The Geochemistry and Geochronology of the End Deposit Nunavut, Canada

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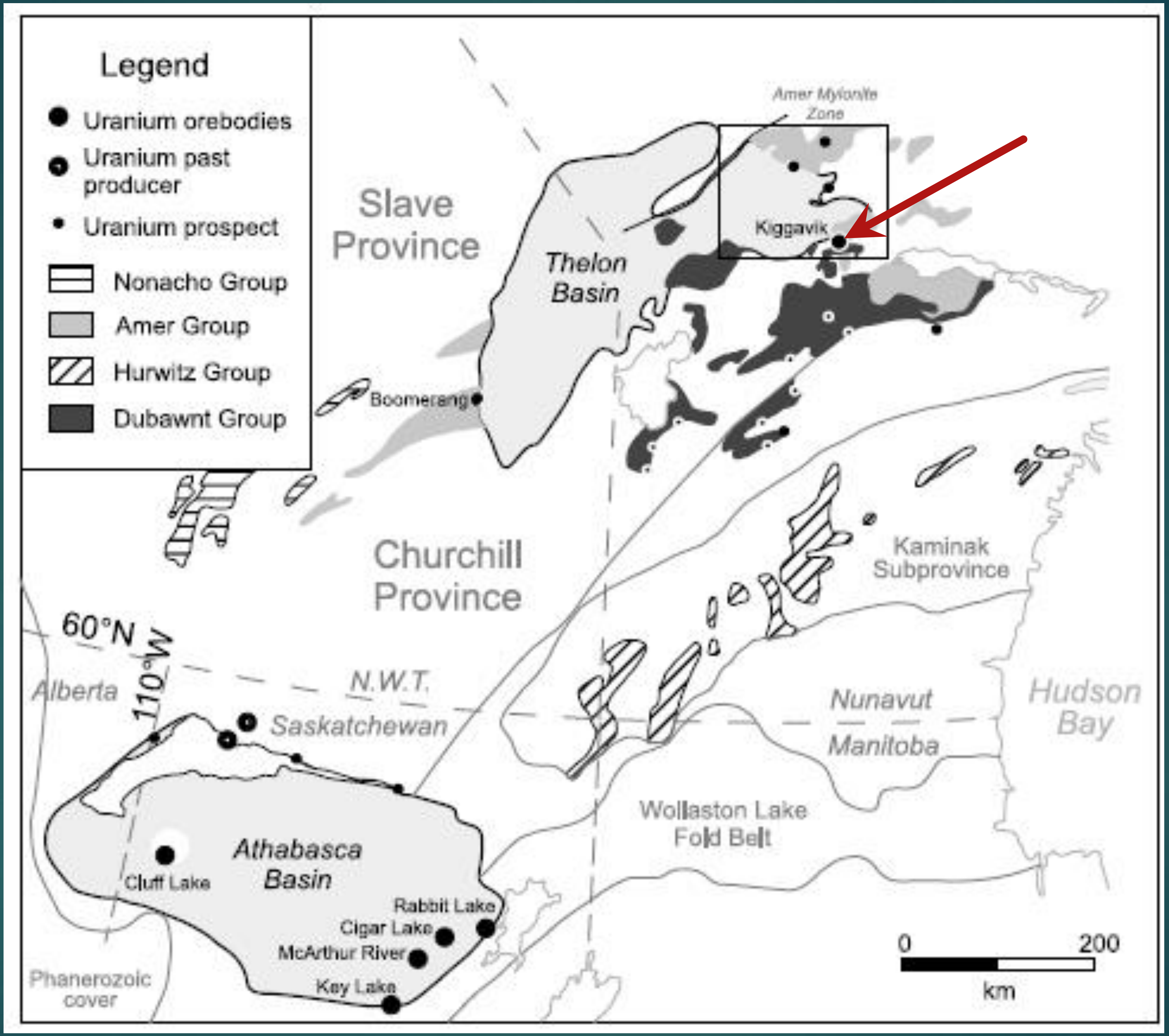
Introduction

- Growing need for “Clean” energy resources
- Nuclear power generates little to no carbon footprint
- As of 2012, there are 437 commercial nuclear reactors
  - Supply 12% of the globes electricity
  - 76 are currently under construction
- There will be continued demand for uranium in the future
- Therefore, current deposits need to be fully understood to develop new exploration models to aid discovering new economic deposits

The Kiggavik Project

- The Kiggavik project is located 80 km west of Baker Lake (~1500 km due north of Winnipeg)
- The project consists of several U deposits and prospects (eg. the Kiggavik Main, Centre, and East Zones, Bong, Andrew Lake, and End)
- End deposit is estimated to contain **12.3 million kg U @ grade of 0.281% U_3O_8**
- Owned and operated by AREVA Resources Canada (ARC), and corporate predecessors, since 1993



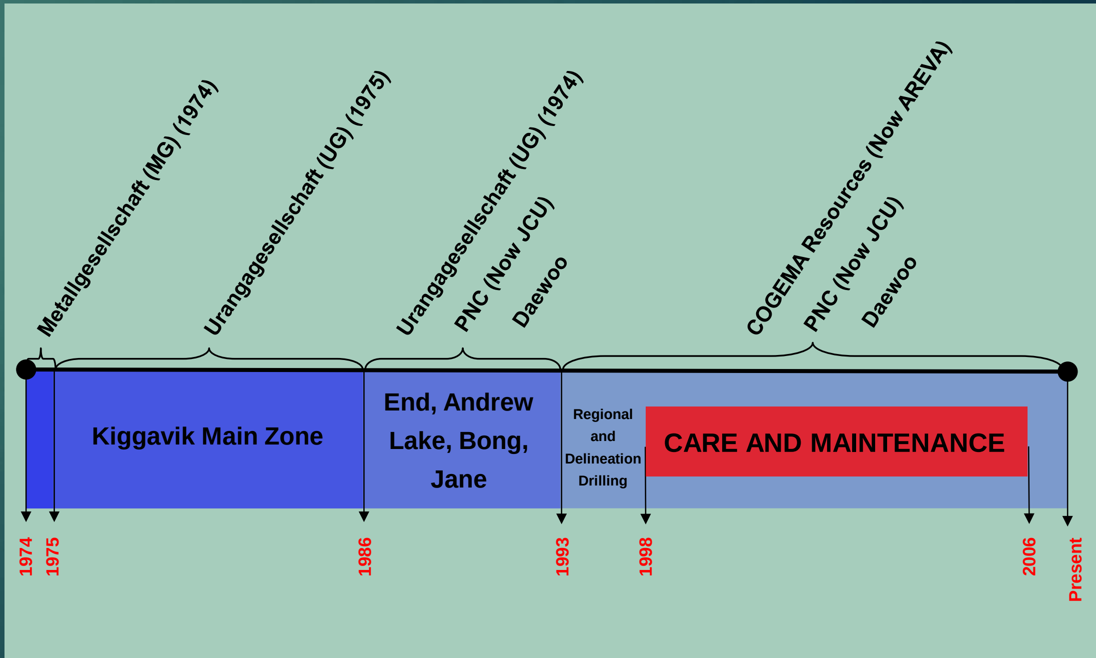
(from Renac et al., 2002)

