THE NATURE OF REE MINERALIZATION IN THE ASHRAM DEPOSIT, ELDOR CARBONATITE COMPLEX, QUEBEC

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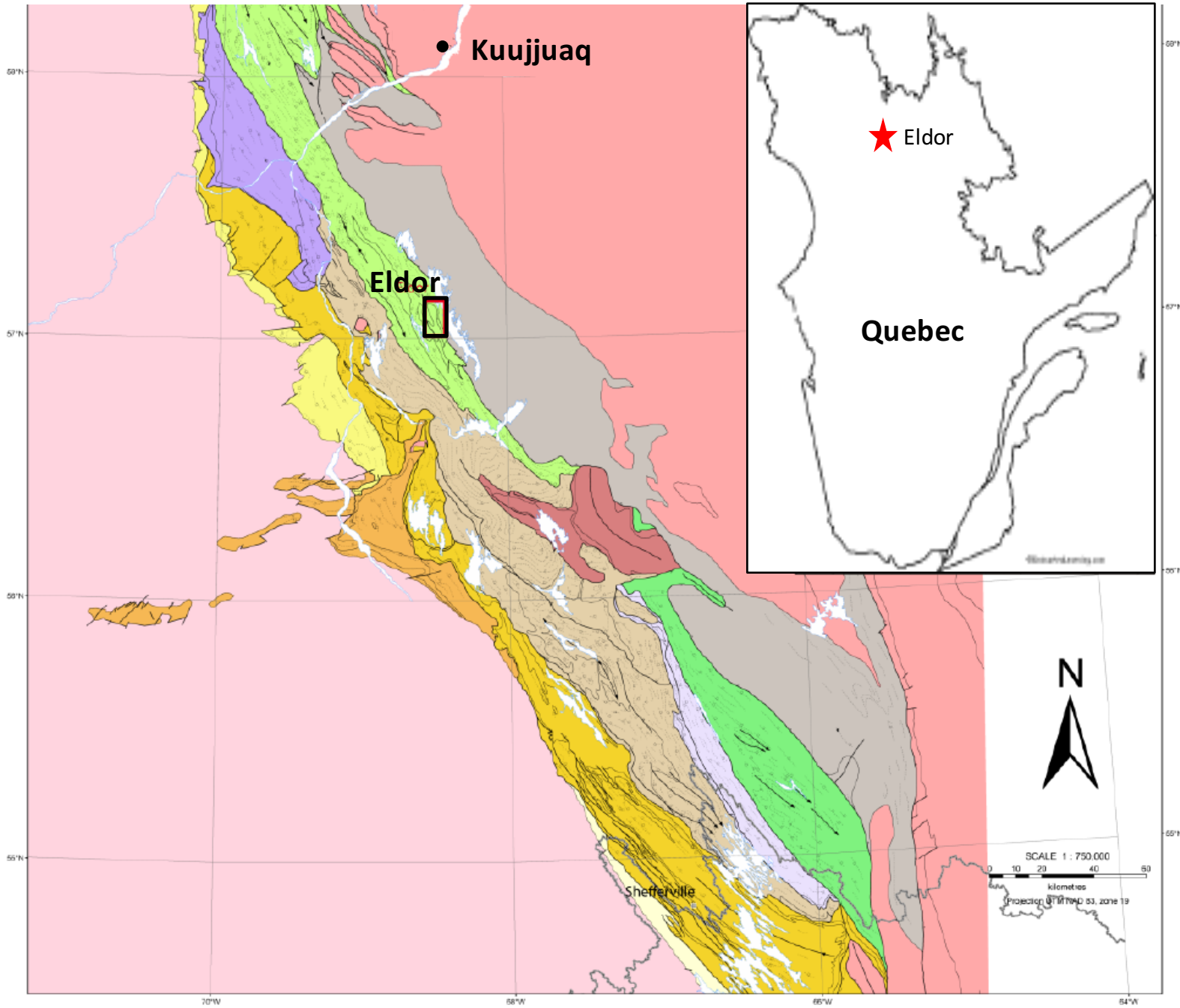
Atelier Divex, May 2016

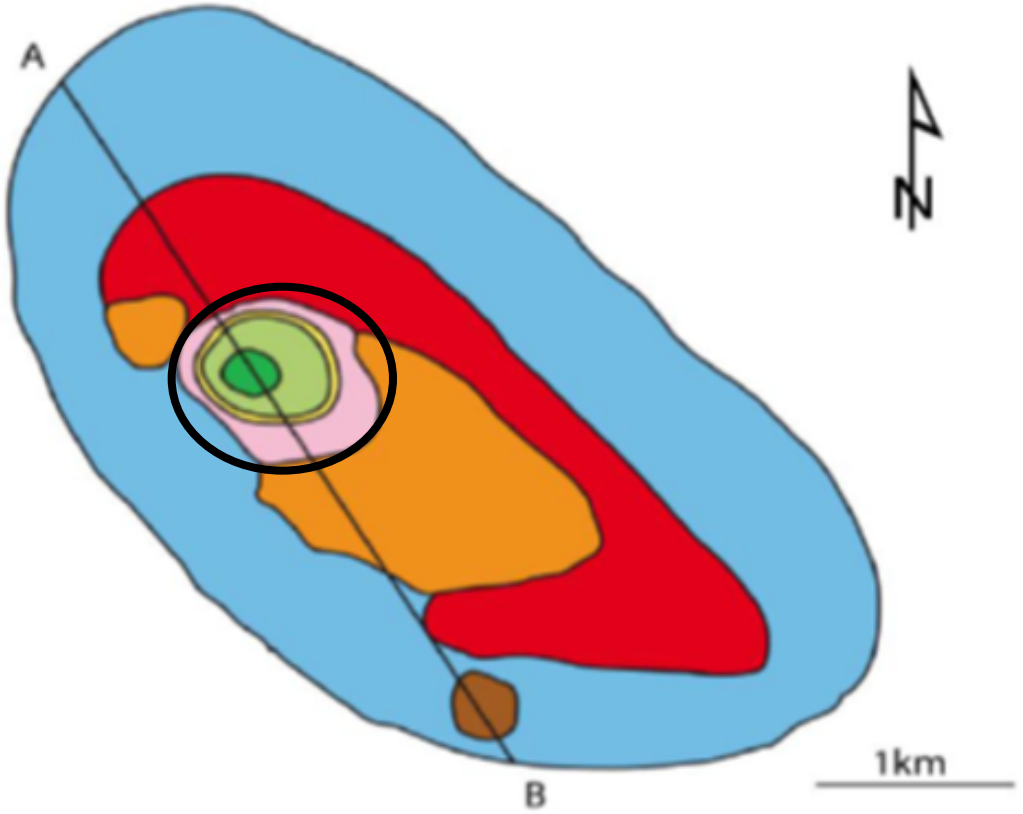
Regional Geology

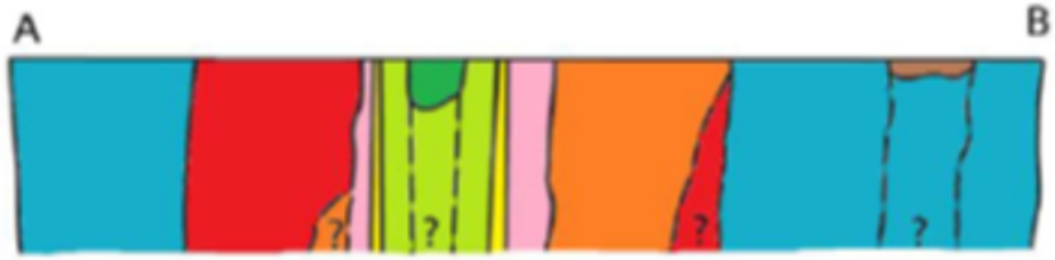
- Labrador Trough
  - Rift basin then fold and thrust belt
- Eldor intruded near end of rifting ≤ 1870 ± 4 Ma
  (Machado et al., 1997)



