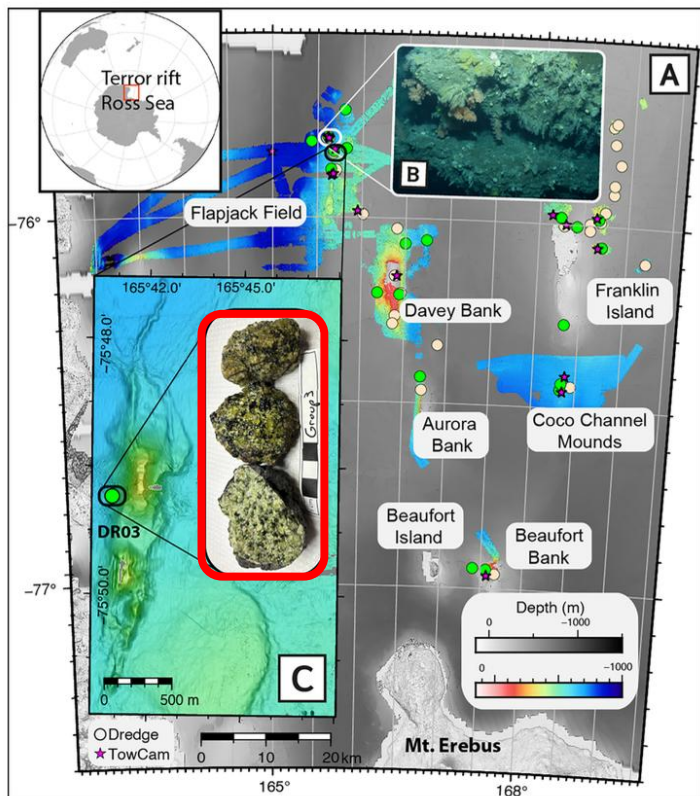


Preliminary results on the composition of the Antarctic mantle below the Terror Rift, Western Ross Sea

Cecile Prigent¹, Marie Walter¹, Kurt S. Panter², Carole Berthod¹, Masako Tominaga³ and Andrew Cross³

¹Institut de Physique du Globe de Paris (IPGP), France, ²Bowling Green State University, USA, ³Woods Hole Oceanographic Institution, USA

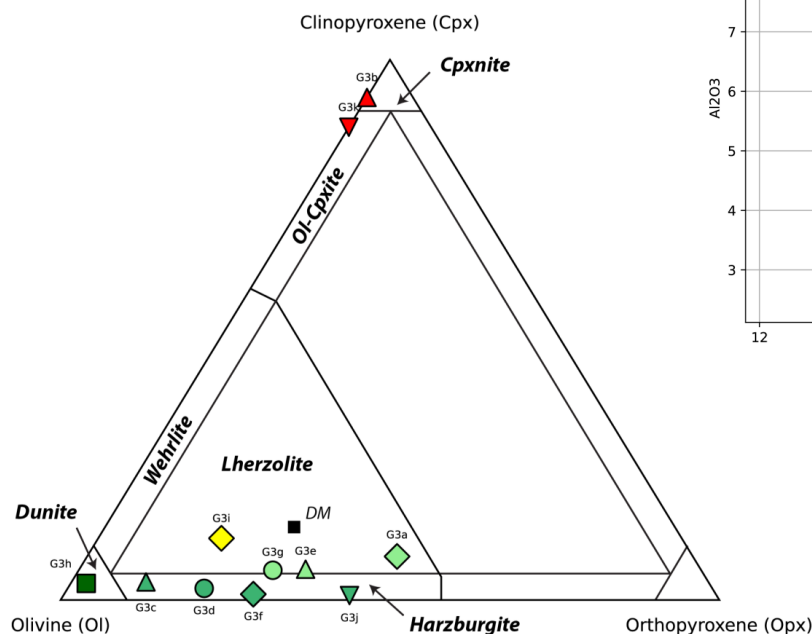
1. Location of studied samples



Tominaga et al. (2025)

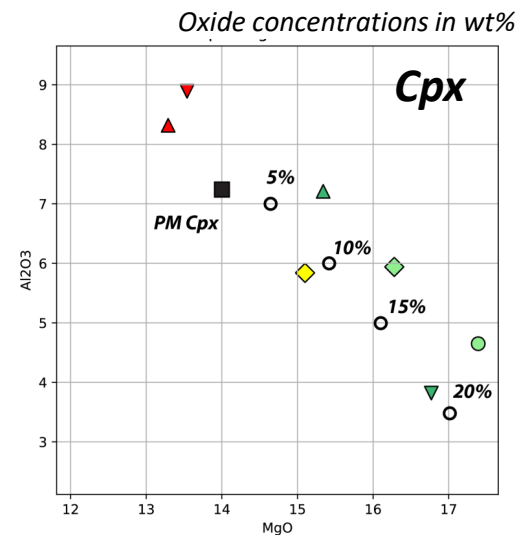
Squid Ridge (<10ka volcanism)

2. Petrological study

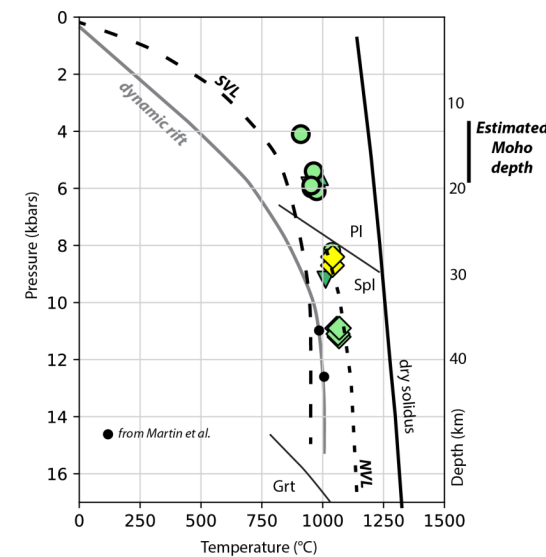


5. Conclusions and implication for rift plumbing system and lava composition

3. Mineral chemistry

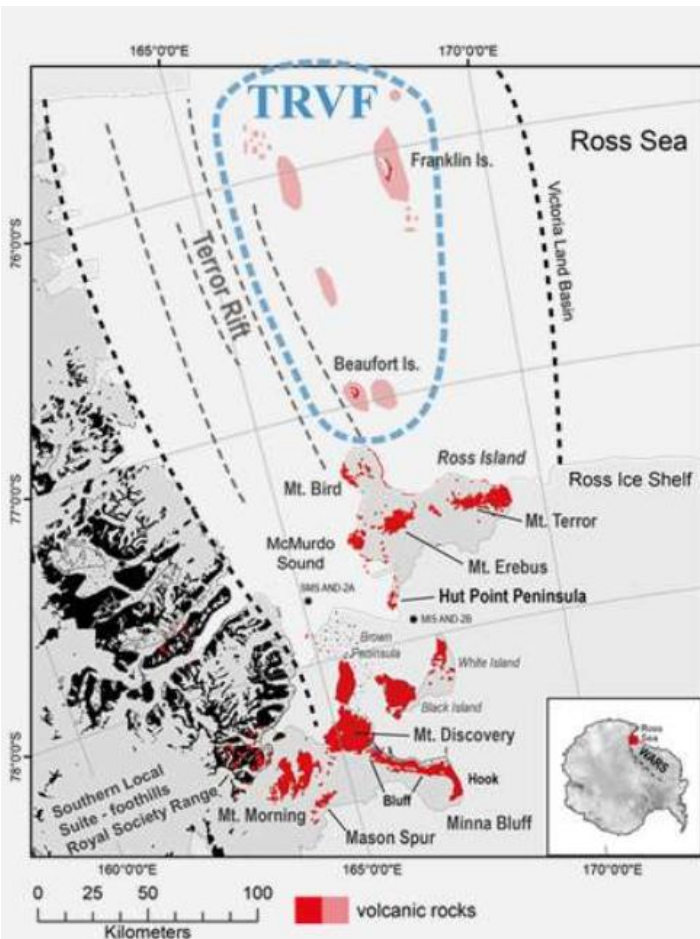


4. Thermobarometry

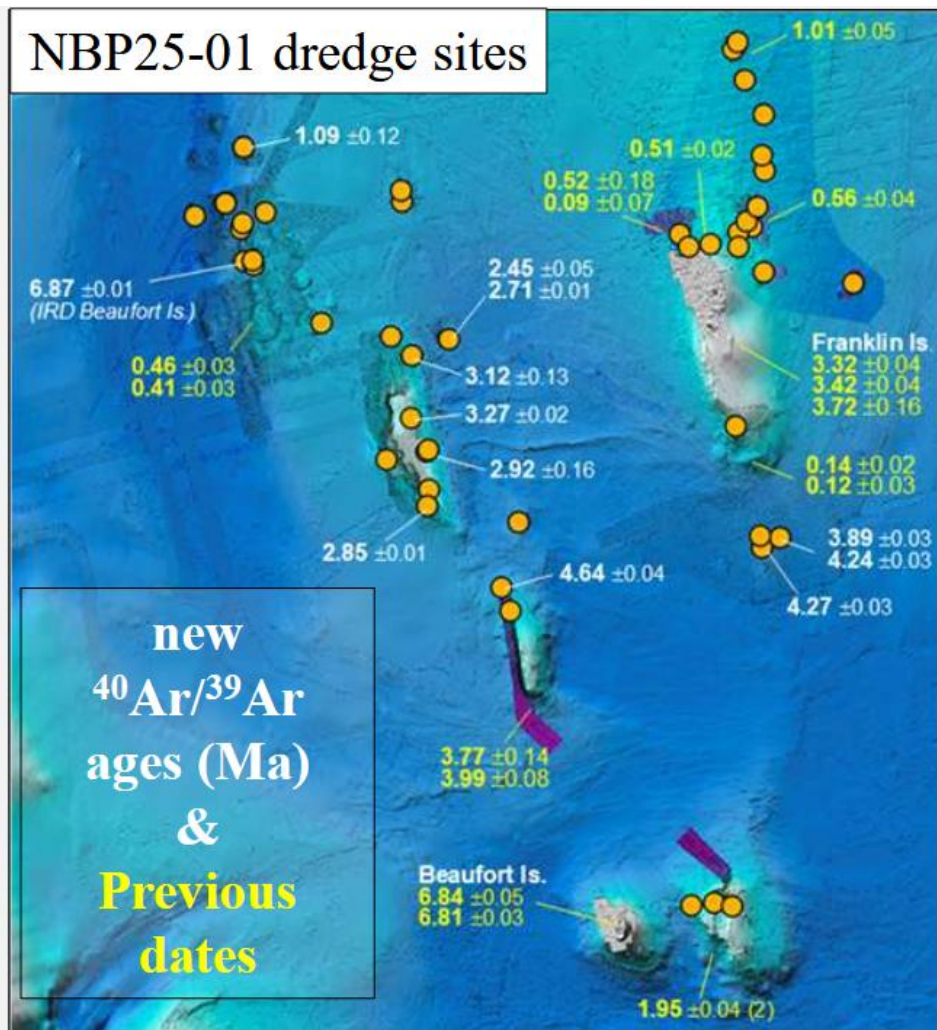


Location of studied samples

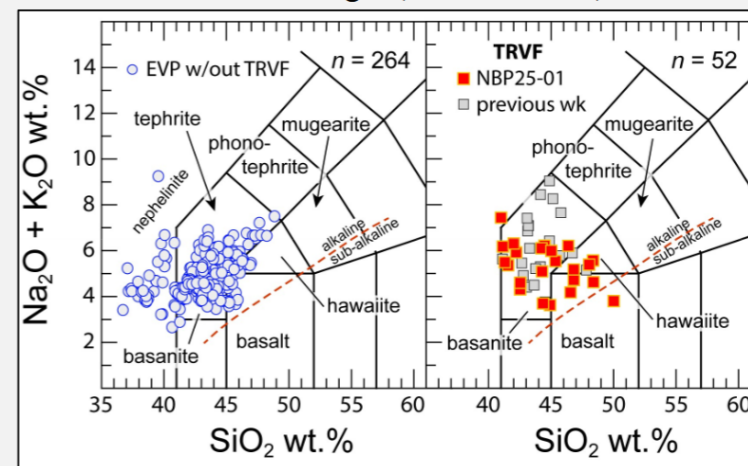
- Magmatic rift part of the WARS
- Youngest phase of extension



Erebus Volcanic Province



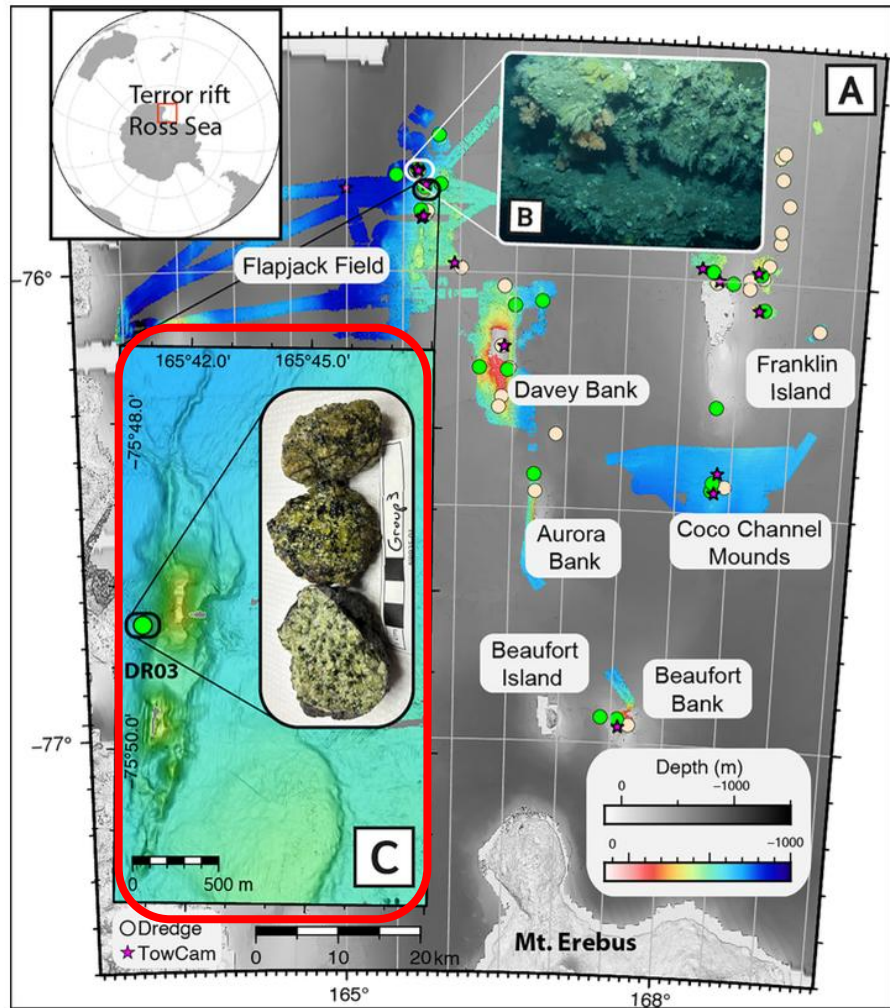
Basalt, 6-14 wt.% MgO (alkaline series)



Mainly alkaline, explosive volcanism

Volcanism age: from 4.6 to <1 Ma

Location of studied samples



Tominaga et al. (2025)

Squid ridge : <10 ka volcanism?