Purpose

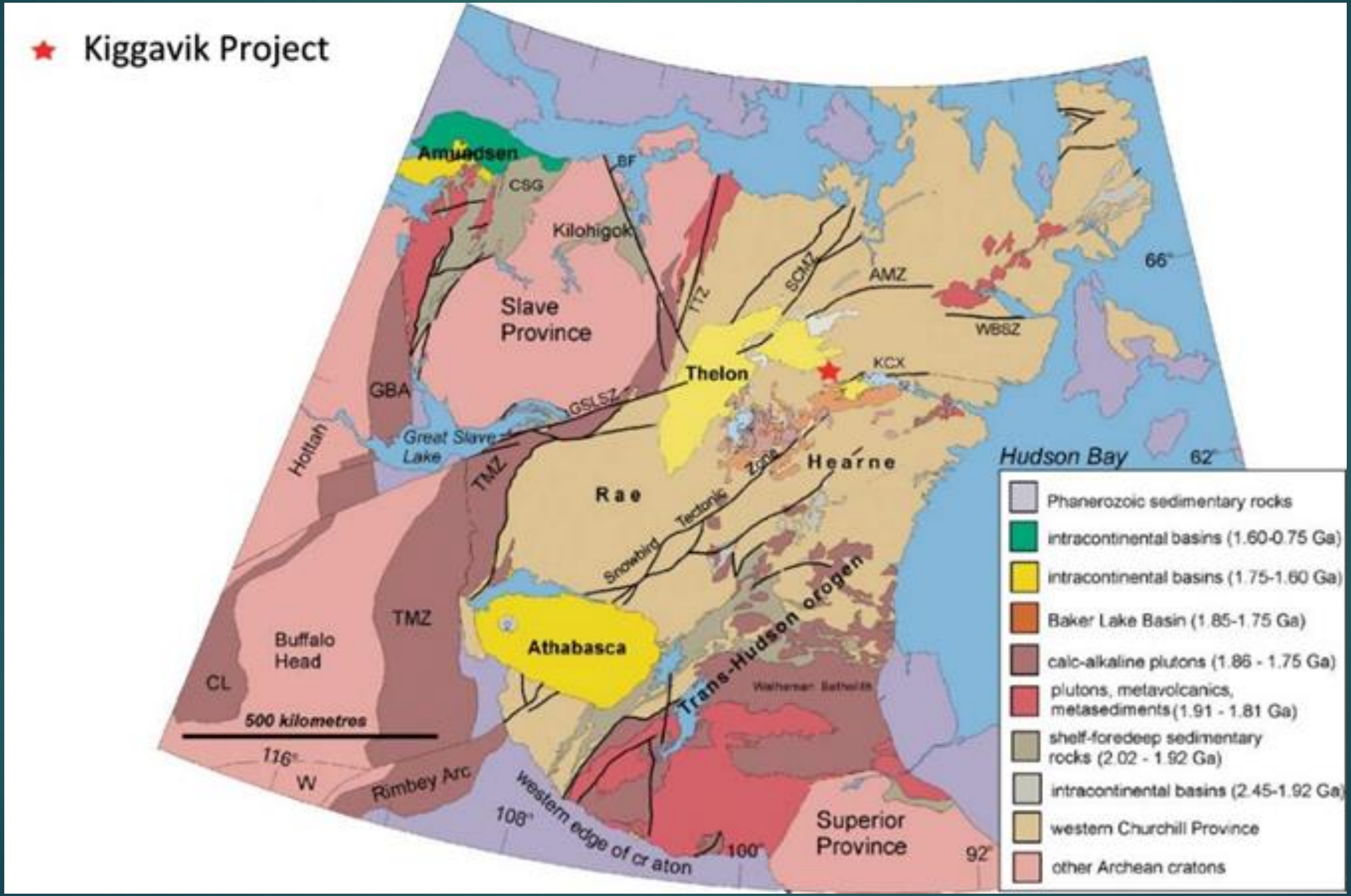
- The goal of this project is to understand the genesis of the End deposit through petrography, isotope geochemistry, and geochronology of the alteration and mineralization, and then relate the findings to other deposits within the area and elsewhere.
- The secondary objective of this project is the use of Ar-Ar dating to date structural features and igneous intrusions
  - Fractures containing clay minerals - to compare against existing U-Pb dating of mineralized material: possible exploration tool
  - Dating of Lamprophyre and Feldspar Porphyry dykes

Discovery of Kiggavik

- First uranium showings in the Thelon Basin area discovered in 1975 by Urangleshellschaft
  - Applied exploration methods used for unconformity deposits in the prolific Athabasca basin, Saskatchewan
- A 2 km radioactive anomaly was discovered using a helicopter-mounted system
- Follow-up ground surveys revealed radioactive frost boils containing up to 1% U_3O_8 and drilled began in 1977
- This led to the discovery of the Lone Gull uranium deposit that was later renamed Kiggavik Main Zone
- Further airborne resistivity and ground gravity surveys led to the discovery of the End, Bong Jane and the Andrew Lake deposits in 1987



