Freie Universität Berlin

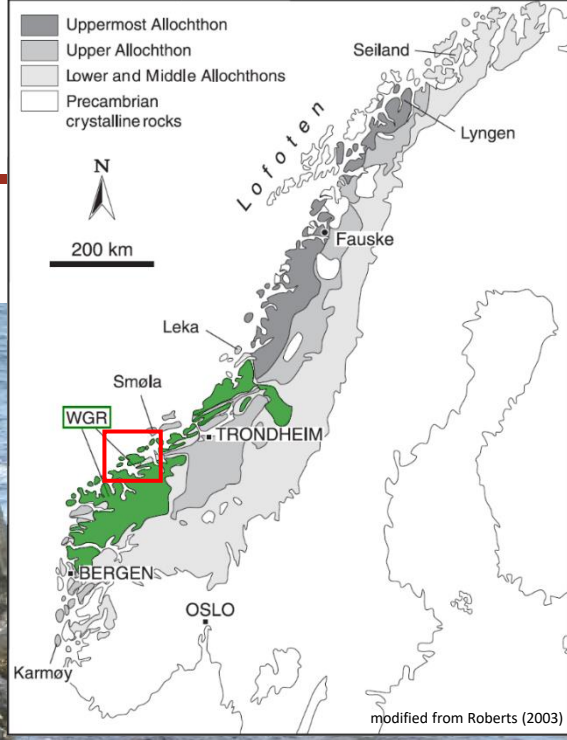
Fluid-rock interactions and amphibolitisation of the lower continental crust

(The Kråkenes Gabbro, Western Gneiss Region, Norway)

Saskia Bläsing

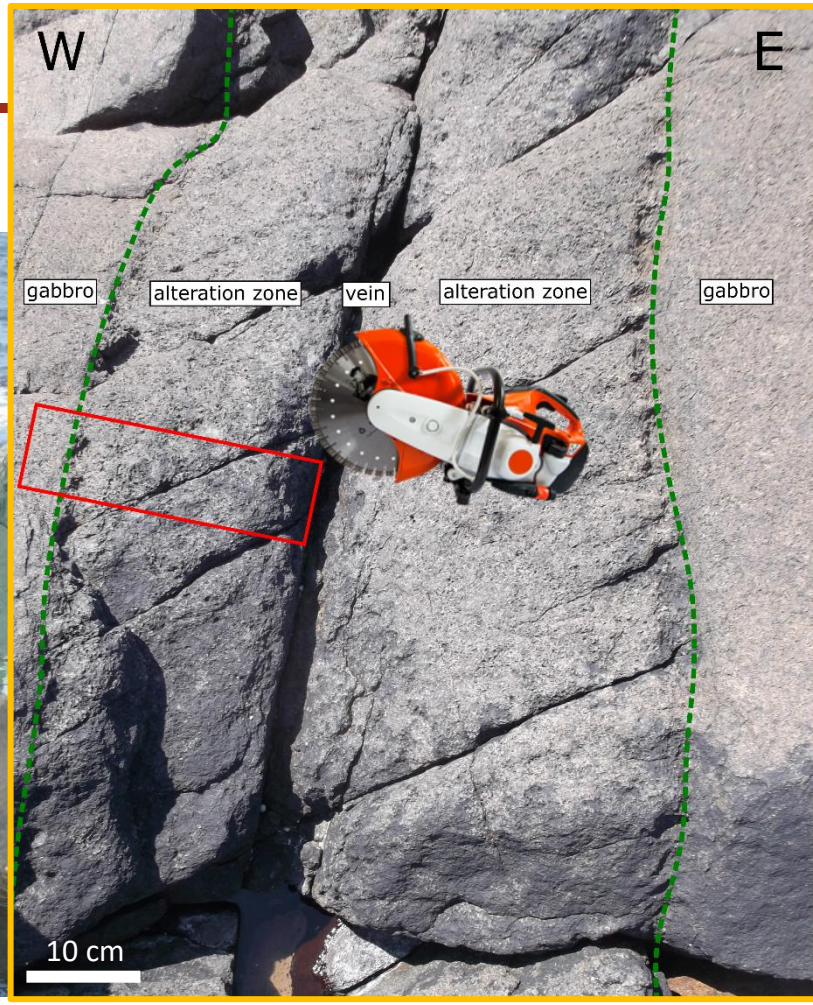
Timm John, Johannes C. Vrijmoed, Michael J. Henehan and Daniel A. Frick

