cut-Off as a function of magnetite (%) and market value of V_2O_5 *					
V_2O_5 market price ($/pound)	**4.00 $**	**5.00 $**	**5.50 $**	**6.00 $**	**7.00 $**
Magnetite (%)	**Cut-Off**	**Cut-Off**	**Cut-Off**	**Cut-Off**	**Cut-Off**
10.00%	0.94%	0.75%	0.68%	0.63%	0.54%
15.00%	0.78%	0.62%	0.57%	0.52%	0.44%
20.00%	0.70%	0.56%	0.51%	0.46%	0.40%
25.00%	0.65%	0.52%	0.47%	0.43%	0.37%
30.00%	0.62%	0.49%	0.45%	0.41%	0.35%
35.00%	0.59%	0.47%	0.43%	0.40%	0.34%
* Mining cost = 1.80$/ Metric Ton; Magnetite separation = 2.50$/ Metric Ton;					
V_2O_5 extraction from concentrate (roasting) 40.00$/ Metric Ton					

***Table 19**: Cut-off relative to magnetite content.*

The resource was also calculated using revenues based on US$4.00 and US$7.00 per pound of V_2O_5 for comparative purposes. The cut-off grade will require re-evaluation in light of prevailing market conditions and other factors including exchange rate, mining method and related costs.

PIT OPTIMISATION

Pit optimisation was performed by iteration using in-house software. The following parameters were used:

- Pit slope = 50º.
- Minimum content of magnetite = 15%.
- Minimum profit required = 25%.
- Selectivity can be smaller than cell unit.
- Pit depth is limited to 200 m.
- Overburden thickness is unknown over almost 50% of the proposed pit. Even if suspected as thin, it was considered as unspecified rock.
- Mining cost = $1.80 per metric tonne of rock.
- Magnetite separation = $2.50 per metric tonne of rock.
- V_2O_5 extraction (roasting) = $40.00 per metric tonne of magnetite concentrate.
- Market value for V_2O_5 = US$5.50 per pound, based on last 3 year average.
- Density for unspecified rock = 3.1 g/cm^3.
- Hydrometallurgical recovery of V_2O_5 from magnetite concentrate = 95%, as suggested from historical metallurgical testing.

MINERAL RESOURCE ESTIMATE RESULTS

Given all the parameters listed above, the inferred resource located within this pit can be estimated as 99,104,000 tonnes of mineralized rock containing 26,067,000 tonnes of magnetite concentrate grading 1.08% recoverable V_2O_5. This represents a total of 282,370 tonnes of V_2O_5 or 621 million pounds of V_2O_5. This pit also contains 165,690,000 tonnes of waste. Thus the potential stripping ratio (waste: mineralization) is estimated at approximately 1.67. Even if headgrade is not a relevant figure for this estimation procedure, it was calculated and reported for comparison purposes. Headgrade is estimated 0.43% V_2O_5 (***table 20***).

Geopointcom is of the opinion that the current Mineral Resource Estimate is representative of what is actually known from this zone. This estimate is compliant with CIM standards and guidelines for reporting mineral resources and reserves.

Resource sensitivity to market price			
Market price V2O5 ($/pound)	4.00 $	5.50 $	7.00 $
Waste (Ton)	103 808 000	165 690 000	205 388 000
Mineralization (Ton)	68 798 000	99 104 000	111 209 000
Magnetite concentrate (Ton)	19 633 000	26 067 000	28 844 000
Ratio W:O	1.51	1.67	1.85
V2O5 (Ton)	226 090	282 370	303 660
Recoverable grade of the concentrate (V2O5)	1.15%	1.08%	1.05%
Eq. Grade for mineralization in place (66.6% net recovery)	0.49%	0.43%	0.41%

***Table 20**: Influence of market price on resource estimates.*

COMPARISON WITH PREVIOUS MINERAL RESOURCE ESTIMATES

The resource and reserve estimate produced in 2002 by SNC-Lavalin within their bankable feasibility study **is obsolete and non-current** and cannot be compared with the current estimate. This 2002 non-current estimate used the conventional approach based on head grade analysis and metallurgical recovery factors, rather than the more rigorous titanomagnetite abundance in the the current estimate.

The present estimation used assay results of the magnetite concentrate as well as measured magnetite abundance (Davis tube). This method is radically different from all historic estimation approaches, as well as from most other current projects. The result is reported in terms of tonnage of magnetite concentrate and grade of this concentrate, which is more realistic when considering that the overall operating cost are dominated by subsequent roasting and hydrometallurgical processing. To allow a comparative figure with previous estimations as well as with other projects, the author estimated the V_2O_5 resource as measured in rock, using unchanged estimation parameters. These results were compiled using only the cells selected within this actual estimation based on magnetite abundance. The value obtained is **99,104,000 tonnes of mineralized rock grading 0.43% V_2O_5**. An overall recovery factor of 66.3% is calculated, in close accordance with metallurgical tests, although details in regard of cells may vary greatly.

Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves and therefore do not have demonstrated economic viability.

The recovery factor can be calculated for each cell within the selected pit (***figure 30***). This factor varies proportionally with the magnetite abundance. If considered as a constant, as done in all previous estimates, it may lead to a high local bias.

The method proposed with the current estimation certainly allows for a more precise local estimation.

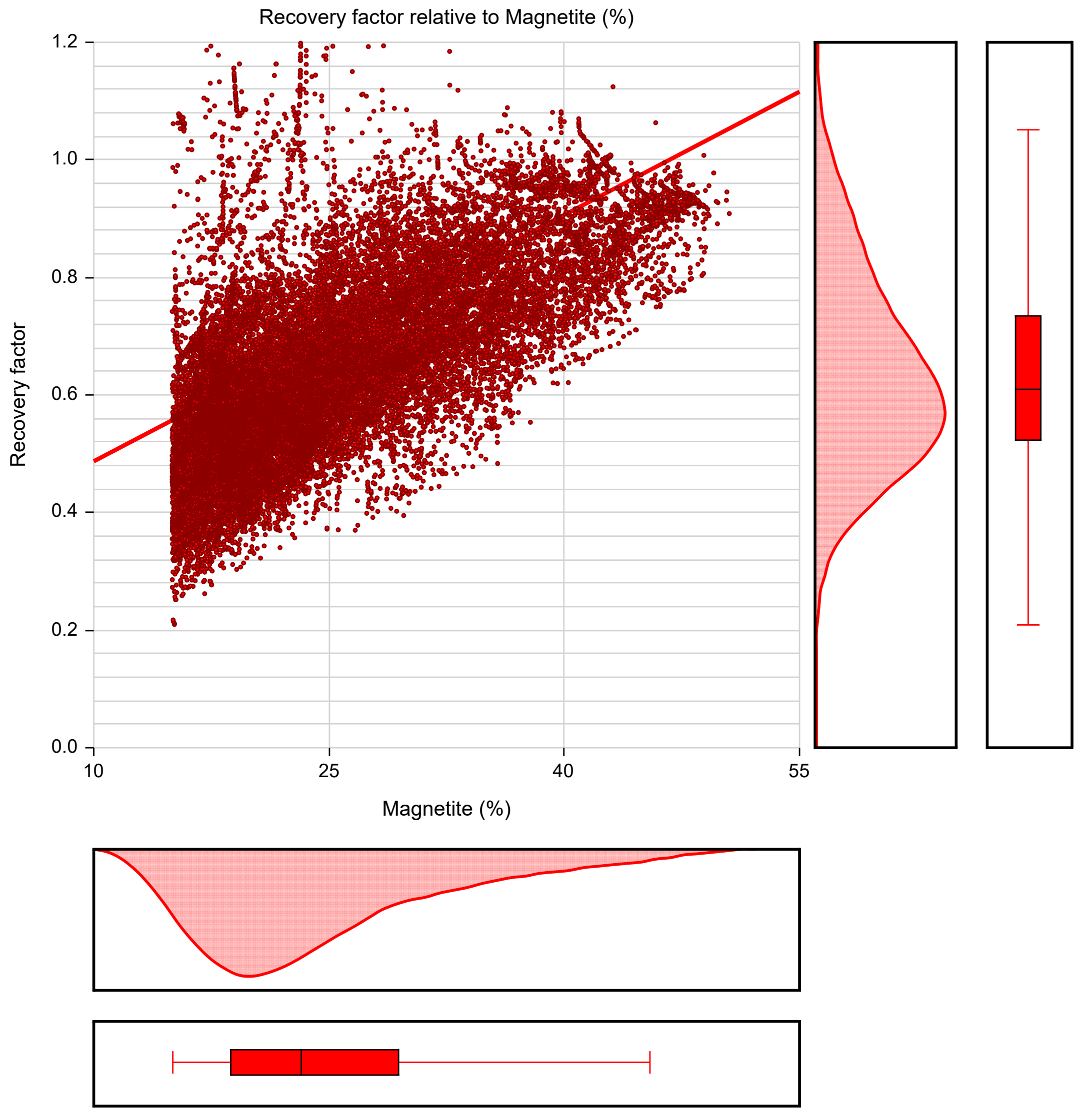


***Figure 30**: Local recovery factor.*

LIMITATIONS ON PIT DEPTH

The required resources to sustain the project for a 20 year mining life are estimated at 63.7 million tonnes, which represent only 64% of the available inferred resources. Consequently, the resource model, initially calculated for a maximum pit depth of 200 metres, with a pit floor at approximately 320 metres *asl*, was recalculated using various maximum pit depths, with floor at 370, 380 and 390 metres *asl* (***table 21***). Optimization parameters were identical, and resources are maintained as inferred only.

It is worth mentioning the constancy of titanomagnetite abundance, vanadium grade and vanadium in titanomagnetite grade.

Pit floor	Ore (mt)	Waste (mt)	Pit ratio	% V_2O_5	Mgt (mt)	%Mgt	%V_2O_5 / mgt
390 m.	53.87 mt	62.80 mt	1.17	0.43%	14.31 mt	26.56%	1.07%
380 m.	61.10 mt	77.37 mt	1.27	0.43%	16.25 mt	26.59%	1.08%
370 m.	68.39 mt	91.82 mt	1.34	0.43%	18.20 mt	26.61%	1.08%
Max.	99.10 mt	165.69 mt	1.67	0.43%	26.07 mt	26.30%	1.08%

***Table 21**: Inferred resources calculated using different maximum pit depth.*

RECOMMENDATION

Lack of drilling information and uneven quality of data required the author to **classify resources as inferred only**. Upgrading this classification will necessitate systematic drilling to be conducted with the objective of building a reliable lithological model including accurate distribution of barren anorthosite within the P2 unit, to a depth of 150 metres (approximately 360 metres *asl.*). The author recommends a drilling program to cover 35 sections spaced 50 metres apart. On each odd section, 400 metres of drilling will be required to cover the proposed pit area with 100 metres between each hole. On each even section, 300 metres of drilling will be required to drill in-between traces from the previous section in a quincunx pattern. It is very important that all drill holes be entirely sampled without gaps. The author also recommends following this drilling pattern from one end to the other of the deposit regardless the presence of historic drill holes or trenches. This will ensure uniformity for all data. This will require 16,000 metres of drilling.

Drilling will require optimization as well for geotechnical purposes, metallurgical sampling and estimating overburden thickness. This is especially important on the south side where the proposed pit will extend outside of currently drilled area.

ITEM 15: MINING RESERVES ESTIMATES

Mining reserves were not calculated for the current project, considering that only inferred resources are determined. Minable tonnages were derived from the inferred resource model described in the previous section. Currently estimated inferred resources being able to sustain the current project for more than 20 years, it is considered that theyare sufficient to support a first economic assessment of the project.

ITEM 16: MINING METHODS

The Lac Doré deposit is located at surface, on an elongated hill crest, suitable for conventional open pit mining methods. As only inferred resources are available designing an elaborate mining plan following the *Whittle model* would be premature. Upgrading of the inferred resource through systematic drilling is recommended prior to designing a Wittle shell model.
The summit of the deposit is located at an altitude of 530 metres above sea level (asl), approximately 80 metres higher that the lowland at 440 metres asl where the mill is anticipated to be located. A saddle along the hillcrest is located between East and West deposits, which can be used as a lateral outlet from the pits to the mill. Thus, the East and West deposits can be mined in the manner of two front-faced quarries, limiting the need for ramps and limiting the up-hill climb for the hauling trucks.

The deposit extends for 2400 metres within VanadiumCorp property. The pit will be limited to the Northeast by the limit of the known mineralization with sufficient thickness, and to the Southwest by BlackRock Metals CDC-2430231. There is no hindrance to the lateral extend of the pit.

Effects on the economic model of changing pit ratio and magnetite grade were calculated in the sensitivity analysis (***Item 22***).

Estimation of mining cost and equipment were provided as a quote from Dynamitage TCG Inc, a well established mine and quarry contractor (Dionne et Vachon, June 27 2017). The quote is based upon the following:

A. Mining rate: 10,680,000 tpy or 29,700 tpd
B. Mill feed: 4,000,000 tpy
C. Ore to waste ratio: 1.67
D. Hauling distance: <2 km
E. Slope: 8%, 40% of distance
F. Wages: According to Civil construction rates.
G. Fuel: 6,000,000 litres per year at $0.93/l
H. Explosive: 1 kg/t, $0.80 per kg.

Required equipment:

A. 2 hydraulic excavator s,125 tonnes (Komatsu PC 1250): $3.6 million

B. 8 Trucks, 100 tonnes (Caterpillar 777): $17.6 million
C. 2 Dozers, 225 kW (Caterpillar D8T): $1.8 million
D. 2 Drill rigs (Atlas Copco D65): $2 million

The quote is all inclusive, including maintenance, administrative building and explosive bunkers. It does not include maintenance garage, ancillary vehicle (water truck, fuel truck, emergency vehicle, etc), pit dewatering and snow removal, which items were included in infrastructure cost and operation cost.

Some specifications on the model were modified once the quote was received, and update was not requested by the first author.

A. Pit ratio is set at 1:1.67, which was reviewed at lower figure of 1.34. Per tonne pricing is expected to increase slightly due to lower volume to handle.
B. Ramps were calculated according to conventional pit mining operation, the configuration being revised to lower ramps lengths and hauling distance. Pricing is expected to lower slightly.

Contracting out the mining operation is considered advantageous compared as operating the mine themselves. It enables to lower the initial capital expenditure, thus improving return on investment, and ensure an efficient operation and start-up.

ITEM 17: CRUSHING, MILLING AND BENEFICIATION

Production of a VTM concentrate requires a conventional crushing and milling circuit, plus a cascade of wet magnetic concentrators. It is a rather simple process, which however require fine tuning to achieve a VTM concentrate that comply with grain size and purity indicated by the digestion process.

Since iron, titanium and vanadium are expected to be recovered by the acid digestion and electro winningprocess, their proportions in the VTM is not expected to be critical in regard of the economics of the projects. Since the efficiency and operating cost of the VanadiumCorp and Electrochem process are not currently known, the contribution of each metal to the economics is imprecise, and cannot be factored into VTM values for the moment. Therefore, no specification in regard of vanadium or titanium content of the VTM is indicated.

According to the current knowledge of the process, the VTM concentrate must respect the following specifications:

- < 2% Silica
- < 2% Lime
- D80 - 200 mesh
    - 80% -38 µm
- <0.1% metallic iron
- <1% moisture

Presence of silicate minerals is not desirable in the titanomagnetite concentrate since they consume sulfuric acid, although not critical. Fineness of the material is required to ensure proper digestion in sulphuric acid. Large grains tend to not dissolve, and require filtration, regrinding and redigesting.

Metallic iron, or filing from the crushing and milling media, tends to produce gaseous hydrogen in the course of acid digestion, and is considered as serious hindrance. Measuring abundance of metallic iron in iron ore is difficult, since filing cannot be separated from magnetite, and because its measurement requires complex redox manipulations. VTM used for bench scale testing has been produced by conventional manganese jaw crusher and carbon steel mini-rod mill. Long term weight losses on crushing and milling equipment was used to estimate abundance of iron filing, suggesting a metallic iron content of about 0.02% Fe. No hydrogen issues were reported during digestion tests, suggesting its acceptability. Metallic iron contamination at industrial scale can be estimated at about 0.4% iron filing based on anticipated consumption of milling media (300 tonnes per month), the effect of which is to be tested.

CMB CIRCUIT DESIGN

The crushing, milling and beneficiation circuit was design for a nominal capacity of 100 tonnes per hour of titanomagnetite production. Such capacity matches approximately the capacity of a salt roasting circuit using the largest rotary kiln that can be manufactured. Such a salt roasting circuit would produce about 8000 tonnes per year (17 million pounds) of vanadium pentoxide flakes, or approximately 10% of the current world production. Such capacity compares with the mill previously designed by SNC-Lavalin in 2003.

Parameters used for design:

- VTM Grade: 26.3%
- Crushing capacity: 500 tph
- Crushing availability: 80%
- Scalping efficiency: 41.3%
- Milling capacity: 268 tph
- Milling availability: 90%
- Milling work index: 22 kWh/t
- Circulating load: 400%

The conceptual process includes (***figure 31***):

1. Primary 500 tph gyratory crusher
2. Secondary 300 tph cone crusher with screen classification
3. Primary dry magnetic separator
4. 3.6 MW primary grinding circuit and screen classification.
5. LIMS rougher
6. 3.5 MW secondary fine grinding circuit with cyclone classification
7. 3 stages LIMS cleaner circuit
8. Belt filter and 100 tph dryer

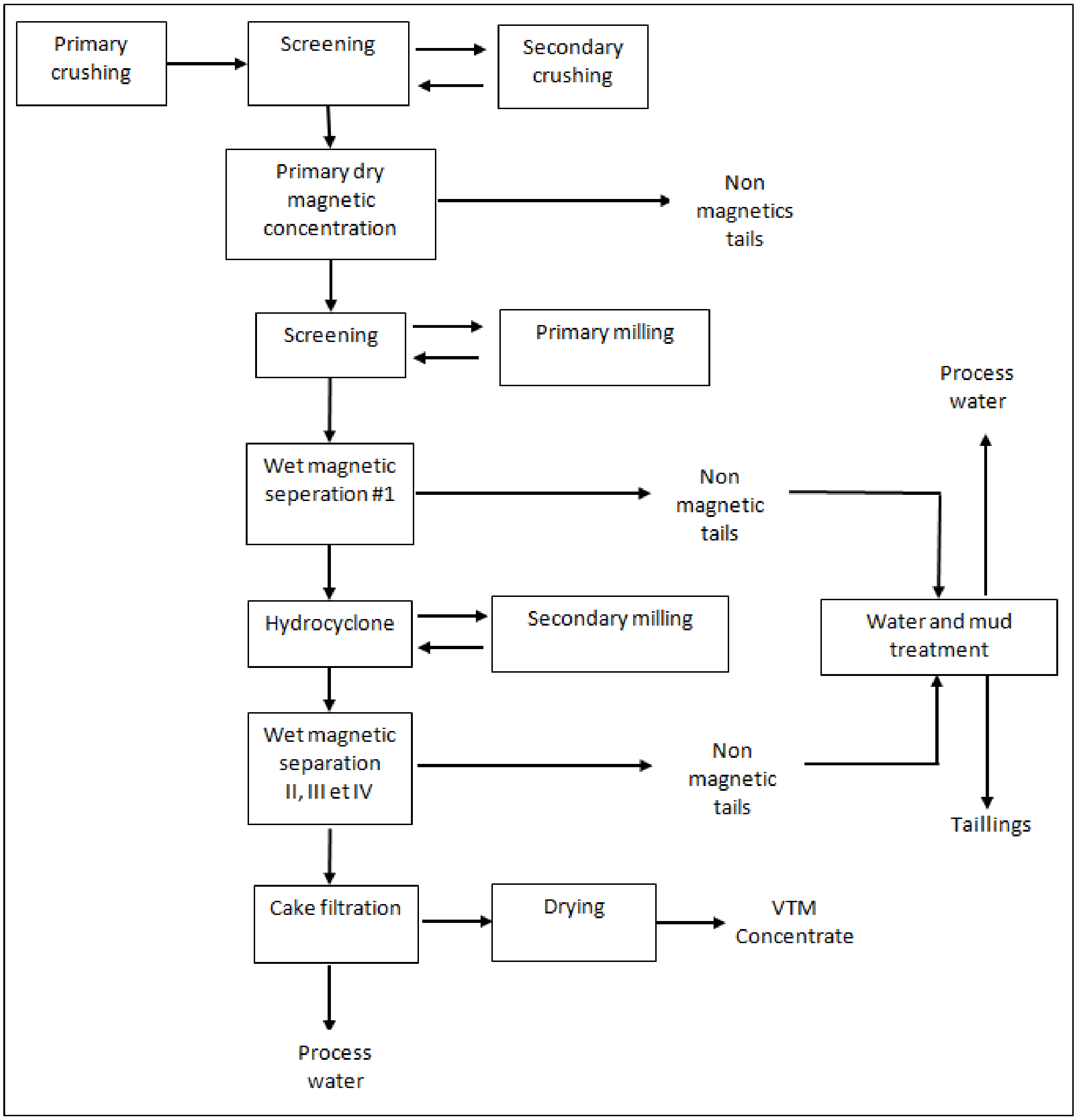


***Figure 31**: Schematic diagram of the crushing, milling and beneficiation circuit.*

No other cleaning process, such as flotation, will be required for the current stage of the project as long as the hydrometallurgical and electrochemical processes feed specifications are not modified.

Various fluxes in the CMB circuit were evaluated, in order to obtain proper equipment sizing and consumption (***figure 32, table 22***).

The reader may notice that no recovery factors were included in the CMB circuit or in the economic analysis. The reason is that resources were initially calculated as recovered

VTM obtained from Davis tube testing. Therefore, recoveries are already factored into the VTM grade, and thus not need to be refactored in the resource, mill design or economic model.

No granular ilmenite recovery circuit is considered, although ilmenite positively dissolved in sulphuric acid and could produce iron and titanium credits similar to titanomagnetite. Separating ilmenite would require cleaning with other processing equipment, the economics of which has not been evaluated.

No sulphide recovery circuit is planned considering their low abundance. Historic tests indicated that tails and waste rocks do not cause acid drainage issues.

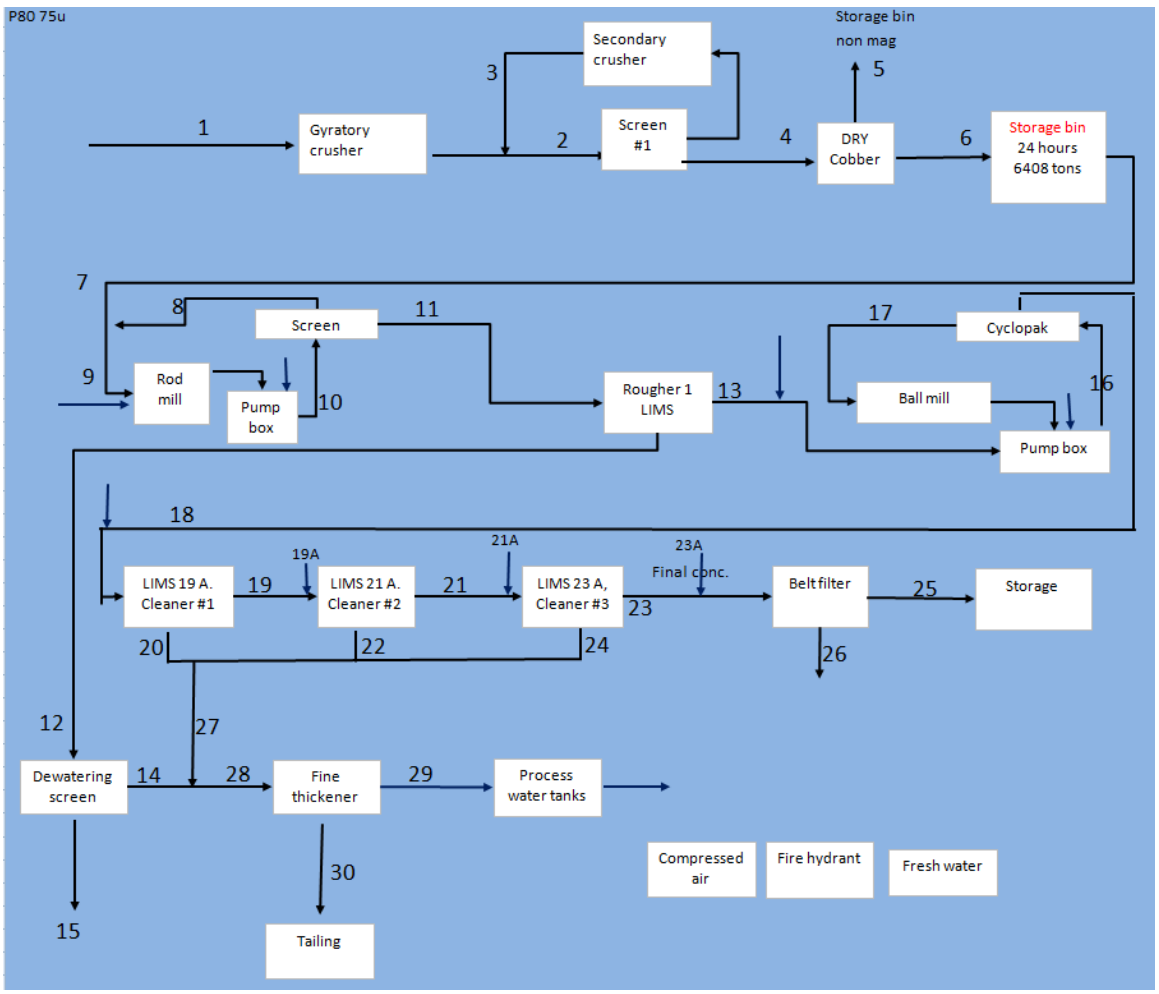


Figure 32: *Fluxes diagram for the crushing, milling and beneficiation circuit. Fluxes are listed in table 20.*

Flux	Solids (tph)		Water (tph)	%Solids	%V2O5	Avail.	Description
1	500.0				0.38	0.8	Crusher feed. Calc: 475 calc., Designed: 500
2	800.0				0.38	0.8	Screen feed
3	300.0				0.38	0.8	Secondary crusher feed
4	500.0					0.8	Cobber #1 feed, Dry, High intensity
5	206.5	41.3% feed				0.8	Non-magnetics tails
6	293.5	58.7% feed				0.8	Storage bin feed
7	267.8	Bin feed x avail.	11.2	96.0%		0.9	Milling feed
8	107.1	40% Milling feed	11.9	90.0%		0.9	Circulating charge: Unknown, estimated 40%
9	375.0	140% Milling feed	160.7	70.0%		0.9	Rod mill feed
10	375.0		638.5	37.0%		0.9	Screen feed
11	267.8	100% Milling feed	626.6	29.9%		0.9	Rougher LIMS feed/ screen underflow
12	104.3		608.4	14.6%		0.9	Rougher LIMS tails
13	163.5	Mill feed x conc.fact	18.2	90.0%		0.9	Primary magnetic conc. (Todd's estimate)
14	62.6	60% of 1st mag conc	603.7	9.4%		0.9	Fine tails/ estimate
15	41.7	40% of 1st mag conc	4.6	90.0%		0.9	Coarse tails/distribution estimate
16	817.5	5x 1st mag conc	770.8	51.5%		0.9	Cyclopak feed
17	654.0	1st mag conc + 300%	280.3	70.0%		0.9	Circulating charge, 300%
18	163.5	1st mag conc.	490.5	25.0%		0.9	Cyclopak overflow
19	122.1	Mag#1 x conc.fact.	30.5	80.0%		0.9	Cleaner LIMS #1 conentrate
19A	0.0		1068.3	0.0%		0.9	Water to LIMS #2
20	41.4	Mag #1-Mag #2	460.0	8.3%		0.9	Cleaneer LIMS #1 tails
21	114.1	Mag #2 x conc,factor.	28.5	80.0%		0.9	Cleaner LIMS #2 conentrate
21A	0.0		998.1	0.0%			Water to LIMS #3
22	8.0	Mag #2 - VTM	1070.3	0.7%		0.9	Cleaneer LIMS #2 tails
23	111.1	100 tph VTM x avail.	27.8	80.0%	1.08	0.9	Final VTM Concentrate
23A	0.0		46.3	0.0%			Water
24	3.0	VTM-mag #2	998.8	0.3%		0.9	Cleaneer LIMS #3 tails
25	111.1	100 tph VTM x avail.	15.2	88.0%		0.9	VTM Cake
26	0.0		58.9	0.0%		0.9	Process water tank
27	52.4	Sum of cleaner tails	2529.2	2.0%		0.9	Total LIMS tails
28	115.0	Rougher + cleaner tails	3132.9	3.5%		0.9	Tail thickener feed
29	0.0		3071.0	0.0%		0.9	Process water
30	115.0	Rougher + cleaner tails	61.9	65.0%		0.9	Fine tails

Table 22*: Fluxes anticipated in the CMB circuit for a production of 100 tonnes per hour of VTM.*

Power consumption to run the mill is estimated at 240 GWh/y (240 thousand MWh/y), for a draw of 31.3 MW. About a third of the power is dedicated to the ball mill and rod mill, while 40% is required for the dryer (***figure 33***). However, dryers can be run on different energy sources such as biomass, which were not evaluated. Power draw of the grinding circuit has voluntarily been over-estimated by the authors, as is the requirement for ancillary equipment, considering that the optimal fineness required by the digestion in the VanadiumCorp-Electrochem process is not defined, and that work-index to grind at such fineness (d80 < 38 µm) is not yet available.

