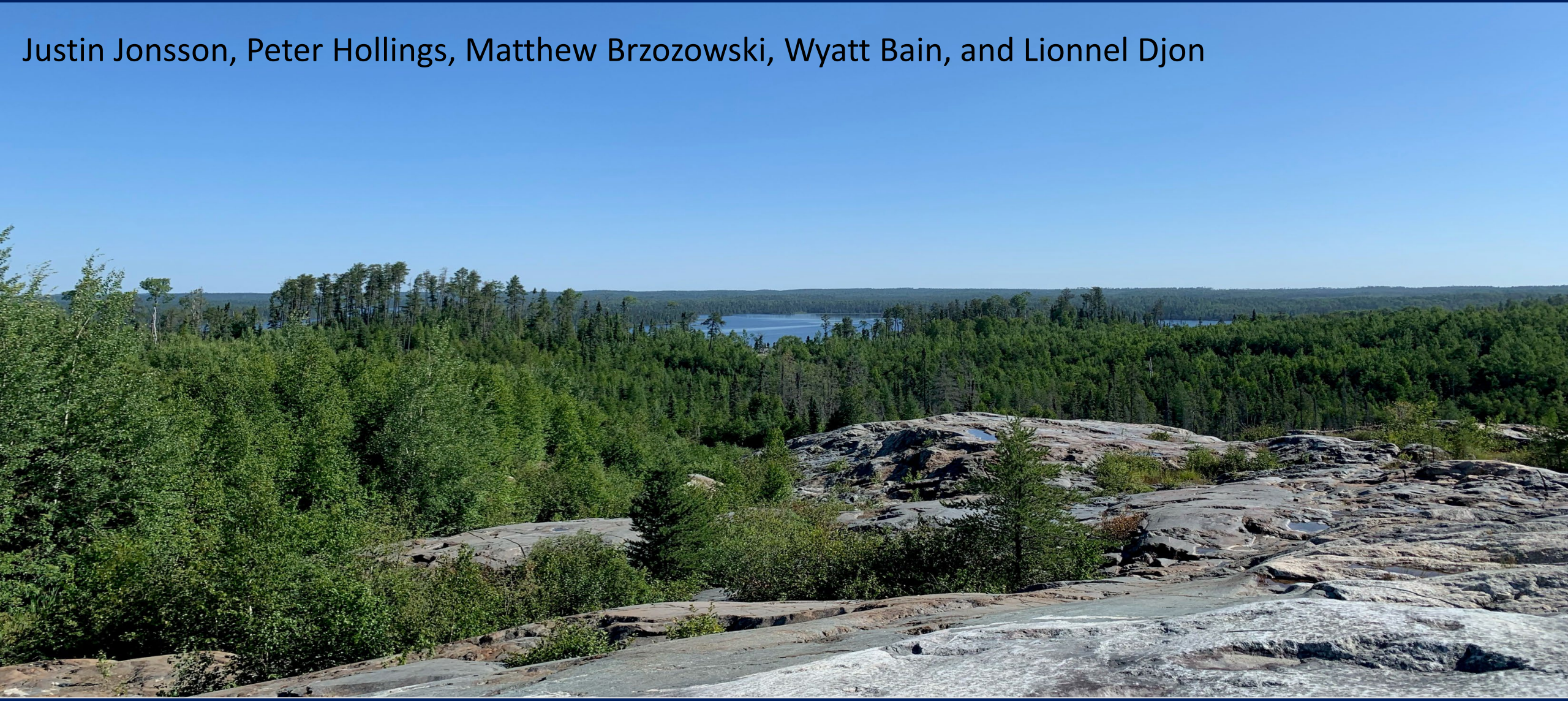
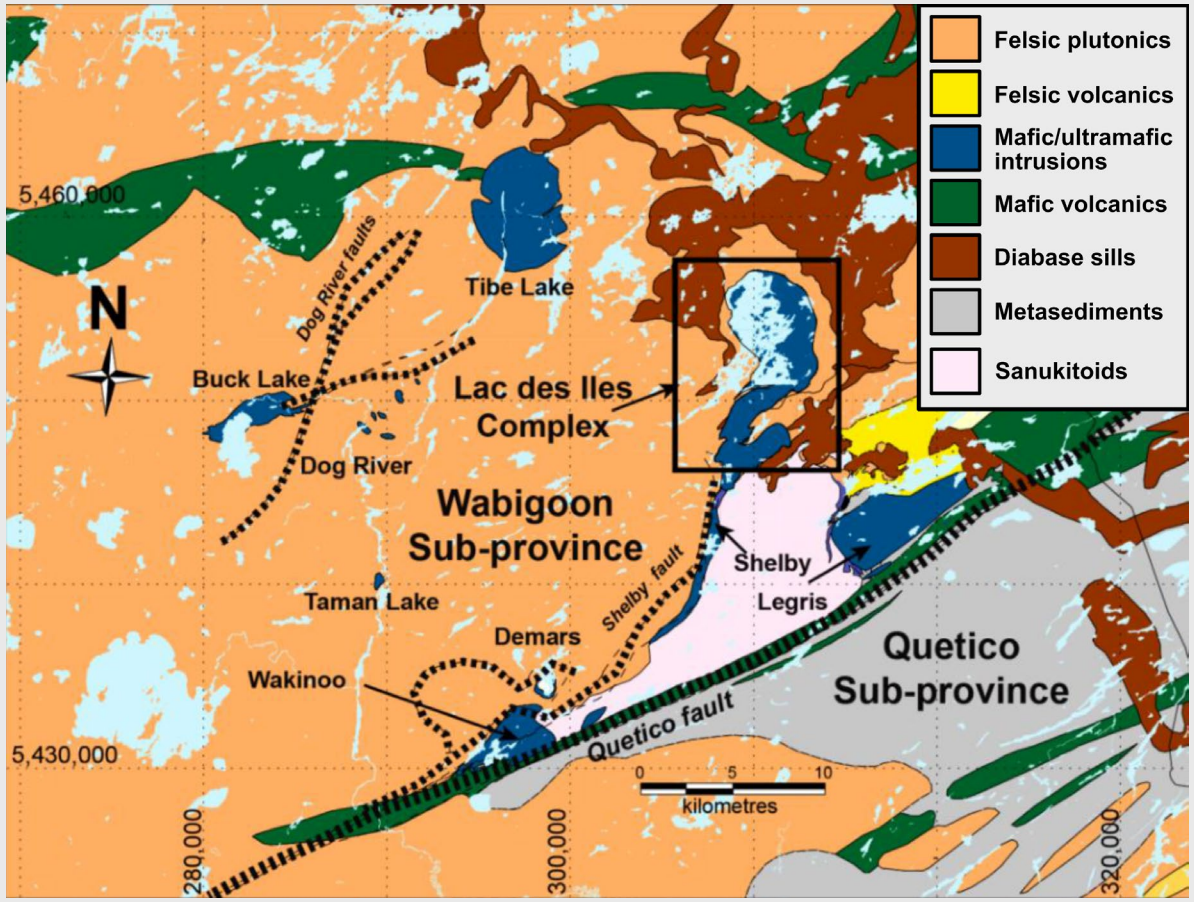
Petrogenesis of mineralized horizons in the Offset and Creek zones, Lac des Iles mine, N. Ontario

Justin Jonsson, Peter Hollings, Matthew Brzozowski, Wyatt Bain, and Lionnel Djon



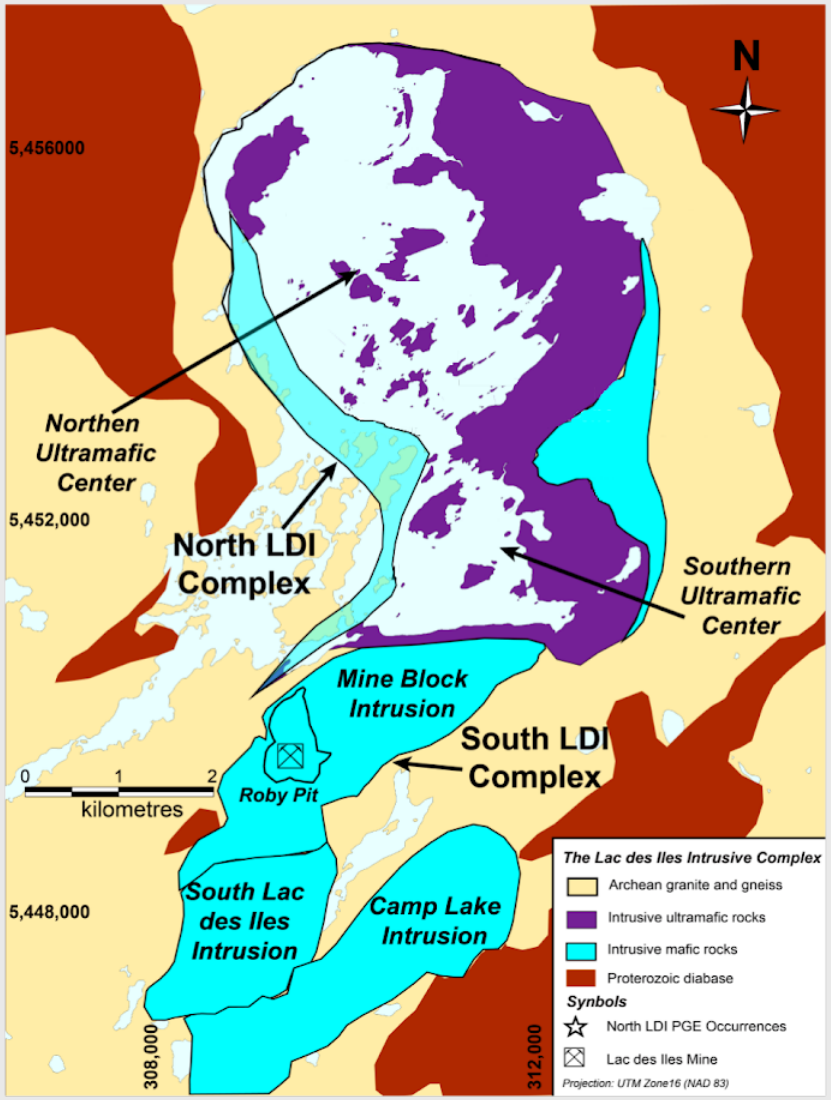
Lac des Iles Suite



Modified from Djon, 2017

- Located in the Marmion terrane of the Superior Province, 80 km north of Thunder Bay
- The Lac des Iles suite is a series of <10 km-wide mafic to ultramafic intrusions