Dredge DR03



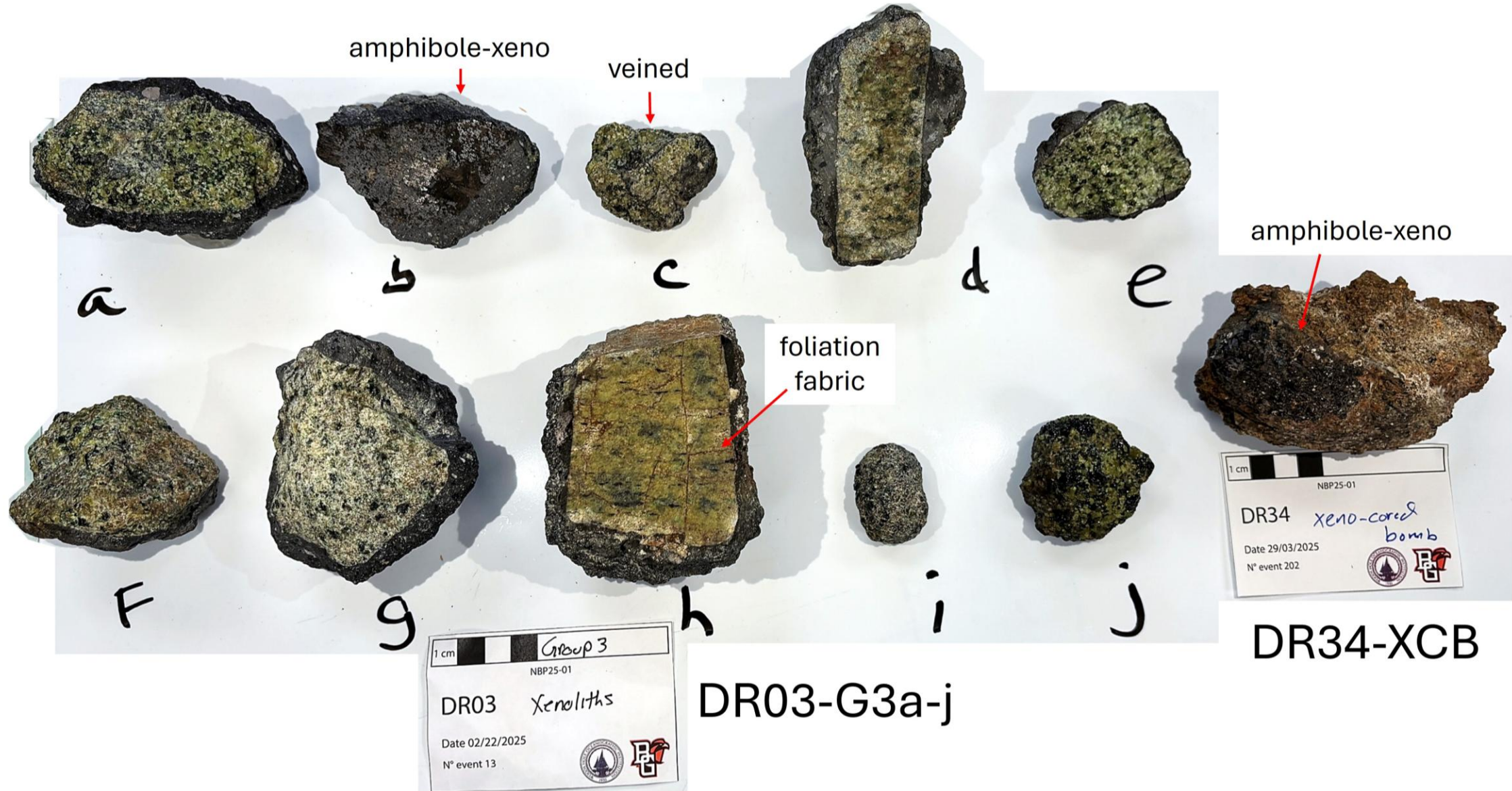
End of sample location
[Go back HOME](#)

From cruise report, NBP25-01

- DR03-G1 : Glass bearing lava samples
- DR03-G2 : Amphibole bearing lava samples
- DR03-G3 : Xenoliths
- DR03-G4 : Volcanic breccia
- DR03-G5 : Mingled lava
- DR03-G6 : Cauliflower
- DR03-G7 : Eratics

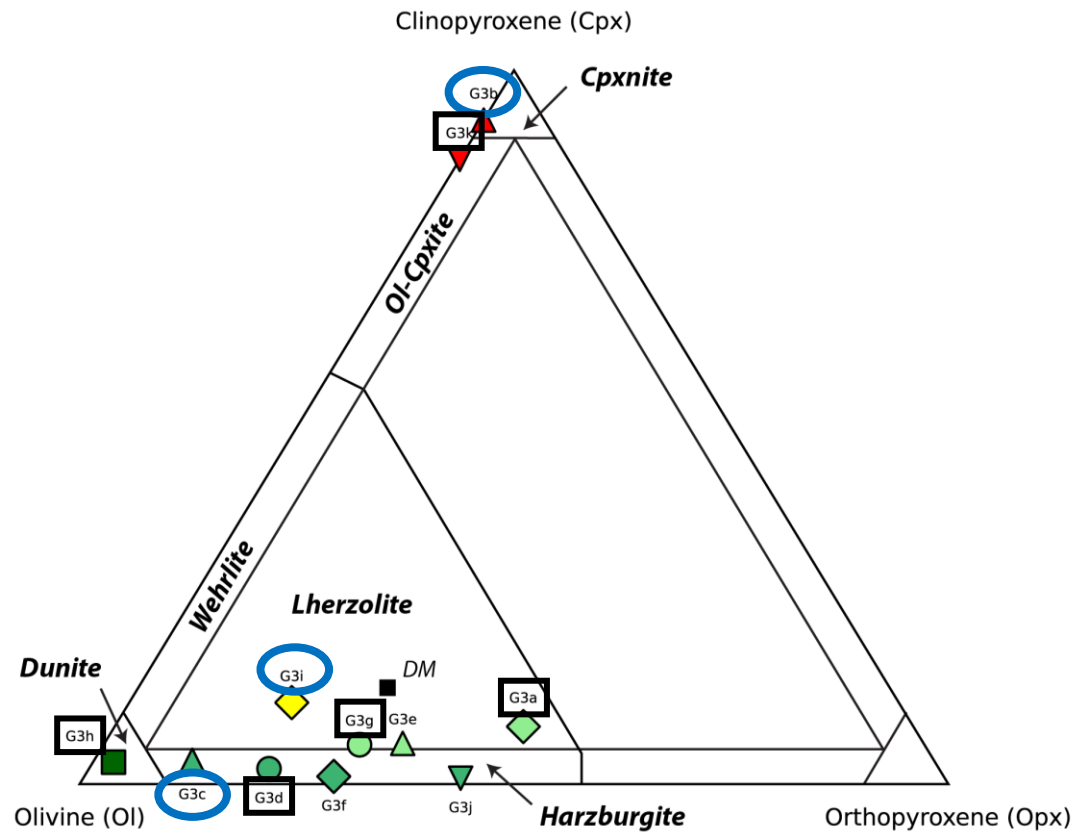


Various sizes, shapes and lithologies among selected samples



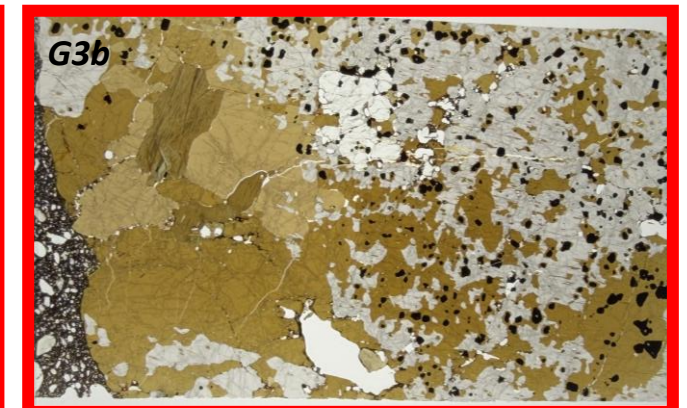
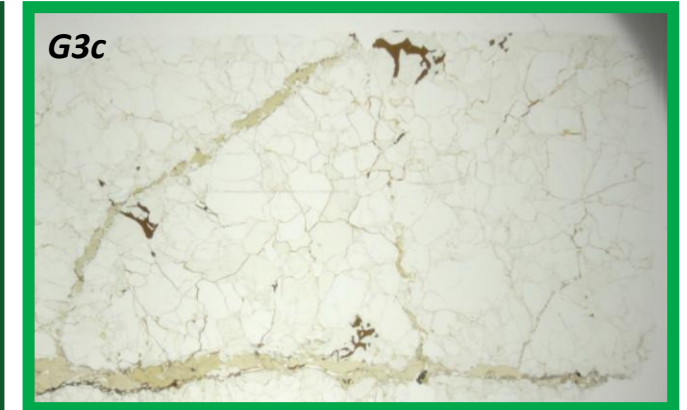
→ Constrain the (thermo-chemical-deformational) history of the heterogeneous mantle below Squid Ridge

Selected samples cover a wide range of lithologies and deformation styles



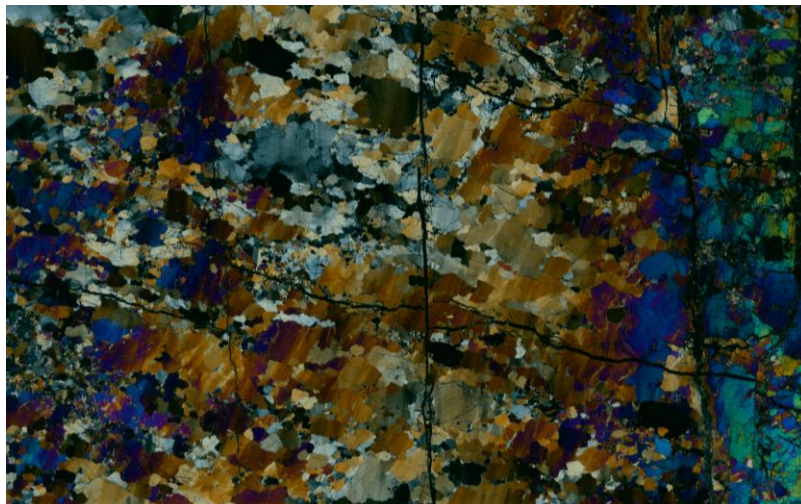
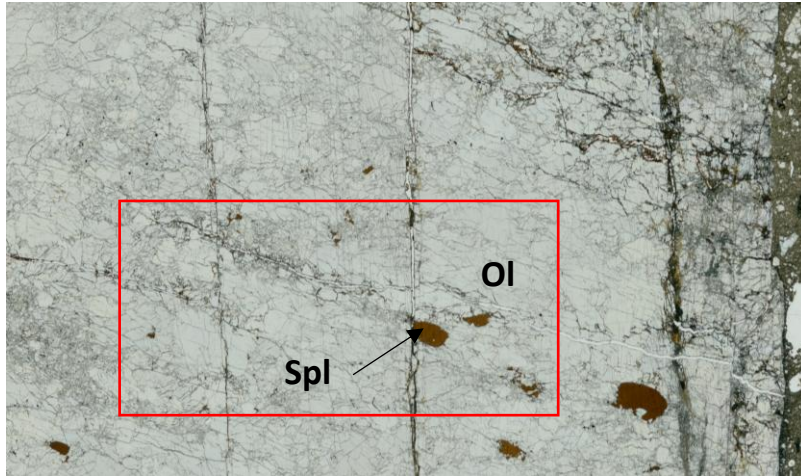
3 with more than 5% amphibole