After Clark & Wares (2006)

Eldor carbonatite general geology





Rim

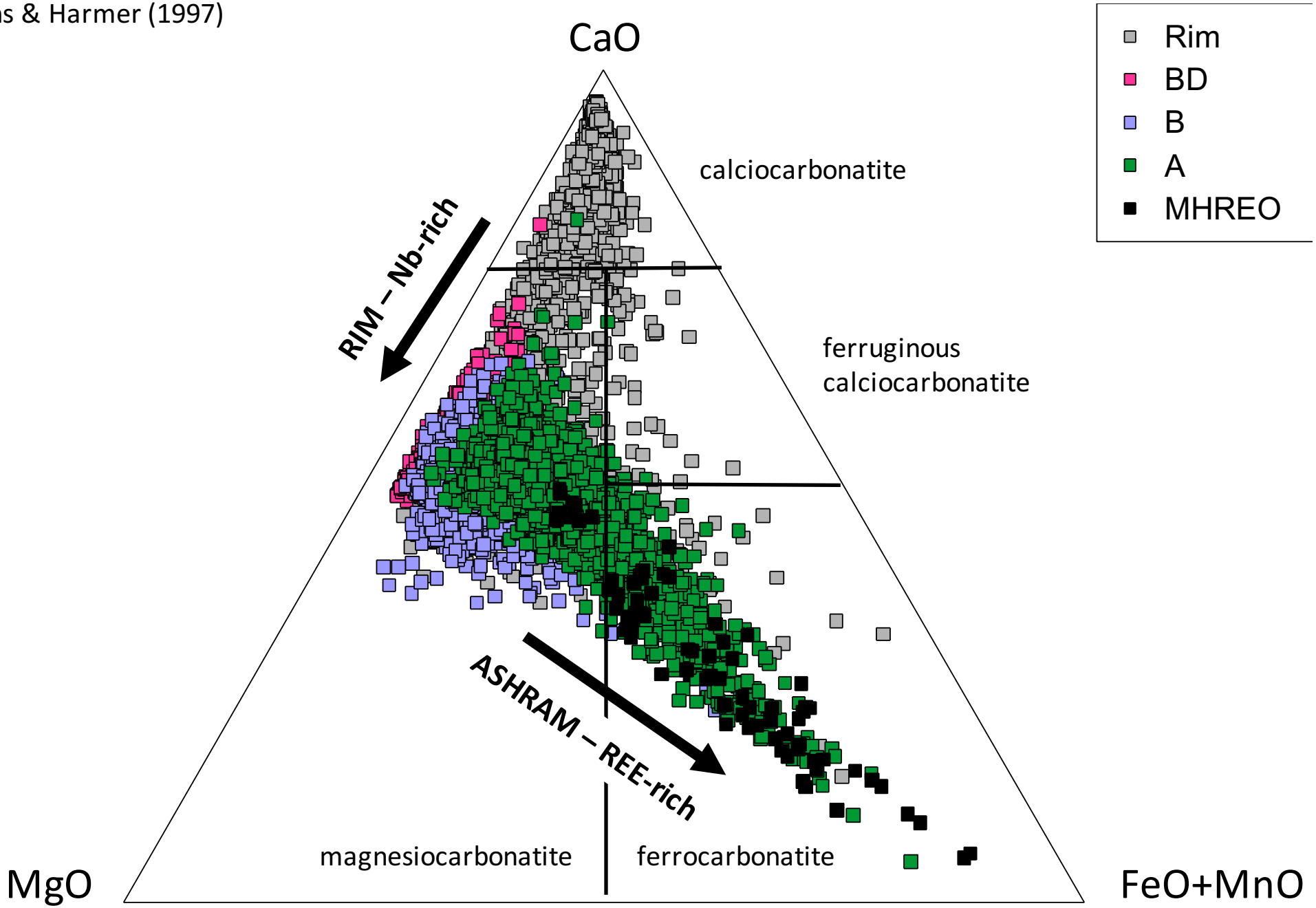
- Fenite
- Apatite-magnetite rocks
- S1-S2 calcite carbonatite
- S3 pyrochlore dolomite carbonatite

Core/Ashram

- 'BD' zone – REflc-dolomite carbonatite
- 'B' zone – monazite-dolomite carbonatite
- 'A' zone – monazite-ferrocarbonatite
- 'MHREO' zone – xenotime-aeschynite-ferrocarbonatite

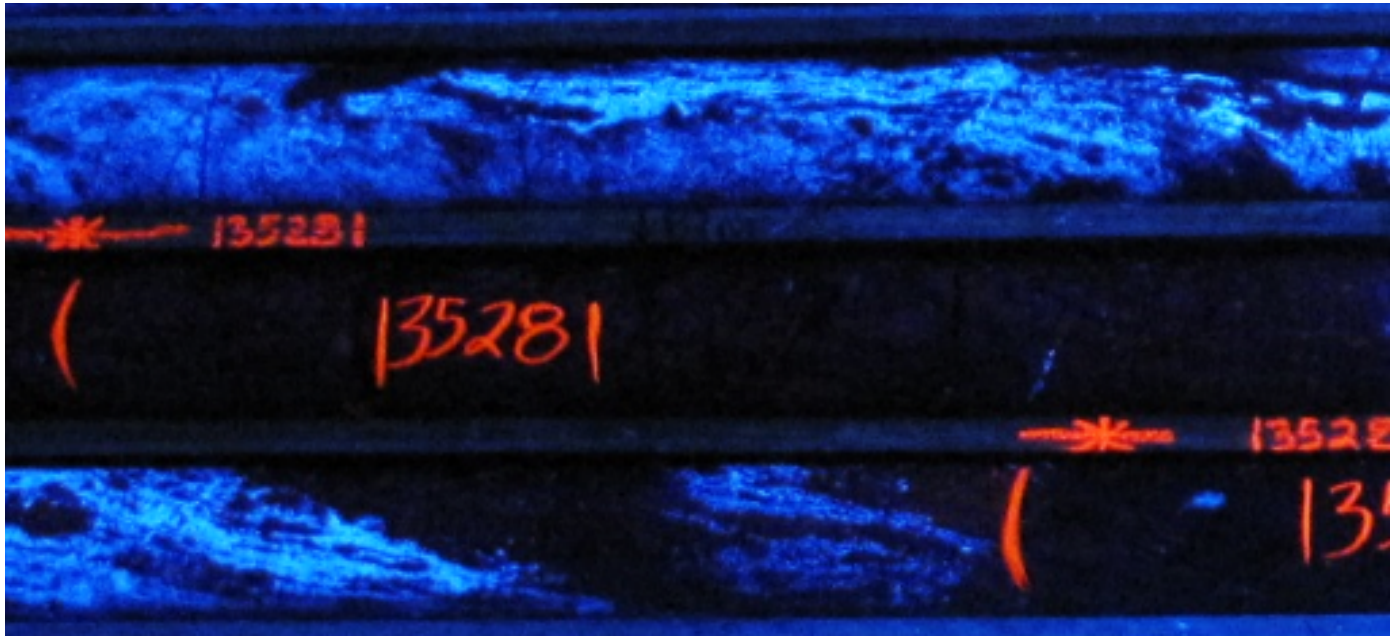
After Schmidt (2013)

