Newfoundland Labrador

Natural Resources

PRELIMINARY GEOLOGICAL ASSESSMENT OF THE JULIENNE LAKE IRON ORE DEPOSIT, WESTERN LABRADOR

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1. Introduction

The Julienne Lake iron ore deposit is located approximately 27 km by road north of the towns of Labrador City/Wabush in western Labrador (Figure 1). Exploration on the Julienne Lake property from the 1950s to the 1970s included reconnaissance and detailed geological mapping and prospecting, ground magnetometer traverses, surface trenching, test pitting and diamond drilling. Historical data indicate a resource of 500,034,000 long tons at 34.2% Fe, with low manganese contents. In 2010, the provincial government conducted a drilling program and preliminary metallurgical study to further evaluate the potential of the resource for development. In total, 42 diamond drill holes were completed with a cumulative length of 9,238.3m. Mechanical trenching on the property was also completed along two grid line sections (total length approx. 1600 m). These data were used to create a new resources estimate for the Julienne Lake iron ore deposit.

This report presents a preliminary geological assessment of the Julienne Lake iron ore deposit. In 2012 the Geological Survey of Newfoundland and Labrador undertook a reevaluation of all data from the Julienne Lake deposit, including logging and geochemical sampling of 11 diamond drill holes from the 2010 drill program (cumulative length 2995 m). In addition, outcrops and exposed trenches at Julienne Lake were remapped, in order to correlate surface exposures to corresponding drill holes and to determine the structure of the deposit.

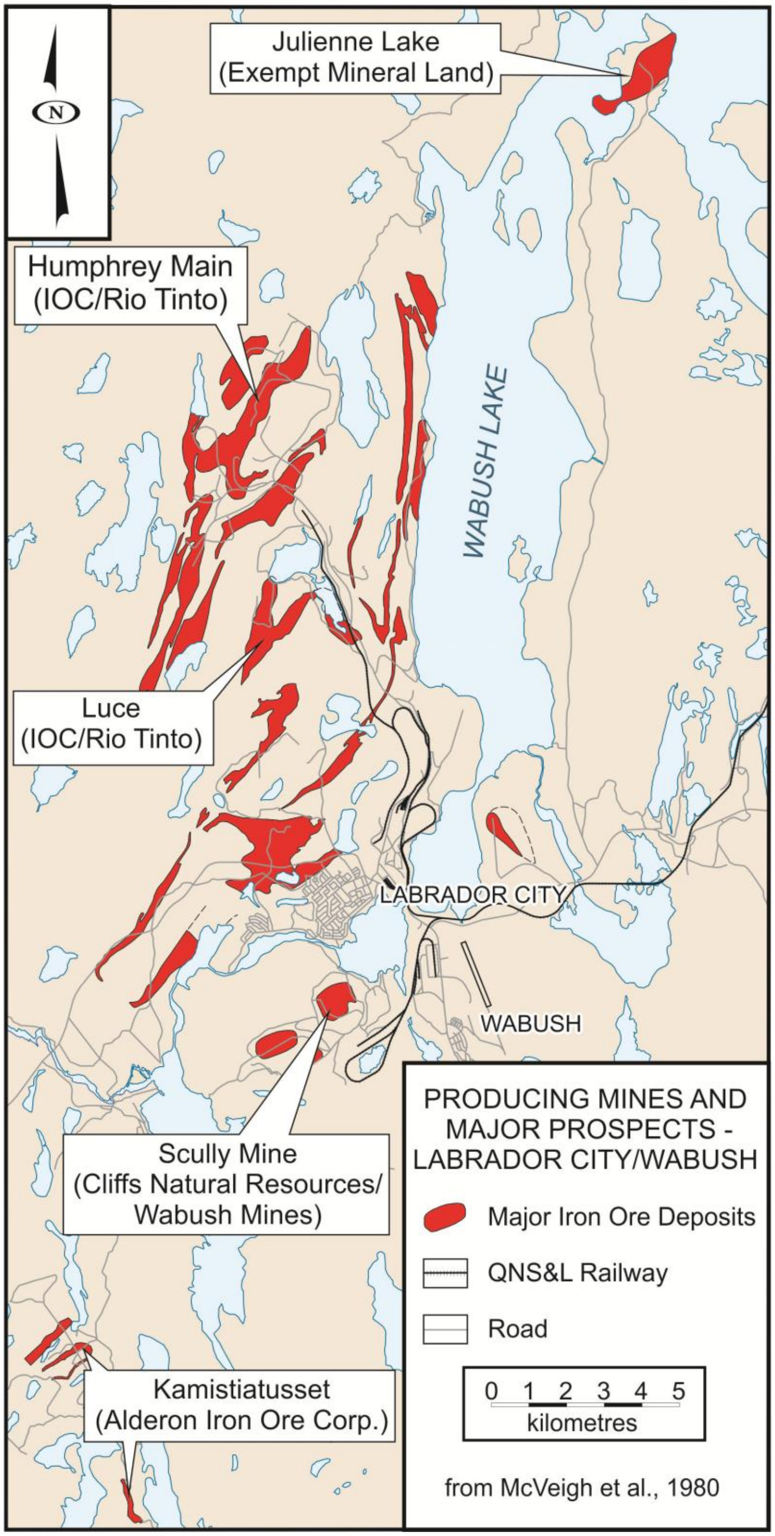

Figure 1. *Map showing distribution of iron ore deposits in the Labrador City-Wabush area (adapted from McVeigh et al., 1980)*