8 characterized by EPMA

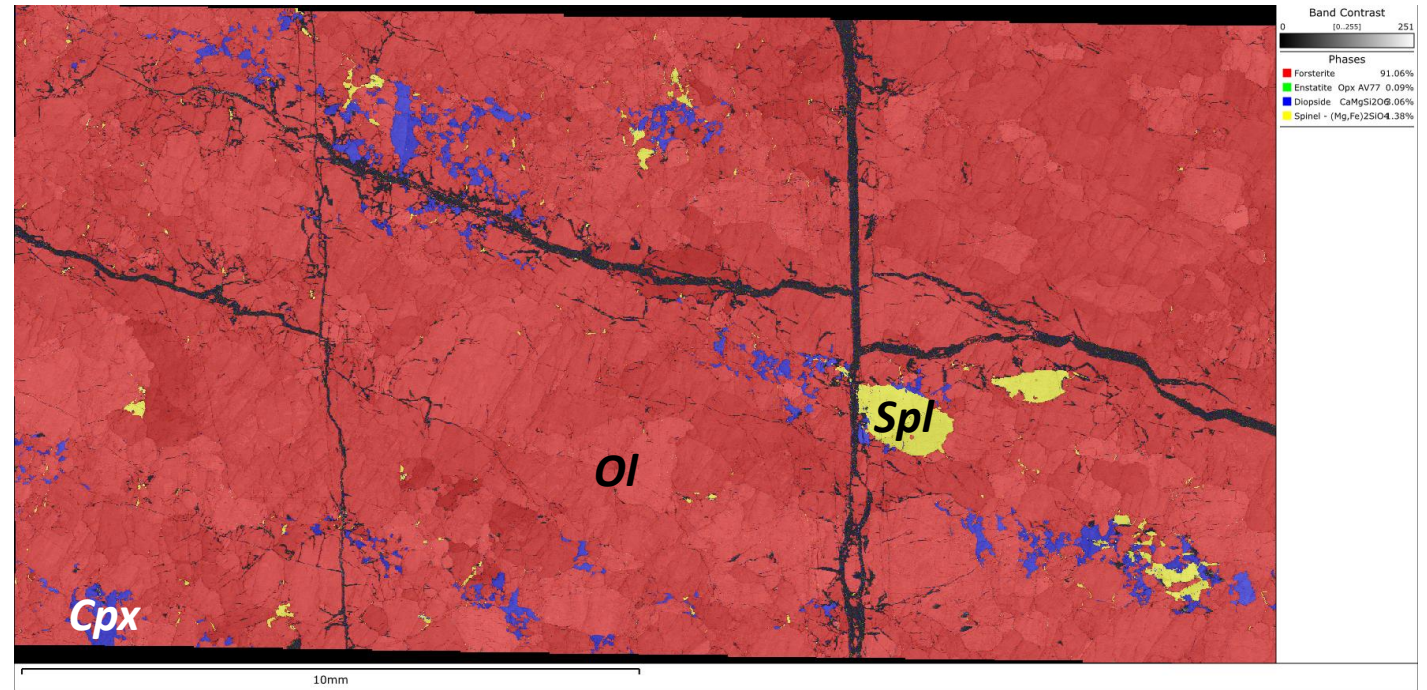


Dunites, harzburgites and lherzolites

Dunite (DR03-G3h)



1 cm



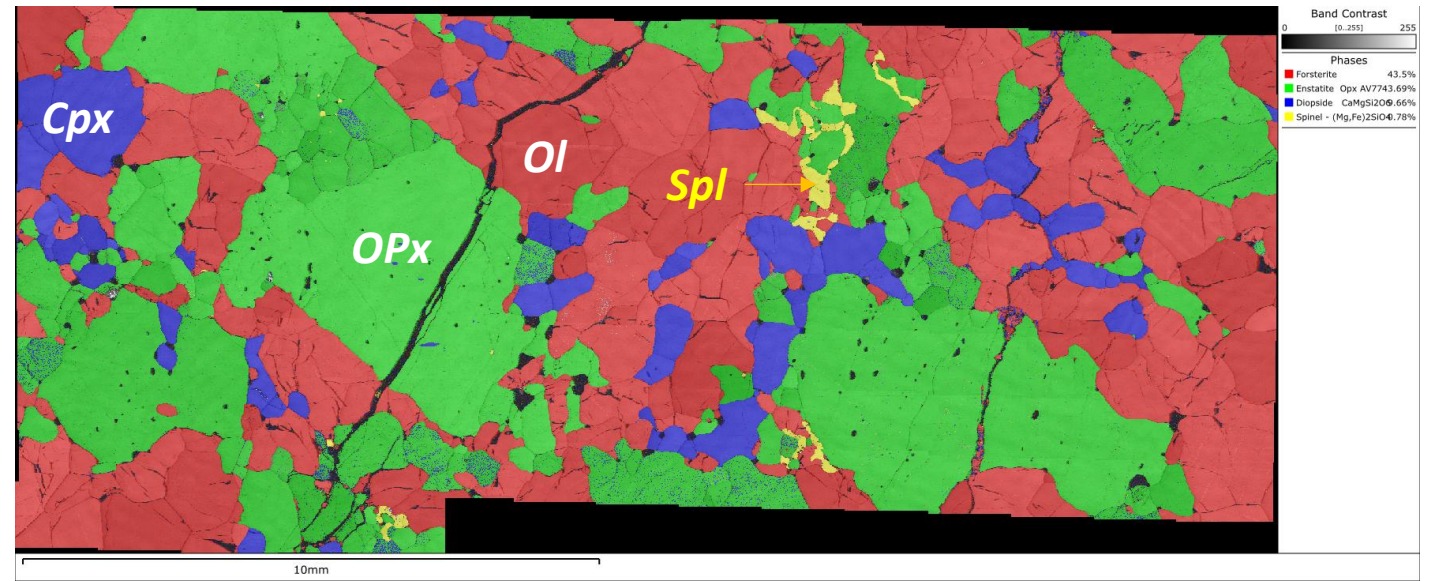
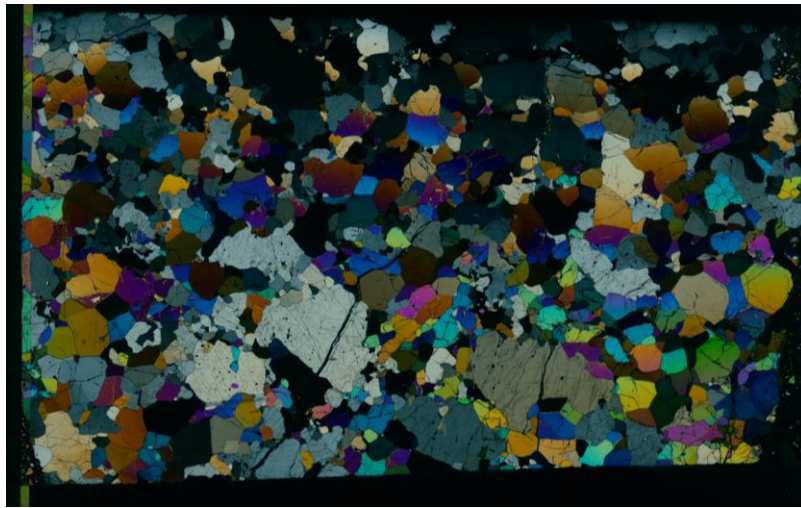
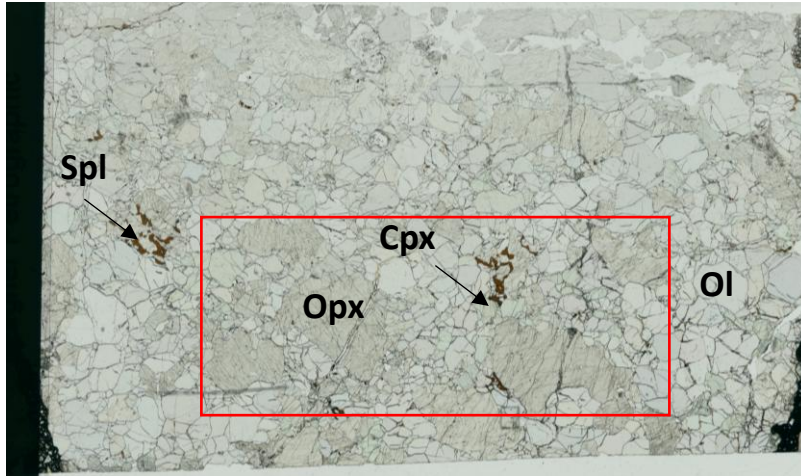
From A. Cross

Melt-rock interaction during deformation by dislocation creep



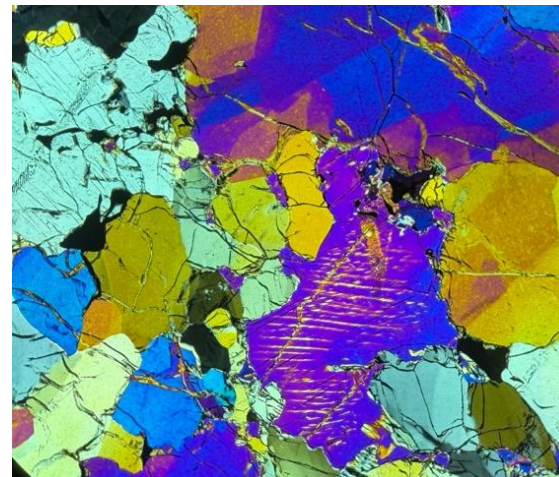
Dunites, harzburgites and lherzolites

Lherzolite (DR03-G3a)



From A. Cross

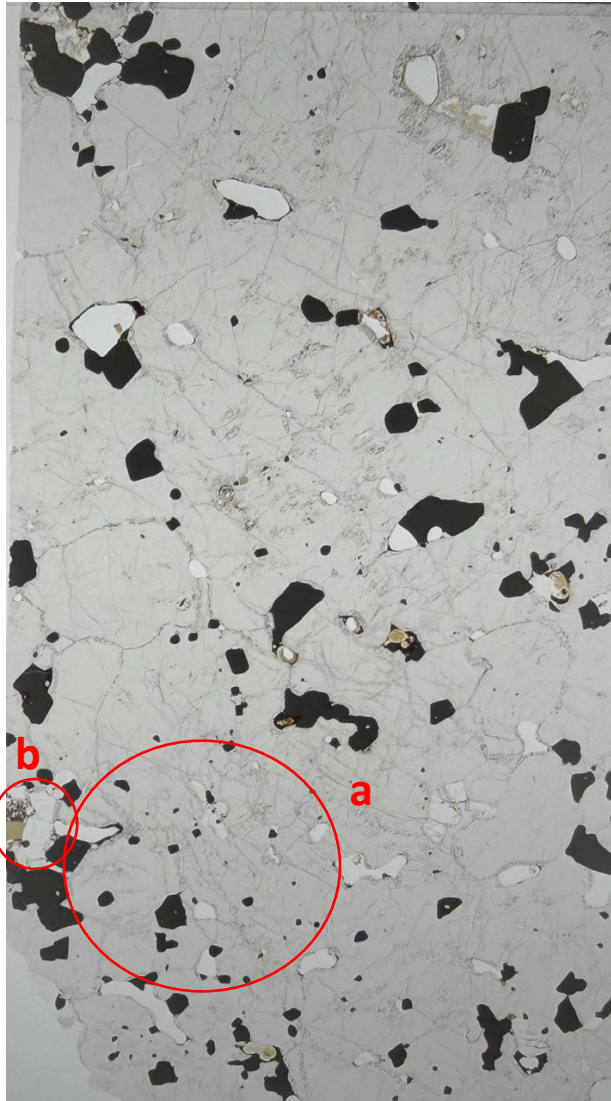
Melt-rock interaction during deformation by dislocation creep



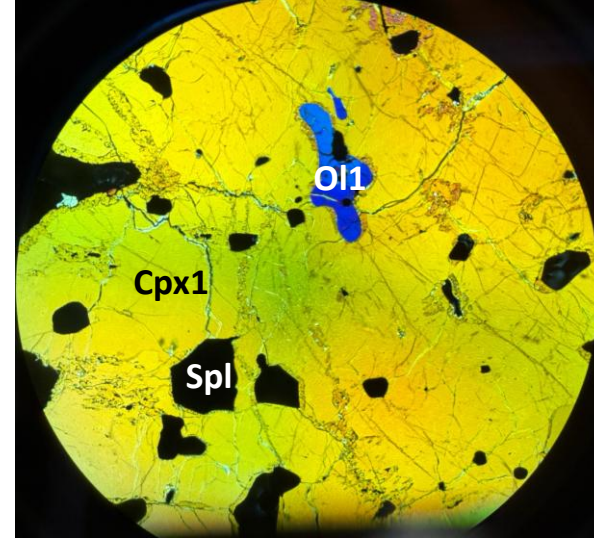
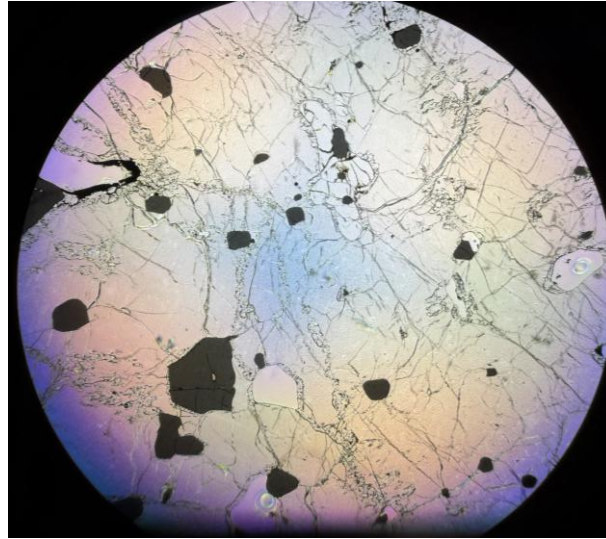
Lherzolite
(DR03-G3g)

