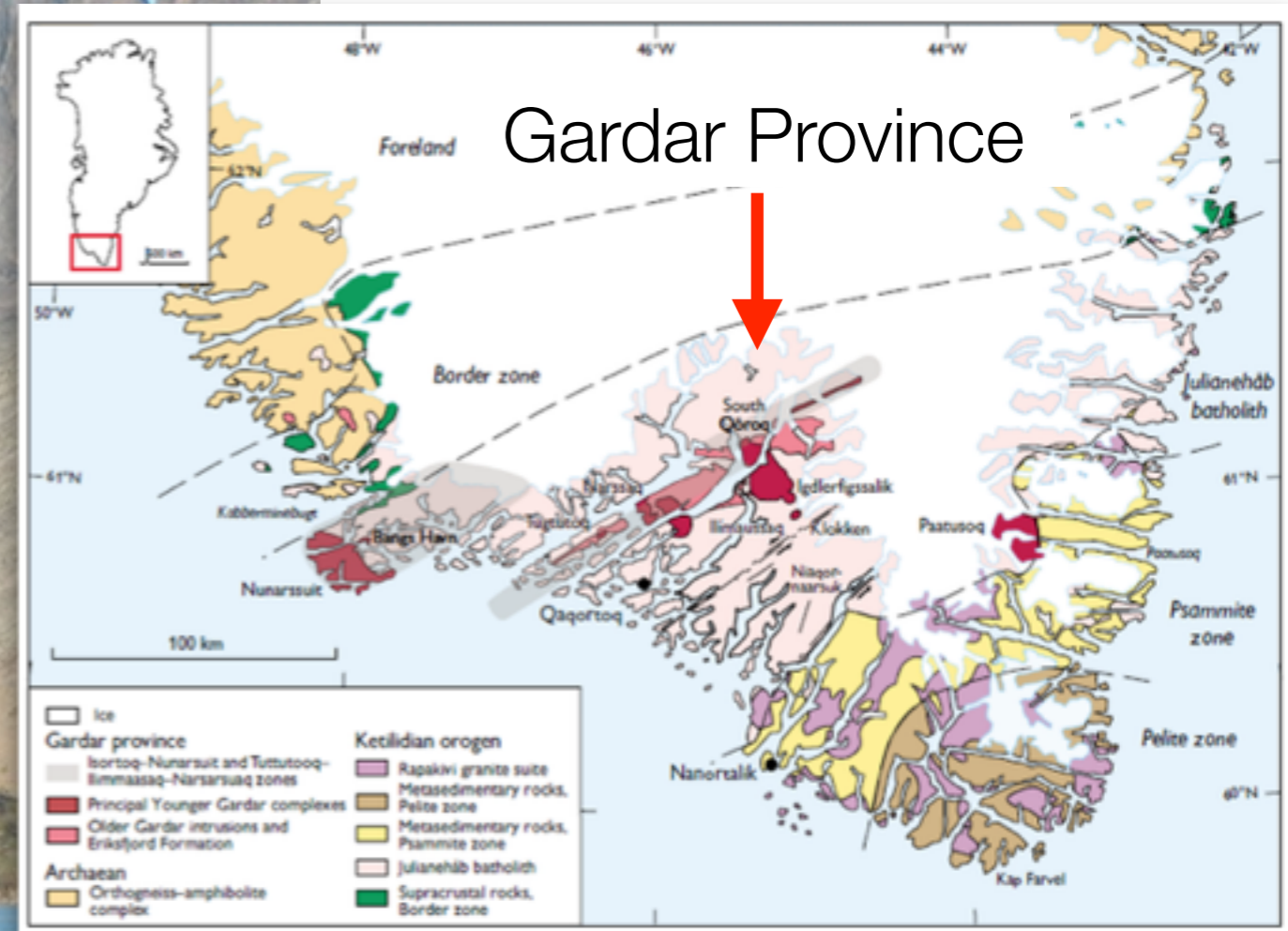
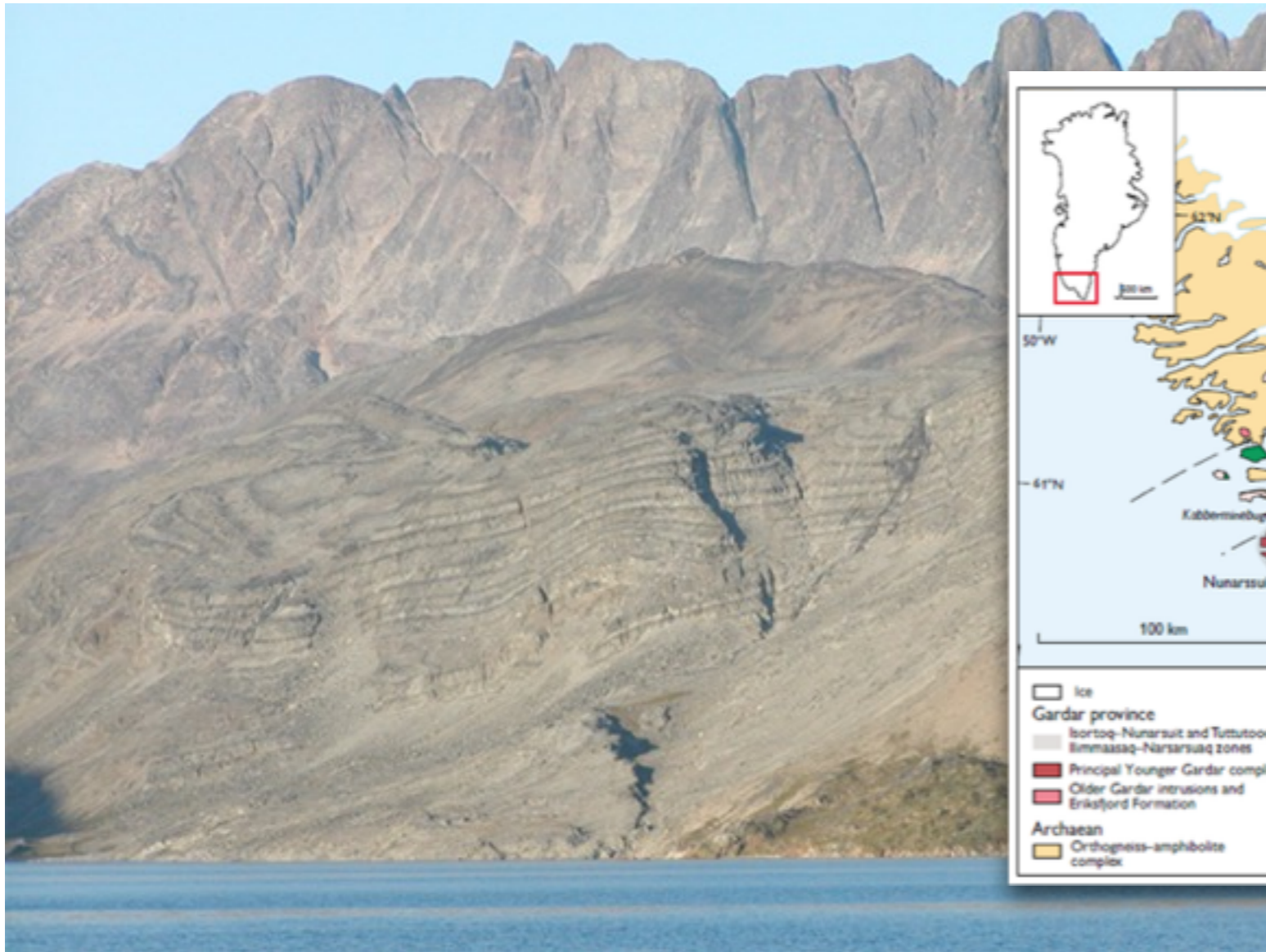


Fingerprints of rare metal enrichment in alkaline igneous systems, as recorded by aegirine pyroxene

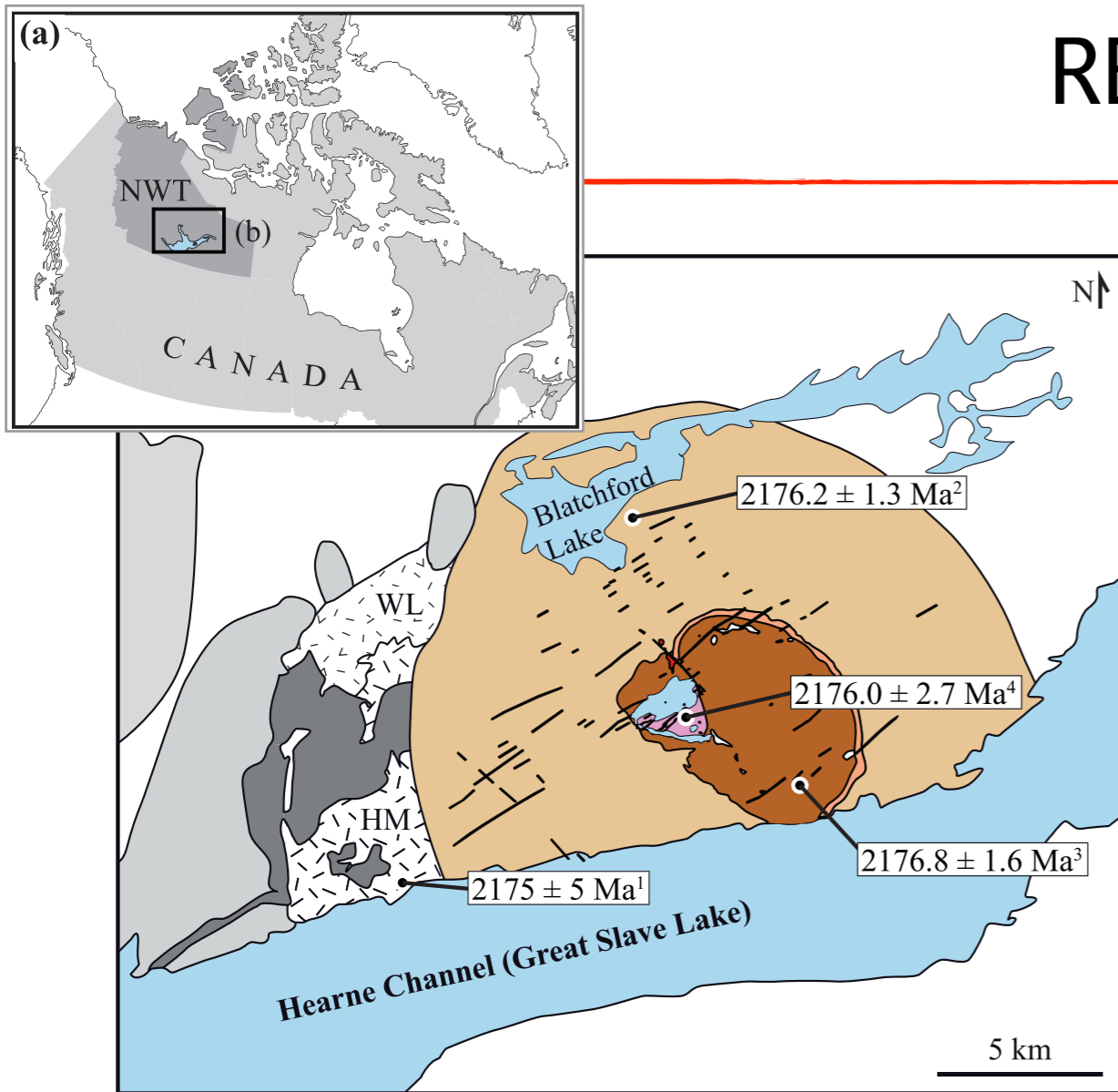
Charlie Beard, John Stix, Vincent van Hinsberg, Max Wilke










