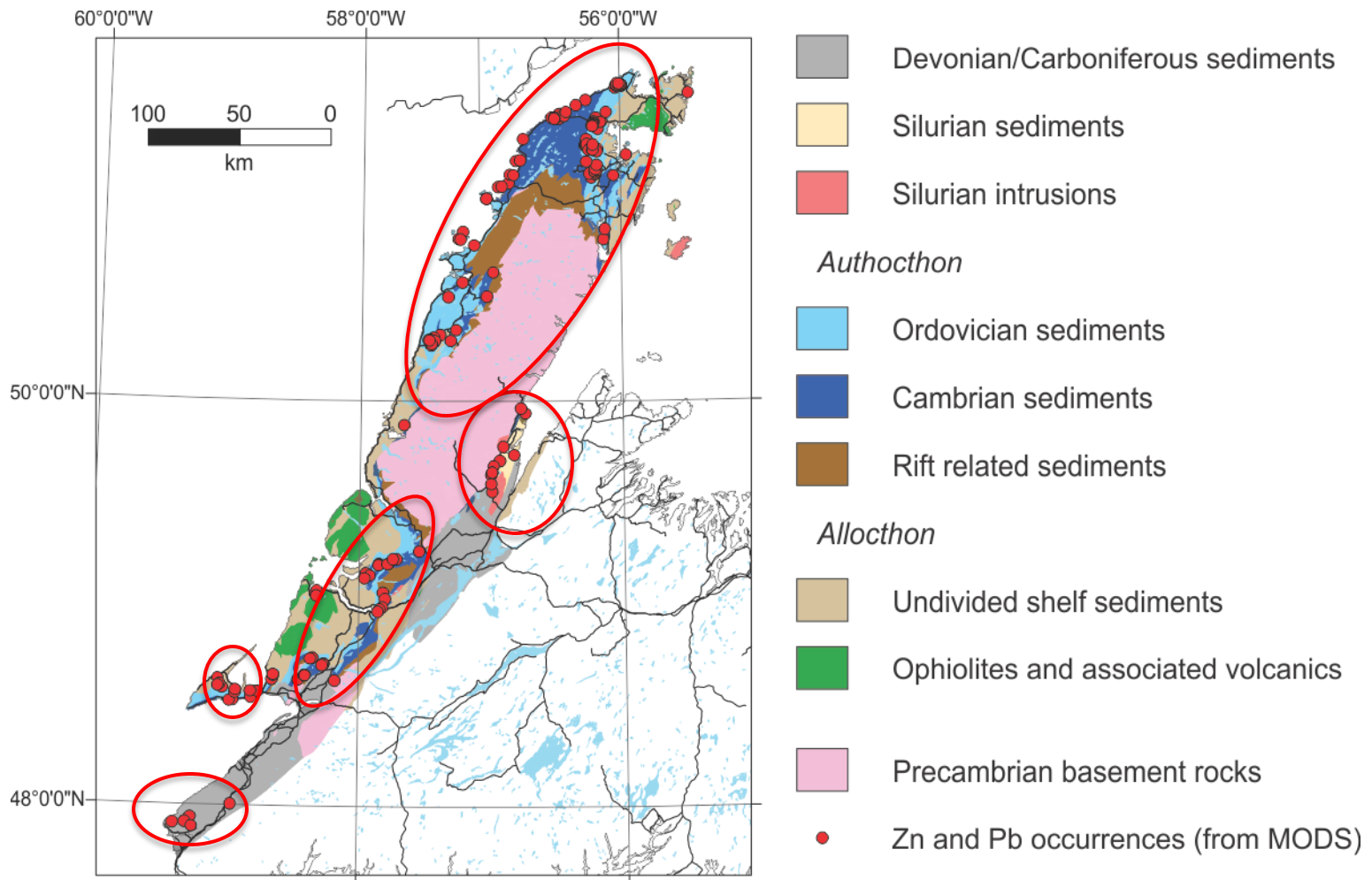


Zinc Mineralization in Western Newfoundland: Exploration Challenges and New Opportunities

James Conliffe and Robert King



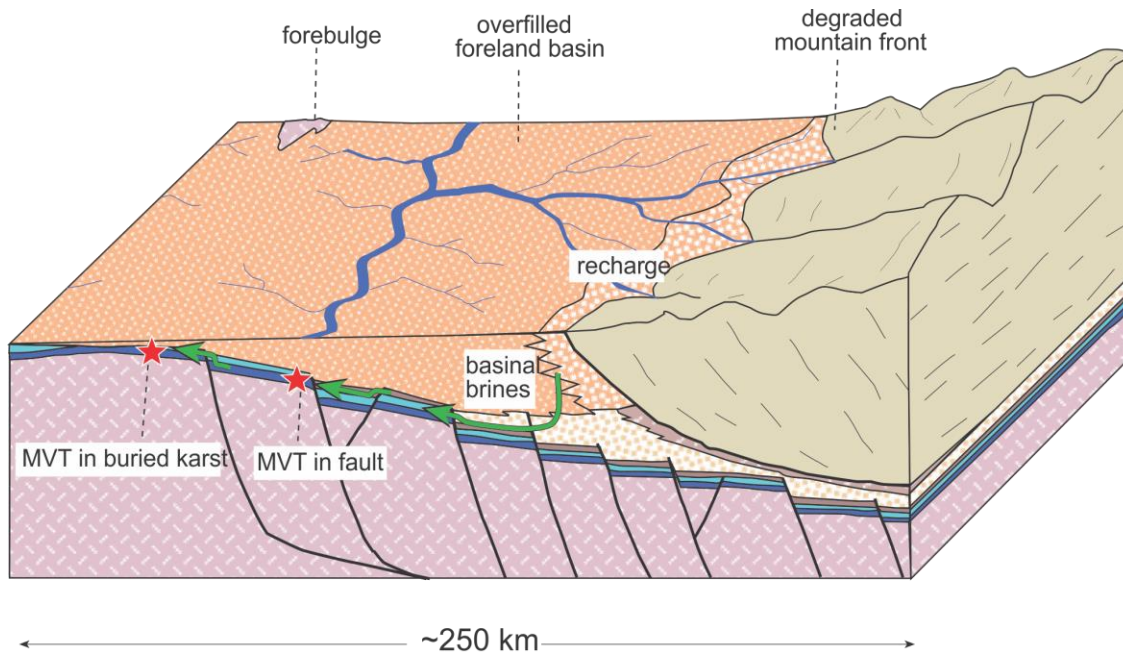
Zn and Pb Occurrences



Carbonate hosted Zn-Pb deposits (MVT)

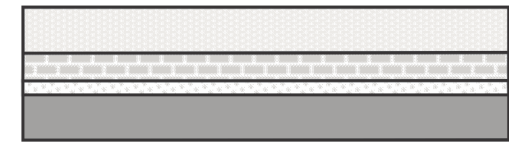
- Epigenetic, stratabound, carbonate-hosted sulphide bodies
 - Sphalerite, galena, iron oxides and carbonates
- Open-space fillings of breccias and fractures and/or replacement of host dolostone
- Found in carbonate platforms adjacent to orogenic belts
- Individual deposits rarely exceed 2 million tons @ < 10% Zn+ Pb
- Occur in clusters termed “districts” containing multiple ore bodies, scattered over hundreds to thousands of square kilometres.