Clinopyroxenites

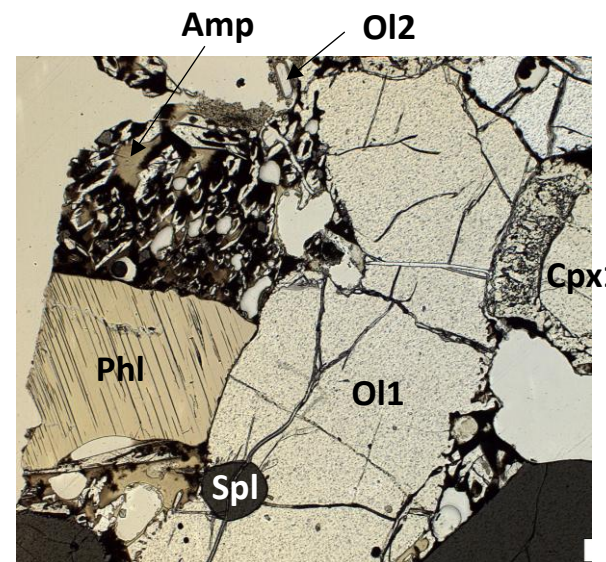
DR03-G3k



a



b

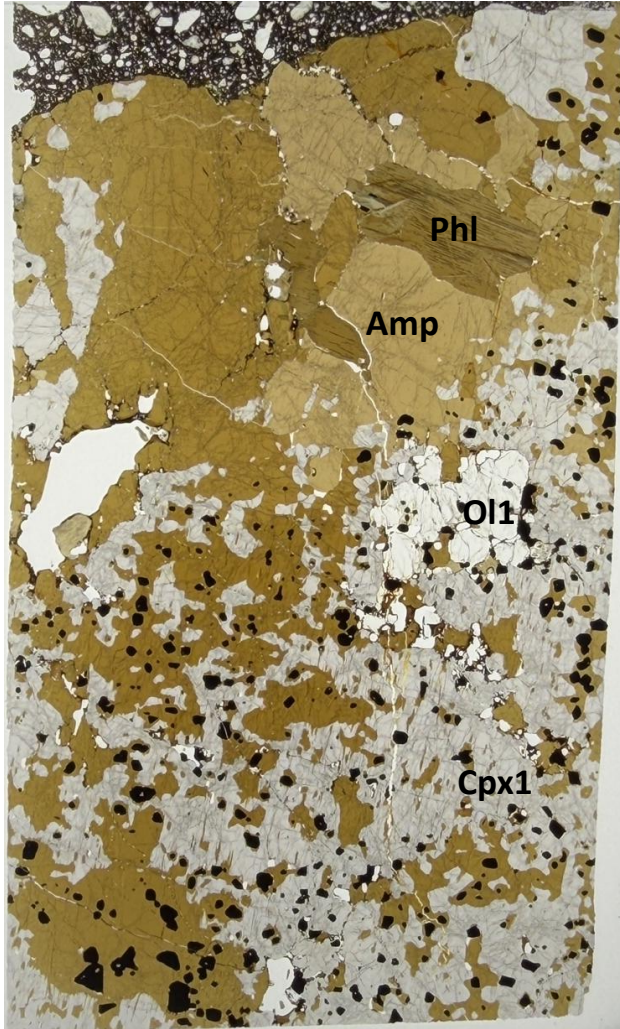


(1) Cpx1 + Ol1 + Spl + Phl

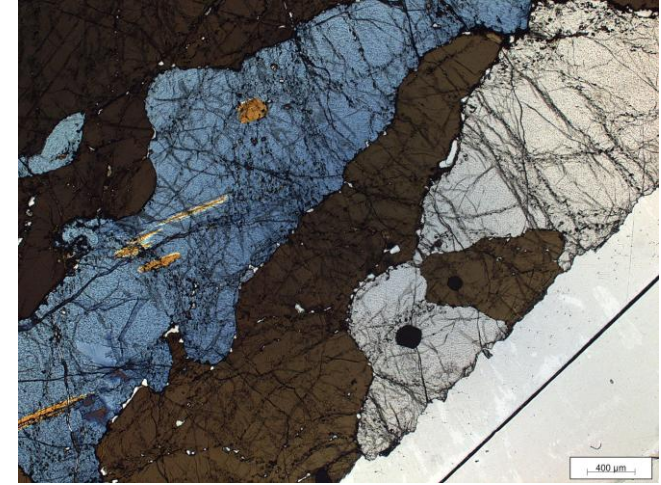
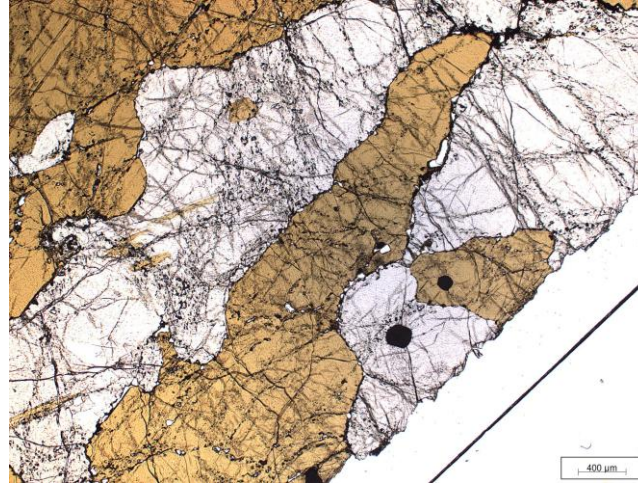
Clinopyroxenite

DR03-G3k : Cpx1 + Ol1 + Spl + Phl

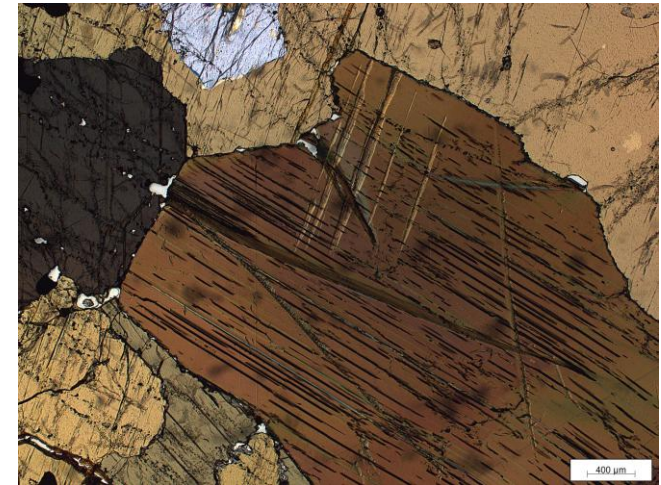
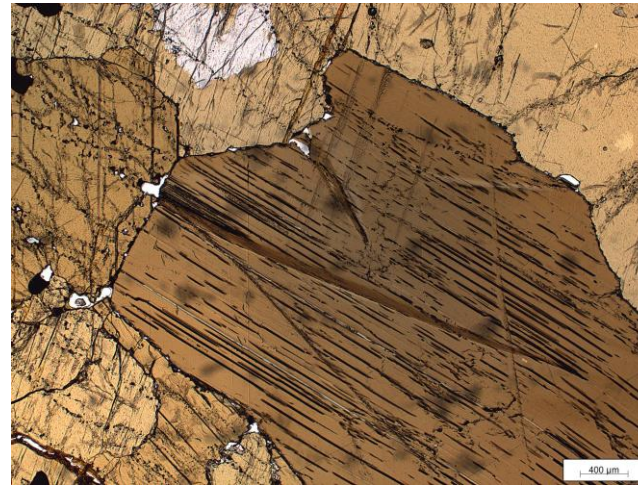
DR03-G3b



a



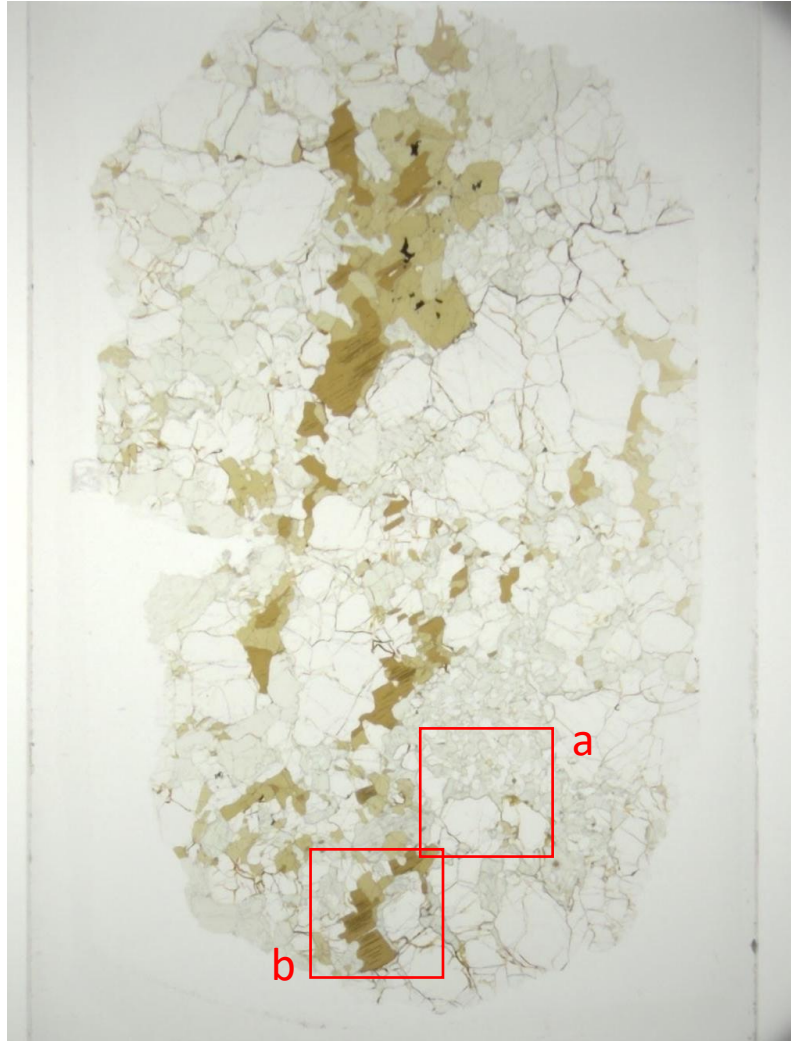
b



(1) Cpx1 + Ol1 + Spl (+ Phl?)
(2) Amp (+Phl?)

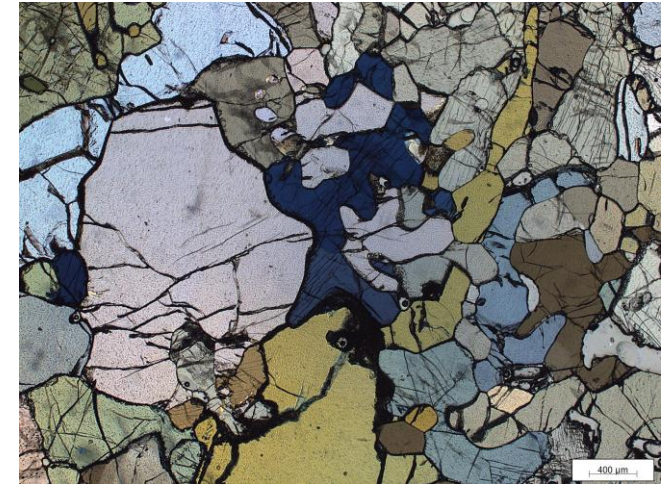
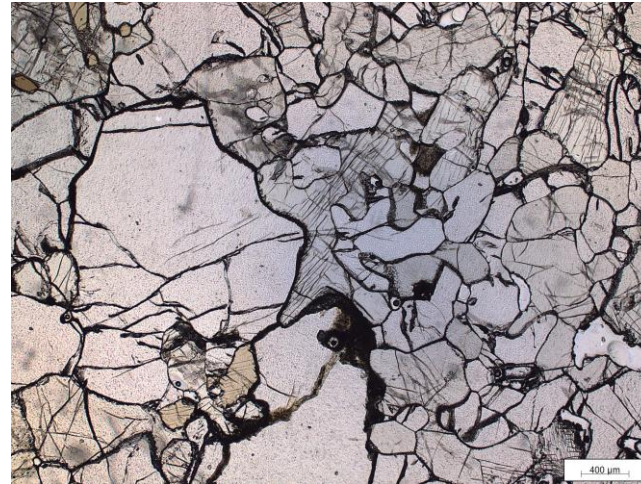
Amphibole/phlogopite formation in peridotites

Hb-Lherzolite (DR03-G3i)

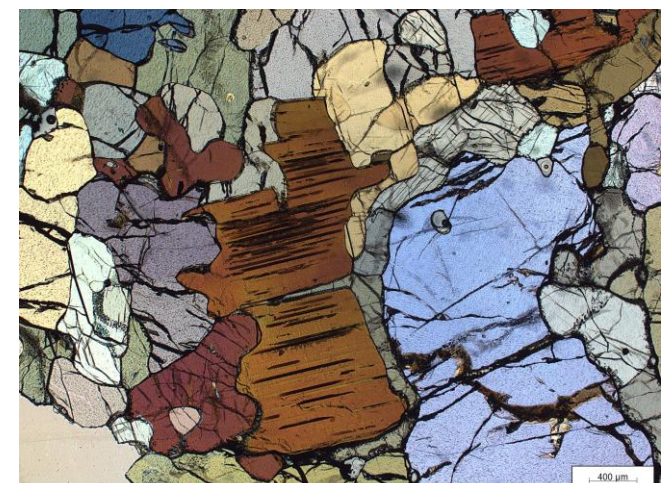


1 cm

a



b



(1) Ol + Opx + Spl (+Phl?)