The Kråkenes Gabbro Body

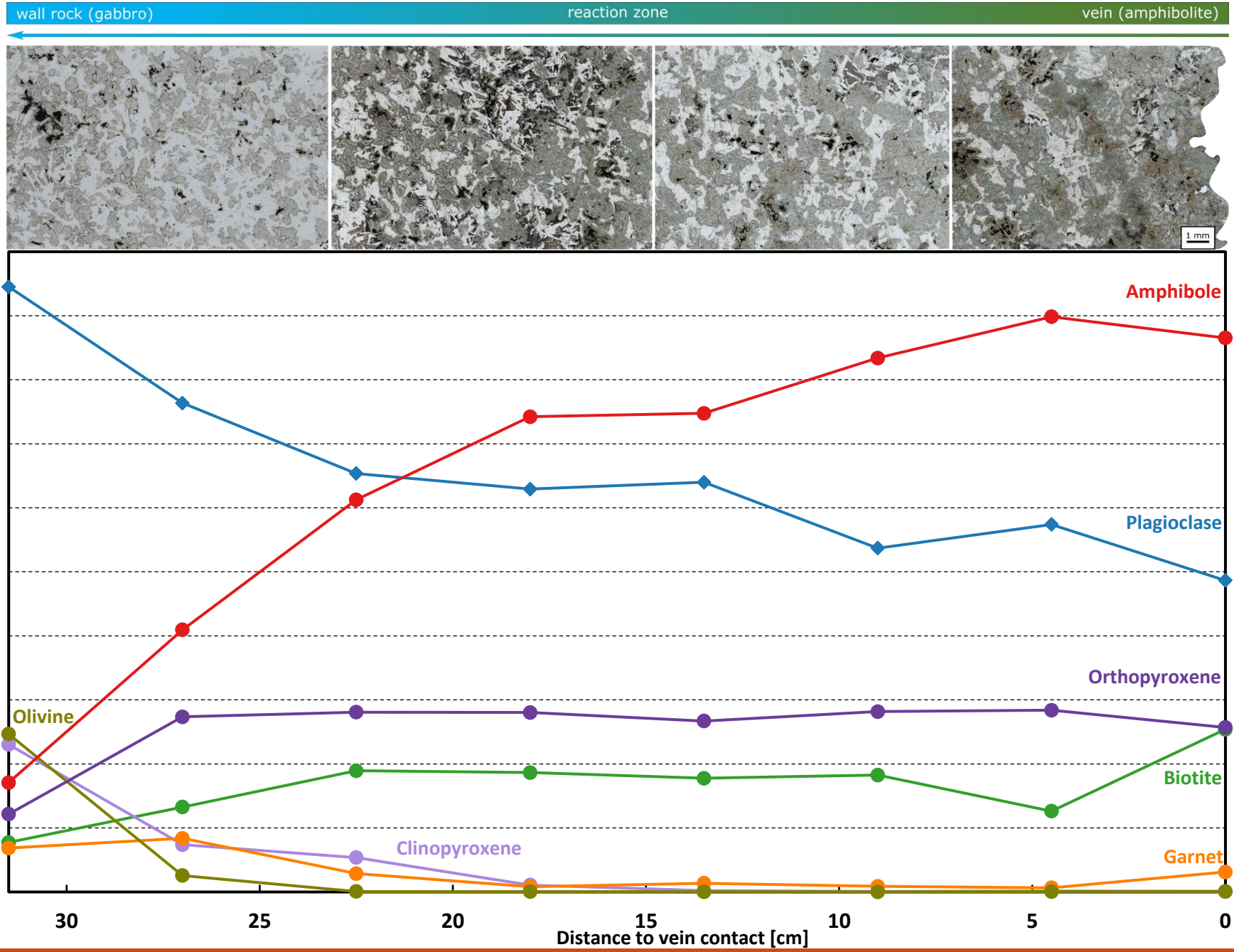


- Mode I cracks (N-S orientated)
- Sharp reaction fronts in contact to the dry gabbro
- Metasomatism at amphibolite-facies conditions (0.6-1.2 GPa, 700 °C)