Carbonate hosted Zn-Pb deposits (MVT)

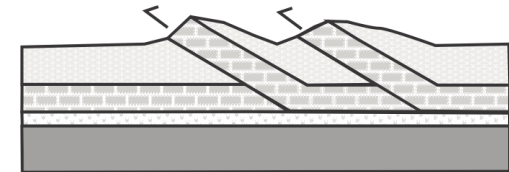


from Bradley & Leach (2003)

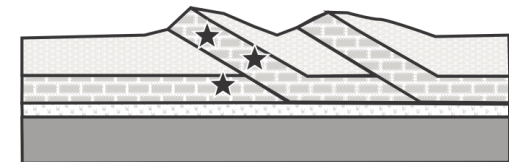
B. Post-deformation MVT



1. Deposition of host rocks



2. Thrust deformation



3. MVT mineralization

- Product of regional scale movement of warm saline aqueous solutions, commonly during compressional tectonics
- In most cases fundamental structural control, on location of ore bodies

Carbonate hosted Zn-Pb deposits (MVT)

Exploration challenges

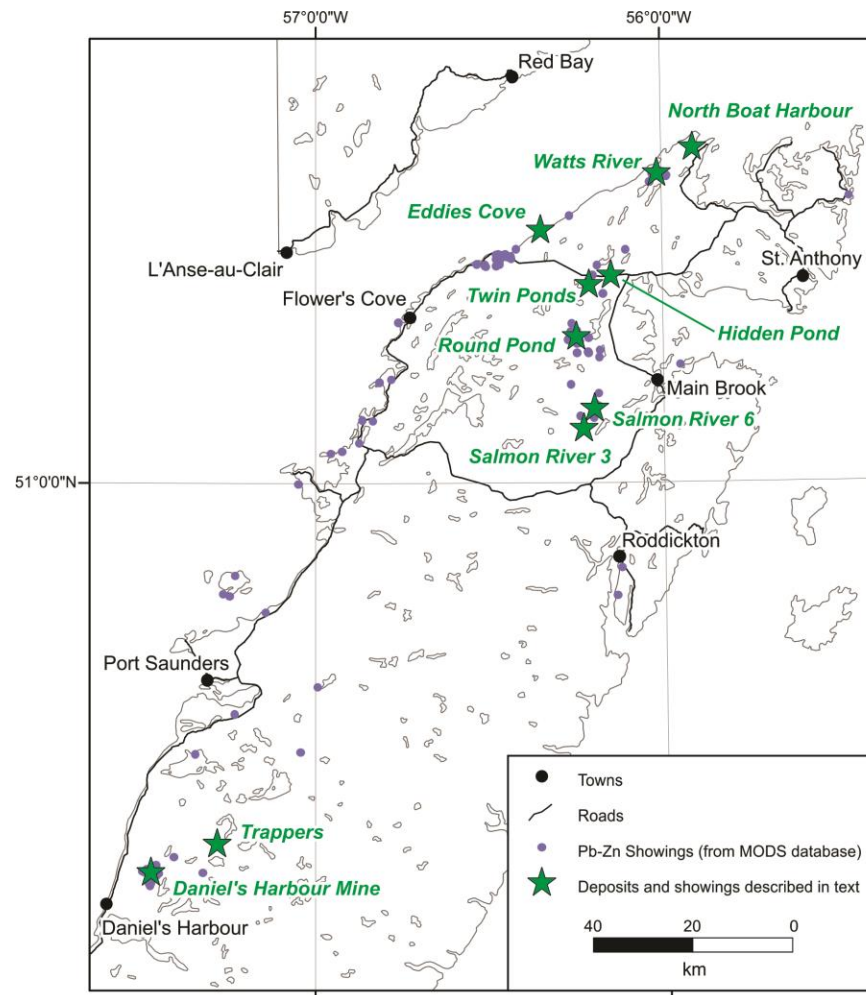
- Small deposits, irregular shaped ore bodies
- Poor geophysical signature (magnetics, gravity, IP), but potential for discoveries based on subtle signatures
- Weak alteration footprint
 - Extensive dolomitization and disseminated sulphides may indicate proximity to ore bodies
 - From ore to barren host rock over < 1m

Carbonate hosted Zn-Pb deposits (MVT)

Why explore for MVT deposits?

- Global demand for zinc rising, production declining
- Relatively high grade deposits
- Simple processing (mineralogy dominantly sphalerite and dolomite)
- Small mine footprint and environmentally friendly
 - Outflow from Daniels Harbour Mine used in fish hatchery

Zn mineralization on the Great Northern Peninsula



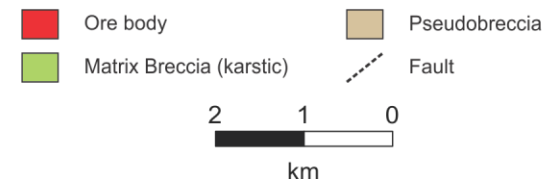
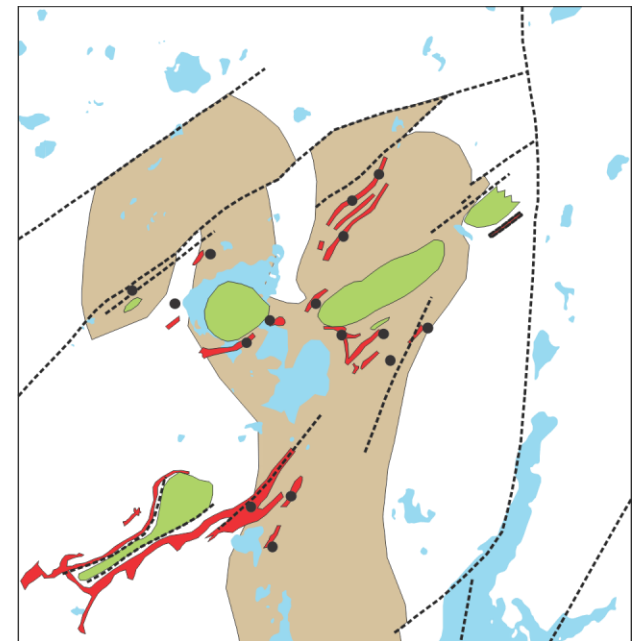
Daniels Harbour Deposit



- Deposit discovered in 1963
- Mine operational from 1975 to 1990
- Total production of 7.2 Mt at 8.9% Zn

Daniels Harbour Deposit

- >15 individual ore bodies mined
 - From 100 m to 4.6 km in length
 - Underground (~80%) and open pit (~20%) mining
 - Majority of ore mined from L zone
 - 4.2 Mt at 8.4% Zn
- Highly irregular sinuous ore bodies, sub-parallel to faults
- Some ore bodies spatially associated with karst breccias

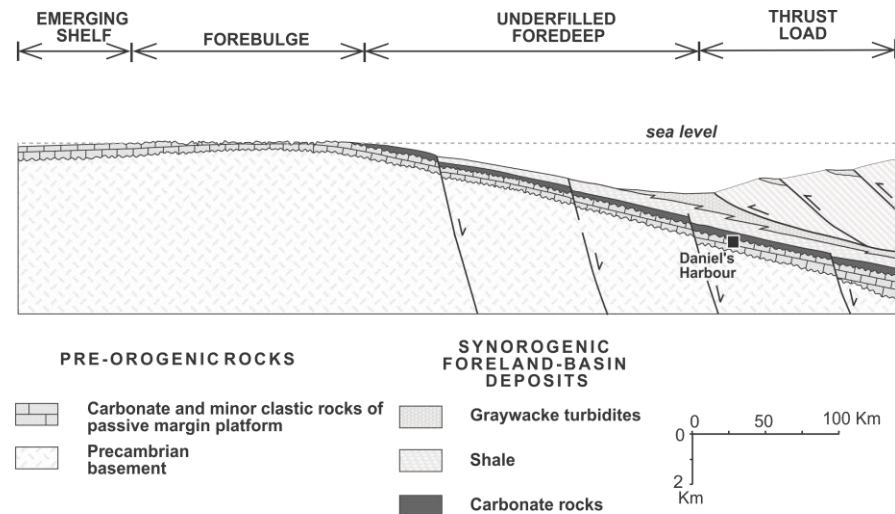


Daniels Harbour Deposit

- Mineralization hosted in pseudobreccia beds (secondary dolomite replacing host rocks) and in fractures connecting mineralized beds
- Sphalerite occurs at top of beds
- Multiple generations of sphalerite precipitation, other sulphides rare (minor pyrite)
- Geology and mineralization described in detail by Lane (1990)