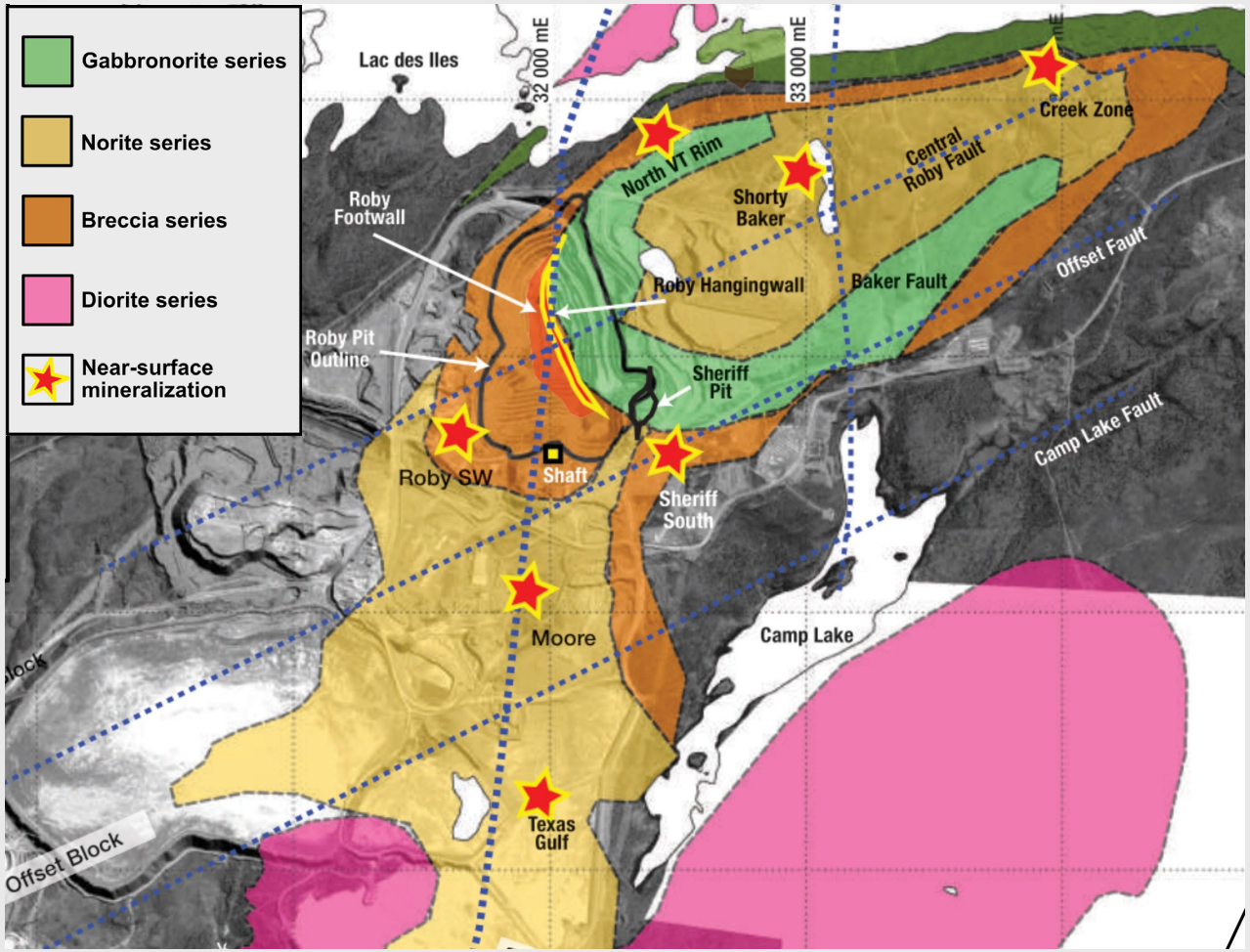
Lac des Iles Complex



- Subdivided into the ultramafic North Lac des Iles Complex (NLDIC) and the mafic South Lac des Iles Complex (SLDIC)

Modified from Djon, 2017

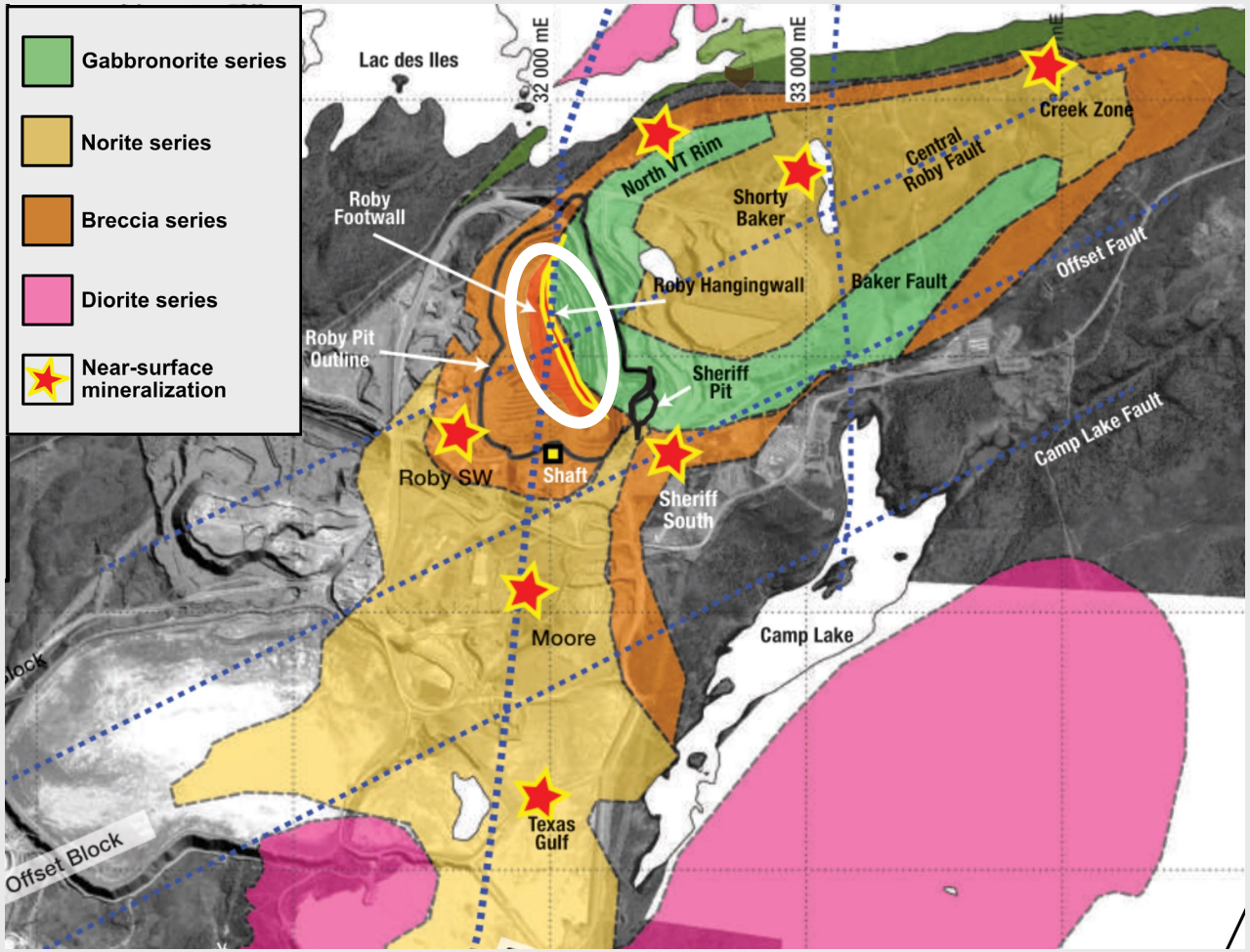
South Lac des Iles Complex



Modified from Implats, 2022

- The South LDI Complex comprises four intrusive domains: gabbronorite, norite, breccia, and diorite
- Mineralization is hosted at breccia-gabbronorite and breccia-norite domain contacts

South Lac des Iles Complex



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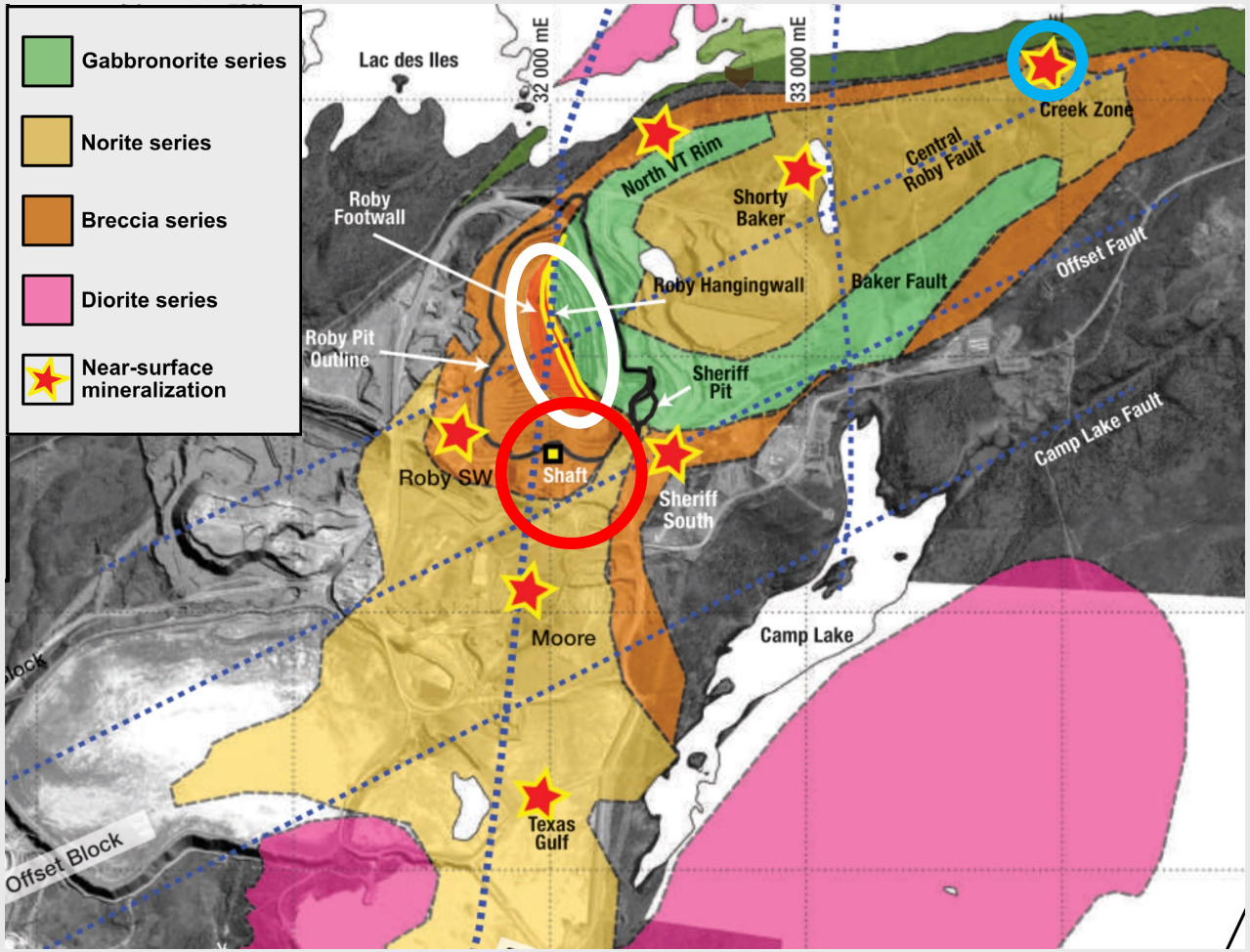
South Lac des Iles Complex