Classification of Gittins & Harmer (1997)



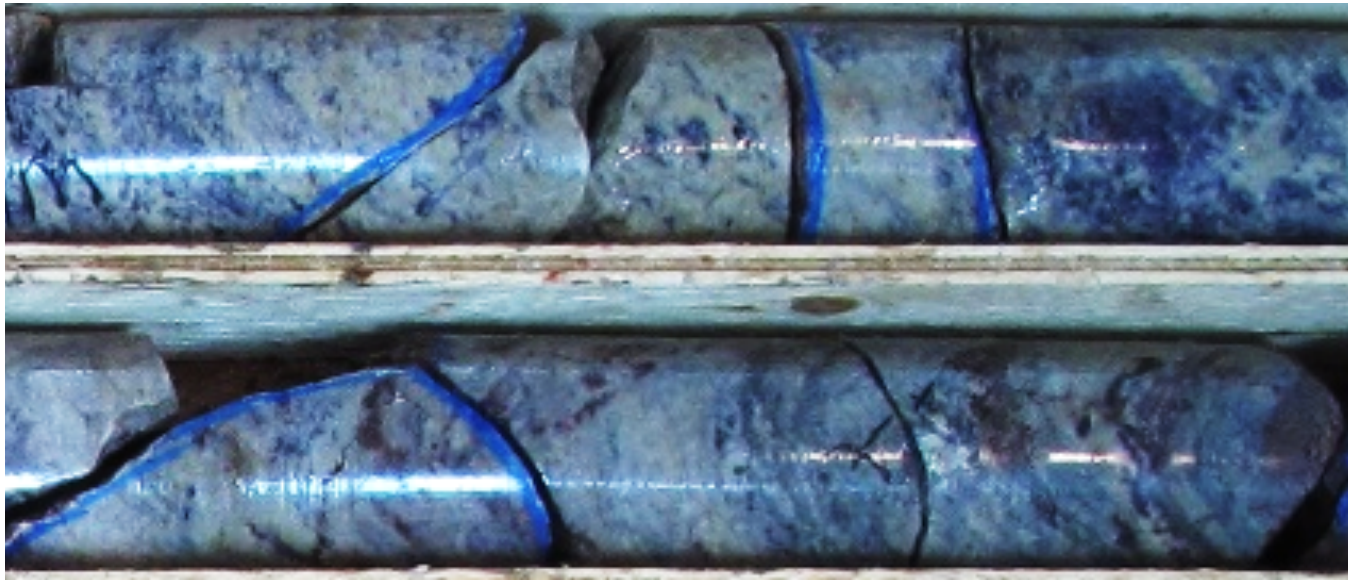
‘BD Zone’ dolomite carbonatite

- average apatite 7%
- 0.5 - 1 wt % TREO
  - MHREO/TREO = 7%
- Pink REE fluorocarbonates (REEflc)
  - Bastnasite-(Ce) $CeCO_3F$
  - Parisite-(Ce) $Ca(Ce,La)_2(CO_3)_3F_2$
  - Synchysite-(Ce) $CaCe(CO_3)_2F$



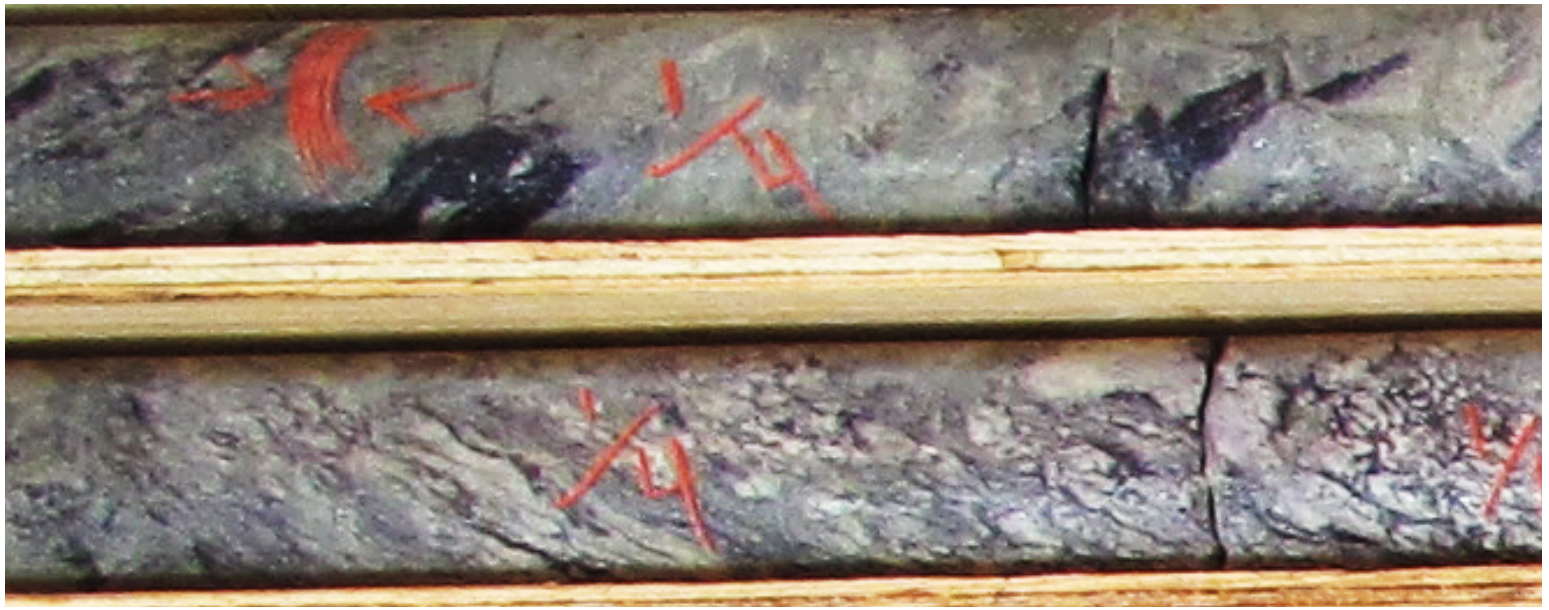
‘B Zone’
dolomite carbonatite

- average fluorite 4%
- 1 – 2 wt % TREO
  - MHREO/TREO = 4%
- monazite-(Ce) ($CePO_4$)
  - mineralization gives yellow tint



‘A Zone’ ferrocarbonatite

- average fluorite 8%
- 1 – 3+ wt % TREO
  - MHREO/TREO = 6%
- monazite-(Ce)