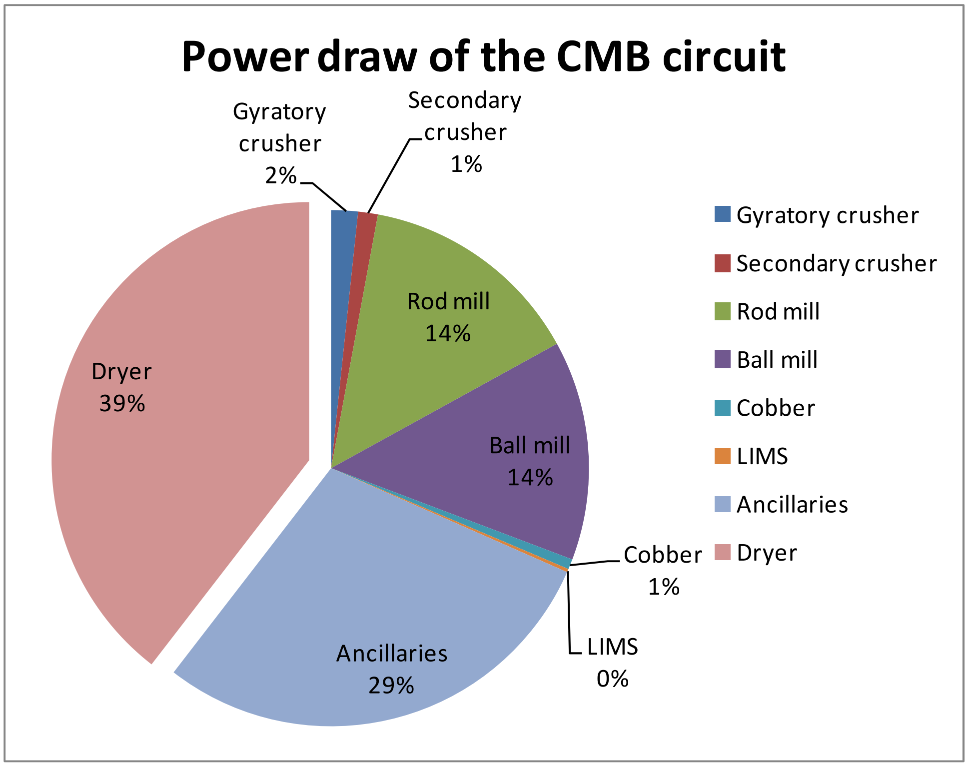


***Figure 33**: Power draw distribution of the CMB circuit*

ITEM 18: INFRASTRUCTURE

Infrastructure requirements for the project were estimated by the first author and M. Eric Larouche P. Eng. Some requirements were estimated based on previous studies, such as those of SNC-Lavalin made in 2002, which had a similar capacity.

The project is located a few kilometres away from where BlackRock Metals is permitted to build their mine and facilities. Only limited information is publicly available in regard of their infrastructure requirement. A road, a power line and a railway spur to the mine site were permitted by the Québec department of environment (*MDDELCC)* which are, by law, accessible to others. However, no considerations are made with these potential infrastructure in the current study, and all infrastructures required for VanadiumCorp Resource project were included as required to be built and maintained.

Infrastructure to be eventually built for the Corner Bay project (C-Bay Minerals) are not located advantageously for the current project, and as such no considerations are made.

Access road

A class 2 gravel road, 8 to 10 metres wide, will be required between the mill and the railway transhipment facility for a distance of 35 kilometres (***figure 34***). About 18 kilometres, from the railway to the junction leading to former Lemoine Mine, would be improvement of the current N-210 forestry road (*Chemin Gagnon Frères*) leading to the BlackRock Metals project. About 17 kilometres, from the junction to former Lemoine Mine to the anticipated site of VanadiumCorp mill, will require construction. The current N-210 road diverges from the site of the mill, causing a significant detour. The road is to be located on Crown's land, which means it is publically accessible to the, and constructed in such a way as to allow co-existence of commuter traffic and heavy hauling trucks. No bridge or other large infrastructure, aside of culverts, are required. About 2 kilometres of gravel road will also require upgrading, from paved highway n^{o}167 to railway transhipment site.

Gravel pits, for road construction purpose, are sparse in the area.

Power line

Construction of a 161 kV tri-phased power line, capable of 400 A, will be required from the existing Obalski line along the highway n^{o}167 (***figure 34***). A down voltage and distribution 50 MW substation is required at the mine site. The former *Lemoine Mine* power line was dismantled, and its corridor is partly located within BlackRock Metals property, and thus only its Western segment is accessible. The 161 kV network is not

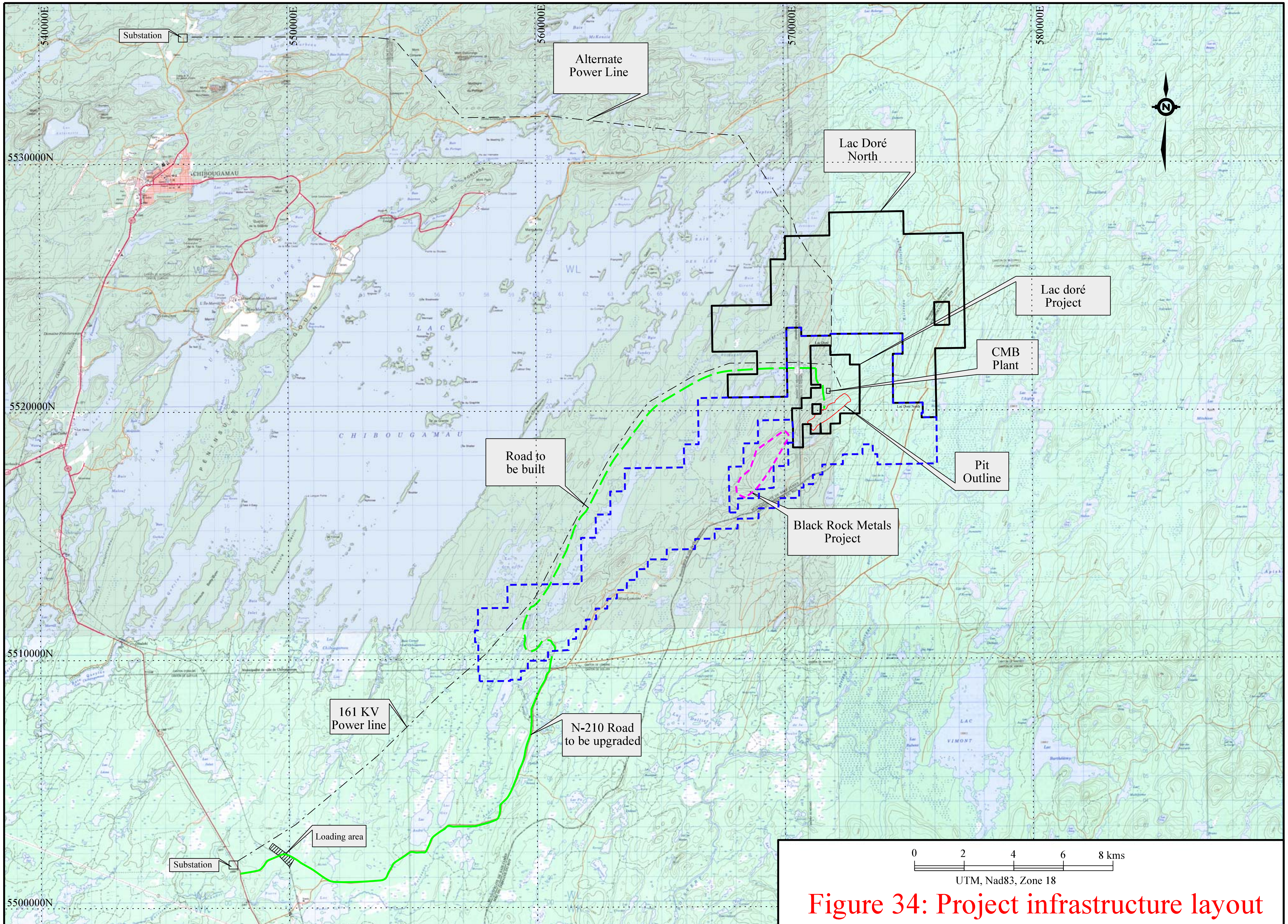


Figure 34: Project infrastructure layout

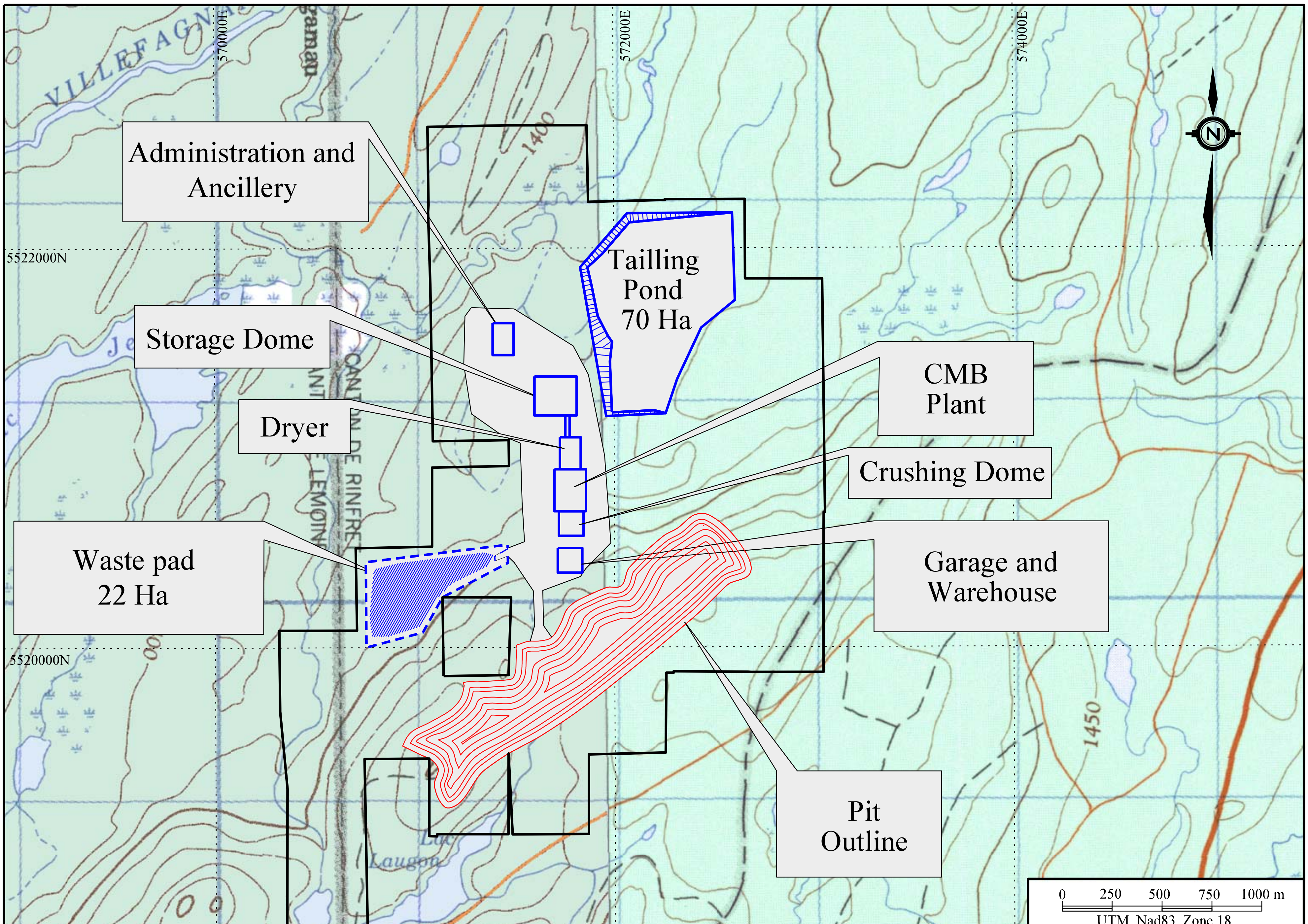


Figure 35: Site layout

the Hydro-Québec standard 235 kV, being tapped from the Saguenay-Lac St-Jean grid locked to *Énergie Électrique Rio Tinto* grid.

In 2002, McKenzie Bay Resources was indicated by Hydro-Québec that the existing Obalski 161 kV line near highway n° 167 provides alimentation for the entire area, and cannot be tapped directly upon. However, such authorization has apparently been granted to BlackRock Metals.If the Obalski line cannot be tapped upon, power can be tapped at the currently un-used Obalski-Troïlus existing line near Dufault Lake, north of Chibougamau. This route represents about 30 kilometres of construction, through an area which is more inhabited.

Fresh water and sewage

No aqueduct or sewage is available near site. Fresh water is to be pumped from wells or from Laugon Lake and treated. A waste water (grey water and brown water) processing plant is to be installed on site, with 100 men capacity.

Waste rock pad

Waste rocks from the Lac Doré deposit are known not to be acid drainage generating (Entraco, 2002). They can be simply discarded in a pile, used for tail pond dam structure, used as crushed stone for road construction, etc. A volume of approximately 35 million cubic metres is estimated over the project life span, equating to a pile of about 15 metres high over 22 hectares (***figure 35***).

Tailing and polishing pond

As for waste rocks, tails from the concentrator are considered to have a very low acid drainage generating potential. As no chemicals are used in the process aside of flocculent, and as no metals are expected to be leached from the silicate material, the tails are considered as inert material and not considered to cause potential ecotoxicity hazard (Entraco, 2002). Impermeable membranes or other lining underneath the ponds are unlikely to be required. Since the process used in the mill is not sensitive to water quality, drainage water can be thoroughly recirculated, without expecting contaminant built-up. Overspills can be discarded in natural drainage as long as suspended fines are properly flocculated.

About 2.42 million tonnes of tails will be discarded per year, for an approximate volume of 1.6 million cubic metres (***figure 35***). This requires a pond of about 0.6 square kilometre (60 hectares), including the polishing pond insert. Build on the side of the hill, approximately at the same location as the pond planned by McKenzie Bay Resources in

2002, and using local topography, a starter embankment dike about 2 kilometres long and 15 metres high is required as initial infrastructure. This is to contain the 9.5 million cubic metres anticipated for the first five years or operation. A diversion ditch can drain runoff water to be recirculated, with an overflow spillway the North toward Sable stream and Boisvert River.

Only one option is provided for the location of the tail pond and waste pad, considering the lack of alternative within the Lac Doré property. However, the Lac Doré North Extension property has been acquired for the purpose of potential locations for such infrastructure, which is located about 3 kilometres to the north of the deposit.

Shipping and handling

VTM concentrate is to be shipped bulk from concentrator to rail loading station by oversize 70 tonnes semi-trailer covered hopper trucks. Trucking can be contracted out, requiring minimal initial investment. Traffic of 240 loads per week is to be expected for the VTM, plus approximately 60 loads per week for consumable and ancillaries, in both directions. This equates to 86 passages per day, plus commuting workers. VTM trucking will require the use of two trucks, plus one on maintenance.

VTM concentrate is to be shipped by rail to the electrowinning plant, to end users across North-America or to seaport. It has to be shipped dry by covered hopper cars, 90 tonnes each, requiring a block of 28 cars per days. This represents about 10,000 carloads a year. Hopper car can initially be leased from car pools companies (eg: TTX, UTLX, GATX etc) to reduce initial investment. The CRAN division, currently own by *Chemin de fer d'intérêt local interne du nord du Québec (CFILNQ)*, a subsidiary of Canadian National Railway, has a loading capacity of 268,000 pounds GVWR, or approximately 90 tonnes effective load per car. No congestion is to be expected from Chibougamau to Chambord, Garneau or Côte St-Luc yards and then to access the North American rail network. However, chronically congestion is reported over the Roberval-Saguenay Railway between Jonquière and Grand-Anse seaport. The economic model is based on a FOB in Chibougamau scenario, meaning that cost of railing is not required.

Construction of a rail spur from CN mainline to the mill site has been disregarded, due to its elevated construction cost (>70 m$). Although the anticipated traffic of 10,000 carloads per year exceeds the industry accepted traffic required for operating (100 carload per miles per year, or 3,000 carloads in the current situation), the saving generated from trucking expenses over the mining life will not be sufficient to pay back the construction cost of the line. This could be revised in the event that BlackRock Metals constructs such a line.

Economics of the project is not sensitive to localisation of the hydrometallurgical and electrowinning plant, which is not decided yet. The cost of expediting of VTM from Chibougamau to another location in North-America is expected to be comparable to the cost of expediting the equivalent iron flakes, vanadium electrolyte and titania sludge to end-users. Weight reduction of magnetite to iron flakes (72%) is to be compensated by higher handling cost. Metallic iron flakes requires to be kept dry to avoid corrosion, while vanadium electrolyte is a hazardous material.

A storage dome with a capacity of 90 days (220,000 tonnes) is needed at the rail transhipment site, for approximately 2,300 square metres. A second storage dome is needed at the concentrator end with a capacity of 10 days (24,000 tonnes). Storage domes must be equipped with conveyors, apron feeders, hoppers, gantry and operator rooms, plus a railcar winch cable or trackmobile. Approximately 0.5 miles (0.8 kilometre) of twin siding tracks is needed to accommodate 56 ore-hopper cars, 40 feet each (***figure 34***).

Buildings

The following buildings are required (***figure 35***):

-Mill and concentrator:	4,000 m^2, 3 floors, industrial shell and foundations
-Administration and office:	700 m^2. 1 floor, light structure
-Maintenance garage:	700 m^2, 2 floors, industrial shell and foundations
-Warehouse:	700 m^2, 2 floors, light industrial shell
-Guard house:	26 m^2, 1 floor, light structure
-Pump houses:	2 x 40 m^2: 1 floor, light industrial shell
-Fuel farm:	40,000 liters diesel fuel.

The following ancillary equipments are required:
-Communication system
-Back-up generators, 5,000 kW
-Firefighting and emergency vehicle
-Helicopter pad
-Assaying laboratory
-Infirmary
-Truck scale
-Lunch room or cafeteria
-Shower room and dry.

ITEM 19: MARKET STUDY

Titanomagnetite is not a widely traded commodity, and only limited open market and public pricing are available. Most of the titanomagnetite mined today is done by vertically integrated vanadium or steel producers. Currently operating producers are Rhovan (Glencore) in South Africa, Nizhny Tagil (Evraz) in Russia, Panganq (Panzhihua Iron and steel) in China, Maracás Menchen Mine in Brazil (Largo Resources). New Zealand Steel seems to be the only complex that smelts titanomagnetite without recovering the vanadium. Similarly, past producers were vertically integrated as well (e.g.: Mapochs Mines in South-Africa which provided Highveld Vanadium and Steel, Rautaruukki Oy in Finland, Windimurra in Australia). Titanium dioxide is recovered from VTM slag only at Pangang and Chengde smelting facilities in China, other smelters discarding their slag as track ballast or construction aggregate. Since no VTM trading is involved in these operations, where mines are captive of the smelter or roaster, no sales price of VTM is disclosed. Unverified information indicates that cost of production at Panzhihua and Chengde (China) being reported at us$140 per tonne of VTM.

BlackRock Metals has not revealed its anticipated pricing for their initial project of selling titanomagnetite to the Chinese steel makers. The recent restructuring of the project as an integrated operation with its own pig-iron and ferrovanadium smelter in Saguenay implies a vertically integrated operation where titanomagnetite pricing will not be disclosed. The change in their business model, from VTM producer dedicated to Chinese steel market to an integrated producer is suggestive of the difficulty to sell the titanomagnetite at sustainable price for them.

Two niche markets are known to the first author for titanomagnetite in North-America. First, magnetite is used for the manufacturing of ferric sulphate, for the water treatment plant market or as additive to fertilizer. One facility, Kemira Water Solution Canada Ltd, is currently operated in Varennes, near Montreal, and imports its magnetite feedstock from Finland, at a price significantly higher than standard iron-ore. Magnetite consumption for this process is estimated at a few hundred thousand tonnes per year in North America. Titanomagnetite can be substituted to magnetite allowing a discount.

Second, micronized magnetite is used as dense media for gravity separator (dense media separator “DMS” plants). The DMS process is widely used for coal cleaning, where magnetite is mixed into water-based slurry to float lighter materials from denser one. DMS magnetite consumption in North-America is estimated as a few hundred thousand tonnes per year, mainly in Western provinces or states, at a cost of $200/tonne. Magnetite for DMS application needs to be micronized (-325 mesh) and thus expensive to produce. Titanomagnetite can be used instead of magnetite without problems.

Ferric sulfate and DMS magnetite market should not be considered as sufficient to support the development of Lac Doré Vanadium project.

Titanium-free magnetite is sold on a large scale as iron-ore. Magnetite, compared to hematite, requires less reduction for smelting, meaning less greenhouse gas production (-30%) and lower energy consumption (-20%). However, not every steel plant is equipped to smelt magnetite. About 583 million tonnes of magnetite is produced yearly on a world-wide basis, accounting for 25% of all iron ore (USGS, 2016). Magnetite concentrates, grading >65% Fe, currently sell for approximately $82 per tonnes, or with a premium of more than us$20 per tonnes when compared to seaborne hematite (62% Fe) (Metalytics, 2017).

Titanium bearing magnetite cannot be used as direct feed to conventional blast furnaces, and its iron content is too low to be economically used in conventional direct reduction plants. However, titanomagnetite can be blended with titanium-free magnetite as feed for conventional steel production, as long as the mixture meets titanium specification lower than 0.3%, a practice currently done by Chinese steelmakers (Metal bulletin, 2016). For such usage, a discounted price is expected for the titanomagnetite concentrate, likely in excess of us$20 per tonnes. Loss on iron credits from smelting titanomagnetite is not compensated by the discount on price.

If titanomagnetite produced at Lac Doré is intended to be used by VanadiumCorp own hydrometallurgical and electrowinning plant in a vertically integrated operation, its pricing can be benchmarked to comparatives. Titanomagnetite can be sold at a premium compared to magnetite, assuming the economics of the reduction process is sufficiently robust, and considering it would be a captive market. A comparative can be the ilmenite market. Ilmenite is currently produced by RioTinto Iron Titanium (*RTIT*) at their Lac Allard mine, Havre St-Pierre, lower North Shore, Québec. About 2 million tonnes of direct shipping ilmenite are produced per year, dedicated for their Sorel pig iron and titanium slag smelter. Ilmenite is currently valuated at approximately us$100/tonne by RTIT (Giroux, personal communication, 2016), a price generally accepted in the titanium industry (Roskill, 2017). A sell price of us$100 per tonne for titanomagnetite is therefore considered as realistic.

A detail account of the vanadium market has been provided in Girard and D'Amours 2015, who concluded that a price of us$6.00 per pound of V_2O_5 can be accepted as a realistic long term price. A price of US$5.50 was used as a base scenario in the 2015 resource estimate (Girard et D'Amours).

ITEM 20: ENVIRONMENTAL AND SOCIAL IMPACTS

Environmental and Social Impact Study has not yet initiated on Lac Doré Vanadium Project by VanadiumCorp Resource Inc..

Complete environmental and social impact assessment are publicly available for the adjacent BlackRock project (*Entraco, 2012*) and the former McKenzie Bay International Lac Doré Vanadium project (*Entraco, 2002*). These two complete ESIS deals with development projects of the same deposit, although with variants. Information listed in Item 20 is partly extracted from these studies. However, although useful and instructive information is disclosed in these studies, this information cannot be extrapolated to VanadiumCorp project, and all aspect of the ESIS will have to be addressed directly. All tests conducted by BlackRock and McKenzie Bay will have to be redone by VanadiumCorp, despite that the outcome of the tests are highly predictable since they were made on material from the same resources.

PHYSICAL ENVIRONMENT

The Chibougamau area is characterized by a sub-polar, sub-humid continental climate. Except for the hills where the deposit is located, the area is relatively flat with gently rolling hills typical of Canadian Shield. Abundance of lakes, bogs and meandering streams witness the flat topography and low surface permeability.

Most of the area is covered by thin overburden dominated by impermeable glacial sediments. Underlying rocks are solid, impermeable with the exception of limited fault-related macroporosity, and almost devoid of surface alteration and weathering profile. Water table is expected to be near the surface.

Soils and organic deposits are typically poorly developed, except in rare bogs or near streams and lake shore.

The area is drained toward Chibougamau Lake to the North, and then into the James Bay watershed. From the property, streams drains to Villefagnant near Jean Lake outlet, then Armitage River and finally to Baie Girard of Chibougamau Lake, for a total distance of approximately 10 km. Laugon Lake, situated just a few hundred meters north of the pit, and Jean Lake, situated upstream on Villefagnant River, should not be affected by the operations.

Water quality was noted by BlackRock Metals as poorly mineralized, with acidity within the range of bicarbonate-carbonates buffers. No metal contaminants were reported.

No industrial activities being present in the area, aside of intermittent logging, ambient air quality is reported as good. Dust and exhaust dispersion were modelled for both BlackRock and McKenzie Bay operations, and indicated within regulations.

A short intermittent drainage system is to be directly impacted by the project. Diversion of these streams will be required, for a few kilometres. This drainage ranges from the hill where the deposit is located, toward a marshland on Villefagnant River, near the outlet of Jean Lake. Drainage perturbation is not expected to affect Jean Lake itself.

BIOLOGICAL ENVIRONMENT

The entire area is in the taiga bioclimatic zone, largely dominated by black spruce, local tamarack and jack pines, and local strands of poplar and white birches. About 95% of the area has been logged in the last 40 years, and mature strands of commercial values are limited to patches protected as moose habitats. No forest of exception is reported in vicinities. According to BlackRock study, no threatened or vulnerable vascular plant has been reported in the vicinities, although *Arethusa bulbosa* (orchid family) and *Utricularia resupinata*, both wetland flowers, are potentially present.

Wildlife includes moose, wolves, foxes, black bears, plus a few species valuated by native for traditional trapping such as beaver, mink, marten and fisher. Most original wildlife habitats were disturbed by logging activities and no habitat of exception are reported aside of trout and walleye spawning grounds. No wildlife species at risk has been reported in vicinities, although some threatened species of bats and voles might be present. Five species of birds recognized as being at risk were identified in the area.

HUMAN ENVIRONMENT

The project is located within Category III lands according to the JBNQA. The area is a Cree' traditional hunting and fishing grounds, trap line O-57, owned by M. Matthew Wapache of Oujebougamau. However, an ambiguity remains if the trap line depends from Oujebougamau or Mistassini nations. No hunting cabin is currently present within the project area.

There is little evidences of fishing or hunting activities from local Chibougamau residents in the project area, and no temporary camps were ever noticed by the authors and no fisherman, grouse hunters or berry pickers were encountered through the years IOS crews were present on site. At the moment of 2017 mandatory site visit, alders had grown closing access road to the site, and no evidence of passage in 2016-2017 was visible.

The closest known archaeological site is located on the shore of Chibougamau Lake, 12 kilometres west of the project site.

CONSULTATIONS

To the author's knowledge, until now, VanadiumCorp Resource representatives made only a few courtesy visits to the First Nations representatives. A presentation of the project was made in Chibougamau Townhall in 2015, with a few courtesy visits to the mayors and representative of *Développement Chibougamau.* No contact was made yet with Mashteuiasth First Nation representatives.

No formal consultation was initiated with communities.

No project notice "*Avis de projet",* or formal project presentation, has been filed to provincial government officials.

It is expected that, upon consultations, the local communities will express interest about job creation, business opportunities, economic benefits and will express concerns about environmental impacts and foreign worker influx. Establishing a liaison bureau by VanadiumCorp will be needed. Economics benefits for the communities are estimated in Item 22.

POLLUTION RISK

Since no chemicals or reactants being used or produced by the mine activity, aside of flocculants in tail ponds, pollution risk is considered minimal. A clear distinction should be made in this regard compared to BlackRock project, which intends to use a flotation circuit involving chemicals. Furthermore, the project clearly contrasts with former McKenzie Bay Resources project, which intended to build a hydrometallurgical complex, and included the legacy of a leachable calcine pond.

Ore, waste rocks and tailings are reported as not acid generating and not leachable. Minimal contamination of the environment is expected in this regard, and no impermeable containment will be required for the waste rock pad and tailing pond.

Mine vehicles and machinery, as well as hauling trucks are likely to be diesel, with their inherent emission and fuel spill risk. Emergency spill response plan will be required, unless electric power vehicle are utilized.

Dusting is expected to be the main contamination source. The deposit being located on a hillcrest, dusting from mining activities would be dispersed by the wind toward south-east if not contained indoors. Except from gyratory crushing, all CMB activities will be enclosed in a building, enabling dust controls. Tails will need to be maintained under a water cover to reduce dusting from the wind. Titanomagnetite will be shipped dry in covered hoppers and handled in enclose facilities. Dusting along road from truck traffic is unavoidable unless the road is paved.

In the event of a titanomagnetite spill, such as in the event of truck accident or train derailment, titanomagnetite is not reactive and not leachable. Damage would be limited to dusting and particle suspension in water. Titanomagnetite has no ecotoxicity for plants and wildlife, but is abrasive and dusting may cause respiratory issues, both for lungs or gills.

In the event of a tailing pond failure, the tails will follow natural drainage towards Jean Lake and ultimately Chibougamau Lake. Since no chemical are used in the process, and since the material is not leachable, no significant chemical contamination, such as dissolved metals, is to be expected. However, mud and suspended particles can be severely harmful to wildlife and fishes, and mitigation procedures, such as contentment dams, should be built.

HEALTH AND SAFETY RISK

Health and safety of the worker is a constant concern in mining projects. The project site being remote, a nurse, paramedic and an ambulance will be required on a permanent basis on site. Evacuation protocols in case of fire, or forest fire, will be required.

Outside of the mining site, the dominant risk will be related to increased road traffic, especially oversize trucks. Since this traffic will use public roads, mitigations will be required. It is recommended that workers commute from Chibougamau, Chapais or First Nations communities by scheduled buses, and heavy trucking be halted during commuting schedules. No worker accommodation camp is expected on site.

Explosives will be used for mining. Proper safety measures will be required according to Federal regulations. Unexploded explosives left in the pits remain of concern, and mitigation must be implemented.

CONSTRUCTION PHASE

The impact related to the construction phase of the project has not been evaluated. These include an increase in traffic on highway n^{0}167 and an influx of non-resident workers. About 500 jobs are expected to be created for a year.

CLOSURE PHASE

The life span of the project is planned for 20 years, although sufficient resources are present to support longer project life. Since workers will be permanent residents from Chibougamau and Native communities, the closure of the project will eventually impact these communities.