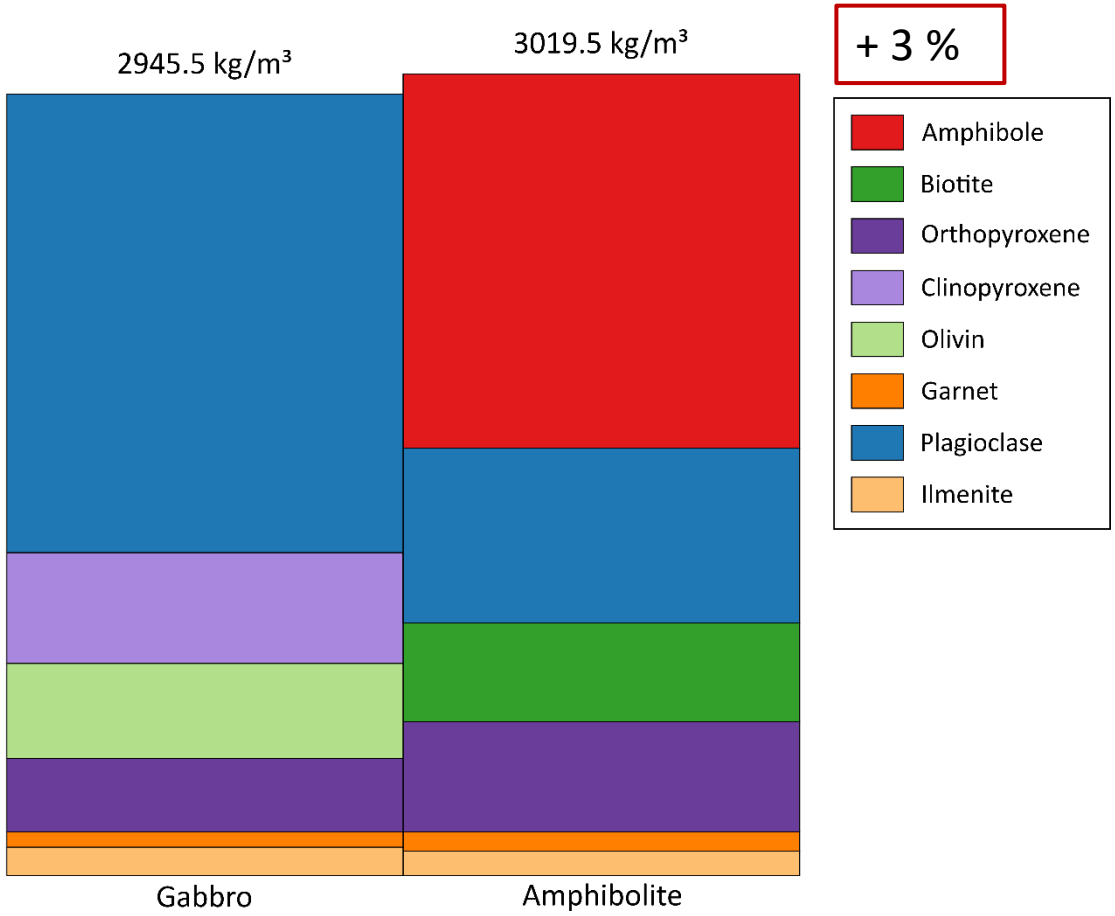
The Kråkenes Gabbro Body



- What happens while hydrating a gabbro?
- How much time is needed to generate a 30 cm alteration zone?


wall rock (gabbro)
reaction zone
vein (amphibolite)
1 mm
Amphibole
Plagioclase
Orthopyroxene
Olivine
Biotite
Clinopyroxene
Garnet
Mineral modal abundance [%]
Distance to vein contact [cm]
50
45
40
35
30
25
20
15
10
5
0
30
25
20
15
10
5
0