Modified from Implats, 2022

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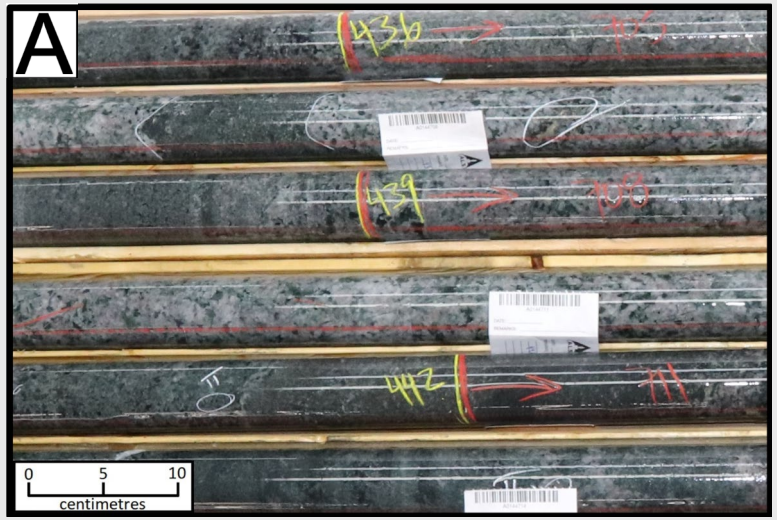
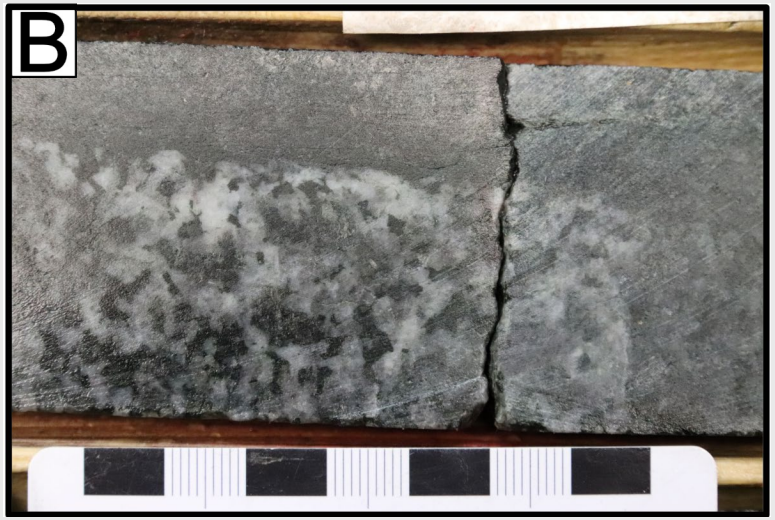
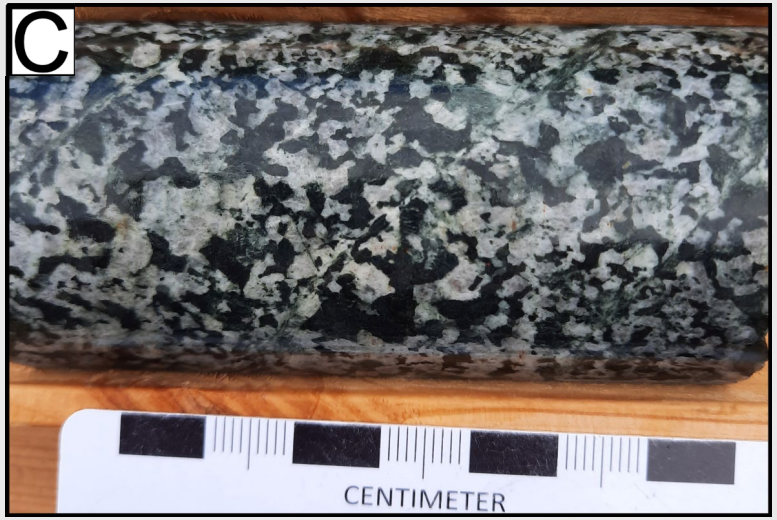
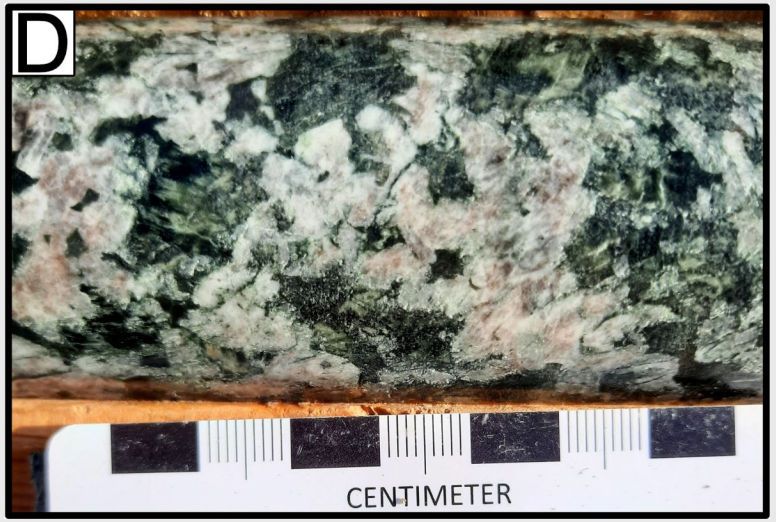
Textural observations – breccia domain