(2) Cpx + Amp

Amphibole/phlogopite formation in peridotites

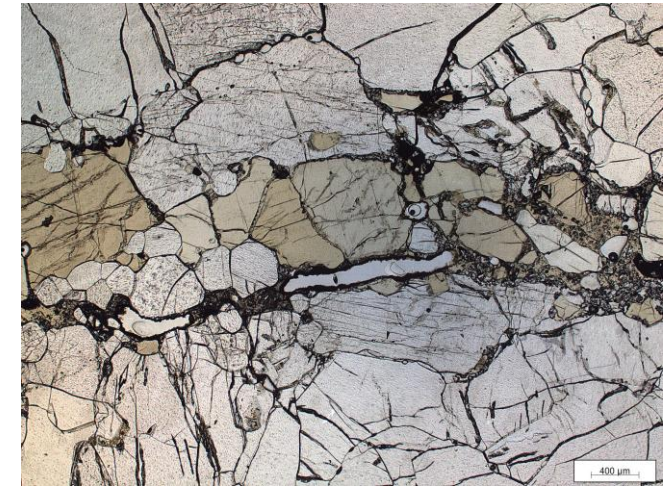
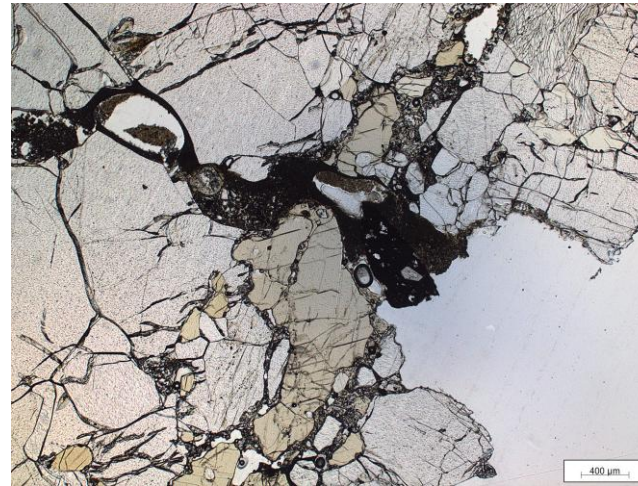
Harzburgite (DR03-G3c)



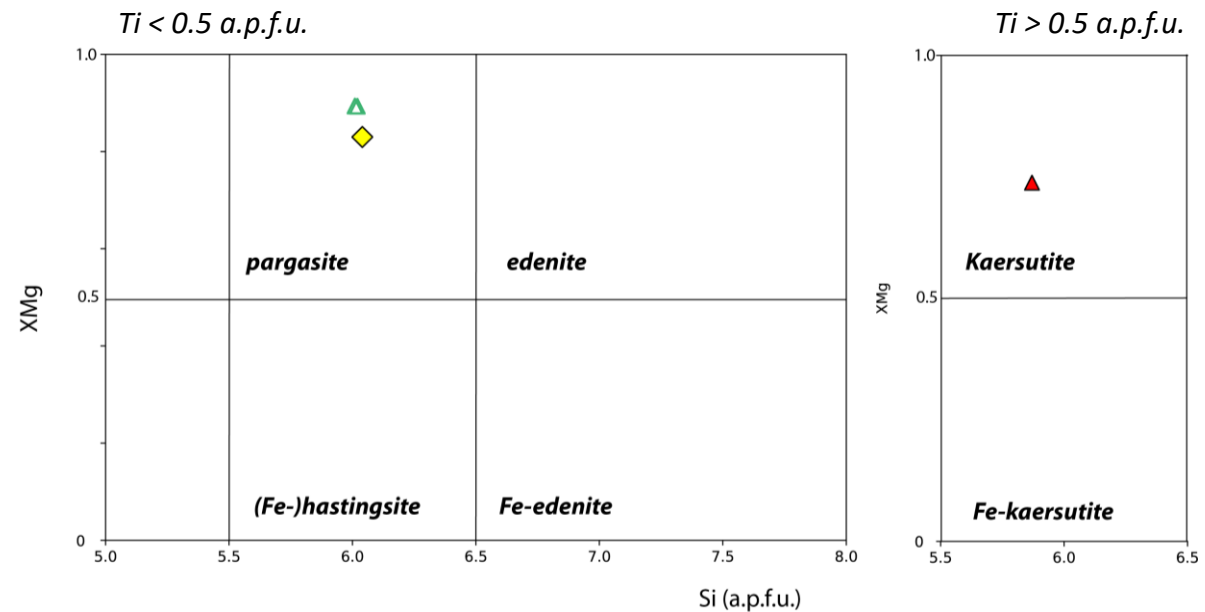
1 cm

(1) Ol + Opx + Spl

(2) Amp

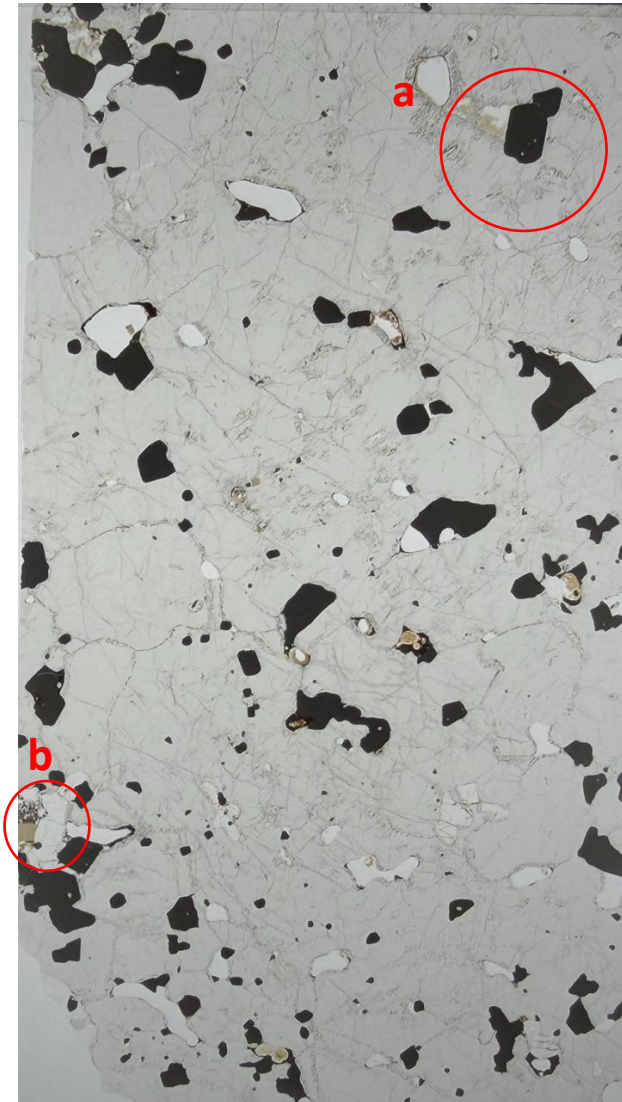


Amphibole composition

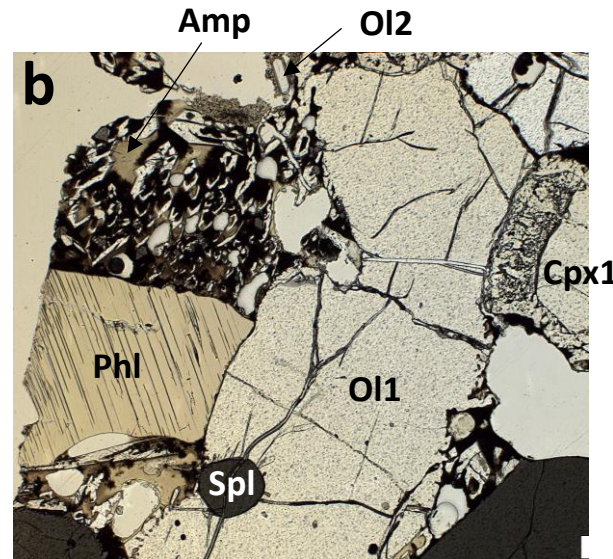
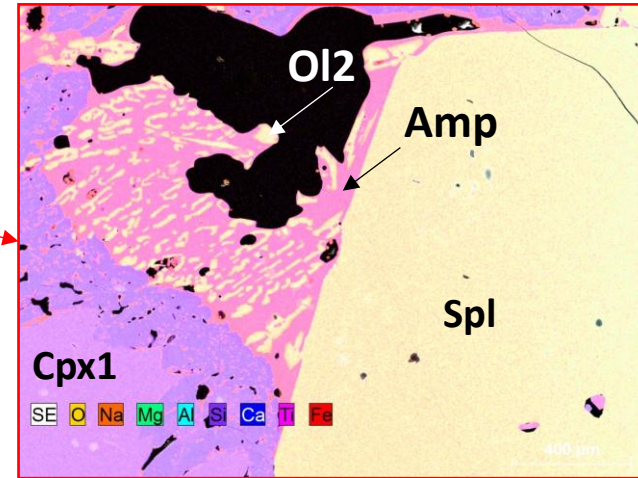
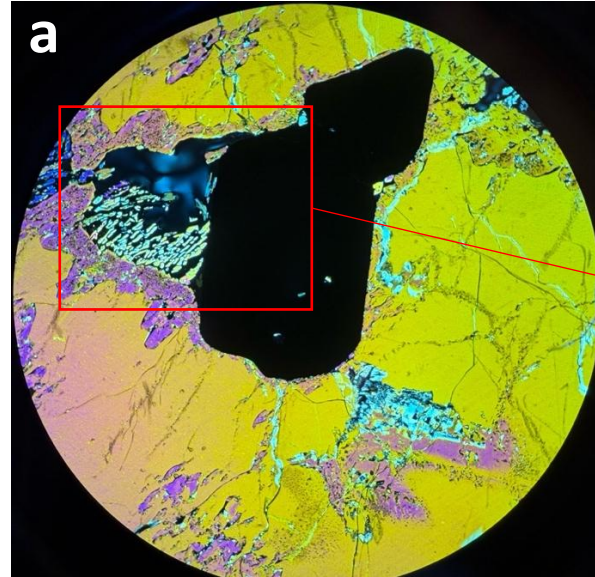


Surrounding lava and late fractures within xenoliths

DR03-G3k



1 cm

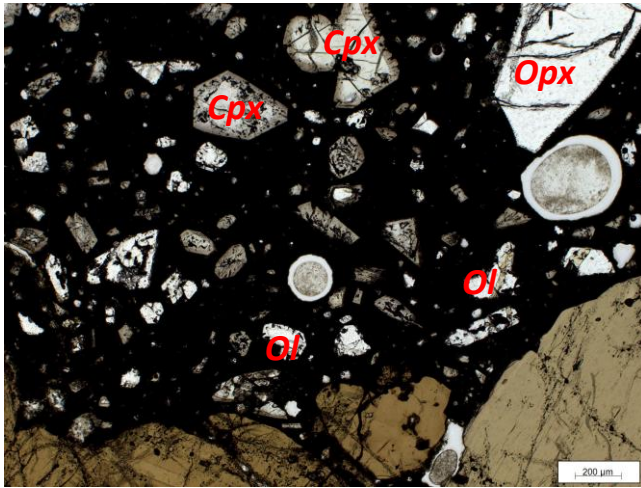


Amp + Ol2 + glass ± Cpx2

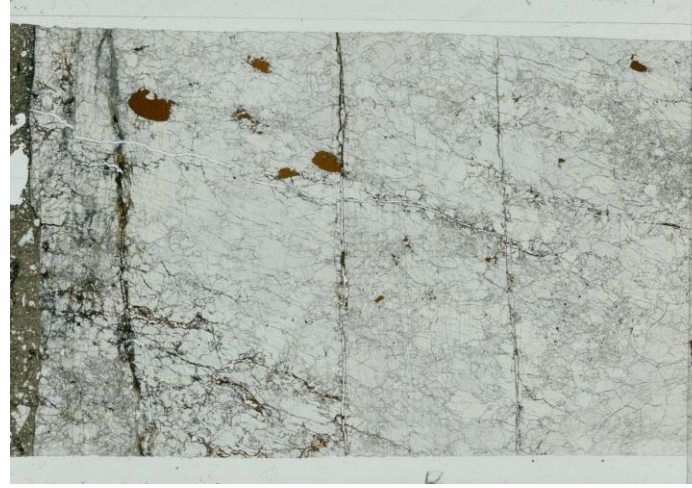
Surrounding lava and late fractures within xenoliths

End of petrological characterization
[Go back HOME](#)

Cpxite (G3b)

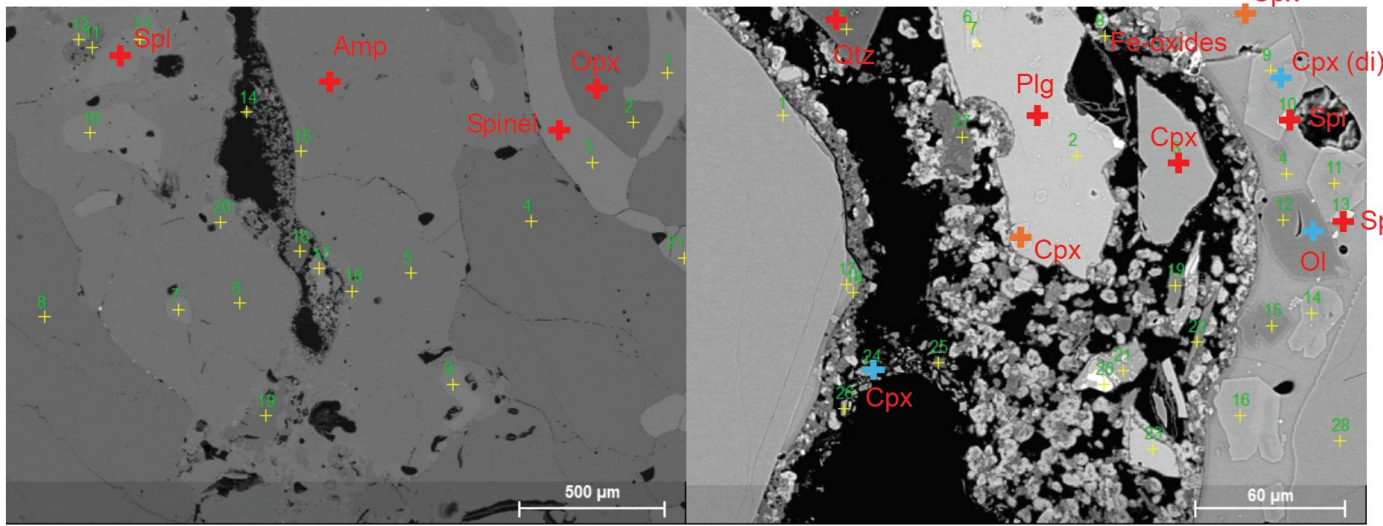
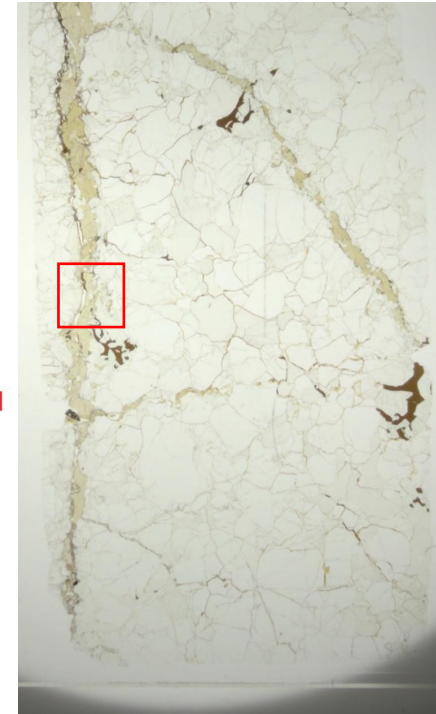