2. Regional Geology

The Julienne Lake iron ore deposit is hosted in the Sokoman Formation, a 30–170m thick sequence of cherty iron-rich sedimentary rocks which are continuous throughout the Labrador Trough. The Sokoman Formation forms part of the Paleoproterozoic Kaniapiskau Supergroup (Zajac, 1974; Wardle and Bailey, 1981), which consists of a lower rift-related sequence and an upper transgressive sequence that progresses from shelf-type rocks at the base through deep water turbidites and into shallow marine or terrestrial rocks at the top (Figure 2). It forms the western part of a larger orogenic belt called the New Québec Orogen and was deposited between 2.17 and 1.87 Ga (Wardle et al., 2002).

In southwestern Labrador, the Labrador Trough extends into the younger Grenville Province, where the sedimentary rocks were highly metamorphosed and complexly folded during the Trans-Hudsonian and Grenvillian orogenies (Klein, 1978; van Gool et al., 2008). Although metamorphosed and deformed, the essential stratigraphy of the sedimentary rocks remains discernable in the Labrador City/Wabush area. The Sokoman Formation has been subdivided into three members (Gross, 1968; Zajac, 1974). The lower part of the Sokoman Formation (Lower Iron Formation) consists largely of a carbonate-silicate facies with some magnetite. This grades upward into an oxide facies with abundant coarse grained hematite and/or magnetite and sugary textured quartz (Middle Iron Formation). These oxide-rich beds are the most important economically, with iron-rich layers and lenses commonly containing more than 50% hematite and magnetite. The upper part of the Sokoman Formation (Upper Iron Formation) is a carbonate-silicate facies with minor oxides. The Sokoman Formation is underlain by quartzites of the Wishart Formation. The overlying rocks (Menihek Formation) consist largely of graphitic, chloritic and micaceous schists.

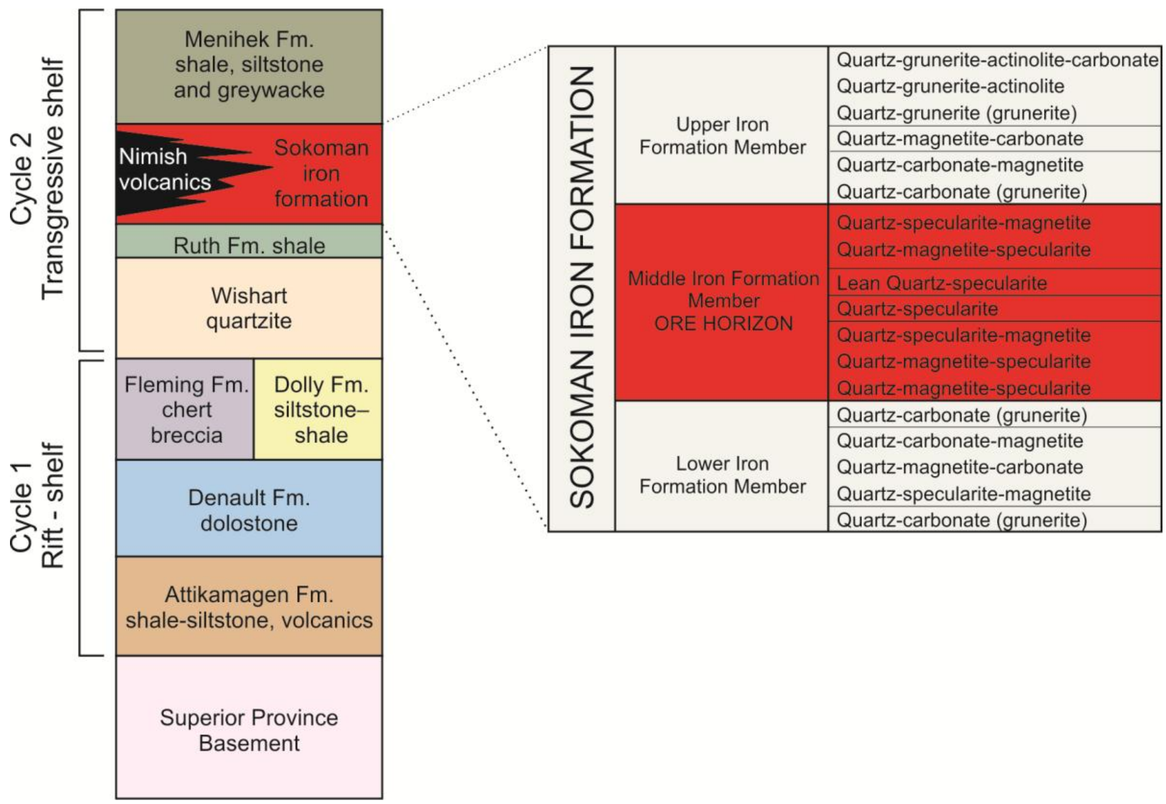

Figure 2. *Stratigraphy of the Kaniapiskau Supergroup, after Zajac (1974)*

3. Objectives

The main objectives of this study were to

- determine the stratigraphy of the Sokoman Formation at Julienne Lake, including any possible marker horizons
- determine the structure of the deposit

- collect samples for additional geochemistry, including trace element and REE
- compare the Julienne Lake deposit with other iron ore deposits in the Labrador City/Wabush area.

