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FLUORIDE IN TILL IN LABRADOR – A DATA RELEASE

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ABSTRACT

Fluoride analysis was determined by ion-selective electrode readings after alkaline fusion for 2483 till samples collected in Labrador between 1983 and 2004 (Figure 1). The samples were collected from the Alexis River, Central Mineral Belt, Letitia Lake, Strange Lake and Labrador Trough regions in Labrador. The results of these analyses are presented in this report.

INTRODUCTION

The Geological Survey of Newfoundland and Labrador has been measuring fluoride in till since the 1990s. Anomalous fluoride in till could provide assistance in exploring for pegmatites, fluorite deposits, or rare-element deposits hosted in granite, given the association of fluorite with mineralizing environments hosting them (*e.g.*, Williams-Jones *et al.*, 2012). In 2018, analytical fluoride results for 18 141 till samples collected on the island between 1985 and 2017 were published (Amor, 2018). Anomalous fluoride concentrations in these till samples were used to determine trace mineralization related to lithium–cesium–tantalum (LCT) pegmatites in central Newfoundland (Magyarosi, 2020). This release reports new fluoride occurrences in till for Labrador, as part of the ongoing till geochemistry program, and to assist surface exploration efforts in regions of suspected rare-element mineralization.

Further investigations into fluoride and its suitability as a geochemical indicator for rare-element abundances in surficial sediments are ongoing, including integrating results from mineralogical and geochemical studies (*e.g.*, Magyarosi, 2020; Magyarosi and Conliffe, 2021) and applying these to surficial-sediment studies.

QUALITY ASSURANCE

STANDARDS

The till certified reference materials (CRM) include those supplied by Natural Resources Canada (Lynch, 1996). These are inserted along with the samples, with the expectation that the analyzed elements fall within the certified values and ranges (*see* https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/mining-resources/till-1-till-2-till-3-and-till-4-certificate-analysis/8137 and other sources). For samples collected in 2001 and 2004, the rock-sample standards AND-1, BS-1, GA-1, GD-1, GA-2, and RY-1 were used as “in-house” standards (Finch *et al.*, 2018). Fluoride is not included in the elemental suite for the Natural Resources Canada till standards, hence fluoride control charts of analytical results from the Geological Survey of Newfoundland and Labrador’s Geochemical Laboratory are used for quality control (Finch *et al.*, 2018). The results of fluoride analysis of multiple certified reference standards from the current Labrador project are presented in Table 2 including the reference material, the mean of fluoride (F) measurements from this study, the type of reference material, the expected fluoride values and ranges (based on repeated measurements of the external and in-house laboratory reference samples), and the amount of “recovery” (*e.g.*, how close the actual measurement was to the standard).