Nepheline Syenite Intrusions as a source for REE

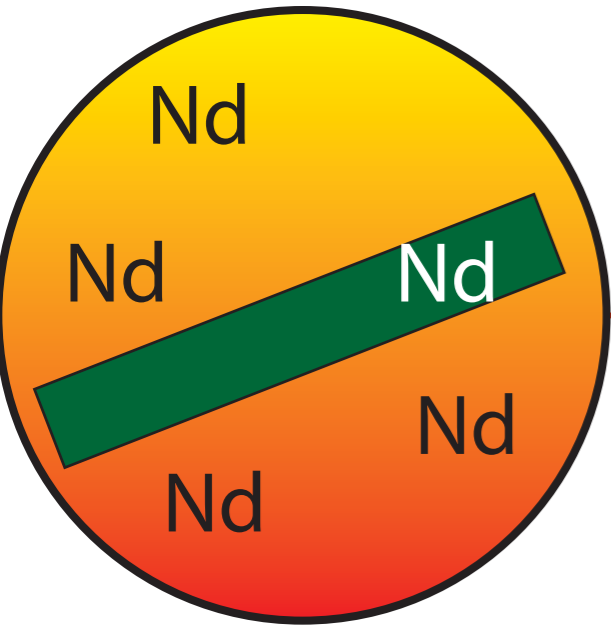


REE + Zr at Thor Lake, Canada



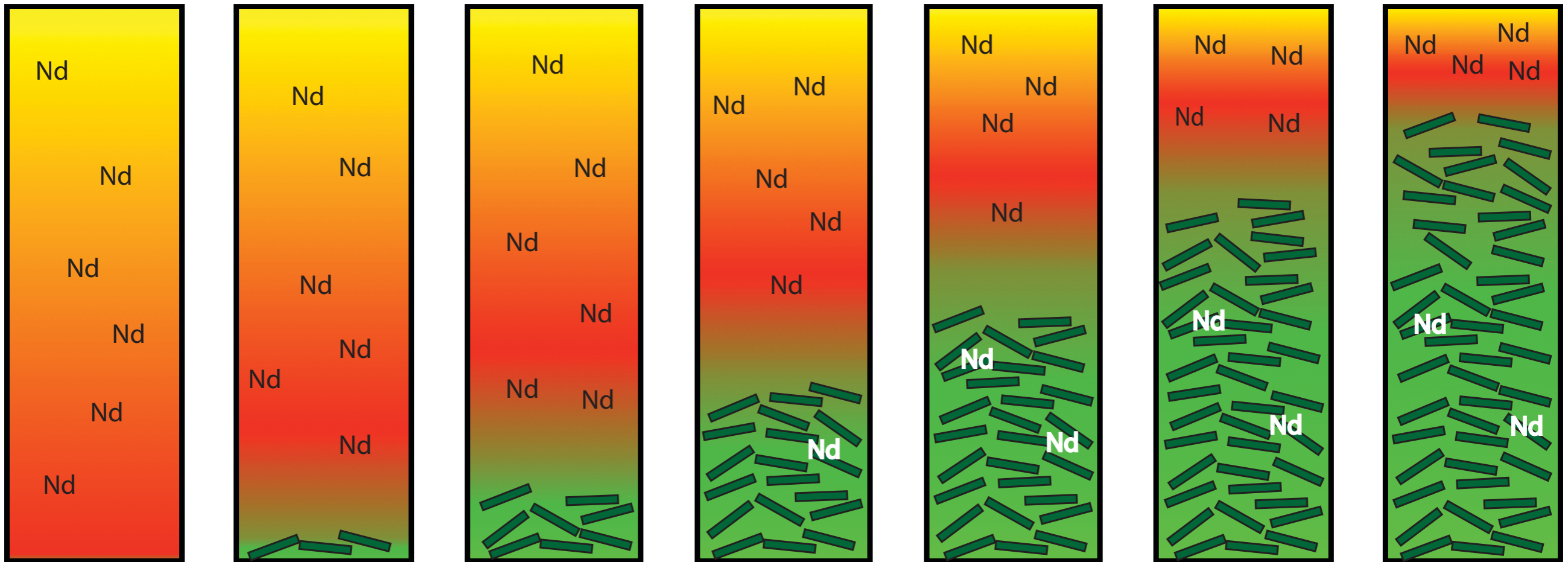
- | | |
|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|  Nechalacho Layered Suite |  Whiteman Lake Quartz Syenite |
|  Thor Lake Syenite, Rim Syenite |  Caribou Lake Gabbro |
|  Grace Lake Granite |  Archean Granite |
|  Hearne Channel and Mad Lake Granite | |





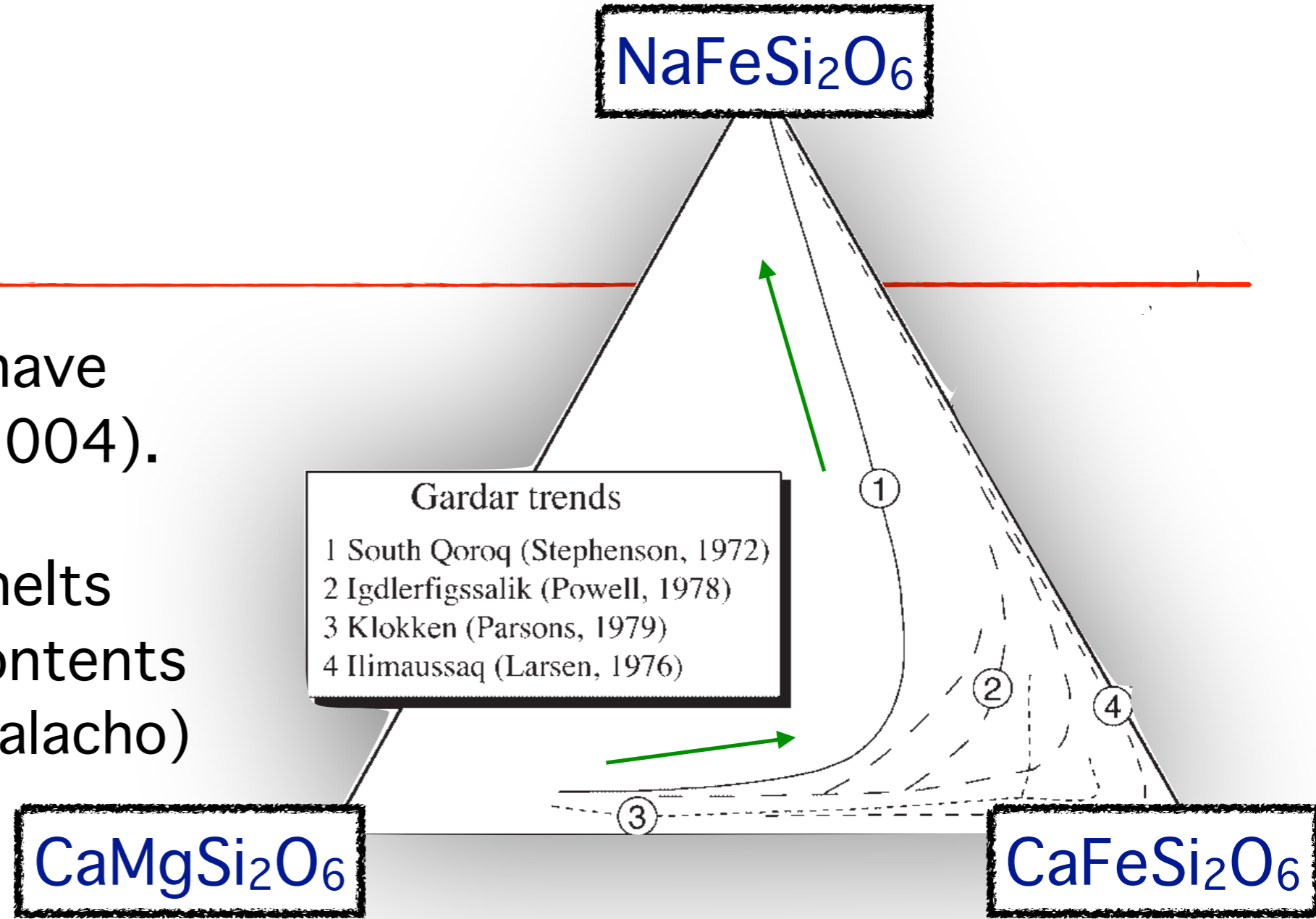
REE enriched by fractional crystallisation

$$D_i^{mineral/melt} = \frac{C_i^{mineral}}{C_i^{melt}}$$



Problem:

- Sodic pyroxenes have high REE (Marks 2004).
- Evolved alkaline melts attain high REE contents (e.g. Gardar, Nechalacho)



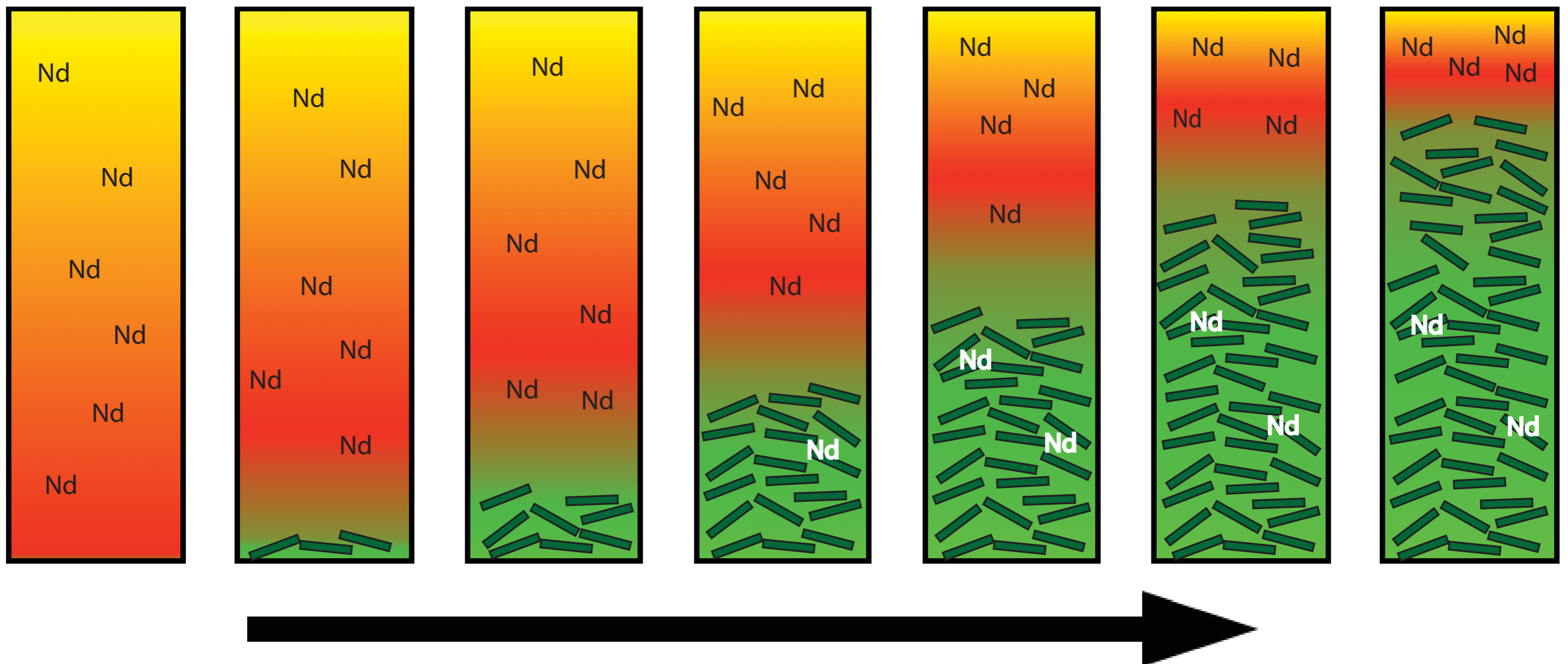
| | | |
|-----------------------------------------|----------------------|----------------------------------------|
| Basanite | Melt | Phonolite |
| $D_{Nd} = ?$ | Element partitioning | $D_{Nd} = ?$ |
| Ca(Fe,Mg)Si ₂ O ₆ | Pyroxene | NaFeIII Si ₂ O ₆ |



Scientific objectives:

Quantify physiochemical controls on element partitioning

- Determine optimal conditions for magmatic enrichment of REE

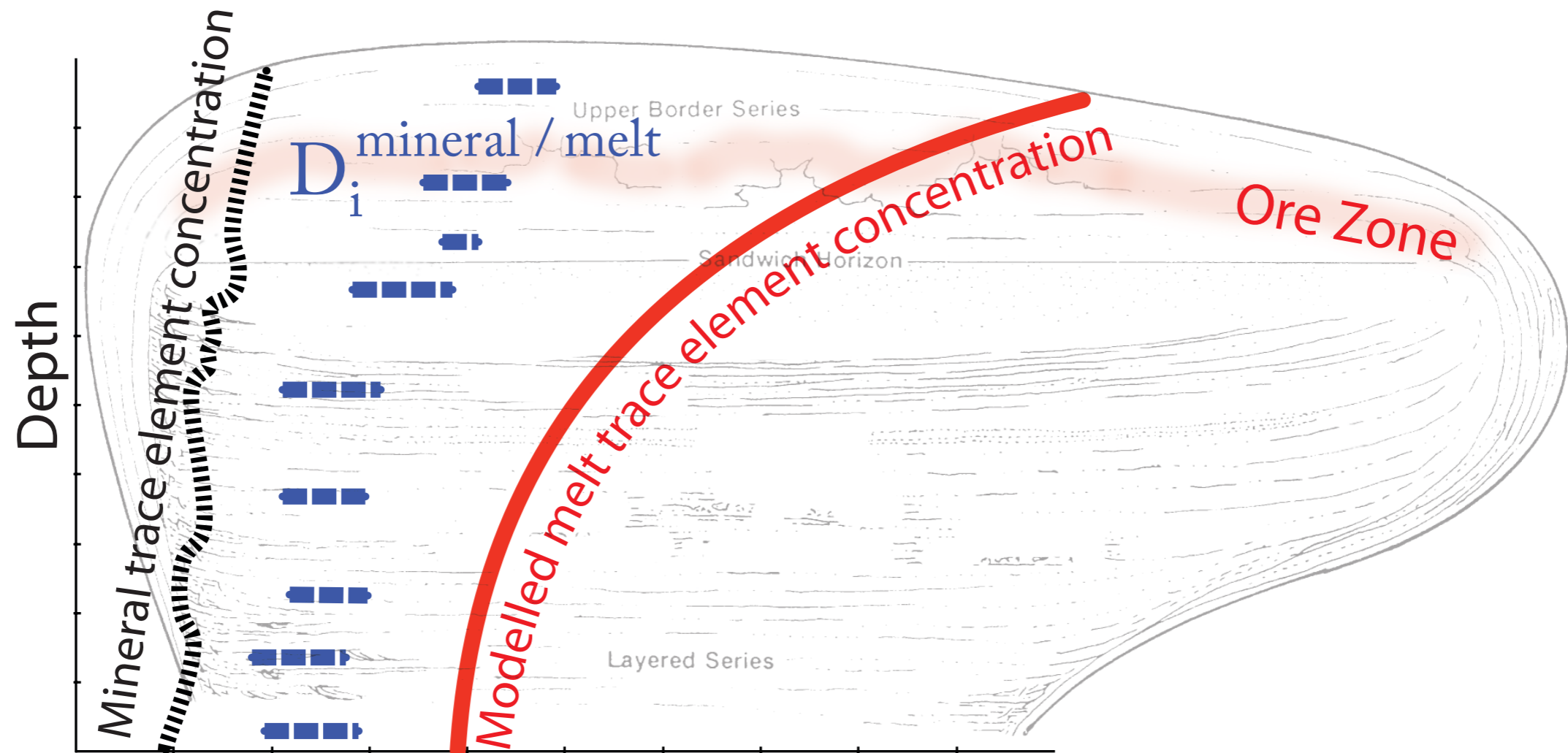


Scientific objectives:

Quantify physiochemical controls on element partitioning

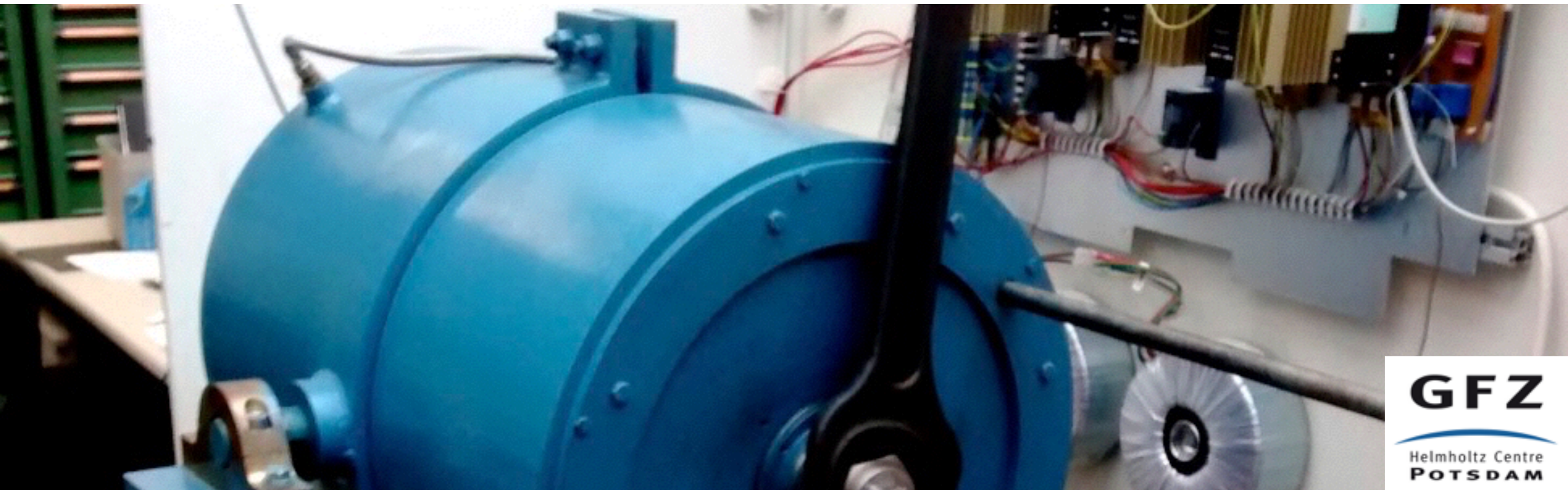
- Determine optimal conditions for magmatic enrichment of REE