Densification



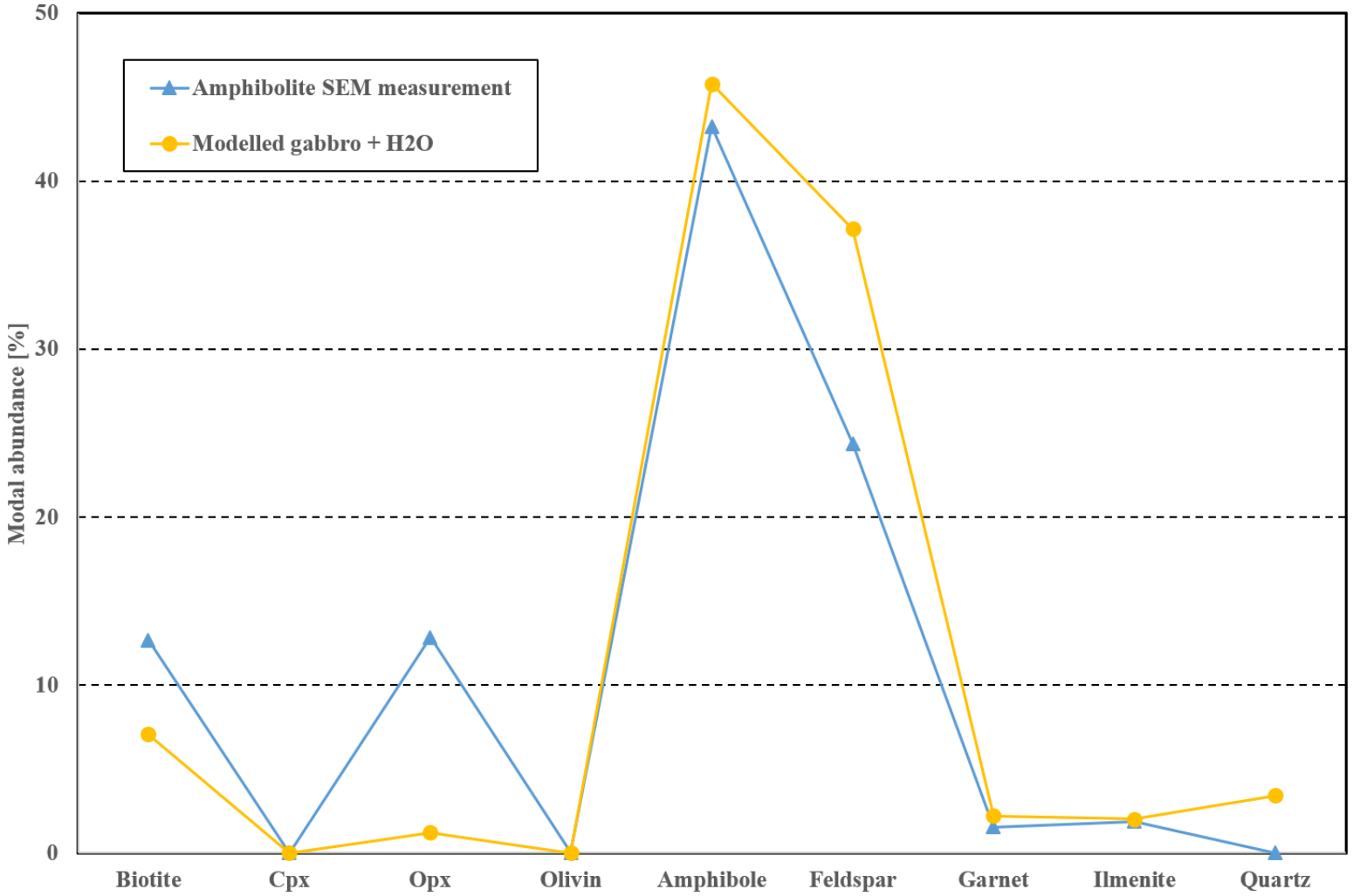
Measured porosity: ~10^{-3} ~10^{-2}

Thermodynamic modelling

- How to transform a gabbro into an amphibolite?
  - Is H_2O enough?
  - What about mass transport?
  - How much time is needed?