Daniels Harbour Deposit



Adapted from Bradley & Leach (2003)

- Ore generation epigenetic during deep burial
- Influx of metal-bearing hydrothermal fluids during fracturing and faulting
- Timing of mineralization enigmatic, but likely associated with thrusting during the Acadian Orogeny (reactivation of Taconic faults)
 - Postdates burial and emplacement of allochthon by ~ 60 Ma (Bradley and Leach, 2003)

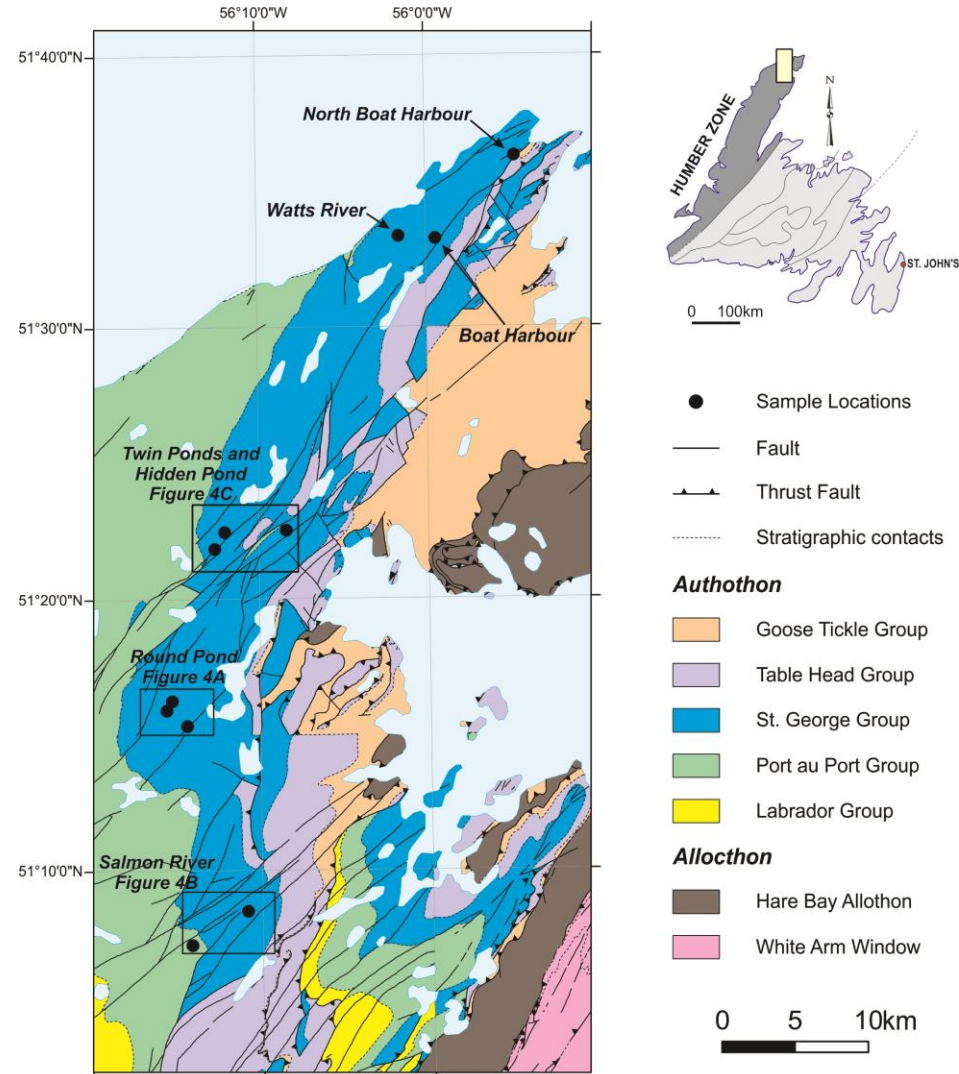
Daniels Harbour Deposit

Lessons learned from exploration

- Ore bodies are generally small and discontinuous
- Abrupt contact between high-grade ore and barren pseudobreccia over < 2 m common
- Deposits discovered by till geochemical studies and bedrock exposures, no “blind” orebodies discovered
- Geophysics has not proved useful in discovering ore bodies
 - Detailed gravity studies may aid in discovery of ore bodies (e.g. Polaris Deposit)
 - Seismic study can identify structures suitable for crustal scale fluid flow
- New discoveries require detailed knowledge of geology, closely spaced drilling programs and some degree of luck!

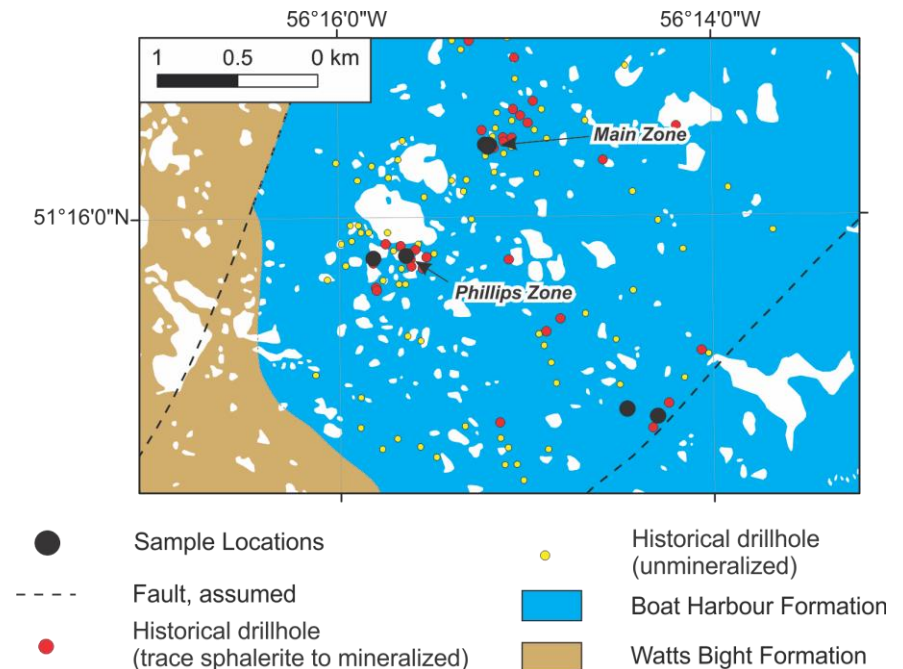
Zn mineralization on the Great Northern Peninsula

- Numerous Zn (\pm Pb) occurrences in Hare Bay/Pistolet Bay areas
- Mineralization hosted in similar setting to Daniels Harbour Deposit
- Exploration in 1970's and 1980's focused on geochemical anomalies
 - Round Pond Deposit
 - (~ 0.4 Mt @ 2% Zn)
 - Salmon River Prospect
 - Twin Ponds Prospect

