TRACKING FLUID-ROCK INTERACTION IN RELICTS OF OCEANIC LITHOSPHERE FROM THE CENTRAL ALPS

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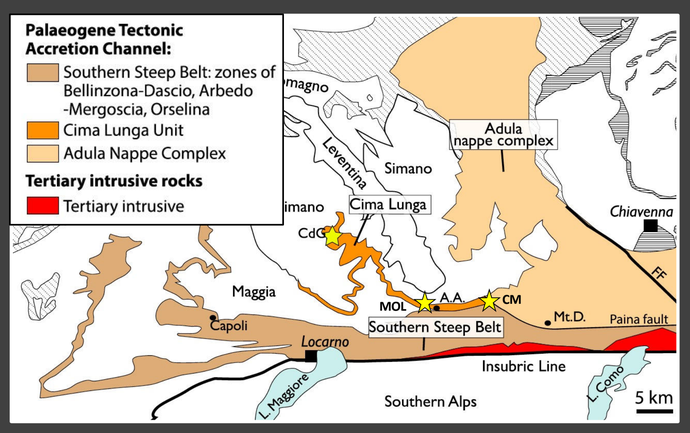
Hydrothermally altered oceanic lithosphere undergoes eclogitization and dehydration during subduction. Fluids liberated by sediments, mafic rocks, and serpentinites, migrate through the overlying lithologies and can cause metasomatism. Since fluids play an important role in subduction and exhumation processes, and for chemical cycling, it is crucial to reconstruct their dynamic during high-pressure (HP) metamorphism. The combination of $\delta^{18}O$ isotopes with age determination and other petrological tools, allows tracking of a) the fluid source and b) at which P-T stage fluids interact with the rocks. This study provides trace element and $\delta^{18}O$ data as well as U-Pb ages of zircons from exhumed relicts of subducted oceanic lithosphere from the Central Alps, combined with field observations and chemical mapping of garnet, to reconstruct the fluid-rock interaction. Here, the results of metabasic rocks are presented.

GEOLOGICAL SETTING

Central Alps



after Piccoli et al., 2021, modified

The Adula Nappe and Cima-Lunga-Unit represent the outer continental European margin of the Piemont-Ligurian-Ocean, which was subducted during the alpine orogeny[1].

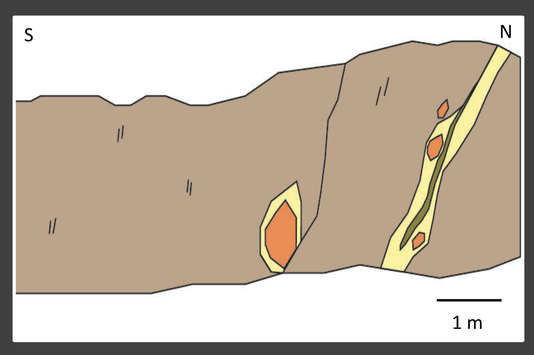
Sample locations are: Valle di Moleno (MOL), Val Cama (CM) and Cima di Gagnone (CdG). In all three locations, lenses of mafic rocks and ultramafic rocks are embedded in ortho- and paragneisses.

Mafic rocks occur as:

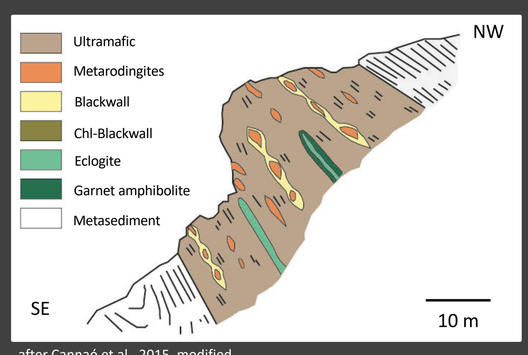
CdG: eclogite, garnet amphibolite, metarodingite
MOL: eclogite, metarodingite
CM: garnet amphibolite, metarodingite