At mine closure, infrastructure will be dismantled, with the exception of what is required to monitor water quality and tailing pond stability over the mandatory period. Infrastructure site as well as the tailing pond must be rehabilitated and revegetated. A mandatory rehabilitation fund is to be set, entrusted at the provincial government.

CUMMULATIVE IMPACTS

Impacts on environments are cumulative among projects, and impact of VanadumCorp Lac Doré Vanadium Project will add to those of BlackRock Metals project, if built. Since the original version BlackRock Metals project, relating to 3,000,000 tonnes VTM per year, has been permitted by MDDELCC, the sum of the impact by this project plus VanadiumCorp project will require complying with maximum emissions, even though BlackRock downsized its project.

LEGAL FRAMEWORK

Mining and environment being provincial jurisdictions, the project is dominantly regulated by provincials laws. The project will be subject to an Environment and Social impact Assessment, under Environment Quality Act (RSQ, c.Q-2, chapter 1, section 22, and chapter 2.) The project must comply with *Directive 019* of MDDELCC.

The project being located within the jurisdiction of the *JBNQA*, pursuant to section 22 of this agreement, the ESIS has to comply with the Evaluating Committee *COMEV* guidelines, which study has to be reviewed by the Provincial Review Committee *COMEX*. Both committees are made of Federal, Provincial and Cree representatives. The project is not regulated by *Bureau des audiences publiques en environnement*, or the public earring process mandatory in Québec outside of the JBNQA.

The Federal legal framework relating to mining project development is described in the *Canadian Environmental Assessment Act (CEAA).* The Lac Doré Vanadium Project being in excess of 3000 tpd mining capacity, preliminary studies must be conducted according to instruction in subsection 16(a) of the *Comprehensive Study List Regulation* of the CEAA.

Wetlands being of Federal jurisdiction, the project must comply with the Fisheries Act (cF-14, section 32, subsections 35(2)), the *Metal Mining Liquid Effluent Regulations (CRC, c.819),* and the *Policy for the Management of Fish Habitat.* Compliance with the following regulation are also mandatory: *Regulation respecting the water property in the public domain of the state; Regulation respecting the Wildlife habitats; Regulation respecting hazardous goods; Petroleum Product Regulation.* Assessments are usually transmitted to the Federal Government once audited by the Provincial Government.

Transportation, hazardous material and explosives are Federal jurisdictions, with their specific regulations.

The project must be compliant to provincial regulation relating to the *Soil Protection and Contaminated Sites Rehabilitation Policy* and the *Regulation respecting the Quality of the Atmosphere*. Finally, the project must also comply with the following: *Regulation on waste water disposal for isolated dwellings; Regulation respecting the quality if drinking water; Regulation respecting pits and quarry; Regulation respecting sanitary conditions in industrial camps; Groundwater catchment regulation; Forest Act, etc.*

ENVIRONMENTAL AND SOCIAL IMPACT STUDY REQUIREMENTS

The environmental and social impact study ESIS must includes the following:

- Project description and context
  - Proponent description
  - Historic context
  - Consultations
    - Cree, Innu and Chibougamau communities
    - Describe the consultation procedure
    - List of concerns and requests
    - List of constrains, including financial issues
  - Project description and reasons
    - Location and technical description
    - Limitations and physical constrains
    - Pros and cons of the project
    - Environmental and social concerns
    - Financial and logistic limitations

        - Permit list
        - First Nations mutual benefit agreements
        - Adjacent projects descriptions
- Environment
    - Outline of the impacted area
    - Ecosystems description and valuation
    - Physiography, drainage, soils, overburden material, geology, etc.
    - Forests
    - Hydrogeology and ground water quality
    - Detailed hydrography and drainage description
    - Sediments and alluviums in surface water
    - Wetland description
    - Flora and fauna description, including vulnerable species
    - Metal contaminations in environment, flora and fauna.
    - Weather and meteorology
    - Air quality
    - Local communities
        - Demography
        - Culture
        - Local economy and development
        - Social cohesion
        - Land use and usage
        - Infrastructure and dwellings
        - Agriculture, forestry, fisheries
        - Recreational activities
        - Traditional use of land, beaver parks and trap lines
        - Noise level and visual environment
        - Archeological and historic sites
- Project description and its impacts
- Available options
        - Advantages and disadvantages of the various options
        - Comparative analysis and arguments
        - Option selections, likelihood and realism
        - Cost estimates
    - Layout and site selection
        - Impacts and limitations
        - Cost and schedule
    - Technology selection
        - Process description
    - Description of predictable impacts
        - Contaminants

        - Trenching and filling
        - Runoff water and drainage diversion
        - Atmospheric emission and dusting
        - Temporary impacts during construction and decommissioning
        - Project schedule
        - Waste rock, tails and residues
        - Pit stability
        - Water intake and effluent
        - Manpower requirement and training program
    - Description of regulations and capacity of the project to comply.
    - Follow-up procedure and committee
- Impact analysis
    - Evaluation of impacts and consequences
        - Soil and agriculture
        - Wetlands, drainage and aquatic flora and fauna.
        - Social impact, including public health and safety
        - Hindrances to populations (noise, odours, etc)
        - Land accessibility
        - Public infrastructure
        - Other industries (forest, etc)
        - Economic fall-outs, education and job creation
        - First Nations traditions (sacred sites, medicinal plants, etc)
        - Landscape and sights.
    - Mitigation procedure
        - Contamination and hindrance mitigation
        - Wetland and wildlife habitat replacement
        - Noise, vibration and dusting management
        - Traffic management
        - Job and business creation, including workforce and housing shortage
        - Site rehabilitation, mine closure and progressive rehabilitation
        - Invasive species management
        - Information and complain management
        - Comparative studies of the various options
    - Risk management
        - Technological and operating risk
            - Accident, spill, fire etc.
        - Mine and explosive safety
        - Road traffic
        - Emergency response plans
        - List of available material, infrastructure and first respondents.

        - Scenario modeling and evacuation plan
    - Environmental surveillance procedure
        - Description of the measures
        - List of equipments and procedures
        - Response plan in case of non-conformity
        - Public information plan
    - Environmental follow-up procedure
        - Monitoring procedure, method and frequency
        - List of effects to be monitored, and time commitments
        - Reporting procedure
        - Non compliance procedure and commitments

To complete the ESIS, the following specific tests and studies must be commissioned:

- Air quality (partly available)
- Archeological evaluation (available)
- Atmospheric dispersion modeling
- Biodiversity inventory (partly available)
- Emergency response plan
- Environment management and follow-up protocol
- Environment emergency and spill response plan
- Kinetic and static leaching tests
- Geotechnical and foundations studies
- Greenhouse gas emission
- Hydrogeology modeling and ground water quality (partly available)
- Mining residues valorization
- Mine site closure plan and reclamation plan
- Night lights and visual impact
- Noise, vibration and seismicity (isophone maps)
- Pit stability
- Slope stability for waste pad and tailing dams
- Soil and physicochemical characterization (partly available)
- Tailing pond design and monitoring plan
- Surface, runoff and groundwater management plan
- Wildlife habitat compensation
- Wetland compensation

According to the Québec's mining act, in order to obtain its authorization certificate, a project must provide an economic evaluation of metal extraction with a facility located in Québec, and a study to valuate the residues.

PERMITTING PROCESS

The overall procedure for permitting is multifold and likely to require about four (4) years. Aside of the main environmental authorization certificate, dozens of other permits of diverse complexities and jurisdictions will be required prior to operate a mine. A non-exhaustive list of government requirements and fees is provided in ***table 23***.

Item	Permit costs and fees	Description	Organism
Project notice	$1366	Intended project description	MDDELCC Environment Canada
ESIS	$58,073	Detailed descriptions	MDDELCC, COMEV
Dangerous residual goods permit	$3,274	Production of dangerous residual goods requires permitting	MDDELCC
Potable water certificate	$2354	Pumping of water from lake or wells require a permit. 75,000 to 379,000 liters per day is anticipated	MDDELCC, Municipality
Waste Water treatment certificate	$654	Grey and brown water treatement facility for less than 1000 person needs permitting	MDDELCC, Municipalities
Construction permit	$200	Construction of buildings and infrastructure requires construction permits	Municipalities Régie du bâtiment
Clean-up attestation	$50900	Up to 8 different permits and certificates are required for entrusting the clean-up of the facility at the end of the project life.	MDDELCC
Residue burrying or burning permit	$9432	Three different permits are required to burry or burn dry residues.	MDDELCC, Municipality
Fuel handling equipement permit	$2947	A permit is required to build and operate fuel handling facilities	MDDELCC, Régie du Batiment, Municipality
Explosives	$390	Each individual who have to handle explosive require a permit.	Sureté du Québec, Municipality
Residual good management plan	n/a	An industrial residues management plan, exclusive of tails.	Municipality

Item	Permit costs and fees	Description	Organism
Rehabilitation plant	$1309	A plan to rehabilitate contaminated soil must be handed	MDDELCC
Dangerous good storage plan	$2621	A plan for the storage of dangerous substance must be handed for safety purpose	Municipality
Wet land intervention	$3274	Permit required for any work impacting wet lands and streams.	MDDELCC
Forest intervention permit		A royalty on logging is payable, for commercial logs only.	MFFP
Temporary camp permit		Various permits are required to operate a temporary camp, prior to build the construction camp	MERN, MDDELCC, Municipality

***Table 23**: Non-exhaustive list of permits required by the project.*

First, a project notice has to be filed with provincial MDDELCC authorities, who will transmit it to *COMEV* and federal authorities. Such notice is usually filed once prefeasibility study is completed, or sufficient understanding of the project is available in order to make appropriate quasi-definitive choices in terms of project definition, scaling, logistics and technologies. In the current project, this notice should be submitted as soon as the resources are properly defined and a mining plan is made available. Since the chemical and electrochemical process plant is not to be constructed on mining site, there is no need to include this aspect in the project notice.

The notice has to be acknowledged by authorities, who will provide their requirements and recommendation to the proponent, VanadiumCorp Resource Inc. Environmental and social impact study, or *Comprehensive study*, can then be initiated by the proponent. The environmental baseline study, which characterizes the state of the environment prior project construction, can be initiated prior to ESIS, ideally prior to any disturbance of the site. The environmental baseline study is to includes various aspect (soil quality, water quality, plants and wildlife inventories, etc), the study of which will span over a year.

As part of the ESIS, an information protocol has to be implemented with the communities, both Chibougamau and First Nations. A liaison bureau has to be opened with dedicated staff in each of the community affected by the project. Information meetings must be held, and an environment assessment committee should be organized. The purpose of this assessment committee is to gather recommendations and concerns of the population, and insure that these are properly dealt with within the ESIS. This mandatory public auditing process is expected to span over a year. Recommendations have to be included in the Feasibility study, including adjustments to the project's logistics and layout.

The ESIS is to be submitted, along with the feasibility study, for reviewing by *COMEX*. Upon review, recommendations and questions will be issued by the *COMEX* to the proponent, VanadiumCorp Resource Inc. Questions will have to be answered, which are likely to require further testing, modeling and engineering. Typically, two cycles of questions and answers are required, a process that may takes up to two years.

Once the ESIS is accepted by the *COMEX*, the provincial and the federal authorities, recommendation is made to the MDDELCC Minister to issue the *Certificat d'Autorisation "CA."*, or environmental authorization certificate. Once the certificate is granted, the proponent can apply at MERNQ to obtain the *Bail Minier*, or mining license. From ESIS acceptance, about 6 months are required to obtain the mining license, and initiate construction.

ITEM 21: CAPITAL REQUIREMENT AND OPERATING COST

HISTORIC ESTIMATES

Since 1973, numerous cost estimates were made in regard of vanadium production at Lac Doré, dealing with various metallurgical options, markets, levels of details, all evolving through time. **None of the historic costs or cash flow estimates are considered current and as such are considered obsolete in the context of the present analysis**. However, insights from the historical data were utilized to provide limits for the current estimates. Updating this data to current conditions led to the conclusion that these historic models do not generate sufficient return on investment to be economically viable.

Economics of vanadium production from VTM mining and alkali roasting with the use of a conventional rotary kiln was independantly evaluated by the first author with the help of Mr. Todd Richardson. With a targeted production of 17 million pounds V_2O_5 per year, the project would generate an approximative IRR between 5% and 7%, at a vanadium price of US$5.50 per lbs. Construction and operation costs were calculated as significantly higher than other recently built projects (e.g. Windimurra, Largo), due to Canadian climate and stricter regulations compared to operations in other countries. To be of economic interest, the project would require a stable vanadium price in the order of US$8.00 per pound of V_2O_5, which is too speculative compared to current market conditions. As such, the alkali roasting option historically contemplated was ruled out.

A smelting option, either using intensive or moderate fusion, was evaluated by the first author, based on current commodity prices and historic cost estimates. However, the current construction cost (approximately $1 billion for a 500,000 tpy smelter) and the weak forecast in the North American steel industry makes this approach unattractive. Such a scenario has recently been retained by BlackRock Metals, who plans to build a mine and a concentrator at Lac Doré at a cost of $350 million, plus an arc furnace to produce pig iron and vanadium-titanium slag in Saguenay, at the cost of $650 million. Many details of the project, currently undergoing feasibility study, are not publicly available (http://www.lesaffaires.com/secteurs-d-activite/ressources-naturelles/metaux-blackrock-place-ses-pions-pour-son-projet-minier-a-chibougamau/595441).

Toll smelting options with various steelmakers were also evaluated. VTM can undergo intensive fusion in a conventional submerged arc furnace equipped with Midrex pre-reduction units and a basic oxygen furnace (BOF) for steel conversion, similar to the Highveld and New-Zealand Steel operations. Such smelters are similar to other direct reduction smelters, which would require minimal modification to use VTM as feed.

Numerous such direct reduction steel plants are currently operating in North-America, such as Arcelor-Mittal in Contrecoeur, Québec.

Similarly, VTM can undergo moderate fusion in a conventional submerged arc furnace, as long as the feed is pre-oxidized rather than pre-reduced such as in the Midrex process. Moderate fusion implies that not all iron is reduced into hot metal, and that the oxidized iron remaining in the slag enables efficient partition of vanadium into this slag. The only moderate fusion smelter in North-America is operated by Rio-Tinto Iron and Titanium in Sorel, Québec, for the smelting of ilmenite. Converting a direct reduction steel plant to a moderate fusion smelter is feasible, both being of similar design.

The drawback of smelting VTM is, for intensive fusion, the losses of about 10-20% of the iron credits per kW/h compared to smelting conventional iron ore, due to lower iron content of the feed. The use of moderate fusion causes even supplementary losses of about 10-15% of the iron credits which are left in the slag. Negotiations were initiated with existing steel producers, to whom VTM concentrates was offered free, delivered by rail to the smelter, in exchange for returning the vanadiferous slag to VanadiumCorp. Considering that viable titanium recovery process is not currently available for silicate-poor iron-rich slag, considering the losses on iron credit and considering the steel market conditions, project remained economically unattractive in near terms, and supplementary toll was requested for smelting VTM. Paying such a toll to the smelter renders the processing of the slag for vanadium recovery uneconomical. In order to make such an option economic, it would be necessary to also recover the titanium credits from the slag. The industrial scaling of the technology required for titanium recovery from slag still needs to be developed for intensive fusion, and has never been pilot plant tested and demonstrated to be economically viable for moderate fusion slag. Although more attractive than conventional VTM salt roasting, toll smelting would be difficult to implement, requiring extensive testing for titanium recovery, and leave VanadiumCorp Resource at the mercy of third-party's smelter. Although not ruled out, the toll smelting and slag roasting scenario are considered as a longer term option that is not contemplated in the current study.

CURRENT VTM PRODUCTION MODEL

The model retained by VanadiumCorp is to pursue the development of an acid digestion and electrowinning option rather than rely upon conventional vanadium recovery processes. Developing a metallurgical process from scratch typically requires years of testing and piloting. Since such operations can be conducted in existing industrial parks anywhere in North America. It is anticipated that permitting of the metallurgical facility would be easier than permitting the mining project itself located on crown or First Nations land. Therefore, it was decided to separate the VTM mining project from the

electrochemical plant, and that the time required obtaining permits for such a mining operation should balance with time to fully test the electrowinning process development and testing.
The current project considers the production of 860,000 tonnes of VTM per year, or 100 tonnes VTM per hour, which would be sold to the electrochemical facility or to third party consumers.

Mineral Resources on which the current preliminary economic assessment is based are not Mineral Reserves and do not have demonstrated economic viability. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves and therefore do not have demonstrated economic viability.

TOTAL CAPITAL COST

Capital requirements to bring the Lac Doré Vanadium project into production according to the current scenario are evaluated at $342 million. This includes construction cost of the mill and concentrator (***table 24***), all required infrastructure (***table 25***) including power line and road upgrade, as well as all indirect preconstruction costs to be incurred, but exclusive of capital required for mining equipment and working capital. Breakdown of capital expenditure is provided in ***figure 36***.

TABLE 24 — CRUSHING, MILLING AND BENEFICIATION CIRCUIT EQUIPMENT COST

CMB	Equipment Name	# of units	Design		Other Design Criteria			Power Draw		Avail	Avg Annual Demand (kWh/a)	Capital Cost
			Exchange rate	0.75 $								
1	Primary Crusher Vault	1			4	hrs	Residence time					$ 466 667
2	Primary Crusher -Gyratory	1	500	t/hr			Gyratory	300	kW	0.8	1 892 160	$ 4 666 667
3	Primary Crusher cooling system	1						30	kW	0.8	189 216	
4	Primary Crusher lube pack	1										
5	Dust collection system -crusher to cobbing	1						100	kW	0.8	630 720	$ 500 000
6	Primary Crusher Bin	1	500	tons								$ 100 000
7	Primary Crusher Discharge Apron Feeder	1						40	kW	0.8	252 288	$ 1 333 333
8	Conveyor #1 - Vib Screen Feed	1			60%	recycle		50	kW	0.8	315 360	$ 1 333 333
9	Secondary Crusher Feed Bin	1			4	hrs	Residence time					$ 120 000
10	Secondary Crusher	1	300.0	t/hr	HP 500 metso short head			355	kW	0.8	2 239 056	$ 2 400 000
11	Secondary Crusher cooling system	1						30	kW	0.8	189 216	
12	Secondary Crusher lube pack	1										
13	Secondary Crusher Bin	1										$ 120 000
14	Secondary Crusher Discharge Belt Feeder	1						25	kW	0.8	157 680	$ 200 000
15	Screen Diverging Pan	1						45	kW	0.8	283 824	$ 400 000
16	Vibratory Screen	1	800.0	t/hr				55	kW	0.8	346 896	$ 800 000
17	Conveyor #2 - Secondary Crusher Feed	1						60	kW	0.8	378 432	$ 700 000
18	Conveyor #3 - Cobber Feed	1						50	kW	0.8	315 360	$ 1 000 000
19	Cobber	2	500	t/hr (for two)				20	kW	0.8	252 288	$ 533 333
20	Conveyor #5 - Cobber Tails Conveyor	1	TBD in feasability					40	kW	0.8	252 288	$ 250 000
21	Conveyor #4 - Cobbed ore Conveyor	1	TBD in feasability					30	kW	0.8	189 216	$ 1 200 000
22	Conveyor #6 - cobbed ore to storage	1	TBD in feasability					60	kW	0.8	378 432	$ 1 000 000
23	Storage capacity bin	2			24	hrs	Residence time					$ 850 000
24	Primary grinder	1-2						3696	kW	0.9	26 225 985	$ 14 666 667
	Feed		268	t/hr								
	Recycle Load		107	t/hr								
	Total Recycle		40%	of Feed								
	Total		375	t/hr								
	Power Requirement		12	kWh/t								
	Total		3696	kW								
	Target Grind		14	mesh								
25	Primary grinder Stack sizer	1	14	mesh								$ 2 666 667
			375	t/hr solid								
			37%	solids								
			1013	t/hr pulpe								
26	Mill Discharge Pump	2	375	t/hr solids				550	kW	0.9	3 902 580	$ 533 333
			37%	solids								
			1013	t/hr pulpe								
27	Rod Mill Rod Feeding system	1							kW	0.9	-	$ 666 667
28	Rod Mill Lube Pack w/ Cooling	1						50	kW	0.9	354 780	
29	Rod Mill Gear Box Lube system	1						50	kW	0.9	354 780	
30	Rod Mill Discharge Sump	1						40	kW	0.5	157 680	$ 133 333
31	Rod Mill Scats Hopper	1										$ 106 667
32	Rougher 1 LIMS	2	268	t/hr for two				20	kW	0.9	283 824	$ 533 333
33	Rougher LIMS feed box	2										
34	Rougher LIMS Dishcharge Chute	2										
35	Ball Mill (w/ Variable Speed Drive)	1						3597	kW	0.9	25 522 576	$ 10 666 667
	Fresh feed		163	t/hr								
	Circulating load		400%									
	ball mill feed		654	t/hr								
	Power Requirement		22	kWh/ fresh ton								
	Total		3597	kW								
	Target Grind		75	micron	D80: 75µm							
36	Ball Mill Cyclone Pack	1	75	micron								$ 2 000 000
			817	t/hr solid								
			51%	solids								
			771	t/hr eau								
37	Mill Discharge Pump	2	817	t/hr solids				600	kW	0.9	4 257 360	$ 453 333
			51%	solids								
			771	t/hr eau								
			1043	m³/h								
38	Ball Mill Ball Feeding system	1										$ 666 667
39	Ball Mill Lube Pack w/ Cooling	1						50	kW	0.9	354 780	
40	Ball Mill Gear Box Lube system	1						15	kW	0.9	106 434	
41	Ball Mill Discharge Sump	1										$ 133 333
42	Ball Mill Scats Hopper	1										$ 106 667
43	Cooling Tower	1						25	kW	0.9	177 390	
44	Rougher 2 LIMS	1	163	t/hr	1		Inline maint spares	15	kW	0.9	106 434	$ 266 667
45	Rougher LIMS feed box	1										$ 20 000
46	Rougher LIMS Dishcharge Chute	1										$ 20 000
47	Cleaner 1 LIMS	1	122	t/hr	1		Inline maint spares	15	kW	0.9	106 434	$ 266 667
48	Cleaner 1 LIMS feed box	1										$ 20 000
49	Cleaner 1 LIMS Dishcharge Chute	1										$ 20 000
50	Cleaner 2 LIMS	1	114	t/hr	1		Inline maint spares	15	kW	0.9	106 434	$ 266 667
51	Cleaner 2 LIMS feed box	1										$ 20 000
52	Cleaner 2 LIMS Dishcharge Chute	1										$ 20 000
53	Non-mag Tails Transfer Tank	1			< 5 minute retention time							$ 10 000
54	Slurry pump: various	15	TBD in feasability					150	kw	0.9	15 965 100	$ 600 000
55	Non-mag Tails Transfer Pump	1	52	t/hr				100	kw	0.9	709 560	
56	Tailings Thickener	1	115	t/hr solids	0.5	m2/t	Pilot plant	50	kW	0.9	354 780	$ 2 000 000
	Estimated Size		30	m diameter	Estimate based on experience							
55	Tails Thickener Feed Box	1										$ 30 000
56	Flocculant system	1			Assumed 20 g /ton solids		Pilot plant	35	kW	0.9	248 346	$ 200 000
57	Tails transfer pump	2			Assumed 50% solids		Pilot plant	200	kW	0.9	2 838 240	$ 186 667
58	Tails booster pump	2						200	kW	0.9	2 838 240	$ 186 667
59	Water Storage Tank	1			60 ft x 30 ft		Approximation -					$ 1 800 000
60	Water services supply pump	2	4000	m³/h				150	kW	0.9	1 064 340	$ 213 333

TABLE 24 CRUSHING, MILLING AND BENEFICIATION CIRCUIT EQUIPMENT COST

CMB	Equipment Name	# of units	Design		Other Design Criteria			Power Draw		Avail	Avg Annual Demand (kWh/a)	Capital Cost
			Exchange rate	0.75 $								
61	Mag Concentrate Belt Filter	1			125m2			30	kW	0.9	212 868	$ 3 333 333
62	Vacuum Pump	1						150	kw	0.9	1 064 340	$ 80 000
63	Filtrate Receiver Tank	1										$ 40 000
64	Belt Filter Discharge Chute	1										$ 20 000
65	Magnetic Concentrate Stacker	1						25	kW	0.9	177 390	$ 300 000
66	Magnetite Covered Storage	1			1 month of storage		Minimal capacity					
67	Tailings Return Pump	1						100	kW	0.9	709 560	$ 53 333
68	Fire Water Pump	2						125	kW	0.9	886 950	$ 80 000
69	Process water pump	2						200	kW	0.9	1 419 120	$ 80 000
70	Gland Water Pump	2						45	kW	0.9	638 604	$ 160 000
71	Fresh water pump	2						45	kW	0.9	319 302	$ 160 000
72	UTEI							100	kW	0.9	709 560	$ 4 000 000
73	Sump Pumps	7						15	kW	0.7	579 474	$ 112 000
74	Weightometers, sampling, magnets	2										$ 400 000
75	Controls and instrumentation	1			2 - 3% of total costs		Controle Laurentide					$ 1 988 160
76	Electricity	1										$ 20 000 000
77	Piping	1			Estimation							$ 15 000 000
78	Training start-up (3 mois)	1										$ 1 750 000
79	Dryer	1	CEM = 5000 Kj/Kg		Estimated by R. Girard, Arianne 2009			12311	kW	0.9	87 354 720	$ 8 000 000
80	Expediting and shipping	1			Estimation ±8%							$ 8 000 000
81	Ancillary	1						7275	kw	0.9	50 986 398	
82	Earthwork and fundations	1										$ 9 613 333
								Note: Numbers in blue are converted from US dollars				
	TOTAL				TOTAL			31 334	kW		239 356 796	$ 130 623 493

TABLE 25:	INFRASTRUCTURE CONSTRUCTION COST ESTIMATES						
	COST Historic	Year	% Industrial inflation	Rounded UNIT COST	UNITS	TOTAL COST	REFERENCE
Direct costs							
Mines							
Dewatering	70 000	2 002	33%	100 000 $	1	100 000 $	2002 Estimate
Stripping and clearing	1 561 037	2 002	33%	2 080 000 $	1	2 080 000 $	2002 Estimate
Mine site levelling	1 522 005	2 002	33%	2 020 000 $	1	2 020 000 $	2002 Estimate
Mill site preparation	994 355	2 002	33%	1 320 000 $	1	1 320 000 $	2002 Estimate
Site road, parking & storage	646 910	2 002	33%	860 000 $	1	860 000 $	2002 Estimate
Access road upgrade							
Potable water system	221 440	2 017	0%	230 000 $	1	230 000 $	Author estimate.
Sewage & drainage systemps	225 387	2 017	0%	230 000 $	1	230 000 $	Author estimate.
Electrical distribution	22 216 053	2 002	33%	29 480 000 $	1	29 480 000 $	2002 Estimate
Communication systems	50 000	2 017	0%	50 000 $	1	50 000 $	Author estimate.
Solid waste disposal	517 980	2 002	33%	690 000 $	1	690 000 $	2002 Estimate
Fuel farm and station	200 000	2 017	0%	200 000 $	1	200 000 $	Author estimate.
Service mobile equipment	0		0%	- $	1	- $	Included in mining quote
Emergency generator	1 357 981	2 002	33%	1 810 000 $	1	1 810 000 $	2002 Estimate
Truck scale	123 146	2 002	33%	170 000 $	1	170 000 $	2002 Estimate
Fresh water & fire protection system	500 000	2 017	0%	500 000 $	1	500 000 $	Author estimate.
Buildings							
Administration office	200	2 014	12%	225 $	6 700	1 958 008 $	ACQ 2014, per sq feet + 30% NDQ
Mill	137	2 014	12%	154 $	40 000	8 007 376 $	ACQ 2014, per sq feet + 30% NDQ
Garage	137	2 014	12%	154 $	6 700	1 341 235 $	ACQ 2014, per sq feet + 30% NDQ
Guard house	200	2 014	12%	225 $	260	75 982 $	ACQ 2014, per sq feet + 30% NDQ
Fresh water pumphouse	200	2 014	12%	225 $	400	116 896 $	ACQ 2014, per sq feet + 30% NDQ
Concentrate tailings pumphouse	200	2 014	12%	225 $	400	116 896 $	ACQ 2014, per sq feet + 30% NDQ
Warehouse	137	2 014	12%	154 $	6 700	1 341 235 $	ACQ 2014, per sq feet + 30% NDQ
Mine site VTM storage Dome	67	2 014	12%	76 $	23 451	2 321 650 $	ACQ 2014, per sq feet + 30% (10 days)
Tailing ponds				- $	1	- $	
Waste rock dump				10 $	307621	3 076 205 $	Author estimate
Concentrator tailings	Volume 5 years	9 384 902	M3				
	Final volume	31 152 505	m3				#DIV/0!
	Area 30 height	1.04	km2				
	Length dam	2	km2				
	lume material 5 ye	182 920	m3	20 $	182 920	3 658 400 $	Author estimate
Infrastructures							
Main access road upgrade (35 km)	200 000	2 017	0%	200 000 $	35	7 000 000 $	Author estimate, per km
Hydro power line tie-in	250 000	2 002	33%	340 000 $	1	340 000 $	2002, 2007 Estimate
161 k v transmission line (32 km)	300 000	2 009	14%	350 000 $	32	11 200 000 $	Author estimate, per km
Site 161/25 kV sub-Station	4 075 477	2 002	33%	5 410 000 $	1	5 410 000 $	2002 Estimate
VTM Transport							
	Daily production	2 400	tpd				
	Turnover	2	days				
	Cars	56	cars, 85 tons, 40 feets				
	Track Length	1.05	Miles				
Rail spurs	2 000 000	2 017	0%	2 000 000 $	1.05	2 090 018 $	Author estimate., per miles
Rail spur VTM Dome	80	2 010	0%	88 $	5 500	483 995 $	Secor 2010, per sq feet, 90 days storage
Rail spur conveyors	500 000	2 017	0%	500 000 $	1	500 000 $	Author estimate.
Total direct costs						88 777 897 $	
Indirect costs							
E.P.C.M Mine				34 133 333 $	5%	1 706 667 $	
E.P.C.M CMB plant				130 623 493 $	15%	19 593 524 $	
E.P.C.M CMB infrastructures and building				88 777 897 $	20%	17 755 579 $	
Feasibility study						15 000 000 $	Author estimate
Environmental and social impact study						5 000 000 $	
Ressource definition				293 $	17 000	4 981 000 $	Cost per metre drilling all inclusive
Rehabilitation fund						5 000 000 $	
Permitting				500 000 $	5	2 500 000 $	Yearly operating cost
Owner cost				4 000 000 $	5	20 000 000 $	Yearly operating cost
Total Indirect costs						91 536 770 $	
Mine capex	Contract based=	yes				- $	
CMB capex						130 623 493 $	
Infrastructure+Building direct costs						88 777 897 $	
Contingency				219 401 390	15%	32 910 209 $	
Total Capex						343 848 369 $	