D (G3h)



In lavas: Amp + Cpx + Ol + glass
In fractures: Amp + glass ± Ol ± Cpx + Fe-oxides

Hx (G3c)



In fractures: Ol + glass + Cpx + Plg + Qtz + Fe-oxides

Clinopyroxenites and Hb-lherzolite – mineral composition

Dunite

■ G3h

Harzburgites

▲ G3c

● G3d

Lherzolites

○ G3g

◇ G3a

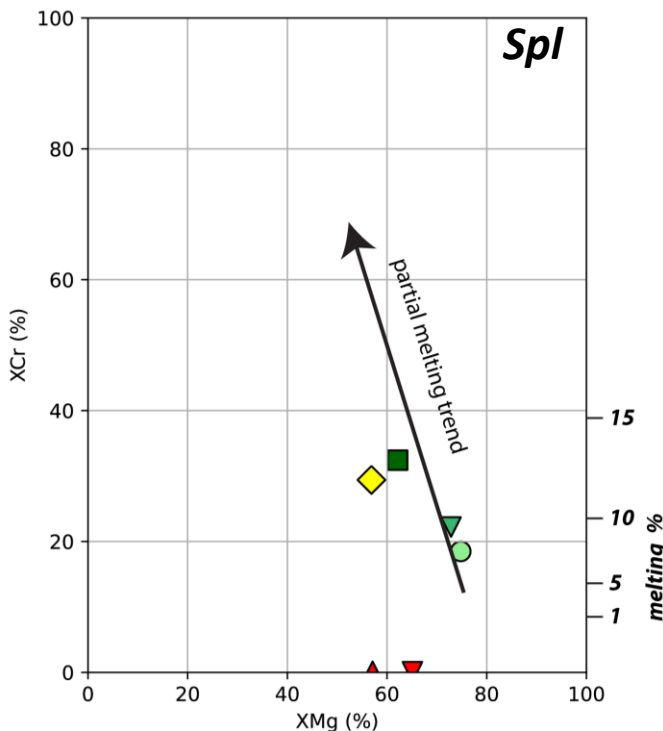
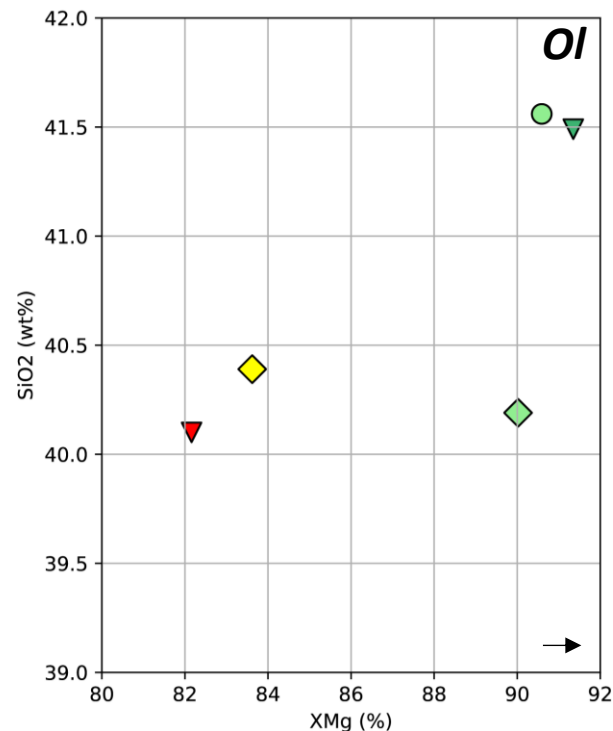
Hb-lherzolite

◇ G3i

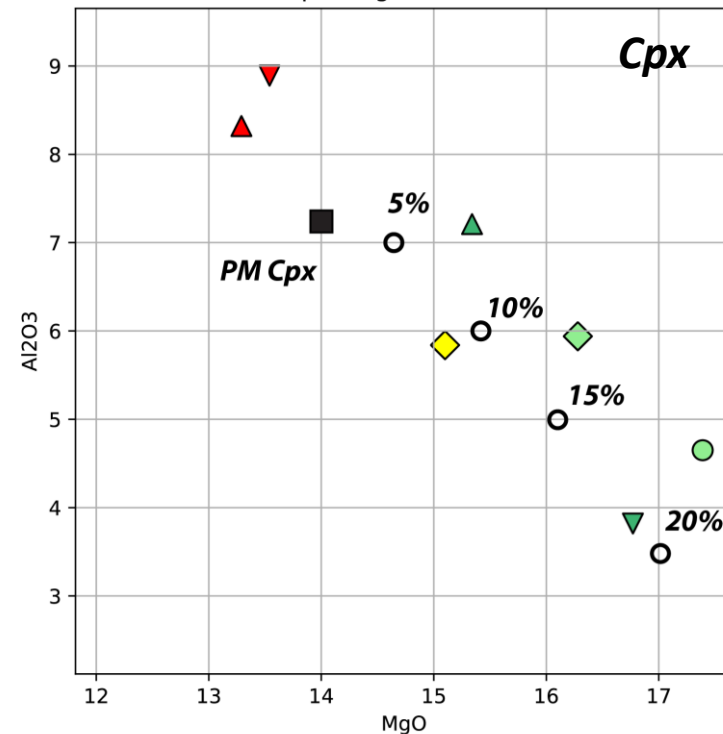
Cpxite

▼ G3k

▲ G3b

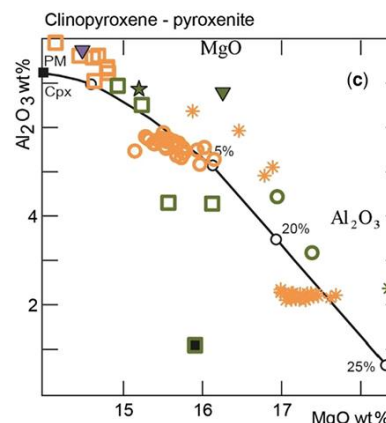


Oxide concentrations in wt%



Peridotite mineral composition suggests that they are residues of melting (5-15%) with increasing melting from lherzolites to dunites (except for Cpx)

Pyroxenites: highly fertile (more than previously described pyroxenites?)
Hb-lherzolite: refertilized peridotites?



Volcanic Field Pyroxenite
 W Oc C WbOw M O Am
 Terror Rift ▼ ★ □ * ● ◆ +
 Ross Island ▼ ★ □ * ● ◆ +
 Mount Discovery ▼ ★ □ * ● ◆ +
 Mount Morning ▼ ★ □ * ● ◆ +
 Southern Local Suite ▼ ★ □ * ● ◆ +

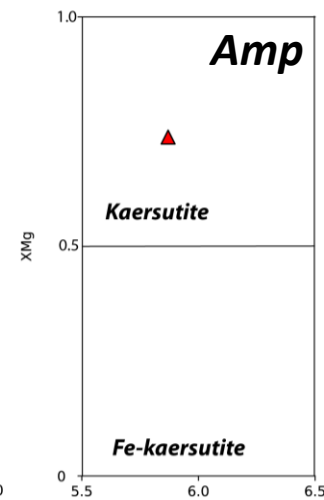
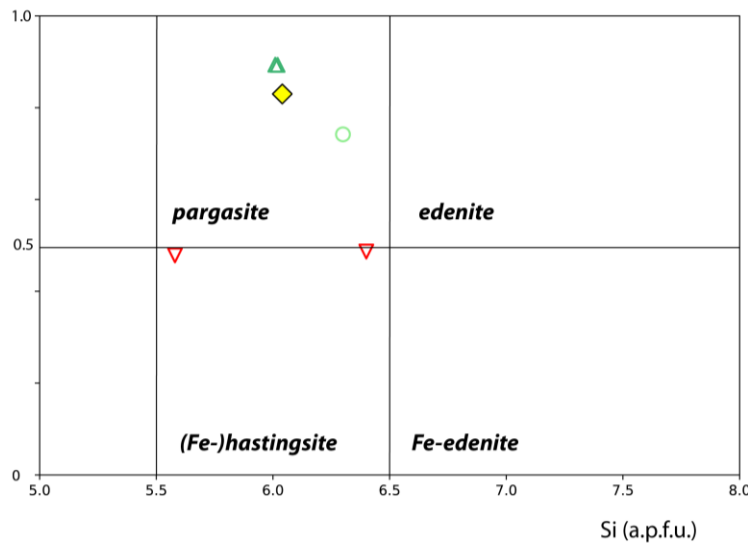
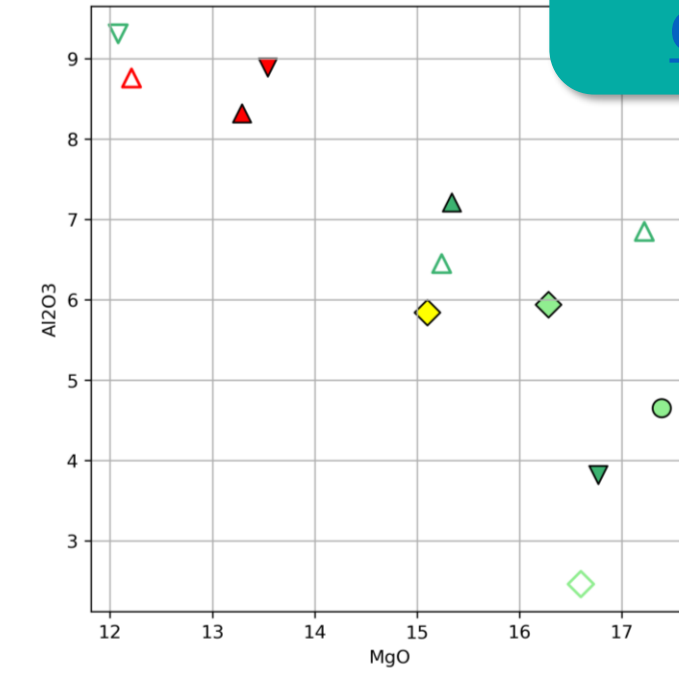
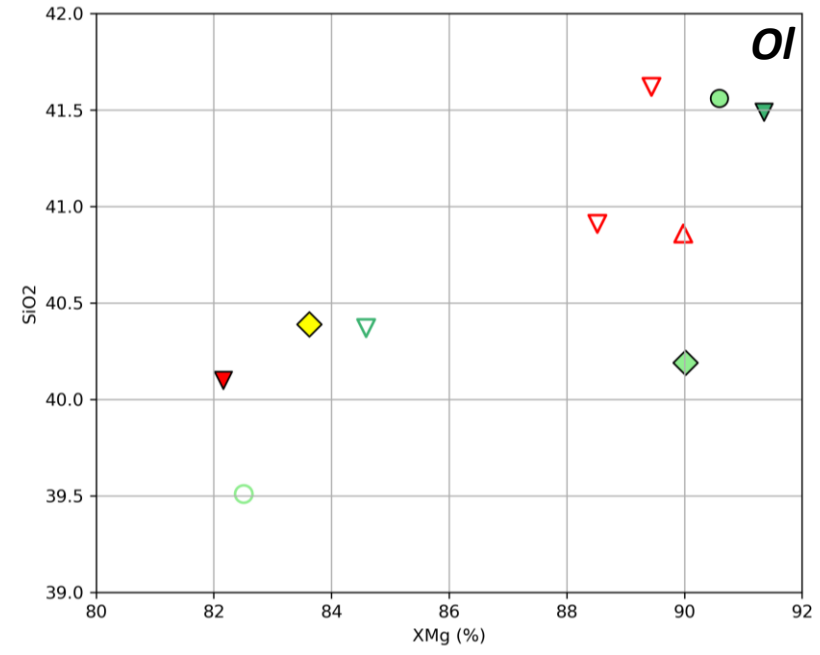
Martin et al. (2021)

Mineral chemistry 1/2

Surrounding lava and late fractures within xenoliths – mineral composition

End of mineral chemical characterization
[Go back HOME](#)

- Dunite**
- G3h
- Harzburgites**
- ▲ G3c
- G3d
- Lherzolites**
- G3g
- ◇ G3a
- Hb-lherzolite**
- ◆ G3i
- Cpxite**
- ▼ G3k
- ▲ G3b



Glass composition in fractures (G3k)

SiO ₂	44.11
Al ₂ O ₃	20.71
CaO	13.21
FeO	7.06
TiO ₂	3.93
K ₂ O	3.91
Na ₂ O	3.54
MgO	1.86

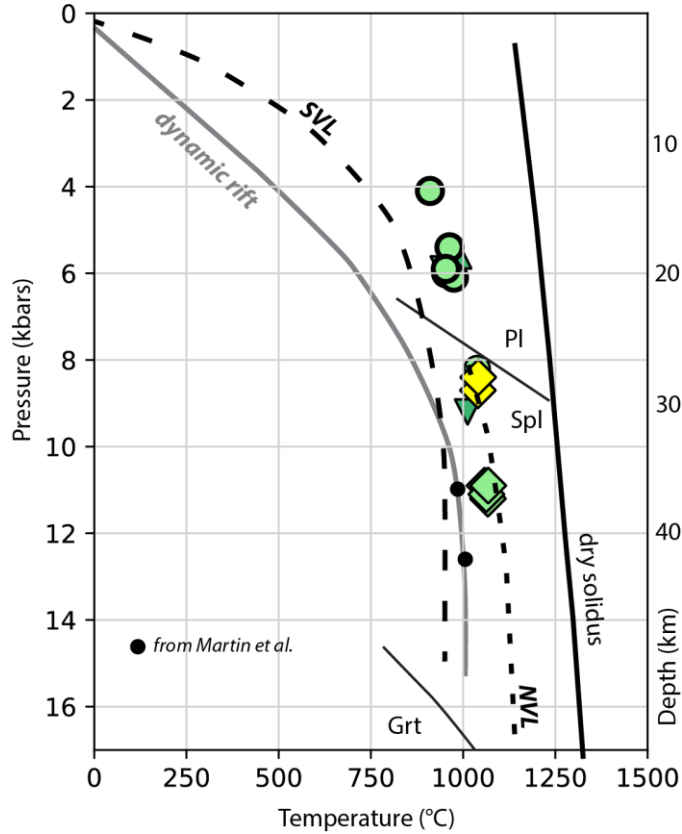
Very low in Cr, Mn, Ni

Thermobarometric estimates

P and T from opx-cpx pair composition (*Putirka, 2008*)

