Metasomatism in Monviso Metagabbros: Birth of the Reaction Rind

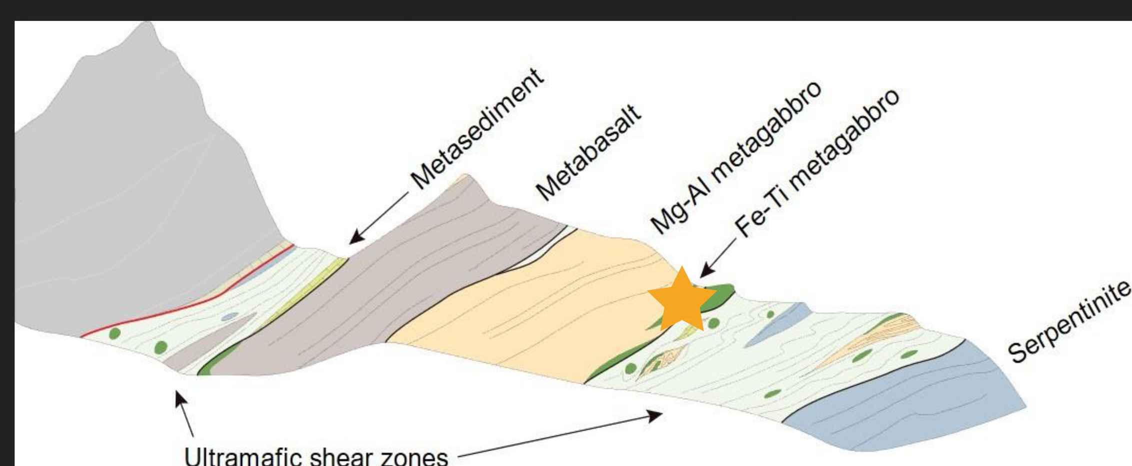
Sona Chaudhary
Advisors: Dr. Sarah Penniston-Dorland and William Hoover
UNIVERSITY OF MARYLAND

Background

- Subduction zones are wet environments. The fluid passing through rocks catalyzes reactions.
- Monviso is an exposed ophiolite sequence in the Western Alps that is primarily eclogite facies, but the chemistry of its metagabbros varies across the unit.
- Reaction rinds record alteration caused by fluid flow, so:

What fluid interacted with Monviso's metagabbros to create their rinds?

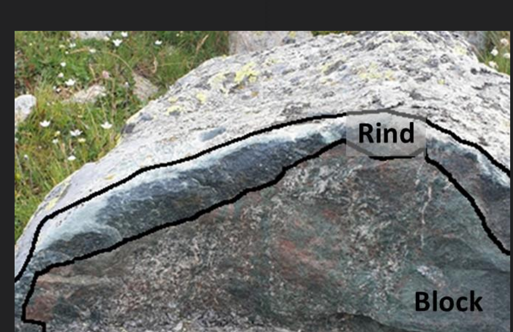
Hypothesis: The fluid source is dehydrated serpentinite; therefore the rind will be enriched in major (Mg) and trace elements (Cr, Co, Sb, Cd) characteristic of serpentinite relative to the block.



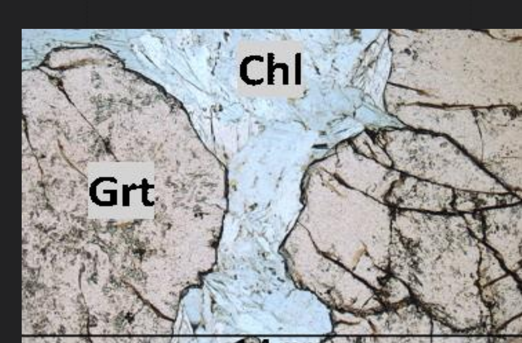
Cross-section across Monviso showing the Lower Shear Zone within the Lago Superiore Unit. Yellow star marks sample collection area (Angiboust et al., 2012).

Samples

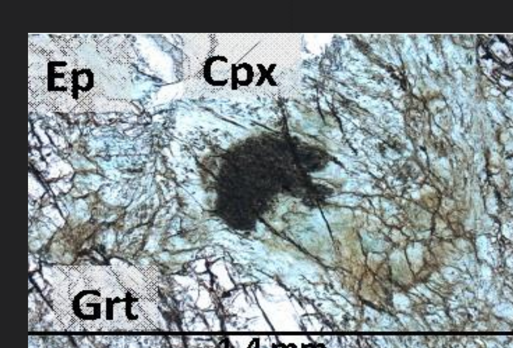
Fe-Ti Metagabbro



Fe-Ti metagabbro outcrop.

