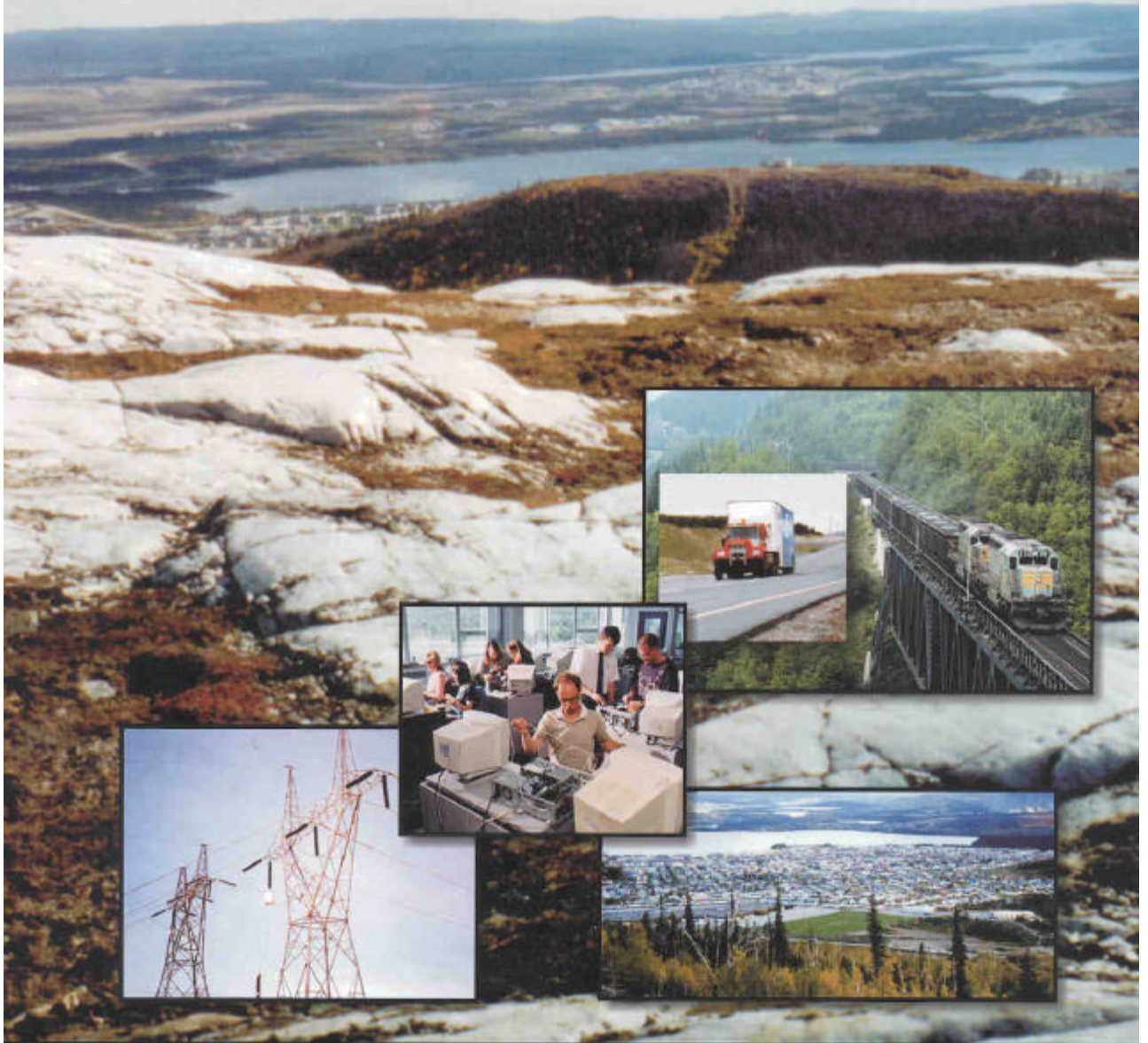


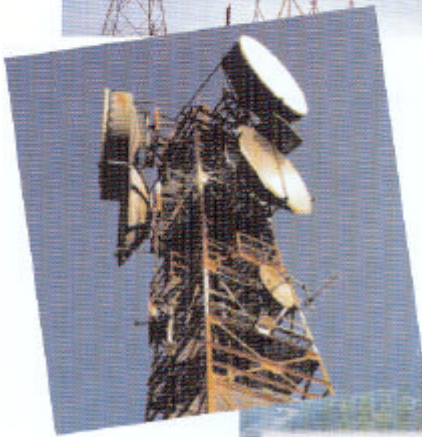
# SILICON METAL SMELTER

*THE LABRADOR ADVANTAGE*



GOVERNMENT OF  
NEWFOUNDLAND AND LABRADOR  
DEPARTMENT OF MINES AND ENERGY

# THE LABRADOR ADVANTAGE



Labrador West is an ideal location for a Greenfield silicon metal smelter. Its key advantages are:

• *Raw Materials* - high-quality quartz from large tonnage quartzite deposits. Other raw materials, such as wood chips, are available locally....

• *Electrical Power* - inexpensive and accessible hydroelectric power....

• *Skilled Workforce* - highly skilled and educated workforce familiar with mining and related industries; innovative training programs....

• *Infrastructure* - a well-developed infrastructure and transportation system....

• *Favourable Business Climate* - a positive business investment environment and regulatory regime...

• *Inviting Lifestyle* - excellent standard of living and a quality lifestyle....

# ABUNDANT NATURAL RESOURCES

Labrador West is primarily known for its iron ore resource and has been a major producer of iron ore concentrate and pellets (55% of Canadian production) for over 40 years. Also, there are vast and extensive, high-quality quartz (quartzite) deposits suitable for commercial exploitation. It possesses not only the mineral resources but the energy resource - a combination conducive to supporting a state-of-the-art silicon smelter.