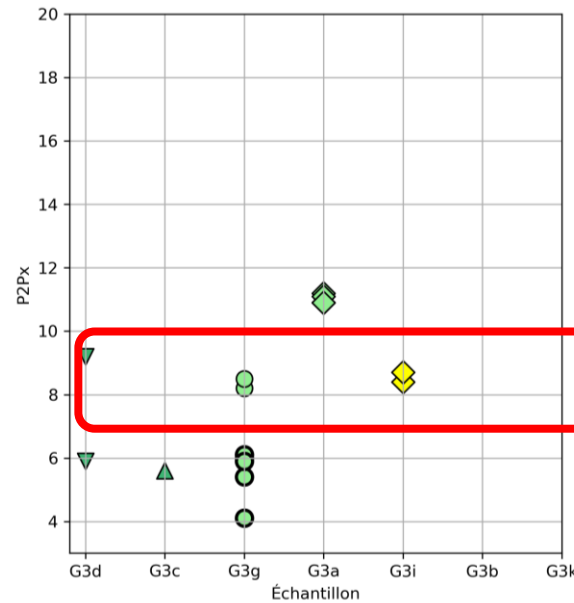
End of thermobarometric characterization
[Go back HOME](#)

- Dunite**
- G3h
- Harzburgites**
- ▲ G3c
- G3d
- Lherzolites**
- G3g
- ◇ G3a
- Hb-lherzolite**
- ◆ G3i
- Cpxite**
- ▼ G3k
- ▲ G3b



Plagioclase only in fractures from G3c...

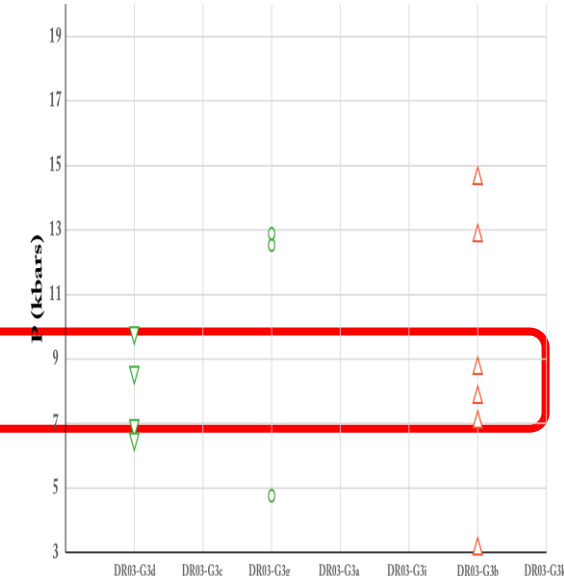
P from opx-cpx pairs (*Putirka, 2008*)



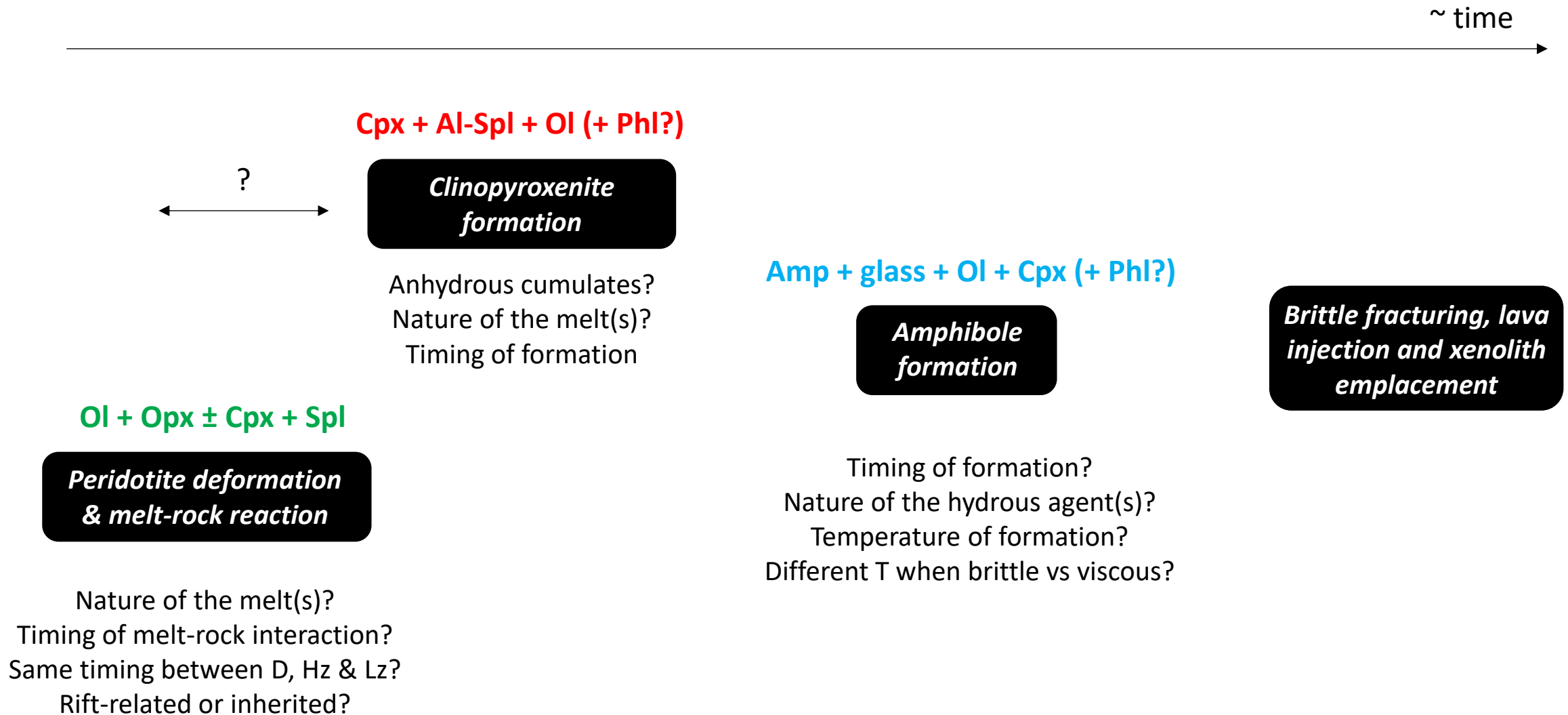
P from amphibole



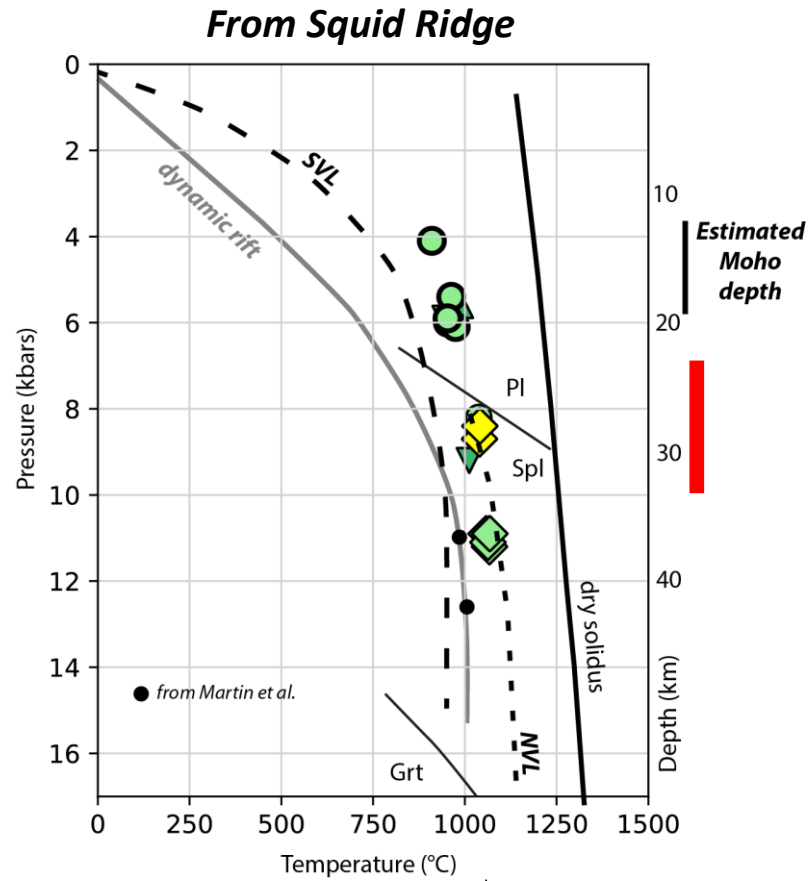
P from Cpx phenocrysts



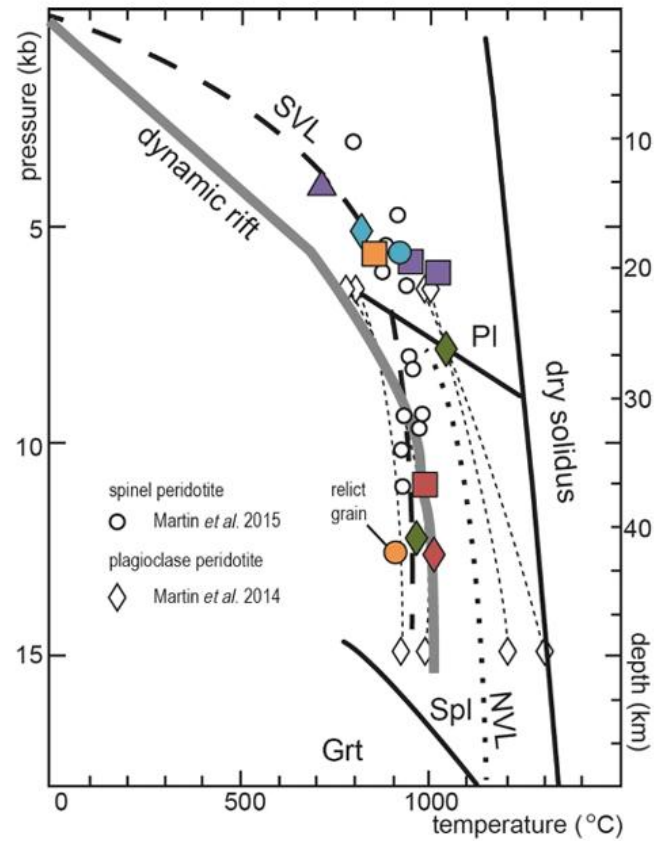
Some preliminary conclusions from sample petrological analysis



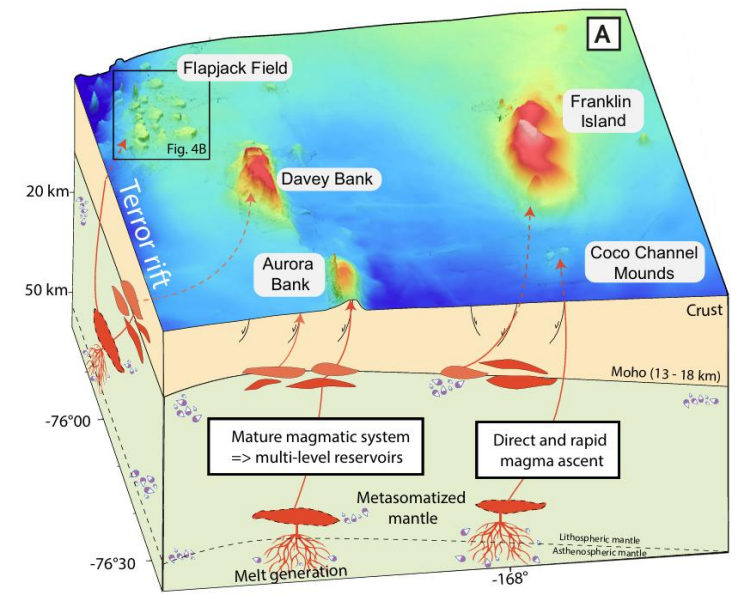
Comparison with previous studies – geotherm and plumbing system



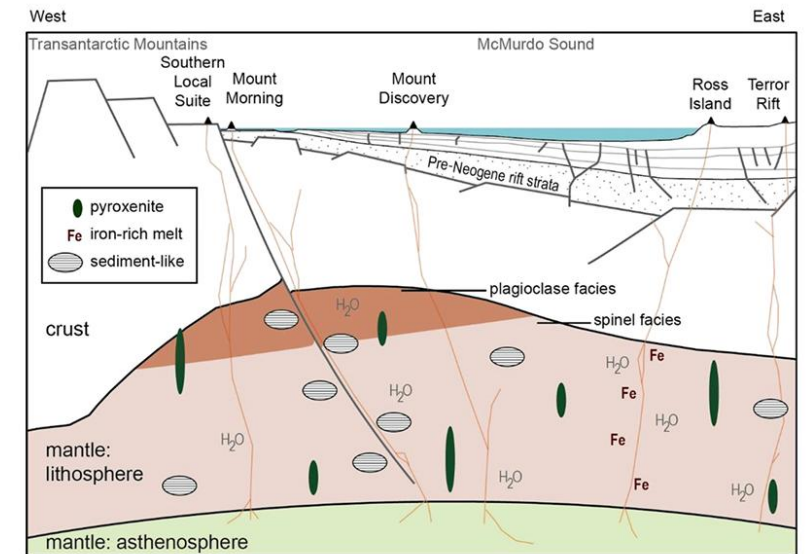
**2 magma chambers:
Moho and wet solidus?**