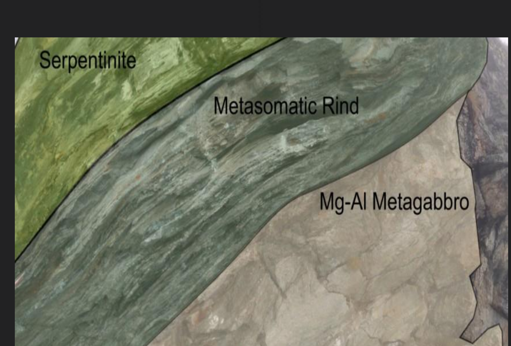


Blocks contain clinopyroxene, garnet, epidote, apatite, and rutile.



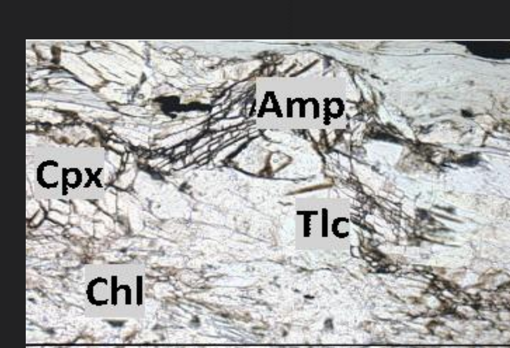
Rinds contain chlorite, clinopyroxene, garnet, talc, apatite, and ilmenite.

Mg-Al Metagabbro



Mg-Al metagabbro outcrop with the rind's metagabbro and serpentinite protoliths. Photo courtesy of Will Hoover.

Blocks contain epidote, clinopyroxene, amphibole, talc, rutile, and phlogopite.



Rinds contain clinopyroxene, chlorite, amphibole, talc, garnet, apatite, and ilmenite.

Conclusions

While both types of metagabbro were enriched in Mg, characteristic of serpentinite, their trace element signatures did not support the hypothesis.

- Fe-Ti metagabbro mass balance suggests alteration by fluid from a mafic source.
- Mg-Al metagabbro mass balance suggests alteration by fluid from a sedimentary source.
- Despite being altered by fluids from different sources, both types of metagabbro have similar mineralogies in the rind, likely influenced by common enrichment in MgO, TiO_2, and P_2O_5.

Results

Fe-Ti Metagabbro

Rind — Block

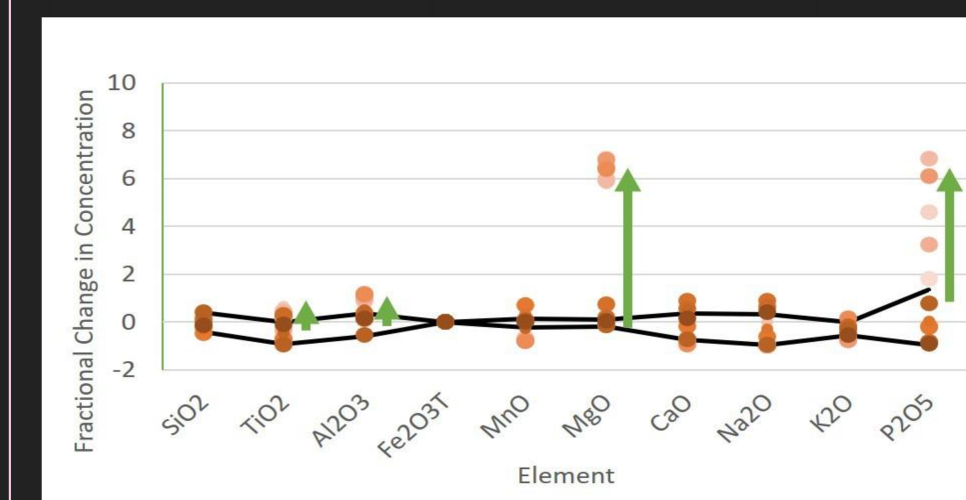
Mg-Al Metagabbro with Serpentinite Protolith