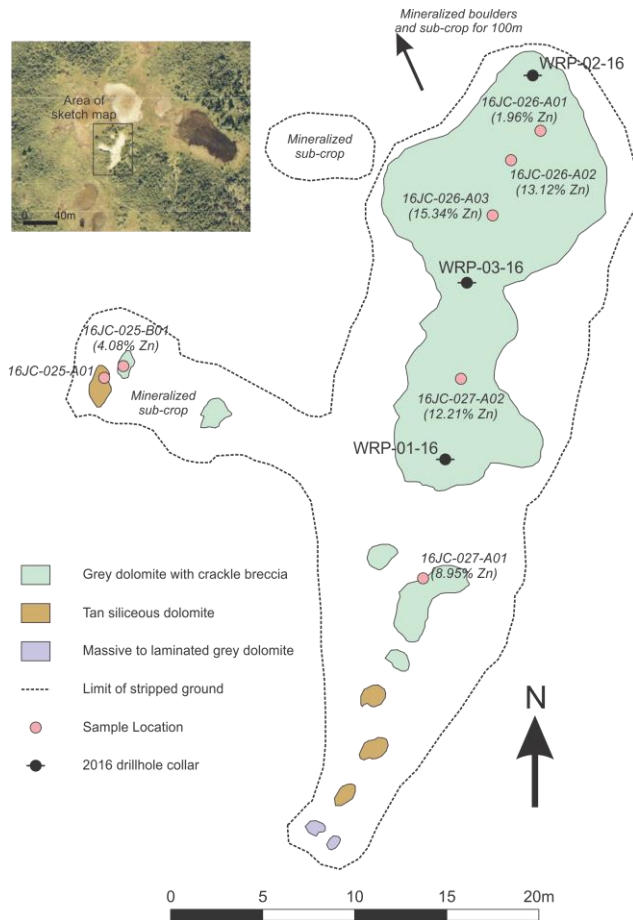


Round Pond Deposit

- Discovered in 1970, drilling in 1971, 1975 and 1983
- Based on soil geochemistry anomalies
- Two main mineralized zones
 - Main Zone (400,000t @ 2% Zn)
 - Phillips Zone (98,000t @ 1.5% Zn)
- Numerous sphalerite showing in surrounding area



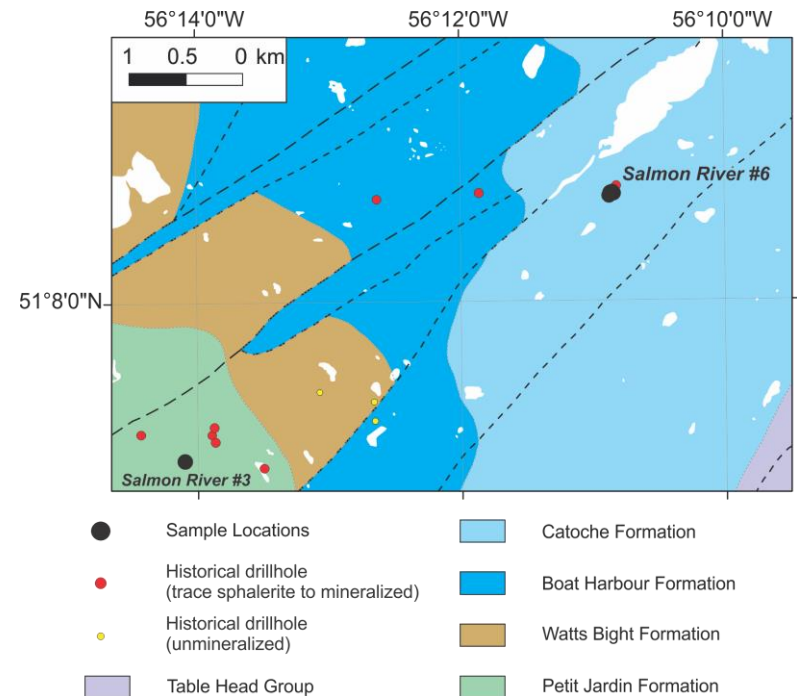
Round Pond Deposit



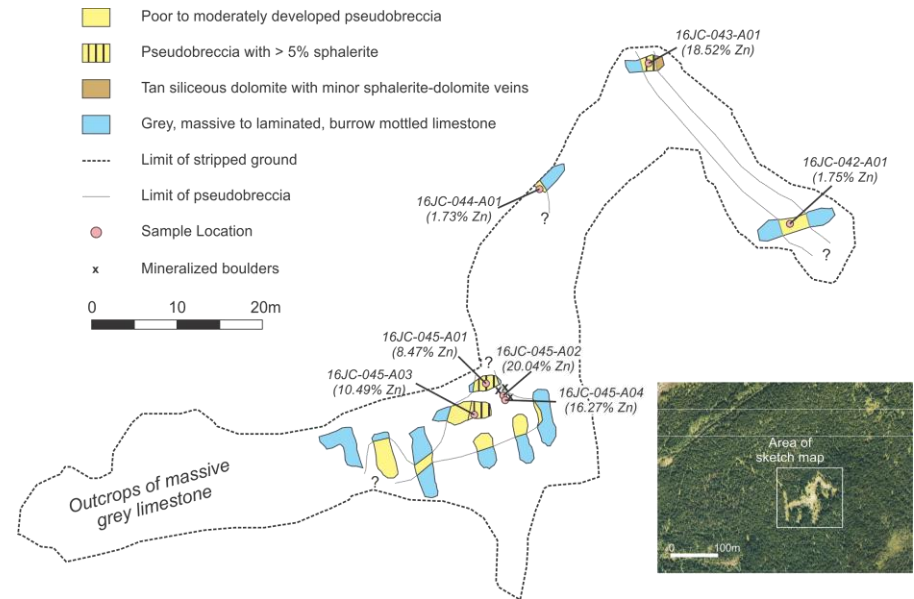
- Crackle breccia, and dolomite fragments cemented by sphalerite and dolomite
 - “Snow-on-the-roof” textures
 - Minor galena and pyrite
- Grab samples up to 24.46% Zn (at Phillips Prospect)
- Drilling shows presence of mineralized pseudobreccia at depth

Salmon River Prospect

- Located ~15 km south of Round Pond Deposit
- Discovered based on soil geochemistry anomalies
- Numerous sphalerite showings
- Main occurrence at Salmon River #6 (Frying Pan Pond)
- Drilling in the 1970's unable to intercept mineralization at depth



Salmon River #6



- Mineralized pseudobreccia exposed in series of trenches
- Extensive pseudobreccia developed
- Zinc mineralization sporadic, but grab samples of sphalerite rich pseudobreccia have 10.49 to 20.04 wt. % Zn