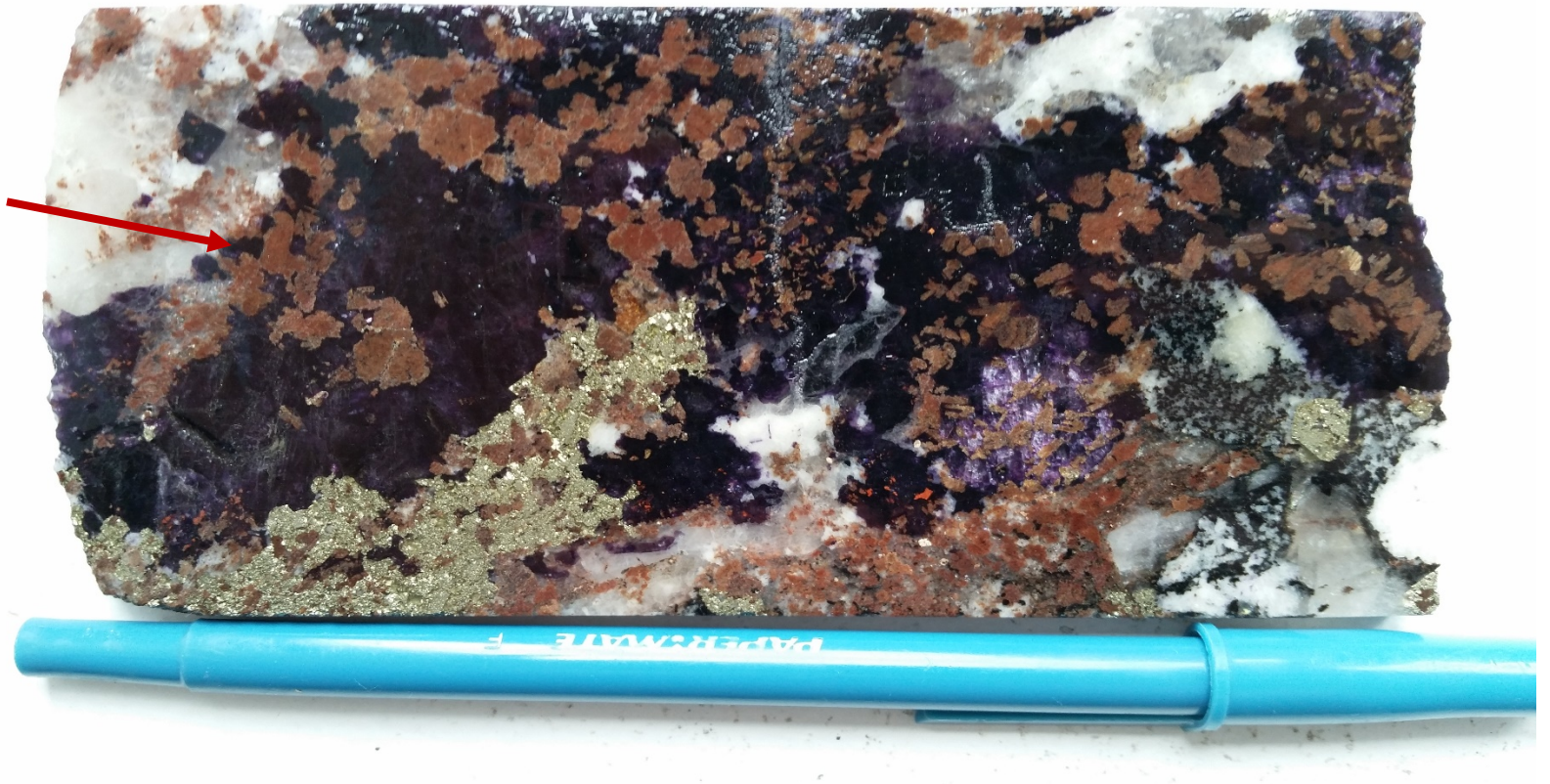
‘MHREO zone’ ferrocarbonatite

- 1 wt % TREO
  - MHREO/TREO ≤ 20%
- Xenotime-(Y) $HREEPO_4$
- Aeschynite-(Y) $(Y,Ca,Fe)(Ti,Nb)_2(O,OH)_6$

MHREO A

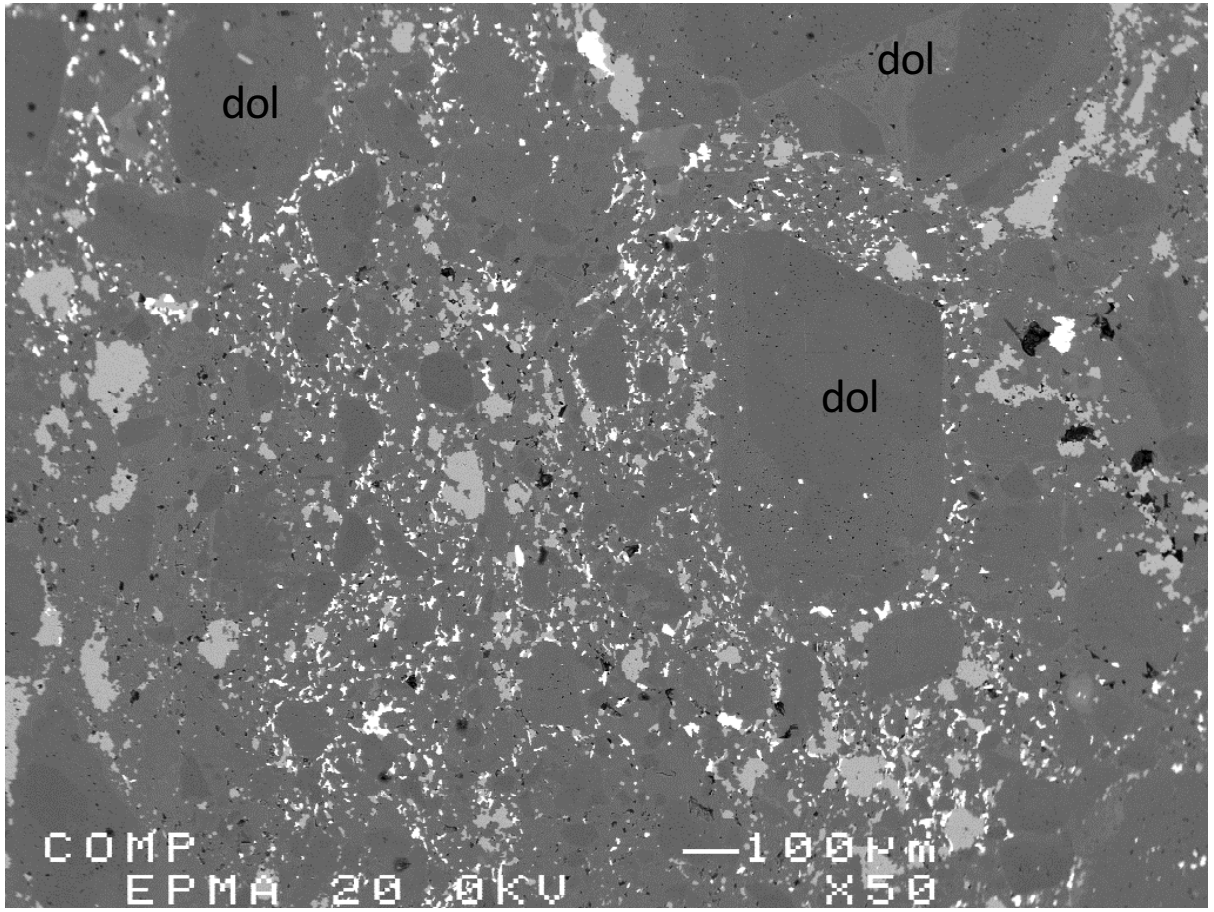
	Grade (wt% TREO)	MHREO/TREO (%)	Principal Ore Mineral(s)
BD	0.5 - 1	7	REE-fluorocarbonates
B	1 – 2	4	monazite-(Ce)
A	1 - 3+	6	monazite-(Ce)
MHREO	1	20	xenotime-(Y), aeschynite-(Y), monazite-(Ce)