Demonstrate application of model on natural system

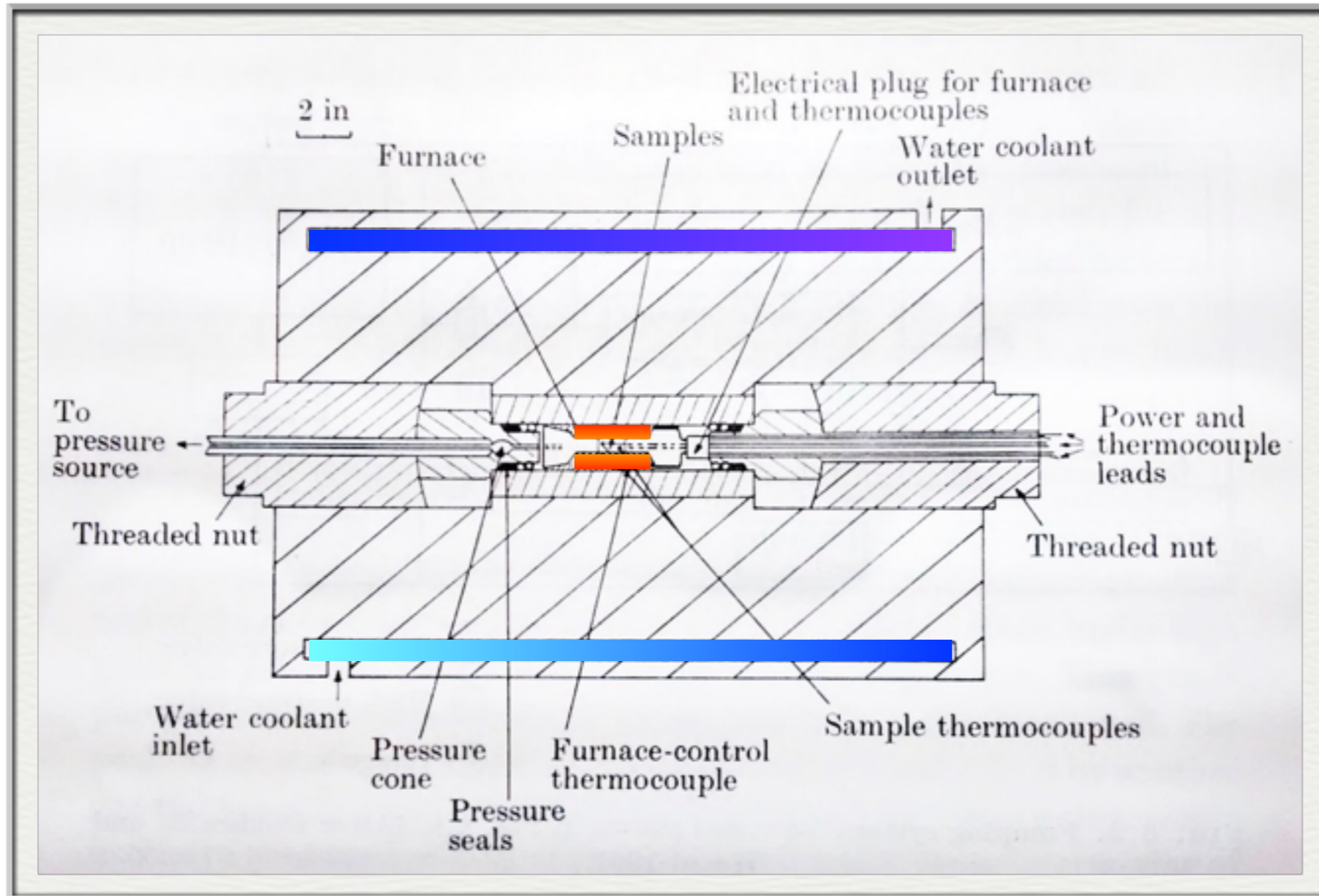




Determine pyroxene-melt partition coefficients

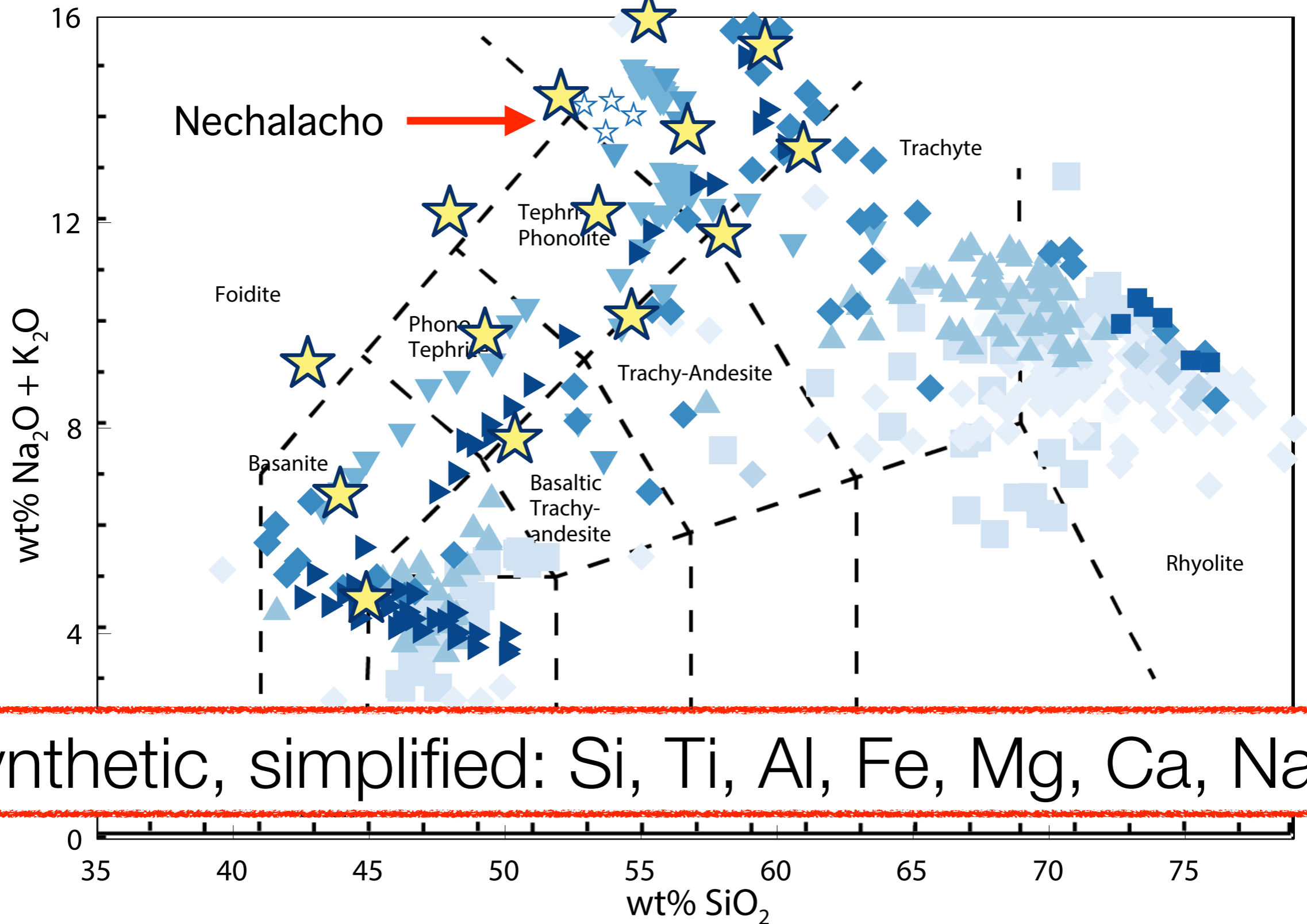


Internally heated pressure vessel

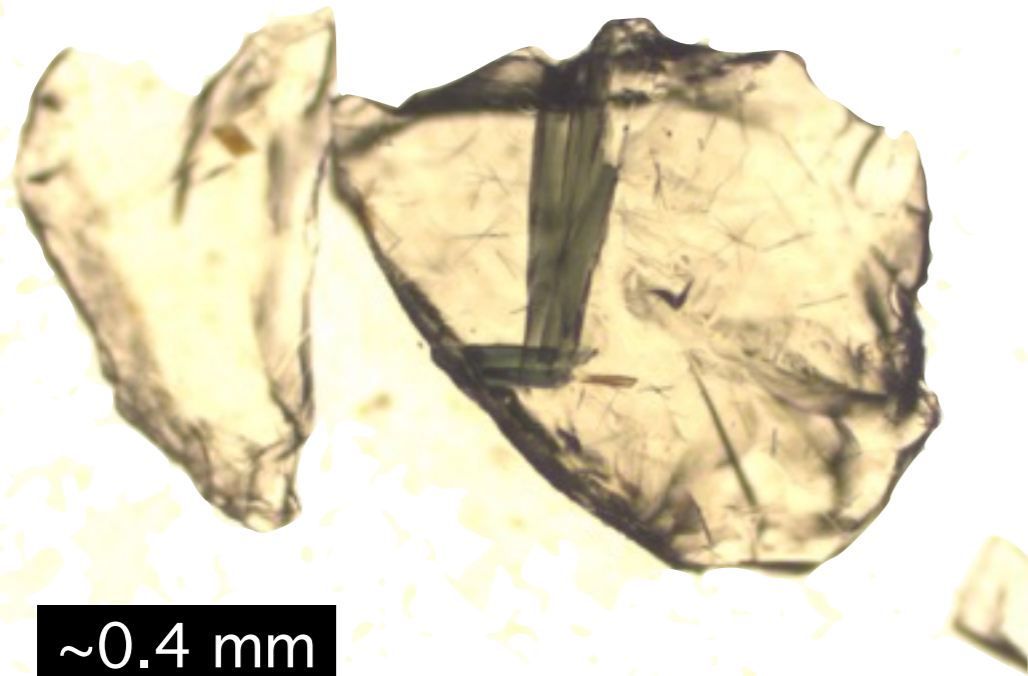


Starting compositions