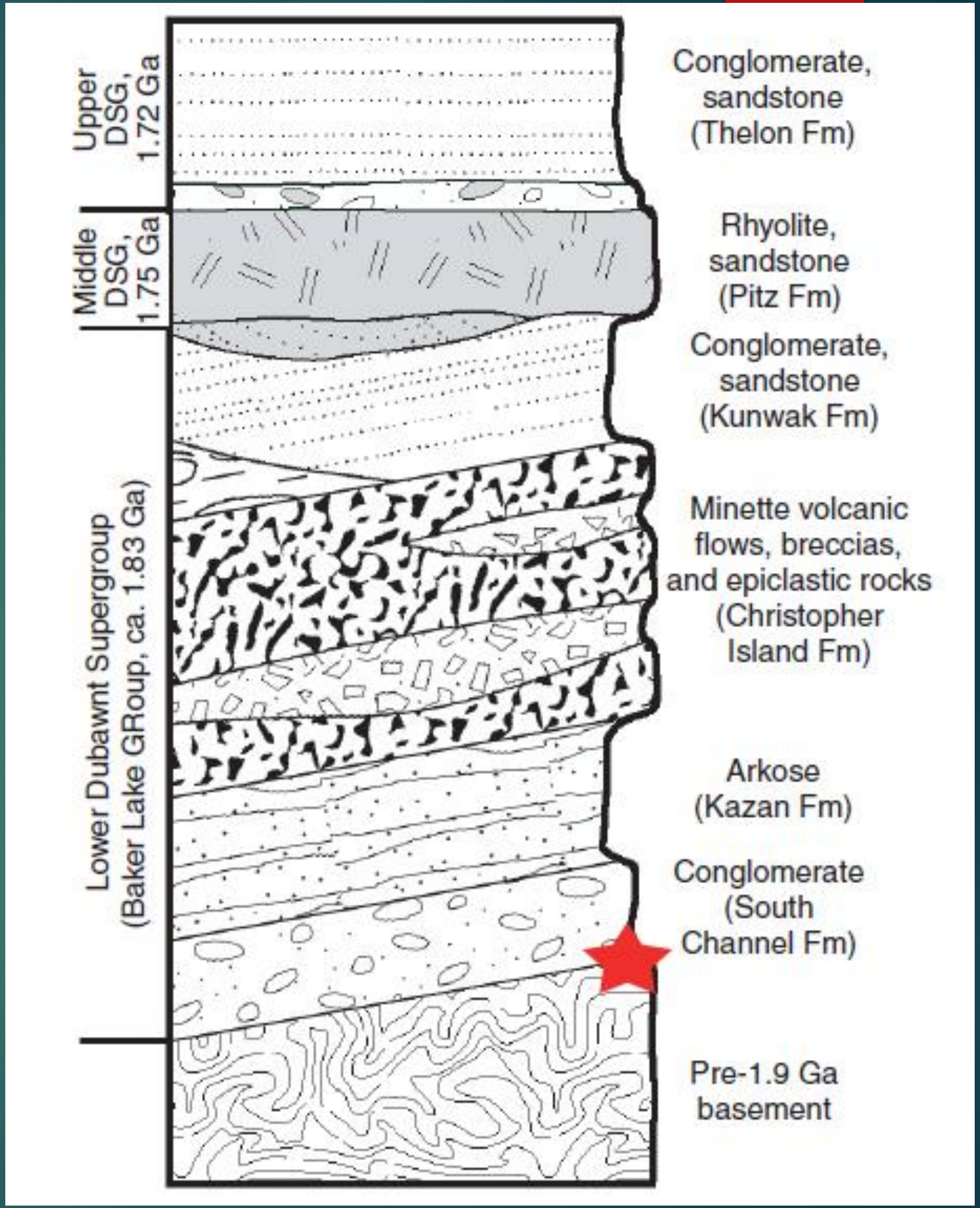
Regional Geology



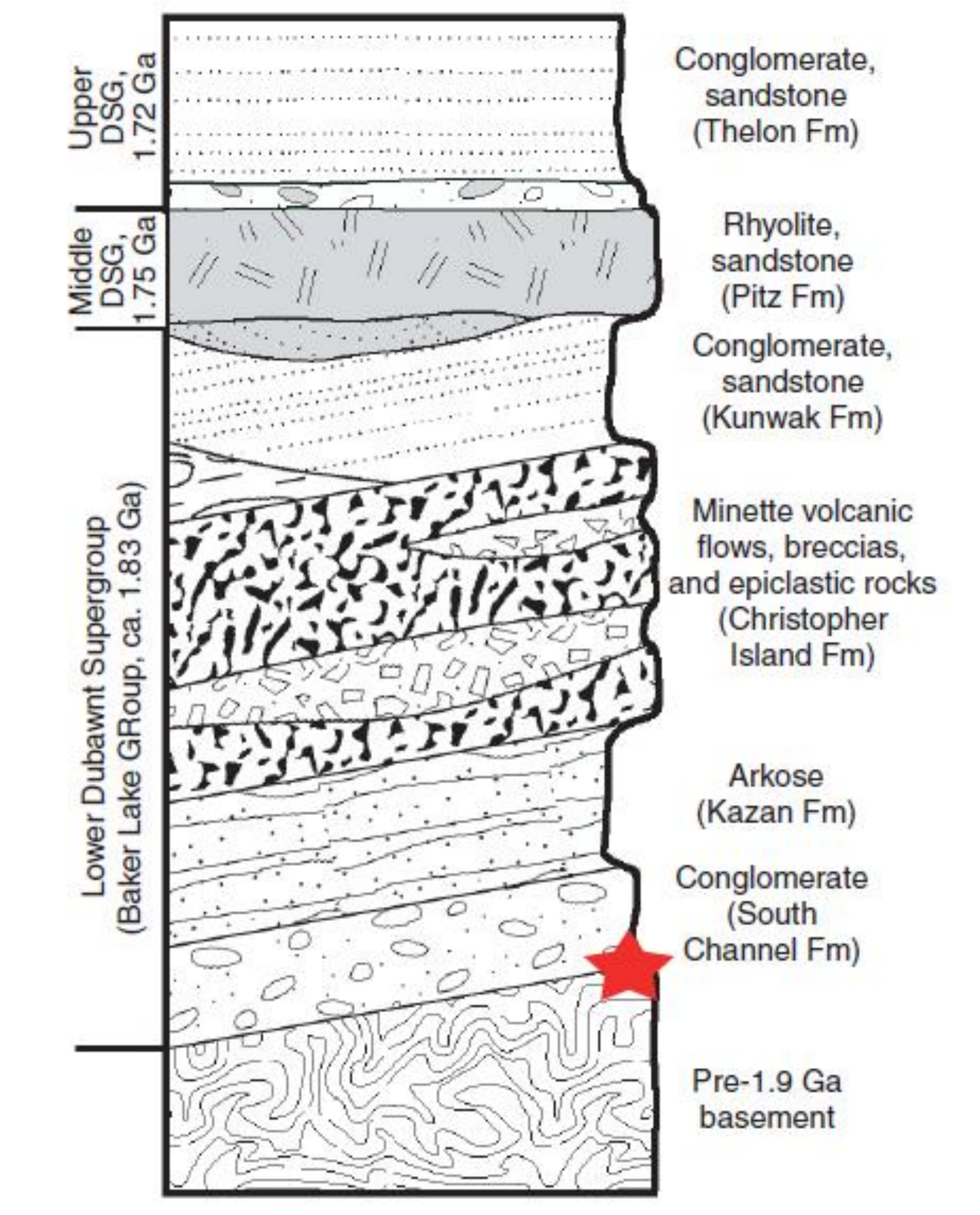
(from Rainbird et al., 2003)