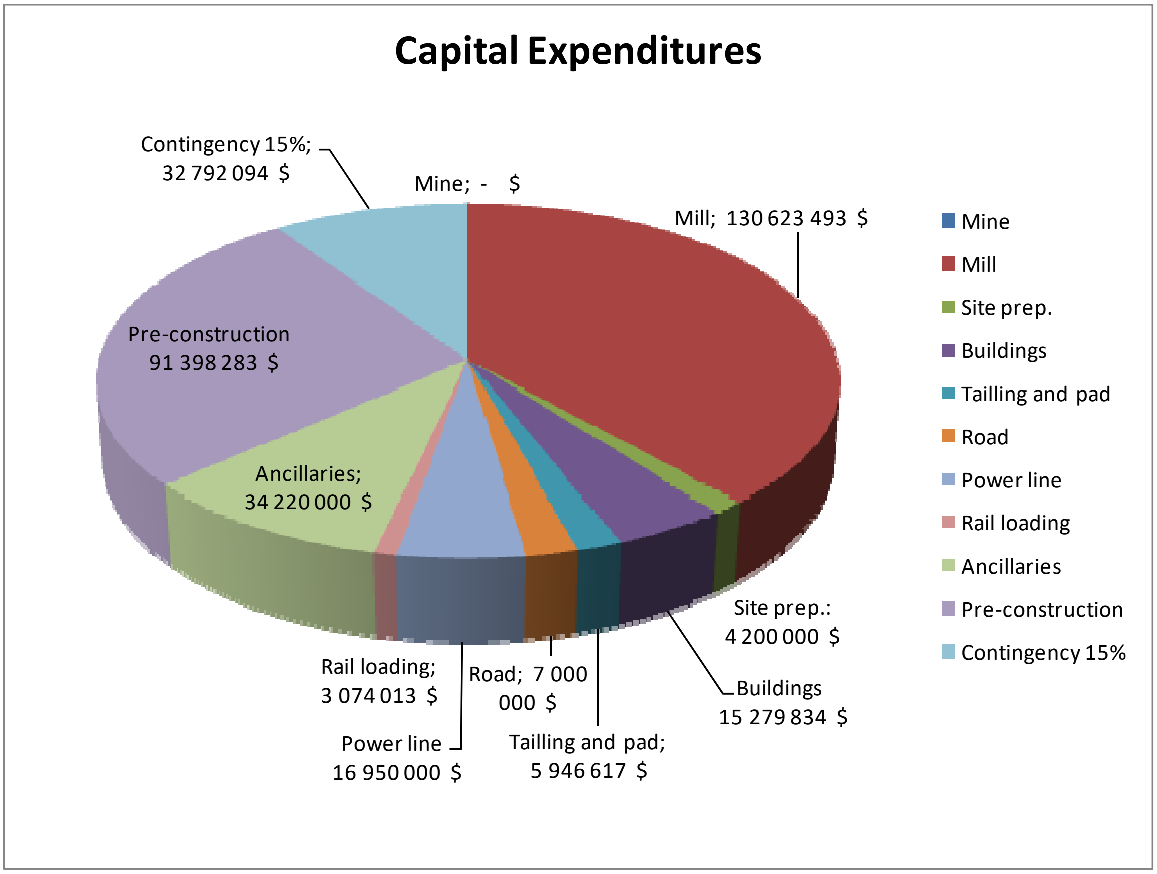


***Figure 36**: Breakdown of capital expenditures for the construction of Lac Doré Vanadium project.*

PRECONSTRUCTION OR INDIRECT COSTS

Prior to initiate construction, the following expenditures will be required (***table 25***):

- Corporate expenses: ($4 m/ year over 5 years) $20 million
- Resource definition: $5 million
- Environmental and social impact study: $5 million
- Feasibility study including metallurgical testing : $15 million
- Permitting and social acceptance ($500,000/year, 5 years) $2.5 million
- Rehabilitation fund: $5 million
- Mining contract down payment (5% Capex) $1.7 million
- EPCM of the CMB plant (15% of Capex) $19.6 million
- EPCM of infrastructure (20% of Capex) $17.6 million

Corporate expenses include all spending anticipated to be needed by the corporation to promote and develop the project, conduct lobbying and representations, plus conduct testing of the electro metallurgical process. This figure is based on the first author's experience.

Cost of resource definition, environmental and social impact study and feasibility study are based on the first author's experience.

Mining contract down payment represents the cost to be expected to secure the mining contract and have a mining plan defined by the contractor. Detailed engineering, procurement and construction management (EPCM) are estimated using industry standard ratios.

The rehabilitation fund represents the cost of rehabilitating the site once the mine halts its production. This money has to be set in a trust account held by the provincial government to obtain the environmental authorization certificate (CA).

MINING CAPITAL AND OPERATING COSTS

It is a common practice to have mining operations managed on a contract basis by specialized contractors. Doing such, capital expenditures are the responsibility of the contractor, and are not required to be included in the economic model. A quote was provided by *Dynamitage TCG Inc*, a well established mining contractor based in Saguenay, Québec (Vachon and Dionne, 2017). The quote, dated July 15th 2017, is all inclusive, except for infrastructure (***tables 26*** and ***27***). Cost breakdown is as follows (***figure 37***):

Mining Equipment cost					Exchange rate	0.75 $	
	Item	**# of units**	**Design**	**Model**		**Unit Cost**	**Capital cost**
1	Excavator	2	125 t	Komatsu PC 1250		2 400 000 $	4 800 000 $
2	Mine truck	8	100 t	Caterpillar 777		2 933 333 $	23 466 667 $
3	Dozer	2	225 kw	Caterpillar D8T		1 200 000 $	2 400 000 $
4	Drill	2		Atlas Copco D65		1 333 333 $	2 666 667 $
5	Support vehicle	6		Pick-up, water truck, etc		133 333 $	800 000 $
6	**Total**						**34 133 333 $**
	Contract base						- $

Table 26*: Capital expenditure to be incurred by the mining contractor and equipment sizing.*

Mining operation cost : July 2017 Quote			
Item		Cost per ton	Cost per year
Drilling		0.94 $	3 053 233 $
Hauling		2.30 $	7 470 677 $
Operating staff		0.08 $	259 850 $
Maintenance		0.20 $	649 624 $
Management		0.06 $	194 887 $
Mobilization		0.02 $	64 962 $
Ancillary		0.09 $	292 331 $
Total		**3.69 $**	**11 985 564 $**

Table 27*: Mining cost as quoted by Dynamitage TCG.*

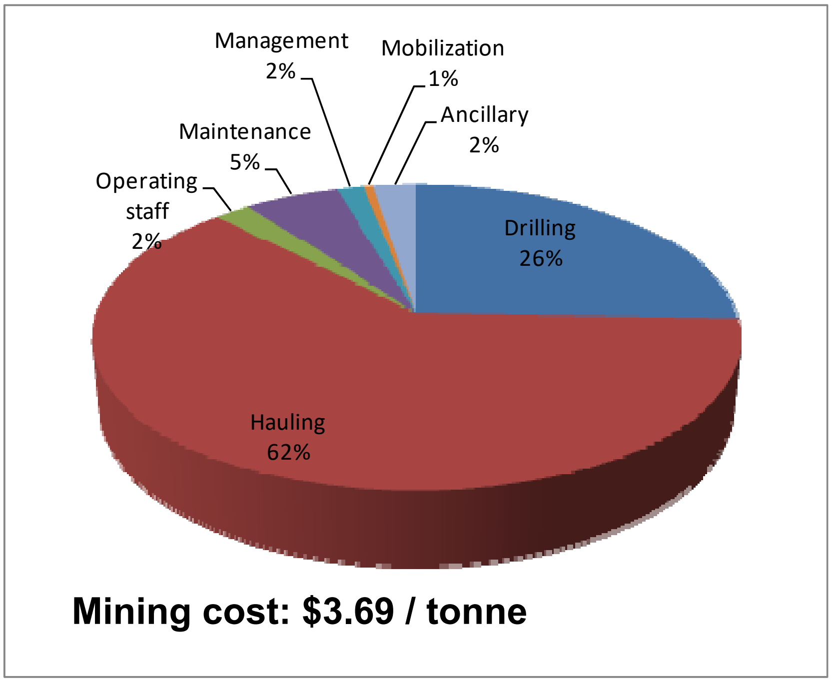


Figure 37*: Breakdown of operating cost for mining, as quoted by Dynamitage TCG Inc.*

CRUSHING, MILLING AND BENEFICIATION

The crushing, milling and beneficiation *"CMB"* plant represents the largest capital cost and operating cost of the project. These costs were estimated by J. Lapointe based on his experience and on limited available processing data. The cost estimation includes various equipment pricings obtained from third parties or experience, as listed in ***table 24***. Costs for the dryer were estimated by the first author, based from an estimate of a previous project and corrected for inflation (Girard, 2009). Estimations are considered as +40%/-25% accurate, acceptable for the purpose of a preliminary economic assessment.

Costs of most pieces of equipment were obtained in US dollars, and converted to Canadian dollars at the indicated exchange rate. Equipment that is manufactured locally, such as commonly available (conveyors, pumps, etc.), piping, metal smith, and sheet metals, were estimated in Canadian dollars directly.

Capital requirements for the construction of the mill and concentrator is estimated at $131 million, including expediting, installation and start-up training, but excluding buildings, infrastructure and EPCM (***figure 38***).

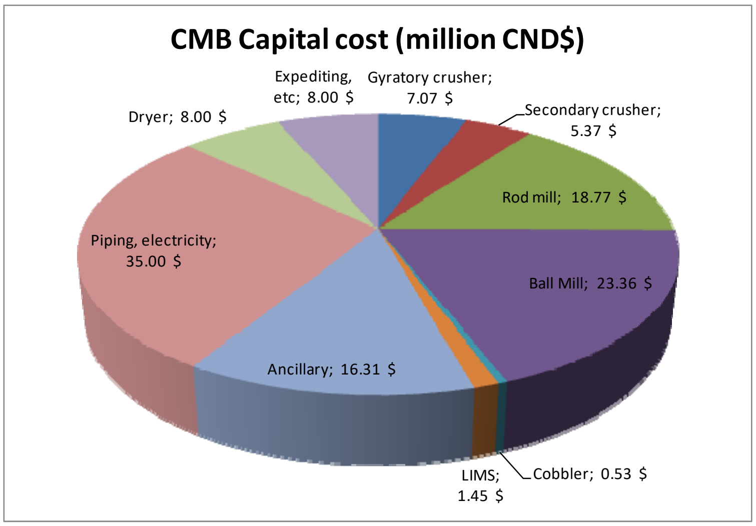


Figure 38*: Breakdown of construction cost for the crushing, milling and beneficiation plant.*

Energy costs include electric power consumption and power draw. Power consumption was estimated by J Lapointe, except for the dryer consumption made by the first author. Recall that power requirement of the milling circuit has voluntarily been over-estimated (grinding and operating motor loads). The power cost is based on Hydro-Québec' L rate (*"large puissance"*) at $0.033/kWh. This rate is not-negotiated, and better rates might be available. The power draw, invoiced separately from consumption by Hydro-Québec, corresponds to the current made available to the operation, either used or not. Yearly pricing is calculated from Hydro-Québec rate ($12.87/kw) (***table 28***).

Power line construction is to be paid by the project (***table 25***). However, this cost is to be credited by Hydro-Québec from power consumption invoices up to its construction expenditures, at which moment ownership of the line is transferred to Hydro-Québec. This means that power is not part of the operation expenditure for almost the first two years of operation of the project and rather considered as an initial capital requirement to be subsequently written-on. This is considered in the cash-flow calculations in Item 22.

TABLE 28 CRUSHING, MILLING AND BENEFICIATION CIRCUIT OPERATING COSTS

ITEMS	DETAILS	QUANTITY	UNIT COST	SOCIAL BENEFITS AND COST	UNITS	WEEKLY COSTS	YEARLY COST (52 weeks)	COST PER TONS (Yearly averages)	REFERENCE
								876000	Yearly tonnage
GENERAL									
Service vehicle	Pick-up maintenance	5	10 000 $		$/Pick-up		50 000 $	0.06 $	Small vehicle maintenance
Service vehicle	Machinery maintenance (Hewitt)	3	24 000 $		$/Vehicle		72 000 $	0.08 $	Heavy vehicle maintenance
Personal safety gears	Overalls, safety boots, etc	70	500 $		$/Worker	673 $	35 000 $	0.04 $	Based on expericen
Safety training							131 658 $	0.15 $	1% total payroll + CNESST
Environmental monitoring		500	100 $		$/analyses		50 000 $	0.06 $	Estimation
	TOTAL GENERAL						**338 658 $**	**0.39 $**	
		On duty worker				**Weekly cost**			
MANPOWER									
Production staff									
Shipping and handling	1 Operator per shift (84h/w)	2	25 $	7.25 $	$/h	5 805 $	301 860 $	0.34 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Production handling	1 Back-up operator per shift (84h/w)	4	25 $	7.25 $	$/h	11 610 $	603 720 $	0.69 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Crusher operator	2 Operator per shift (84h/w)	4	26 $	7.54 $	$/h	12 074 $	627 869 $	0.72 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Milling operator	1 Operator per shift (84h/w)	2	29 $	8.41 $		6 734 $	350 158 $	0.40 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Mag sep operator	1 Operator per shift (84h/w)	2	29 $	8.41 $		6 734 $	350 158 $	0.40 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Water management	1 Operator per shift (84h/w)	2	26 $	7.54 $		6 037 $	313 934 $	0.36 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Control room	1 Operator per shift (84h/w)	2	35 $	10.15 $		8 127 $	422 604 $	0.48 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Foreman	1 per shift (84h/w)	2	42 $	12.18 $		9 752 $	507 125 $	0.58 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
Maintenance									
Overall	3 Electricians/instrumentations (84h/w	3	30 $	8.70 $	$/h	10 449 $	543 348 $	0.62 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
	9 Millwright (84h/w)	9	27 $	7.83 $	$/h	28 212 $	1 467 040 $	1.67 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
	1 Foreman (84h/w)	1	29 $	8.41 $	$/h	3 367 $	175 079 $	0.20 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
	1 Planning (40 h/w)	1	29 $	8.41 $	$/h	1 496 $	77 813 $	0.09 $	40 h/w
	1 Manager (40h/w)	1	42 $	12.18 $	$/h	2 167 $	112 694 $	0.13 $	40 h/w
Technician									
Plant support	1 Technician (metallurgy)(84 h/w)	1	25 $	7.25 $	$/h	2 903 $	150 930 $	0.17 $	12 hrs/day; 7d/7d rotation, Sunday on overtime X1,5
	1 technician (environment)(40 h/w)	1	35 $	10 $	$/h	1 806 $	93 912 $	0.11 $	40 h/w
Supervision									
	1 General manager (40 h/w)	1	80 $	20.80 $	$/h	4 032 $	209 664 $	0.24 $	40 h/w
	1 General foreman (40 h/w)	1	65 $	16.90 $	$/h	3 276 $	170 352 $	0.19 $	40 h/w
	1 Metallurgist (84h/w)	1	62 $	16.12 $	$/h	7 031 $	365 602 $	0.42 $	12 hrs/day, 14/14 rotation
	1 Safety manager / trainer (40h/w)	1	27 $	7.02 $	$/h	1 361 $	70 762 $	0.08 $	40 h/w
	2 Clerks (40 h/w)	2	22 $	5.72 $	$/h	2 218 $	115 315 $	0.13 $	40 h/w
	1 Gate and safety	1	27 $	7.02 $	$/h	1 361 $	70 762 $	0.08 $	40 h/w
Contingency	15%					20 483 $	1 065 105 $		Overtime, travel time, shut down, etc.
	TOTAL M & M						**8 165 804 $**	**9.32 $**	
		Yearly consuption				**Cost**	**Yearly cost**	**Cost per tons**	
SERVICES									
Power consumption	Plant (kWh/a)	239 356 796			kWh	0.033 $	7 826 967 $	8.93 $	L rate, 1 avril 2017
Power draw	Plant (kW)	31 334			kW	12.87 $	403 271 $		Hydro-Québec
Fuel consumption	Delived on site, bulk.								
Fixed equipements	Back-up Generators, etc	5 000			liters	0.72 $	3 600 $	0.00 $	Pétrole MJ, 12 june 2017
Vehicle, diesel	Loader, fork lift, bobcat, etc	4 000			liters	0.88 $	42 240 $	0.05 $	Pétrole MJ, 12 june 2017
Vehicle, gas	Pick-up	12 000			liters	0.93 $	11 160 $	0.01 $	Pétrole MJ, 12 june 2017
Tail management	Plant	1 910 659			m3	1.00 $	1 910 659 $	2.18 $	
	TOTAL SERVICES COST						**10 197 897 $**	**11.64 $**	
		Weekly tonnage	**Loads**	**$/loads**		**Weekly cost**	**Yearly cost**	**Cost per tons**	
TRANSPORT and HANDLING									
VTM trucking	From mill to track, contract based	16 800	240	180.00 $		43 200 $	2 246 400 $	2.56 $	Off-road trucks, 70 tons, 1.5 hours round-trip, $120/h
VTM transloading	Truck to train	16 800	240	23.33 $		5 600 $	291 200 $	0.33 $	1 operator, 8 h/d, 7/7, $100/h
Road Maintenance	Grading in summer, plowing in winter		8	120.00 $		960 $	49 920 $	0.06 $	Hourly rate
Crusing and milling media	Tonnage according to consummation	70	30	1 650 $		3 850 $	200 200 $	0.23 $	Semi-trailer, 30 t., Estimation JL
Ancillary and consumable	Tonnage according to consummation	150	30	1 650 $		8 250 $	429 000 $	0.49 $	Semi-trailer, 30 t., Estimation JL
Fuel	Included on pricing.								
	TOTAL TRANSPORT AND HANDLING						**3 216 720 $**	**3.67 $**	
						Unit cost	**Yearly cost**		
Consummable									
Crushing and milling media	Balls and rods	300	t/mois			1350	4 860 000.0 $	5.55 $	2017 estimation price
Floculant	20 g/ton of tails	78 840	kg/an		$/kg	3.50 $	275 940 $	0.32 $	Flomin 305 prices
Spare parts	Pumps, belts, rolls, impeller, conveyors, crusher parts, etc.	2 000 000	$/an			2 000 000 $	2 000 000 $	2.28 $	Estimation
Ancillary	Furniture, tools, consummables, etc.	200 000	$/an			200 000 $	200 000 $	0.23 $	Estimation
	TOTAL CONSUMMABLES						**7 335 940 $**	**8.37 $**	
SUB - TOTAL							**29 255 000 $**	**33.40 $**	$/tons of VTM
TOTAL plus contingency						**10%**	**32 180 500 $**	**37 $**	$/tons of VTM
TOTAL plus contingency								**13.72 $**	$/ton of milled rocks

Fuel consumption for the mill is considered as minimal, being required only for handling and service vehicles plus the back-up generator sets.

Aside of energy cost, operating cost of the mill and the concentrator includes maintenance, staffing, consumables and administration (***table 28***). Maintenance is indicated as parts, millwrights and travel expenses, for a total of $4.4 million per year. It is equivalent to 3.7% of the construction cost, close to the accepted value of 4%. Staffing is evaluated using author's experience and standard wages for the area, assuming a 10-15% discount since workers are commuting home every day compared to most other operations in the area where workers are lodged on site with a weekly or biweekly schedule. A total of approximately 100 workers are required for the overall operation, including contracted mining and VTM trucking, but excluding external service providers. A 15% contingency is added to overall wages.

The more significant consumables are grinding media plus their transportation cost, for approximately $5.3 million per year including expediting (***table 28***). Grinding media prices were updated from old retailer quotes (Molycop, Magotteaux). For tails settling, *Flomin 305* was used as preliminary estimation.

INFRASTRUCTURE COSTS

Construction costs for infrastructure were estimated by the first author and E. Larouche, P.Eng. Most of the costs were estimated from either previous studies (SNC-Lavalin, 2002) or other projects where the author was involved (Girard, 2009). Where estimated from older projects, costs were updated using Canada Statistics published national inflation (12% since 2010 and 33% since 2002). No correction was made to take into account the sectorial inflation rates related to manpower, steel price and manufacturing. List of ancillary infrastructure is provided in ***table 25***.

POWER LINE AND SUBSTATIONS

A 161 kV power line is to be built for 32 kilometres, at the estimated cost of $350,000 per kilometres, for overall cost of $11.2 milllion (***table 25***). A tie-in station at the cost of $340,000 and a 50 MW on-site devolting station at the cost of $5.4 million are required. No maintenance cost is indicated, since the power line will be Hydro-Québec responsibility after less than 2 years.

ACCESS ROAD

The class-2 access road from highway n° 167 has to be upgraded or partly built over 35 kilometres. A construction cost of $200,000 per kilometre is estimated, based on forest industry standards, for $7 million (***table 25***). A yearly maintenance cost, based on typical contracting, is estimated at $50,000 per year. This expense might be covered by the municipality, but this option has not been accounted for.

BUILDINGS

Major buildings include administrative offices (6,700 sq ft), which should be built according to commercial standards. Industrial steel framed buildings are required for the mill (40,000 sq ft), the maintenance garage (6,700 sq ft) and the warehouse (6,700 sq ft). Smaller buildings include guard house, fresh water pumphouses and a tailings pond pump house. Costs were estimated from the typical construction costs published by Secor (2014, *Association de la construction du Québec*), indexed for inflation, plus 30% to account for the remote location, either for commercial construction ($200/sq ft) or industrial building ($137/sq ft) (***table 25***).

A mill-site VTM storage dome capable to host 10 days of production (24,000 tonnes) is required, for a calculated area of 5,500 sq ft. A second larger dome, capable to host 90 days of production (216,000 tonnes) is planned at the truck-rail transhipment site, for a calculated area of 24,000 sq ft.

WASTE PAD

A waste rock dump site has to be cleared and levelled. It will require about 22 hectares to pile the waste rock over the 20 year mine life, assuming the 1.34 strip ratio. Since the rock is not acid generating, minimal preparation and no impermeable lining is required. A $10 per square metre preparation cost is estimated, for a total of $2.1 million (***table 25***).

TAILLING AND SETTLING POND

To contain the tails from the concentrator over the first five years of production will require a pond approximately 0.7 km^2, capable to contain about 9 million cubic metres of tails. A two kilometres long dyke, 15 metres maximum high is required; meaning about 190,000 cubic metres of material is needed, at $20 per cubic metre. Thus, an initial cost of $5.4 million is forecast. Subsequently, the dyke can be built using the tails and waste rock at minimal cost to be included in the operating cost, estimated at cost of $1.00 per tonne, or $2 million per year plus flocculent (***tables 25, 28***).

RAIL SIDING

The rail siding includes 1.05 miles (1.6 km) of track to be laid, at the estimated cost of $2.09 million. Aside of the aforementioned dome shelter, the site will require a conveyor and hopper plus ancillaries, estimated at $500,000 (***table 25***).

TRUCKING

Trucking of the VTM from mill site to rail siding is to be subcontracted. Operating a heavy hauler semi-trailer is estimated to cost $120 per hour, based on lumber industry standards. This represents $180 per 70 tonne load, or a yearly cost of $2.25 million. Minimal capital expenditures are included in rail siding and mill site cost. Shipping of the milling media and other equipment or consumables from Montreal is estimated at $600,000 per year (***table 28***).

CONTINGENCY

A 10% contingency was added to capital and operating expenditures of the mill. No such contingency was applied to other infrastructure and operation contracted to third parties.

OVERALL OPERATING COST

Overall operating costs are currently estimated at $57.95 per tonnes of VTM concentrate. If VTM concentrate is sold at us$100 per tonne, this represents, at current exchange rates, an operating ratio of 2.30, which exceeds the generally accepted sustainable ratio for mining operations of 1.7.

Mining operations represent 43% of the operating costs, and are considered as the most flexible costs (***figure 39***). Selective mining may temporarily improve performance in the event of short term price collapses. Selective mining at the beginning of the operation can also be optimized, easing costs in the start-up years. Cost of trucking and handling to the rail spur is marginal (6%), compared to many other industrial mineral operations.

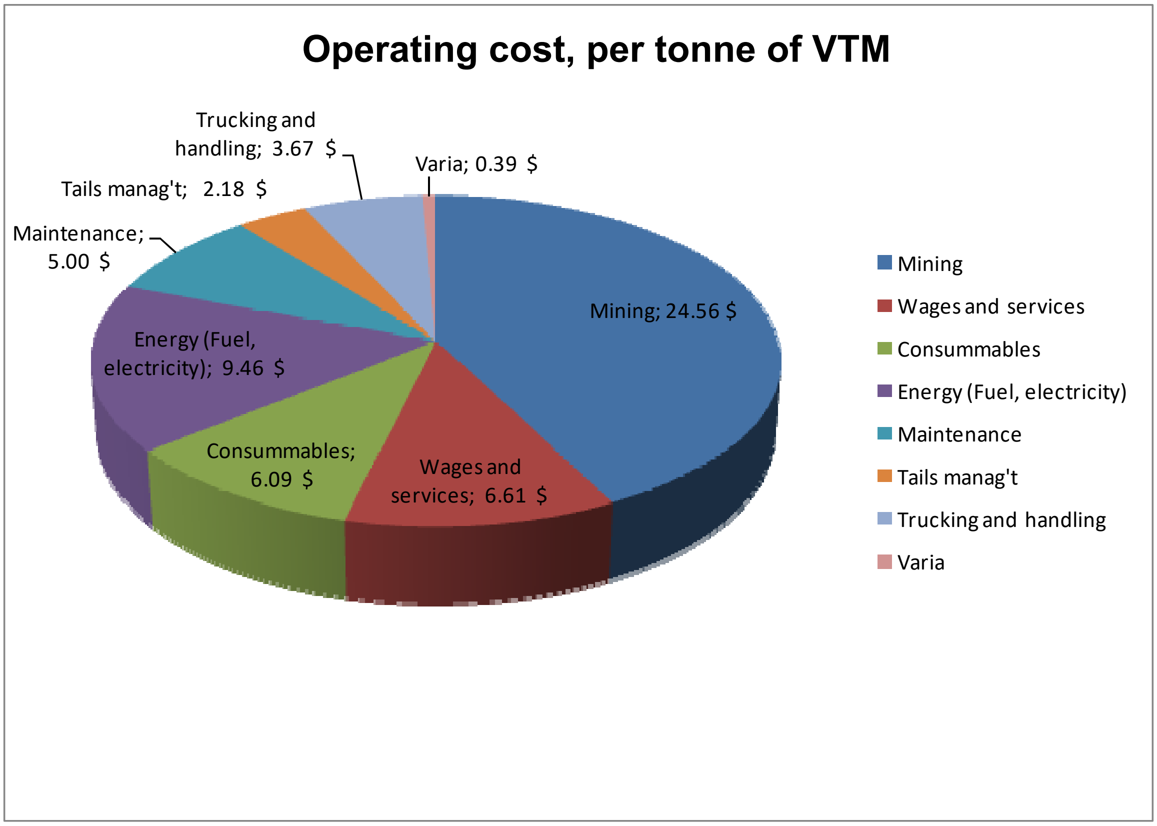


Figure 39*: Breakdown of operating cost per tonne of VTM, FOB at the rail in Chibougamau.*

ITEM 22: ECONOMIC MODEL

A series of yearly cash-flows are calculated over a mining life of 20 years, plus 4 pre-production years with negative cash-flows (***tables 29*** and ***30***). A limit of 20 year mining life was decided by the first author; despite the fact the deposit has a resource for about 30 years. This decision is based on the fact that the commodities to be produced are not dedicated to conventional markets. Vanadium is to be produced primarily for electrolyte used in redox flow batteries. As this commodity is tightly related to the implementation of a new energy storage technology, it is impossible to forecast its outcome in 25 years, the possibility of being replaced by a different technology by then cannot be excluded. A second commodity to be produced is electrolytic iron, the price of which is expected to be tightly related to the steel industry and metallic powder casting industry, itself currently driven by the automotive industry. Using electrolytic iron in replacement of scrap, hot briquetted iron (HBI) or pig iron for the production of steel technically feasible, and would open a very large market for the product. But it must be considered only as a low value option, attractive only if production cost is low enough, which will be heavily dependant on electricity costs. Furthermore, the world production of steel is deeply dependant on infrastructure construction in emerging markets, the evolution of which is difficult to predict. For these reasons, the first author is reluctant to forecast past 25 years from now.

Various input parameters for the base case scenario are provided in ***table 29***. The economic model is built in such a way to be interactive with the input parameters in order to conduct the sensitivity analysis.