Coarse-grained REflc in late vein with fluorite, quartz, pyrite, feldspar

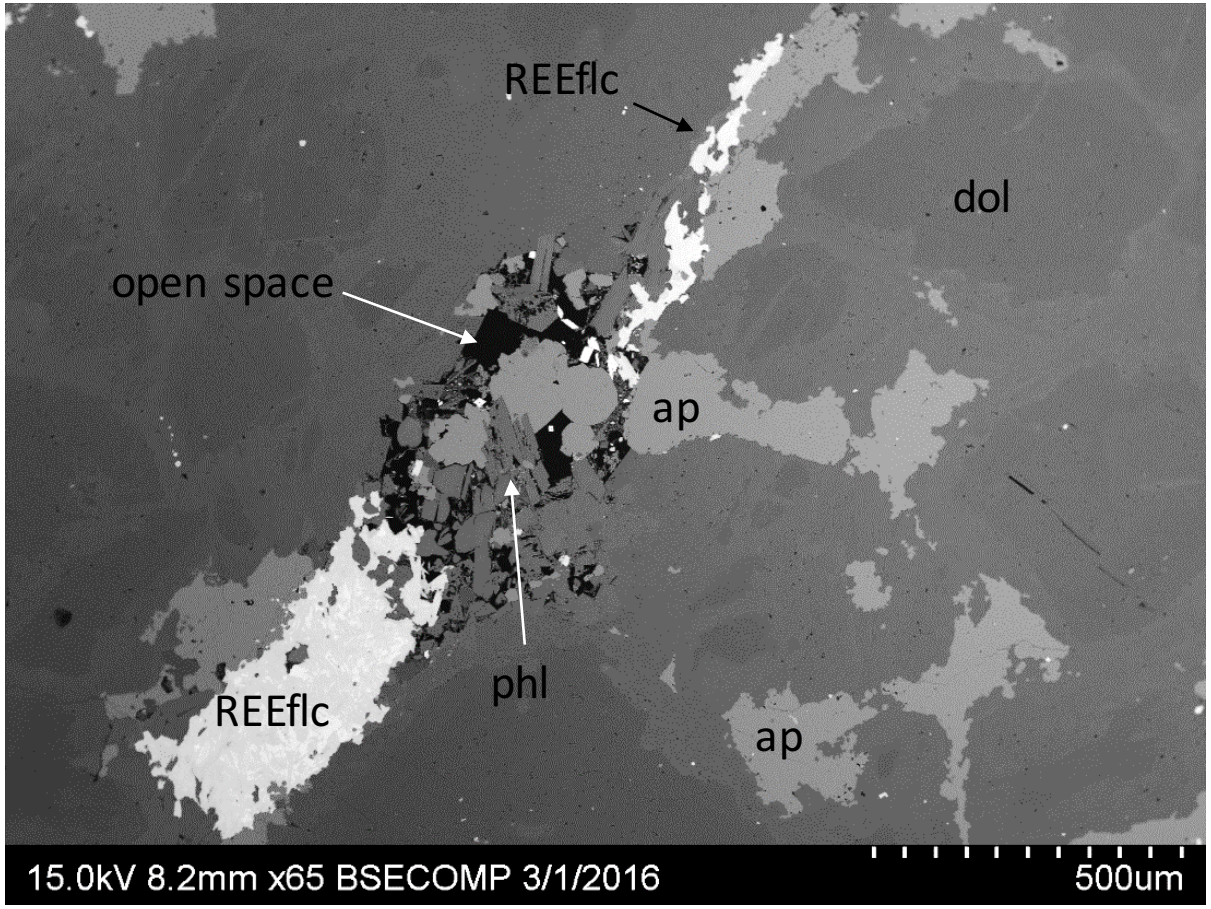


‘BD zone’ ore textures

Disseminated fluorite, apatite and REEflc in breccia

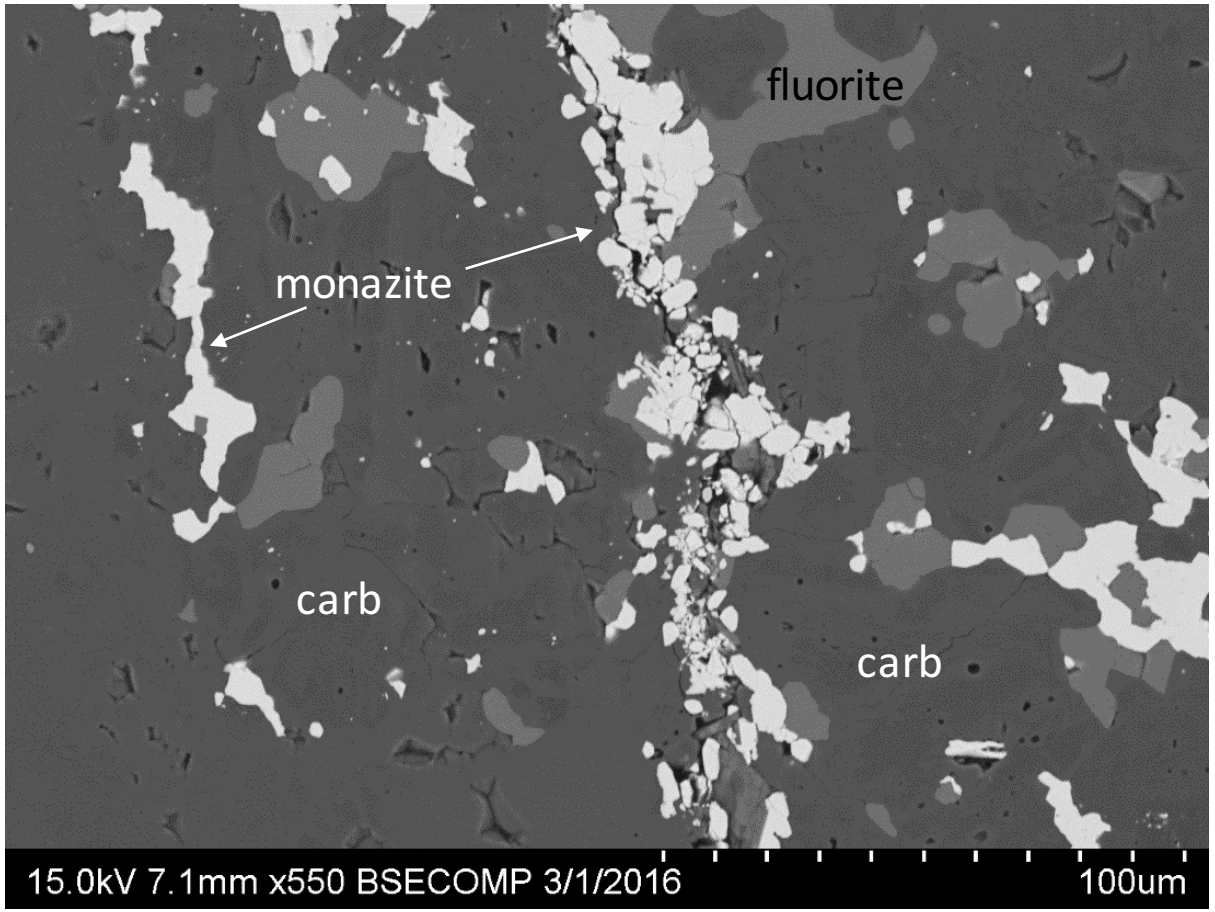


REEflc in veins and vugs

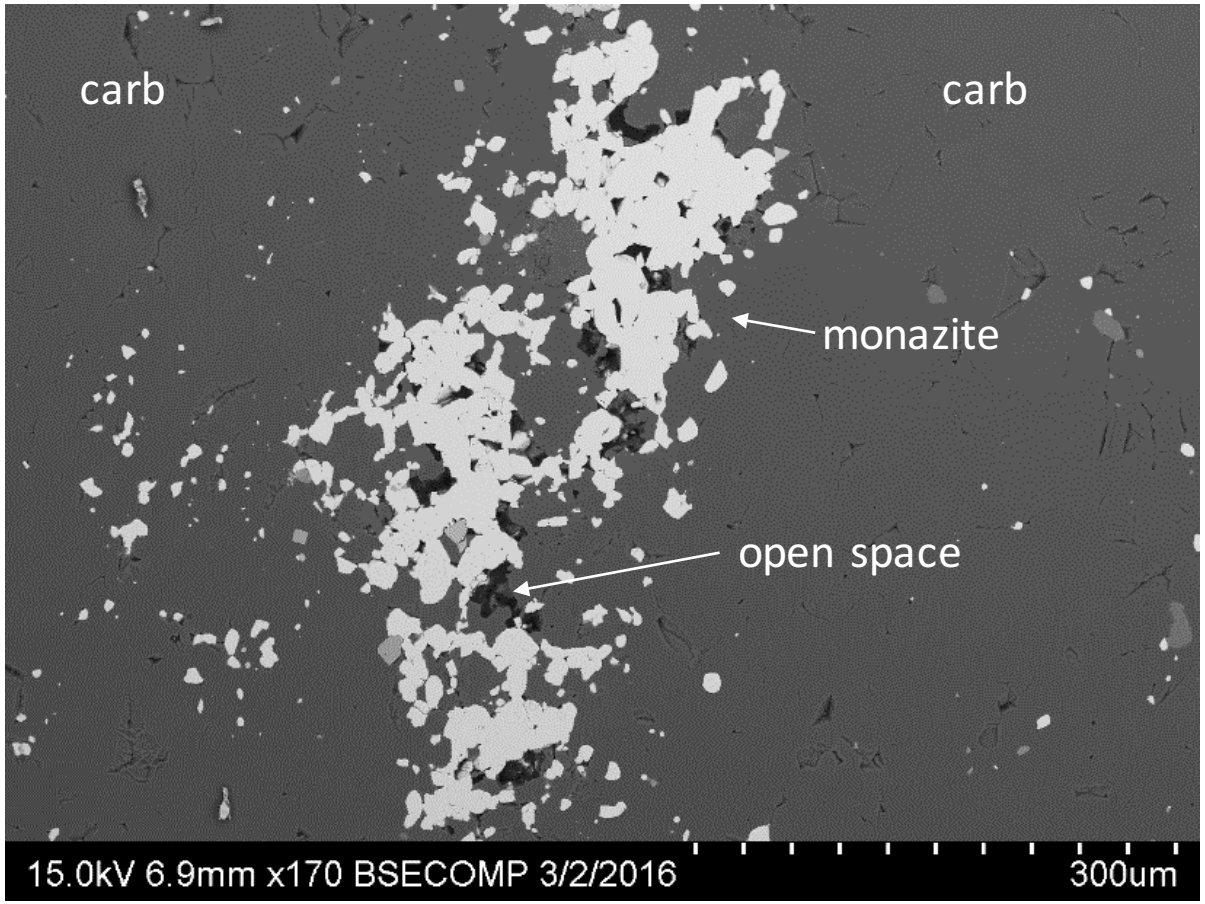


Monazite-(Ce) textures