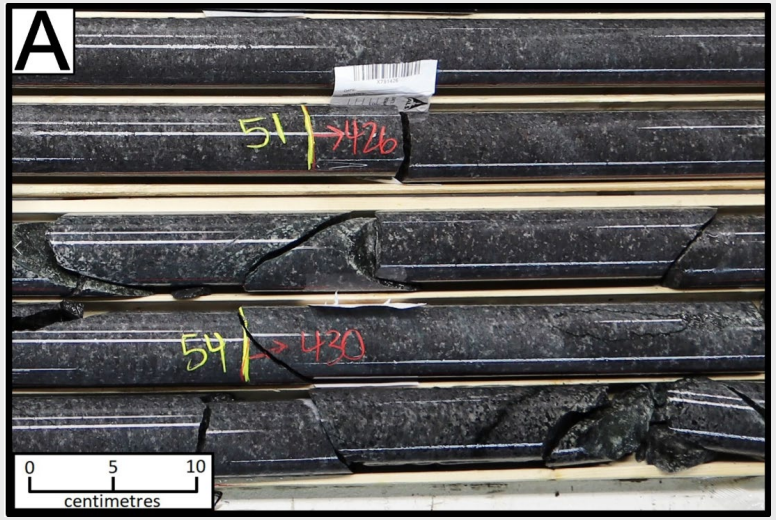


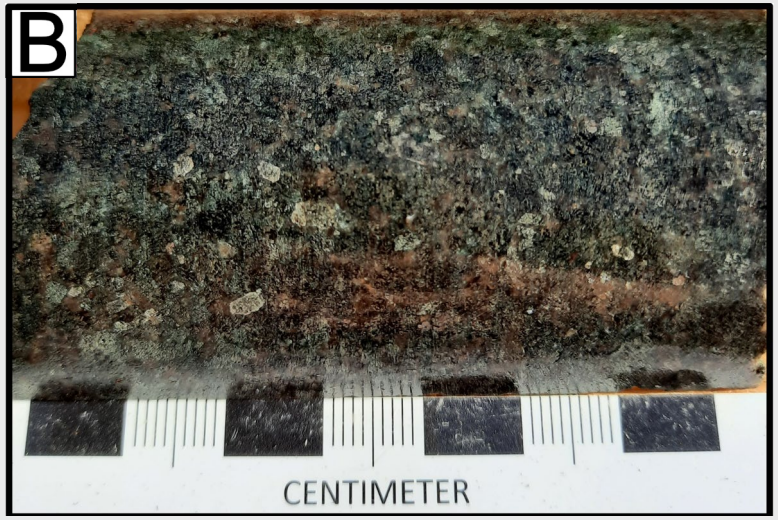


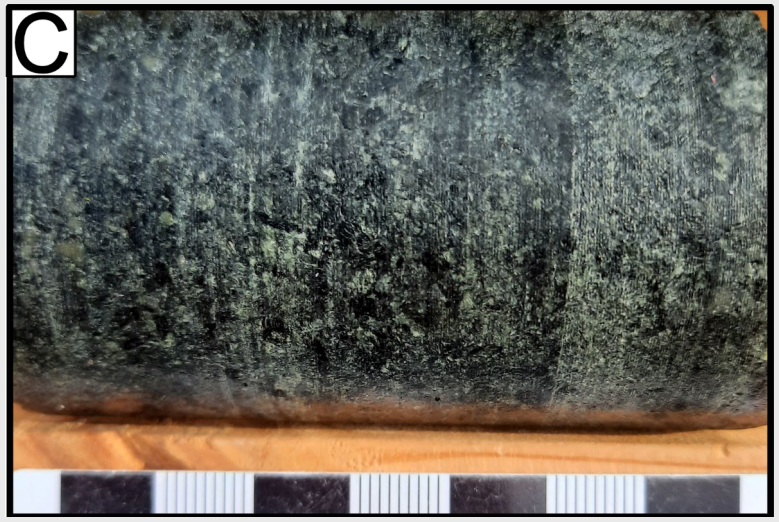




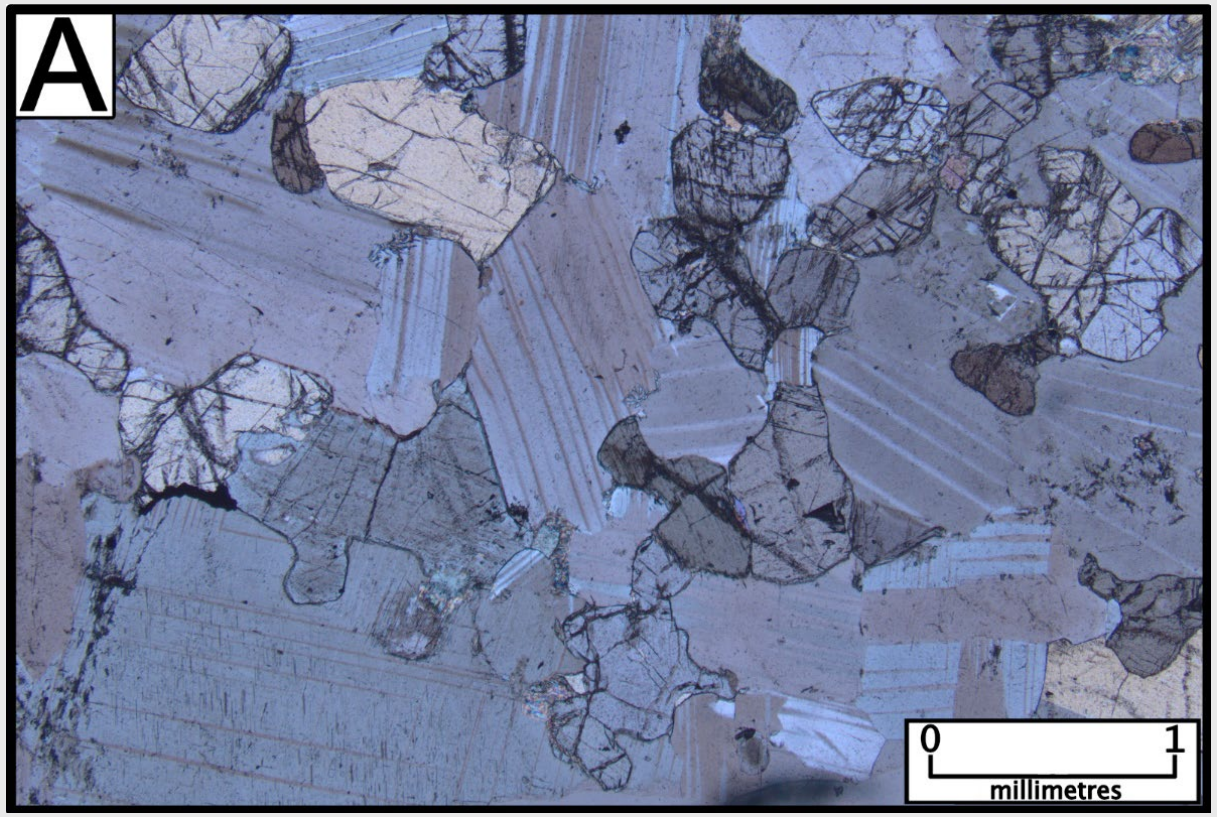
Textural observations – norite domain



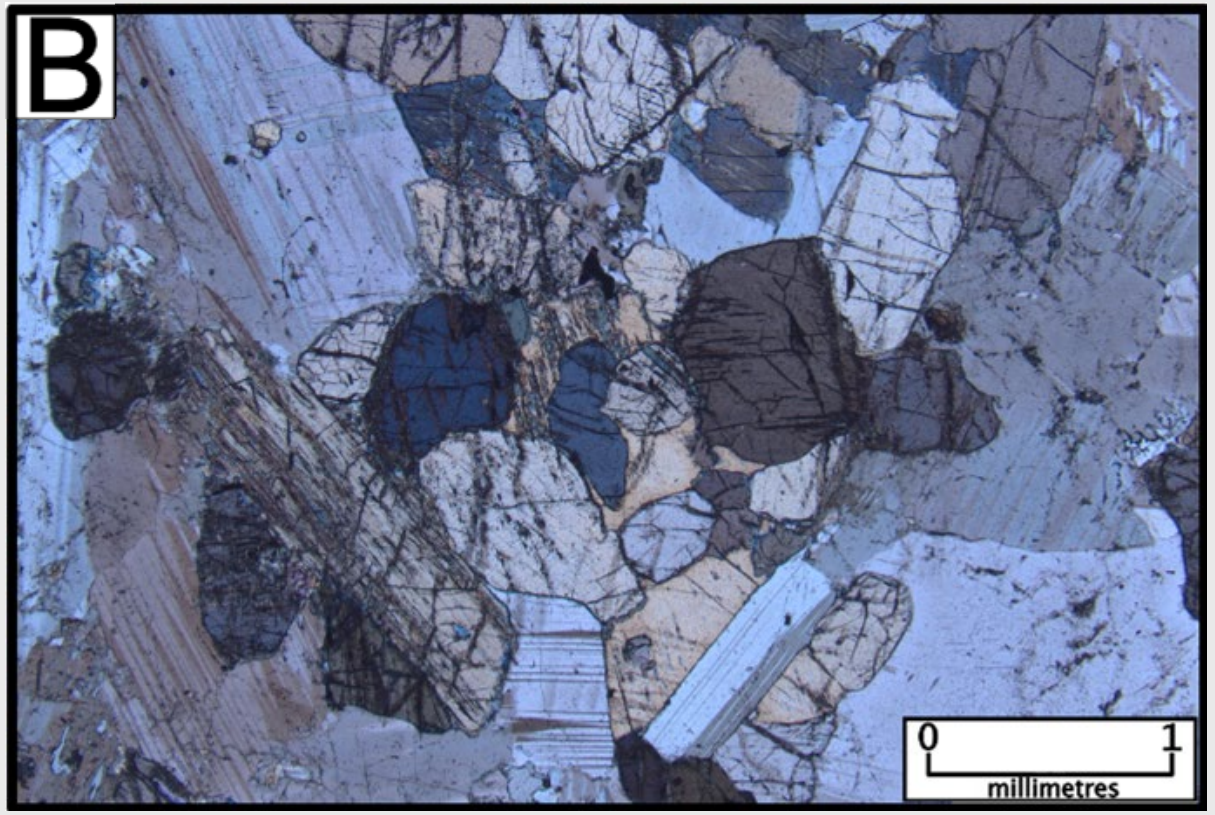




Petrographic results – magmatic silicates

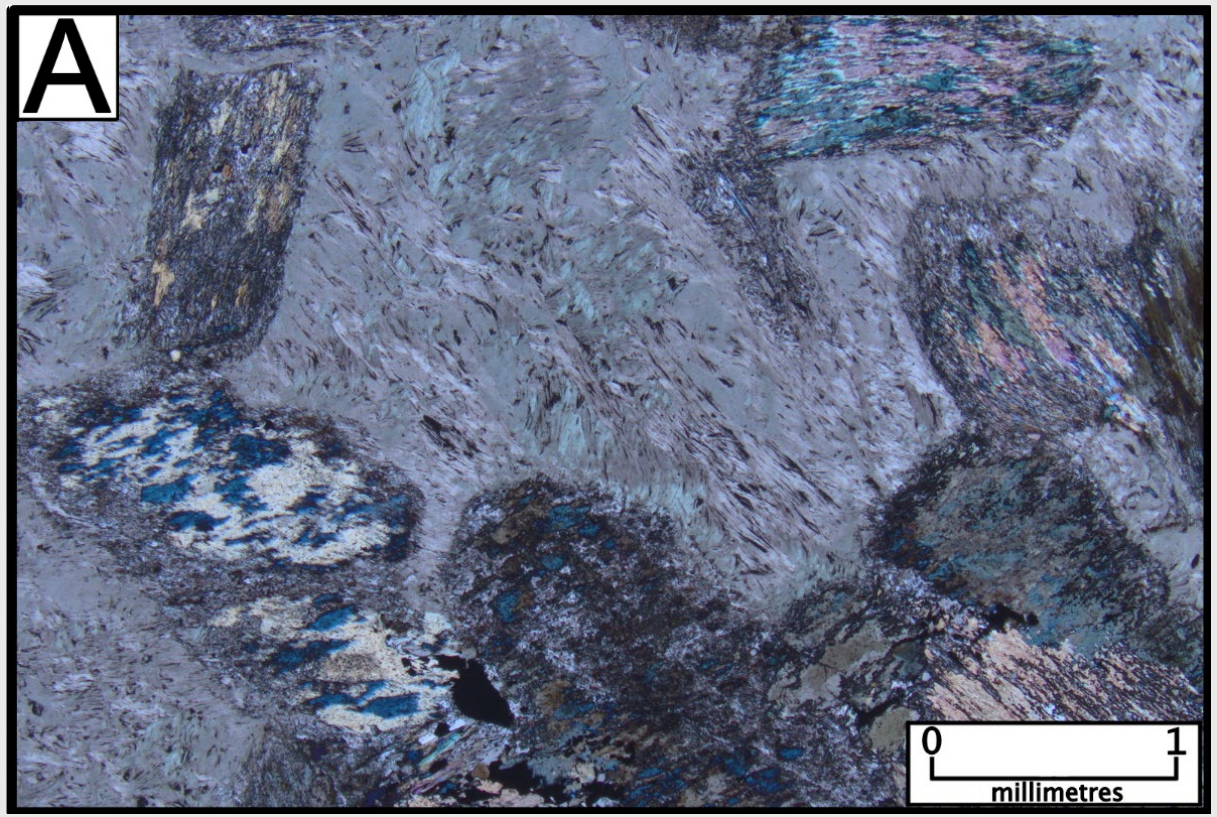


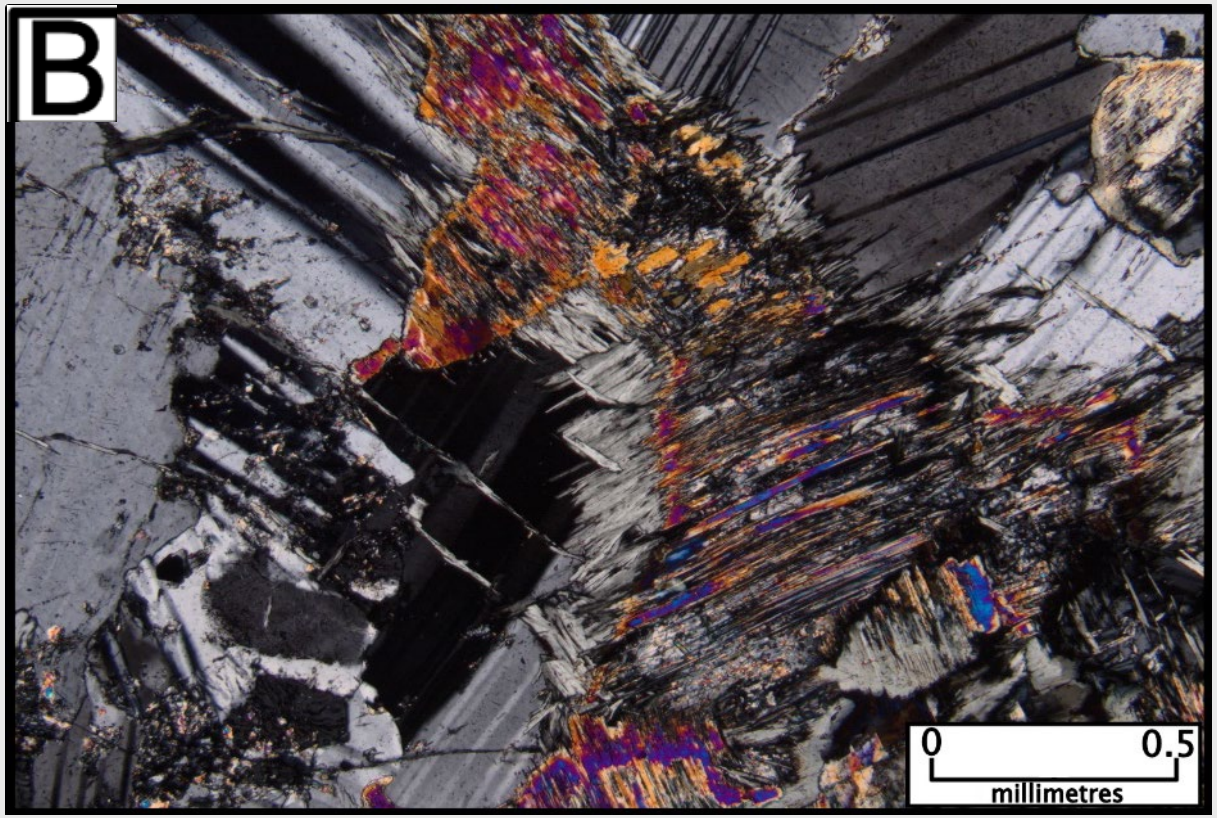
Typical breccia domain