Inferred Resource:	99,104,000 tonnes at 26.3% VTM
Inferred VTM Resources:	26,067,000 tonnes
Required resources:	63,663,000 tonnes, or 63%
Average Pit ratio:	1.34 tonnes of waste per tonne of ore.
VTM Production rate:	100 tonnes per hours, 24/24, 365, 90% availability
Currency exchange rate:	0.75 US$/CDN$
VTM price:	US$100/tonne, FOB Chibougamau
Inflation:	2% yearly
Discount rate:	0%
Depreciation rate:	15%
Interest rate:	10%
Equity-debt ratio:	100% equity
Total investment:	$343,299,705
Overall operating cost:	$57.95/tonnes VTM

Table 29*: Input parameters for the economic model.*

TABLE 30: ECONOMIC MODEL: YEARLY CASH FLOWS (All figures in Canadian Dollars)

Project year		1	2	3	4	5	6	7	8
Mining year						1	2	3	4
Investment (scalable)		14 481 000 $	19 500 000 $	149 330 351 $	159 914 807 $	- $	- $	- $	- $
Working capital requirement (3 months OPEX)		- $	- $	- $	- $	8 548 145 $	11 503 939 $	14 712 892 $	15 007 150 $
Investment+Working capital addition		14 481 000 $	19 500 000 $	149 330 351 $	159 914 807 $	3 982 459 $	4 323 551 $	396 465 $	404 395 $
Total investment		14 481 000 $	33 981 000 $	183 311 351 $	343 226 158 $	351 774 303 $	354 730 097 $	357 939 050 $	358 233 308 $
Fiscal Depreciated value, 1st January		- $	- $	126 930 798 $	224 779 145 $	157 345 402 $	110 141 781 $	77 099 247 $	53 969 473 $
Fiscal Depreciated value, 31 December		- $	- $	88 851 559 $	157 345 402 $	110 141 781 $	77 099 247 $	53 969 473 $	37 778 631 $
Salvage value (scalable)		- $	- $	78 042 757 $	190 218 847 $	161 686 020 $	137 433 117 $	116 818 149 $	99 295 427 $
Inflation cost	2%					100%	102,0%	104,0%	106,1%
Inflation Commodity	2%					100%	102,0%	104,0%	106,1%
Efficiency (Ramping up)		0%	0%	0%	0%	70%	90%	100%	100%
Mined ore, year	Tonnes	0	0	0	0	2273684	2923308	3248120	3248120
Mined ore, cummulative	Tonnes	0	0	0	0	2273684	5196992	8445113	11693233
Residual resources	Tonnes	99104000	99104000	99104000	99104000	96830316	93907008	90658887	87410767
Pit-Ratio		0	0	0	0	1,34	1,34	1,34	1,34
Waste, year	Tonnes	0	0	0	0	3046737	3917233	4352481	4352481
Waste, cummulative	Tonnes	0	0	0	0	3046737	6963970	11316451	15668932
Mined total, yearly	Tonnes	0	0	0	0	5320421	6840541	7600602	7600602
Mined total, cummulative	Tonnes	0	0	0	0	5320421	12160962	19761564	27362165
VTM production, yearly	Tonnes	0	0	0	0	604800	777600	864000	864000
VTM production, cummulative	Tonnes	0	0	0	0	604800	1382400	2246400	3110400
OPEX Mine (scalable)		- $	- $	- $	- $	19 632 354 $	25 241 598 $	28 046 220 $	28 046 220 $
Opex Mill + Transport (Scalable)		- $	- $	- $	- $	1 752 717 $	2 253 494 $	2 503 882 $	2 503 882 $
OPEX Mill + Transport (non-scalable)		- $	- $	- $	- $	12 807 508 $	16 466 796 $	18 296 440 $	18 296 440 $
Power (not-discounted)		- $	- $	- $	- $	5 403 824 $	6 947 774 $	7 719 748 $	7 719 748 $
Power (Discounted)		- $	- $	- $	- $	- $	1 151 598 $	7 719 748 $	7 719 748 $
Total OPEX		- $	- $	- $	- $	34 192 579 $	45 113 485 $	56 566 290 $	56 566 290 $
Opex mine with inflation (for mining taxes)		- $	- $	- $	- $	19 632 354 $	25 746 430 $	29 179 287 $	29 762 873 $
Total OPEX with inflation		- $	- $	- $	- $	34 192 579 $	46 015 754 $	58 851 568 $	60 028 599 $
Environment taxes, tailing (per tons)	0,03 $	- $	- $	- $	- $	58 945 $	75 787 $	84 208 $	84 208 $
Environment taxes, contaminant (/t)	2,00 $	- $	- $	- $	- $	10 641 $	13 681 $	15 201 $	15 201 $
Municipal + school taxes	2,67%	- $	- $	- $	- $	416 116 $	424 438 $	432 927 $	441 586 $
Water taxes (cubic meter water)	0,07 $	- $	- $	- $	- $	2 621 $	3 370 $	3 745 $	3 745 $
Carbon taxes	Unknown								
Native royalties	0%	- $	- $	- $	- $	- $	- $	- $	- $
Revenus		- $	- $	- $	- $	80 640 000 $	103 680 000 $	115 200 000 $	115 200 000 $
Revenus factored for inflation		- $	- $	- $	- $	80 640 000 $	105 753 600 $	119 854 080 $	122 251 162 $
EBITDA		- $	- $	- $	- $	45 959 098 $	59 220 569 $	60 466 432 $	61 677 824 $
EBITDA/CAPEX		0,00%	0,00%	0,00%	0,00%	13,06%	16,69%	16,89%	17,22%
Depreciation allocation		- $	- $	38 079 240 $	67 433 744 $	47 203 620 $	33 042 534 $	23 129 774 $	16 190 842 $
Processing allocation		- $	- $	- $	- $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $
Working capital requirement		- $	- $	- $	- $	3 982 459 $	4 323 551 $	396 465 $	404 395 $
Loan	0%	- $	- $	- $	- $	- $	- $	- $	- $
Interest on loan	10%	- $	- $	- $	- $	- $	- $	- $	- $
Loan Payback			- $	- $	- $	- $	- $	- $	- $
Mining taxes	1%	- $	- $	- $	- $	610 076 $	800 000 $	800 000 $	800 000 $
Mining taxes	4%	- $	- $	- $	- $	- $	287 $	426 992 $	499 532 $
Taxable revenues		- $	- $	(38 079 240) $	(67 433 744) $	(27 979 298) $	(746 950) $	9 984 968 $	18 062 752 $
Operating Margin						-35%	-1%	8%	15%
Provision for losses 5 years		- $	- $	(38 079 240) $	(105 512 983) $	(133 492 281) $	(134 239 231) $	(124 254 263) $	(68 112 272) $
Taxable revenues after provision		- $	- $	- $	- $	- $	- $	- $	- $
Profit margin		0%	0%	0%	0%	0%	0%	9%	16%
Provincial income taxes	16%	- $	- $	- $	- $	- $	- $	- $	- $
Provincial income taxes	22%	- $	- $	- $	- $	- $	- $	- $	- $
Provincial income taxes	28%	- $	- $	- $	- $	- $	- $	- $	- $
Federal income taxes	15%	- $	- $	- $	- $	- $	- $	- $	- $
After taxes profits		- $	- $	- $	- $	45 349 021 $	58 420 283 $	59 239 440 $	60 378 292 $
After taxes and Loan payback profits		- $	- $	- $	- $	45 349 021 $	58 420 283 $	59 239 440 $	60 378 292 $
Residual on investment payback		14 481 000,00 $	33 981 000 $	183 311 351 $	343 226 158 $	347 208 618 $	306 183 147 $	248 159 330 $	189 324 285 $
After Taxe and payback profits		- $	- $	- $	- $	- $	- $	- $	- $
Cumulative net profits		- $	- $	- $	- $	45 349 021 $	103 769 304 $	163 008 744 $	223 387 036 $
Discout rate	10%								
IRR Pre-taxes		**17,46%**							
IRR Post Taxes		**15,42%**							
MIRR		**7,28%**							
DIRR Pre-taxes		**6,78%**							
DIRR Post-taxes		**4,93%**							
NPV Pre-taxes		**1 057 031 629,31 $**		Cash flows with inflation	(343 226 158) $	45 959 098 $	59 220 569 $	60 466 432 $	61 677 824 $
NPV Post-taxes		**813 905 816,75 $**			(343 226 158) $	45 349 021 $	58 420 283 $	59 239 440 $	60 378 292 $
DNPV Pre-taxes		**211 780 826,36 $**		Discounted Cash flows	(343 226 158) $	41 780 998 $	48 942 619 $	45 429 325 $	42 126 783 $
DNPV Post-taxes		**138 687 717,31 $**			(343 226 158) $	41 226 383 $	48 281 225 $	44 507 468 $	41 239 186 $
Communities and social benefits									
Total yearly taxes		- $	- $	- $	- $	1 098 400 $	1 317 563 $	1 763 072 $	1 844 270 $
Wages income taxes		- $	- $	- $	- $	1 973 216 $	2 536 992 $	2 818 880 $	2 818 880 $
Cummulative taxes		- $	- $	- $	- $	3 071 616 $	6 926 171 $	11 508 123 $	16 171 274 $
Overall taxe rates		0%	0%	0%	0%	7%	7%	8%	8%
Wages minus taxes		- $	- $	- $	- $	3 664 544 $	4 711 557 $	5 235 063 $	5 235 063 $

Project year	9	10	11	12	13	14	15	16
Mining year	5	6	7	8	9	10	11	12
Investment (scalable)	- $	- $	- $	- $	- $	- $	- $	- $
Working capital requirement (3 months OPEX)	15 307 293 $	15 613 439 $	15 925 707 $	16 244 222 $	16 569 106 $	16 900 488 $	17 238 498 $	17 583 268 $
Investment+Working capital addition	412 483 $	420 732 $	429 147 $	437 730 $	446 484 $	455 414 $	464 522 $	473 813 $
Total investment	358 533 451 $	358 839 597 $	359 151 866 $	359 470 380 $	359 795 264 $	360 126 646 $	360 464 656 $	360 809 426 $
Fiscal Depreciated value, 1st January	37 778 631 $	26 445 042 $	18 511 529 $	12 958 070 $	9 070 649 $	6 349 454 $	4 444 618 $	3 111 233 $
Fiscal Depreciated value, 31 December	26 445 042 $	18 511 529 $	12 958 070 $	9 070 649 $	6 349 454 $	4 444 618 $	3 111 233 $	2 177 863 $
Salvage value (scalable)	84 401 113 $	71 740 946 $	60 979 804 $	51 832 833 $	44 057 908 $	37 449 222 $	31 831 839 $	27 057 063 $
Inflation cost	108,2%	110,4%	112,6%	114,9%	117,2%	119,5%	121,9%	124,3%
Inflation Commodity	108,2%	110,4%	112,6%	114,9%	117,2%	119,5%	121,9%	124,3%
Efficiency (Ramping up)	100%	100%	100%	100%	100%	100%	100%	100%
Mined ore, year	3248120	3248120	3248120	3248120	3248120	3248120	3248120	3248120
Mined ore, cummulative	14941353	18189474	21437594	24685714	27933835	31181955	34430075	37678195
Residual resources	84162647	80914526	77666406	74418286	71170165	67922045	64673925	61425805
Pit-Ratio	1,34	1,34	1,34	1,34	1,34	1,34	1,34	1,34
Waste, year	4352481	4352481	4352481	4352481	4352481	4352481	4352481	4352481
Waste, cummulative	20021414	24373895	28726376	33078857	37431338	41783820	46136301	50488782
Mined total, yearly	7600602	7600602	7600602	7600602	7600602	7600602	7600602	7600602
Mined total, cummulative	34962767	42563368	50163970	57764571	65365173	72965774	80566376	88166977
VTM production, yearly	864000	864000	864000	864000	864000	864000	864000	864000
VTM production, cummulative	3974400	4838400	5702400	6566400	7430400	8294400	9158400	10022400
OPEX Mine (scalable)	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $
Opex Mill + Transport (Scalable)	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $
OPEX Mill + Transport (non-scalable)	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $
Power (not-discounted)	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $
Power (Discounted)	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $
Total OPEX	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $
Opex mine with inflation (for mining taxes)	30 358 130 $	30 965 293 $	31 584 598 $	32 216 290 $	32 860 616 $	33 517 829 $	34 188 185 $	34 871 949 $
Total OPEX with inflation	61 229 171 $	62 453 754 $	63 702 830 $	64 976 886 $	66 276 424 $	67 601 952 $	68 953 991 $	70 333 071 $
Environment taxes, tailing (per tons)	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $
Environment taxes, contaminant (/t)	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $
Municipal + school taxes	450 417 $	459 426 $	468 614 $	477 986 $	487 546 $	497 297 $	507 243 $	517 388 $
Water taxes (cubic meter water)	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $
Carbon taxes								
Native royalties	- $	- $	- $	- $	- $	- $	- $	- $
Revenus	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $
Revenus factored for inflation	124 696 185 $	127 190 109 $	129 733 911 $	132 328 589 $	134 975 161 $	137 674 664 $	140 428 157 $	143 236 720 $
EBITDA	62 913 443 $	64 173 775 $	65 459 314 $	66 770 563 $	68 108 037 $	69 472 261 $	70 863 769 $	72 283 108 $
EBITDA/CAPEX	17,55%	17,88%	18,23%	18,57%	18,93%	19,29%	19,66%	20,03%
Depreciation allocation	11 333 589 $	7 933 512 $	5 553 459 $	3 887 421 $	2 721 195 $	1 904 836 $	1 333 385 $	933 370 $
Processing allocation	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $
Working capital requirement	412 483 $	420 732 $	429 147 $	437 730 $	446 484 $	455 414 $	464 522 $	473 813 $
Loan	- $	- $	- $	- $	- $	- $	- $	- $
Interest on loan	- $	- $	- $	- $	- $	- $	- $	- $
Loan Payback	- $	- $	- $	- $	- $	- $	- $	- $
Mining taxes (1%)	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $
Mining taxes (4%)	573 522 $	648 993 $	725 972 $	804 492 $	884 582 $	966 273 $	1 049 599 $	1 134 591 $
Taxable revenues	24 081 633 $	28 666 571 $	32 255 184 $	35 153 951 $	37 577 562 $	39 676 453 $	41 556 087 $	43 290 449 $
Operating Margin	19%	23%	25%	27%	28%	29%	30%	30%
Provision for losses 5 years	- $	- $	- $	- $	- $	- $	- $	- $
Taxable revenues after provision	- $	28 666 571 $	32 255 184 $	35 153 951 $	37 577 562 $	39 676 453 $	41 556 087 $	43 290 449 $
Profit margin	21%	25%	28%	31%	33%	34%	36%	38%
Provincial income taxes (16%)	- $	4 586 651 $	5 160 829 $	5 624 632 $	6 012 410 $	6 348 232 $	6 648 974 $	6 926 472 $
Provincial income taxes (22%)	- $	- $	- $	- $	- $	- $	26 754 $	66 975 $
Provincial income taxes (28%)	- $	- $	- $	- $	- $	- $	- $	- $
Federal income taxes (15%)	- $	4 299 986 $	4 838 278 $	5 273 093 $	5 636 634 $	5 951 468 $	6 233 413 $	6 493 567 $
After taxes profits	61 539 921 $	53 838 145 $	53 934 234 $	54 268 346 $	54 774 411 $	55 406 287 $	56 105 030 $	56 861 503 $
After taxes and Loan payback profits	61 539 921 $	53 838 145 $	53 934 234 $	54 268 346 $	54 774 411 $	55 406 287 $	56 105 030 $	56 861 503 $
Residual on investment payback	129 358 475 $	68 239 286 $	14 830 288 $	- $	- $	- $	- $	- $
After Taxe and payback profits	- $	- $	39 103 946,32 $	54 268 346,15 $	54 774 411,28 $	55 406 287,37 $	56 105 030,14 $	56 861 502,94 $
Cumulative net profits	284 926 957 $	338 765 103 $	392 699 337 $	446 967 683 $	501 742 094 $	557 148 382 $	613 253 412 $	670 114 915 $
NPV Pre-taxes (cash flows with inflation)	62 913 443 $	64 173 775 $	65 459 314 $	66 770 563 $	68 108 037 $	69 472 261 $	70 863 769 $	72 283 108 $
NPV Post-taxes (cash flows with inflation)	61 539 921 $	53 838 145 $	53 934 234 $	54 268 346 $	54 774 411 $	55 406 287 $	56 105 030 $	56 861 503 $
DNPV Pre-taxes (discounted cash flows)	39 064 298 $	36 224 423 $	33 590 978 $	31 148 960 $	28 884 456 $	26 784 564 $	24 837 319 $	23 031 626 $
DNPV Post-taxes (discounted cash flows)	38 211 449 $	30 390 229 $	27 676 790 $	25 316 584 $	23 229 697 $	21 361 522 $	19 664 471 $	18 117 827 $
Total yearly taxes	1 927 093 $	10 898 209 $	12 096 847 $	13 083 357 $	13 924 326 $	14 666 424 $	15 369 136 $	16 042 146 $
Wages income taxes	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $
Cummulative taxes	20 917 247 $	34 634 336 $	49 550 063 $	65 452 300 $	82 195 506 $	99 680 810 $	117 868 826 $	136 729 852 $
Overall taxe rates	8%	21%	23%	24%	25%	25%	26%	26%
Wages minus taxes	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $

Project year	17	18	19	20	21	22	23	24
Mining year	13	14	15	16	17	18	19	20
Investment (scalable)	- $	- $	- $	- $	- $	- $	- $	- $
Working capital requirement (3 months OPEX)	17 934 933 $	18 293 632 $	18 659 504 $	19 032 695 $	19 413 348 $	19 801 615 $	20 197 648 $	20 601 601 $
Investment+Working capital addition	483 289 $	492 955 $	502 814 $	512 870 $	523 128 $	533 590 $	544 262 $	(27 757 361) $
Total investment	361 161 092 $	361 519 790 $	361 885 663 $	362 258 853 $	362 639 507 $	363 027 774 $	363 423 806 $	363 827 759 $
Fiscal Depreciated value, 1st January	2 177 863 $	1 524 504 $	1 067 153 $	747 007 $	522 905 $	366 033 $	256 223 $	179 356 $
Fiscal Depreciated value, 31 December	1 524 504 $	1 067 153 $	747 007 $	522 905 $	366 033 $	256 223 $	179 356 $	125 549 $
Salvage value (scalable)	22 998 504 $	19 548 728 $	16 616 419 $	14 123 956 $	12 005 363 $	10 204 558 $	8 673 874 $	7 372 793 $
Inflation cost	126,8%	129,4%	131,9%	134,6%	137,3%	140,0%	142,8%	145,7%
Inflation Commodity	126,8%	129,4%	131,9%	134,6%	137,3%	140,0%	142,8%	145,7%
Efficiency (Ramping up)	100%	100%	100%	100%	100%	100%	100%	100%
Mined ore, year	3248120	3248120	3248120	3248120	3248120	3248120	3248120	3248120
Mined ore, cummulative	40926316	44174436	47422556	50670677	53918797	57166917	60415038	63663158
Residual resources	58177684	54929564	51681444	48433323	45185203	41937083	38688962	35440842
Pit-Ratio	1,34	1,34	1,34	1,34	1,34	1,34	1,34	1,34
Waste, year	4352481	4352481	4352481	4352481	4352481	4352481	4352481	4352481
Waste, cummulative	54841263	59193744	63546226	67898707	72251188	76603669	80956150	85308632
Mined total, yearly	7600602	7600602	7600602	7600602	7600602	7600602	7600602	7600602
Mined total, cummulative	95767579	103368180	110968782	118569383	126169985	133770586	141371188	148971789
VTM production, yearly	864000	864000	864000	864000	864000	864000	864000	864000
VTM production, cummulative	10886400	11750400	12614400	13478400	14342400	15206400	16070400	16934400
OPEX Mine (scalable)	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $	28 046 220 $
Opex Mill + Transport (Scalable)	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $	2 503 882 $
OPEX Mill + Transport (non-scalable)	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $	18 296 440 $
Power (not-discounted)	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $
Power (Discounted)	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $	7 719 748 $
Total OPEX	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $	56 566 290 $
Opex mine with inflation (for mining taxes)	35 569 388 $	36 280 776 $	37 006 391 $	37 746 519 $	38 501 449 $	39 271 478 $	40 056 908 $	40 858 046 $
Total OPEX with inflation	71 739 733 $	73 174 527 $	74 638 018 $	76 130 778 $	77 653 394 $	79 206 462 $	80 790 591 $	82 406 403 $
Environment taxes, tailing (per tons)	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $	84 208 $
Environment taxes, contaminant (/t)	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $	15 201 $
Municipal + school taxes	527 736 $	538 290 $	549 056 $	560 037 $	571 238 $	582 663 $	594 316 $	606 202 $
Water taxes (cubic meter water)	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $	3 745 $
Carbon taxes								
Native royalties	- $	- $	- $	- $	- $	- $	- $	- $
Revenus	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $	115 200 000 $
Revenus factored for inflation	146 101 455 $	149 023 484 $	152 003 954 $	155 044 033 $	158 144 913 $	161 307 811 $	164 533 968 $	167 824 647 $
EBITDA	73 730 833 $	75 207 513 $	76 713 726 $	78 250 064 $	79 817 128 $	81 415 534 $	83 045 907 $	84 708 889 $
EBITDA/CAPEX	20,41%	20,80%	21,20%	21,60%	22,01%	22,43%	22,85%	23,28%
Depreciation allocation	653 359 $	457 351 $	320 146 $	224 102 $	156 871 $	109 810 $	76 867 $	53 807 $
Processing allocation	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $	26 124 699 $
Working capital requirement	483 289 $	492 955 $	502 814 $	512 870 $	523 128 $	533 590 $	544 262 $	(27 757 361) $
Loan	- $	- $	- $	- $	- $	- $	- $	- $
Interest on loan	- $	- $	- $	- $	- $	- $	- $	- $
Loan Payback	- $	- $	- $	- $	- $	- $	- $	- $
Mining taxes (1%)	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $	800 000 $
Mining taxes (4%)	1 221 283 $	1 309 708 $	1 399 902 $	1 491 901 $	1 585 739 $	1 681 453 $	1 779 082 $	1 878 664 $
Taxable revenues	44 931 493 $	46 515 755 $	48 068 979 $	49 609 363 $	51 149 819 $	52 699 572 $	54 265 259 $	55 851 719 $
Operating Margin	31%	31%	32%	32%	32%	33%	33%	33%
Provision for losses 5 years	- $	- $	- $	- $	- $	- $	- $	- $
Taxable revenues after provision	44 931 493 $	46 515 755 $	48 068 979 $	49 609 363 $	51 149 819 $	52 699 572 $	54 265 259 $	55 851 719 $
Profit margin	39%	40%	42%	43%	44%	46%	47%	48%
Provincial income taxes (16%)	7 189 039 $	7 442 521 $	7 691 037 $	7 937 498 $	8 183 971 $	8 431 931 $	8 682 442 $	8 936 275 $
Provincial income taxes (22%)	107 917 $	150 104 $	194 003 $	240 020 $	288 512 $	339 791 $	394 137 $	451 809 $
Provincial income taxes (28%)	- $	- $	- $	- $	- $	- $	- $	- $
Federal income taxes (15%)	6 739 724 $	6 977 363 $	7 210 347 $	7 441 404 $	7 672 473 $	7 904 936 $	8 139 789 $	8 377 758 $
After taxes profits	57 672 870 $	58 527 816 $	59 418 437 $	60 339 240 $	61 286 433 $	62 257 422 $	63 250 458 $	64 264 383 $
After taxes and Loan payback profits	57 672 870 $	58 527 816 $	59 418 437 $	60 339 240 $	61 286 433 $	62 257 422 $	63 250 458 $	64 264 383 $
Residual on investment payback	- $	- $	- $	- $	- $	- $	- $	- $
After Taxe and payback profits	57 672 870,30 $	58 527 816,29 $	59 418 437,24 $	60 339 240,34 $	61 286 433,37 $	62 257 422,47 $	63 250 457,61 $	64 264 382,76 $
Cumulative net profits	727 787 785 $	786 315 601 $	845 734 039 $	906 073 279 $	967 359 712 $	1 029 617 135 $	1 092 867 592 $	1 157 131 975 $
NPV Pre-taxes (cash flows with inflation)	73 730 833 $	75 207 513 $	76 713 726 $	78 250 064 $	79 817 128 $	81 415 534 $	83 045 907 $	84 708 889 $
NPV Post-taxes (cash flows with inflation)	57 672 870 $	58 527 816 $	59 418 437 $	60 339 240 $	61 286 433 $	62 257 422 $	63 250 458 $	64 264 383 $
DNPV Pre-taxes (discounted cash flows)	21 357 196 $	19 804 489 $	18 364 656 $	17 029 494 $	15 791 393 $	14 643 299 $	13 578 669 $	12 591 437 $
DNPV Post-taxes (discounted cash flows)	16 705 776 $	15 412 203 $	14 224 301 $	13 131 577 $	12 125 194 $	11 197 545 $	10 341 955 $	9 552 491 $
Total yearly taxes	16 688 852 $	17 321 140 $	17 947 498 $	18 574 014 $	19 205 086 $	19 843 927 $	20 492 919 $	21 153 862 $
Wages income taxes	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $	2 818 880 $
Cummulative taxes	156 237 584 $	176 377 604 $	197 143 983 $	218 536 877 $	240 560 844 $	263 223 651 $	286 535 451 $	310 508 192 $
Overall taxe rates	26%	27%	27%	27%	28%	28%	28%	28%
Wages minus taxes	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $	5 235 063 $

Preproduction expenses, including all required studies and engineering as well as construction span over a 4 year period and are included in total investments.

Production efficiency (ramping-up) was estimated at 70% for the first year, 90% the second year, and 100% subsequently. Mining and milling rates were balanced according to production rates, affecting the VTM production, the power consumption and trucking cost, but not affecting the other milling and operating costs.

Waste mining is assumed as reflecting an overall pit ratio of 1.34 the first year, which would be maintained constant throughout the mine life. The first author is fully aware that such scenario is unlikely, and that waste removal would be reduced for approximately the first 5 years, and increased significantly in the last five years. However, elaborating a detailed mining plan is meaningless until measured and indicated resources are made available.

The salvage value is the value that can be recovered by selling equipment and scrap, to be added to cash-flows at the end of the operation, and calculated yearly. Recoverable equipment and vehicles were depreciated by 50% the first year, buildings were depreciated to 30%, and scrap metals to 10%. No salvage value is indicated for infrastructure such as the tailing pond, the road, the power line, etc. A yearly depreciation of 15% is applied to subsequent years of operation, down to the scrap value. Depreciation rates for the calculation of salvage value are different than the fiscal depreciation, and not to be confused.

Working capital is included to allow operating from the moment the rock is mined until VTM is sold and paid by the consumer. This working capital is calculated as the operating cost for a period of 3 months, allowing inflation and efficiency. Working capital has to be borrowed for the first year of production, and subsequent increases taken from generated revenues. Since this capital returns back to the cash-flow, it does not need to be added to initial capital expenditures.

Operating costs for mining and milling were calculated independently. Operating costs were further divided into scalable and non-scalable costs. Scalable costs are those which are affected by the 0.6 power rule for scaling costs (such as manpower requirement and equipment purchase cost), while non-scalable costs are those which are a linear function of the throughput, not affected by economies of scale, such as trucking and power consumption.

Inflation was applied to the operating costs, including wages and consumables. It has not been applied to VTM selling price, since such variation would induce taxation issues complex to forecast. This is based on historical trends where wages, equipment and service prices increase over time, while the commodity prices increase at much lower rates over the same period.

Power costs have been discounted to $0 against the purchased of the power line by Hydro-Québec until the line is paid back, or about 20 months.

TAXES

It is clearly stated in National Instrument 43-101 that all economic models have to be calculated and disclosed on a post-tax basis, meaning that the effect of all taxes to be paid have to be taken into account to disclose the internal rate of return (*IRR*) and net present value *(NPV*). Obviously, taxes are taken against revenues and therefore reduce profitability. However, the various types of taxes are calculated in different manners. Their effects on projected cash-flows are complex and require thorough modelling. Overall, aside from reducing profitability, taxes act as buffers against fluctuations on revenues, smoothing the yearly cash-flows.

Six types of taxes apply to mining projects in Québec, each of which with a different calculation. Sales taxes (PST+GST) as well as income taxes and social benefits paid by workers were not included in the model.

- First Nation royalties: No such royalties or other voluntary payment to First Nations or local communities was included in the economic model. It is common knowledge that some mining operations made agreements with First Nations in order to accelerate permitting. However, these agreements are typically confidential (even to government), and cannot therefore be taken into account in the current model. To the author's knowledge, although such information cannot be officially verified, payments to First Nations are calculated as between 6% to 8% of the net pre-tax income, and should thus be considered as an income tax, not as a royalties as usually claimed. These agreements do not include the other benefits which might be required such as preferential employment or business opportunities.
- Various types of environmental taxes, imposed by the provincial government, are to be included in operating costs, and directly deducted from revenues.
    - Tailings: A $25 per 1000 tonnes of tails taxes, factored by 0.5 since it is not acid generating. Costs were calculated yearly based on tonnage of tailings.
    - Effluent: A tax is applicable on effluents contained in water. Since nearly all water is to be recycled, no such cost is included.

  - Dust: A tax of $2 per tonne of dust released into the atmosphere is payable. Dust has been estimated at 0.1% of the overall mined tonnage.
  - Water: A royalty of 0.07$ per cubic metre of fresh water is payable. It is estimated that 10% of the water used by the operation is to be lost by evaporation or seepage at the tail and finishing pond, plus the water evaporated by drying (8% of VTM tonnage).
  - Carbon: No carbon tax was factored in, the cost of which not being known.
- Municipal and school taxes: Annual municipal and school taxes are indicated as 2.67% of the buildings and other non-production related equipment. The tax was calculated on building construction cost, indexed for inflation.

Environmental taxes and royalties, and municipal taxes are to be considered as operating costs, not related to profits, and thus subtracted from revenues to calculate earnings before interest, taxes, debt and amortization (*EBITDA*).

If a loan was procured for capital expenditures, interest on the loan must be subtracted from revenues to calculate *EBITDA*. The loan itself needs to be paid from net revenues after amortization. Payback period is relevant only on scenarios where a loan is indicated in the model.

