

# Creeping gabbro: dissolution-precipitation creep facilitating deformation in mafic rocks

Amicia Lee<sup>1</sup>, Holger Stünitz<sup>1,2</sup>, Mathieu Soret<sup>2</sup>, Matheus Ariel Battisti<sup>3</sup>, Jiří Konopásek<sup>1</sup>

<sup>1</sup>UiT Arctic University of Norway, Norway, <sup>2</sup>Université d'Orléans, France, <sup>3</sup>Universidade Federal do Rio Grande do Sul, Brazil.

✉ amicia.lee@uit.no    @amiciale

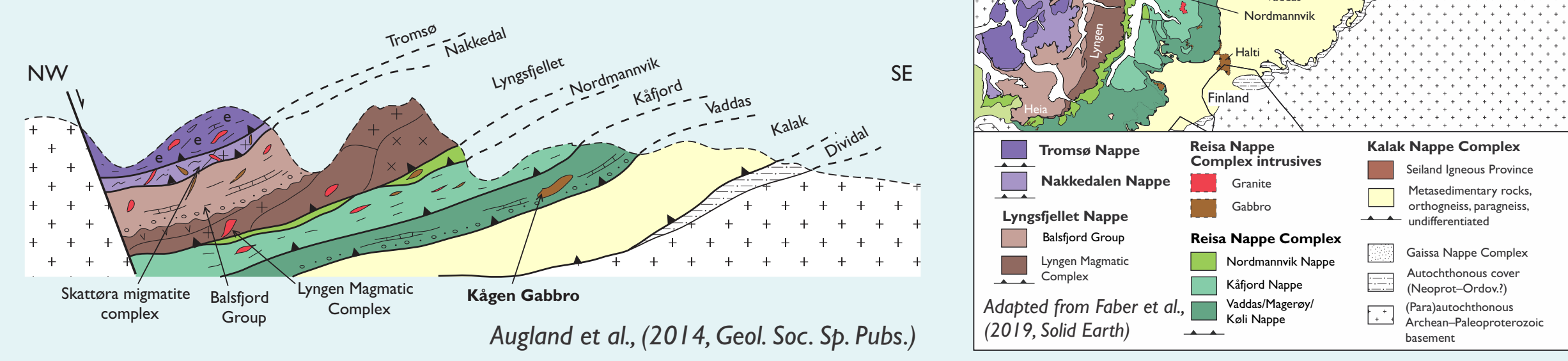


## 1. Background

Strain localisation and fabric development in the lower crust is controlled by the active deformation mechanisms. Understanding the driving forces of such deformation aids in quantifying the stresses and rates of the deformation processes. Here we show that diffusion creep plays a major role in deformation of gabbro lenses at upper amphibolite facies conditions.