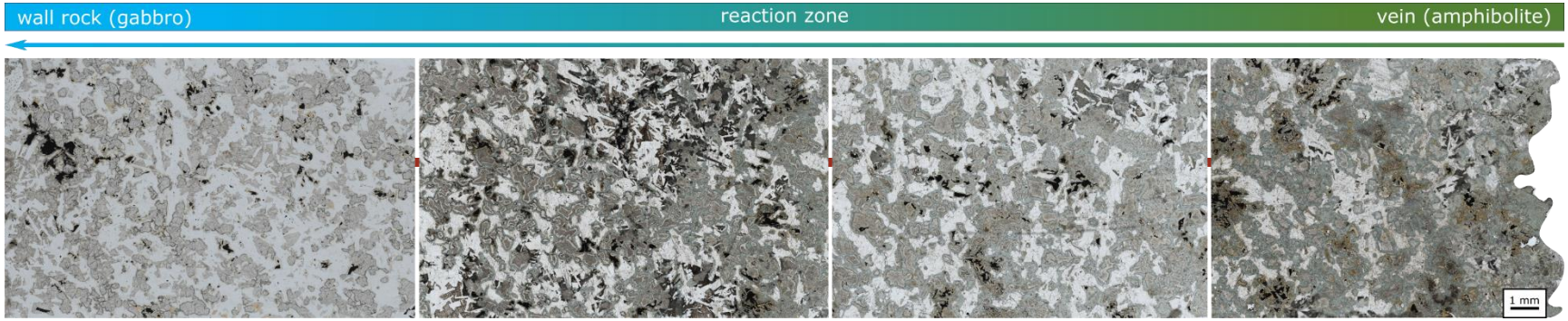
Thermodynamic modelling

Step 1: Rebuild measured amphibolite mineral assemblage from XRF data



Thermodynamic modelling

- How to transform a gabbro into an amphibolite?
  - Is H_2O enough? **NO**
  - What about mass transport?