- In Québec, a mining tax, a kind of hybrid between an income tax and a royalty, is to be paid, based on the "*valeur à la tête du puits*", or the value produced at the mine. This tax is of 1% of the revenues minus the mining cost (excluding CMB cost). This tax increases to 4% for values above $80 million in revenues. It is calculated after *EBITDA.*
- A 30% fiscal depreciation is allowed yearly, both by provincial and federal income taxes. It is based on amortized construction costs, including half rate (15%) for the first year. This allocation is to be reduced from taxable revenues.
- A processing allocation is further allocated by the provincial government, calculated at 20% of the mill construction costs, not amortized, not actualized for inflation. This allocation is applicable only if extractive metallurgy is conducted in Québec, thus if the hydro-electrometallurgy plant is constructed in Québec. was assumed as applicable and payable in the current model.
- Income taxes, both provincial and federal, are calculated on earnings after mining tax, interest, fiscal amortization and accumulated operating losses. Operating losses (negative cash-flows) are applicable up to five years retroactively, but not proactively. A provision for 5 years losses is included in the model.

- The provincial income tax rate is progressive based on profit margins. It stands at 16% for profit margin below 35%, at 22% for profit margins between 35% and 50%, and at 28% for a profit margin above 50%.
  - The profit margin is defined as the ratio between taxable revenues and gross revenues.
  - Taxable revenues are defined as net revenues minus mining taxes, royalties and allocations.
- The federal income tax is fixed at 15% of the profits minus mining taxes and allocation, but before provincial income tax.

After-taxes profits are calculated as revenues minus all operating costs, amortization and taxes. After-taxes and after-loan payback are calculated, although not relevant to equity financing. Payback time was calculated, as comparative only, at 5 years and 6 months after construction approximately.

The ratio of *EBITDA* versus total investment is calculated at 18.96% for the first year that efficiency reaches 100%, and increases subsequently with inflation.

ECONOMIC PARAMETERS

The cash-flow model takes into account the following economic parameters:

- Inflation: A 2% yearly inflation rate is included, in accordance to the general target of the Bank of Canada. Inflation was applied to most cost of operations, but not to the revenues, since sectorial inflation on commodities is almost nil for the last 20 years. The overall effect of inflation is to decrease profitability. It is to be noted that inflation is usually not taken into into account for IRR and NPV calculation. However, since inflation has significant impact on taxation, it has to be factored in. Since commodities has typically an inflation rate lower than costs of industrial goods and manpower, different inflation rates can be applied to the model.
- Currency exchange: Cash-flows are calculated and expressed in Canadian dollars. Equipment or consumables purchased outside of Canada were quoted in American dollars, as well as VTM selling prices, and converted to Canadian dollars, using 0.75 US$ to 1.00CND$ exchange rate.
- Equity-debt ratio: The equity-debt ratio represents the ratio between the capital provided by equity financing and bank loans. The effect of loans is complex, causing a decrease in required capital to be included in the cash-flow model, but also causing a decrease in revenue due to interest payments and loan payback. The current cash-flow model involves no debt financing, meaning that the total capital requirement was used for IRR and NPV calculations. The equity-debt ratio to be used to finance construction is the sole prerogative of the client.

- Discounts on cash-flows, to be considered for IRR and NPV, represent the excess compared to the IRR and NPV made from a similar capital vested in a more secure investment, and should be regarded as the premium on risk for the project. A 10% discount rate was used, considering the intrinsic risk of the project.

CASH FLOWS

Cash flows generated by the project were calculated through time (***figure 40***).

- Years 1 to 4 relate to construction, while production is the subsequent 20 years.
- Investments include the initial pre-construction and construction cost (years 1 to 4), plus yearly additions required as working capital. Negative investment at closure relates to salvage value.
- Operating costs are combined mining, milling, trucking and administrative costs. Progressive increases in costs in years 5 to 7 relate to fixed per-tons item affected by the increased efficiency (throughput).
- EBITDA represents net earnings before interest, taxes, debt and amortization.
- After tax profits represent net earnings once taxes and interest are paid, but excluding capital payback.
- Taxes are the sum of all federal, provincial, municipal, mining and environmental taxes. Income tax payments start once the investment is paid back, at year 10.
- After payback profits are the net earnings once the initial investment (equity plus debt) was paid, and represents when investors start earning revenues.

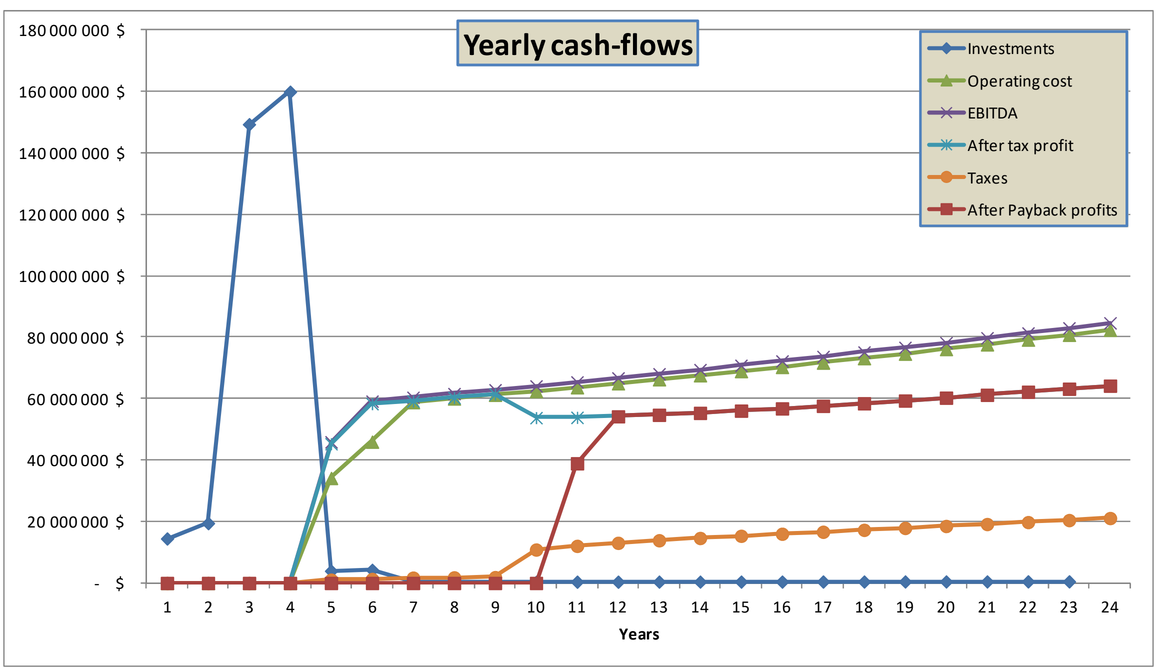


***Figure 40**: Evolutions of cash-flows though the project life time. Investments are concluded on year 6. The jigs at year ten (or year six of production) represent when the total investment is paid back, and the moment when the project starts generating revenues for investors (red line). Convergence of operating costs (green) and EBITDA (purple) is fortuitous, while convergence of after-tax profits (light blue) and after payback profits (red) are intrinsic.*

RETURN ON INVESTMENT

The internal rate of return (IRR), or *Return on investment*, is the discount rate at which the net present value of all the cash flows (both positive and negative) from a project or investment equal zero. Identical results were obtained while calculated using detailed calculations as well as Excel' imbedded formula. The reader will notice that IRR is sensitive not only to revenues and expenses, but also to the time function related to these cash flows[3].

$$\sum_{n=0}^{N} \frac{C_n}{(1+r)^n}=0$$

C_n: Cash flows over year "n"	n: Current year
r: IRR	N: Total number of years

The net present value (NPV) of the project is the sum of all expenses and revenues generated through the life of the project. It relates to IRR by the following formula:

	IRR	*NPV*
Pre-taxes:	*17.46%*	*$1 057 million*
Post-taxes:	*15.42%*	*$814 million*

The discounted internal rate of return (DIRR) and the discounted net present value (DNPV) are based on discounted cash flows, the discount being an arbitrary rate assumed to represent the return rate that a risk-free investment would generate. This takes into account the time-value of the money, meaning it removes from the generated cash flows the amount of cash flow a similar investment would have generated if invested in a guaranteed loan. Otherwise stated, the DNPV and DIRR represent the cash flows that the project would generate in excess to compensate for the inherent risk. The model used a discount rate of 10%, or 5% above interest on household mortgage in a Canadian Bank, which is typical for mining projects.

[3] The time function affecting the *IRR* makes it deviate from the simple ratio between yearly profits and capital investment.

10% discount	*DIRR*	*DNPV*
Pre-taxes:	*6.78%*	*$212 million*
Post-taxes:	*4.92%*	*$139 million*

The modified internal rate of return (MIRR) is the rate of return calculated accounting for the cost of capital (interest on loan from the bank for a similar investment) and the interest that the capital would have generated if leased to a bank. At current low interest rates, it approximates the DIRR.

Post-taxes MIRR: 7.28%

FINANCIAL BENEFITS TO SOCIETY

From the cash-flow model, financial benefits to society in general and the local communities can be approximated (***table 30***). These figures, seldom released, are significant in regard of the social acceptability issue. Although approximate, sum of direct and indirect payments to communities and governments is similar to NPV, for a total of $697 million over the mining life (***figure 41***).

Direct payments to the federal government include only the income tax ($117 million). Excise tax on fuel is dominated by trucking costs and included herein. Indirect payment is dominated by worker’s income tax and GST (14% of income approximately, $27.8 million).

Direct payments to the provincial government include the income tax ($131 million), the mining tax ($42 million) and the environment taxes ($1.5 million). Indirect payments include worker’s income taxes and PST (24% of income approximately, $47.7 million), as well as Hydro-Québec’s dividends (30% of payment, according to a pro-rata of their last annual report, $42 million).

Direct payments to the local community are limited to municipal taxes ($10 million). However, indirect payments to the local community include the net wages of the worker ($129 million), plus a ratio of the value of contracts to local businesses (20% mining for $84 million, 30% trucking for $18 million, 50% maintenance for $42 million).

Direct payments to First Nations communities cannot be evaluated until negotiations are undertaken, while indirect payments are included within other community benefits.

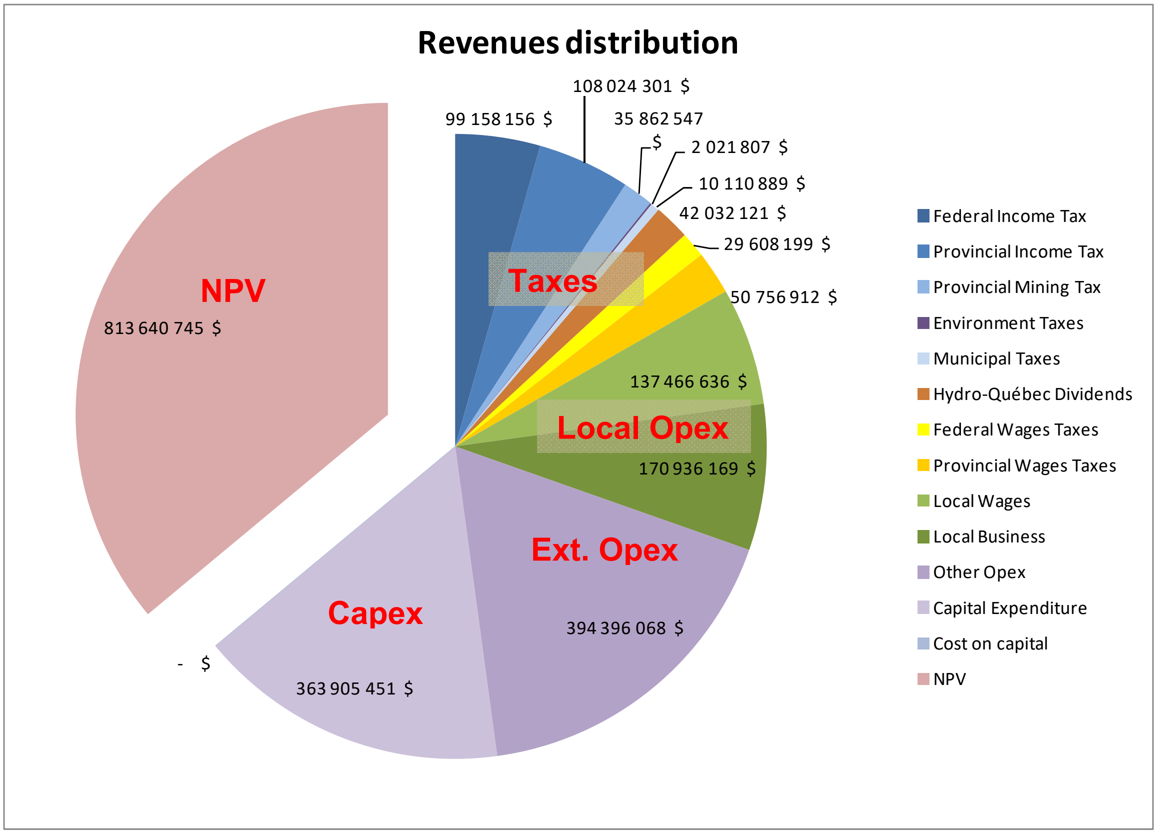


***Figure 41**: Breakdown of revenues over the project life, between the various payments in communities and government, the capital expenditure, the external operational expenses and the expected net profits (NPV). Notice that the sum of payments to government and local communities is similar in amount to the NPV.*

SENSITIVITY ANALYSIS

Economic models are based on the premise that the key variables are properly evaluated and that they will be constant through time, which is not the case. Due to the intricate nature of the variables, their diverse covariance and non-linearity, financial results cannot be simply calculated. Fluctuation of the variables has to be tested one or two at the time to evaluate their sensitivity. By doing such, sensitive variable that can be modified (ex.: Capex, Opex, etc.) can be optimized through subsequent studies. Similarly, resilience of the project to fluctuation of variable out of the control of the operator (such as commodity price or exchange rates) can be evaluated.

Properly evaluating the effect of fluctuation of all variable at once would require a probabilistic or conditional approach (Monte-Carlo simulation), which is out of reach of the present study.

Sensitivity to resources and mining

Due to the lack of systematic and dependable drilling, the resources estimation for the project is currently the weakest parameter of the economic model, and the most likely to be modified, being only categorized as *"**Inferred Resources**"*. Based on the current estimation and current project outline, only 64% of the calculated resources are required. Based on such, pit configuration was reviewed using various maximum depth, and resources models recalculated (***table 21***). Depths of 100, 110 and 120 metres were modeled, where the relation with ratio and resources are not linear (***figure 42***). For the current model, a pit depth of 120 metres with a pit ratio of 1.34 was selected, and economic model calculated accordingly. Inaccuracy in pit ratio would impact on the overall mining cost. To evaluate the effect, the economic model was run using pit ratios from 0.8 (waste/ore) to the original 1.67. Even using the 1.67 pit ratio, considered as a worst case scenario, the IRR remains acceptable, suggesting project resilience to this variable. The effect of pit ratio is further discussed hereafter on the sensitivity analysis on scale.

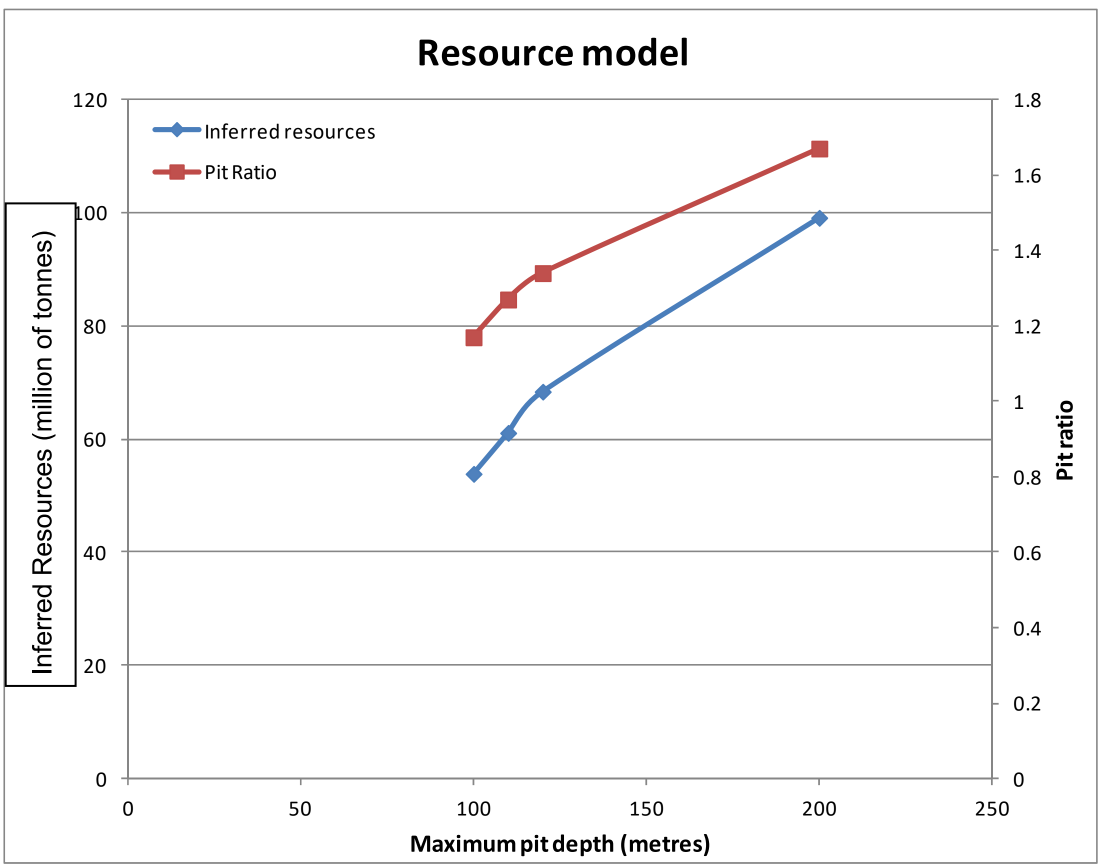


***Figure 42**: Relation between resources available using various maximum pit depth and pit ratio (waste removal/mineralization). Resources have a near linear relation with depth, as expected from mining a slab-shaped body. The 200 metres model, which*

encompasses the entire resources available, deviate from the linear relation since it does not reach the 200 metres depth over the entire pit area. A similar relation is suggested for the relation of pit ratio in regard of maximum depth.

The second impact from uncertainties related to the resources is on overall grade, or VTM abundance (***figure 43***). Average VTM abundance within the current model is nearly not affected by pit depth, oscillating from 26.3% to 26.6%. However, it may change with improvement of resource definition, especially by implementing a more selective mining plant. Also, as stated in Item 13, the currently estimated resource model invokes the cost and revenues of vanadium extraction on top of titanomagnetite production, which will definitively require revision. The effect of more or less selective mining is two fold, in the sense it increases or decreases the pit ratio and thus the amount of waste to be mined, but reduce or increase the amount of feed at the mill. Furthermore, the currently contemplated metallurgical process being less sensitive to vanadium grade in the concentrate, this would enable to tap more resources in the VTM rich vanadium poor P3 Unit, and reduce the amount of VTM poor vanadium rich P0 and P1 Units. The impact of grade variation was modeled from 20% to 35% VTM. This modeling takes into account the variation in mining rate and mill feed, the cost of which was adjusted for scale (see hereafter). Sensitivity analysis suggests that VTM abundance can be reduced down to 23% before that the project IRR drops below 10%. Again, even using the worst case scenario at 20% VTM, the IRR remains acceptable, suggesting project resilience to the fluctuation on grade and pit ratios (black curve on ***figure 43***).

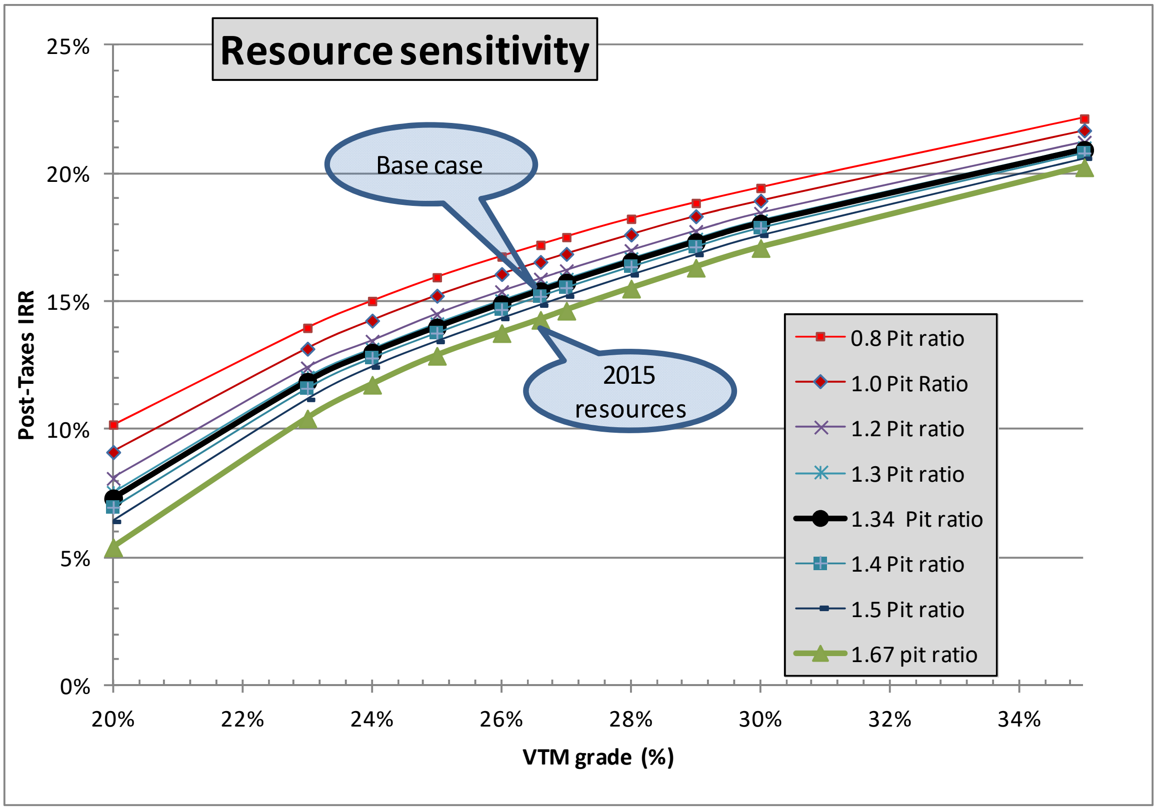


***Figure 43**: Sensitivity of post-tax IRR in regard to resource uncertainties. Fluctuations of either the pit ratio or mined VTM grade do not affect the rate of return below 10% except if VTM abundance drops below 23%, suggesting resilience in this regard.*

Opex and Capex

Cash-flows of the project are impacted by operating cost, both in terms of net earnings and taxation. Mining and milling costs have different non-linear impacts, being related to different volume of material, as well as in regard to taxation rates. For example, mining tax is affected only by mining cost, whereas depreciation is affected only by milling cost. The effect of both mining and milling costs were evaluated separately, using percentage variations between -30% and +30%, although they proved to generate similar impacts on rates of returns (***figure 44***). The worst case scenario, which involves a 30% increase in both mining and milling cost, leads to post-tax IRR of 11.3%, suggesting the economic model is resilient to fluctuation of these parameters.

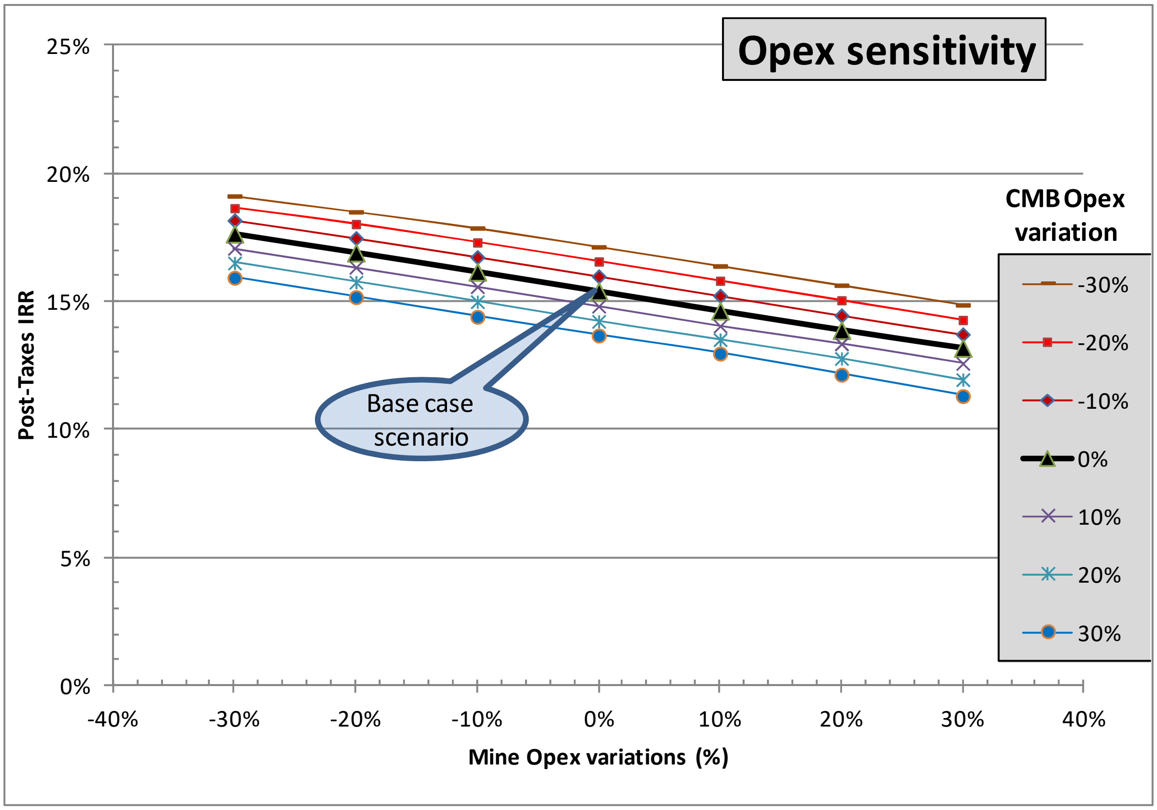


***Figure 44**: Sensitivity of post-tax IRR in regard to operating costs. Mining and milling cost fluctuations, from -30% to +30%, were evaluated separately, and suggest the resilience of the project to fluctuation of operating cost.*

Variations on initial capital expenditures affect directly the IRR, although with some complexities due to the time function caused by fiscal and debt amortization. Effects of capex fluctuations have been modeled from -30% to +50%, and even such extreme scenarios maintain IRR to almost 10%, suggesting the resilience of the project to construction overruns. Combined effect of Capex and Opex, either mining or milling, is presented in ***figure 45***. It can be noted that a ±10% variation in Capex require about an inverse 30% variations in operating cost, either at the mine or the mill, to be compensated. This signifies that, in the course of final engineering of the project, it is more important to work on capex reduction, than operating cost reduction.

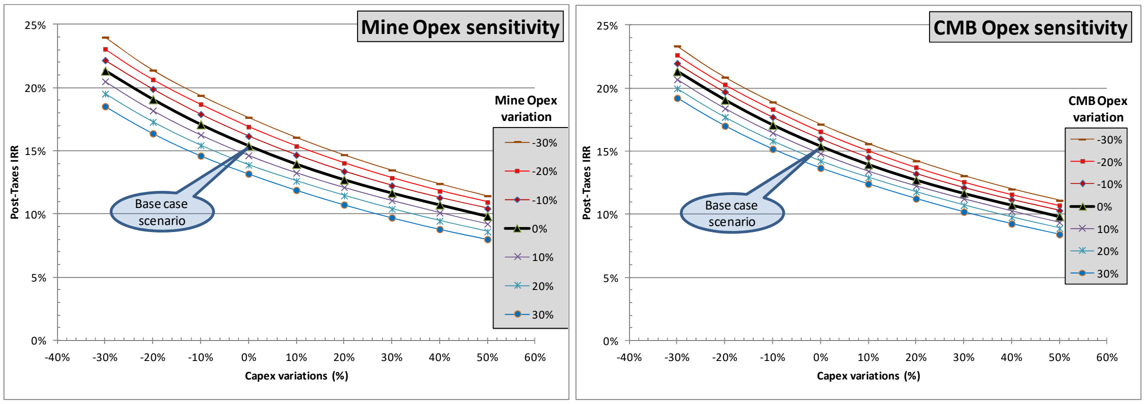


***Figure 45**: Sensitivity of post-tax IRR regarding combined Capex and Opex variations. Notice that the effect of Opex variations on mining and milling are almost similar. Combined worst case cost escalations brings IRR nearing 10%. Note that any Capex variation requires an inverse Opex variation about three times larger to be compensated.*

Market conditions

Market conditions are, by far, the variable having the most dramatic effect on project profitability. The selling price of VTM is currently assumed at typical ilmenite pricing, although it remains uncertain if it could be sold as such to a third party. This price is above the current iron ore price, and conventional steel makers would apply a penalty to use it as feedstock. Effects of VTM prices have been tested from US$50/tonne, an significantly discounted price, to US$150/tonne, an sgnificant premium price (***figure 46**, black line*). According to the model, the project remains viable with a VTM price down to US$80/tonne, where IRR drops to about 8.8%, but investment is hardly justified at lower pricing. Negative cash-flows occur at US$62/tonne, meaning doldrums may be sustainable over short time spans.