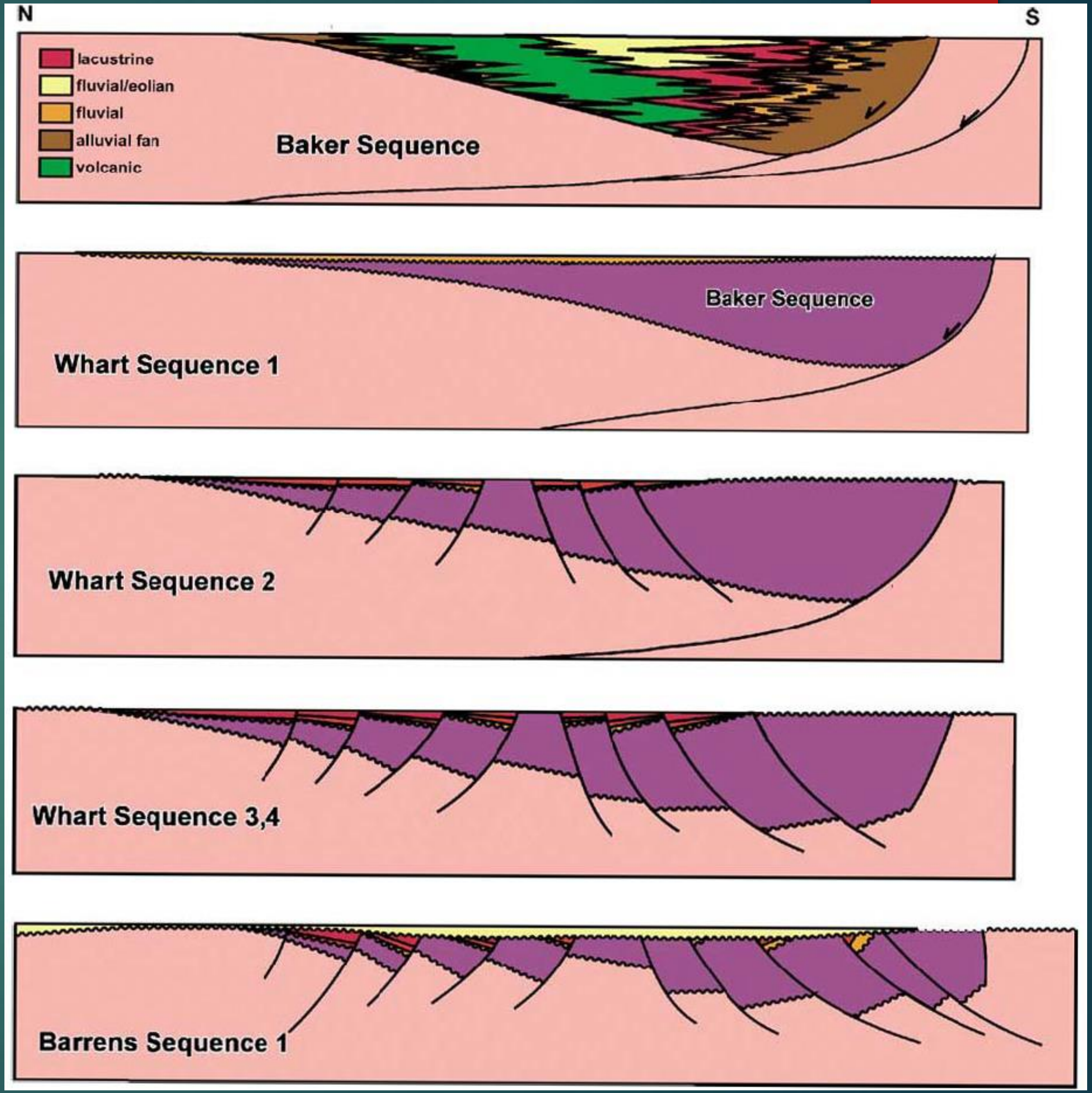
Dubawnt Super Group

- Baker Lake Group (1.845 – 1.785 Ga)
  - South Channel Formation
  - Kazan Formation
  - Christopher Island Formation
  - Kunwak Formation
- Wharton Group (1.758 – 1.754 Ga)
  - Amarook Formation
  - Pitz Formation
- Barrensland Group (1.720 Ga)
  - Thelon Formation
  - Kuungmi Formation
  - Lookout point Formation



(after Peterson, 2006)

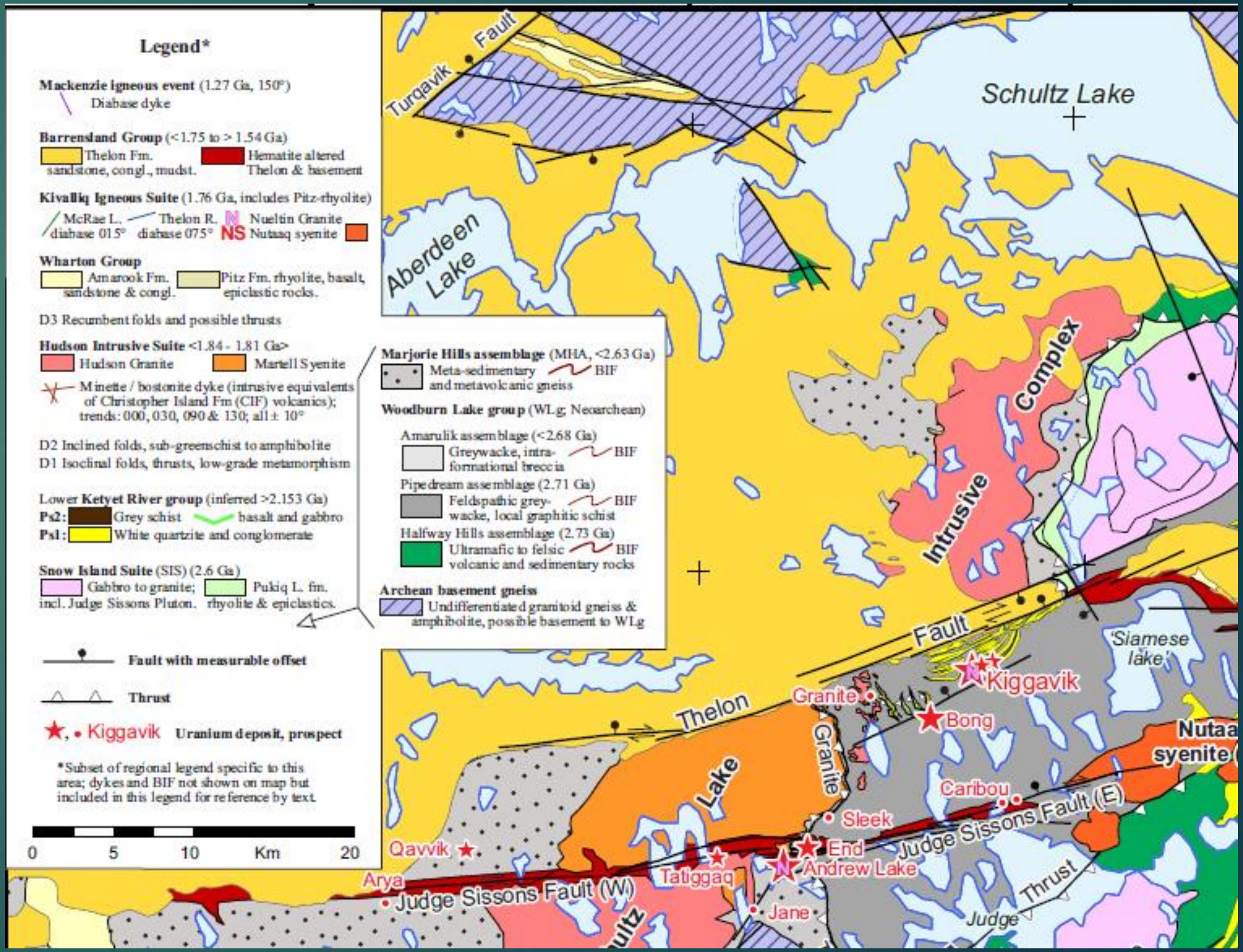




(from Rainbird et al., 2003)

Local Geology

- Kiggavik – Andrew Lake structural trend
- Woodburn Lake Group
- The End deposit is hosted within the Pipedream Assemblage
  - Lamprophyre
  - Feldspar Porphyry dykes
  - Hydrothermal hematite
  - Quartz breccia
- Three main structures identified
  - N40-N70 - ENE trend
  - N160 – Late faulting event
  - N110-120 –relationship unclear



(from Sharpe et al., 2015)