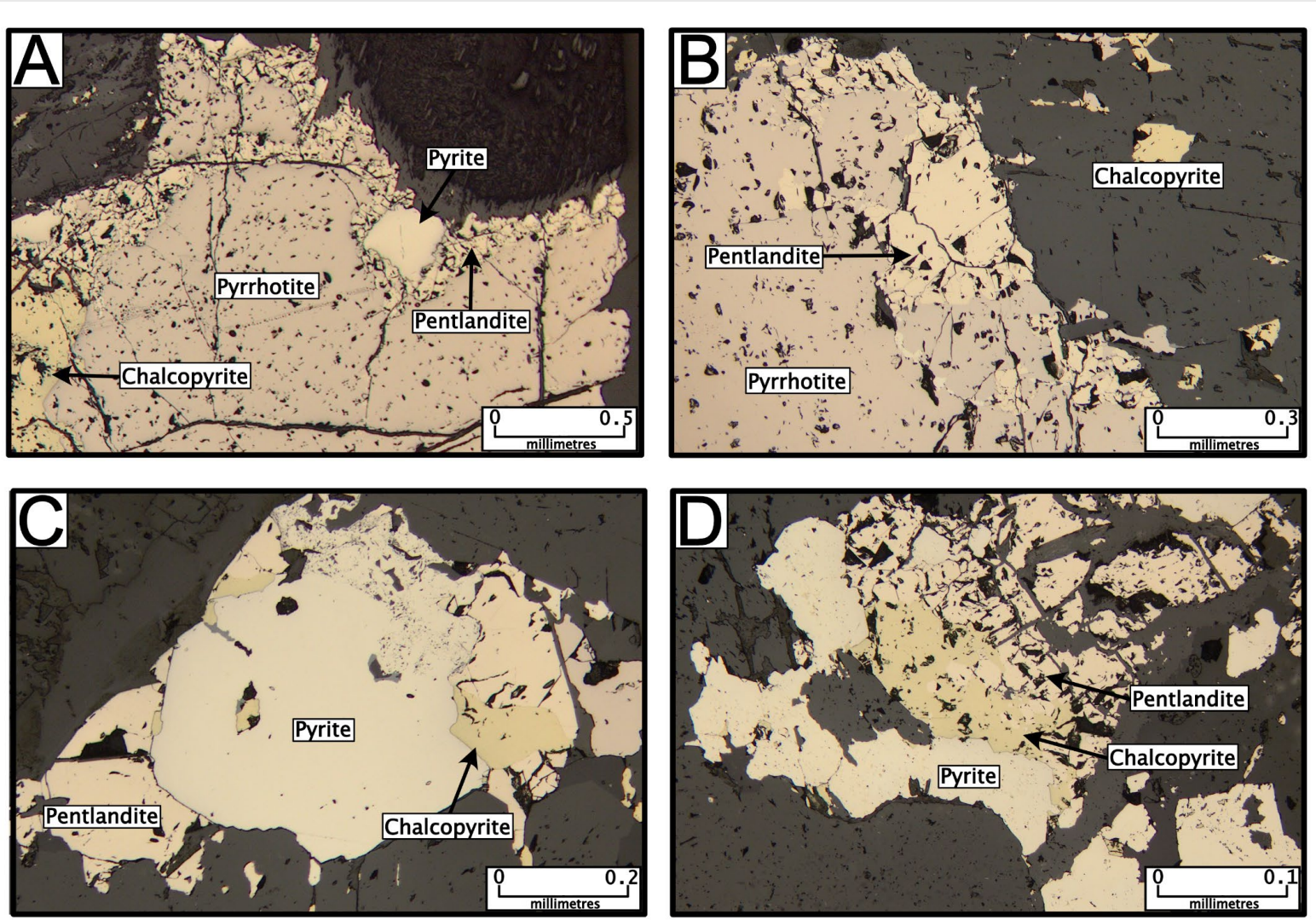
Typical norite domain

Petrographic results – alteration



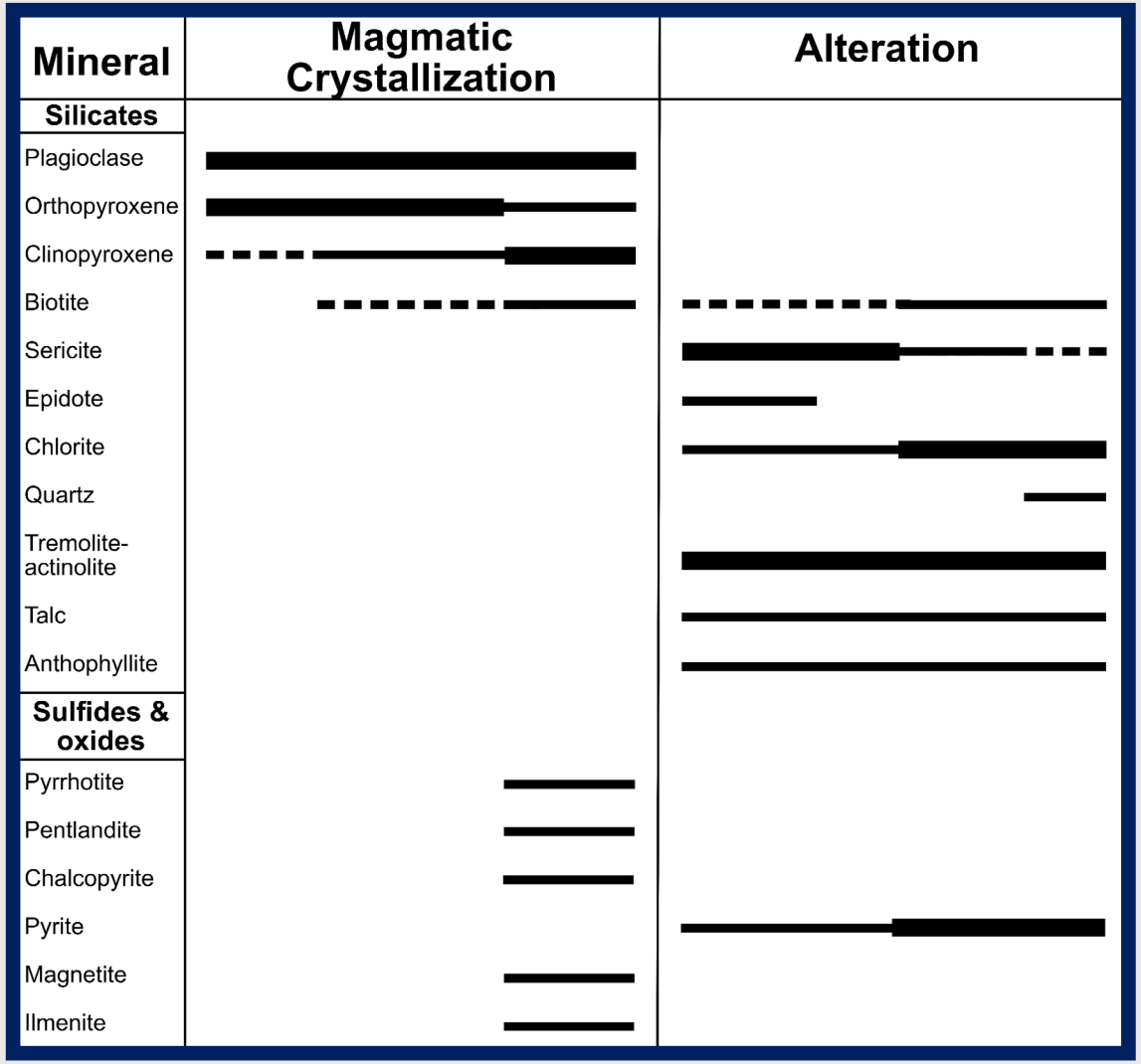


Petrographic results - sulfides

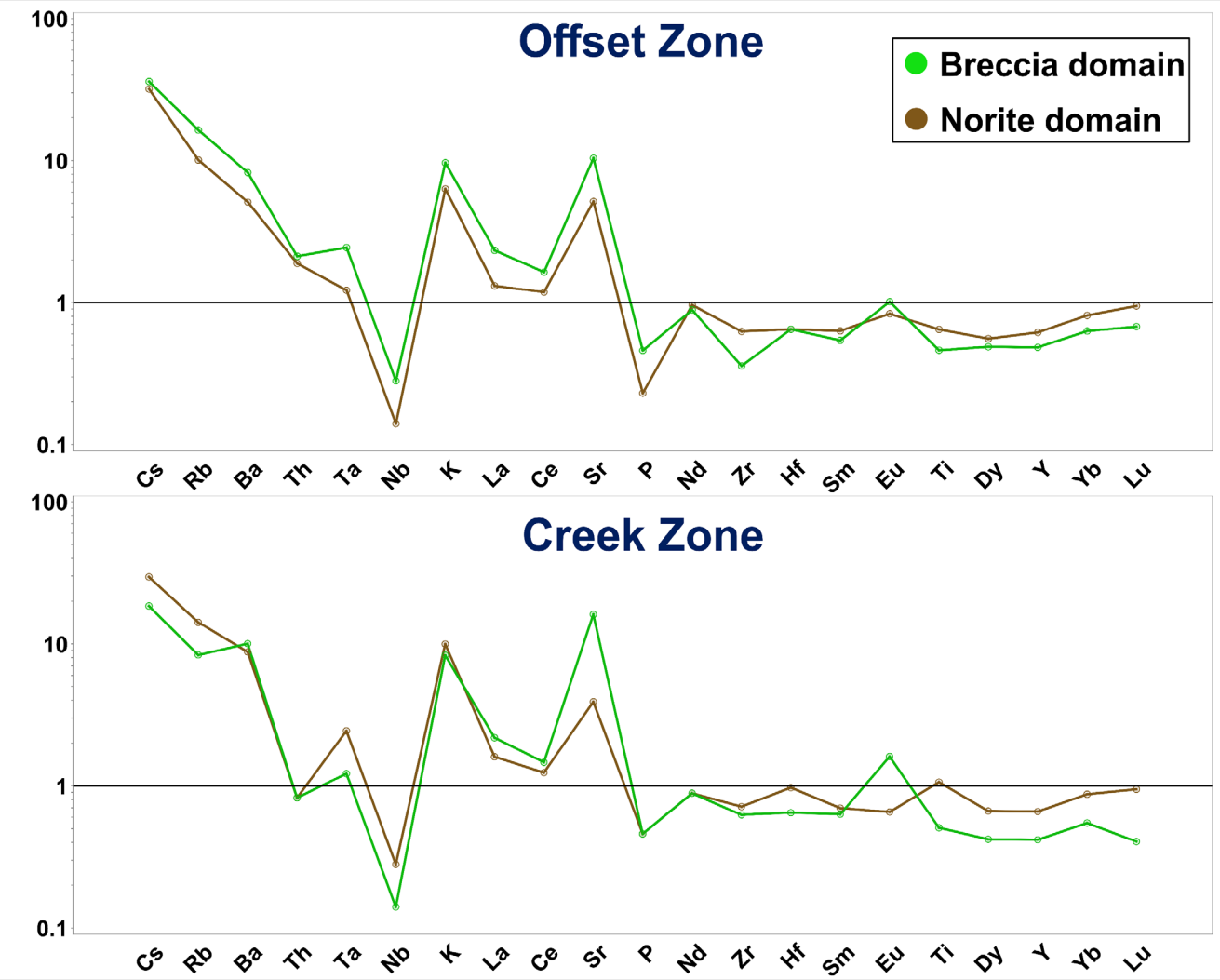


- Magmatic sulfide assemblage occurs as polysulfide disseminations.
- Pyrite, where present, replaces pyrrhotite in situ.
- No evidence for major sulfide remobilization.