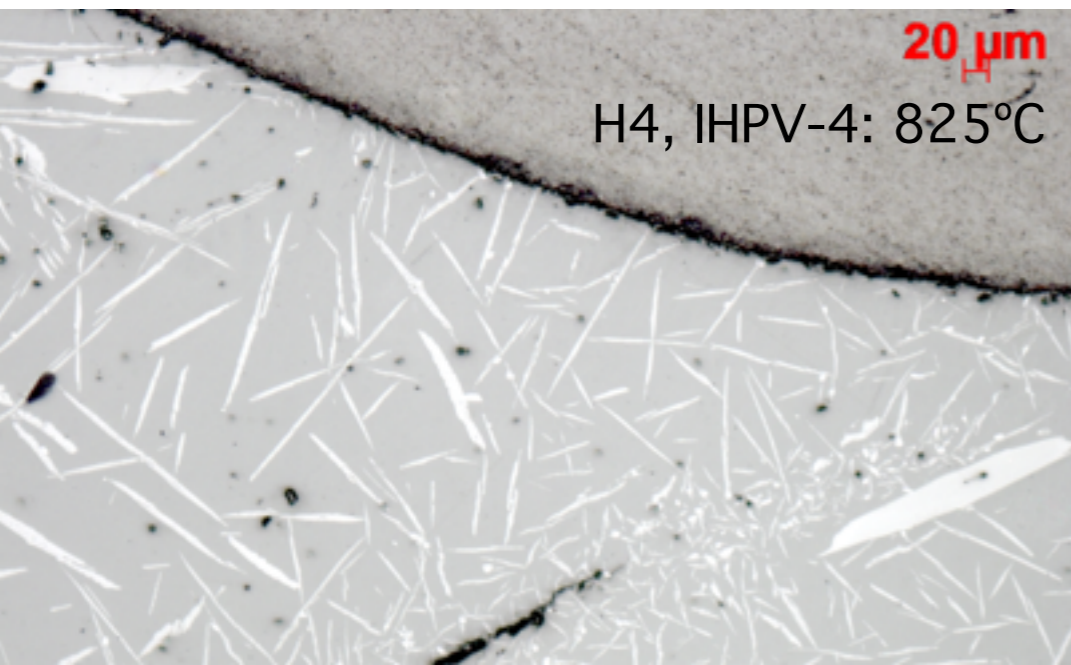
H₂O Sat, 2 kBar



Run products:



H5_2, IHPV-5: 700°C, 2 KBar, Aegirine Augite



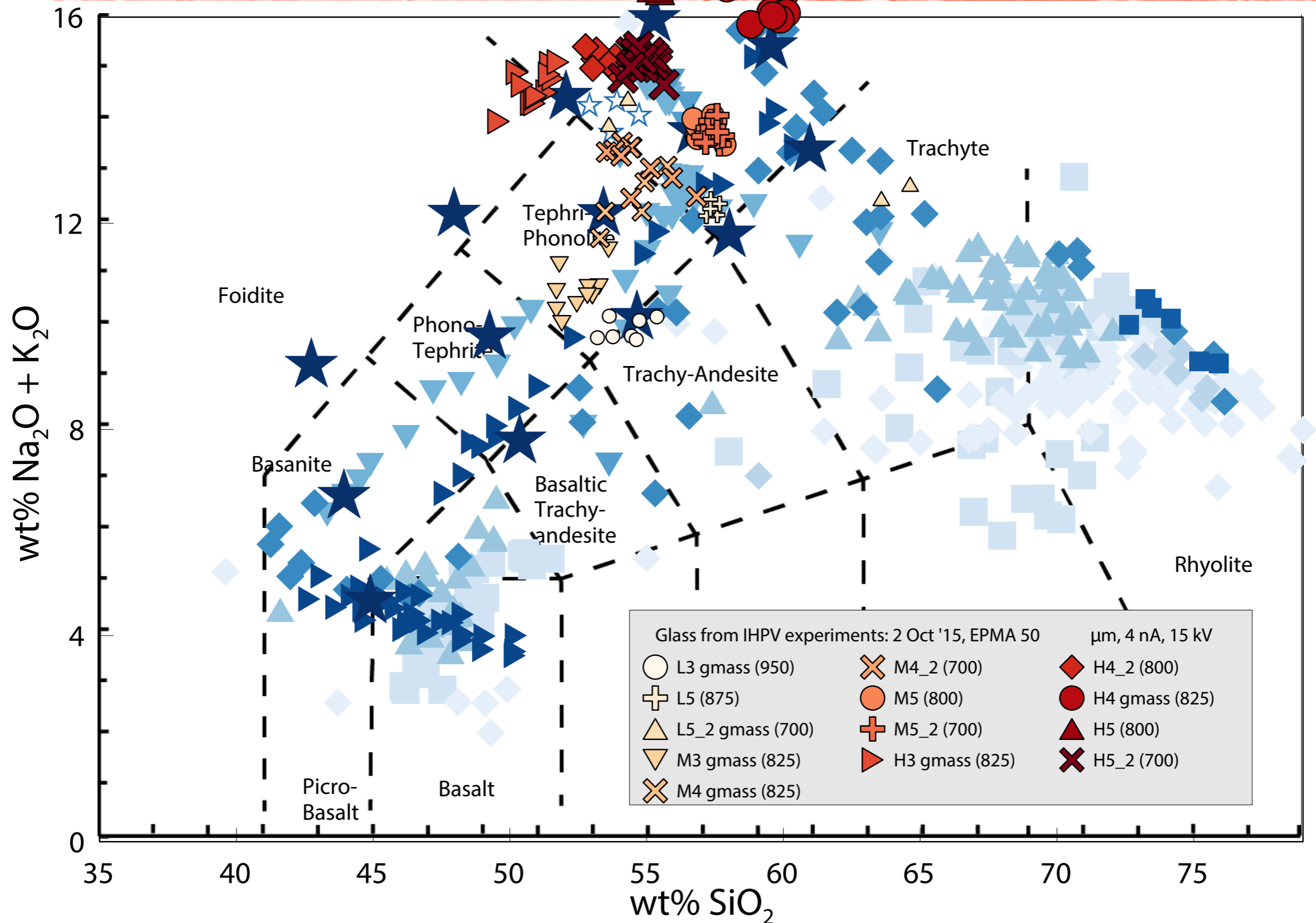
H4, IHPV-4: 825°C



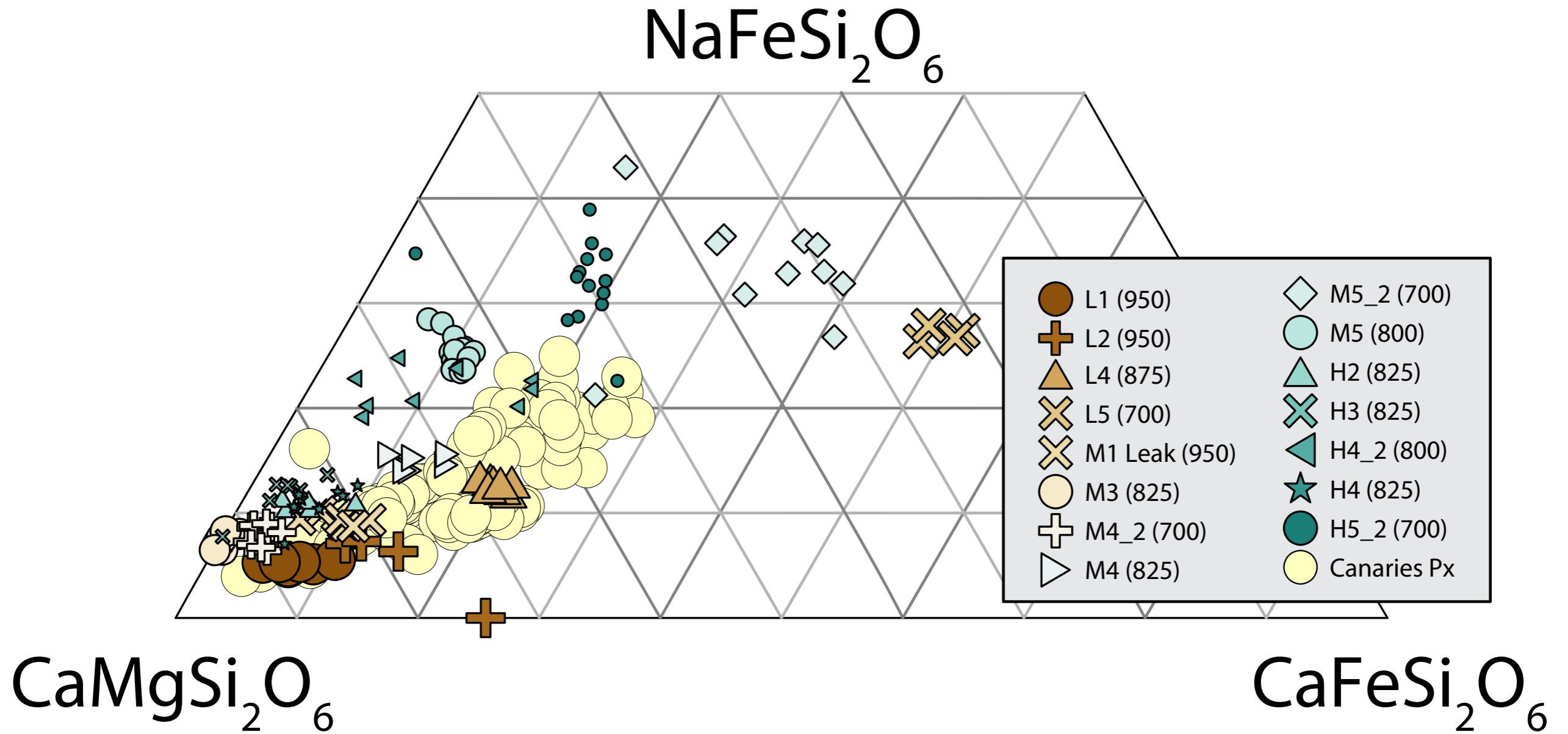
M5, IHPV-2: 800°C, 2 KBar, Aegirine Augite