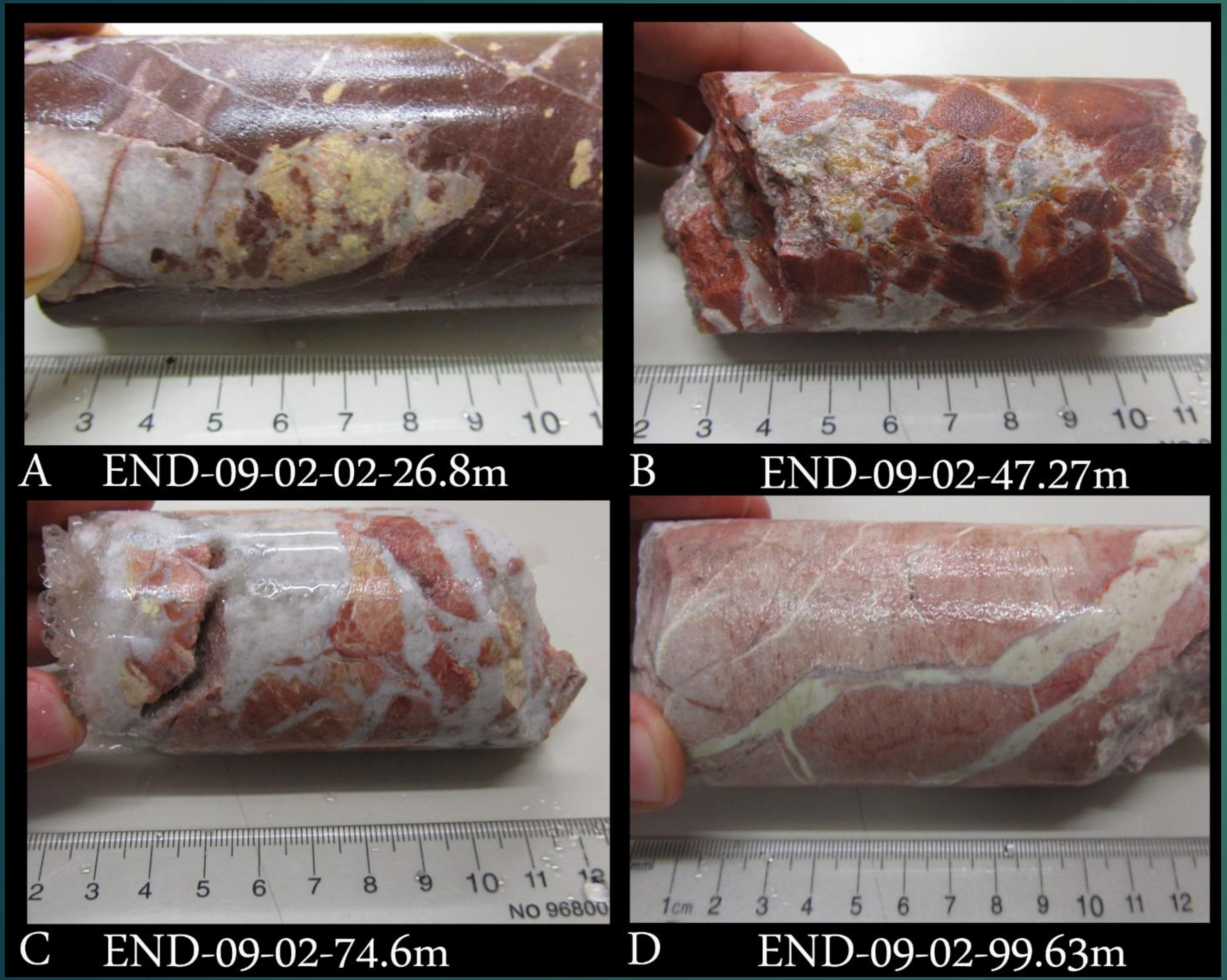
Alteration

- Host-rock alteration along the Kiggavik – Andrew Lake is dominated by clay minerals, with lesser amounts of other minerals
  - Illite
  - Sudoite
  - Hematite
  - Aluminum Phosphate-Sulphate minerals (APS)
- Host rock was subject to greenschist metamorphism; lower amphibolite at the most
- Later hydrothermal alteration was restricted to faults within the area and later overprinted by several hematization events
- The replacement of metamorphic phyilosicitates by hydrothermal alteration caused a release of iron

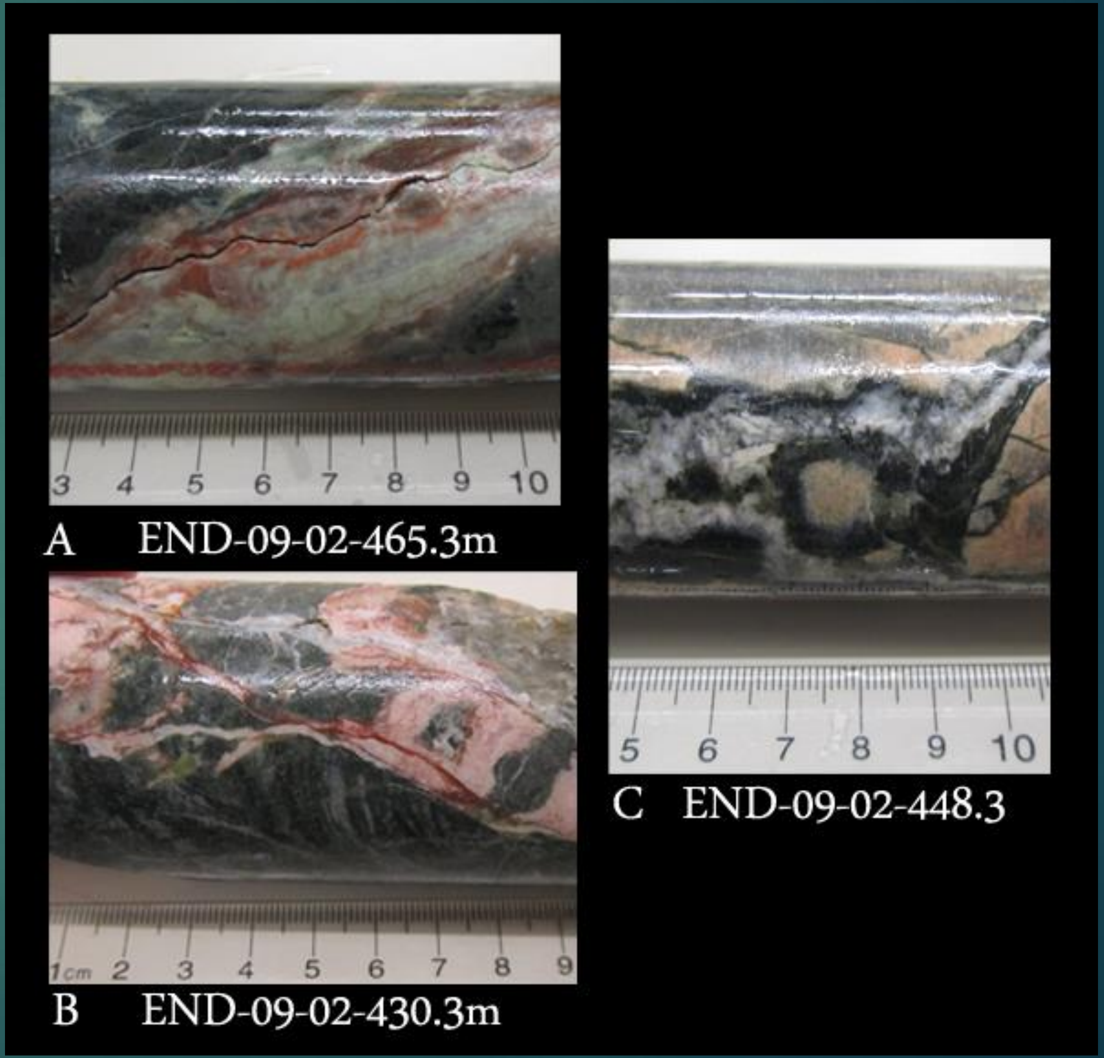
Mineralization

- Uranium throughout the End deposit is polyphased
  - Pitchblende (uraninite) rimming pyrite within granitic veins
  - Finely disseminated as pitchblende (uraninite) to coffinite along foliation planes
  - Fractures that cross cut the local foliation
  - Reduced and oxidation fronts either syn or post to late-brittle faults
- Suggests multiple remobilization events, thus difficult to determine the source and the primary age of formation
- Uranium mineralization is oriented parallel to foliation, parallel to the silica quartz breccias, and with later orientations at N-S to ENE