Table 1: *List of 2010 drill holes logged during this project*

Hole ID	Section	Length (m)	East	North	Dip	Azimuth
JL10-01	L1800E	300	648456.89	5889290.1	-90	0
JL10-01A	L1800E	293	648457.68	5889289.1	-50	150
JL10-05+EXT	L1800E	575	648413.64	5889363.8	-90	0
JL10-08	L1800E	302	648341.7	5889493.9	-90	0
JL10-11A+EXT	L1800E	355	648266.39	5889624.6	-90	0
JL10-14	L1350E	185	648017.96	5889136.7	-90	0
JL10-15	L1800E	273	648195.36	5889753.7	-90	0
JL10-16	L1350E	182	648064.01	5889052.8	-90	0
JL10-16A	L1350E	176	648064.63	5889051.8	-50	150
JL10-17B	L1800E	181	648094.81	5889923.9	-90	0
JL10-20	L1800E	133	648055.18	5889998.8	-90	0

4. 2012 Summer Fieldwork

Summer fieldwork in 2012 focused on logging drill core from government drilling in 2010. These drill holes were from two sections across the property, L1350E and L1800E, which correspond to the two trenches opened in 2010. In total, 2955m of drill core (located in Goose Bay, Labrador), representing eleven holes were logged as part of this project (Table 1) and 338 samples were taken for further geochemical analysis (trace element and REE).

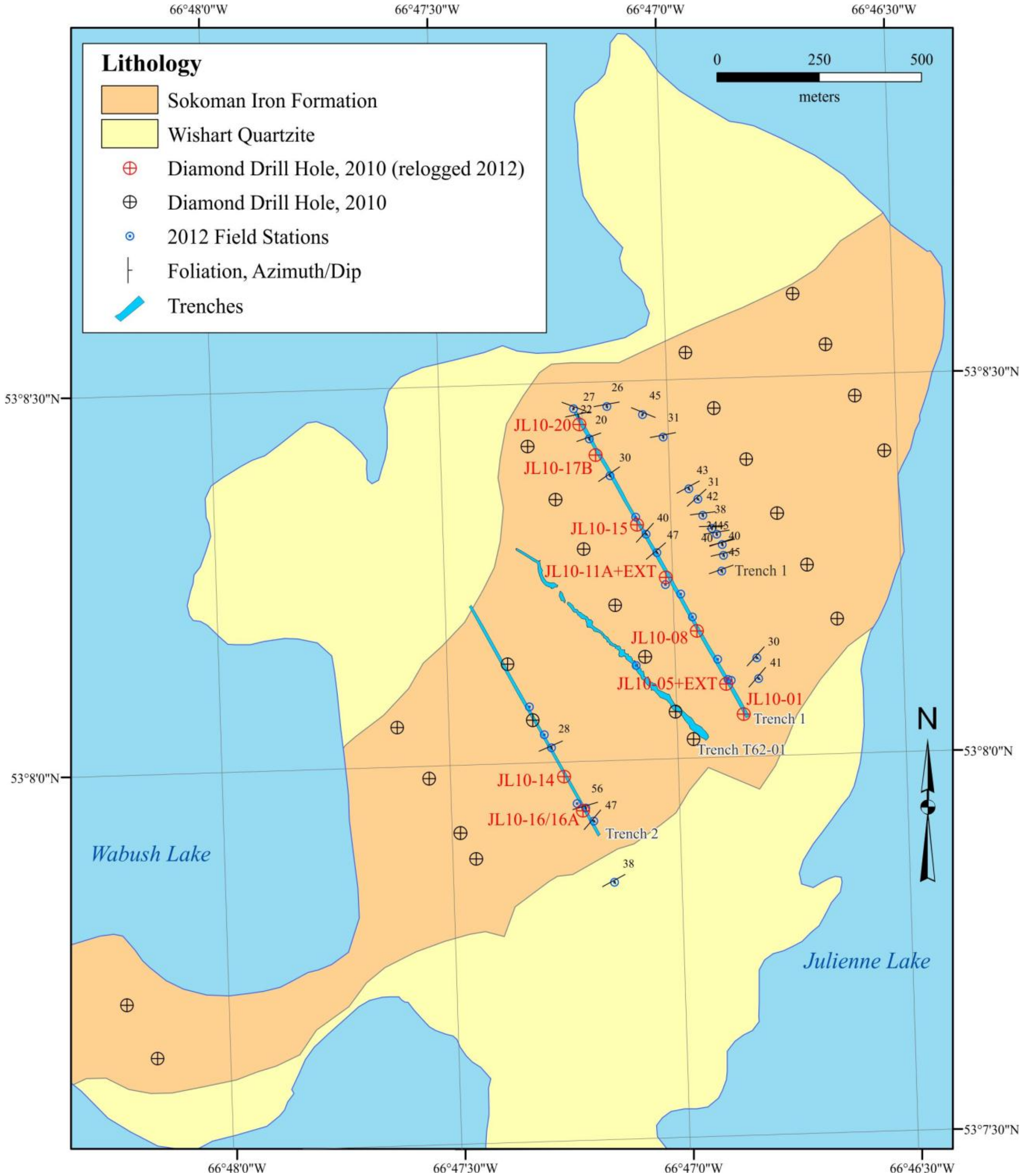

Figure 3. *Surface plan map of the Julienne Lake peninsula, showing main iron formation contacts and location of trenches, 2012 field stations and 2010 diamond drill holes*

In addition, outcrops and previously exposed trenches at the Julienne Lake deposit were mapped, in order to collect structural data. During this mapping, 26 geochemical samples were collected for correlations with drill core samples.