Preliminary experiment glasses

H₂O Sat, 2 kBar



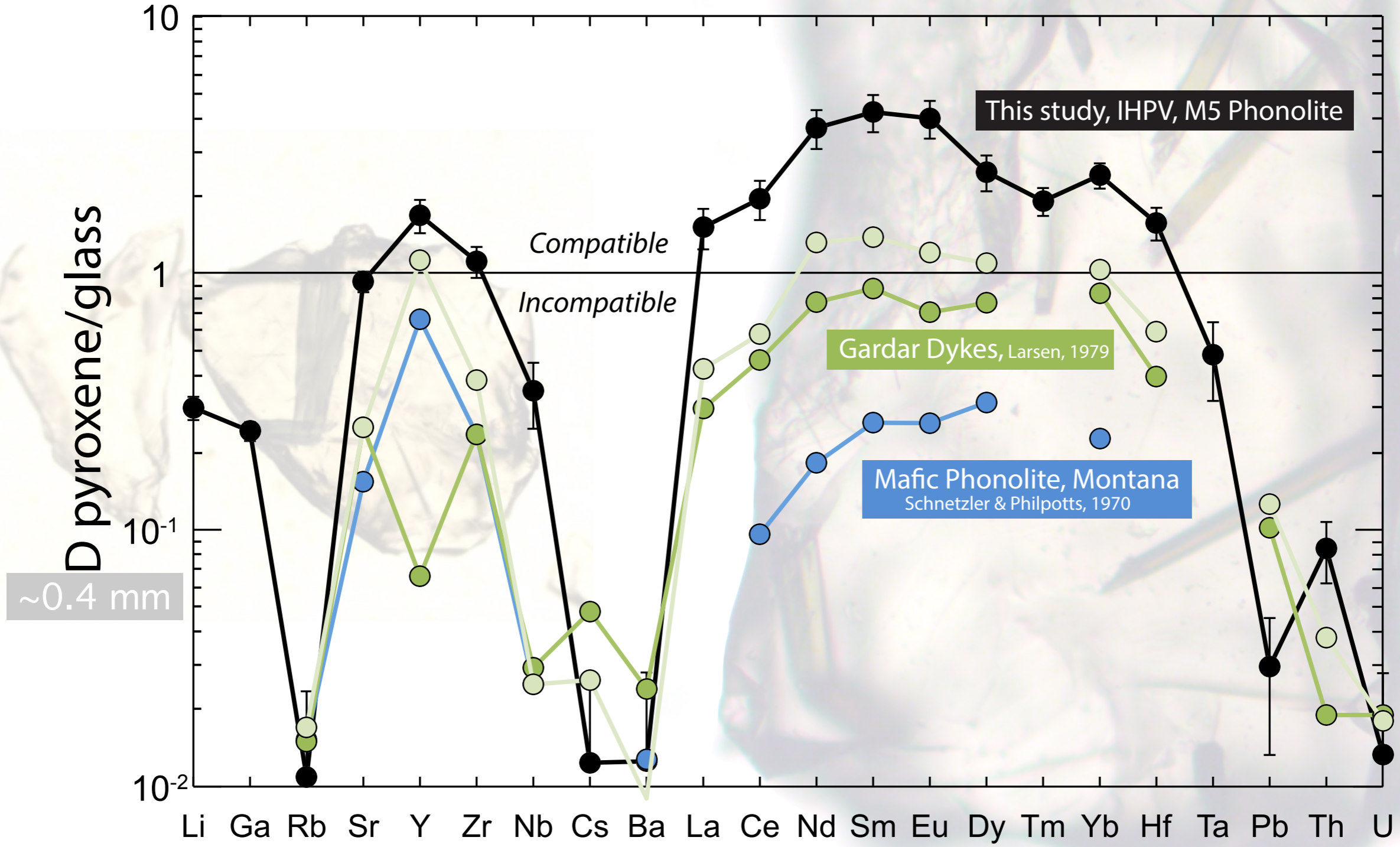
Preliminary experiment pyroxenes



~ 0.25 mm

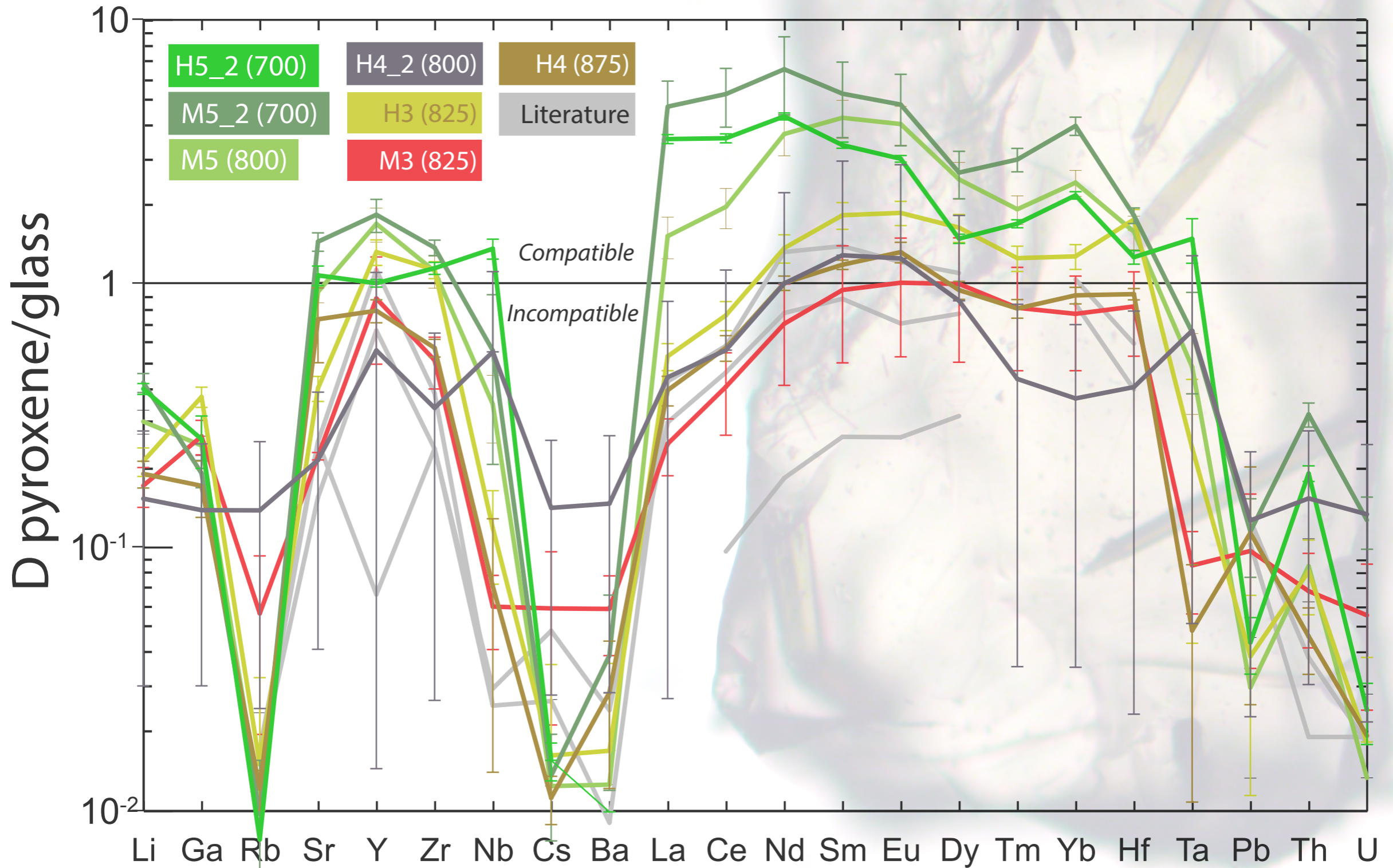
Element partitioning

!! $D_{REE} > 1$

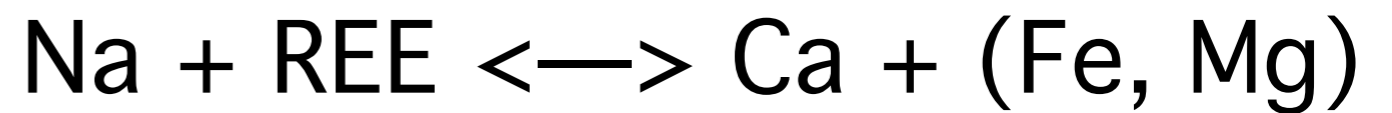
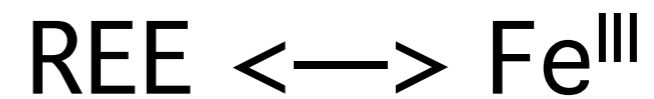