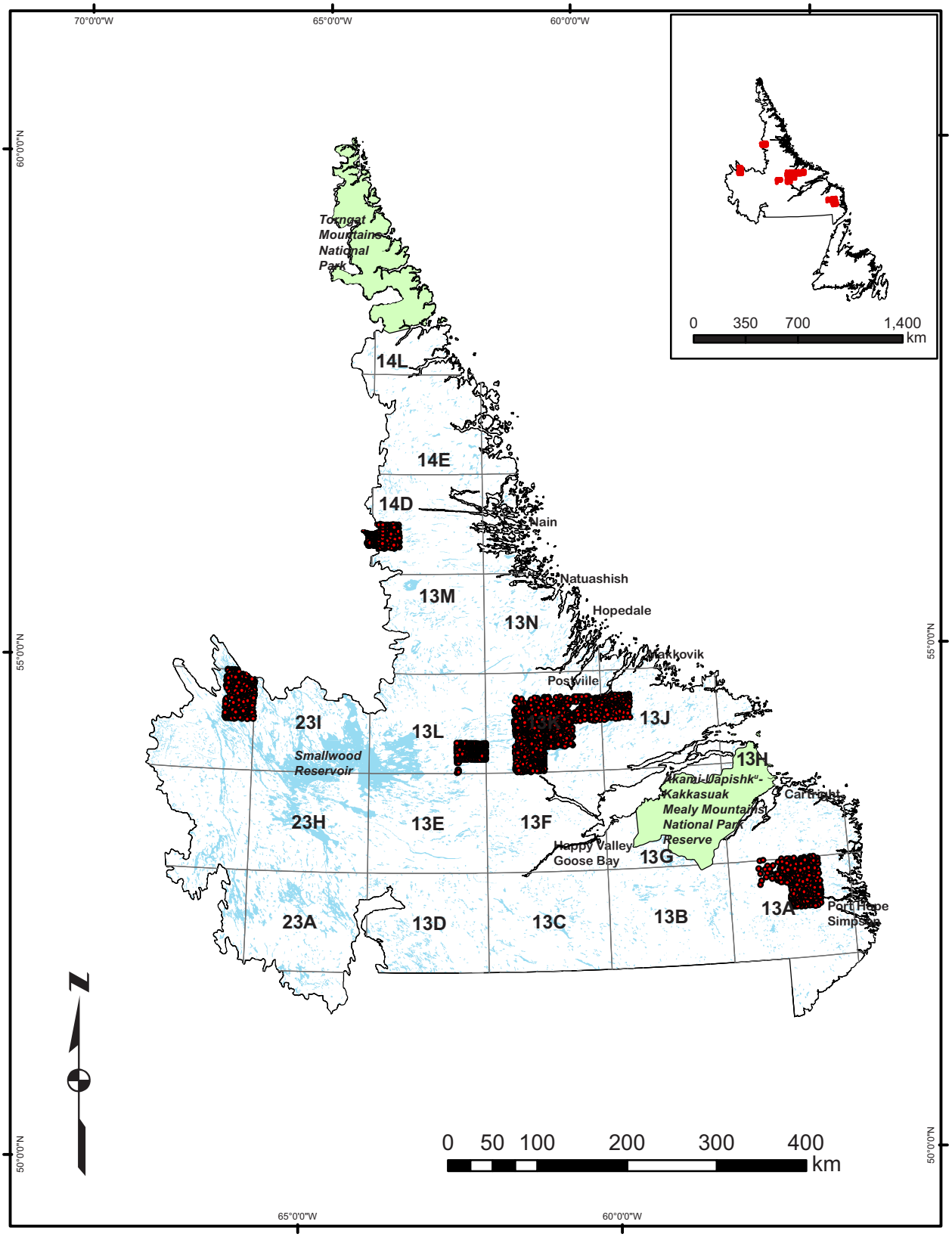

Figure 1. *Map of Labrador showing the distribution of the 2483 samples, with the associated regions labelled.* See *Table 1 for more details.*

Table 1. Table of minimum and maximum fluoride values are presented, along with the total amount of samples analyzed, sieve sizes, areas and NTS sheets associated with the samples. The lab number series, the Open Files and the geologists associated with the samples are also presented

Geologist and Year Sampled	Associated Open File	NTS Map Sheet	Area	Sieve Size (µm)	Sample Series Range* (Lab Number)	F Min (ppm)	F Max (ppm)	Number of Samples
Vanderveer, 1983	LAB/1479	24A/08, 14D/05	Strange Lake	<63	8033001–8033206	231	801	166
Batterson, 1984	LAB/1479	24A/08, 14D/05	Strange Lake	<63	5038928–5038728	197	798	367
Batterson, 1985	13L/0121	13L/01, 13L/08	Letitia Lake	<63	5037069–5037275	84	1180	176
Batterson, 1986	LAB/1392	13J/12, 13K/07 13K/09 13K/10	Moran Lake, Melody Lake	<180	5030001–5031111	74	2258	522
Liverman, 1992	23J/0303	23J/09, 23J/16	Cavers and Hollinger Lake	<63	7230458–7230833	191	1335	284
McCuaig, 2001	13A/0046	13A/10, 13A/14 13A/15	Alexis River	<180	8830013–8830511	151	1468	367
McCuaig, 2004	13K/0283	13K/03, 13K/11	Snegamook Lake	<180	8830909–8831596	73	585	601