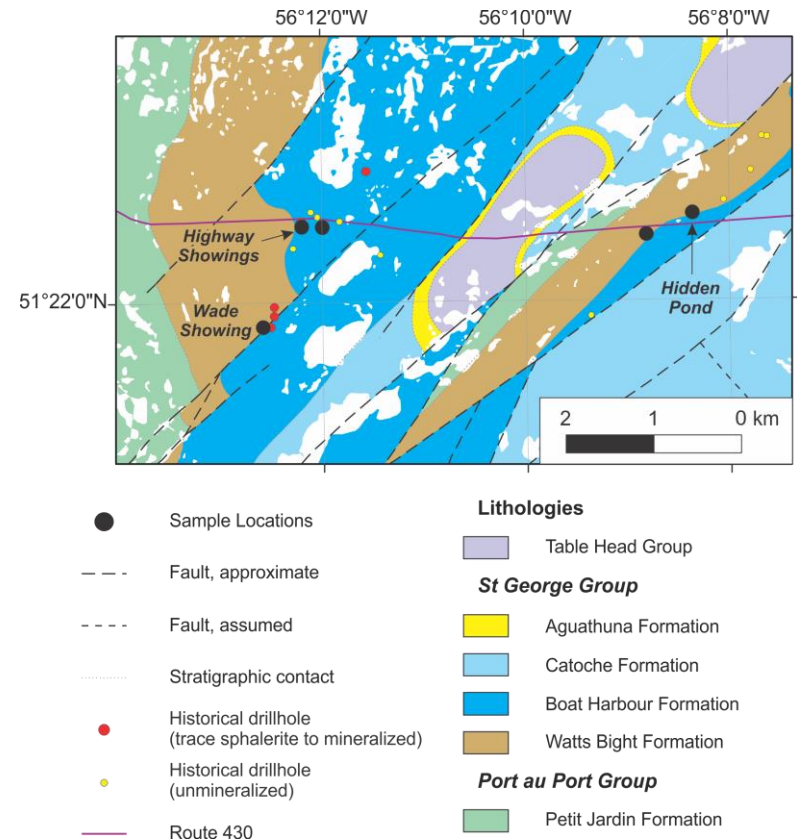
Salmon River #6

- Multiple generations of sphalerite mineralization
 - Early red sphalerite, with dolomite and calcite cement
 - Late yellow sphalerite in quartz-orthoclase-dolomite cement



Twin Ponds Prospect

- Located ~12 km north of Round Pond Deposit close to Highway 430
- Discovered in 1970's based on soil geochemistry anomalies
- Mineralization occurs in trench south of highway (Wade Showing) and in outcrops along highway
- Grab samples with 5.65 wt % Zn (Wade Showing) and 6.73 to 11.96 wt % Zn (Highway Showings)



Twin Ponds Prospect

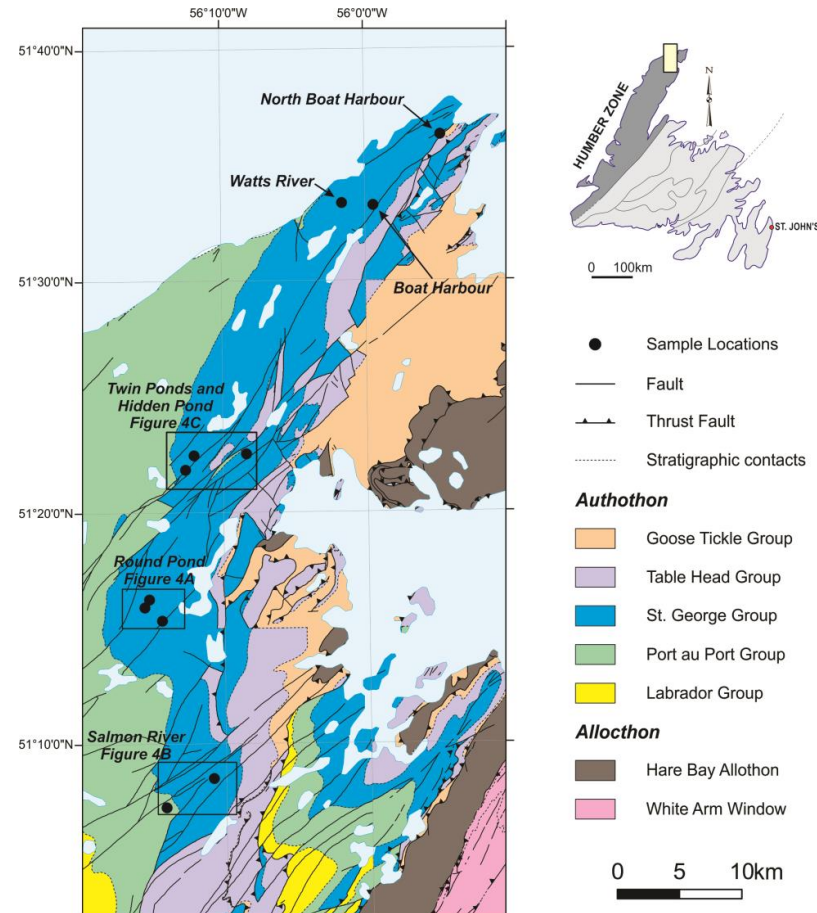


- Mineralization similar to Round Pond Deposit
 - Sphalerite lining dolomite clasts in crackle breccia
 - Mineralized pseudobreccia stratigraphically below crackle breccia along highway

Zn mineralization on the Great Northern Peninsula

Other occurrences

- A number of other sphalerite occurrences located along strike from known deposits and prospects
 - North Boat Harbour
 - Watts River
 - Hidden Pond
- Moderate to well developed pseudobreccias recorded in a linear belt with > 60 km strike length

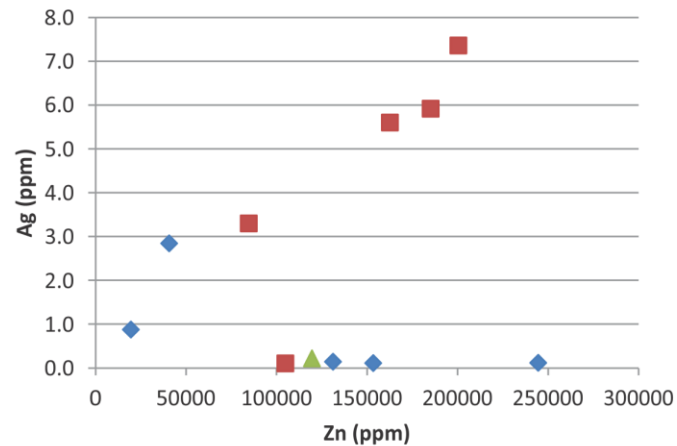
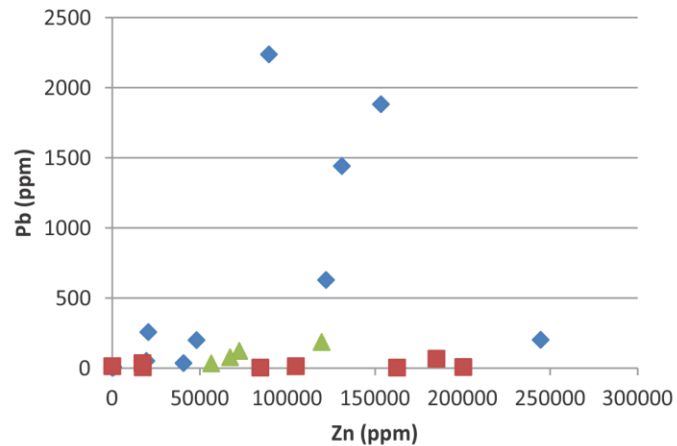
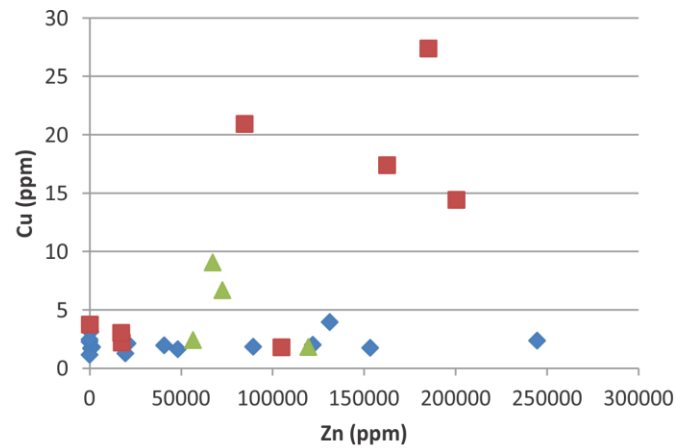
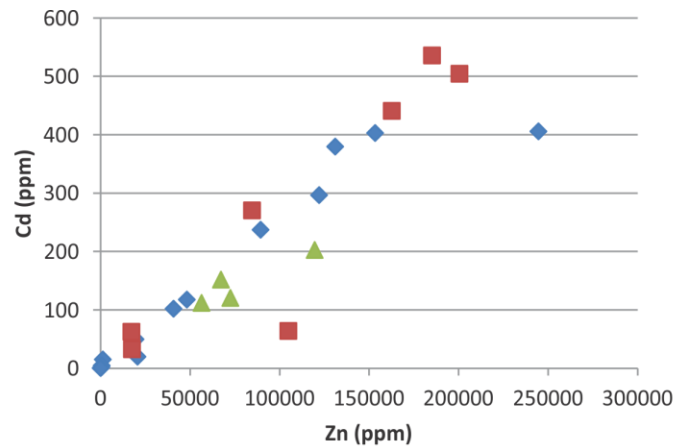