Paragenesis



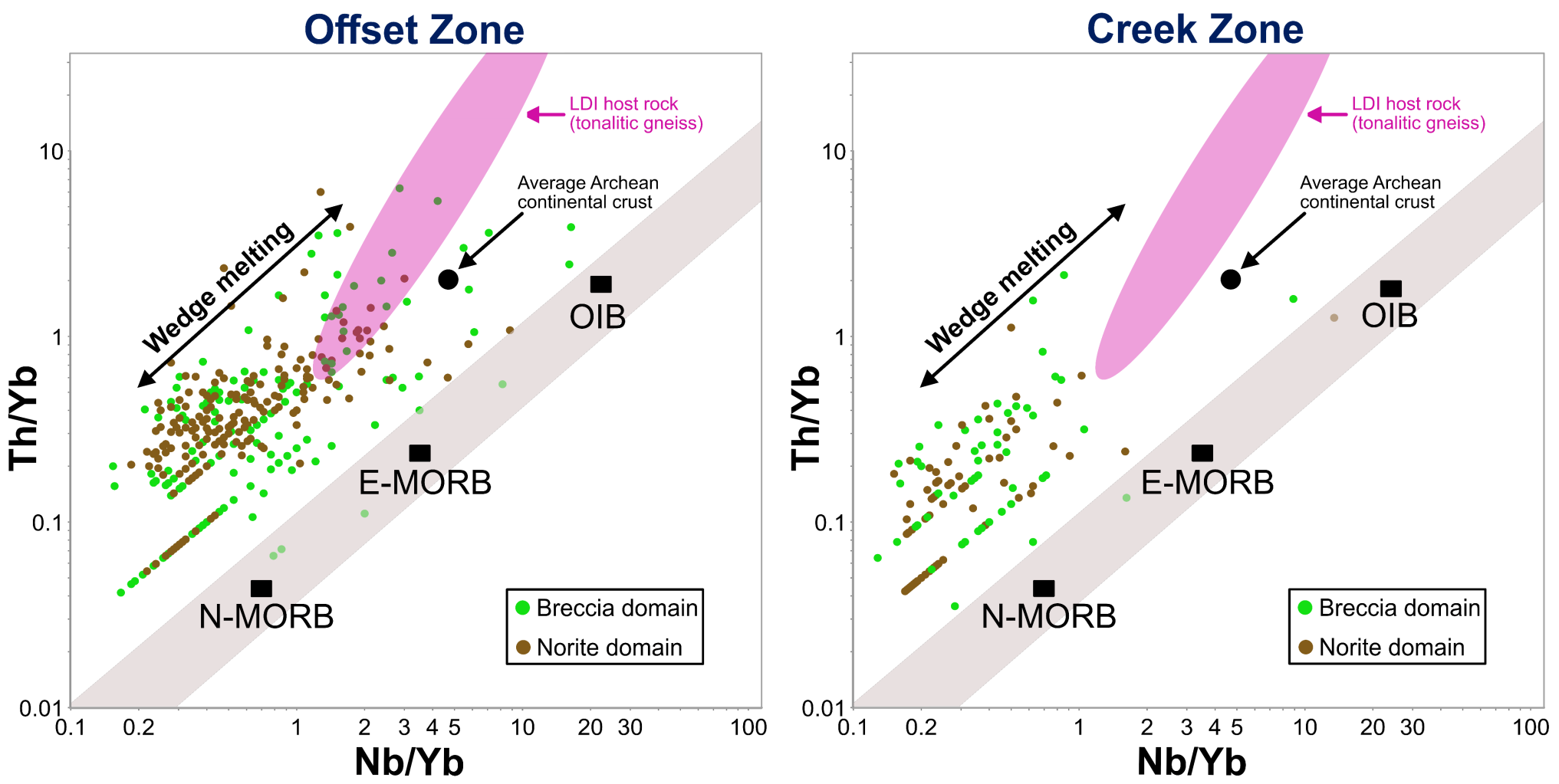
Primitive mantle-normalized plots



- Breccia and norite domains appear to have formed via similar processes
- Evidence of both magmatic arc setting and crustal contamination

Normalizing values from Sun and McDonough (1989)

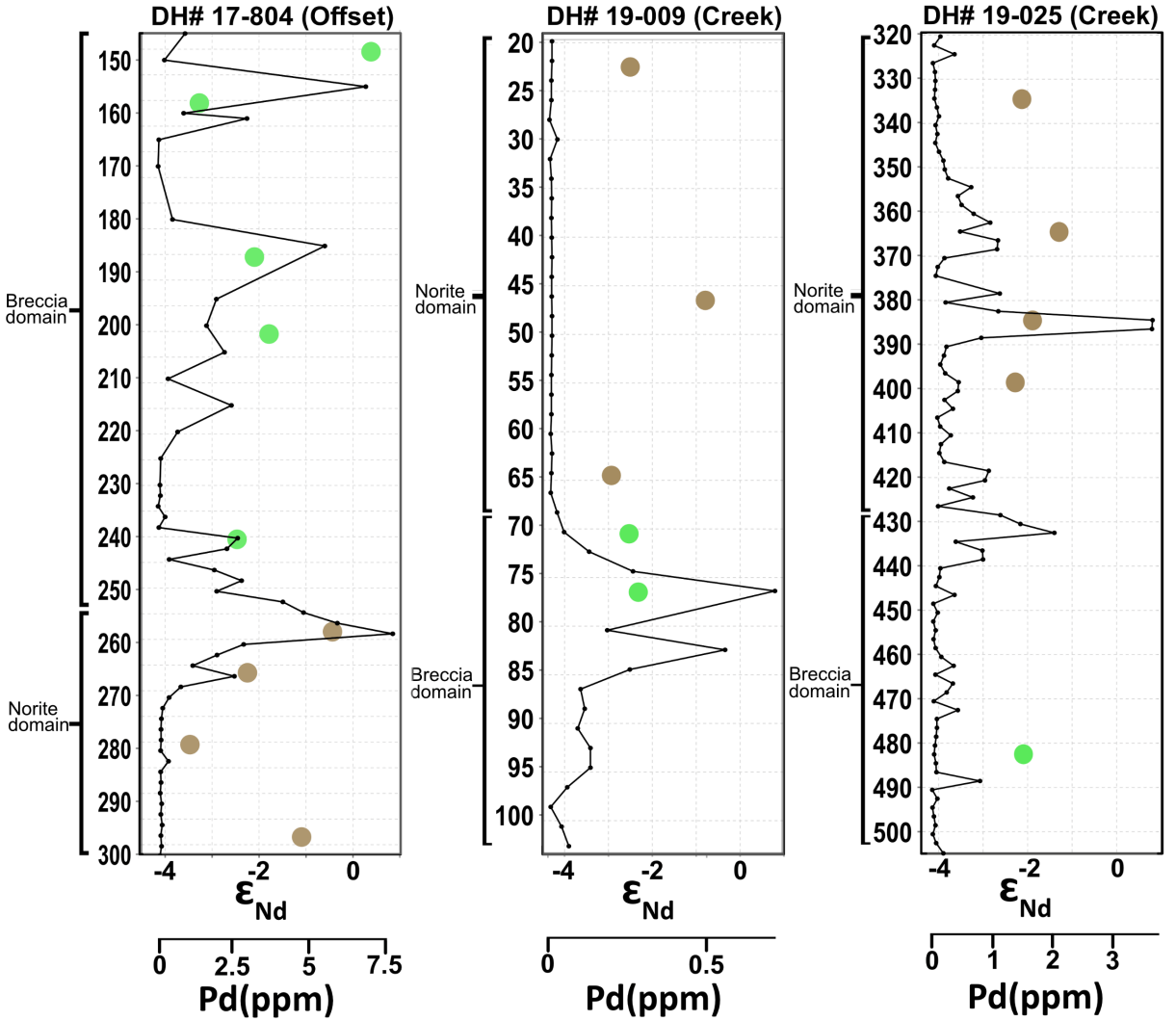
Evidence for arc setting



Mantle array from Pearce et al. (2008).