* These numbers represent the upper and lower numbers of the sample series only, as some samples could not be located for analysis. Samples with not enough material for analysis (*i.e.*, not analyzed) are labelled as -9. *See* Appendix 1 for a complete list of samples

The results of the reference material analysis indicate that most of the CRM values are within 10% of the recommended values, with the exception of the analysis of in-house rock standards in Batch 1 (Table 2).

DUPLICATES

Thompson–Howarth (1978) plots (Figure 2) of 120 laboratory duplicate analysis pairs display a graphical estimate of the precision. However, this type of graphical analysis does not account for the dependence of precision on concentration (*see* Amor, 2018). This type of dependence is illustrated in Figure 3, where the relative standard deviation is plotted against the concentrations of fluoride in till, and the spread of the duplicate readings is less for samples of higher concentrations. In Figure 4, the ratio plot (ad.plot3-Garret, 2018) is used to display the ratio of the duplicate readings versus the mean of the duplicate readings (*see* Garrett, 2015). This display indicates that most of the duplicate readings (in this figure) fall within the classical estimates of the 95%

Table 2. Table summarizing means, upper and lower limits and the average recovery from multiple fluoride analyses from internal (AND-1, BS-1. GA-1, GD-1, GA-2, and RY-1) and external (TILL1-4) standards

Batch CRM or in-house control	Average F ppm measured (ISE)	Material	GSNL Laboratory mean of replicate analysis (in-house materials)	Upper Limit	Lower Limit	Average Recovery
Batch 1						
AND-1 (n=3)	356	Rock standard	273	342	205	130%
BS-1 (n=3)	292	Rock standard	212	265	159	138%
GA-1 (n=3)	311	Rock standard	280	350	210	111%
GD-1 (n=3)	248	Rock standard	214	267	160	116%
GD-2 (n=3)	22	Rock standard	22	28	17	100%
RY-1 (n=3)	119	Rock standard	106	133	80	112%
Batch 2						
TILL-1 (n=4)	376	Till standard	378	472	283	98%
TILL-2 (n=5)	489	Till standard	465	582	349	99%
TILL-3 (n=4)	263	Till standard	260	326	195	101%
TILL-4 (n=3)	379	Till standard	362	452	271	105%
Batch 3						
TILL-1 (n=23)	375	Till standard	378	472	283	99%
TILL-2 (n=23)	455	Till standard	465	582	349	98%
TILL-3 (n=22)	261	Till standard	260	326	195	100%
TILL-4 (n=4)	366	Till standard	362	452	271	101%
Batch 4						
TILL-1 (n=5)	354	Till standard	378	472	283	94%
TILL-2 (n=5)	445	Till standard	465	582	349	96%
TILL-3 (n=5)	257	Till standard	260	326	195	98%
TILL-4 (n=4)	380	Till standard	362	452	271	105%
Batch 5						
TILL-1 (n=2)	372	Till standard	378	472	283	98%
TILL-2 (n=2)	454	Till standard	465	582	349	98%
TILL-3 (n=2)	245	Till standard	260	326	195	94%
TILL-4 (n=1)	336	Till standard	362	452	271	93%

confidence interval for the concentration range of the readings, with the exception of 9 outliers, 7 of which are near the 95% confidence bounds (Figure 3).

The results from the standard and duplicate analyses are considered satisfactory. The results of this report and database will be discussed in a future publication.