5. Rock Types

5.1. Middle Iron Formation (MIF)

The MIF is the principal ore bearing formation at Julienne Lake. It has been divided into three lithological units.

Quartz-specularite schist (QS)

Quartz-specularite schist is the dominant rock type in the Sokoman Formation at Julienne Lake, making up > 95% of the total thickness of iron formation in the logged drill holes. Overall this unit ranges from semi-massive QS, with disseminated quartz and specularite (Fig. 4), to well banded QS with alternating quartz-rich and specularite-rich bands (Fig. 5). In places, QS grades into bands of almost pure hematite. In previous reports this unit was subdivided into a number of separate rock type: banded semi-massive specularite-quartz schist; quartz-specularite schist; quartz-specularite-granular hematite schist; and quartz-granular hematite schist (Coates et al. 2012). However, field observations and detailed logging of drill core indicate that these units represent a rock type, with varying degrees of alteration and recrystallization.

Mineralogically, this unit consists of medium to coarse grained specularite and quartz (with minor red granular hematite, goethite and limonite). In places the unit is highly leached and friable (Fig. 6). Magnetite is generally rare, although several magnetite-rich horizons were identified (magnetic susceptibility measurements up to 74.5 x10-3 SI). These magnetite-rich units correspond to coarser-grained QS, and most likely represent remnant magnetite remaining after the transformation of magnetite to martite.

Alteration throughout the unit ranges from minor hematization and red staining of the core to intense and pervasive alteration to hematite, goethite and limonite. Alteration is strongest in brecciated zones or along foliations in banded QS, and is most likely related to late stage fluid flow (deep weathering?).

Mn-rich iron formation

Intervals of pyrolusite-bearing Mn-rich iron formation account for < 2.5% of the total thickness of iron formation in the logged drill holes. These units have a characteristic black sooty appearance (Fig. 7), with disseminated specularite, quartz and pyrolusite and numerous pyrolusite-bearing veinlets. They form thin beds (generally less than 5m thick) with sharp upper and lower contacts (Fig. 8) and rare pyrolusite veinlets in the overlying and underlying units. It appears that manganese concentration in these beds is associated with hydrothermal fluid flow (supergene or surficial enrichment), and is not recorded at deeper levels (> 300m).

Lean white quartzite

Lean white quartzite makes up < 3% of the total thickness of iron formation in the logged drill holes. It consists of 60-80% medium- to coarse-grained quartz, with variable amounts of disseminated specularite, limonite and goethite and rare specularite bands (Fig. 9). This unit is similar to the middle quartzite at Wabush Mines (Farquharson and Thalenhorst, 2006) and may prove a useful marker horizon.

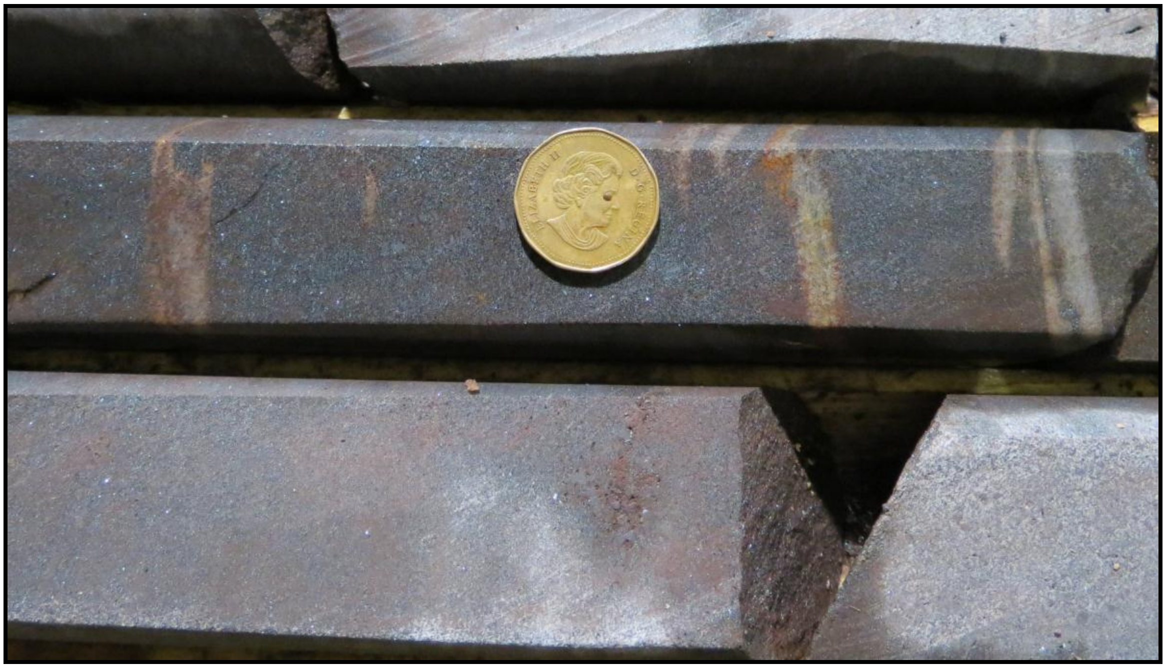

Figure 4: *Massive QS iron formation with thin quartz-rich layers (from JL10-15)*