The optimal scale for the project is an annual production capacity for silicon metal of 35 000 tonnes. At this level, the smelter would require 437.5 GWh of electricity and 90 000 tonnes of quartz per annum. Proximity to the Churchill Falls hydroelectric project, and the region's existing available electricity ensure a competitive energy price.

## THE NATURAL RESOURCE

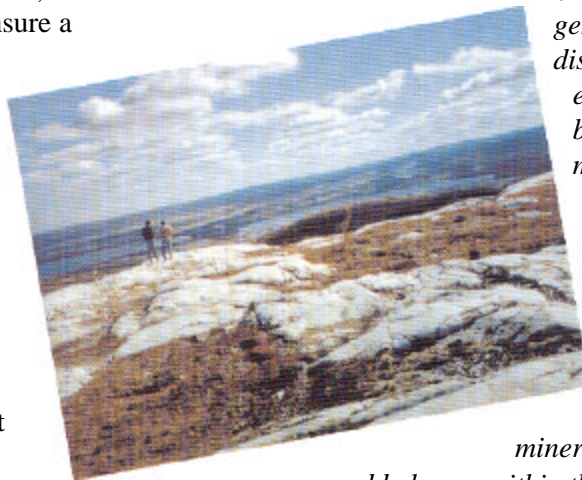
### Quartz

The Labrador Trough, a metamorphic sequence of sedimentary rocks, contains large and extensive deposits of quartzite (Wishart Formation), as well as the more famous dolomitic marble and iron ore. The quartzite is prominent in the Labrador City and Wabush area where it forms notable ridges. The quartzite is of a high quality with potential resources in the tens of millions of tonnes. Dean and Meyer (1985) described the quartzite as follows:

*The Wishart Quartzite is a prominent physiographic unit exposed on the west side of Wabush Lake. The white quartzite ridges north and west of Labrador City are particularly clean and represent significant reserves of high quality silica. Most of the larger ridges are within 5 km of Labrador City and several are adjacent to existing iron ore mining operations.*

*The quartzite ridges vary in size from 100 m long by 10 m wide to 3000 m long by 700 m wide and some have more than 100 m of vertical relief. Many ridges are adjacent to iron oxide deposits since the Wishart Formation generally underlies the iron-bearing Sokomon Formation in the Wabush Lake area.*