Rind — Block

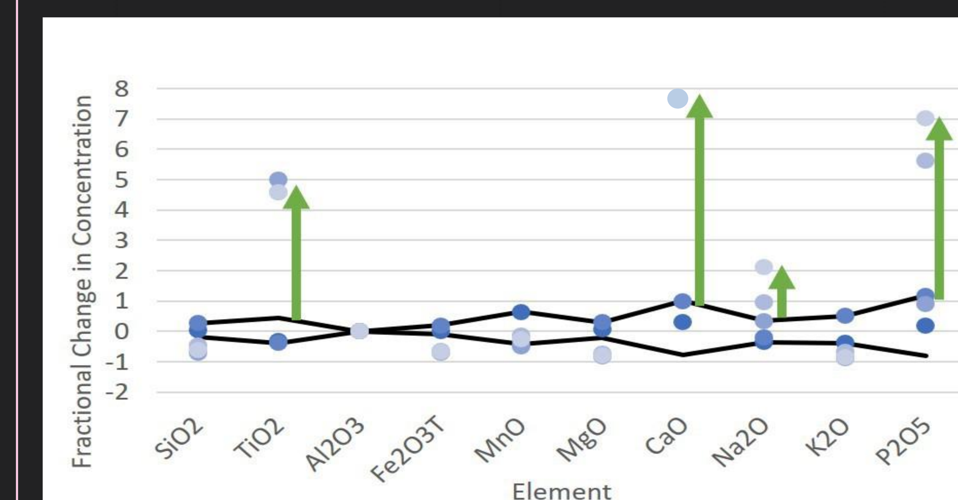
Mg-Al Metagabbro with Metagabbro Protolith

Rind — Block

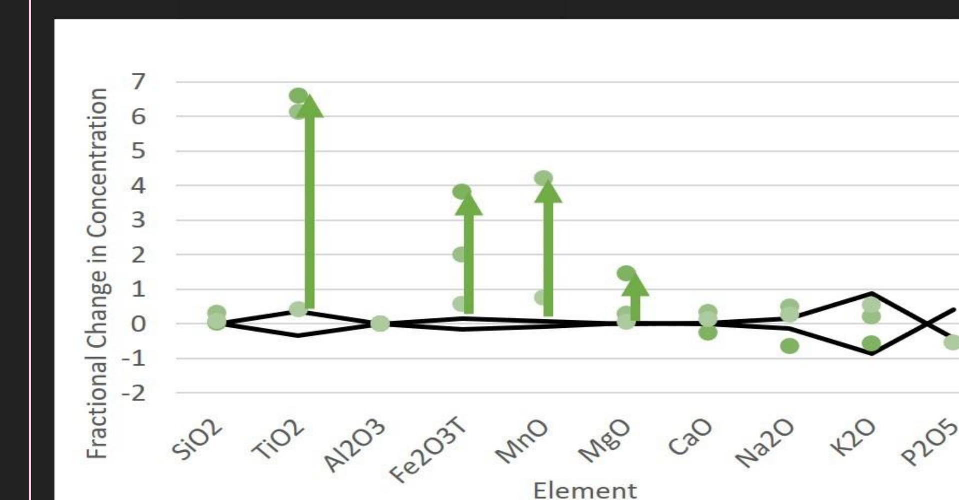
Major Element Mass Balance



Enriched in TiO_2, Al_2O_3, MgO, and P_2O_5. Area in black lines is variation attributed to natural rock heterogeneity. Green arrows indicate enriched elements.