Sampling highlights

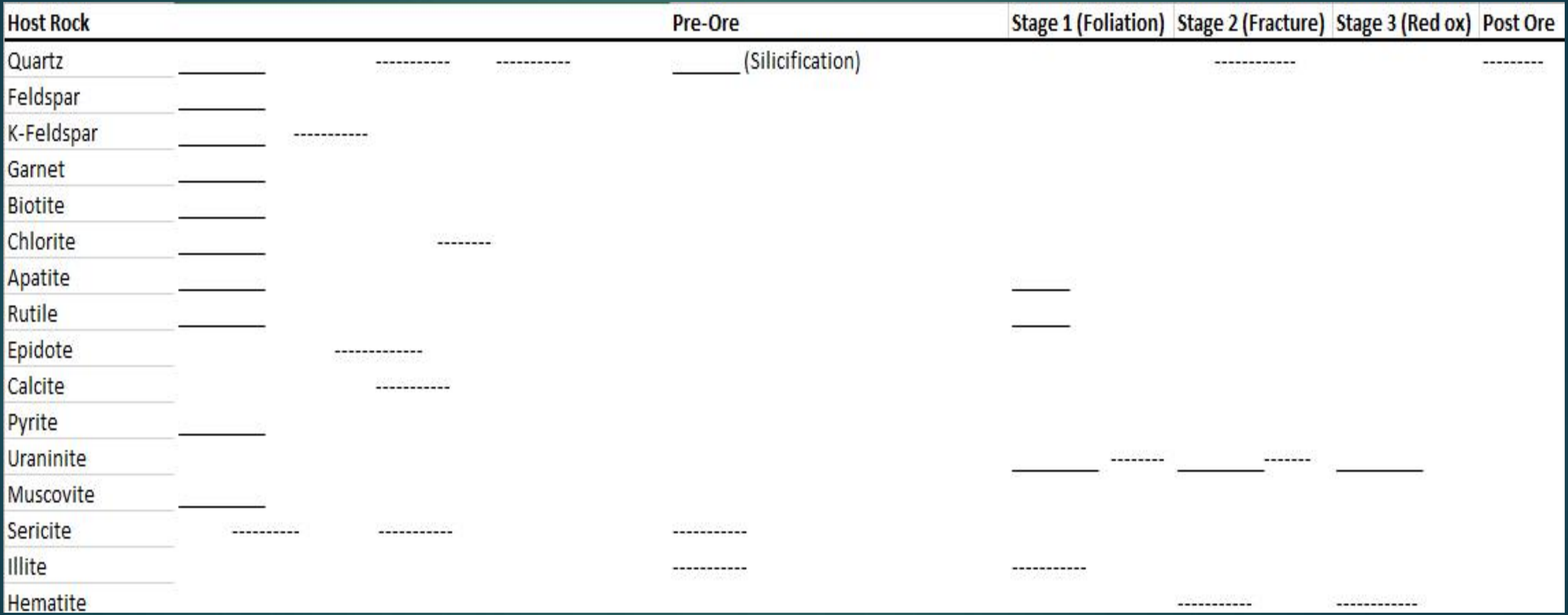


A END-09-02-02-26.8m
B END-09-02-47.27m
C END-09-02-74.6m
D END-09-02-99.63m



A END-09-02-465.3m
B END-09-02-430.3m
C END-09-02-448.3

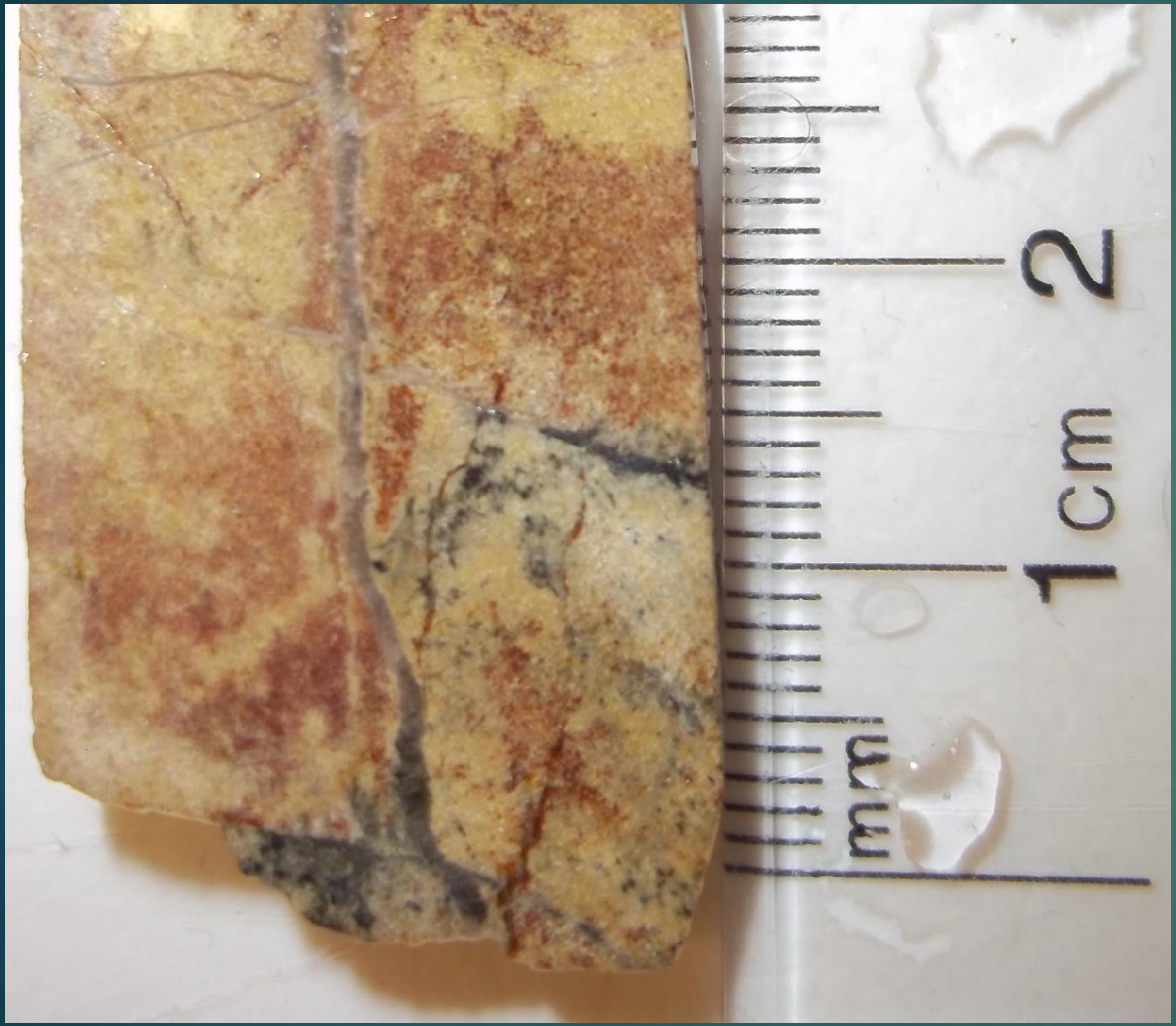
Preliminary Mineral Paragenesis

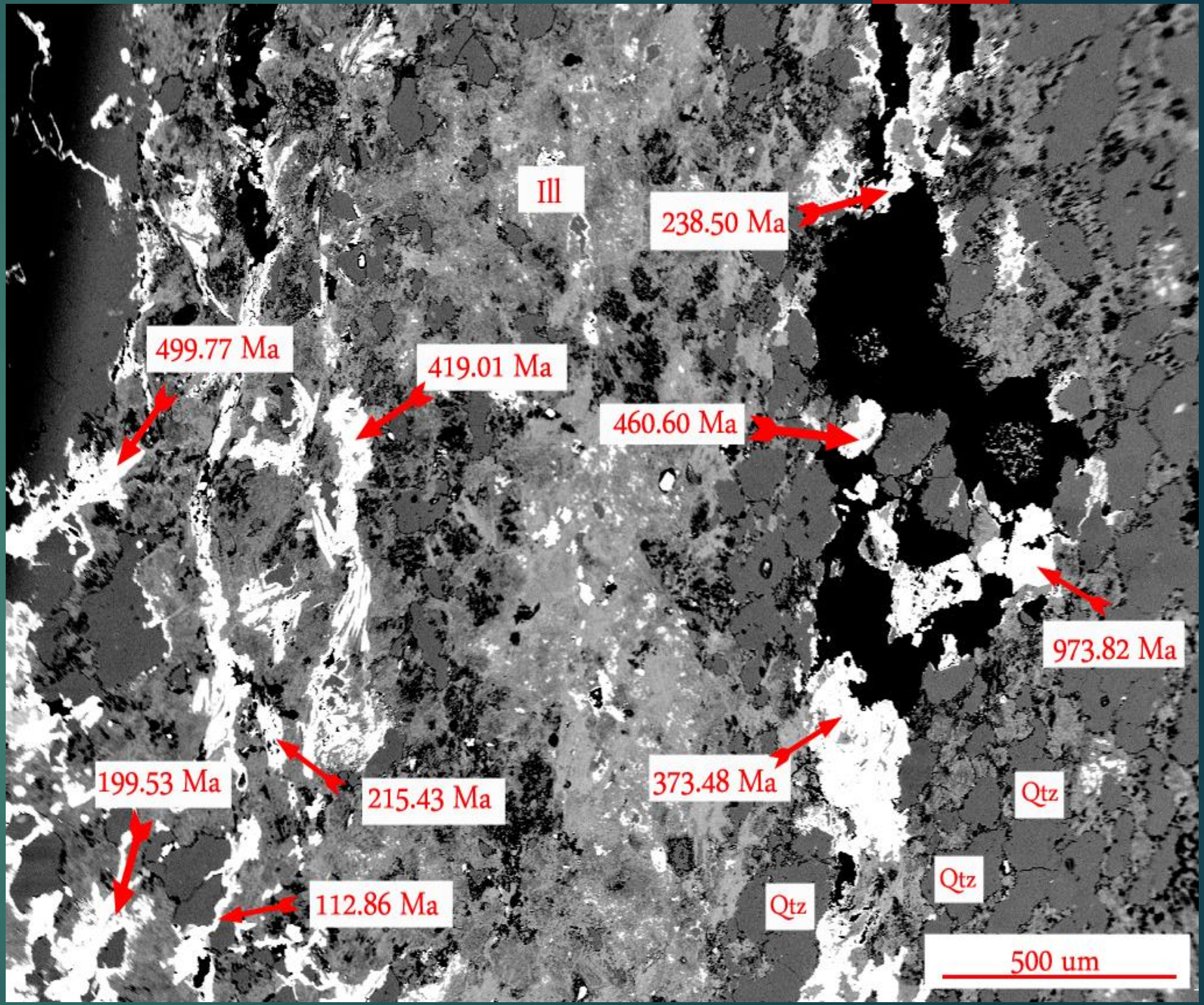


U-Pb Chemical Ages