*The quartzites occur as four distinct types: (1) massive white recrystallized quartzite forms the largest and most prominent ridges. It is remarkably free of impurities and shatters when broken by a hammer. Outcrops are generally brilliant white, often glacially polished, and may contain local, narrow diffuse light brown to pink zones; (2) granular quartzite is generally white to gray and has a distinct rough, granular weathered surface. Ridges dominated by this type often contain zones of massive whiter quartzite and narrow bands of micaceous quartzite may also occur; (3) micaceous quartzite occurs in bands generally less than 1 m thick and contains up to 10% muscovite, chlorite, biotite and other silicates. These minerals may represent original muddy layers within the quartzites; and (4) white friable quartzite occurs only in one area on the north side of the Fermont Highway, 1.5 kms west of Labrador City. This unique exposure is so friable that it may be sampled with an ordinary shovel and can be considered to be a silica sand deposit.*



Dean and Meyer (1985) collected 383 samples from 34 sections measuring 25 m to 500 m in length. Of these, 251 samples indicated SiO<sub>2</sub> content higher than 99%. Further, only 15 of the 383 samples contained less than 98% SiO<sub>2</sub>. Results from this initial sampling indicated that the quartzite meets, or exceeds, the specifications required for the manufacture of silicon metal (see Table A at back).

These deposits are amenable to easy and cheap mining quarrying because of their continuous thickness, length and vertical relief. Metallurgical testing has also shown that the quartz has excellent qualities for "lump" silica having extremely low levels of impurities, in particular titanium; it has excellent handling characteristics with low levels of fines generated during transit. The average chemical composition of 17 samples ready for shipment is 0.0571% Fe<sub>2</sub>O<sub>3</sub>, 0.0311% Al<sub>2</sub>O<sub>3</sub>, 0.069% CaO, and 0.0012% TiO<sub>2</sub>, (see Table B at back).

The quality and suitability of these deposits for silicon metal production is attested to by the recent (1999) development of a local silica mining operation. It is being operated by Shabogamo Mining & Exploration (SME), a locally owned company, which supplies lump quartzite feed-stock to the SKW Canada silica smelter at Bécancour, Quebec, under a ten-year contract agreement for up to 1 000 000 tpa. SME has proven reserves of 1.2 million tonnes and anticipates that this will be significantly increased.

Mining operations consist of a crushing and screening plant at the mine site. The material is then transported 10 km to a processing plant with a rated capacity of 200 tph; the plant is adjacent to the main rail line. At the processing plant, the quartzite is washed, re-screened, sampled, and classified before being loaded into rail cars for shipment to Sept Îles, Quebec, and then via the St. Lawrence River to the Bécancour smelter.

*Wood Chips*

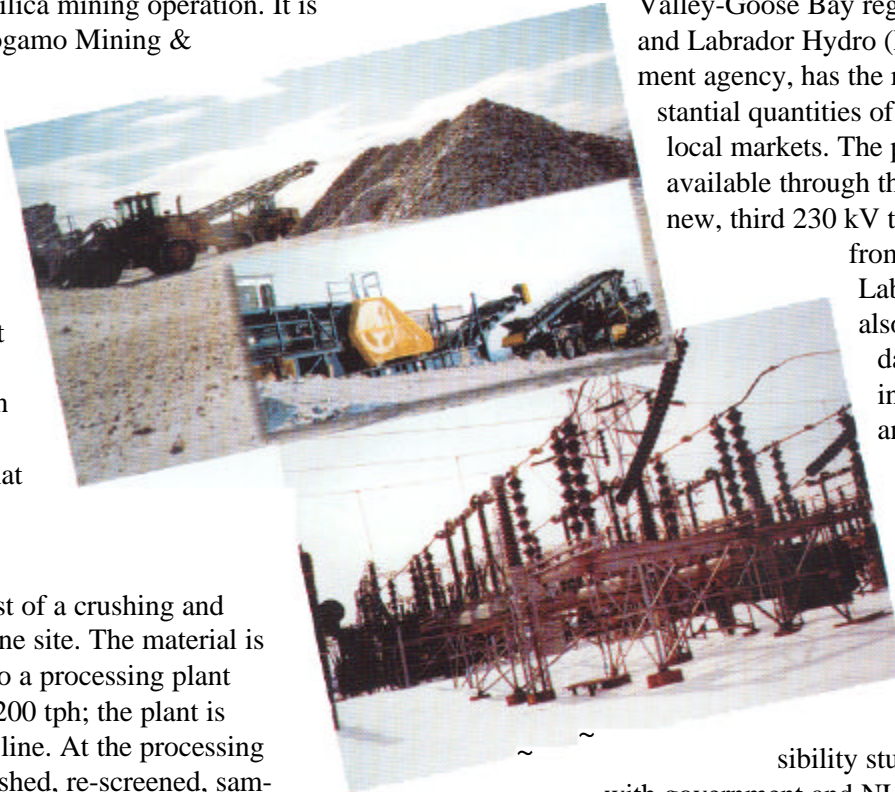
Abundant forest resources for making wood chips are available in the immediate vicinity of Labrador City and