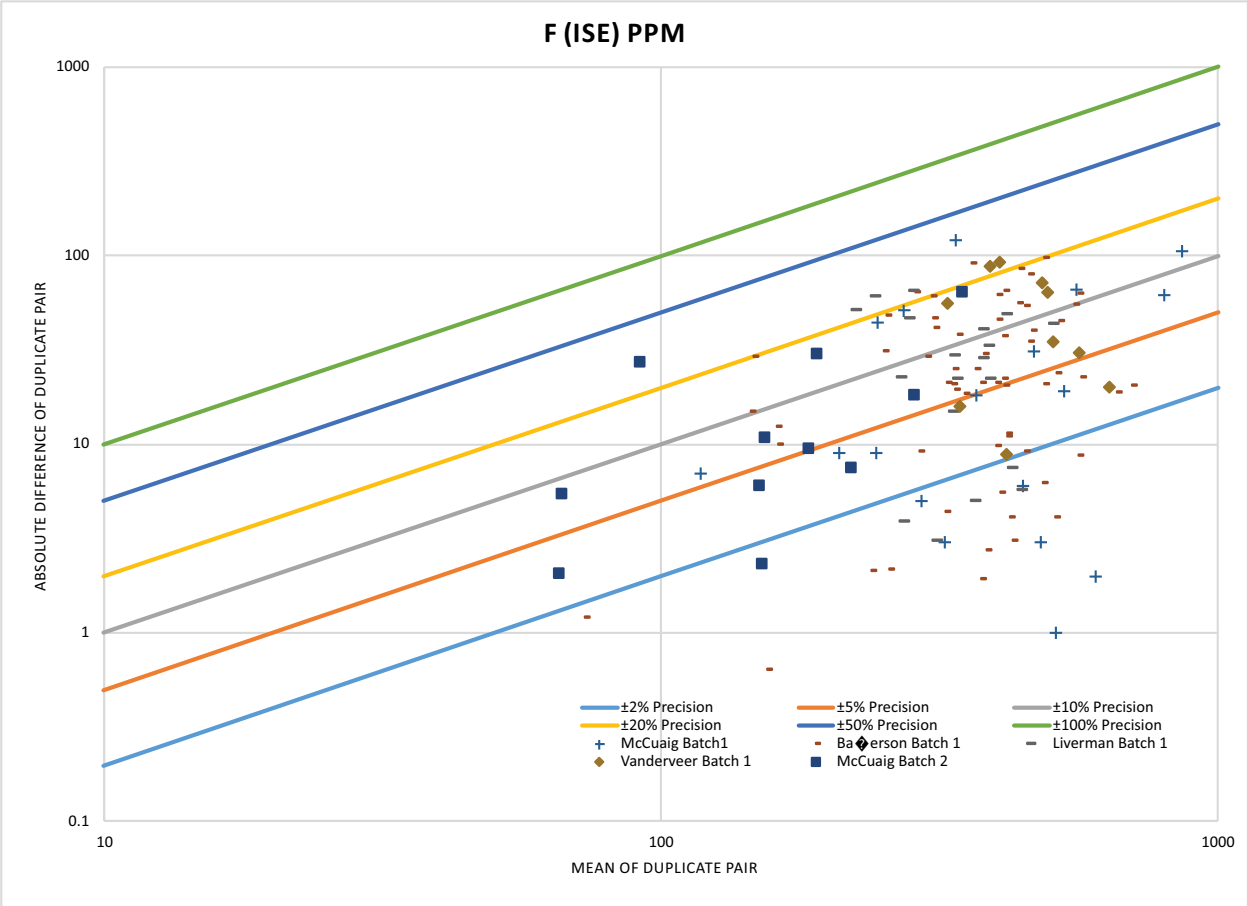

Figure 2. *Thompson–Howarth plot showing the absolute difference between a duplicate pair and the mean. Most of the results of the duplicate lab analysis are within 20% precision - with 9 outliers.*