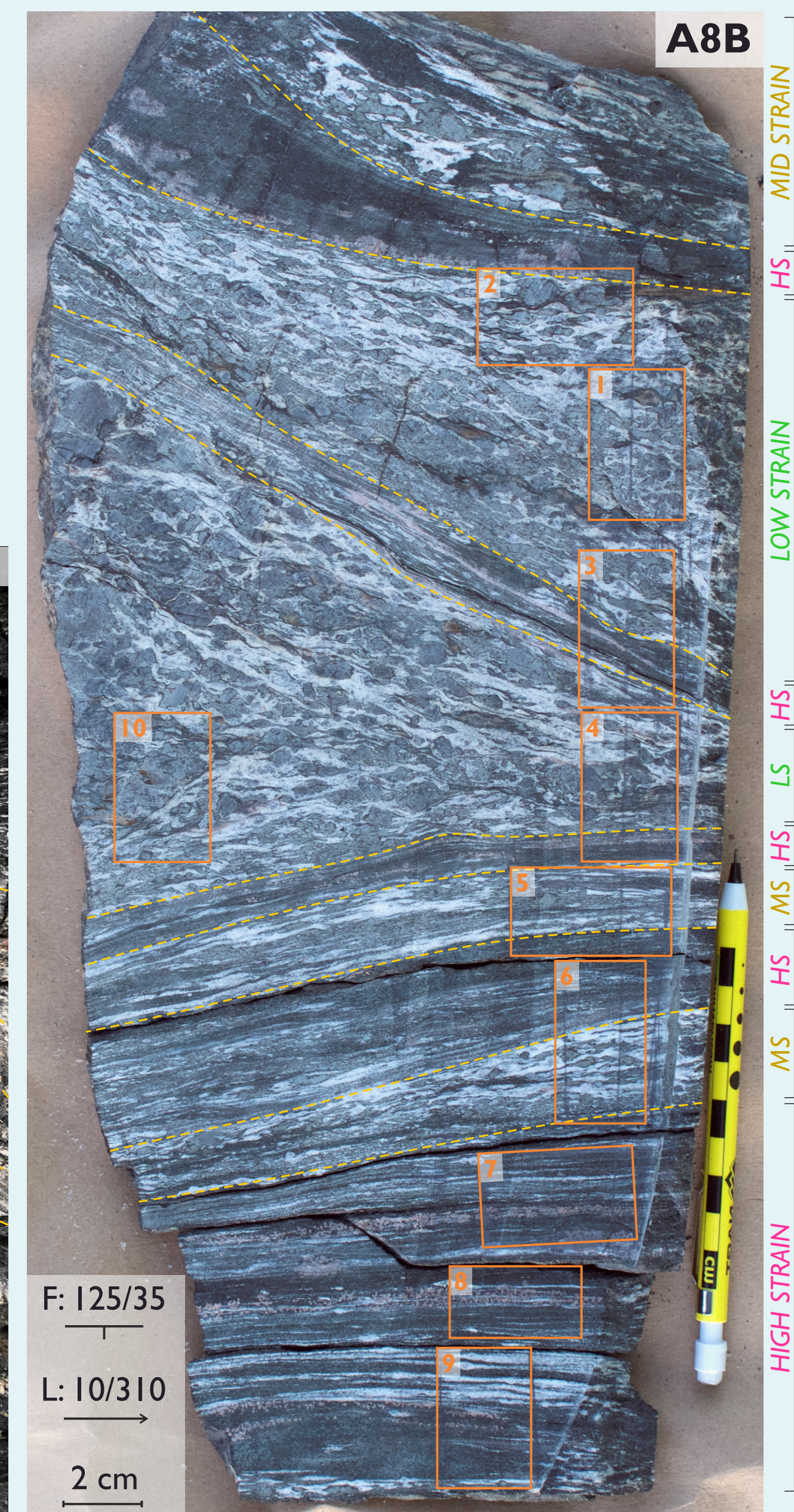
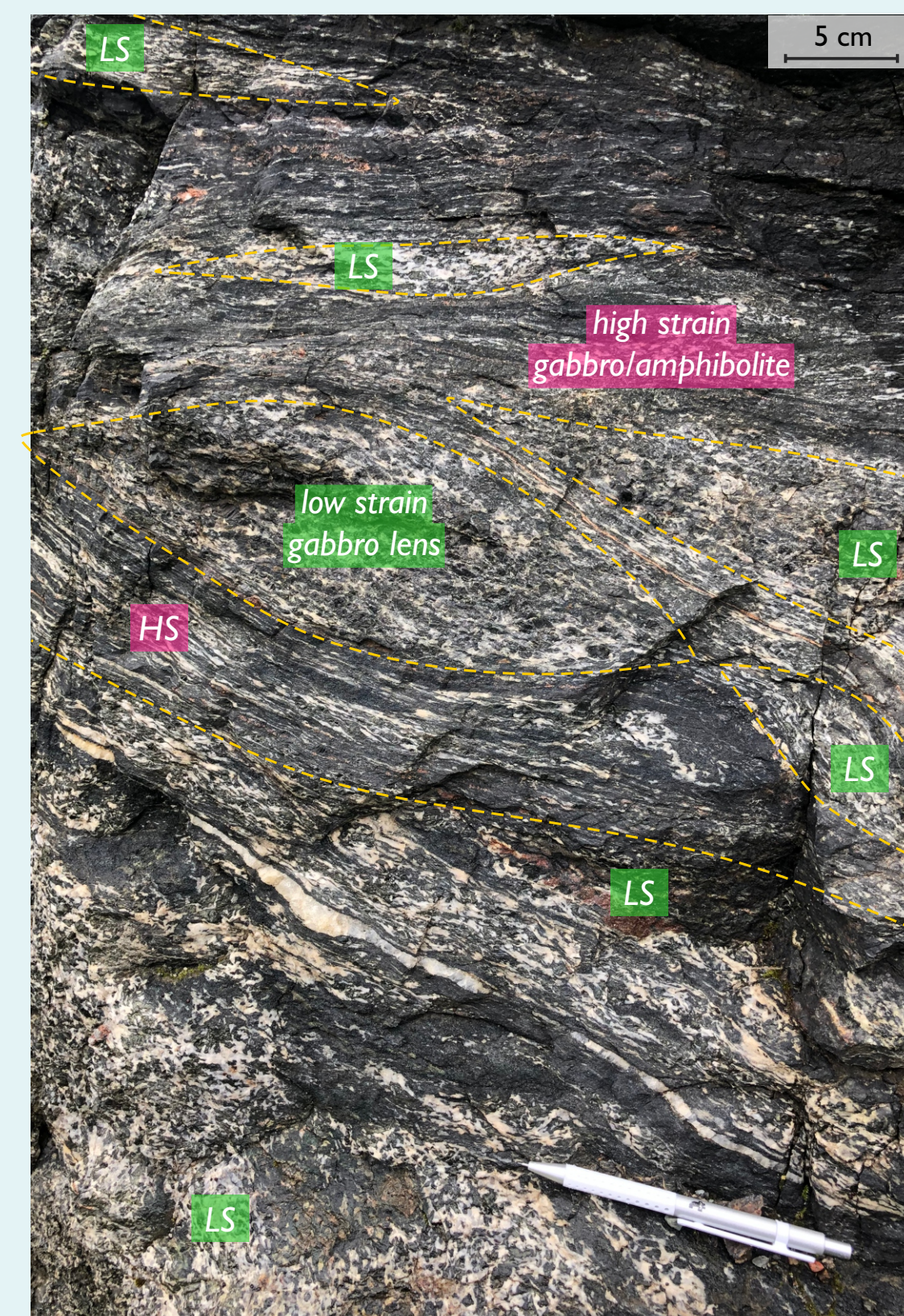
## 2. Geological context