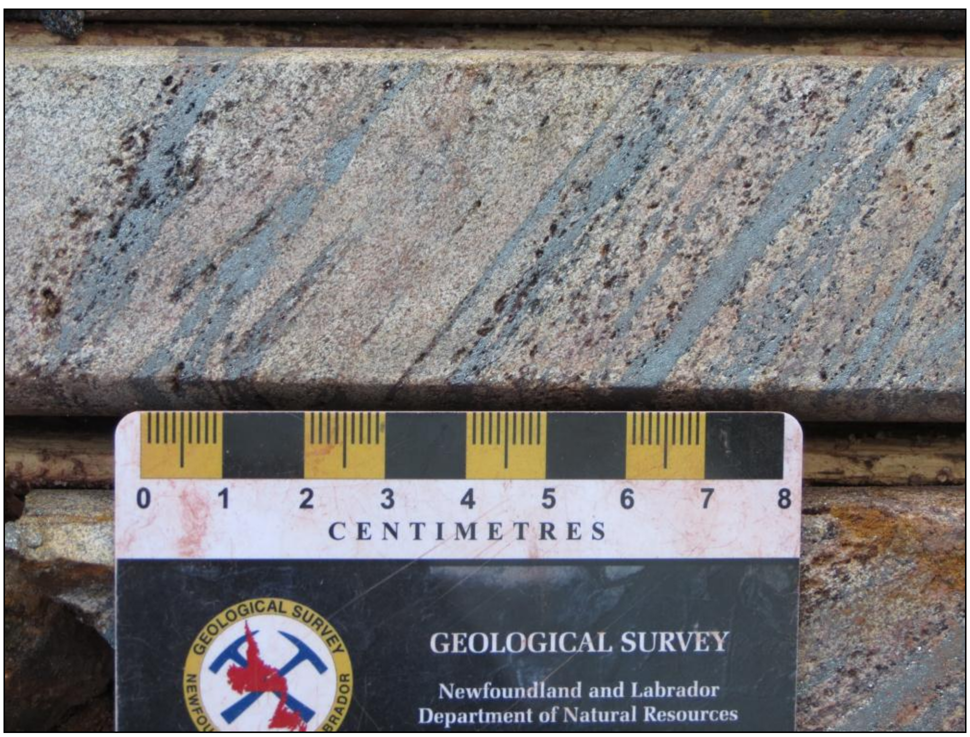

Figure 5: *Banded QS iron formation, with quartz-rich layers and bands of pure specularite (from JL10-16)*

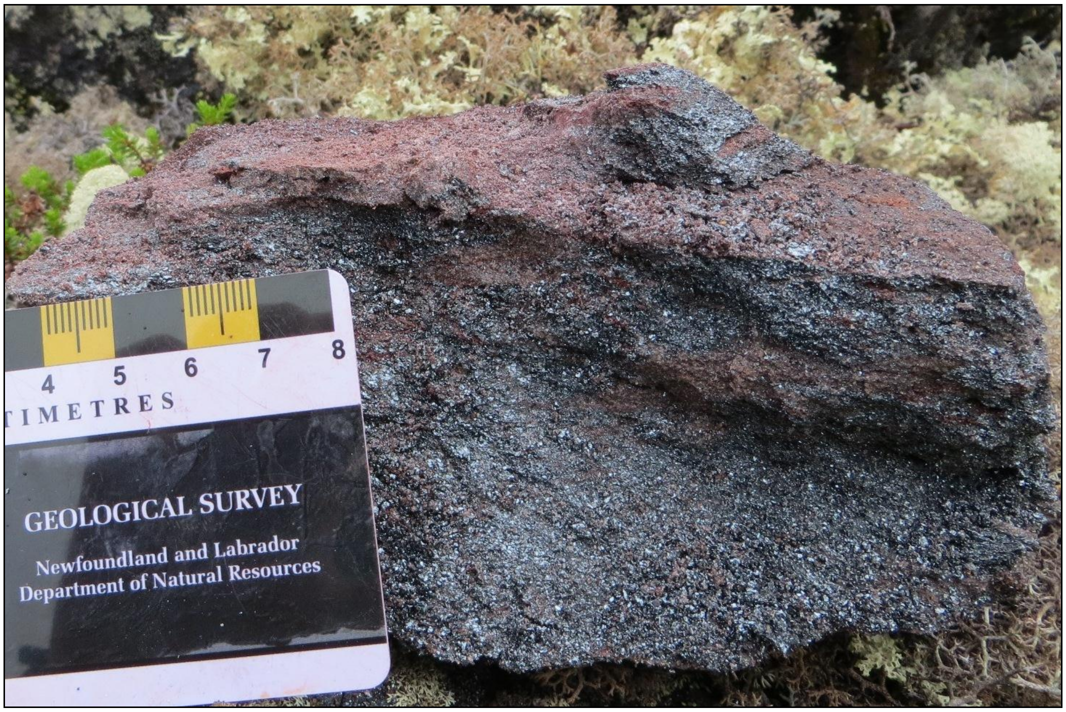

Figure 6: *Massive, friable quartz-specularite iron formation*

Figure 7: *Pyrolusite-bearing, Mn-rich iron formation, with typical black sooty appearance (from JL10-17B)*