Current Research

- Geochemical and isotopic studies underway (BSc thesis by Robert King)
 - Bulk geochemistry
 - Electron microprobe analysis
 - Sulphur isotopes
 - Lead isotopes
 - SEM-MLA analysis

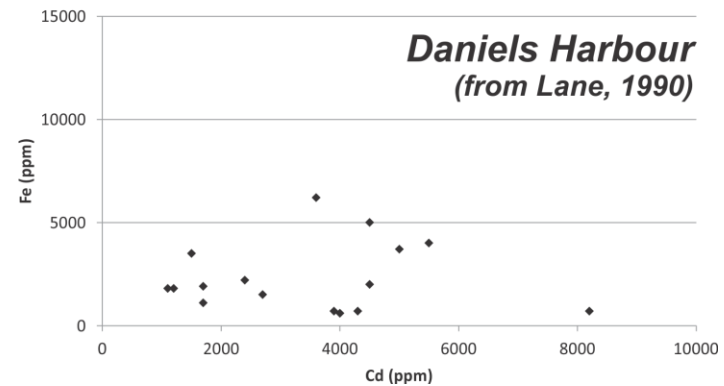
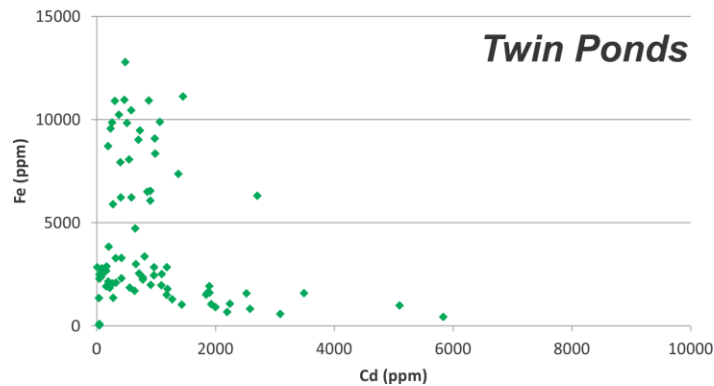
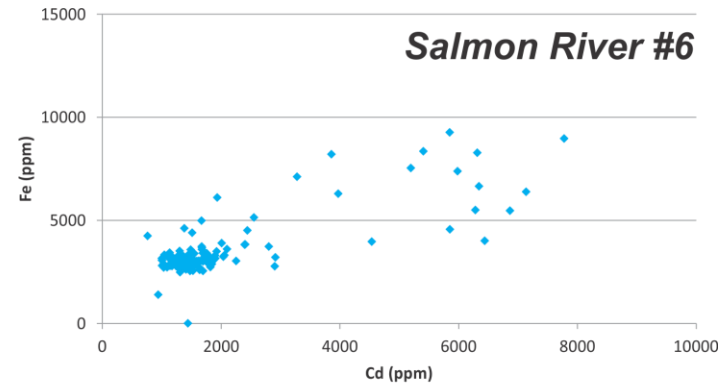
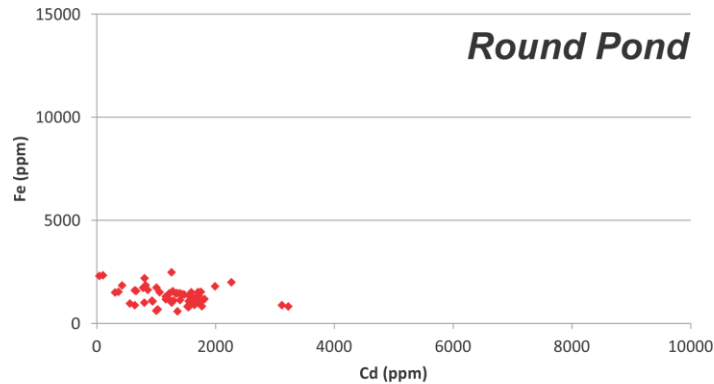
Develop genetic model for these occurrences, and compare with Daniels Harbour Deposit

Bulk Geochemistry



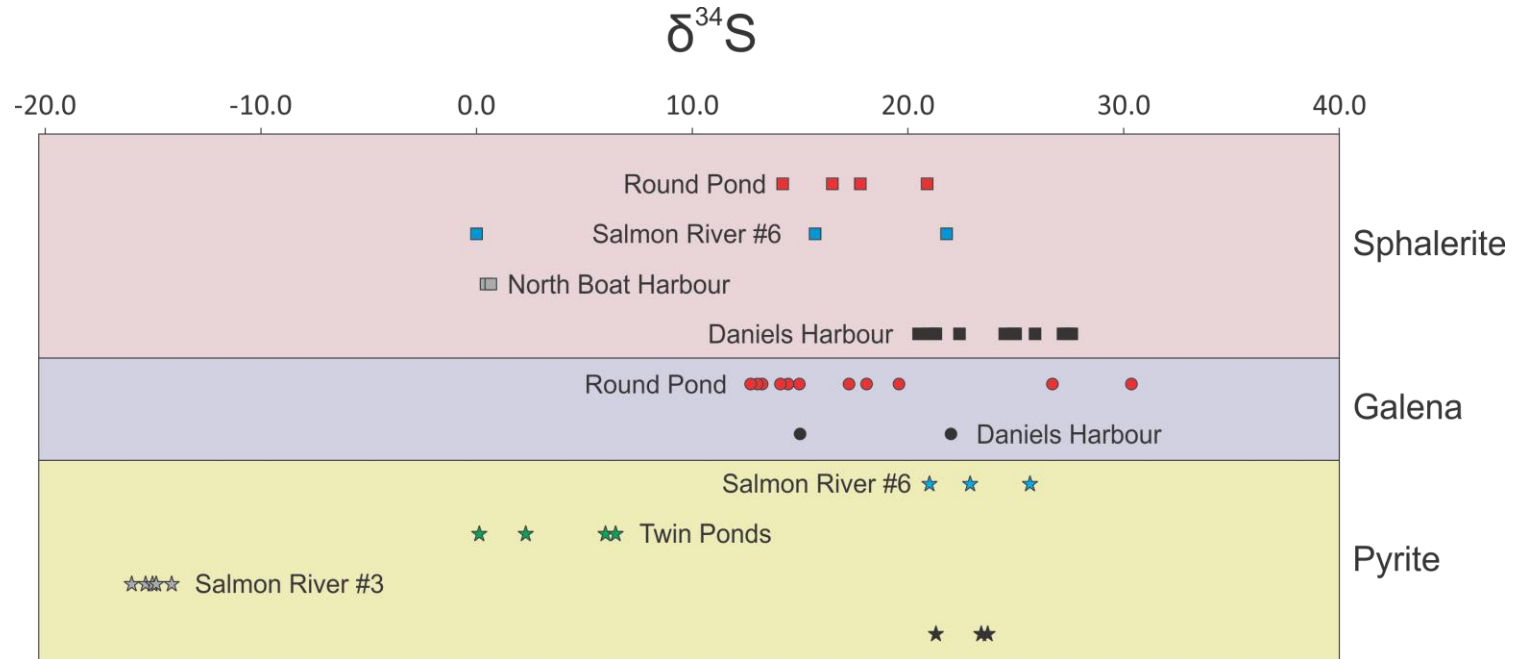
- ◆ Round Pond
- Salmon River
- ▲ Twin Ponds