The Kågen gabbro intruded the Vaddas Nappe at 439 Ma at pressures of 7-9 kb temperatures of 650-900°C and depths of 26-34 km (Getsinger et al., 2013, G<sup>3</sup>).

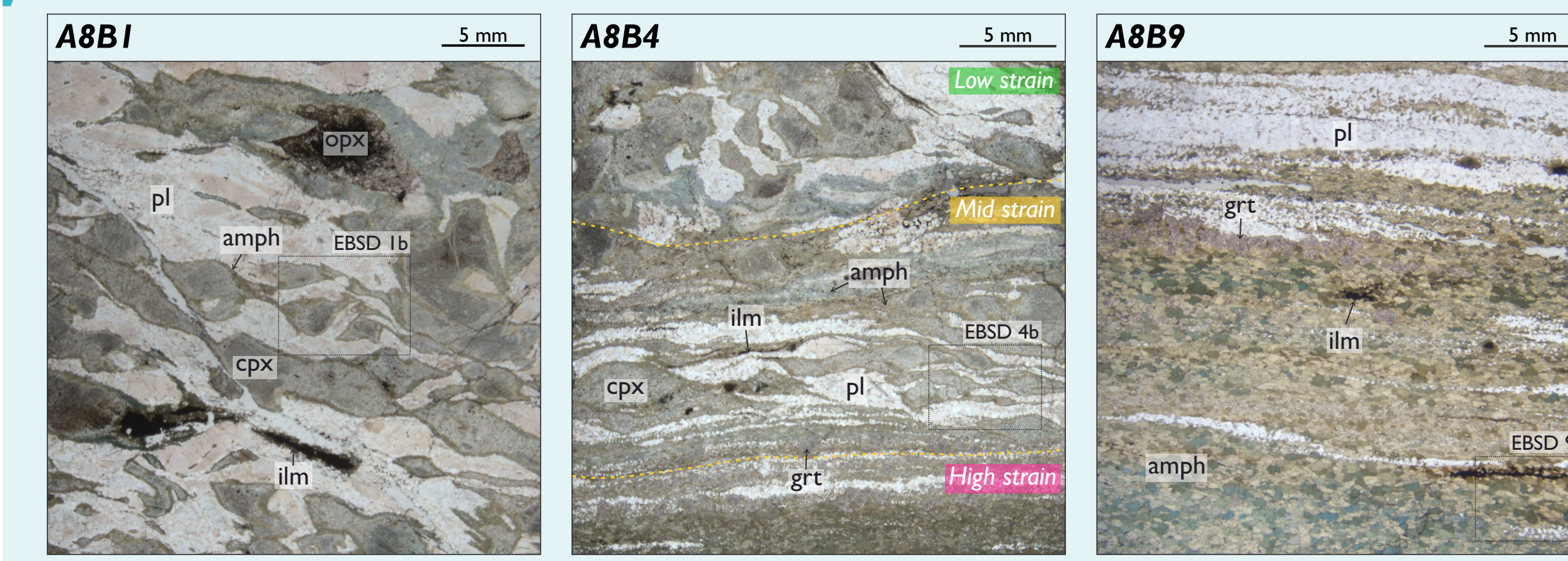


## 3. Sample description

The margin of the Kågen gabbro on south Arnøya is made up of undeformed gabbro lenses with mylonites wrapping around them.