Wabush. Large forest resources are also available along the year-round Trans Labrador Highway that runs east, from Labrador City to Churchill Falls and Happy Valley-Goose Bay.

*Electrical Power*

The Churchill Falls hydroelectric project is one of the largest underground hydro generating plants in the world and supplies large quantities of low-cost power to the iron ore mining and beneficiation operations in Labrador West and Quebec, the aluminum smelters and other power-intensive industries in Quebec and to the populace of Labrador West and the Happy Valley-Goose Bay region. Newfoundland and Labrador Hydro (NLH), a government agency, has the right to recall substantial quantities of this power to serve local markets. The power can be made available through the construction of a new, third 230 kV transmission line from Churchill Falls to Labrador West. It would also accommodate expected growth in the iron ore industry and in the general market.

The price of power to the silicon metal project would be determined during any project feasibility study in conjunction with government and NLH. However, power will be competitively priced.



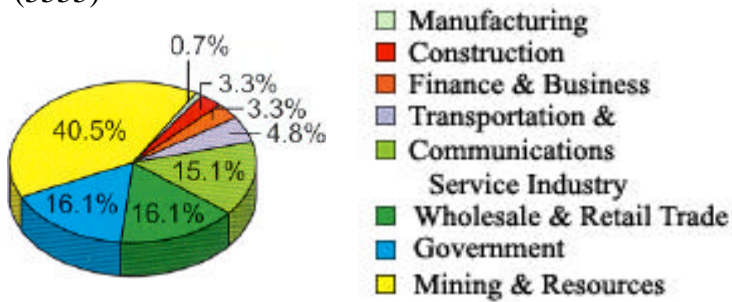
***“A world-class mineral resource”***

# WORKFORCE WITH INDUSTRIAL EXPERTISE

## HUMAN RESOURCES

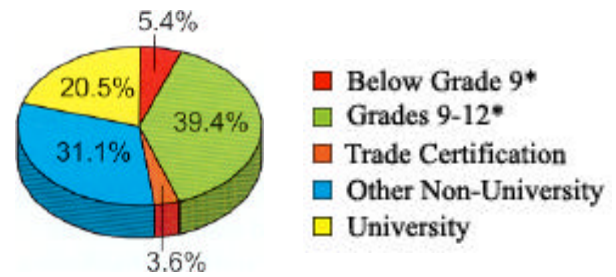
The Labrador West region developed about 40 years ago as an iron ore mining and beneficiation centre. Thus, minerals-related activities account for about 40% of the total local labour market. Therefore, there is a substantial local tradition of employment in the metals industry and all skills relevant to silicon smelter operations are available locally.

Labour Force (1996)  
(5555)



The labour relations climate reflects the understanding that cooperation among all parties to maximize efficiency is essential because the market for mineral products is global in nature, and extremely competitive. The number of work-related disputes has steadily declined to its present-day historical low.