Martin et al. (2021)



Tominaga et al. (2025)

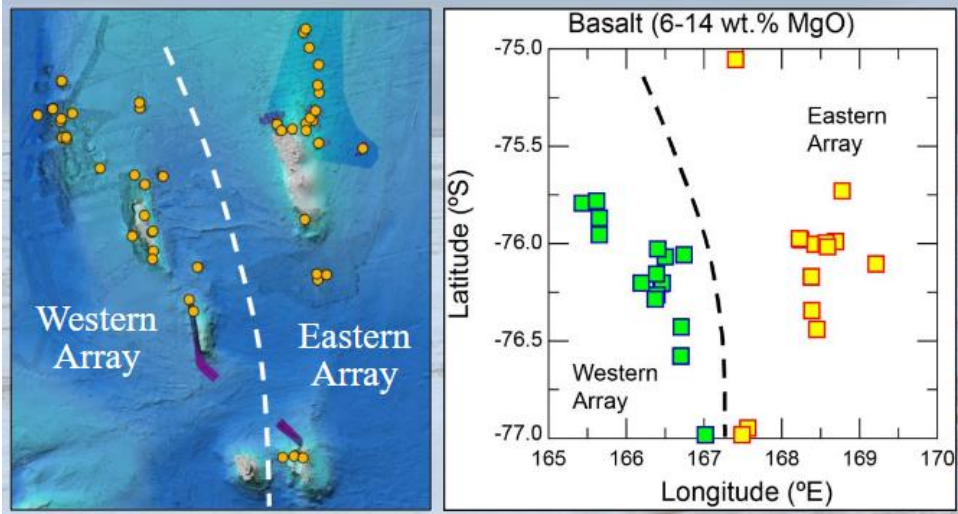


Martin et al. (2021)

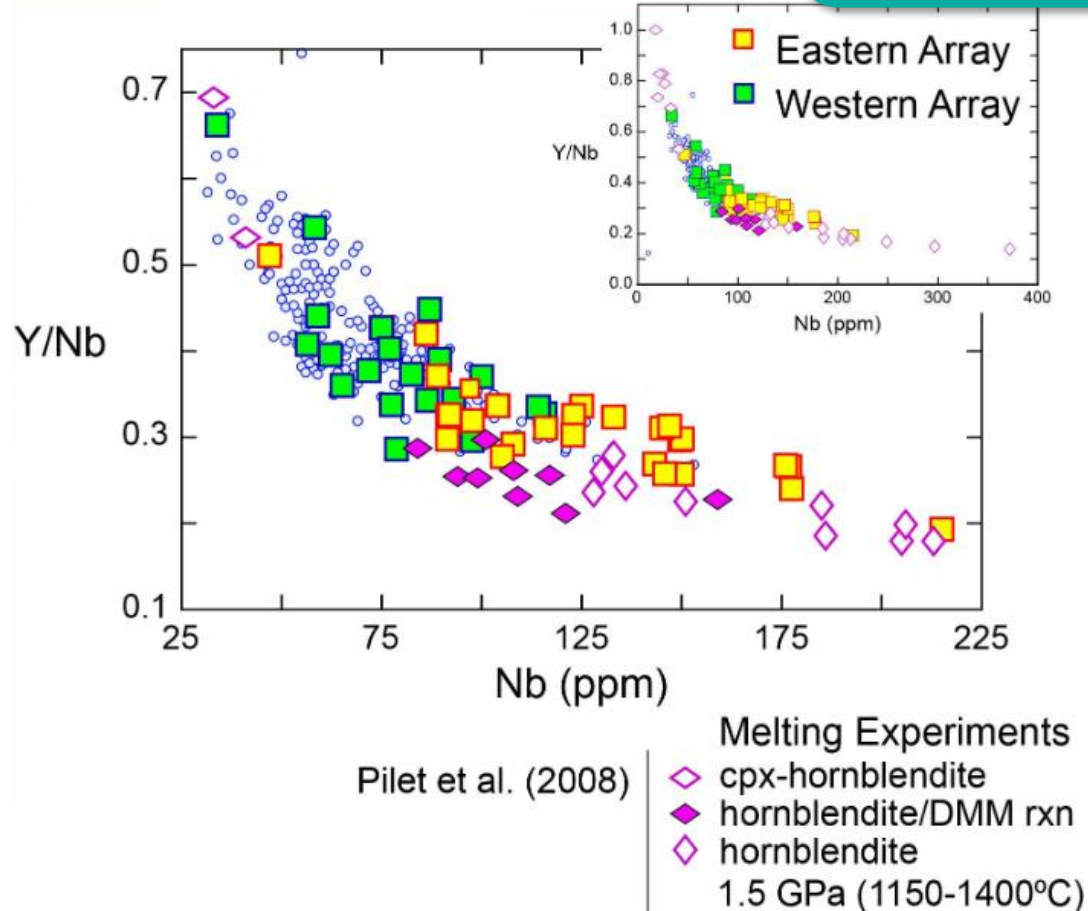
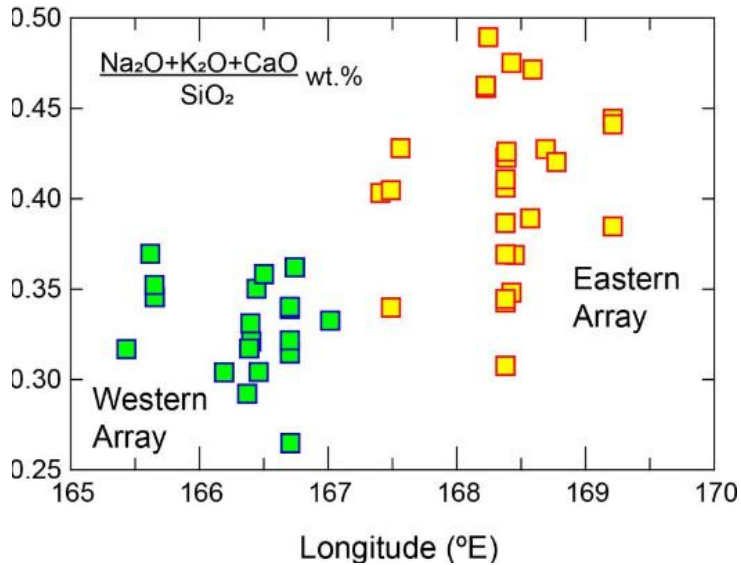
Comparison with lava composition

End of conclusions and implications
[Go back HOME](#)

Two volcanic chains



... with different lava composition

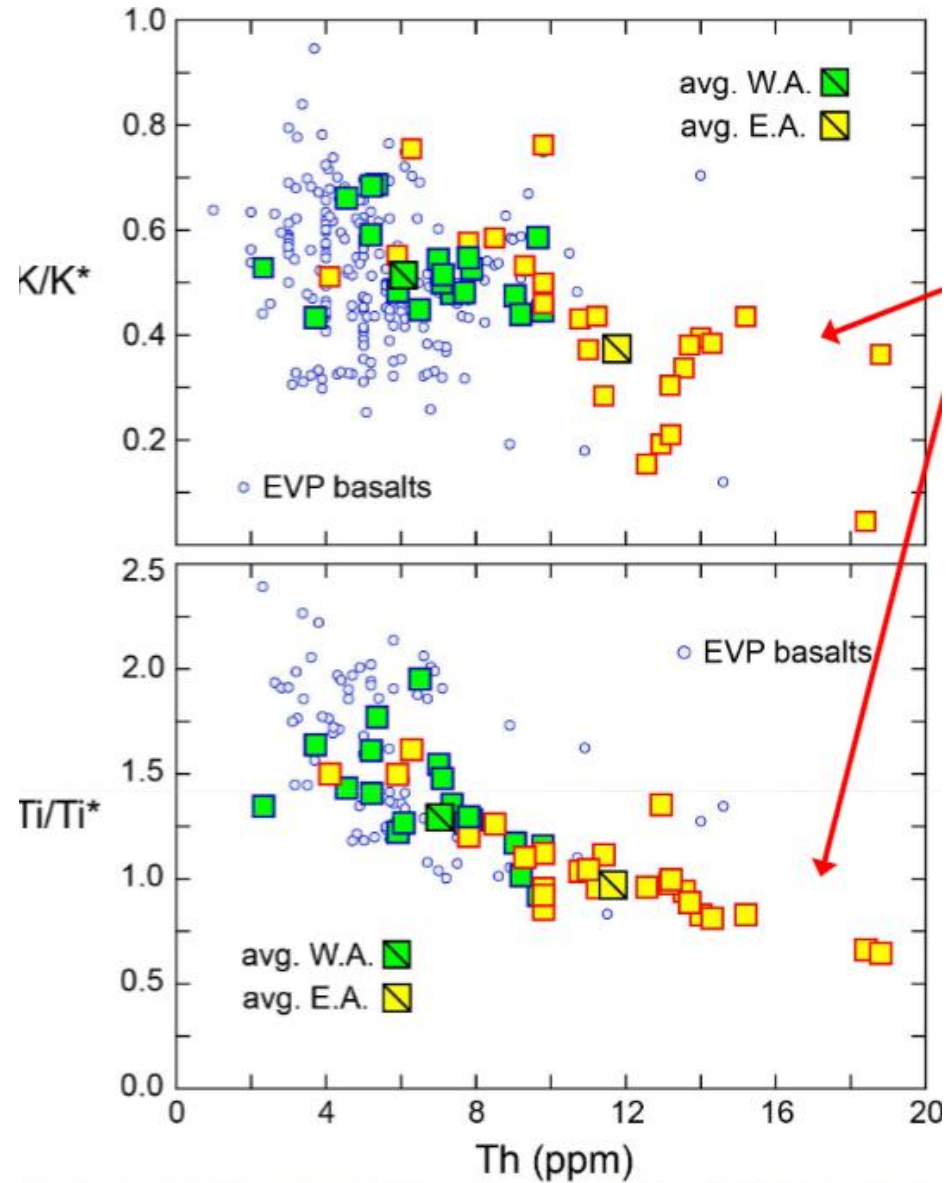
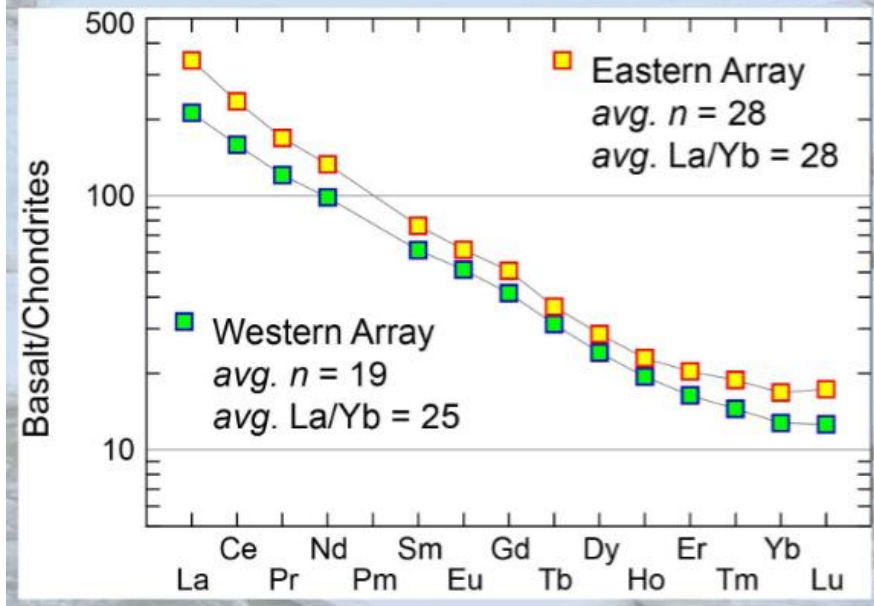
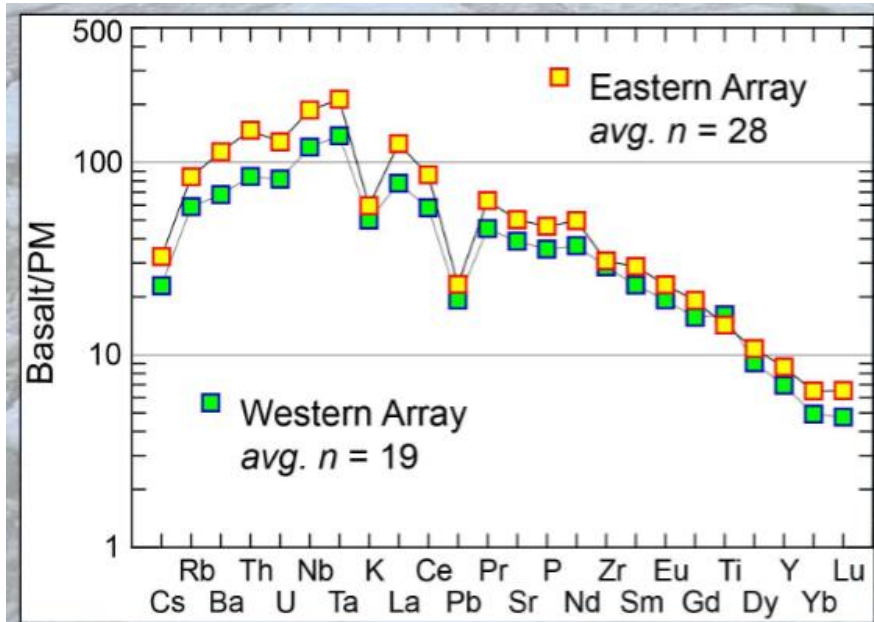


Is it a result of spatial mantle compositional heterogeneity?

→ More amphibole melting on the eastern array?

→ More clinopyroxenite melting on the western array?

Comparison with lava composition



$$K/K^* = K\text{-anomaly} = \log(K_N) - \log(Nb_N) + \log(La_N)/2$$

$$Ti/Ti^* = Ti\text{-anomaly} = \log(Ti_N) - \log(Gd_N) + \log(Dy_N)/2$$