Sphalerite Geochemistry



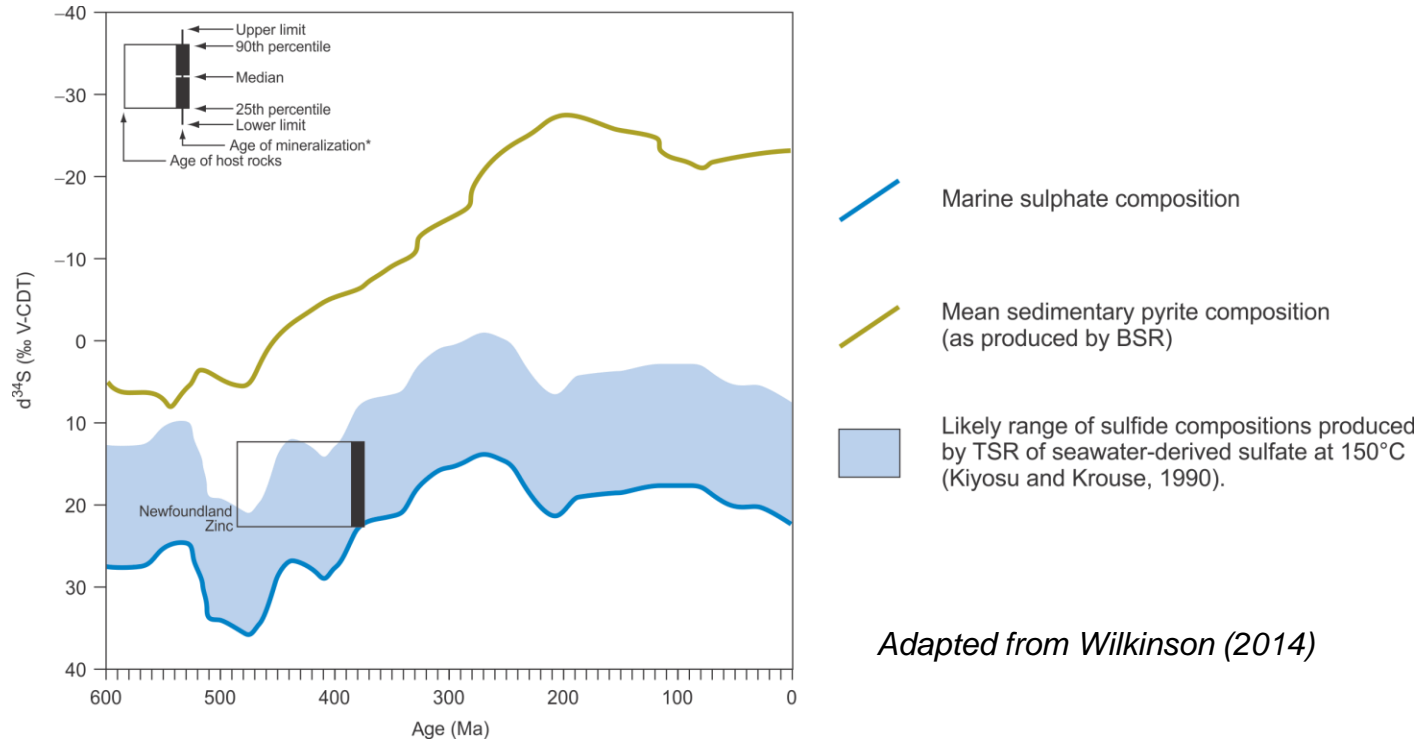
- Significant variations between occurrences
- Fe and Cd related to temperature and fluid source: implications for genetic model

Sulphur Isotopes



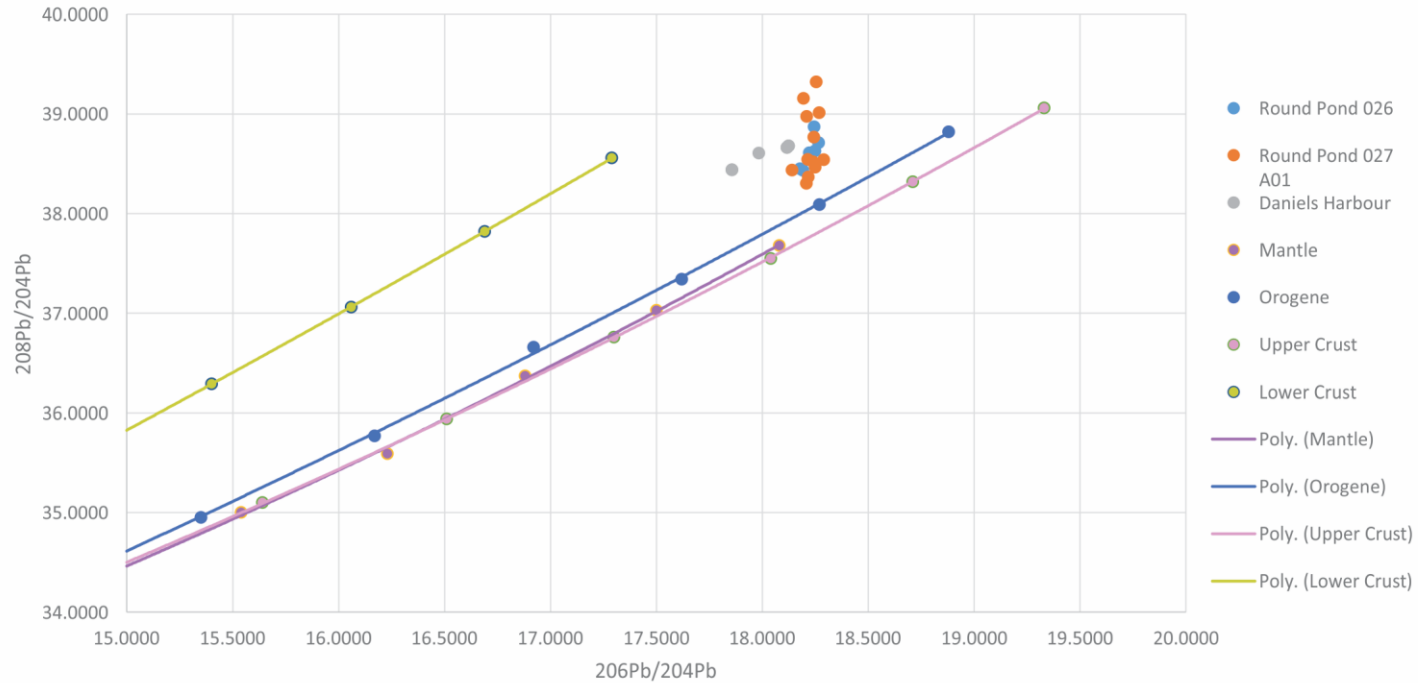
- Data from Round Pond and Salmon River similar to Daniels Harbour
- Lower $\delta^{34}\text{S}$ in sphalerite due to alteration