Achieved Education Level (Age 15+)



\* Percentages include individuals aged 15 years or older who are still in high school

The workforce in Labrador West is well educated, highly skilled and very stable. As illustrated in the pie chart, approximately 55% of the working-age population has achieved an educational level beyond high school, and approximately 85% graduated high school. In a nation-wide comparison of twenty economic zones, Labrador West performed extremely well in high school graduation rates and in various basic and math skills performance indicators.

The Iron Ore Company of Canada and the United Steel Workers of America in partnership with the College of the North Atlantic, and local community stakeholders have established the highly innovative "Employee of The Future Program". This industrial training program is designed to develop a flexible, multi-skilled employee ready to meet the needs of today's highly technical workplace.



# A HIGHLY DEVELOPED INFRASTRUCTURE

## INFRASTRUCTURE AND TRANSPORTATION

The Labrador West region consists of the towns of Labrador City, Wabush and Churchill Falls. The nearby town of Fermont, Quebec, is part of the same economic region. The region offers a full range of social, recreational, educational and medical facilities as well as an inventory of both residential and industrial properties designed to accommodate future expansion.

The area has a well-developed telecommunication system including customized telephone networks, and cellular and teleconferencing services. Under a federal government program Labrador is becoming a leader in the integration of information and communications technologies into the community and local businesses. This includes internet connectivity, video-conferencing and high-speed data and voice transfer.

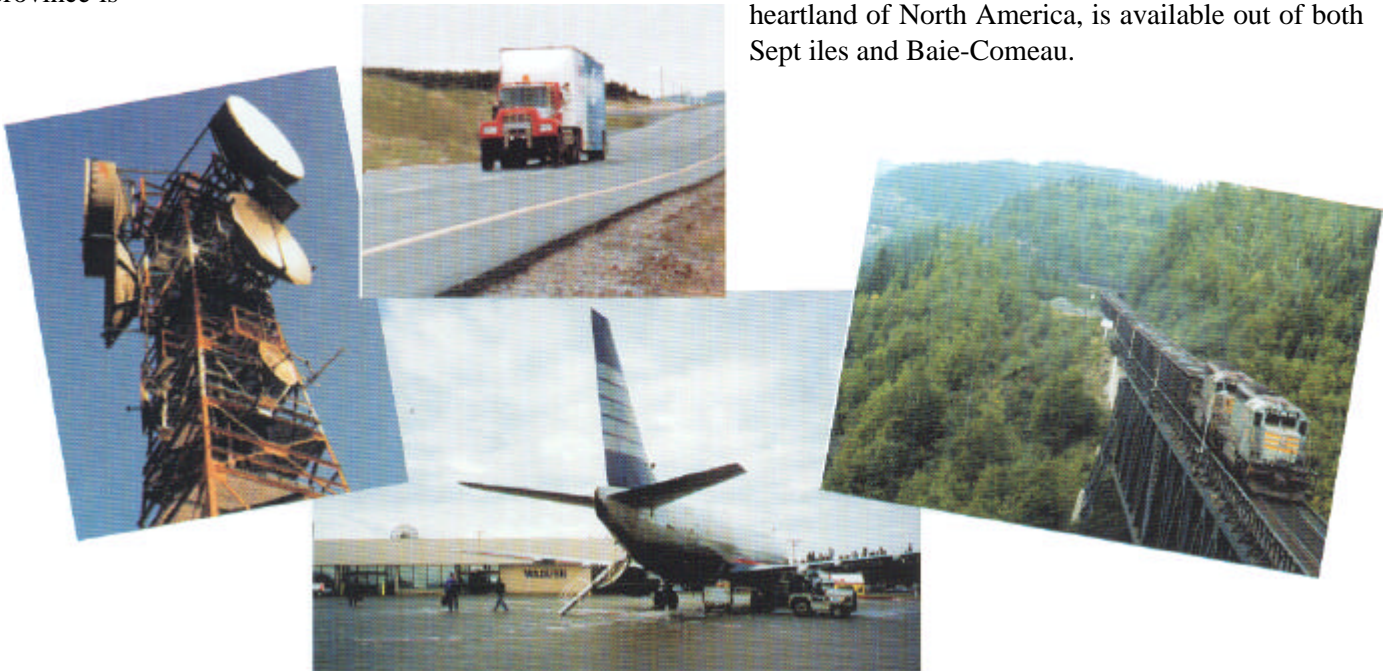
Provincial telecentres provide on-line access to investment opportunities, statistical information, community profiles, major library indexes and government procurement and public tendering information. The province is

a participant in distance education and telemedicine and is recognized as a world leader in the provision of these types of services.