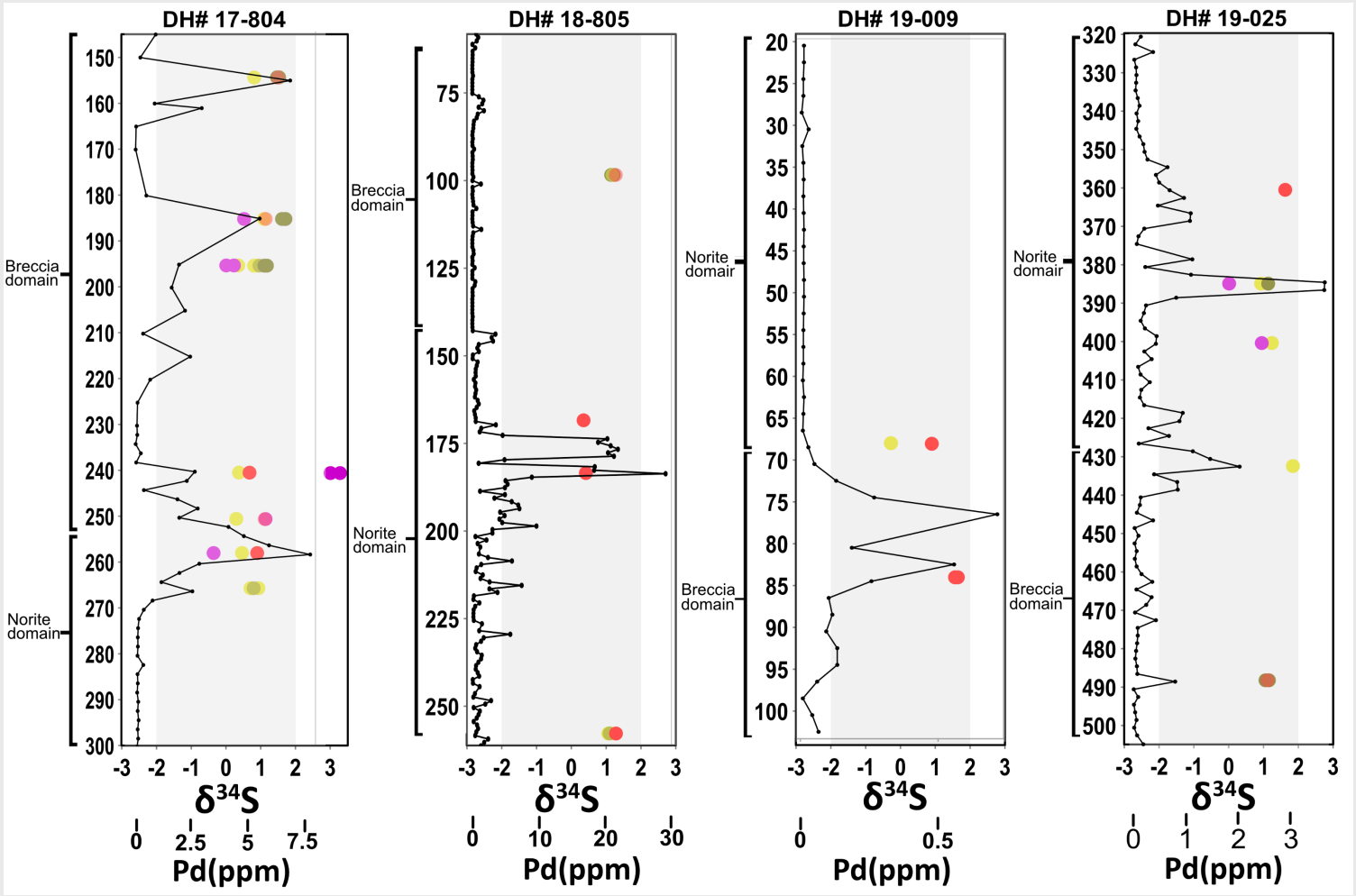
Tonalite chemistry from Bain (2022) & Brugmann et al. (1997)

Evidence for crustal contamination



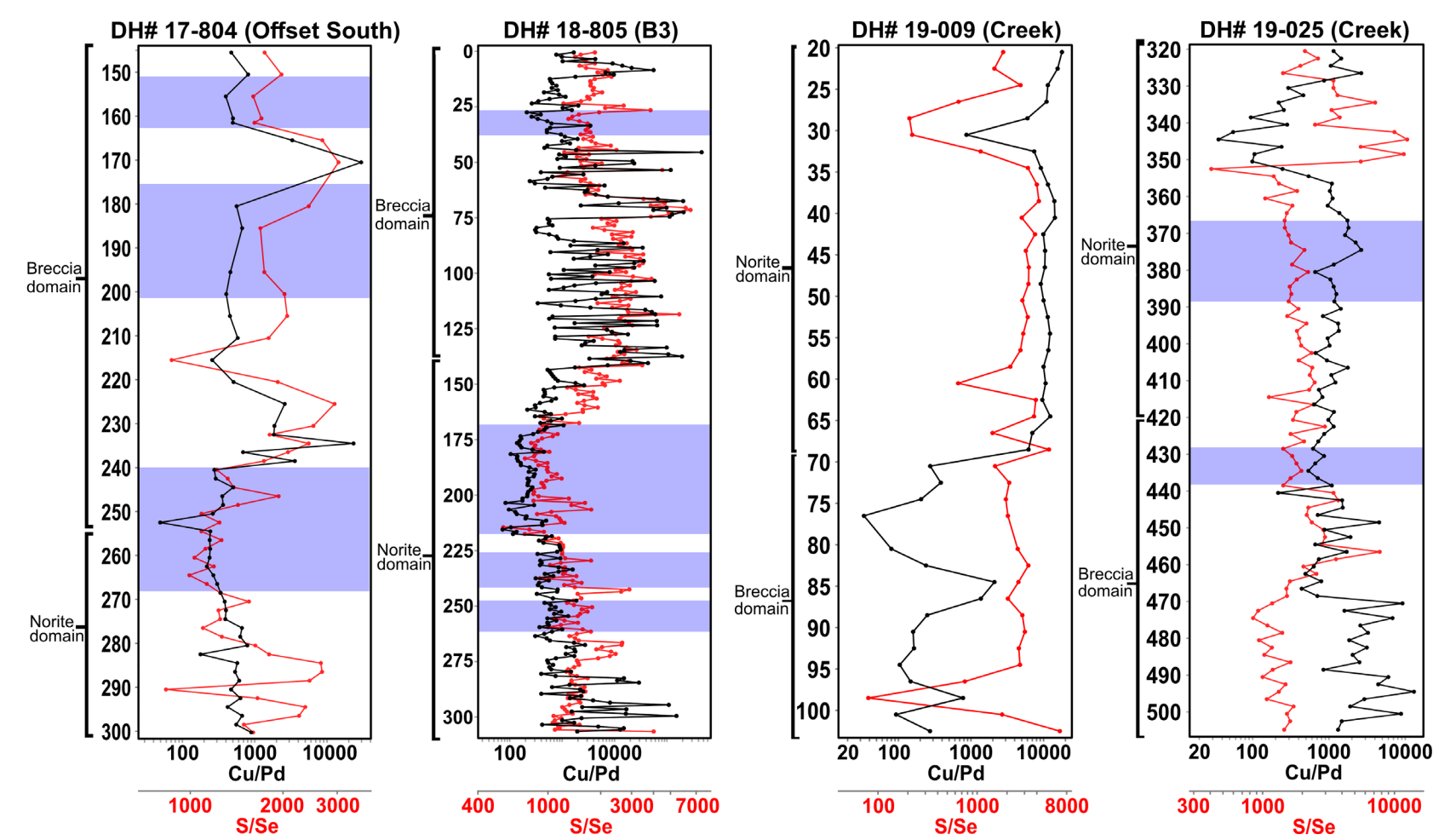
- ε_{Nd} ranges from -3.47 to +0.38
- ε_{Nd} of country rock = -1.77
- ε_{Nd} of depleted mantle at 2.689 Ga = +2.24 (DePaolo, 1981)

Sulfur isotopes



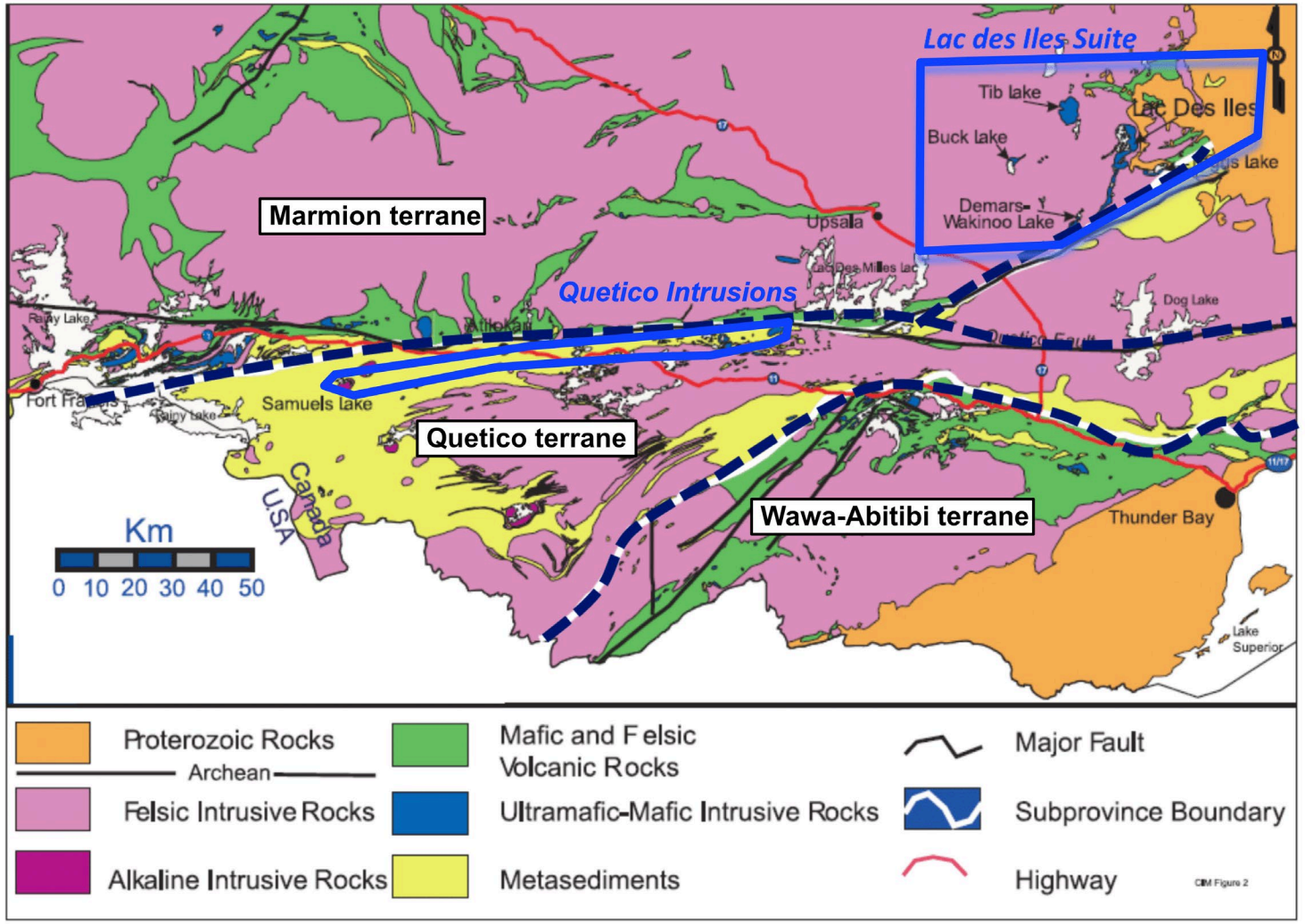
- Sulfur isotope values display mass-dependent fractionation
- ^{34}S values are within the range of mantle-sourced sulfur