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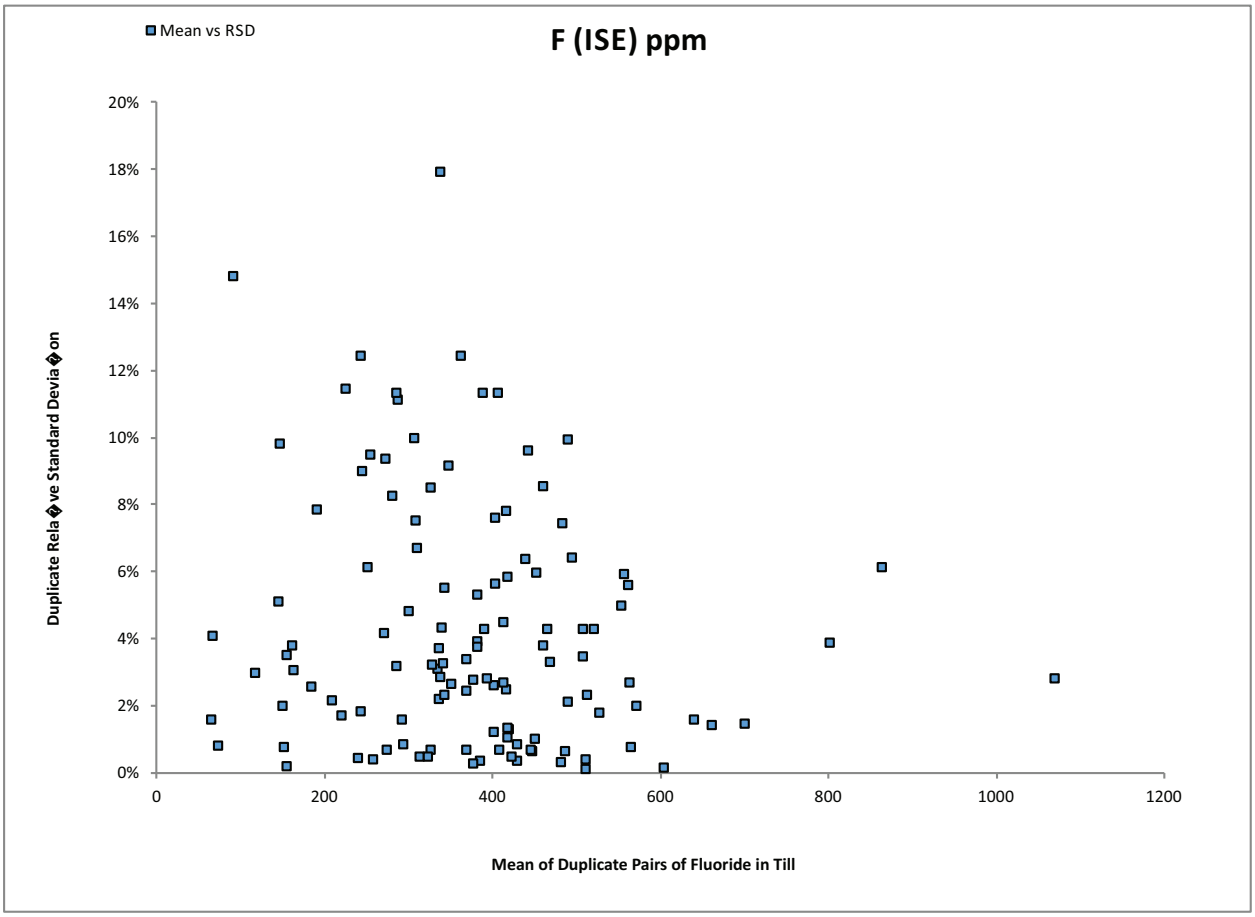

Figure 3. *Plot showing the relative standard deviation (RSD) compared to the mean of duplicate pairs. The relative standard deviation of the duplicates improves with concentration for the bulk of the duplicate pairs.*