Labrador West is served by the Quebec North Shore & Labrador Railway which links the region to Sept îles, Quebec, a deepwater, year-round port. Iron ore is the principal outbound product while inbound traffic consists of supplies to the iron ore mining industry and the general community. Because outbound traffic is substantially in excess of inbound, it would probably be possible to negotiate attractive backhaul freight rates for materials and supplies required for a silicon smelter.

As an alternative to the railroad, the Baie-Comeau Road and Trans Labrador Highway link the region with the year-round port of Baie-Comeau in Quebec. This highway network is the principal supply route to the communities of Fermont, Labrador City, Wabush, Churchill Falls and Happy Valley-Goose Bay. Since most trucks return empty, it would probably be possible to negotiate heavily discounted backhaul freight rates for silicon metal shipments, at least to Baie-Comeau.

Low-cost shipping to the Great Lakes, the industrial heartland of North America, is available out of both Sept îles and Baie-Comeau.



# A FAVOURABLE BUSINESS CLIMATE

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## FRIENDLY INVESTMENT ENVIRONMENT

The federal, provincial and municipal governments in Canada are committed to positive economic development and offer a variety of incentives to ensure the success of new projects. At the local level, economic agencies offer support and incentives for new business ventures.

The Canadian government currently assesses a basic federal corporate tax of 28% of net income on all businesses. Substantial deductions from this base rate exist for certain sectors. For example, a manufacturing and processing tax credit of 7% is available. Furthermore, the federal government has announced that within five years the corporate tax rate would be reduced from 28% to 21% for businesses not currently eligible for special tax treatment. A federal investment tax credit of 10% of the cost of qualified property used in the province is also available.

A new or expanding company may qualify for status under the province's Economic Diversification and Growth Enterprise Program (EDGE). EDGE provides for start-up assistance, the leasing of Crown Land for a nominal fee, and tax breaks to qualifying companies, including:

*A 10-year waiver on the provincial income tax of 14% of net income, phased in over an additional five years.*

*A 10-year waiver on the 2% health and post-secondary education tax that is assessed on gross salaries and wage bills in excess of \$400 000, phased in over an additional five years.*

*"A competitive  
tax regime ....  
ready for the global  
marketplace"*

A dedicated facilitator will assist the investor in gaining access to funding and in obtaining permits and licenses or any other authorizations necessary to implement a business plan. The facilitator will also assist in accessing various other incentive programs in such areas as human-resource development.

There are some mandatory employee benefit programs to which both companies and employees must contribute.

*At the federal level, companies and employees must contribute to both Employment Insurance and the Canada Pension Plan.*

*At the provincial level, employers must carry workers compensation premiums that alleviate an individual company's responsibility to carry independent liability insurance.*

The Provincial Sales Tax and the Federal Goods and Services Tax (GST) are combined to form the 15% Harmonized Sales Tax (HST). Because businesses are allowed full input tax credits for HST paid in the province, the effective tax rate is 0%.



# A LIFESTYLE TO APPRECIATE

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## AN INVITING LIFESTYLE

Labradorians live close to nature, having a relaxed pace of life that emphasizes quality. Labrador offers clean air and water, a spectacular natural environment and abundant opportunities for outdoor recreation in which the stresses and strains of modern living find many avenues for healthy release. With a relaxed pace of life, a low crime rate, and nature at their doorstep, it is no wonder that Labradorians are renowned for their friendliness, spirit and sense of community.

In the Labrador West area, affordable housing is just minutes from shopping, schools, parks and restaurants. The towns offer a wide range of activities including cultural centres, nightlife, sporting activities and a wide range of social clubs and service organizations. Outdoor recreational opportunities abound, including downhill and cross-country skiing, snowmobiling, golfing, boating, hunting and fishing.