  - How much time is needed?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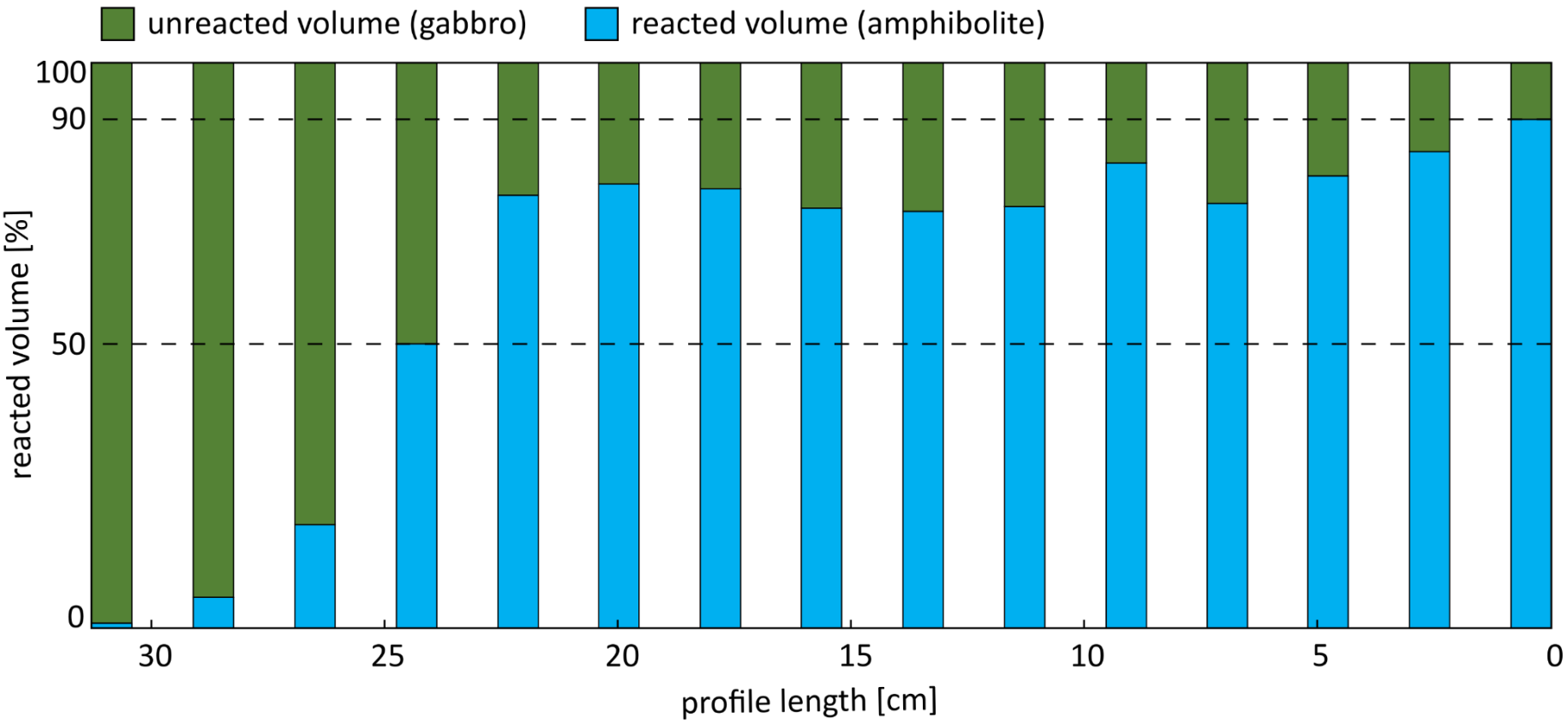
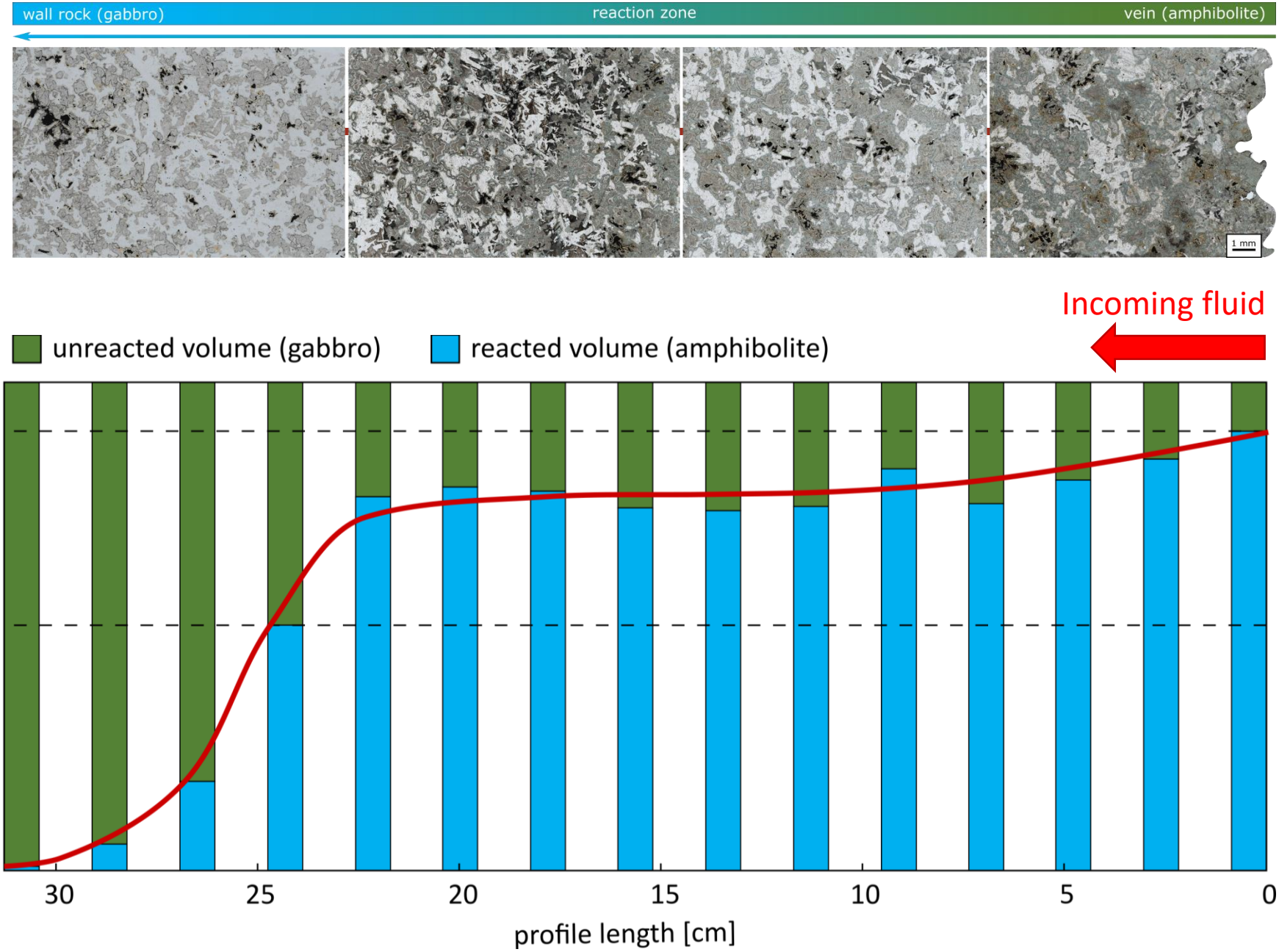
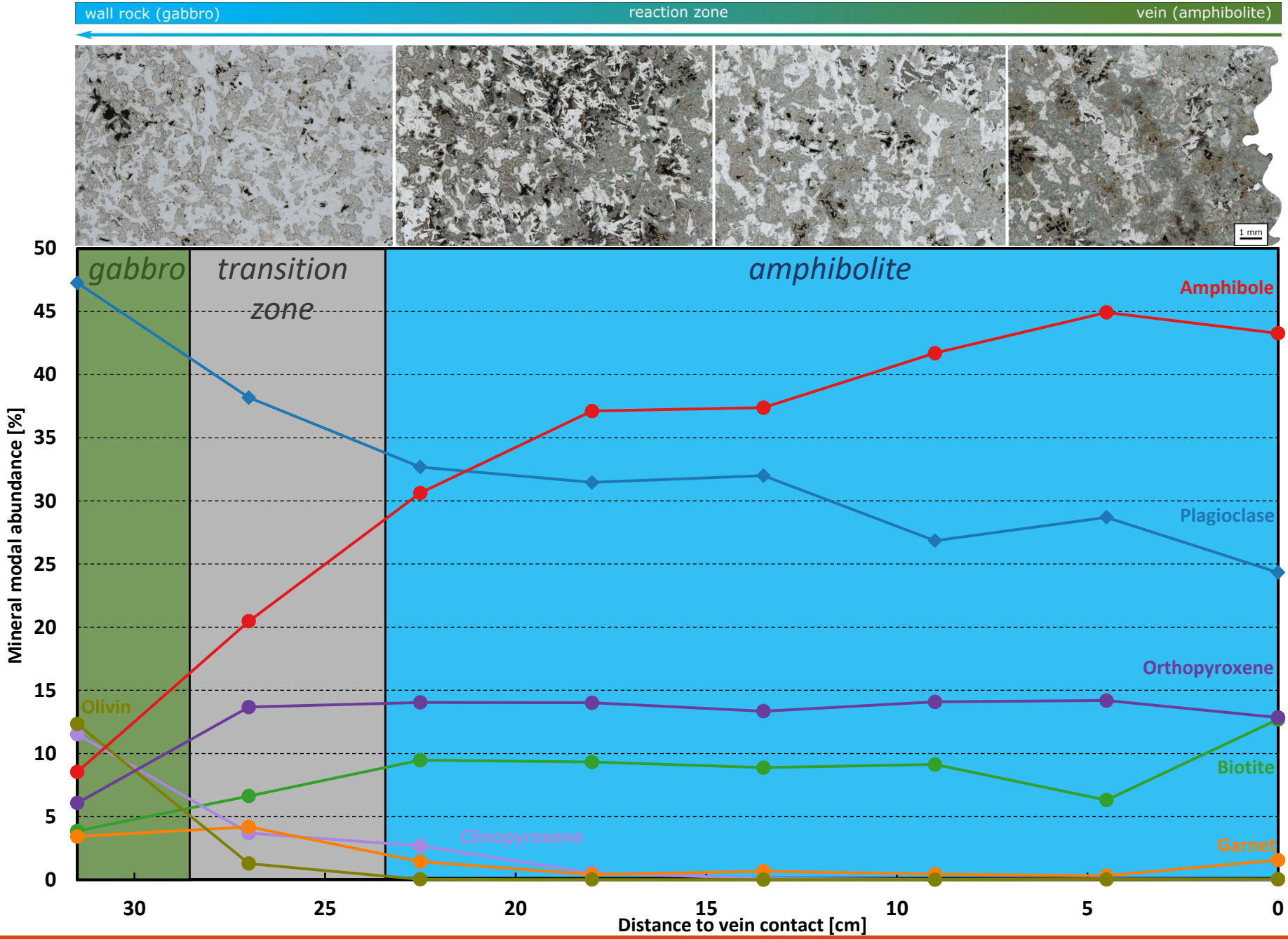
reaction zone
vein (amphibolite)
1 mm