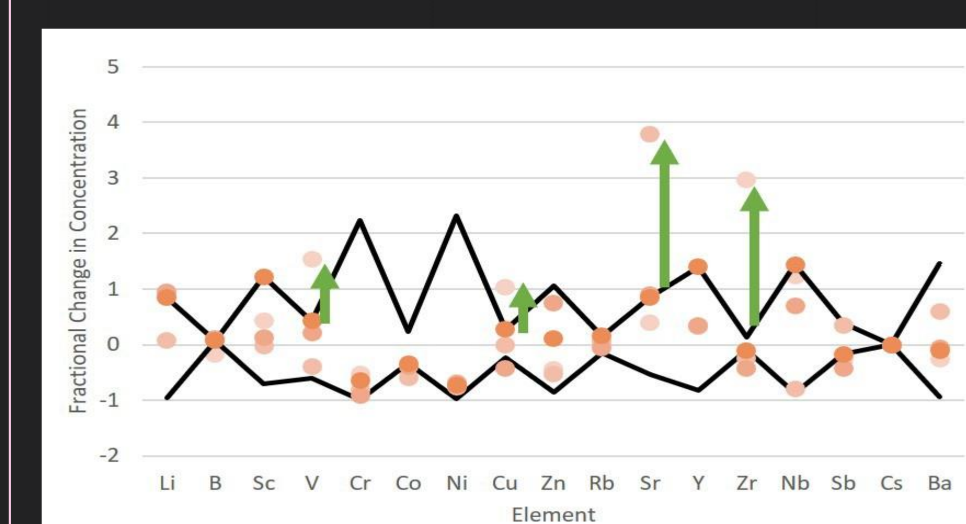


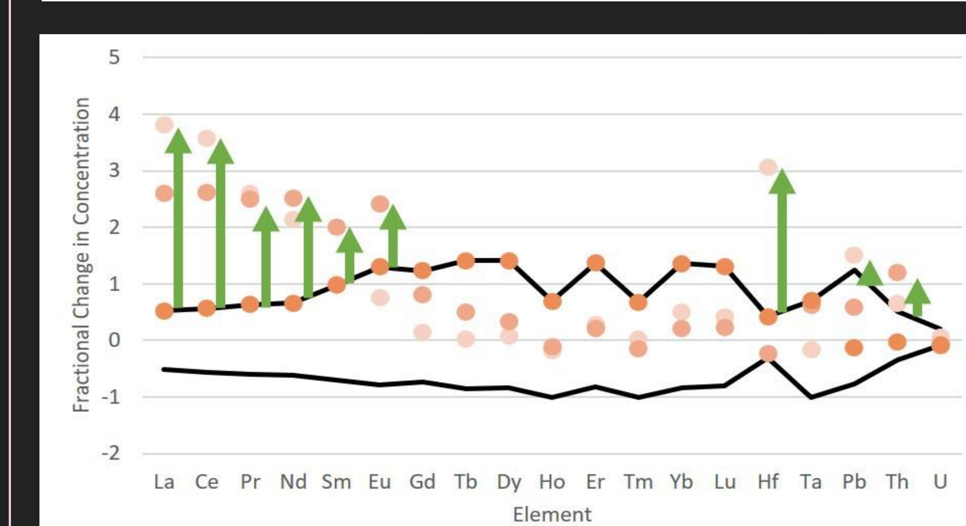
Enriched in TiO_2, CaO, Na_2O, and P_2O_5.



Enriched in TiO_2, Fe_2O_3, MnO, and MgO.