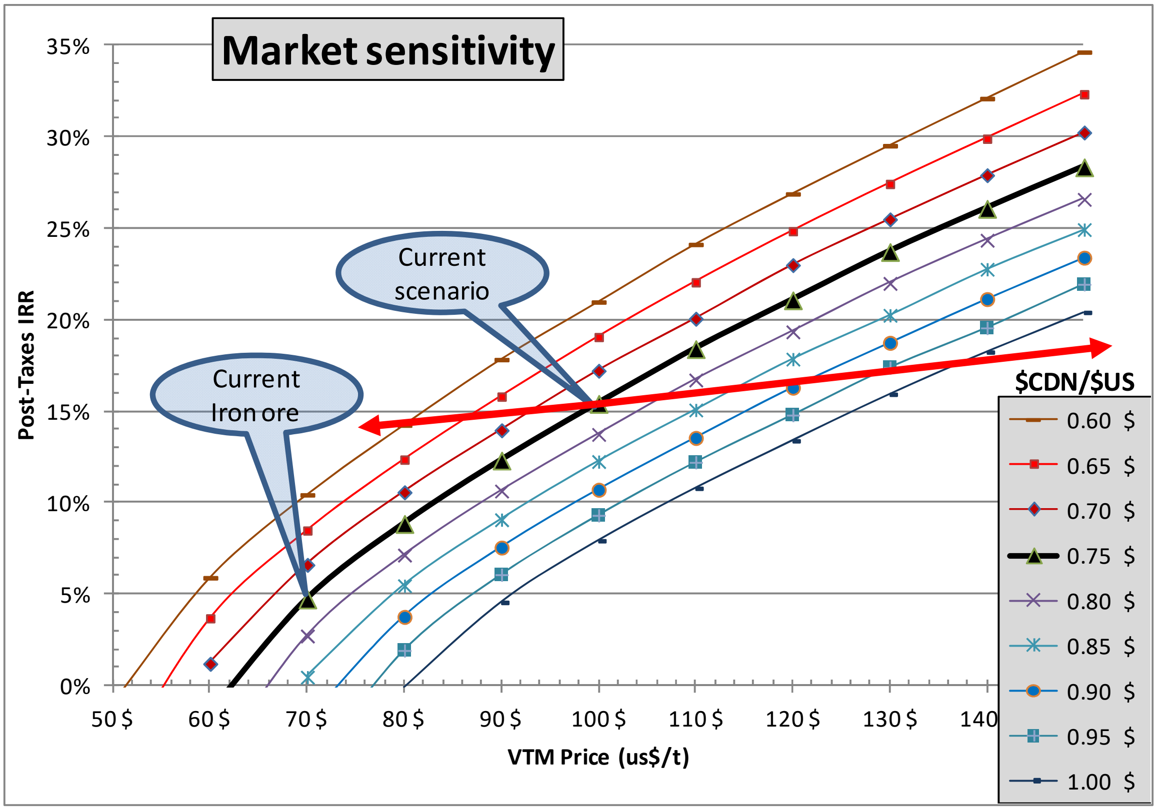


***Figure 46**: Sensitivity of the post-tax IRR against market fluctuation, here including VTM pricing and exchange rates. It is noted that VTM pricing is the most influential parameter on the overall economic model, and that selling prices below US$80 per tonne of VTM may jeopardize its profitability. Covariance between these two parameters dampers their effect, as suggested by the red arrows.*

Most commodities, including VTM, are priced in US dollars, compared to most expenses of the project. The impact of exchange rates between US and Canadian dollars is multifold. A decrease in exchange rates (lower Canadian dollar) implies higher sales revenues compared to operating cost, improving profitability. Some consumables, such as milling media and flocculent, are imported, and thus negatively affected by a low Canadian dollar. At construction, most large pieces of equipment are to be imported, and thus paid in US dollars. A low exchange rate at the time of construction will increase the Capex, and thus reduce profitability. This impact would be constant through time and will not be affected by successive exchange rate fluctuations. Depending on financial structure, required capitals can be either in Canadian or US dollars. If the project is financed on the American market, cost of capital will be negatively impacted by a low exchange rate. The retained scenario is that the project if financed thoroughly in Canadian dollars. Parity between Canadian and US dollars will lower the IRR to approximately 10%, suggesting resilience in regard of such fluctuation. Iron ore prices and CDN/US exchange rates are nearly covariant. Since these two variables counteract each-other in the current economic model, the effect of their fluctuations partly counterbalance each-other, providing some resilience to price variations.

Scale

It is commonly accepted that larger projects have lower production costs and thus, better economics. Modifying the scale of the project would require a complete re-engineering of all key components, from hauling trucks to sag mills to rail spur. Recalculation of construction and operating costs for various throughputs is beyond the reach of the current study. However, escalation of cost with scale can be approximated using the 0.6 power rule, an accepted practice in engineering for preliminary cost estimation.

$$C_s = C_1 S^{0.6}$$

Where C_S is the cost of the project at a specified scale, C_1 is the cost of initial project, and S is the scaling factor. This scaling rule applies to almost every cost related to construction except pre-construction expenses which are scale independent. Scaling of the operating cost is more complex, since some costs are directly related to production such as power consumption, milling media, trucking cost, tail management, and environmental taxes. Inversely, other costs such as mining, manpower, maintenance, management are affected by power rule.

Inferred resources of 99.1 mt were considered as the maximum available, which can sustain a maximum production rate of 155 tonnes of VTM per hour over a period of 20 years. Exceeding this rate would exhaust the resources and reduce project life, which decrease the IRR due to the higher capital requirement. Also, a relation exists between the required resources and the pit ratio, and thus mining cost. A linear regression between resources and pit ratio was calculated from ***table 21*** which provide a rough approximation of the pit ratio to be used for the various scenarios.

$$\text{Pit ratio} = 1.09 \times \text{Resources} \times 10^{-8} + 0.6$$

The effect of scaling the project was computed for both the post-tax IRR and its Capex (***figure 47***). It suggests that IRR reach a maximum of 16.08% for a throughput of 120 tonnes VTM per hours. At a throughput of 150 tph, inferred resources (99.1 mt) are exhausted after 20 years of production, meaning that pit ratio is increase to 1.67 and profitability is reduced accordingly. Increasing the throughput above such level will shorten the mine life, and decrease profitability due to higher capital investment increases. Inversely, reducing throughput at 50 tonnes of VTM per hours reduces IRR at 11.36% while further size reduction makes it uneconomical. Final scale of the project will be dictated by the market, or how much VTM can be sold. This aspect must be addressed by the outcome of the new hydrometallurgy and electrowinning processes currently being developed.

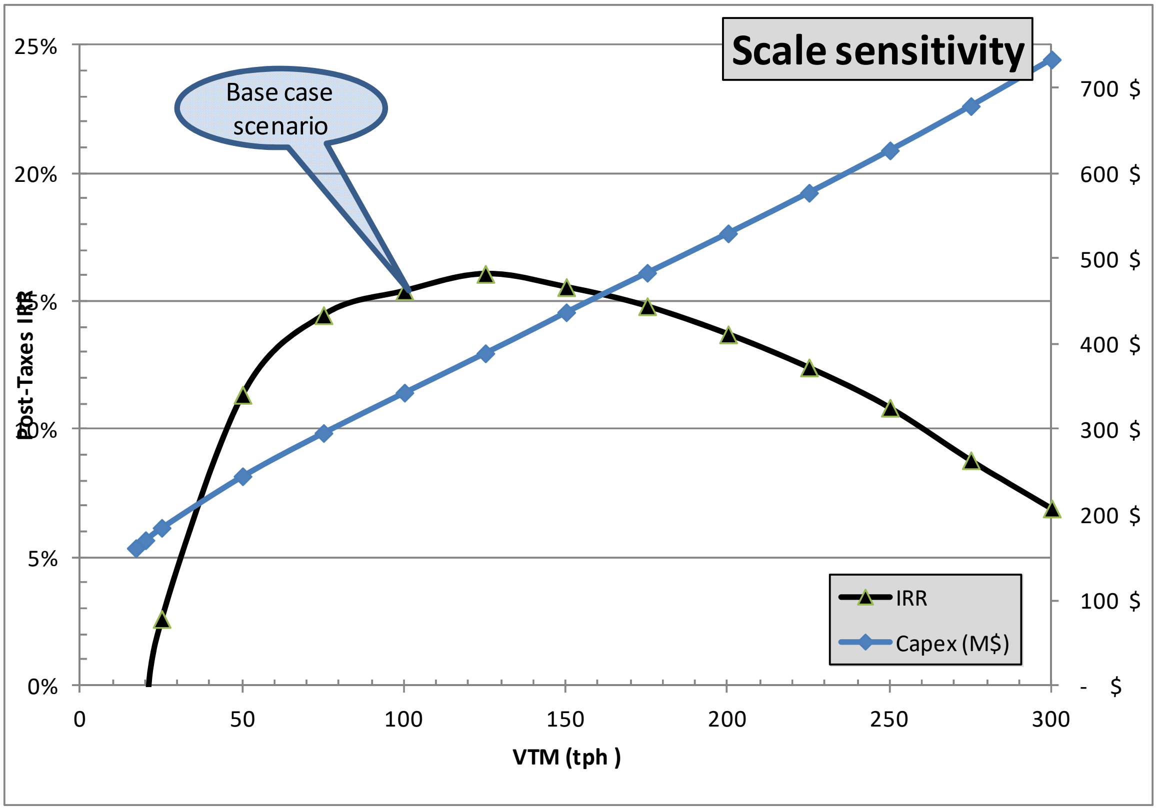


Figure 47*: Sensitivity of the post-tax IRR and capital cost of the project to its size. The model is limited by the currently defined 99.1 mt inferred resources. The best return on investment is modeled at 120 tph VTM, with a rapid decrease with increasing throughput due to waste rock removal and mine life shortening. Downscaling below 50 tph VTM causes non-profitability.*

Equity-debt ratio

Financing of the construction can be either by equity, or through an industrial loan from an investment bank. Loan financing implies no share dilution, but is attached to interest that must be paid in priority, with these payments applied against net earnings. Increasing debt increases the interest burden, up to the point the net revenues do not generate acceptable returns on investment for the equity financing portion. The effect of the equity-debt ratio of the financing is impacted by interest rates being paid. The model indicates that interest rates above 15% are negatively impacting the post-tax IRR, and that such impact starts being significant above 50% debt financing (***figure 48***). Interest rates and availability of capital are to be dictated by market conditions and corporate decisions.

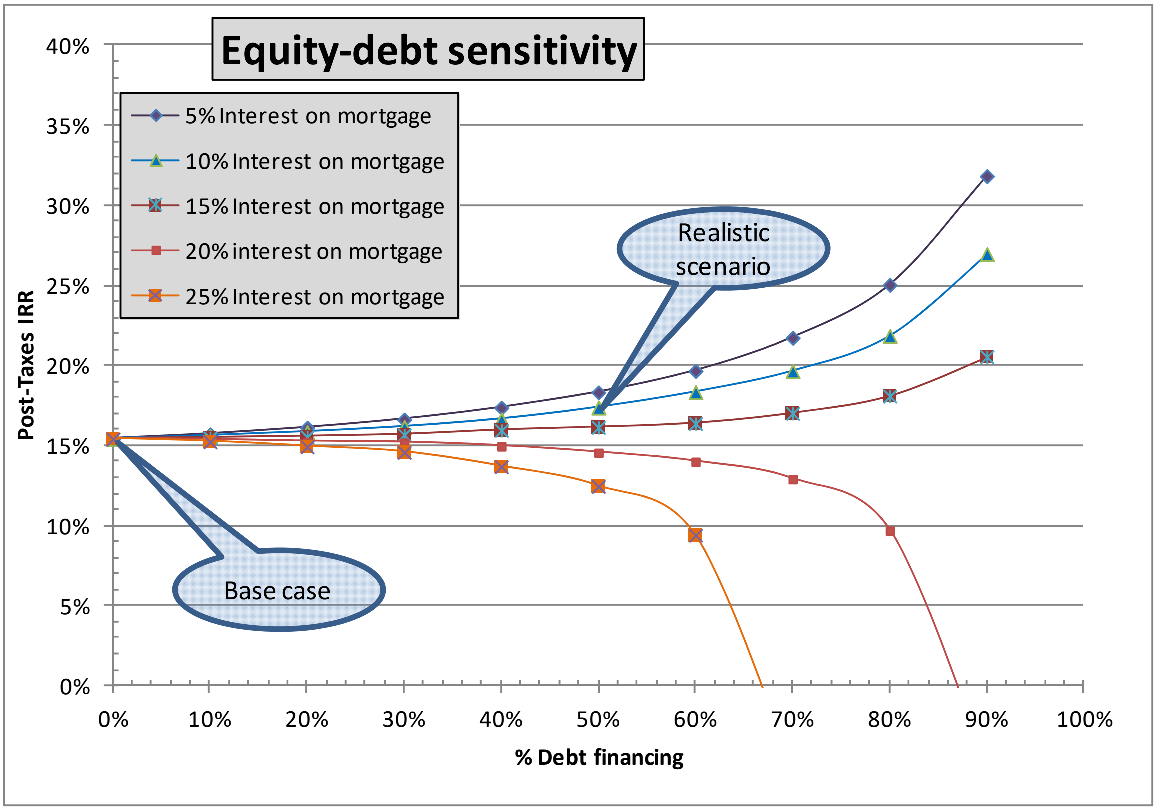


***Figure 48**: Effects of debt financing on the post-tax IRR of the equity financing. The model indicates that debt financing up to 50% has marginal impact on IRR, but that above such threshold the model becomes very sensitive to interest rates. A realistic scenario would be 50% debt financing at 10% interest.*

Discount rate

NPV and IRR are typically stated as discounted, which discounting rate is arbitrary and selected on the inherent risk of the project. A discount of 5% is typically used for industrial projects, 7% for gold mines, 10% for base metal mines, and 12% for industrial mineral such as the current project. Positive cash flows are maintained with discount rates up to 15% for the base case scenario of the current project (***table 31, figure 49***).

Discount	0%	2.5%	5%	7.5%	10%	12.5%	15%
DIRR	15.4%	12.6%	9.9%	7.4%	4.9%	2.6%	0.4%
DNPV ($ million)	814 $	553 $	369 $	237 $	139 $	65 $	8 $

***Table 31**: Calculated internal rate of returns and net present values according to various discounting rates.*

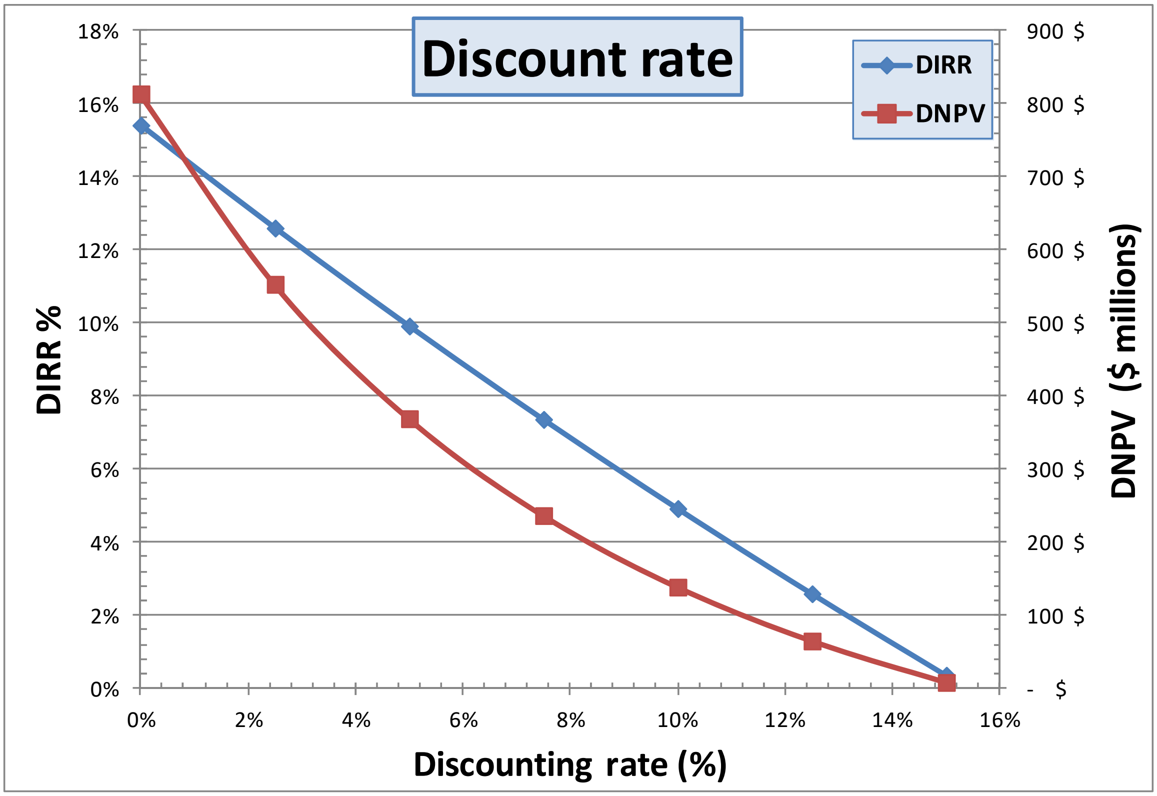


***Figure 49**: Relation between Internal rate of return on investment (IRR), net present value (NPV) versus the discount rate applied to compensate for risk.*

ITEM 23: ADJACENT PROPERTIES

The ***Lac Doré*** and ***Lac Doré North*** properties are located in vicinity of the Chibougamau mining district. The area has experienced intense exploration activity in the past and recurrent waves of staking. VanadiumCorp properties are currently enclaved, and surrounded by various other companies (***figure 50***) except to the north of **Lac Doré North** property.

LAND AVAILABILITY

The area encompassing the 17 kilometres long aeromagnetic anomaly associated with the magnetite layers is currently entirely covered by either VanadiumCorp or BlackRock. VanadiumCorp's **Lac Doré** property is surrounded by BlackRock property, while the **Lac Doré North** is partly enclosed.

PROPERTIES IN CONFLICT

No dispute of claims is currently reported in vicinities of **Lac Doré** and **Lac Doré North** properties.

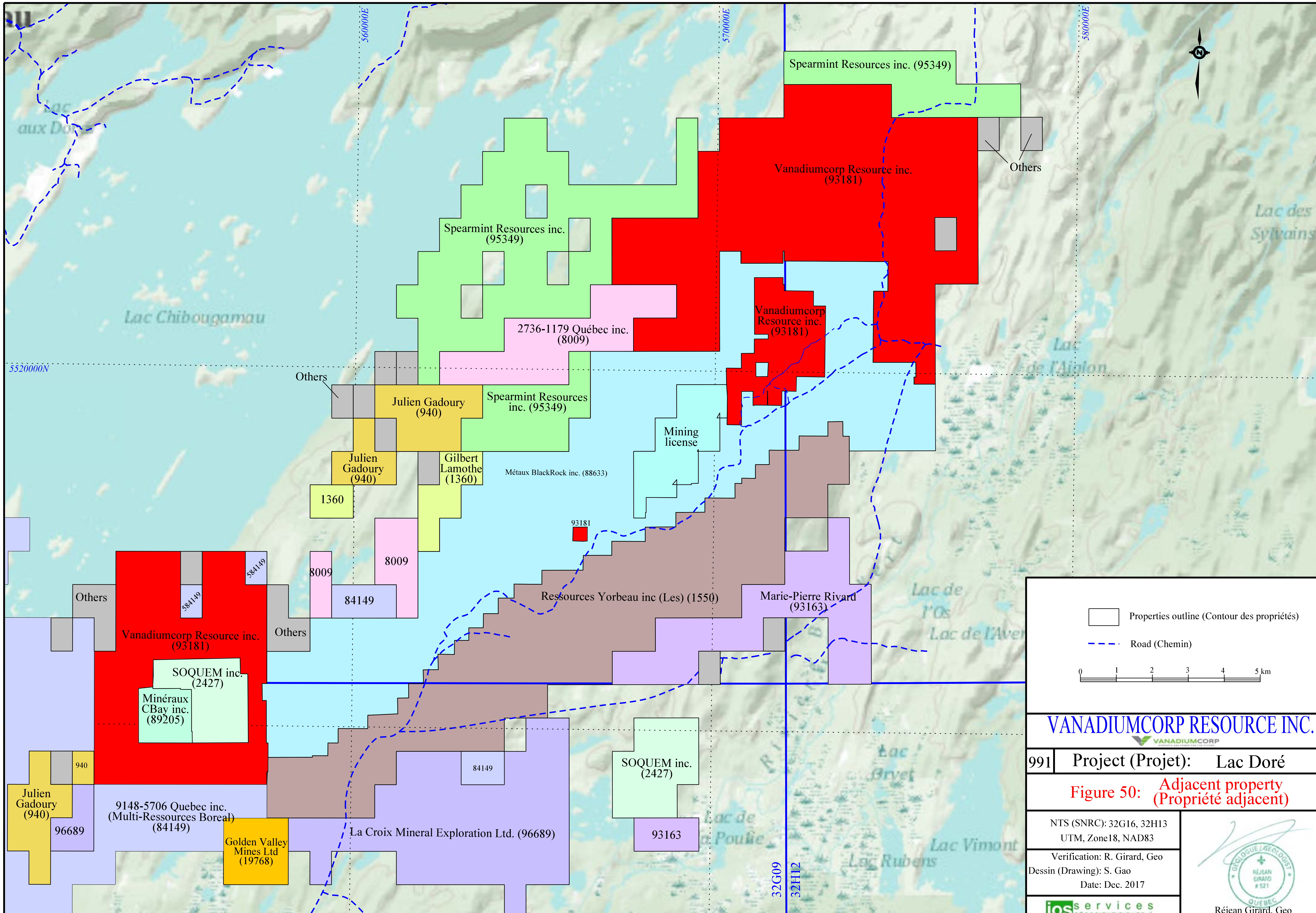
SURROUNDING PROPERTIES

BlackRock Metals Inc.

BlackRock Metals hold 308 map-designated cells, for 52 km^2, covering the Southwest and Armitage Deposits, as well as surrounding lands for exploration or infrastructure. These claims include the area currently in demand of a mining lease (*Renvoi au Ministre #41080,* registered December 2014). Their titles are in good standing and well managed. BlackRock conducted important stripping and drilling efforts in order to estimate resource on the Southwest and Armitage Deposits, and are currently concluding a feasibility study in regard of the construction of a 800,000 tonnes of VTM per year mine complex. Infrastructure construction is currently permitted, pending conclusion of their financing.

A strip of claims to the south of initial BlackRock Metals property, was acquired by BlackRock from Cogitore Resources (Cogitore press release, November 7, 2014).

Work conducted by BlackRock Metals and available in assessment files includes:



VANADIUMCORP RESOURCE INC.

991	Project (Projet): Lac Doré

Figure 50: Adjacent property (Propriété adjacent)

NTS (SNRC): 32G16, 32H13
UTM, Zone18, NAD83

Verification: R. Girard, Geo
Dessin (Drawing): S. Gao
Date: Dec. 2017

ios services géoscientifiques inc.

Réjean Girard, Geo

- The Southwest Deposit was trenched (1638 metres, 2009) and drilled (103 holes for 23,066 metres in 2010-2011-2012).
- The Armitage Deposit was trenched and drilled (81 holes for 18,763 metres (2011-2012).

In May 2012, BlackRock completed a bankable feasibility study (Genivar, 2012) for a plan to produce 3 million tonnes per year of VTM, dedicated to the Chinese steel market. However, being a privately owned company, BlackRock has no obligation to disclose such study, the detail of which was maintained strictly confidential. Detailed resource estimates were not published, although incomplete numbers were disclosed in environmental and social impact studies.

The BlackRock environmental and social assessment study, conducted by Entraco Groupe-Conseil, was published by the *Canadian Environmental Assessment Agency* (Federal Agency) on May 2013 (www.ceaa-acee.gc.ca/050/documents_staticpost/62105/90328/vol1-eng.pdf). It contains limited information regarding the mine and its resources, and is currently the most detailed and reliable description of 2013 version of the project. Descriptions provided in other BlackRock presentations cannot be relied upon.

In 2014, BlackRock Metals announced that the scope of their project was changed to a mine complex with a nominal capacity of 800,000 tonnes of VTM per year, to be shipped to Grande-Anse seaport in Saguenay. A 500,000 tonnes per year smelter dedicated to the production of pig iron and ferrovanadium was announced to be built at this location.

LIMITATIONS ON SIMILARITIES

The mineralization found on *Lac Doré* and *Lac Doré North* properties is a continuation of the mineralization on the adjacent BlackRock Metals properties. However, there is no guarantee that VanadiumCorp deposits are equivalent to BlackRock deposits in regard to the resource and economic viability. Only a thorough feasibility study, including all the various aspects of such a project, will establish the economic viability of the project.

Yorbeau Resources Inc.

Yorbeau Resources Inc., recently acquired the former Cogitore property to the south of BlackRock Metals. Yorbeau is a company dedicated towards base metal exploration, and their presence is not considered as a hindrance. Their property is anchored on the former *Lemoine Mine*, which was a small but rich volcanic massive sulphide deposit. Important exploration efforts were conducted by Cogitore on this property.

Third parties

To the Northeast, North and Northwest, the **Lac Doré North** property is bounded by map designated cells belonging to Spearmint Resources Inc. a corporation unknown to the author. A few cells to the Northeast belong to individual prospectors.

LAND AVAILABLE FOR STAKING

Land is available for staking only to the East of **Lac Doré North** properties.

AVAILABILITY OF INFORMATION

Information regarding the adjacent properties was obtained from the *Gestim* on-line registry of the Natural Resources Ministry. Information regarding exploration work upon these property was obtained from the *Examine* on-line report library available at the *Ministère de l'Énergie et des Ressources naturelles du Québec*.

INDEPENDENCE OF THE AUTHORS

Most of the available information on neighbouring properties was acquired from public domain assessment files, government work, press releases and web sites. The author is independent of the holders and operators of the adjacent properties. However, IOS was involved on the adjacent BlackRock project in 2008 when the company was structured. In the same period, an IOS geologist was hired by Cogitore to work on Lemoine project in 2007-2009 periods.

VALIDATION OF THE INFORMATION

Work conducted by BlackRock and Cogitore on their properties has not been verified by the author.

ITEM 24: OTHER RELEVANT INFORMATION

No other relevant information is available about the project. In the previous reports (Girard 2014, Girard and D'Amours, 2015), an extensive review of the vanadium market was offered, based on a review made by Mr. T. Perles (Perles, 2015). A description of the vanadium-based flow battery was also available. The reader is invited to refer to this review if interested in the topics.

ITEM 25: INTERPRETATION AND CONCLUSION

The current preliminary economic study regarding the extraction of vanadium from Lac Doré titanomagnetite is built upon the development of a proprietary non-conventional electrochemical process. It is the last of a long series of attempts to demonstrate the economic feasibility of extracting vanadium from the Lac Doré magnetite. All historic evaluations, since the early 1960's, failed to generate sufficient return on investment in regard of their inherent risk to justify construction, and an innovative solution was needed.

The conventional route for the extraction of vanadium as primary product is alkali roasting, as currently used at Rhovan in South-Africa and Largo in Brazil only. All other facilities or attempts in the world have failed; Windimurra in Australia being the best known example. The only two operating facilities are running on VTM concentrate that has almost twice the vanadium grade than Lac Doré concentrate. Furthermore, these two facilities are operated in jurisdiction with less stringent regulations. Also, both projects involve Glencore, a large and experienced miner and metal trader. The alkali roasting option was evaluated in depth for the Lac Doré Vanadium project, and proved to be of limited economic interest.

About 75% of the vanadium produced in the world is a by-product of steel manufacturing from VTM smelting. The bulk of this production is located is in China and Russia, and most operations are apparently in financial difficulties, with only limited production capacity in occidental economies. The former largest producer, Highveld Iron and Vanadium, in South-Africa, was decommissioned recently. New-Zealand Steel halted its vanadiferous slag production. Although a modern direct reduction plant for steel production can be converted to use VTM instead of conventional vanadium-free iron ore and scrap metal, the use of VTM as feed in exchange for returning the vanadiferous slag to VanadiumCorp was explored with some smelters. The losses of iron credits due to the presence of 10-20% unrecoverable titanium do not compensate for the saving on feedstock. Construction of a smelter, either using direct reduction and intensive fusion, or using pre-oxidation and moderate fusion was evaluated, and proved to be of too feeble economic interest compared to its construction cost.

The difficulty with building a vanadium production facility resides in the intrinsic vanadium market structure. Vanadium is a commodity dominantly produced as by-product of steel mills, while its main market is as additives to steel itself. As steel allowing agent, vanadium can be replaced by other metals such as molybdenum, chromium or niobium, depending on applications. Its market price is then dictated by price of competing metals. The bulk of vanadium being a minor by-product of steel production, the steelmakers have the capacity to sell vanadium at prices that cannot be sustained by vanadium primary producer during low-market periods. Surges in vanadium prices are noted from time to time, which are trigged by incidental event, and do not represent a realistic long-term pricing to be used for an economic study. Therefore, due to these recurrent disruption in market, aiming to become a primary vanadium producer using conventional process is not realistic neither is the construction of a smelter.

Similarly, the emergence of vanadium redox batteries as market is limited by vanadium pricing. Since vanadium account for nearly 50% of the battery cost, alternate energy storage technology are substitute if vanadium price is above approximately us$ 8.00 per pound V_2O_5 equivalent.

The premise of the current project is that VanadiumCorp and Electrochem Technologies and Materials will succeed in the development of their chemical and electrochemical extraction process. Contrarily to conventional processes, the one currently developed enables the recovery of all metals present in the VTM, thus adding credits from vanadium, iron, titanium and silica. The Electrochem's process for iron electrowinning has significantly lower requirements in regard of energy consumption, with about half the kW/h per tonne for electrolytic iron, compared to conventional iron or steel making process. Furthermore, the two VanadiumCorp-Electrochem and Electrochem processes do not require autoclavation and enables regeneration of sulphuric acid without the use of supplementary steps such as pyrolysis, compared to other chemical process involving chlorination. Although the VanadiumCorp and Electrochem processes are demonstrated to work at prototype scale, the demonstration at pilot plant scale must be conducted, and its economic feasibility must be proven. Developing a new metallurgical process is typically a long and difficult venture.

From this standpoint, the first author recommended VanadiumCorp to adjust their business strategy in regard of the development of the Lac Doré Vanadium project, and to evaluate the economics of producing VTM concentrate only at the site, and to sell this VTM to a different business unit that would process it to extract metals using the technologies under development. In this regard, the Lac Doré Vanadium project must be economical by itself in producing VTM concentrate, and be capable to compete with other VTM producer to feed the VanadiumCorp-Electrochem chemical plant. If not economical, the construction of Lac Doré Vanadium project would not be justified, and the author would recommend VanadiumCorp to buy its feed from an existing producer.