Monazite-(Ce) in veins

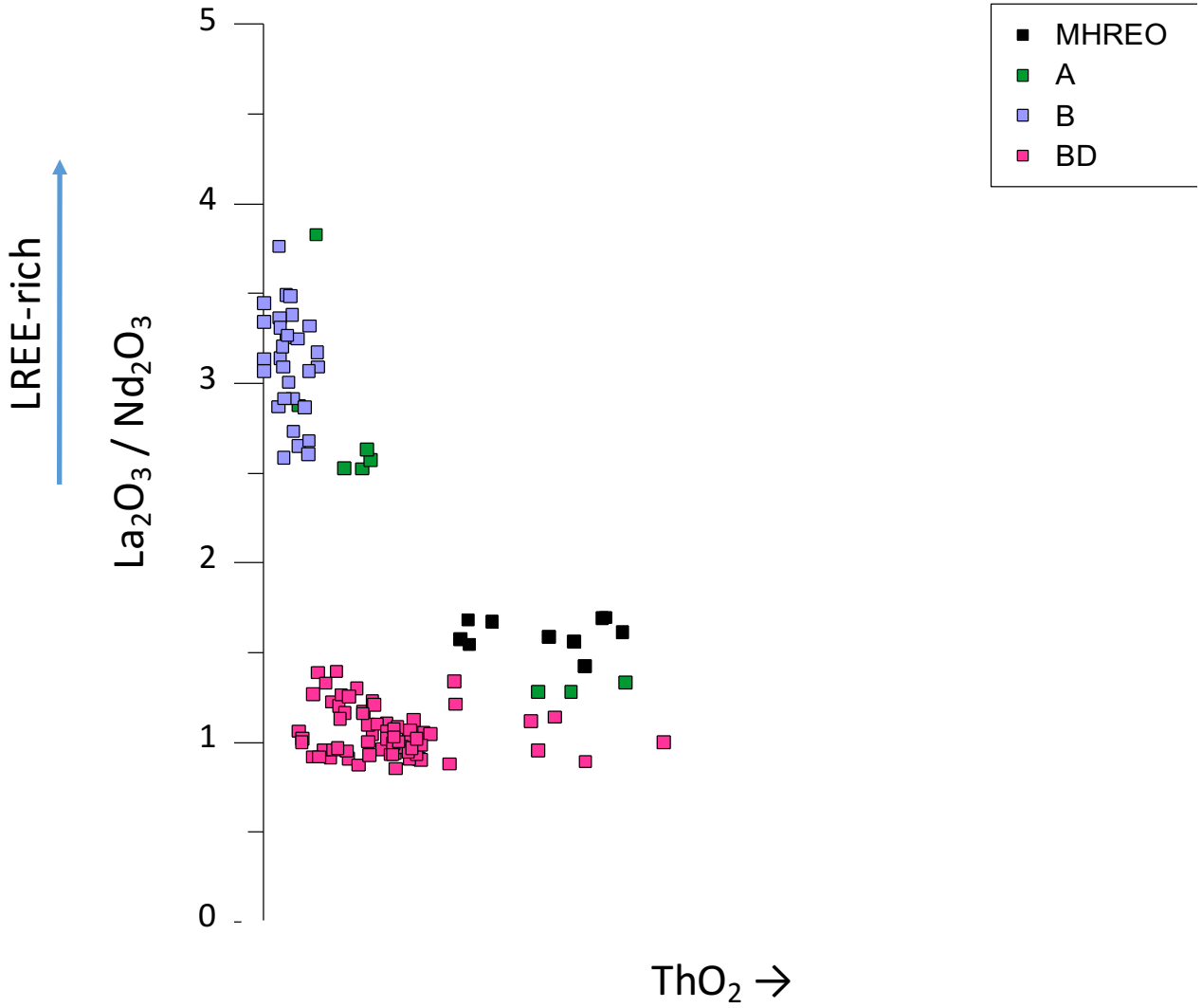


Monazite-(Ce) in vugs

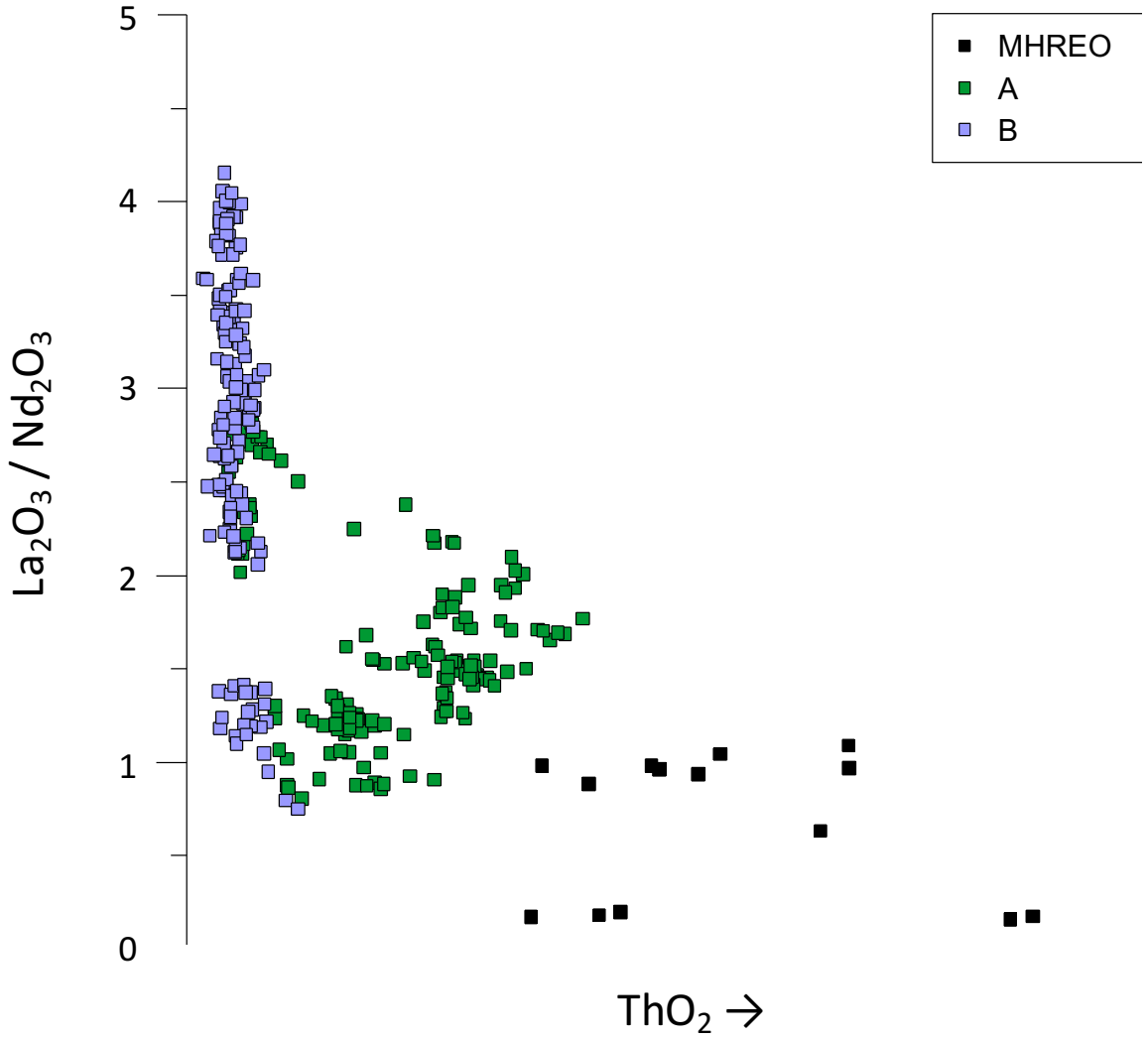


Mineral Chemistry

Bastnasite



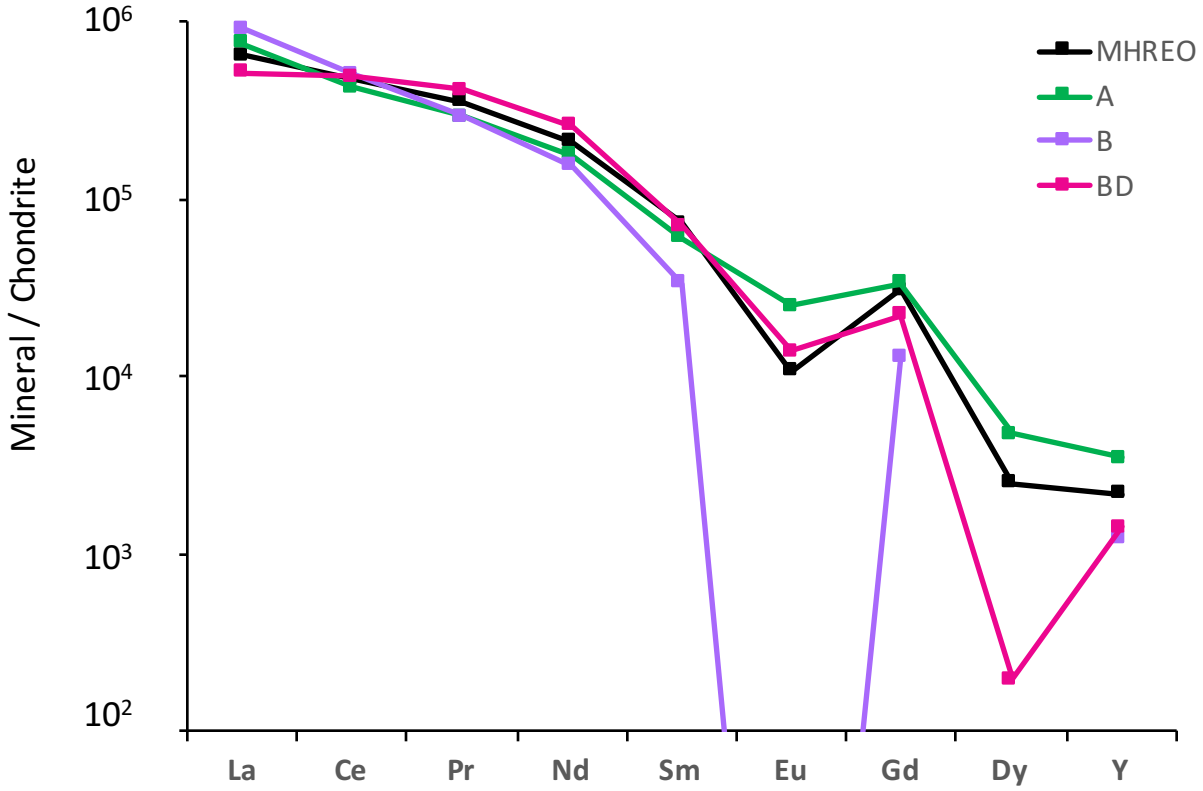
Monazite



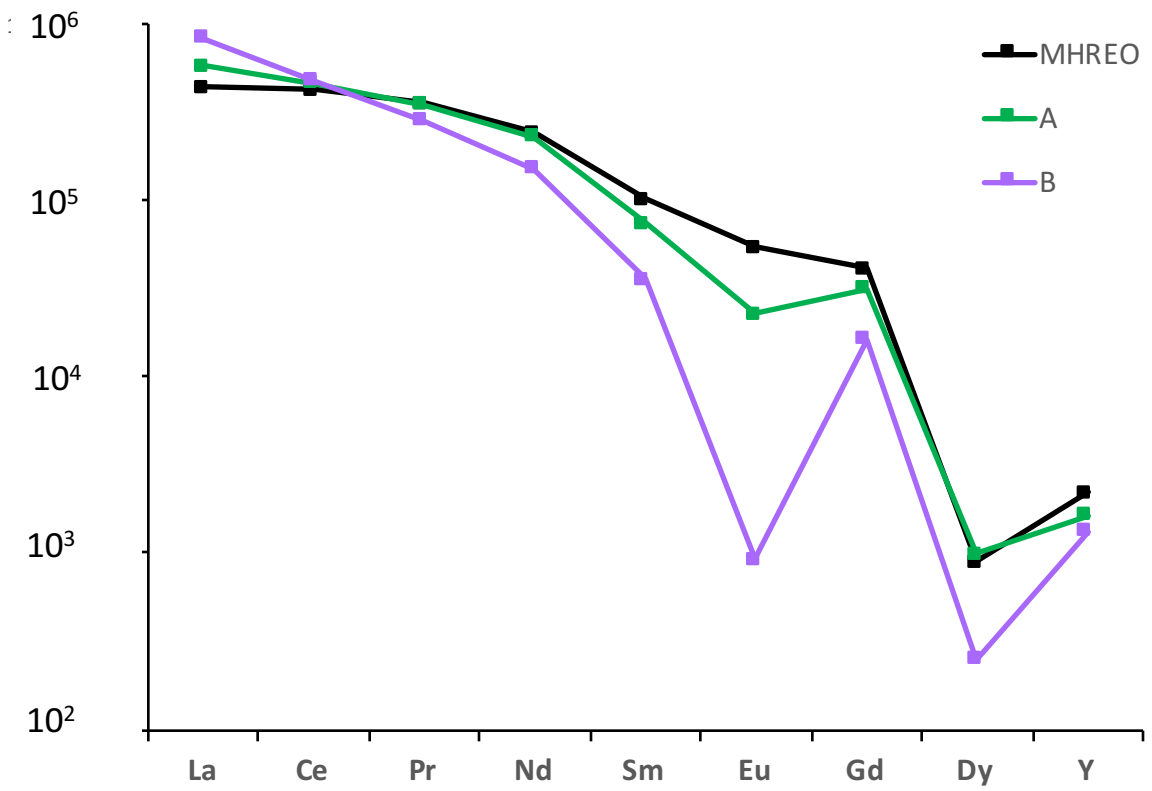
Mineral Chemistry

- From B to MHREO
  - ↓ Eu anomaly = ↑ fO_2
  - ↑ MREE

Bastnasite