Figure 8: *Gently dipping bed of Mn-rich iron formation, from north end of Trench 1*

Figure 9: *Lean white quartzite outcrop, with thin specularite bands*

Figure 10: *Lean white quartzite (from JL10-16)*

5.2. Lower Iron Formation (LIF)

The LIF has been recorded at the base of the MIF in all eight drill holes which penetrated the Sokoman Iron Formation. It ranges in thickness from 1.55 to 16.35m and commonly has faulted upper and/or lower contacts. The LIF is commonly strongly altered and brecciated (Fig. 11), making identification of primary mineralogy difficult. Mineralogy is generally red hematite, quartz, goethite, limonite, and iron silicates, with rare specularite bands. Euhedral garnet pseudomorphs (replaced by hematite and limonite) have also been recorded. This unit is similar to the Basal Iron Silicate Unit recorded at the Wabush Mine. Due to the large amount of heavily oxidized material in the LIF it is likely that this unit is of lesser economic importance compared to the MIF.

Figure 11: *Brecciated and strongly altered Lower Iron Formation (from JL10-14)*

5.3. Wishart Quartzite

The Wishart Quartzite defines the footwall contact of the Sokoman Iron Formation at Julienne Lake, and has been recorded in all drill holes which penetrate the iron formation. The quartzite is well-bedded in outcrop (Fig. 12), and is strongly recrystallized with coarse grained quartz. Thin bands of hematite and hematite staining recorded close to the upper contact. Core recovery is poor, and the quartzite close to the contact with the iron formation is intensely leached and friable, in places consisting entirely of micaceous sand (Fig. 13).

Figure 12: *Well-bedded Wishart Quartzite in quarry south of the Sokoman Iron Formation*

Figure 13: *Intensely leached micaceous sand in the Wishart Quartzite (from JL10-17B)*

6. Structure

The structure of the Julienne Lake iron ore deposit has been the subject of some debate. Initial mapping and drilling subdivided the Sokoman formation into a series of lithological units which defined the limbs of a refolded northeast-southwest trending syncline (Knowles, 1960). During the fieldwork and trenching program of the 2010 exploration program no evidence was found for the postulated hinge zone reported by Knowles (1960). Based on these data, the structure of the deposit was reinterpreted by Coates et al. (2012). The lower contact of iron formation with the underlying Wishart Quartzite was interpreted as a northeasterly striking gently to moderately southeasterly dipping conformable boundary. The southeastern contact was defined by a steep, northeast-trending fault (Coates et al., 2012). The unusual thickness of the Sokoman Iron Formation on the Julienne Lake peninsula (up to 573m) was attributed to thrust stacking (Clarke, *pers. comm.*).

During this project, structural data were collected from drill core and bedrock exposures (including exposed trenches). These data indicate that the Julienne Lake iron ore deposit is structurally complex, with multiple phases of folding and faulting. Preliminary observations include:

- The majority of beds strike to the northeast (040° to 080°) and dip gently to the southwest at 20 to 50 degrees
- Small-scale isoclinal folds (Fig. 14) and rapid changes in bedding attitude are commonly recorded in drill core
- Evidence for a major fold hinge was observed in the historical trench T62-01 (Fig. 15) and in Trench 1 close to the collar of drill hole JL-10-11A (Fig. 16)

- Numerous intervals of clay-like fault gouge are recorded in drill core, particularly along section L1800E
- The lower contact of the Sokoman Formation is strongly brecciated and commonly faulted, possible representing a basal thrust

Due to the highly faulted nature of the Sokoman Formation it is difficult to correlate units between drill holes, especially at the south end of section L1800E, where complicated folding and thrust repetition is likely responsible for the thickness of the iron formation. However, initial interpretations along section L1350E indicate that the deposit represents an overturned syncline (Fig. 17). This is consistent with regional structural patterns, which record kilometre-scale, NNE-trending folds and thrust repetition (Van Gool et al., 2008).

Figure 14: *M-type folding in possible fold hinge, associated with alteration (from JL10-08)*

Figure 15: *Folded bands of coarse grained specularite (from historical trench T62-01)*