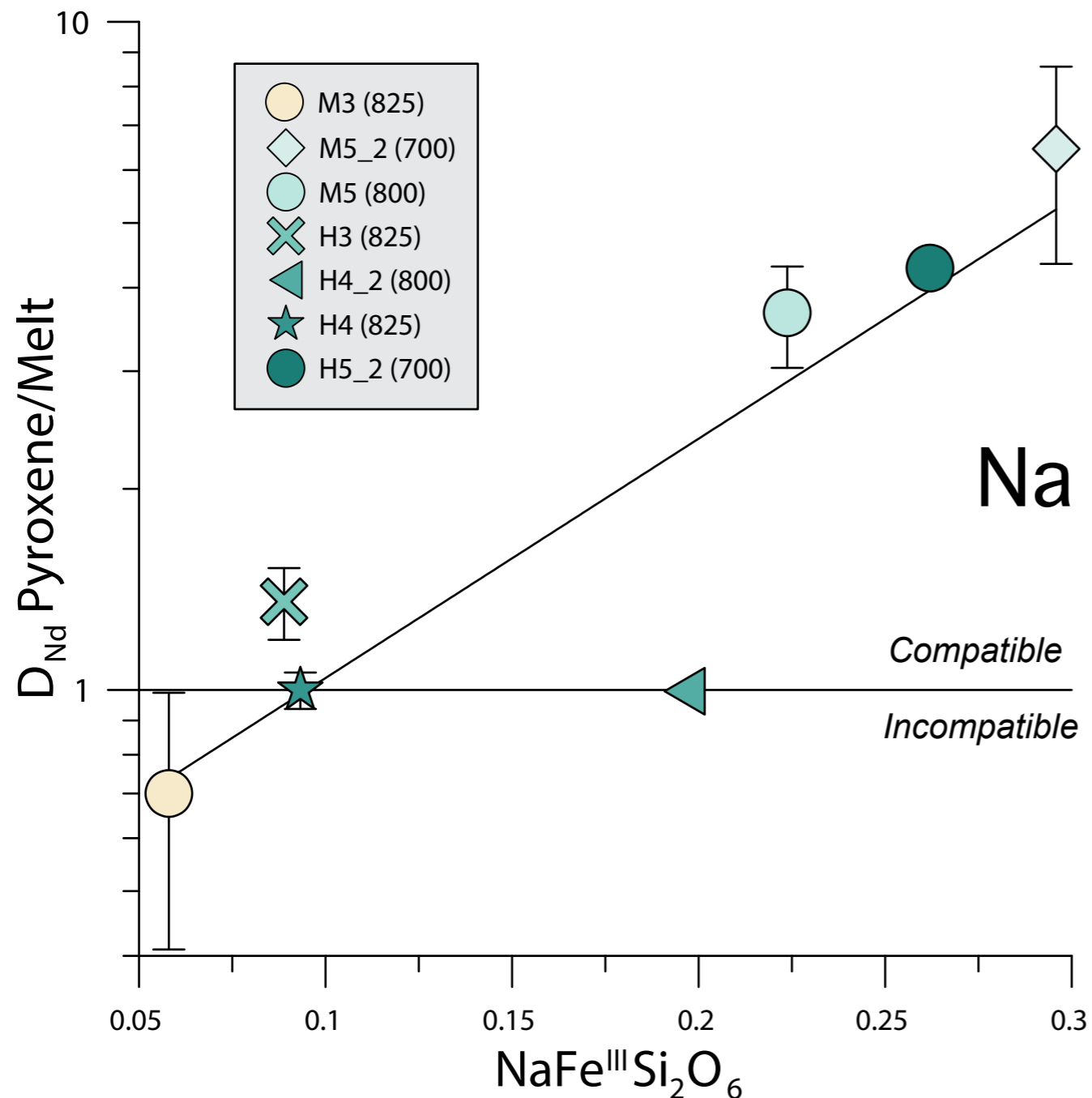


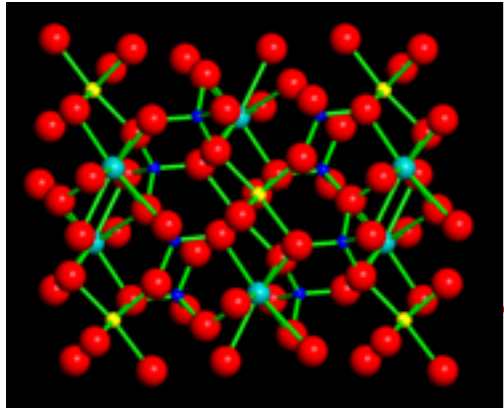
~ 0.25 mm

Element partitioning

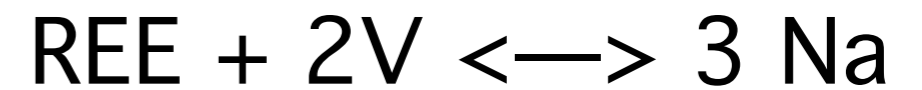
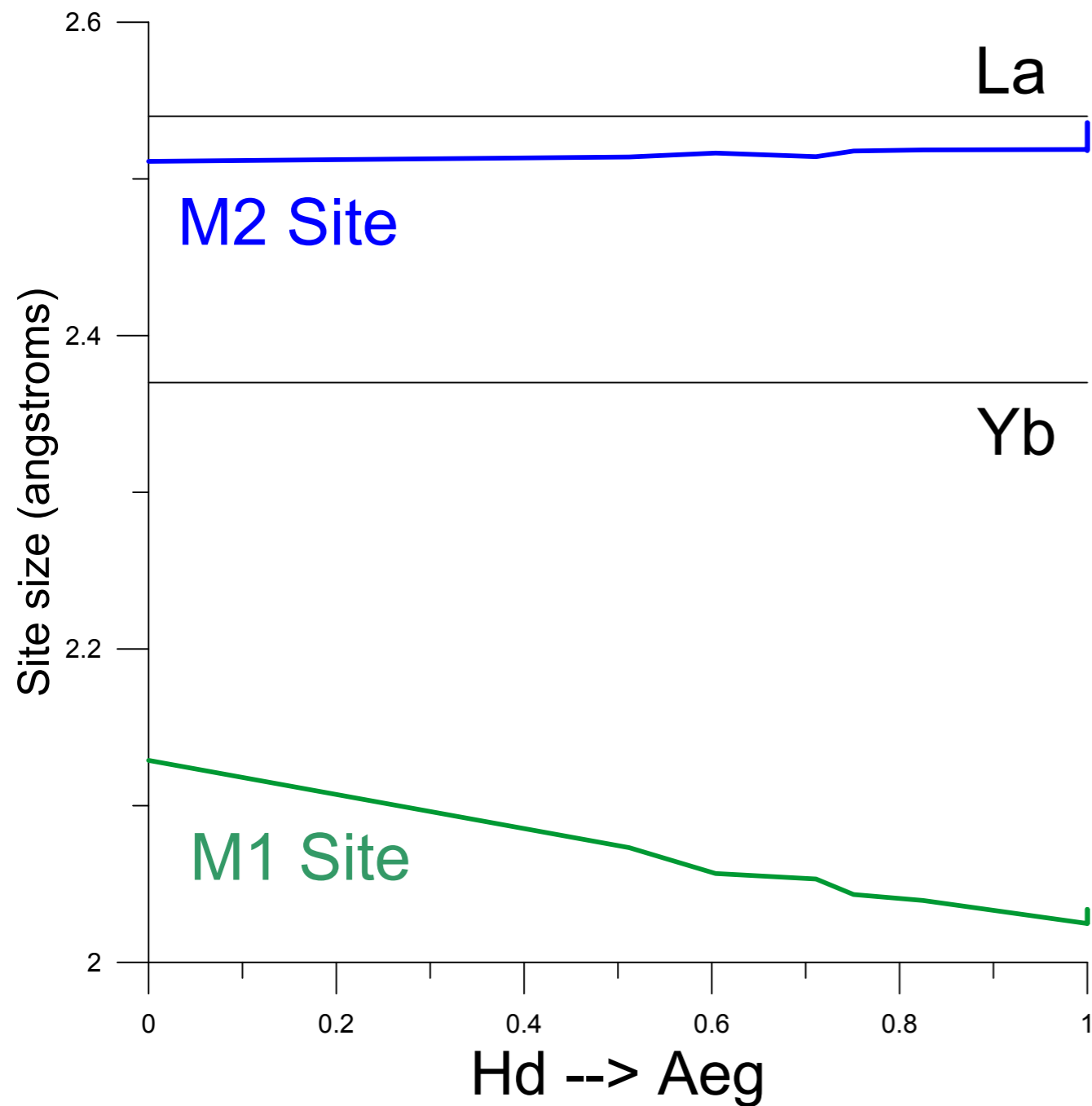


D_{REE} correlated with aegirine fraction

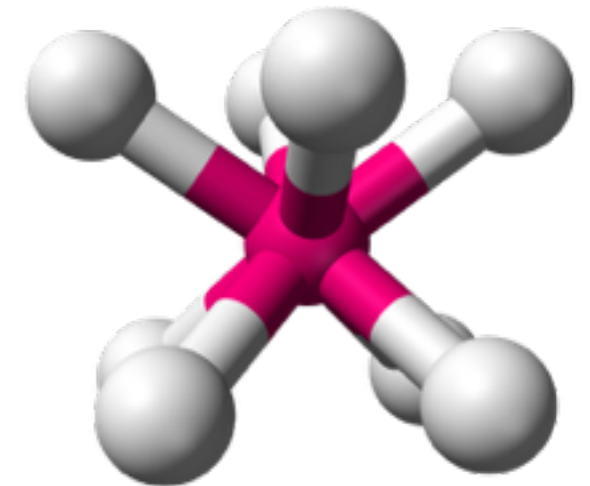
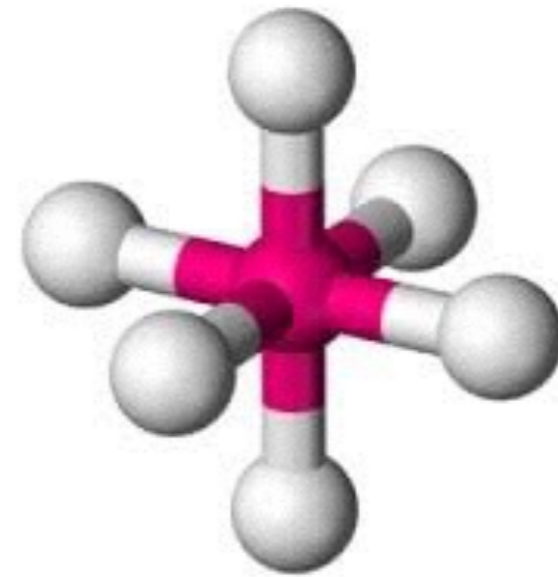