Labrador West combines the advantages of modern living with life close to nature. It is a fine place to live, work, and raise a family.

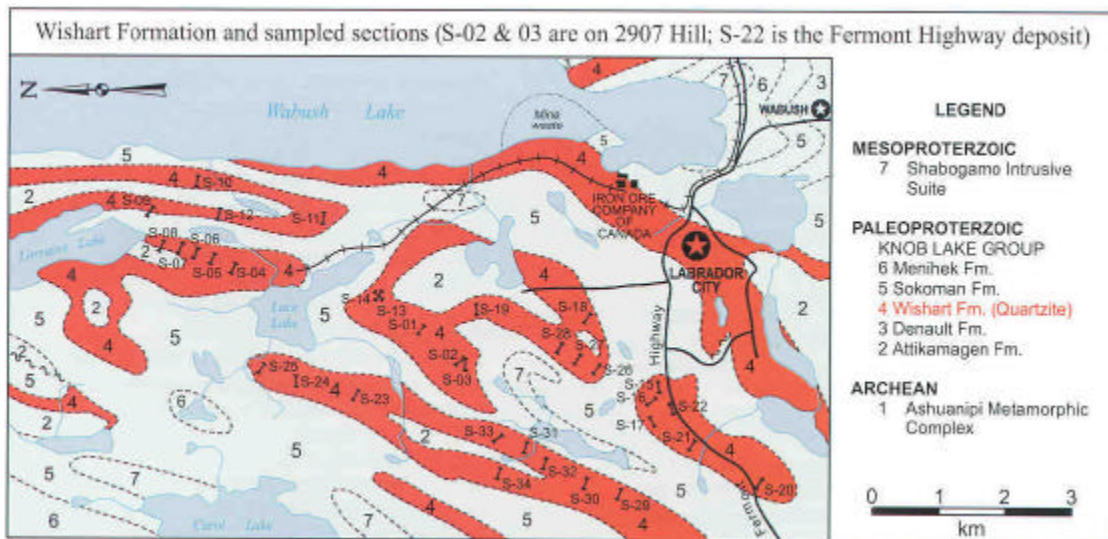


*"... a great place  
to live and work"*



**Table A.** Average chemical analyses for channel-sampled sections (shown on figure below) across quartzite ridges in the Labrador West area (from Meyer and Dean, 1986)