- EMPA analysis of 3 uraninite-bearing samples from drill hole END-10-03
- U-Pb chemical ages were calculated using Ranchin (1968) on phases of uraninite mineralization

$T = Pb \times 7550 / (U + 0.36Th)$ *All elements are in weight %





BSE image of END-10-03-267

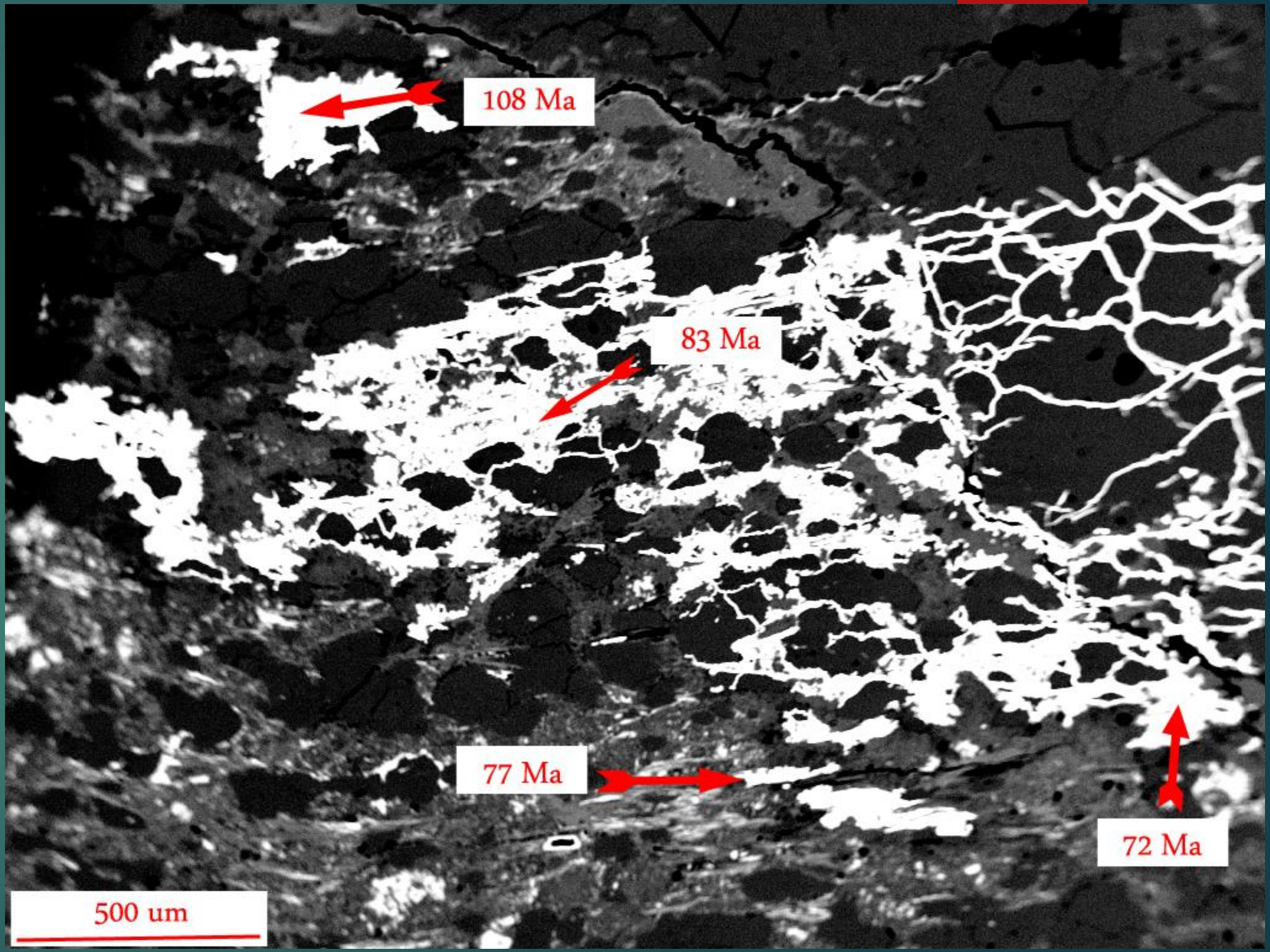
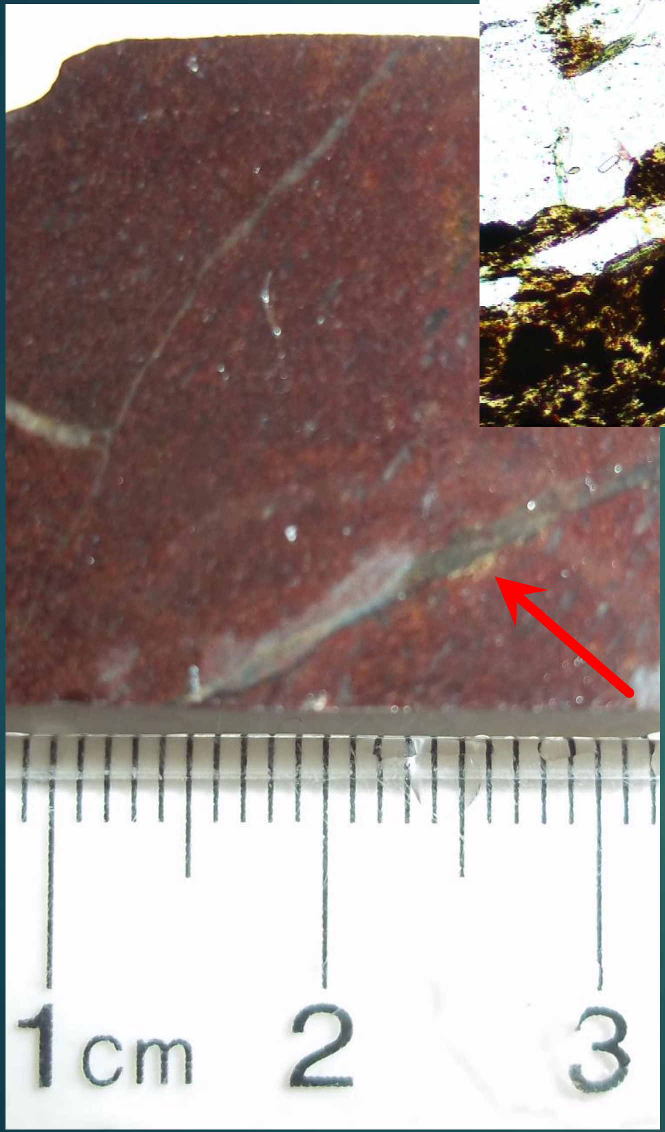
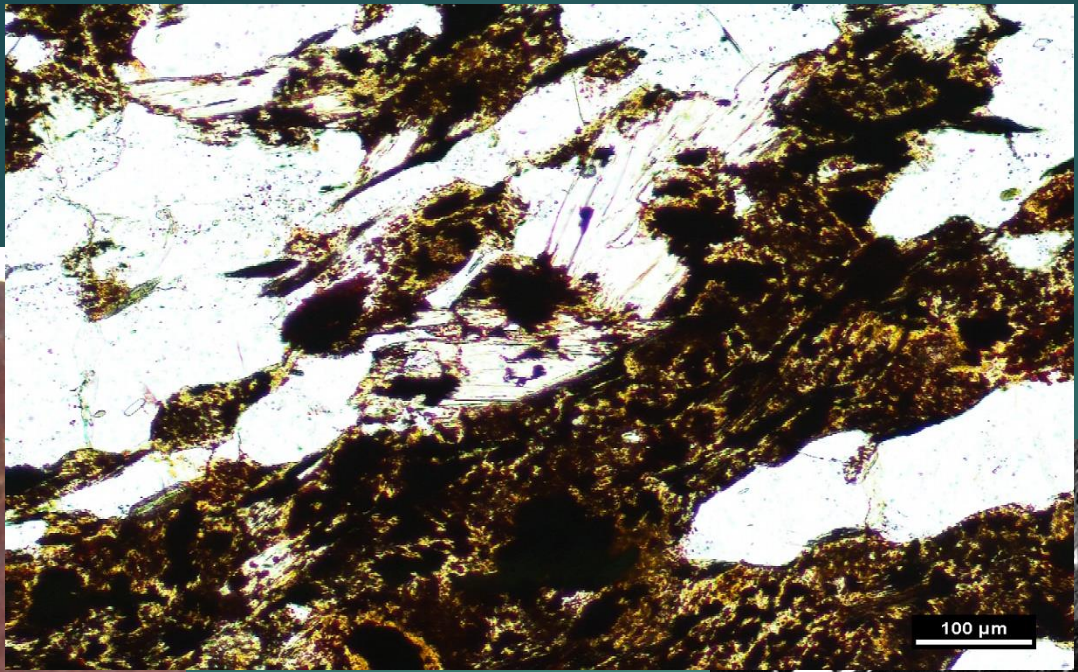