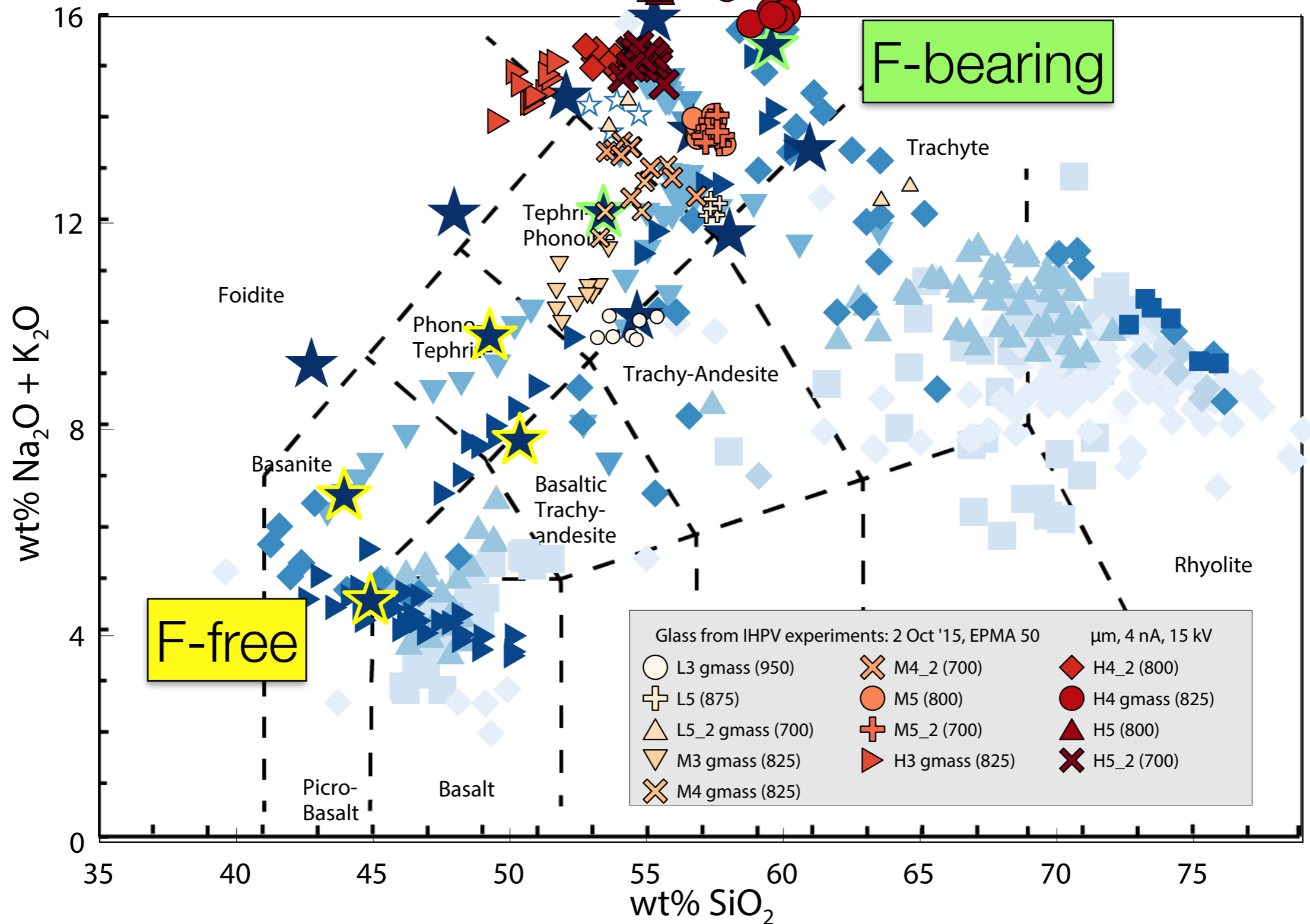
Lattice site sizes



Fluorine – The link to natural systems?

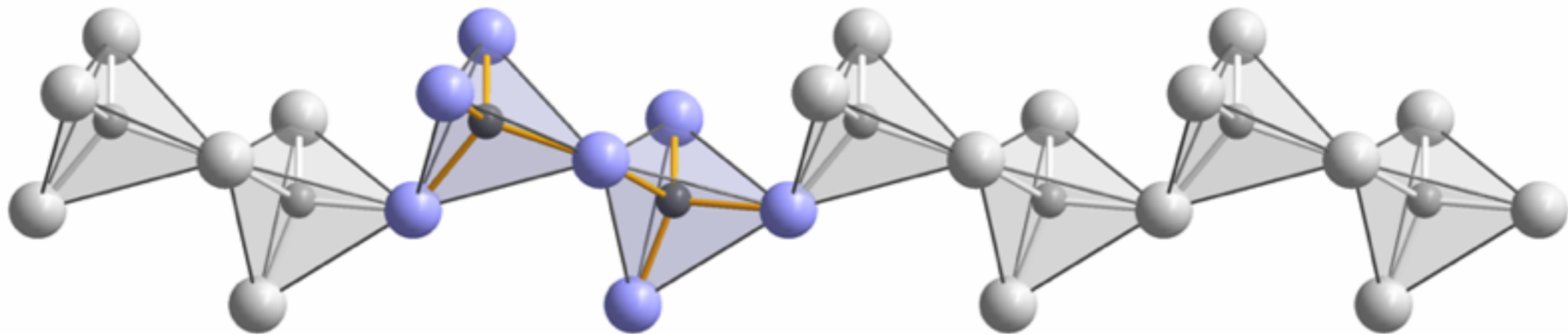
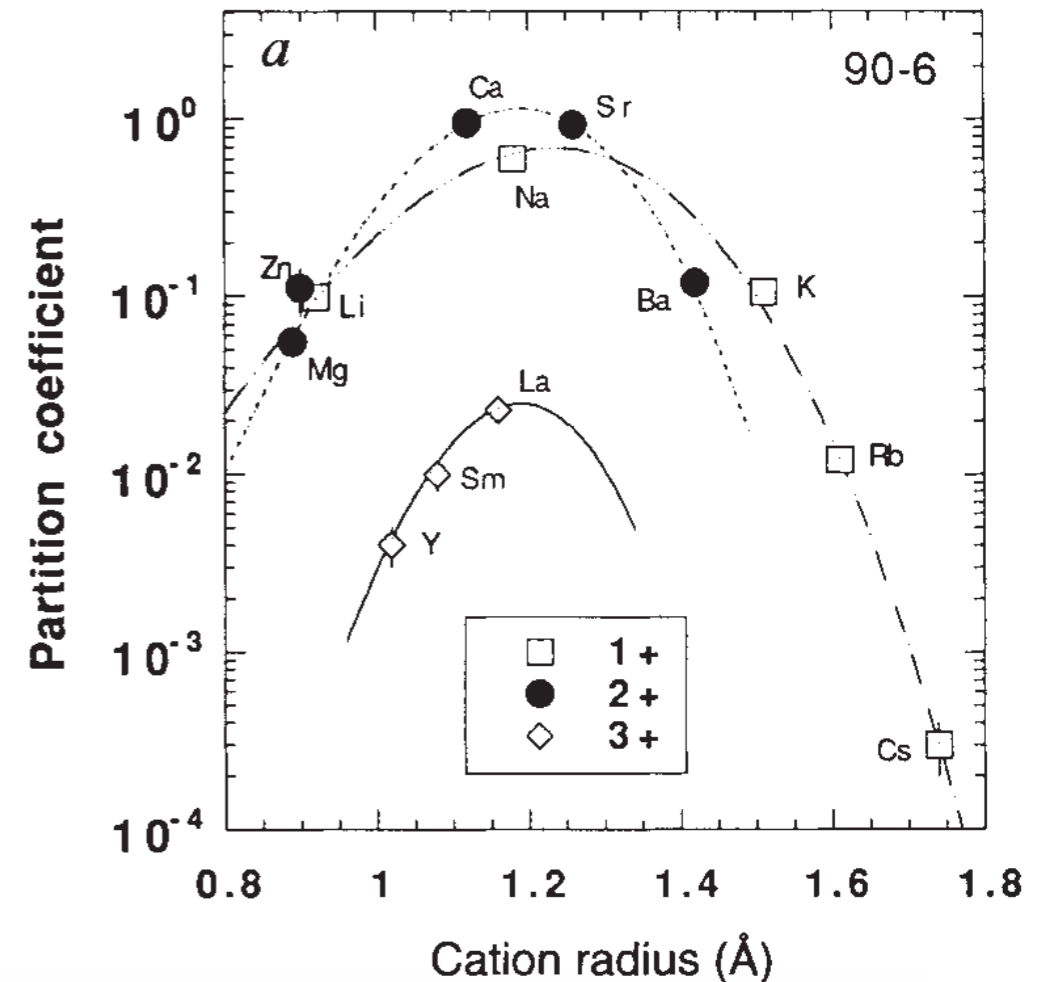


Summer 2016:



Future:

- Build partitioning model which predicts changes with mineral chemistry
- Mafic and F-bearing experiments



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The Bosses:



John Stix



Vincent van Hinsberg

Volcano pokerers:

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Maria Stuff
Julia Pohlenz

EconGeol:

Willy Group
Longbo Yang