Sulphur Isotopes



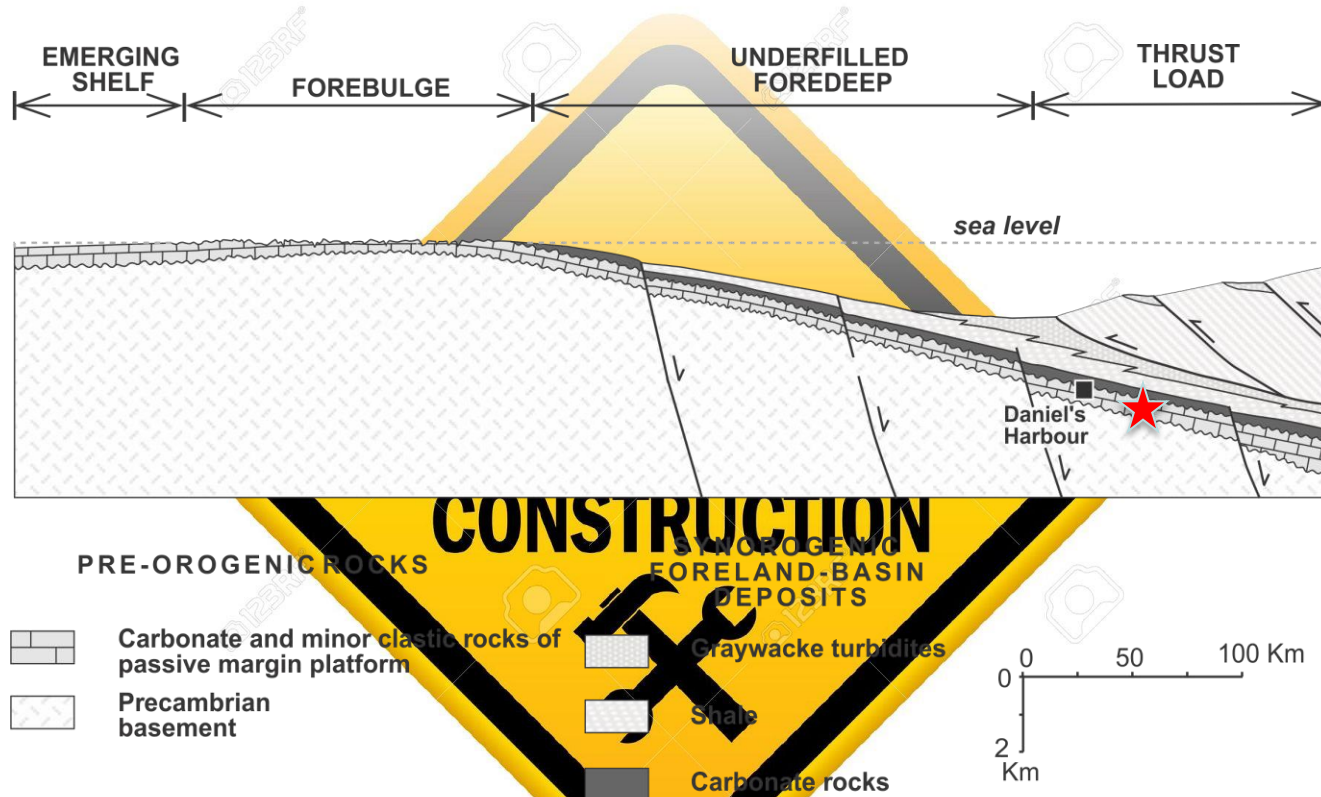
- Positive values related to thermochemical sulphate reduction (TSR) of seawater sulphate?

Lead Isotopes



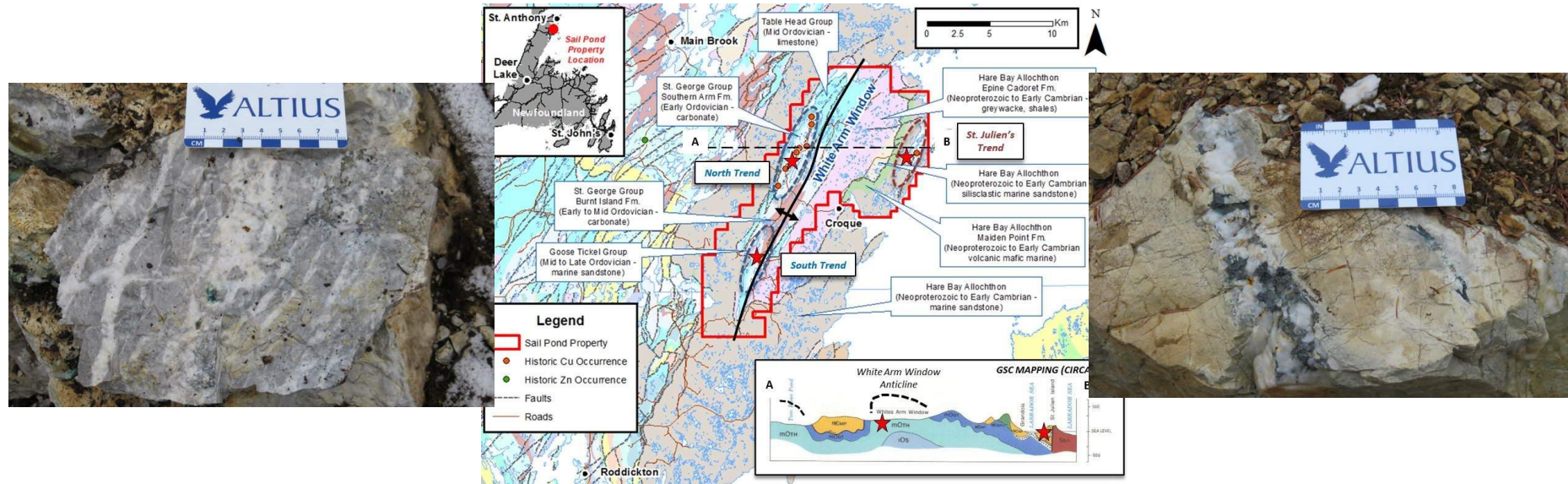
- Pb derived from Grenvillian basement?
- Vertical trend? Fractionation?

Genetic model



Adapted from Bradley & Leach (2003)

Zn mineralization on the Great Northern Peninsula



- Polymetallic (Cu-Ag-Pb-Zn) mineralization in brecciated St. George Group dolomites in White Arm Window (metamorphosed)
- Deeper equivalent of MVT mineralization?

Zn mineralization on the Great Northern Peninsula

- Known occurrences on in Hare Bay and Pistolet Bay areas have many similarities to Daniels Harbour Deposit
- Exploration for “blind” orebodies difficult but potential exists for future discoveries
 - 60 km of moderate to well developed pseudobreccias
- Research continuing on developing genetic model to aid exploration and development of new exploration targets



Thanks to

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