The current preliminary economic study on the Lac Doré Vanadium project is positive, with an estimated internal rate of return *IRR* of 15.42%, allowing an initial capital investment of $343 million. This suggested profitability is sufficient to justify the investment required for completing a bankable feasibility on the project. **The current preliminary economic study is preliminary and conceptual in nature, implies an elevated level of uncertainties, and must not be used to justify the investment in construction of the project.**

Sensitivity of the economic model was tested against variability of the various input parameters. It is estimated that the project can withheld significant construction cost overrun or significant operating cost increases. The most sensitive input parameter remains the sale price of VTM. However, since the VTM is dedicated to be sold to a subsidiary business, it should provide stable revenues compared selling to free market. The economic resilience of the Lac Doré Vanadium project therefore relies upon the success of the VanadiumCorp-Electrochem and Electrochem Technology metal recovery processes, which must be further demonstrated.

The weakest point of the current study remains the lack of detail on resources, which are only classified as inferred category. Currently, 99.1 million tonnes of inferred resources, grading 26.3% recoverable VTM by magnetic concentration is estimated, while only 64 million tonnes are required for the life of the project. Although the overall resource available in the deposit is quite well established, their detailed distribution is uncertain. The current level of details does not allow the authors to develop a mining plan, even conceptual. Systematic drilling of the deposit is a prerequisite into developing dependable resources and subsequent mining plan. Mineral Resources are not Mineral Reserves and do not have demonstrated economic viability. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves and therefore do not have demonstrated economic viability.

The project is elaborated using a production of 100 tonnes of VTM per hour. Such rate is close to what was selected for previous scenarios, such as the one used by McKenzie Bay Resources in their non-current 2002 Feasibility, or the BlackRock Metals project. From this scenario, the effect of scaling the project, from 16 to 300 tonnes per hour, were modelled, assuming a maximum resource of 99.1 mt. Optimal return on investment has been calculated for the 120 tph VTM production rate. Increasing the production rate to reduce operating cost will be hampered by the reduced mine life due to limited resource currently available.

Milling and beneficiating the VTM can be conducted using conventional technologies and is considered as a well established process, used by numerous facilities around the world. The current level of detail available from historic metallurgical tests do not allow for detailed processing design. Further metallurgical testing will be required and a geometallurgy model of the deposit is needed to proceed with a feasibility study.

No severe restrictions to the project development are expected environmentally. The waste rocks and the tails from the concentrator are not acid generating, and content of leachable metals are low. The beneficiation circuit does not require the use of chemicals, involving only magnetic separation. Water is to be used in closed circuit, and no significant effluents are anticipated. Contamination to the environment is expected to be limited to dusting from the mine and trucking along the road. No significant lakes, marsh or streams will be affected directly by the project. However, the CMB plant, waste pad and tail pond are located upstream of Armitage and Villefagnant rivers, which are affluent of Chibougamau lake, and care should be taken to avoid release of particle suspension into drainage system. Numerous aspects of the project needs reviewing in regard of environmental impact, such as energy choice for the dryers or VTM transportation options.

Although environmental and social impact studies were conducted on the same area for the similar production in the past (McKenzie Bay Resources in 2002 and BlackRock Metals in 2014), the environmental baseline study is to be conducted prior to any further disturbance in the area, such as the construction of adjacent BlackRock project.

The Lac Doré Vanadium project is located adjacent to the BlackRock Metals project, which is already permitted in regard to environmental impacts, for a production of 2,000,000 tonnes per year of VTM concentrate. Since impacts on environment are cumulative, the impact from Lac Doré Vanadium project plus BlackRock project must exceed regulations. So the limitations will be for VanadiumCorp to to obtain its permit.

Chibougamau is a resource community built on mining and forestry activities. Therefore, the community is generally receptive to mining projects. However, the population is also acquainted to mining project promotion, and will show scepticism as well, especially since the development of a vanadium mine in the region has failed recurrently. From the release of the current study, VanadiumCorp should establish transparent communication in a skilled manner with the community, both Chibougamau and First Nations. Negotiation of mutual benefit agreements with First Nations should be prioritized. Hindrances from competing projects are to be expected.

The results of the current preliminary economic assessment of the Lac Doré Vanadium project, despite its inherent inaccuracies and conceptual nature, justify the investment into completing the feasibility study of the project and to initiate the process of environmental and social impact study required for the permitting of the project. A four year schedule is to be anticipated to complete these tasks in order to obtain permits. Simultaneously, it is recommended that VanadiumCorp pursue the development of their VanadiumCorp-Electrochem process for the recovery of electrolytic iron, vanadium based electrolyte and titania by-product.

ITEM 26: RECOMMENDATIONS AND BUDGET

The authors have reviewed relevant information to the VanadiumCorp owned **Lac Doré** Vanadium project, calculated the resources and calculated the economic model for its development, and do recommend that it is justified to complete a feasibility study and conduct the environmental and social impact study. However, weakness were identifies in regard of resource definition, metallurgical process and environmental base-line, which require investment to be made prior to initiate feasibility study itself.

PHASE 1: PILOT PLANT METALLURGICAL TESTING

A budget of $1 million was indicated by VanadiumCorp for the first tranche of financing of the project.

The environmental base line study must be initiated as soon as possible, regardless of the timing of the other aspects of the project. This should be initiated in early 2018 to prevent interference potentiallycaused by drilling program and the possibility of the BlackRock Metal's project construction.

The project development is heavily dependent on the outcome of the chemical and electrochemical process currently under development. Efforts should be focused on conducting pilot plant testing of the process. Such pilot testing will require collecting a representative bulk sample of 50 tonnes of fresh material from the deposit. A concentrate of titanomagnetite will be manufactured out of the sample, to produce in excess of 10 tonnes of concentrate. A small chemical and electrochemical pilot plant will have to be built at Electrochem Technologies and Material Inc facilities for the purpose of testing the two integrated processes, plus the purification of the vanadyl sulphate liquor. About 6 tonnes of electrolytic iron, 150 kilograms of V_2O_5 equivalent of vanadyl sulfate, and 1 tonne of titania by-product are expected, which should be sufficient to qualify these products with potential end users.

Budget for phase 1 is as follows, not including VanadiumCorp corporate cost. Costs are all inclusive in Canadian denomination (***table 32***):

Envir. base line	$1000/day	100 days	$ 100,000
Bulk Sampling	$1000/tons	50 tonnes	$ 50,000
VTM concentration	$2000/tons	50 tonnes	$ 100,000
Pilot plant set-up.			$ 500,000
Pilot plant operation	$1000 / day	25 days	$ 250,000
Total Phase 1			$1,0000,000

***Table 32**: Budget for minimum phase one financing.*

PHASE 2: FEASIBILITY STUDY

If sufficient financing is available, it is recommended to proceed into a feasibility study of the project. Depending on the availability of capitals, the start-up of initial steps of the study can precede the completion of the here above metallurgical study in order to gain time. A global budget of $20,000,000 million should be anticipated, over a period of two years. A further two years will be required to complete the permitting process, for a total of four years. Some aspects at this stage of development may be conducted concurrently.

Resource definition

A drill program should be initiated to upgrade the resources into indicated and measure category over the entire deposit, from lines 7+00 East to line 24+00 East. Respecting the drill pattern outlined in item 13 will require a total of 18 fences spaced every 100 metres with 400 metres of drilling each, plus 17 infill fences to complete the 50 metres spacing for 300 metres of drilling each. A total of 16,000 metres of drilling is required, in 88 holes. Holes must be inclined 45^{o} toward Northwest, oriented 320^{o}, and PQ in diameter to enable collecting sufficient material for metallurgical testing including autogenous grinding and drop mill tests. Assaying and Davis tube testing every 3 metres is recommended. The program should be initiated as soon as capital is available, as it will require the involvement of 2 drill rigs over a period of four months.

Metallurgy

In order to proceed with engineering of the plant, a complete testing of the metallurgy is required, including full scale VTM beneficiation and full scale pilot plant testing of the chemical and electrochemical process. Since the chemical and electrochemical plant do not need to be built near the mining site, it should not be included in the prefeasibility study in order to avoid unnecessary delays on its completion. Only pilot plant testing of crushing, milling and beneficiation, drying and handling of the VTM concentrate should be included. Full pilot plant testing of the chemical and electrochemical processes shouldl be conducted in parallel, although not part of the mining project. It is recommended to use the core from drilling for the metallurgical testing, a total weight of 64 tonnes is expected to be available.

Engineering

Engineering aspects to be included in feasibility should include the design of infrastructure such as the power line, upgrade of the road, tailing and finishing ponds, geotechnical and general CMB plant design and equipment sizing. Geotechnical and civil engineering must be conducted. Multiple options must be studied in regard of tailing pond location and design, including subjacent geotechnical work. The various alternatives outlined in the current PEA must be evaluated in detail, such as the the road and powerline alternate route, the choice of energy source for the dryers and transport options. Detailed designs and quotes for the equipment must be completed.

Environmental and social impact study

A project notice must be filed at MDDELCC as soon as feasible.

Aside of the aforementioned environmental baseline study, a complete environmental and social impact study must be initiated rapidely to be submitted to the COMEX-COMEV, MEDDLCC and MERNQ within two years. The study must include evaluation of risk, elaboration of environmental mitigation or compensation plan, the testing for acid mine drainage potential, an evaluation of effluents, a hydrologic study, modelling of atmospheric dispersion, evaluation of the social impacts and elaboration of a mutual benefit agreement with First Nations. A efficient and transparent communication plan must be established with communities and authorities, which will require opening and maintaining a community liaison bureau in Chibougamau.

Once the feasibility study is remitted to authorities, it should be anticipated that two years will be needed to answer questions of government representatives and local communities, and that supplementary studies will be requested. Relations with authorities and the liaison office with community must be maintained throughout the process.

Market study

A market study, to be conducted by a recognized firm, must be completed to evaluate the value of the various products (electrolytic iron, vanadyl sulphate, titania by-product, amorphous silica, gypsum, oxygen and potentially other metals and master alloys), their market size and to establish marketing strategies. The chemical and electrochemical process will produce numerous products, each of which with its own market. Since the markets of these products are not related, they can be located in different region, and detailed studies will be needed to establish the plant in the most strategic location. It is anticipated that most product will be dedicated to the North-American market. The complexity of this market study must not be underestimated, nor is its potential impact on the future economics of the overall project.

Aside of markets for the various product from the chemical process, a market study for VTM itself should be conducted. The option of selling part of the production to consumers for niche product must be considered as complementary or back-up plant.

Budget for phase 2 is as follow, in Canadian denomination, not including VanadiumCorp corporate costs (***table 33***):

Drilling	16,000 metres	$300 / metres	$5,000,000
Resource estimation and mining plan			$ 200,000
Geotechnical and civil eng.	50 holes + 1000 hours	$2000/ holes $200 / hours	$ 300,000
Metallurgical testing			$2,000,000
Road and power line design	500 hours	$200 per hours	$ 100,000
Tailing pond design	500 hours	$200 per hours	$ 100,000
Pit design and Hydrology	10 holes + 1000 hours	$10000 / holes $200 / hours	$ 300 000
CMB plant engineering	15,000 hours	$200 / hours	$3,000,000
Feasibility and management	5,000 hours	$200/hours	$1,000,000
Market study	2,500 hours	$200/hours	$ 500,000
Environmental impact study	15,000 hours	$200 / hours	$3,000,000
Permitting	12,500 hours	$200/hours	$2,500,000
Liaison bureau	4 years	$500,000/year	$2,000,000
Total phase 2			**$20,000,000**

***Table 33**: Budget for phase 2 program.*

The author considers the budgets and targets presented in the above recommended program to be realistic and legitimate, and, if properly managed, they will provide a reasonable chance to obtain permitting for the project, notwithstanding the risks inherent to any exploration project.

Signed in Saguenay, Chibougamau and Val-d'Or on December 28, 2017
Effective date of the report: December 12, 2017

Lac Doré, Vanadium, December 28 2017,

Réjean Girard
Professional Geologist, OGQ nº 521
IOS Services Géoscientifiques inc.

Lac Doré Vanadium Project 2017

Éric Larouche, P.Eng
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ITEM 28: CERTIFICATE OF QUALIFICATION

RÉJEAN GIRARD, PROFESSIONAL GEOLOGIST

I, Réjean GIRARD, P. Geo., do hereby certify that:

1. I am currently employed as a senior geologist by:
   IOS Services Geoscientifiques Inc.
   1319 Boulevard St-Paul
   Chicoutimi, Québec, G7J 3Y2
2. I graduated with a degree in geology from *Université Laval* in Ste-Foy, Québec, in 1985. In addition, I completed 5 years of graduate studies in mineral resources at *Université du Québec à Chicoutimi*.
3. I am a member of the *Ordre des Géologues du Québec*, #521.
4. I have worked as a geologist for 32 years since my graduation from university.
5. I have been involved as project manager regarding the work conducted on the current deposit since 1997 with various past owners, including McKenzie-Bay Resources representative during the completion of the now-obsolete SNC-Lavalin feasibility on the Lac Doré. I have also been involved in numerous other vanadium or iron-titanium projects located in Québec, and overall in more than 1400 different exploration projects across the world. I have also directed a commercial mineralogy and mineralurgy testing facility for 20 years.
6. I have read the definition of "*qualified person*" set out in National Instrument 43-101 (NI-43-101) and certify that by reason of my education, my affiliation with a professional association (as defined in NI-43-101), and past relevant work experience, I fulfil the requirements to be a "*qualified person*" for the purpose of NI-43-101.
7. I am responsible for the preparation of the technical report entitled "*The Lac Doré vanadium project: First preliminary economic assessment, Chibougamau, Québec, Canada, NI-43-101 technical report*", dated on December 28th 2017, with an effective date of December 12th 2017 and relating to the **Lac Doré** and **Lac Doré North** properties. I last visited the properties on July12th 2017.
8. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report of which the omission to disclose would make the Technical Report misleading.
9. I am independent of the issuer and their former partner, having applied all the tests in section 1.5 of National Instrument 43-101.
10. I have read National Instrument 43-101 and Form 43-101-F1, and the Technical Report was prepared in compliance with that instrument and form.
11. I consent to the filing of the Technical Report with any stock exchange or other regulatory authority, and publication of the Technical Report by them on publicly accessible websites.

Dated December 28th, 2017

Lac Doré Vanadium Project 2017

GÉOLOGUE / GEOLOGIST RÉJEAN GIRARD # 521 QUÉBEC

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Réjean Girard, P.Geo
IOS Services Géoscientifiques Inc.

CHRISTIAN D'AMOURS, PROFESSIONNAL GEOLOGIST

I, Christian D'Amours, residing at 895, rue Lévis, Val-d'Or (Qc), do hereby certify that:

1. I am an independent geologist with the consulting firm, GeoPointCom, located at 895 rue Levis, Val d'Or, Québec, Canada, J9P 4B8.
2. I graduated in geology, as a professional geologist, from the University of Québec in Montréal.
3. I have been practicing the profession of geologist on an ongoing basis since May 1985.
4. From 1985 to 1994 the practice of my profession was mainly oriented towards exploration. From 1994 to 1999, I worked primarily in the field of mining. Since 1999, I have been working predominantly in the evaluation of resources, reserves and geostatistics.
5. I am a member of the Order of Geologists of Québec (#226);
6. I have read the definition of "*qualified person*" set out in Regulation 43-101/NI43-101 and certify that by reason of my education, affiliation with a professional association (as defined in Regulation 43-101) and past relevant work experience, I fulfill the requirements to be a "*qualified person*" for the purposes of Regulation 43-101.
7. I am responsible for the preparation of Section 14 and co-author of sections 1 of the report entitled "The Lac Doré Vanadium Project: First Preliminary Economic Assessment (according to National Instrument 43-101 and Form 43-101F1)" (the "Technical Report"), effective date of December 12th 2017 and dated on December 28st 2017, prepared for VanadiumCorp Resource inc.
8. I had no prior involvement with the property that is the subject of the Technical Report and its previous 2015 version disclosing the resource estimate.
9. I did not visit the property.
10. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report, the omission to disclose which would make the Technical Report misleading.
11. I am independent of the owners of the lands covered by this report within the meaning of section 1.5 of National Instrument 43-101 Standards of Disclosure for Mineral Properties ("NI 43-101").
12. I have read the NI 43-101 and Form 43-101F1, and hereby certify that this report was prepared in compliance with NI 43-101 and Form 43-101F1. The report gives a true picture of the state of scientific and technical knowledge as of December 12th 2017.

Dated: December 28st 2017

Lac Doré Vanadium Project 2017

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Christian D'Amours, P.Geo

Geopointcom Inc.

JONATHAN LAPOINTE, PROCESS ENGINEER

I, Jonathan Lapointe, Eng., do hereby certify that:

1. I am currently employed as a process engineer by:
   Metchib Metallurgical Services inc.
   888, 3rd Street,
   Chibougamau, Quebec, G8P 1R2
2. I graduated with a bachelor degree in “Génie des matériaux et de la métallurgie” from *Université Laval in Quebec city*, in 2003.
3. I am a member of the *Ordre des Ingénieurs du Québec*, #132193
4. I have worked for 14.7 years in mineral processing since my graduation from Laval University.
5. I have been involved as an engineer since April 27th, 2006.
6. I have read the definition of "*qualified person*" set out in National Instrument 43-101 (NI-43-101) and certify that by reason of my education, my affiliation with a professional association (as defined in NI-43-101), and past relevant work experience, I fulfill the requirements to be a "*qualified person*" for the purpose of NI-43-101.
7. I am responsible for the preliminary mineral beneficiation process diagram evaluation of item 17 and mineral processing parts of item 1 and 21 of the technical report entitled “*The Lac Doré Vanadium Project: First Preliminary Economic Assessment, Chibougamau, Québec, Canada, NI-43-101 technical report*”, signed on December 28th 2017, with an effective date of December 12lth 2017 and relating to the **Lac Doré** and **Lac Doré North** properties. I visited the properties on July 12th 2017.
8. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report of which the omission to disclose would make the Technical Report misleading.
9. I am independent of the issuer and their former partner, having applied all the tests in section 1.5 of National Instrument 43-101.
10. I have read National Instrument 43-101 and Form 43-101-F1, and the Technical Report was prepared in compliance with that instrument and form.
11. I consent to the filing of the Technical Report with any stock exchange or other regulatory authorities, and publication of the Technical Report by them on publicly accessible websites.

Jonathan Lapointe, Eng.
Metchib Metallurgical Services Inc.

ÉRIC LAROUCHE, PROFESSIONNAL ENGINEER

I, Éric Larouche, P. Geo., do hereby certify that:

12. I am currently employed as an geological engineer by:
    IOS Services Geoscientifiques Inc.
    1319 Boulevard St-Paul
    Saguenay, Québec, G7J 3Y2
13. I graduated with a degree in geological engineering from *Université du Québec à Chicoutimi*, Québec, in 2010. In addition, I completed 2 years of graduate studies in mineral resources at *Université du Québec à Chicoutimi*.
14. I am a member of the *Ordre des Ingénieurs du Québec*, #5016826
15. I have worked as a engineer for 7 years since my graduation from university.
16. I have been involved as engineer in a wide variety of exploration project as well as in various operating mines. Since 2015, I work as engineer at Opinaca mine, Goldcorp Inc.
17. I have read the definition of "*qualified person*" set out in National Instrument 43-101 (NI-43-101) and certify that by reason of my education, my affiliation with a professional association (as defined in NI-43-101), and past relevant work experience, I fulfil the requirements to be a "*qualified person*" for the purpose of NI-43-101.
18. I am responsible for the preparation of item 18 and part of items 1 and 21 of the technical report entitled "*The Lac Doré Vanadium Project: First Preliminary Economic Assessment, Chibougamau, Québec, Canada, NI-43-101 technical report*", signed on December 28th 2017, with an effective date of December 12lth 2017 and relating to the **Lac Doré** and **Lac Doré North** properties. I did not visit the property.
19. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report of which the omission to disclose would make the Technical Report misleading.
20. I am independent of the issuer and their former partner, having applied all the tests in section 1.5 of National Instrument 43-101.
21. I have read National Instrument 43-101 and Form 43-101-F1, and the Technical Report was prepared in compliance with that instrument and form.
22. I consent to the filing of the Technical Report with any stock exchange or other regulatory authority, and publication of the Technical Report by them on publicly accessible websites.

Dated: December 28th 2017

Lac Doré Vanadium Project 2017

Éric Larouche, P.Eng
IOS Services Géoscientifiques Inc.

INGÉNIEUR - ENGINEER
Eric Larouche
5016826
QUÉBEC

APPENDIX 1

CLAIMS LIST

OWNER	##	PROPERTY	NTS	OWNERSHIP	ROW	CELL	TITLE	NUMBER	REGISTRY	EXPIRATION	AREA (HA)	CREDITS	FEES	REQUIREMENT	DATE
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0010	0007	CDC	2430406	30-07-2015	20-04-2018	53.1	230.23 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0010	0005	CDC	2430404	30-07-2015	20-04-2018	16.92	2 050.16 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0010	0006	CDC	2430405	30-07-2015	20-04-2018	19.13	2 317.95 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0011	0006	CDC	2430396	30-07-2015	20-04-2018	55.53	6 728.44 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0011	0007	CDC	2430397	30-07-2015	20-04-2018	55.53	5 948.45 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0011	0005	CDC	2430407	30-07-2015	20-04-2018	48.38	58 062.78 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0012	0007	CDC	2430398	30-07-2015	20-04-2018	55.52	4 387.25 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0012	0006	CDC	2430402	30-07-2015	20-04-2018	55.52	12 925.01 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0012	0005	CDC	2430408	30-07-2015	20-04-2018	40.12	4 861.27 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0013	0006	CDC	2430399	30-07-2015	20-04-2018	55.51	6 726.04 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0013	0007	CDC	2430403	30-07-2015	20-04-2018	55.51	9 803.80 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0013	0005	CDC	2430409	30-07-2015	20-04-2018	24.66	2 988.01 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0014	0006	CDC	2430400	30-07-2015	20-04-2018	55.5	3 604.83 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0014	0007	CDC	2430401	30-07-2015	20-04-2018	55.5	5 944.83 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0008	0058	CDC	2429531	24-07-2015	23-06-2018	7.64	15 235.35 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0008	0059	CDC	2429532	24-07-2015	23-06-2018	0.07	17.48 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0009	0060	CDC	2429535	24-07-2015	23-06-2018	31.42	40 649.07 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0009	0059	CDC	2429534	24-07-2015	23-06-2018	22.24	43 552.33 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0009	0058	CDC	2429533	24-07-2015	23-06-2018	36.7	24 052.77 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0010	0059	CDC	2429538	24-07-2015	23-06-2018	45.85	25 557.87 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0010	0058	CDC	2429537	24-07-2015	23-06-2018	0.02	4.99 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0010	0058	CDC	2429536	24-07-2015	23-06-2018	19.06	18 867.37 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0010	0060	CDC	2429539	24-07-2015	23-06-2018	50.05	73 925.13 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0011	0059	CDC	2429541	24-07-2015	23-06-2018	10.54	2 632.25 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0011	0060	CDC	2429542	24-07-2015	23-06-2018	53.57	11 818.50 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0011	0059	CDC	2429540	24-07-2015	23-06-2018	8.06	2 012.89 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0012	0059	CDC	2429543	24-07-2015	23-06-2018	21.42	3 009.42 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0012	0060	CDC	2429544	24-07-2015	23-06-2018	55.52	9 805.24 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0013	0059	CDC	2429545	24-07-2015	23-06-2018	4.47	336.33 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32G16	100%	0013	0060	CDC	2429546	24-07-2015	23-06-2018	10.92	2 727.15 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32H13	100%	0009	0001	CDC	2429547	24-07-2015	23-06-2018	6.11	16 413.26 $	32.77 $	487.50 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32H13	100%	0010	0001	CDC	2429548	24-07-2015	23-06-2018	49.76	68 797.54 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32H13	100%	0010	0002	CDC	2429549	24-07-2015	23-06-2018	37.9	32 110.22 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32H13	100%	0011	0002	CDC	2429550	24-07-2015	23-06-2018	50.5	25 159.18 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32H13	100%	0011	0001	CDC	2429530	24-07-2015	23-06-2018	55.53	25 857.36 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32H13	100%	0012	0001	CDC	2429551	24-07-2015	23-06-2018	44.77	9 347.43 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ	32H13	100%	0012	0002	CDC	2429552	24-07-2015	23-06-2018	26.7	6 154.25 $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0015	0060	CDC	2407353	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0015	0059	CDC	2407352	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0016	0058	CDC	2407355	16-07-2014	15-07-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0016	0059	CDC	2407356	16-07-2014	15-07-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0016	0060	CDC	2407357	16-07-2014	15-07-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0016	0057	CDC	2407354	16-07-2014	15-07-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0006	CDC	2407363	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0004	CDC	2407361	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0003	CDC	2407360	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0002	CDC	2407359	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0001	CDC	2407358	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0005	CDC	2407362	16-07-2014	15-07-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0001	CDC	2407364	16-07-2014	15-07-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0003	CDC	2407366	16-07-2014	15-07-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0002	CDC	2407365	16-07-2014	15-07-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0011	0057	CDC	2459449	30-08-2016	29-08-2018	55.53	- $	64.09 $	780.00 $	12-déc-17

OWNER	##	PROPERTY	NTS	OWNERSHIP	ROW	CELL	TITLE	NUMBER	REGISTRY	EXPIRATION	AREA (HA)	CREDITS	FEES	REQUIREMENT	DATE
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0011	0056	CDC	2459448	30-08-2016	29-08-2018	55.53	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0012	0057	CDC	2459450	30-08-2016	29-08-2018	55.52	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0057	CDC	2459451	30-08-2016	29-08-2018	55.51	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0057	CDC	2459452	30-08-2016	29-08-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0007	CDC	2459453	30-08-2016	29-08-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0008	CDC	2459454	30-08-2016	29-08-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0004	CDC	2459455	30-08-2016	29-08-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0011	0054	CDC	2412408	22-09-2014	21-09-2018	55.53	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0011	0055	CDC	2412409	22-09-2014	21-09-2018	55.53	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0012	0056	CDC	2412410	22-09-2014	21-09-2018	55.52	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0056	CDC	2412414	22-09-2014	21-09-2018	55.51	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0055	CDC	2412413	22-09-2014	21-09-2018	55.51	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0054	CDC	2412412	22-09-2014	21-09-2018	55.51	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0053	CDC	2412411	22-09-2014	21-09-2018	55.51	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0053	CDC	2412415	22-09-2014	21-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0054	CDC	2412416	22-09-2014	21-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0056	CDC	2412418	22-09-2014	21-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0055	CDC	2412417	22-09-2014	21-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0015	0057	CDC	2412419	22-09-2014	21-09-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0015	0058	CDC	2412420	22-09-2014	21-09-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0017	0058	CDC	2412421	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0017	0060	CDC	2412423	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0017	0059	CDC	2412422	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0013	0009	CDC	2412424	22-09-2014	21-09-2018	55.51	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0014	0009	CDC	2412425	22-09-2014	21-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0015	0009	CDC	2412426	22-09-2014	21-09-2018	55.49	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0008	CDC	2412430	22-09-2014	21-09-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0005	CDC	2412427	22-09-2014	21-09-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0009	CDC	2412431	22-09-2014	21-09-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0007	CDC	2412429	22-09-2014	21-09-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0016	0006	CDC	2412428	22-09-2014	21-09-2018	55.48	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0006	CDC	2412437	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0001	CDC	2412432	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0002	CDC	2412433	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0003	CDC	2412434	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0004	CDC	2412435	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0005	CDC	2412436	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0009	CDC	2412440	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0008	CDC	2412439	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0017	0007	CDC	2412438	22-09-2014	21-09-2018	55.47	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0018	0003	CDC	2412443	22-09-2014	21-09-2018	55.46	3 964.86 $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0018	0002	CDC	2412442	22-09-2014	21-09-2018	55.46	1 388.30 $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0018	0004	CDC	2412444	22-09-2014	21-09-2018	55.46	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0018	0005	CDC	2412445	22-09-2014	21-09-2018	55.46	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0018	0001	CDC	2412441	22-09-2014	21-09-2018	55.46	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0058	CDC	2429527	24-07-2015	28-09-2018	0.25	- $	32.77 $	325.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0059	CDC	2429528	24-07-2015	28-09-2018	20.07	- $	32.77 $	325.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0013	0060	CDC	2429529	24-07-2015	28-09-2018	18.93	- $	32.77 $	325.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0059	CDC	2429526	24-07-2015	28-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0060	CDC	2429525	24-07-2015	28-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32G16	100%	0014	0058	CDC	2429524	24-07-2015	28-09-2018	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ NORD	32H13	100%	0013	0008	CDC	2174067	04-11-2008	03-11-2018	55.51	- $	64.09 $	1 170.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0013	0002	CDC	2433670	01-10-2015	30-09-2019	16.82	- $	32.77 $	325.00 $	12-déc-17

OWNER	##	PROPERTY	NTS	OWNERSHIP	ROW	CELL	TITLE	NUMBER	REGISTRY	EXPIRATION	AREA (HA)	CREDITS	FEES	REQUIREMENT	DATE
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0013	0003	CDC	2433671	01-10-2015	30-09-2019	17.17	- $	32.77 $	325.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0013	0004	CDC	2433672	01-10-2015	30-09-2019	17.41	- $	32.77 $	325.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0013	0001	CDC	2433669	01-10-2015	30-09-2019	16.51	- $	32.77 $	325.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0014	0001	CDC	2433673	01-10-2015	30-09-2019	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0014	0002	CDC	2433674	01-10-2015	30-09-2019	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0014	0003	CDC	2433675	01-10-2015	30-09-2019	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0014	0004	CDC	2433676	01-10-2015	30-09-2019	55.5	- $	64.09 $	780.00 $	12-déc-17
Vanadiumcorp Resource inc.	93181	LAC DORÉ EXTENTION	32H13	100%	0014	0005	CDC	2433677	01-10-2015	30-09-2019	55.5	- $	64.09 $	780.00 $	12-déc-17