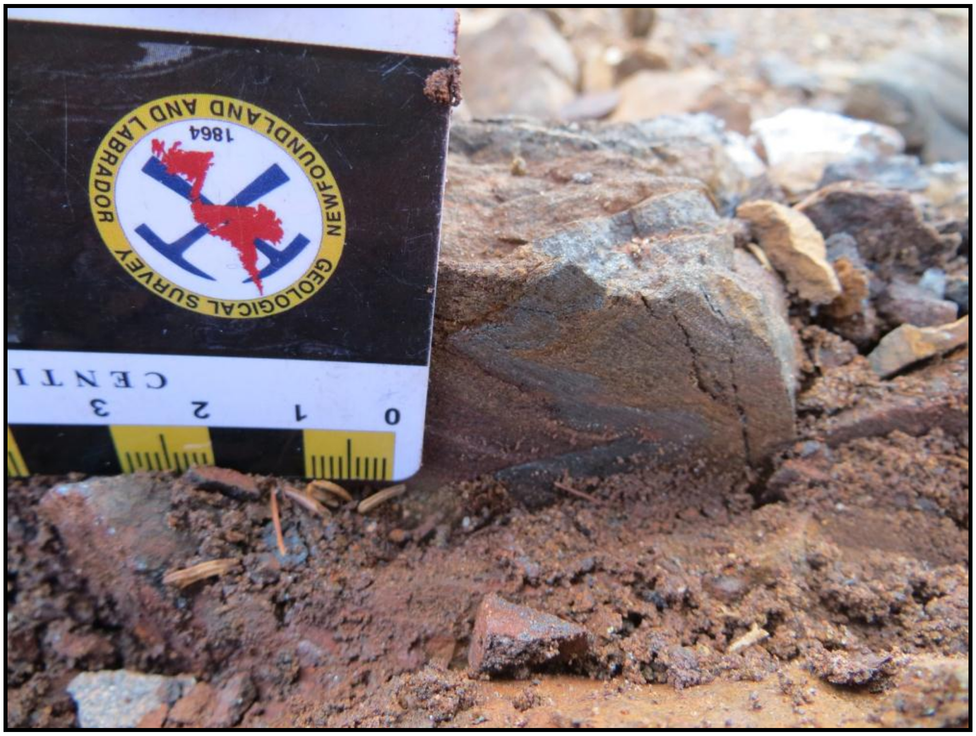

Figure 16: *Tight isoclinal folding of specularite band (from Trench 1, close to collar of JL-10-11A)*

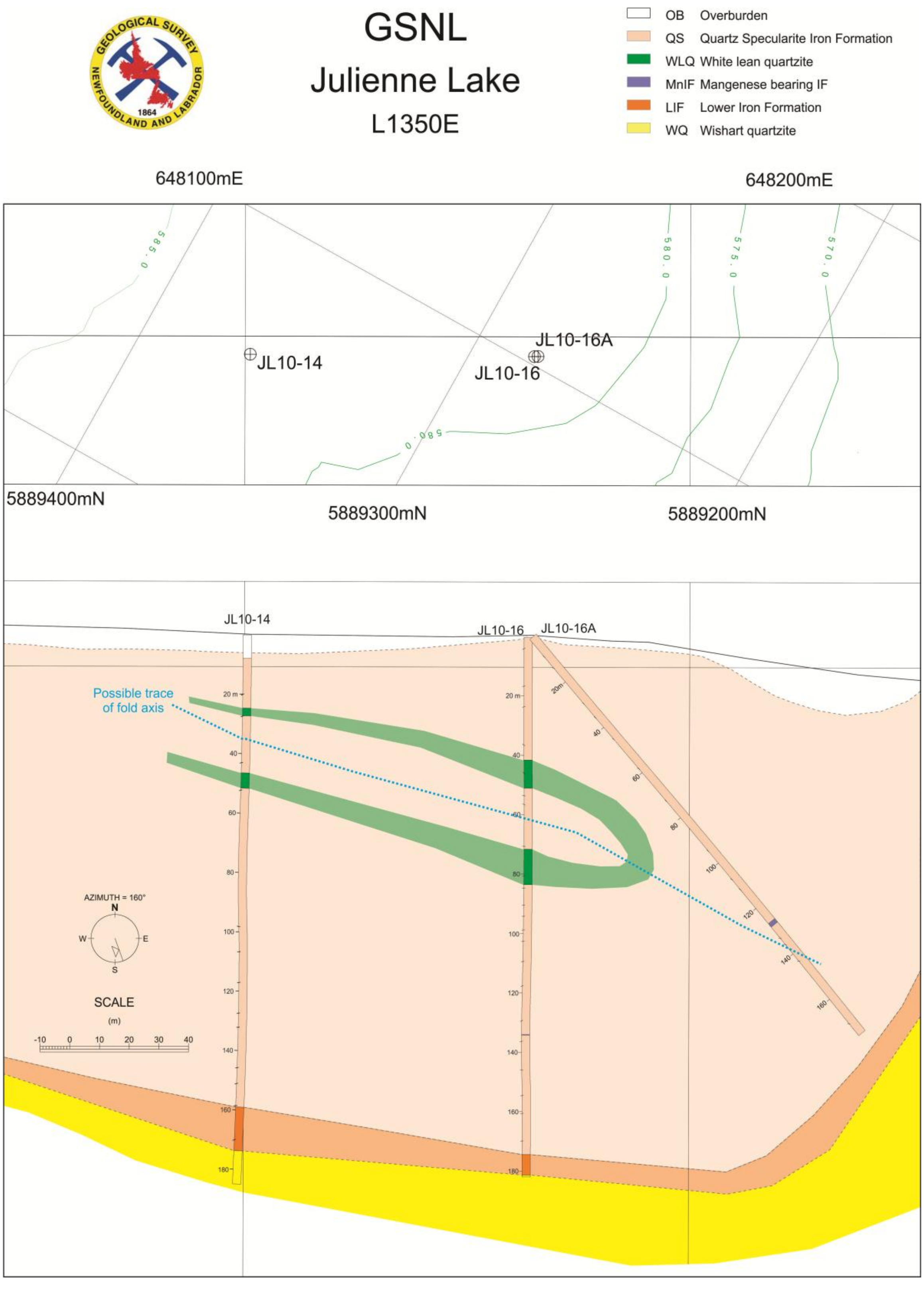

Figure 17: *Preliminary cross section from south end of Trench 2 (section L1350E).*