FIELD OBSERVATIONS AND SAMPLE DESCRIPTION

Valle di Moleno

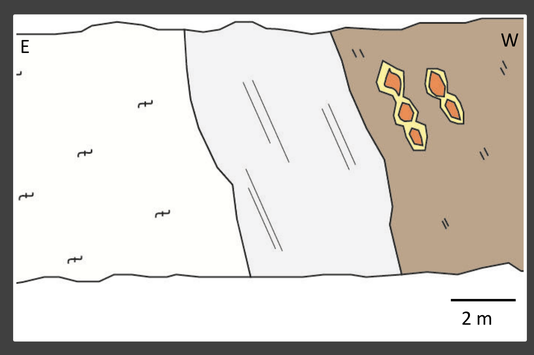


Cima di Gagnone

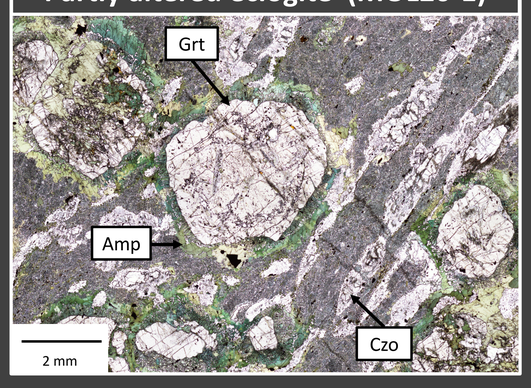


after Cannaó et al., 2015, modified

Val Cama

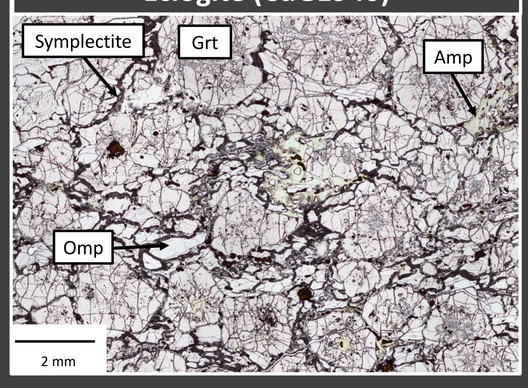


Partly altered eclogite (MOL20-1)



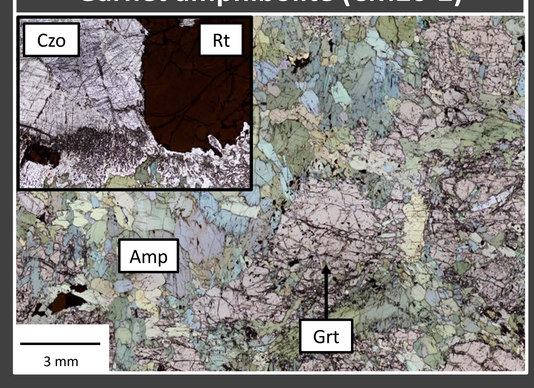
- HP assemblage: Grt + Omp + Czo + Rt
- Matrix: fine-grained symplectite (Amp + Pl)
- Retrograde amphibole (green) around garnet

Eclogite (CdG1940)



- HP assemblage: Grt + Omp + Rt
- Small symplectites (Amp + Pl) around garnet and omphacite
- Less retrograde amphibole (light green)

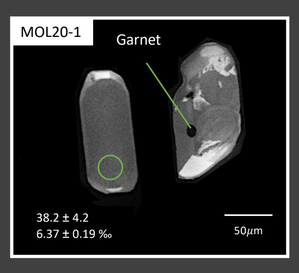
Garnet amphibolite (CM20-2)

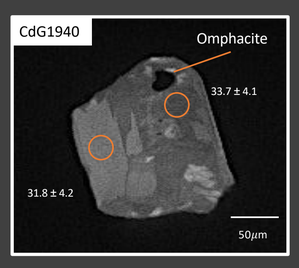


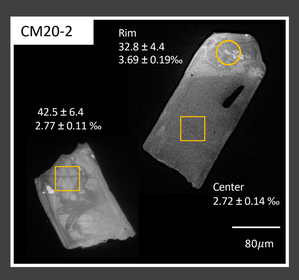
- Strongly altered rock with garnet porphyroblasts, amphibole and high pressure vein of big rutiles and clinozoisite
- Symplectite (Pl) around vein