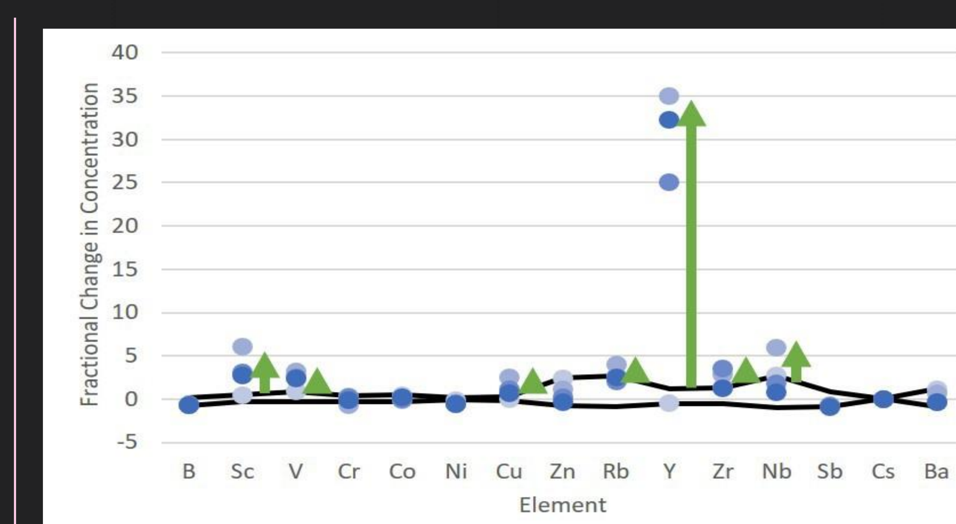
Trace Element Mass Balance

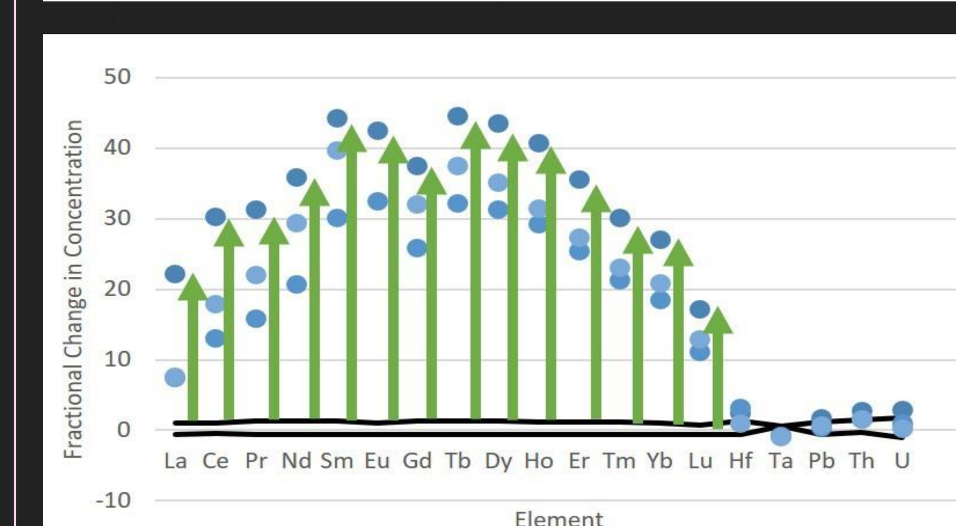




Enriched in V, Cu, Zr, Sr, Light Rare Earth Elements, and High Field Strength Elements.

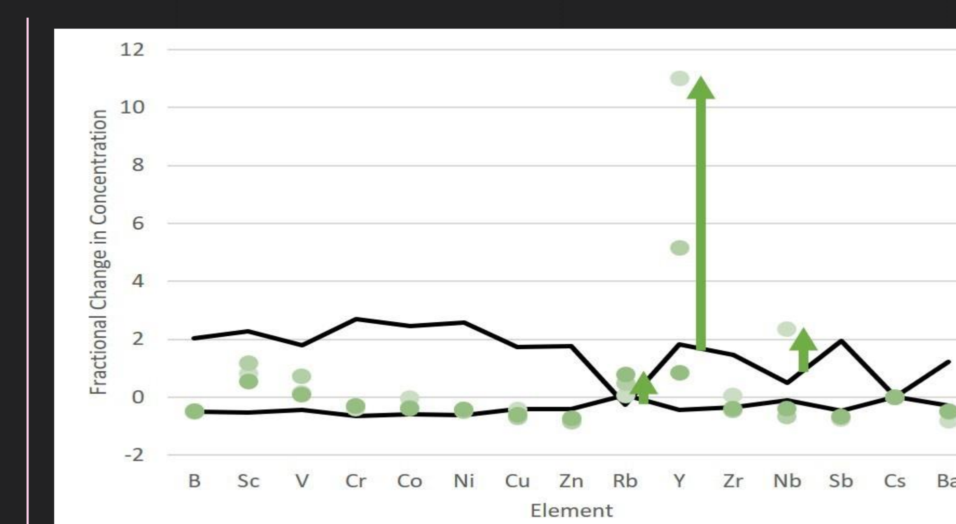
Supports alteration by mafic fluid source
(Sajona et al., 1996).

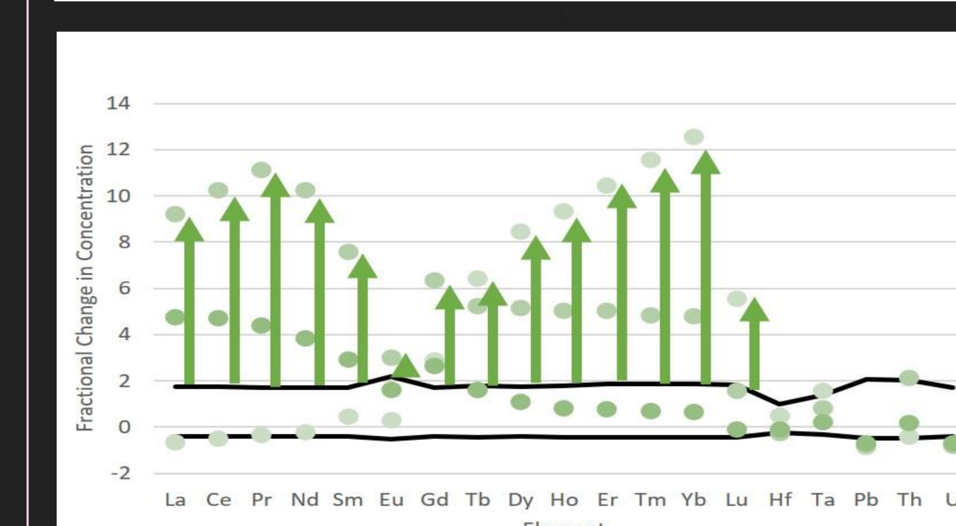




Enriched in Sc, V, Cu, Rb, Y, Zr, Nb, and Rare Earth Elements.

Supports alteration by sedimentary fluid source
(McLennan, 2001).





Enriched in Y, Rb, and Rare Earth Elements.

Supports alteration by sedimentary fluid source
(Nicholls, 1967).

Acknowledgements

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References

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