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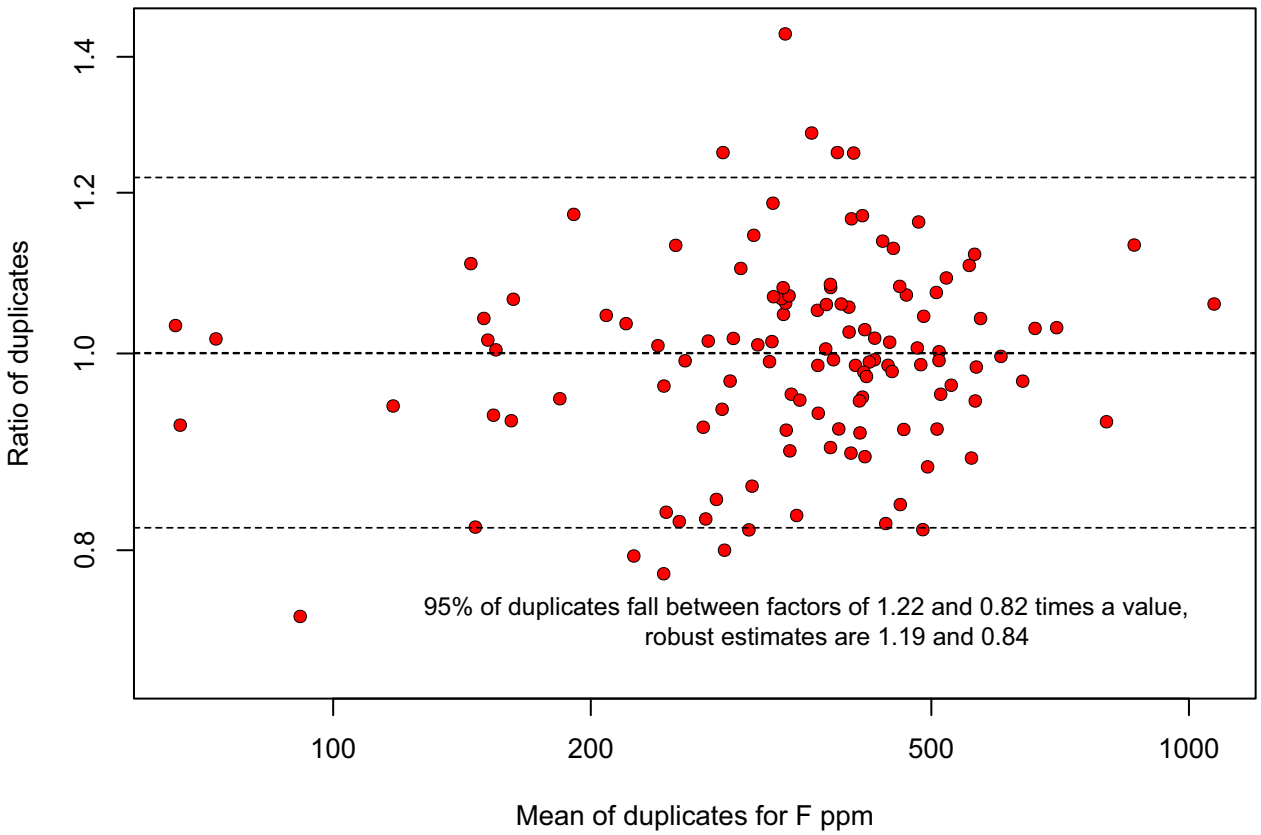

Figure 4. *Logarithmically scaled plot showing the ratio of the duplicates* vs. *the mean of duplicate pairs (Garrett, 2015, 2018). The ratio of duplicates is 1 if the variance is 0, and the graph allows for an easy way to visualize the spread of the duplicate data with concentrations. Variance is detected between two of the samples, with the rest falling under or near the classic estimate of the 95% confidence bounds.*

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APPENDIX

Appendix A is available through this link.

APPENDIX A: Database of Fluoride Results from 2483 Samples in Labrador.