Figure 5. BSE image of END-10-03-223.3





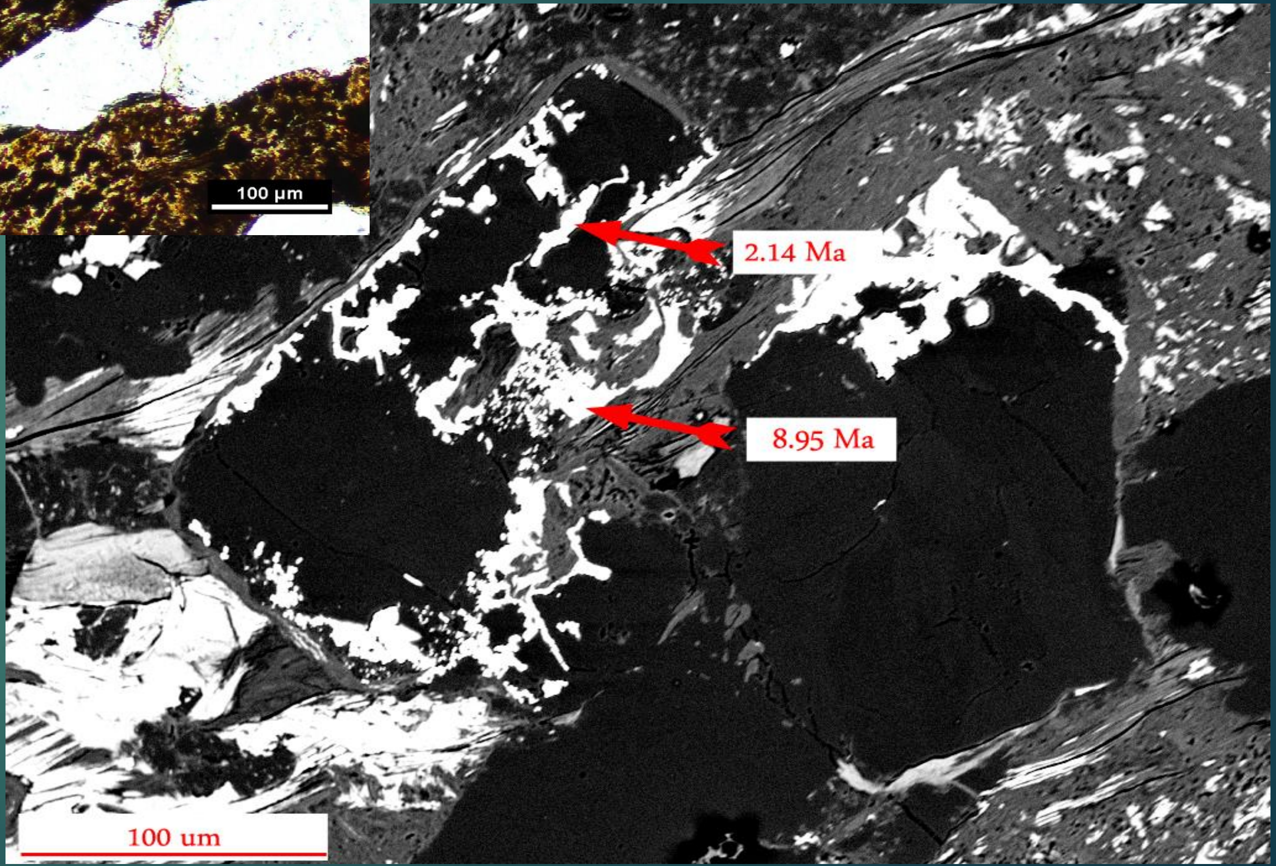


Figure 6. BSE image of END-10-03-244.5m

Work to be completed

- Submission of samples with clay bearing structures for Neutron activation
- Further EMPA analysis of uraninite bearing samples
- U-Pb dating of Uranium Phases using SIMS
- Oxygen and hydrogen isotopes of sericite and Illite
- Oxygen isotope analysis of Uranium-bearing minerals
- Ar-Ar analysis of non-mineralized and mineralized structures
- Data Interpretation and Writing

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