Association of mineralization with R-factor

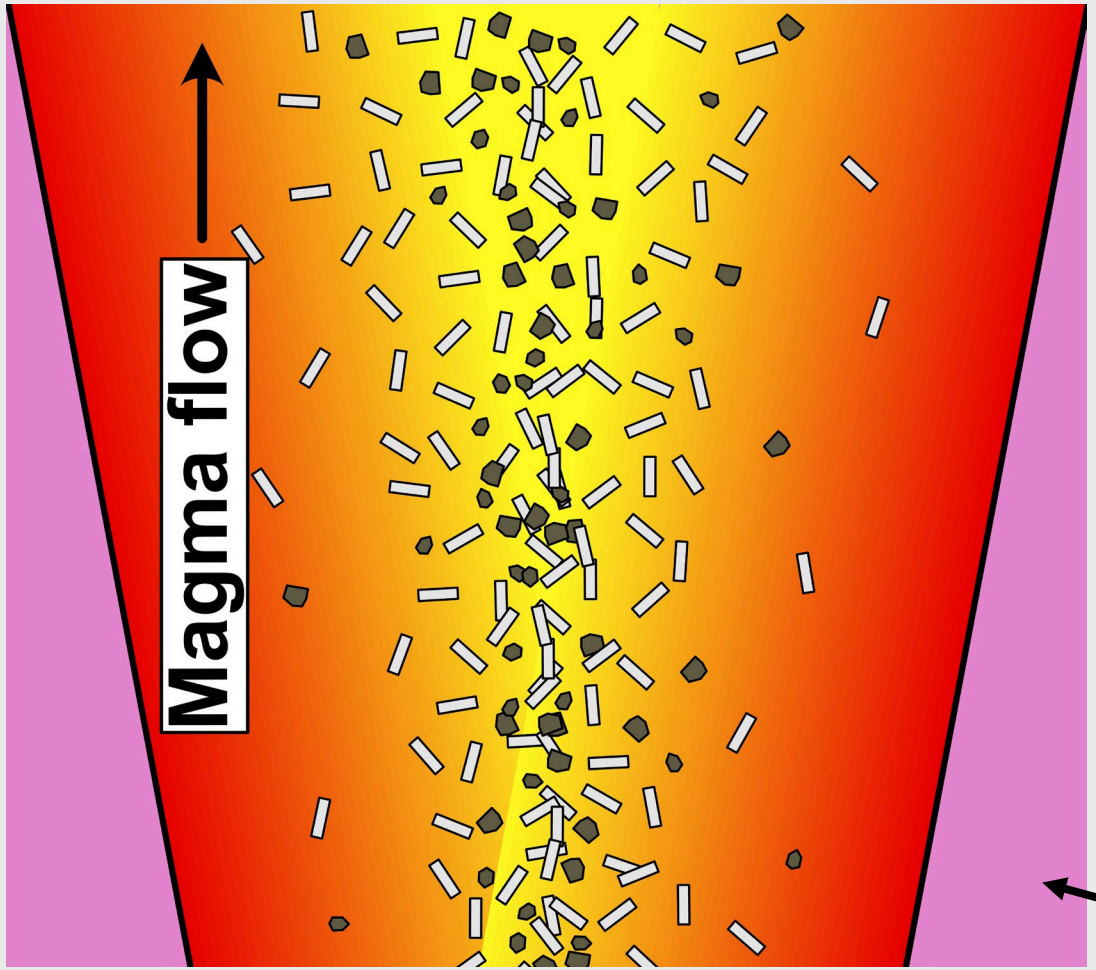


- Blue boxes = >10 m of >1 g/t Pd
- High Pd corresponds with high R-factor (low Cu/Pd and S/Se) in Offset Zone
- No relationship observed in Creek Zone

Tectonic setting

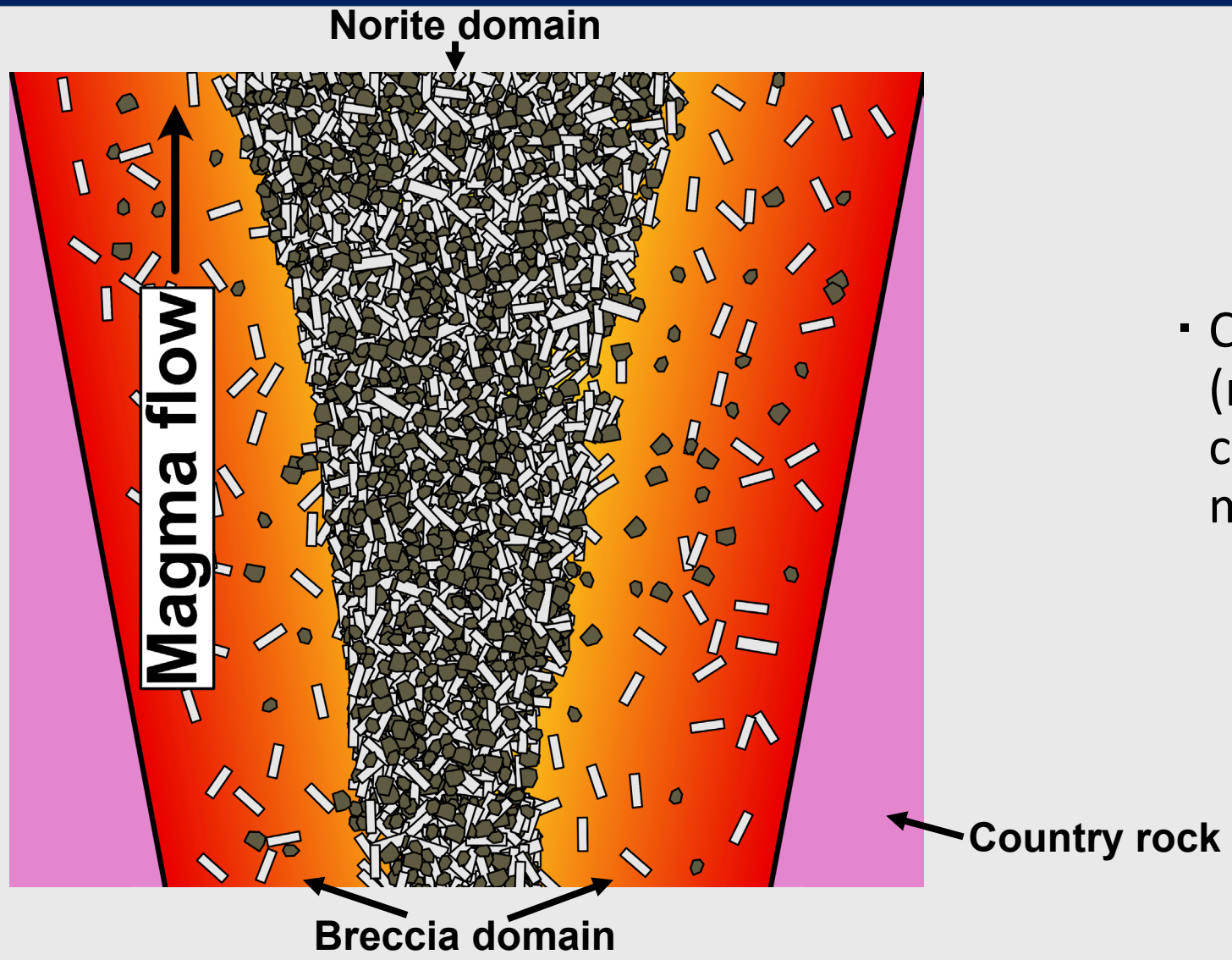


Emplacement model – Stage 1



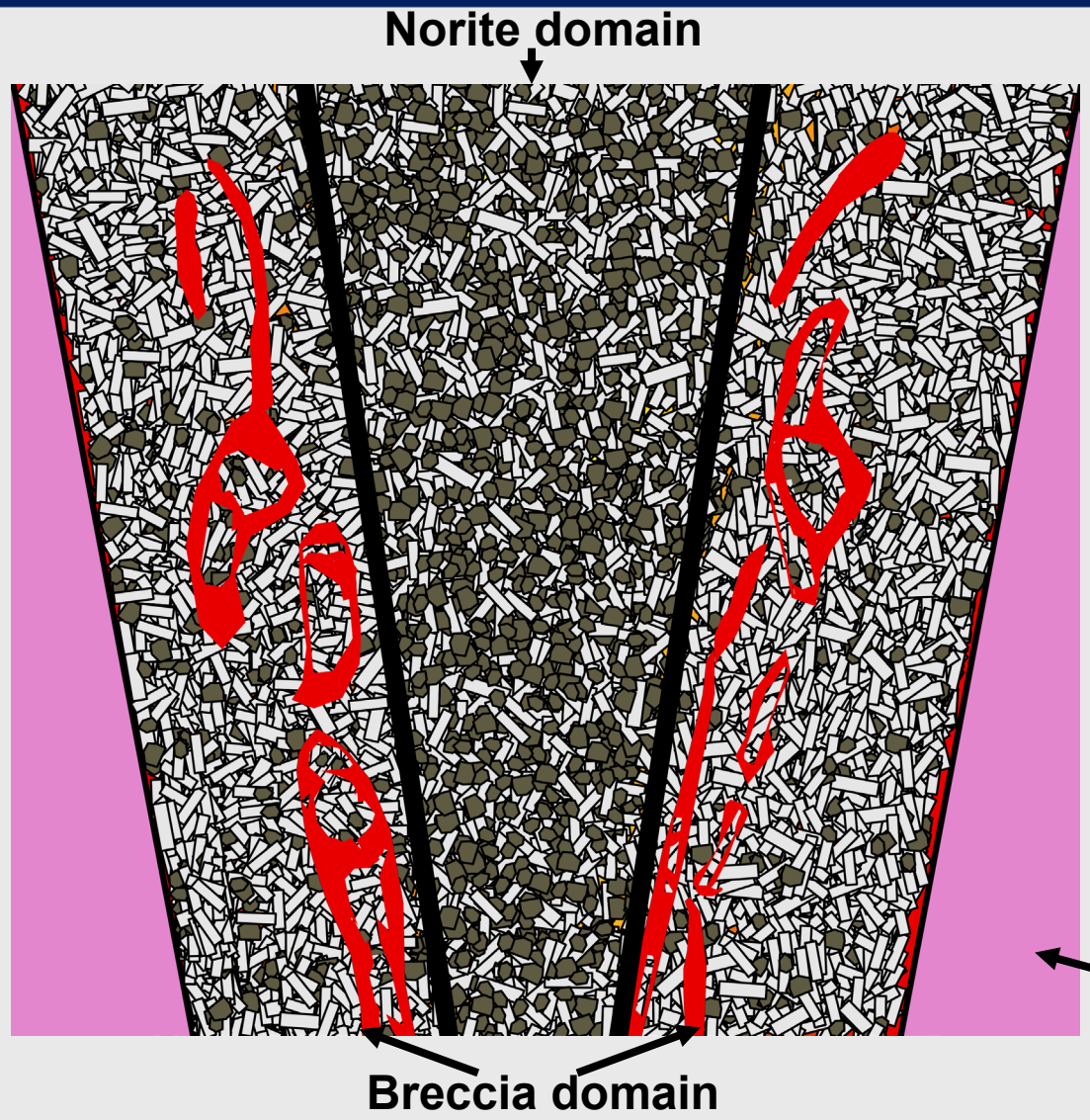
- Early-forming crystals move to centre of conduit as magma flows upward

Emplacement model – Stage 2



- Centre of intrusion (norite domain) crystallizes earlier and is more orthopyroxene-rich

Emplacement model – Stage 3



- Late-stage magma pulses carry PGE-rich sulfides and preferentially intrude the breccia domain

Acknowledgments

- Dr. Peter Hollings
- Dr. Lionnel Djon and the exploration team at Impala Canada
- Dr. Matt Brzozowski and Dr. Wyatt Bain
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