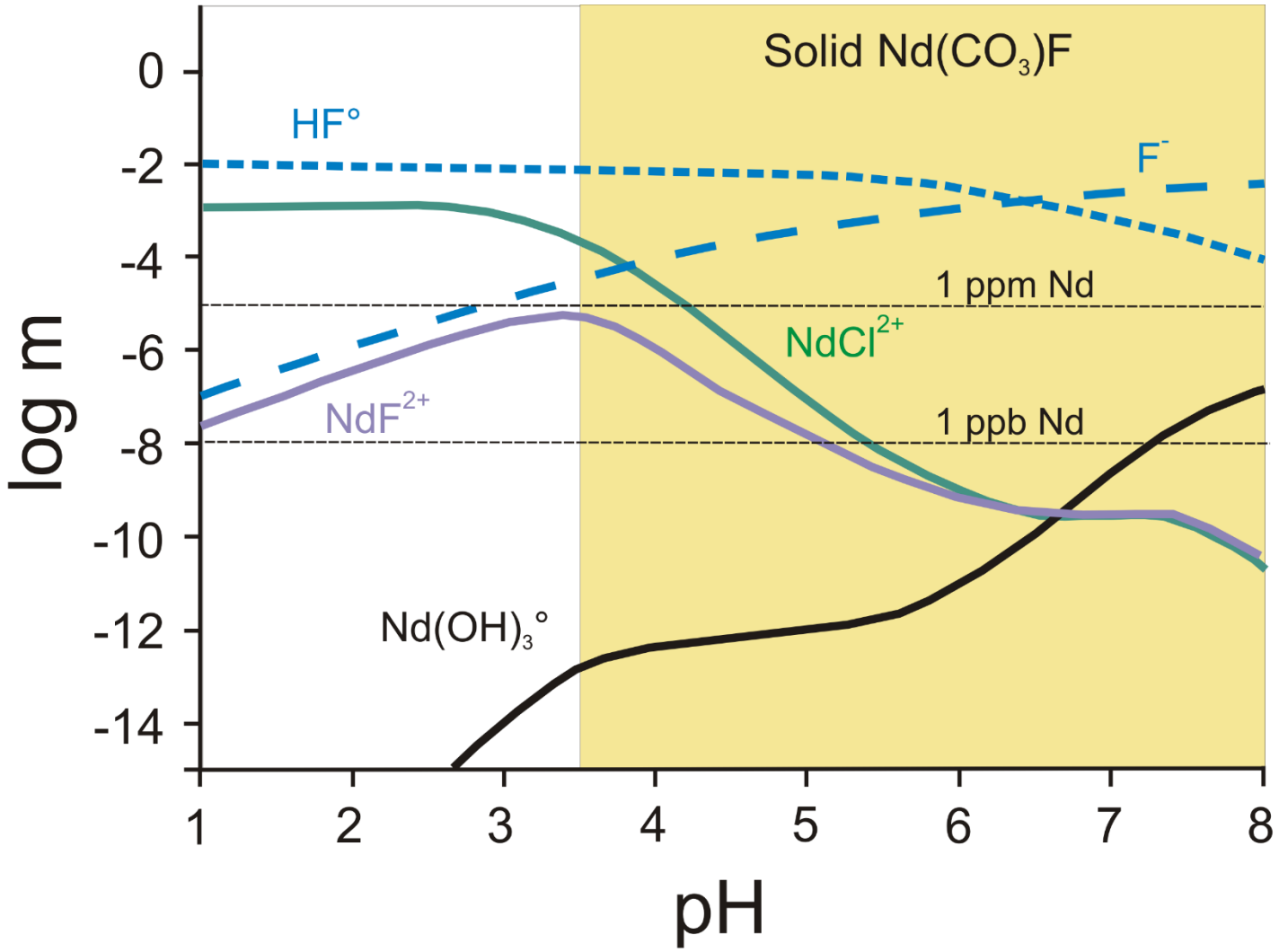
Monazite



Chondrite values of McDonough & Sun (1995)

Possible REEflc depositional mechanism

- Acidic (pH < 3.5) fluid with low [F^-]
- Fluid buffered by carbonate host rock to higher pH (>3.5)
- HF° dissociates, F^- available, fluorite and REEflc precipitate



After Migdisov & Williams-Jones (2014)

The monazite-(Ce) enigma

- Not yet understood
  - ↑pH, ↓T or Δ ligand activity
- PO_4^{3-} is a depositional ligand
- BD zone has abundant apatite → why no monazite?
- Same fluid deposited REEflc and monazite (within same zone) but PO_4^{3-} locked in a less accessible phase in BD?

or

- Total replacement of monazite by REEflc?