unreacted volume (gabbro)
reacted volume (amphibolite)
reacted volume [%]
100
90
50
0
30
25
20
15
10
5
0
profile length [cm]


wall rock (gabbro)
reaction zone
vein (amphibolite)
1 mm
Incoming fluid
unreacted volume (gabbro)
reacted volume (amphibolite)
100
90
50
0
reacted volume [%]
30
25
20
15
10
5
0
profile length [cm]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reaction zone
vein (amphibolite)
1 mm
gabbro
transition zone
amphibolite
Amphibole
Plagioclase
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Garnet
Clinopyroxene
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Mineral modal abundance [%]
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10
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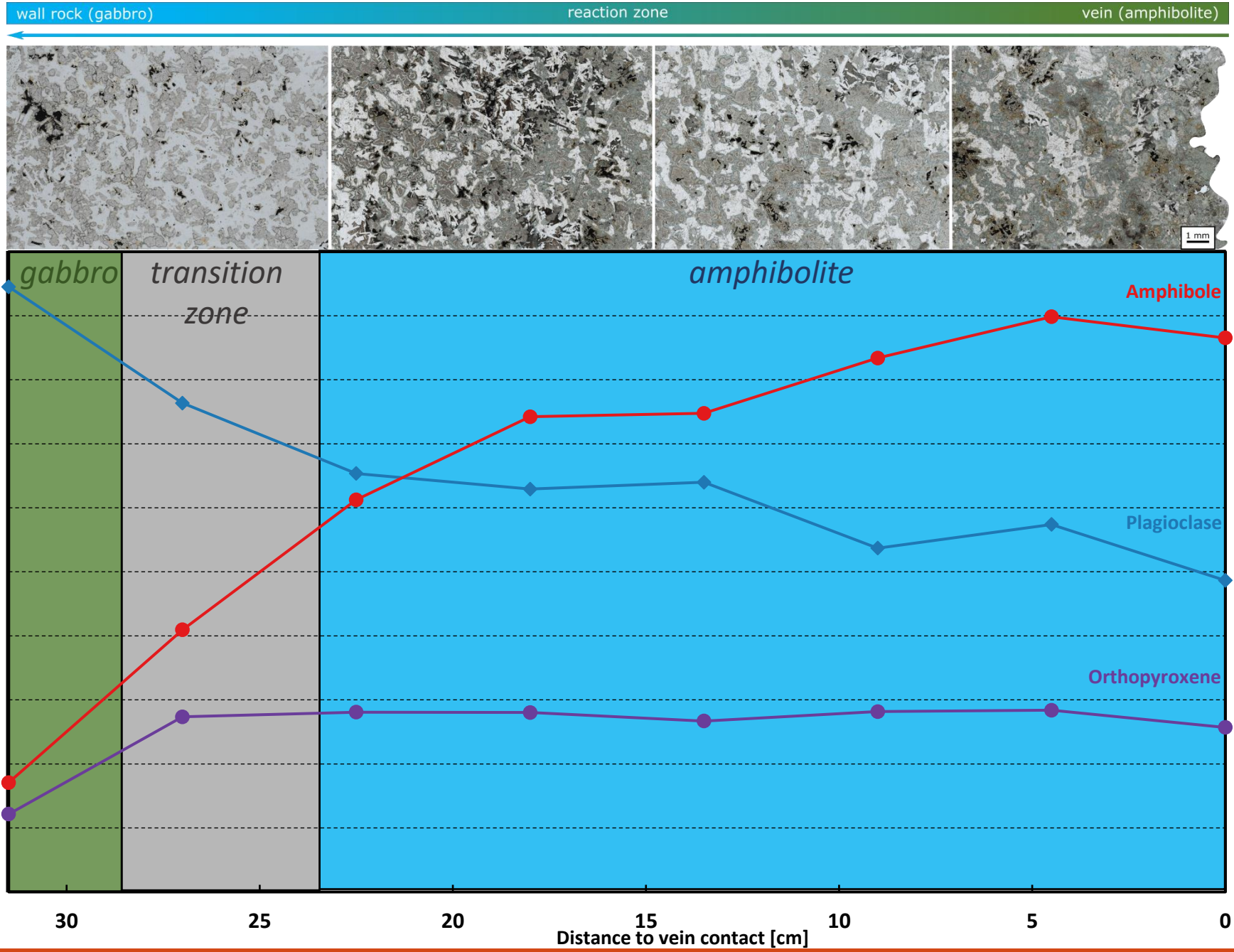
Distance to vein contact [cm]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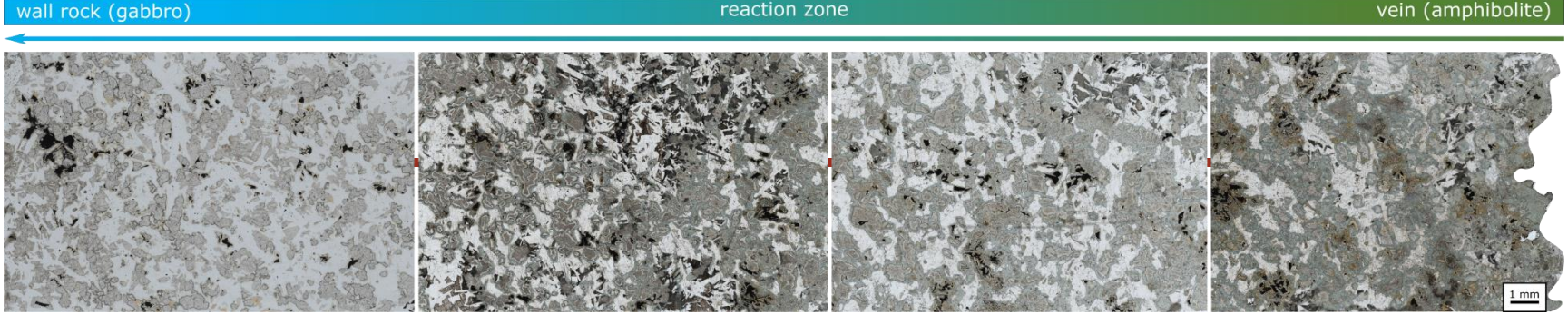