7. Comparison with other nearby iron ore deposits

The iron ore deposit at Julienne Lake is located close to a number of other large metataconites type iron deposits, including operating mines at Carol Lake and the Scully Mine in Labrador City/Wabush (Fig. 3) and Mont-Wright and Bloom Lake in adjacent Québec. In addition, there are a number of advanced exploration projects in the Labrador City/Wabush area, including the Kamistiatusset (Kami) project (5 km southwest of Wabush) which is slated to go into production in 2015. Despite the close proximity of these deposits there are significant variations in terms of mineralogy, alteration and stratigraphy, which have important implications for development of individual deposits.

The Julienne Lake iron ore deposit shares a number of characteristics with a number of these deposits, particularly the Scully Mine and the Rose North Deposit at Kami. These include;

- The mineralogy of the iron formation (specularite >> magnetite),
- The extent of secondary weathering (leading to the development of limonite, goethite and secondary hematite)
- The presence of Mn-rich intervals and a narrow layer of Fe-silicate–rich iron formation at the base of the Sokoman Formation

Geological interpretations of the Rose North Deposit by Alderon geologists suggest that it is hosted in the same basin as the Scully Mine, termed the Wabush Basin. The Wabush Basin extends from the Rose Lake area NNE beyond the town of Wabush. Due to the similarities between these deposits and the Julienne Lake iron ore deposit, the iron formations on the Julienne Peninsula may represents a continuation of this basin.

8. Future Studies

Current research is focused on identification of marker horizons in the Julienne Lake iron ore deposit, which will lead to a better understanding of the structure of the deposit. Geochemical data from drill core and outcrop samples may lead to better correlations between drill holes. In addition, regional studies are aimed at comparing the geological and geochemical of the Julienne Lake iron ore deposit with other nearby deposits, which may aid in future exploration in the Labrador City/Wabush area.

References

Alderon Resource Corp.

Various public documents regarding company's Labrador Trough activities, posted at www.sedar.com

Coates, H., Thein, A.M., Cote, M.

2012: Report on the 2010 exploration program, Julienne Lake iron deposit, western Labrador, Newfoundland & Labrador, for Department of Natural Resources, Government of Newfoundland and Labrador, 214 pages.

Farquharson, G., Thalenhorst, H.

2006: Wabush Mines, Review of Scully Mine Reserves, by Strathcona Mineral Services Limited, for Department of Natural Resources, Government of Newfoundland and Labrador, Company Report, 27 pages.

Gross, G.A.

1968: Geology of Iron Deposits of Canada, Volume III. Iron Ranges of the Labrador Geosyncline. Geological Survey of Canada, Economic Geology Report 22, page 179.

Klein, C.

1978: Regional metamorphism of Proterozoic iron-formation, Labrador Trough, Canada. American Mineralogist, v. 63, p. 898-912.

Knowles, D.M.

1960: A report of studies conducted during 1959-1960 on the Julienne Lake deposit, Labrador, Canadian Javelin Limited, Newfoundland and Labrador Geological Survey, Assessment File 23G/0124, 1960, 59 pages.

McVeigh, H.G., Elliott, R.A., Neal, H.E. and Rolling, F.J.

1980: Potential for further iron ore development in Newfoundland and Labrador. Hatch Associates Ltd. Unpublished report (for Department of Mines and Energy, Government of Newfoundland and Labrador), 175 pages. [GSB# LAB/0523]

Newfoundland and Labrador Geological Survey

1975: Julienne Lake iron deposit, Labrador, summary report, Mineral Development Division, Department of Mines and Energy, Province of Newfoundland Government Report, 1975, 20 pages, [023G/02/0071].

Van Gool, J.A.M., Rivers, T., Calon, T.

2008: Grenville Front Zone, Gagnon terrane, southwestern Labrador: Configuration of a midcrustal foreland fold-thrust zone. Tectonics, v. 27, TC1004.

Wardle, R.J., Bailey, D.G.

1981: Early Proterozoic Sequences in Labrador. In: Campbell, F.H.A. (Ed.), Proterozoic Basins of Canada. Geological Survey of Canada Paper 81–10. pp. 331–359.

Wardle, R.J., James, D.T., Scott, D.J., Hall, J.

2002: The Southeastern Churchill Province: synthesis of a Paleoproterozoic transpressional orogen: Proterozoic evolution of the northeastern Canadian Shield: Lithoprobe eastern Canadian Shield onshore– offshore transect. Canadian Journal of Earth Sciences, v. 39, pages 639–663.

Zajac, I.S.

1974: The Stratigraphy and Mineralogy of the Sokoman Iron Formation in the Knob Lake Area, Quebec and Newfoundland. Geological Survey of Canada, Bulletin 220, p. 159.