RESULTS

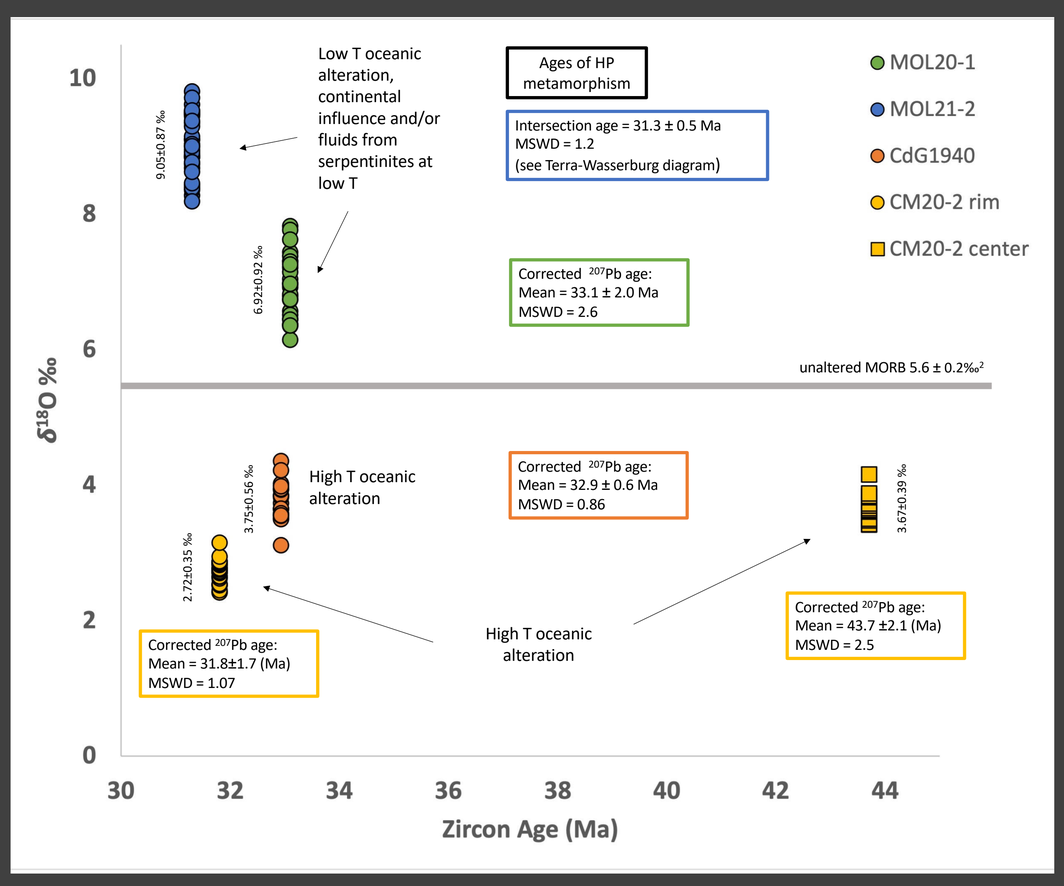
CL Images of Zircons



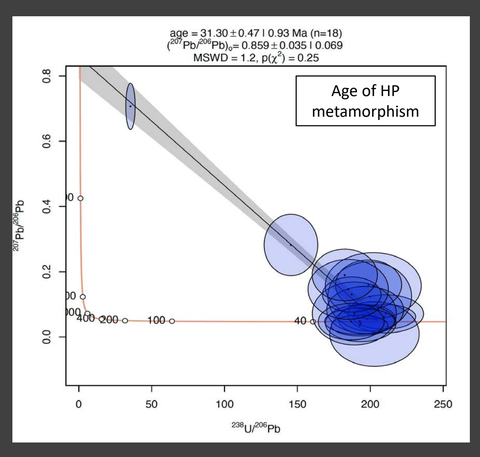




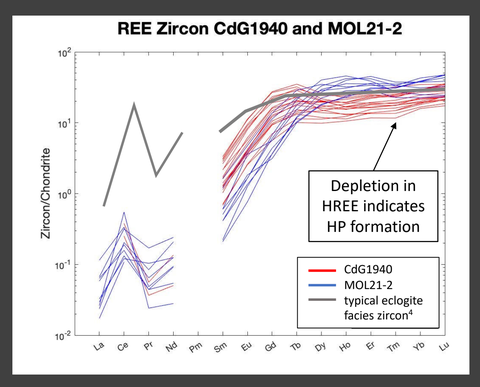
Oxygen Isotopes and Ages



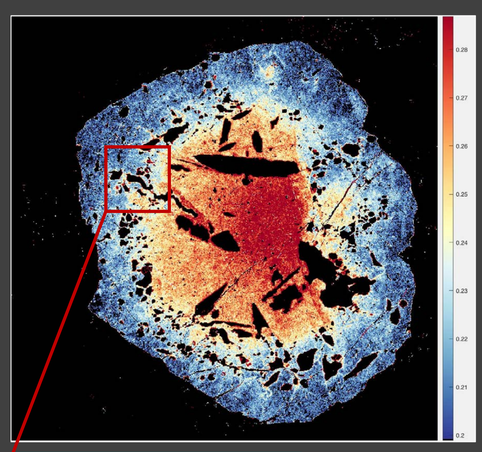
Terra-Wasserburg Diagram

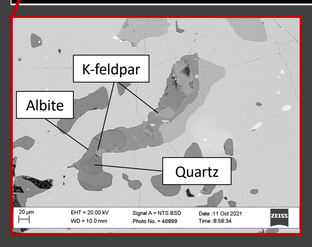


REE Pattern



Polyphase Inclusions in Garnet





Polyphase inclusions give evidence for HP melting

Garnet map (MOL20-1) shows XGrs. A slight disturbance in zonation is visible - on the right side. Along the disturbed zonation, polyphase inclusions (backscatter image) of k-feldspar, albite, and quartz could be observed.

DISCUSSION AND CONCLUSIONS

- Chl-harzburgite is the remaining rock after antigorite out, which indicates dehydration of serpentinites during subduction
- HP vein formation (CM) and polyphase inclusions in garnet (MOL) are evidence of fluid interaction during HP stage
- Zircons of CdG and MOL have HP inclusions and are depleted in HREE
  - the ages can be interpreted as a late HP stage
  - CM ages (rims) are comparable to those of MOL and CdG
- More evidence is needed to interpret the age of CM centers
- CdG and CM zircons have low $\delta^{18}O$ values that reflect ocean floor alteration of the protolith at high T
- MOL zircons have higher $\delta^{18}O$ values that could reflect the three following possibilities:
  - Low T ocean floor alteration of protolith
  - Continental influence
  - Fluids from serpentinites at low T

REFERENCES

[1] Trommsdorf, 1990: Metamorphism and tectonics in the Central Alps: The Alpine lithospheric mélange of Cima Lunga and Adula.

[2]Miller et al., 2001: An O-isotope profile through the HP–LT Corsican ophiolite, France and its implications for fluid flow during subduction.

[3]Rubatto, 2017: Zircon: The metamorphic mineral.

Figures

Cannaó et al., 2015: B, Sr and Pb isotope geochemistry of high-pressure Alpine metaperidotites monitors fluid-mediated element recycling during serpentinite dehydration in subduction mèlange (Cima di Gagnone, Swiss Central Alps).

Piccoli et al., 2021: Deep subduction, melting, and fast cooling of metapelites from the Cima Lunga Unit, Central Alps.