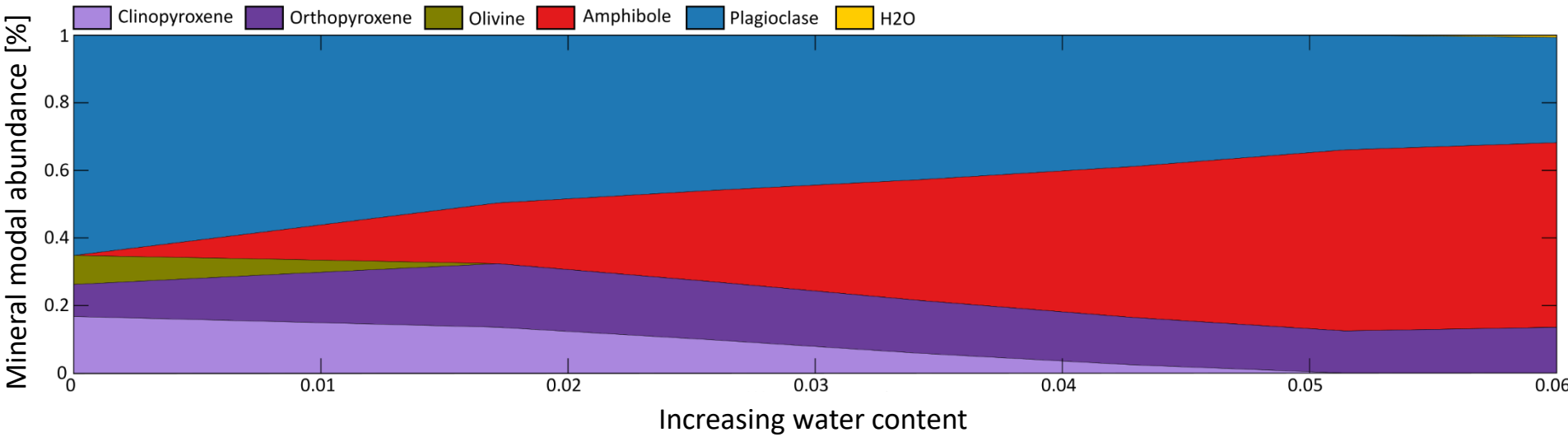

- Effective bulk composition
  - + MgO
  - - SiO_2, CaO
- → Ratios of reactant phases fit at constant PT conditions
- T = 700 °C, P = 0.63 GPa

Thermodynamic modelling

- How to transform a gabbro into an amphibolite?
  - Is H_2O enough? **NO**
  - What about mass transport? **YES**
  - How much time is needed? **?**

Thermodynamic modelling

- How to transform a gabbro into an amphibolite?
  - Is H_2O enough? **NO**
  - What about mass transport? **YES**
  - **How much time is needed? ?**
    - Main reaction due to continuous water supply
    - Element transport “keeps” porosity