Section	No. of Samples	(percent)											Total	(SiO <sub>2</sub> calc.)
		SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>tot</sub>	MgO	CaO	Na <sub>2</sub> O	K <sub>2</sub> O	TiO <sub>2</sub>	MnO	P <sub>2</sub> O <sub>5</sub>	LOI		
S-01	3	99.47	0.10	0.10	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.22	99.97	99.49
S-02	22	99.08	0.09	0.05	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.28	99.56	99.49
S-03	23	99.10	0.13	0.07	0.02	0.03	0.02	0.03	0.01	0.01	0.02	0.27	99.67	99.40
S-04	7	99.05	0.06	0.03	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.34	99.53	99.48
S-05	4	99.09	0.10	0.06	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.25	99.53	99.52
S-06	8	99.40	0.10	0.06	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.18	99.81	99.56
S-07	11	99.36	0.08	0.17	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.26	100.04	99.38
S-08	6	99.10	0.08	0.51	0.02	0.04	0.01	0.01	0.01	0.02	0.02	0.33	100.11	98.96
S-09	6	99.12	0.12	0.23	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.18	99.71	99.36
S-10	5	98.62	0.22	0.28	0.12	0.15	0.01	0.04	0.02	0.01	0.02	0.44	99.92	98.69
S-11	10	98.47	0.27	0.60	0.08	0.03	0.01	0.03	0.02	0.01	0.02	0.23	99.75	98.69
S-12	7	97.57	0.64	0.88	0.16	0.05	0.10	0.13	0.02	0.02	0.03	0.32	99.90	97.65
S-13	14	99.18	0.08	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.20	99.53	99.61
S-14	14	98.95	0.14	0.12	0.01	0.01	0.01	0.03	0.01	0.01	0.02	0.23	99.50	99.41
S-15	5	98.57	0.10	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.22	99.05	99.50
S-16	6	99.10	0.13	0.03	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.20	99.51	99.55
S-17	4	93.66	4.93	0.10	0.02	0.01	0.01	0.26	0.02	0.01	0.01	0.43	99.45	94.20
S-18	8	99.14	0.23	0.06	0.02	0.01	0.01	0.05	0.01	0.01	0.01	0.31	99.82	99.28
S-19	5	98.73	0.12	0.06	0.01	0.04	0.01	0.02	0.01	0.01	0.03	0.22	99.22	99.48
S-20	4	93.49	3.47	0.46	0.23	0.05	0.03	0.23	0.11	0.01	0.03	0.78	99.86	94.61
S-21	6	98.83	0.26	0.08	0.02	0.02	0.01	0.06	0.03	0.01	0.02	0.28	99.59	99.22
S-22	4	98.66	0.22	0.04	0.02	0.03	0.01	0.01	0.01	0.01	0.02	0.33	99.32	99.32
S-23	10	98.12	0.38	0.18	0.03	0.06	0.12	0.05	0.01	0.01	0.01	0.31	99.27	98.83
S-24	7	99.31	0.13	0.16	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.26	99.93	99.35
S-25	10	98.72	0.23	0.39	0.03	0.04	0.01	0.02	0.03	0.02	0.01	0.19	99.66	99.03
S-26	27	99.15	0.06	0.09	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.22	99.59	99.53
S-27	26	98.88	0.23	0.09	0.02	0.03	0.03	0.05	0.02	0.01	0.01	0.27	99.59	99.25
S-28	16	98.86	0.28	0.11	0.02	0.02	0.01	0.05	0.02	0.01	0.01	0.22	99.59	99.25
S-29	3	99.19	0.10	0.07	0.02	0.02	0.01	0.02	0.03	0.01	0.01	0.17	99.62	99.55
S-30	6	98.81	0.30	0.09	0.03	0.05	0.08	0.05	0.03	0.01	0.04	0.30	99.75	99.05
S-31	7	99.01	0.10	0.15	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.24	99.61	99.38
S-32	6	99.33	0.08	0.15	0.02	0.03	0.01	0.02	0.02	0.01	0.02	0.27	99.90	99.39
S-33	51	99.09	0.10	0.21	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.25	99.74	99.32
S-34	6	99.10	0.11	0.03	0.01	0.03	0.01	0.01	0.02	0.01	0.01	0.25	99.57	99.50



**Table B.** Chemical analyses of quartzite product ready for shipment to smelter

Sample No.	(percent)			
	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	TiO <sub>2</sub>
04-13-069	0.0245	0.0676	0.0054	0.0009
04-14-070	0.0322	0.0674	0.0052	0.0009
04-17-071	0.0185	0.0576	0.0049	0.0008
04-18-072	0.0260	0.0579	0.0062	0.0008
04-19-073	0.0306	0.0476	0.0025	0.0012
04-20-074	0.0342	0.0523	0.0049	0.0011
04-24-075	0.0410	0.0490	0.0048	0.0008
05-01-076	0.0305	0.0628	0.0101	0.0012
05-02-077	0.0294	0.0508	0.0095	0.0012
05-03-078	0.0370	0.0653	0.0161	0.0012
05-04-079	0.0525	0.0870	0.0043	0.0016
05-08-080	0.0378	0.0737	0.0095	0.0024
05-09-081	0.0350	0.0543	0.0084	0.0012
05-10-082	0.0341	0.0663	0.0122	0.0014
05-11-083	0.0188	0.0303	0.0031	0.0008
05-15-084	0.0409	0.0718	0.0097	0.0026
05-16-085	<u>0.0360</u>	<u>0.0668</u>	<u>0.0079</u>	<u>0.0017</u>
Average (17 samples)	0.0311	0.0571	0.069	0.0012

NOTE: The average SiO<sub>2</sub> content is approximately 99.5%

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Department of Mines and Energy: <http://www.gov.nf.ca/mines&en/>

Labrador West: <http://www.labradorwest.com>

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