## 4. Microstructure

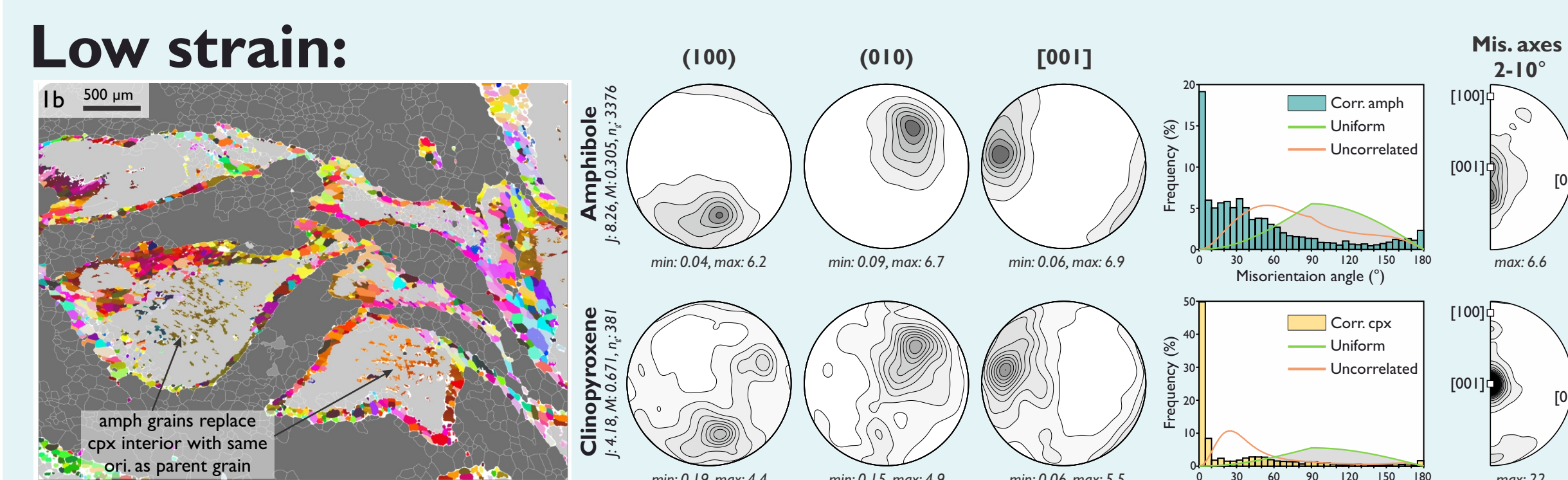


**Low strain**  
Partial metamorphism of gabbro, strained cpx with amph rims.

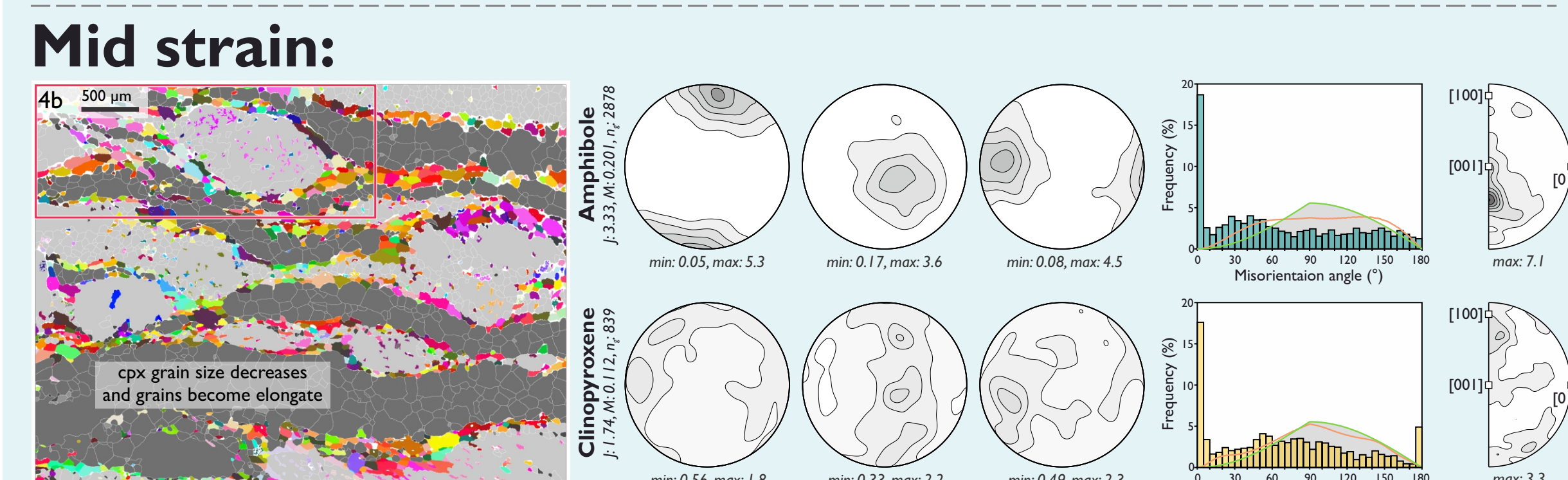
**Mid strain**  
Cpx grains more elongated with more amphib replacement.

**High strain**  
Alternating amphib and plag layers, cpx completely replaced.

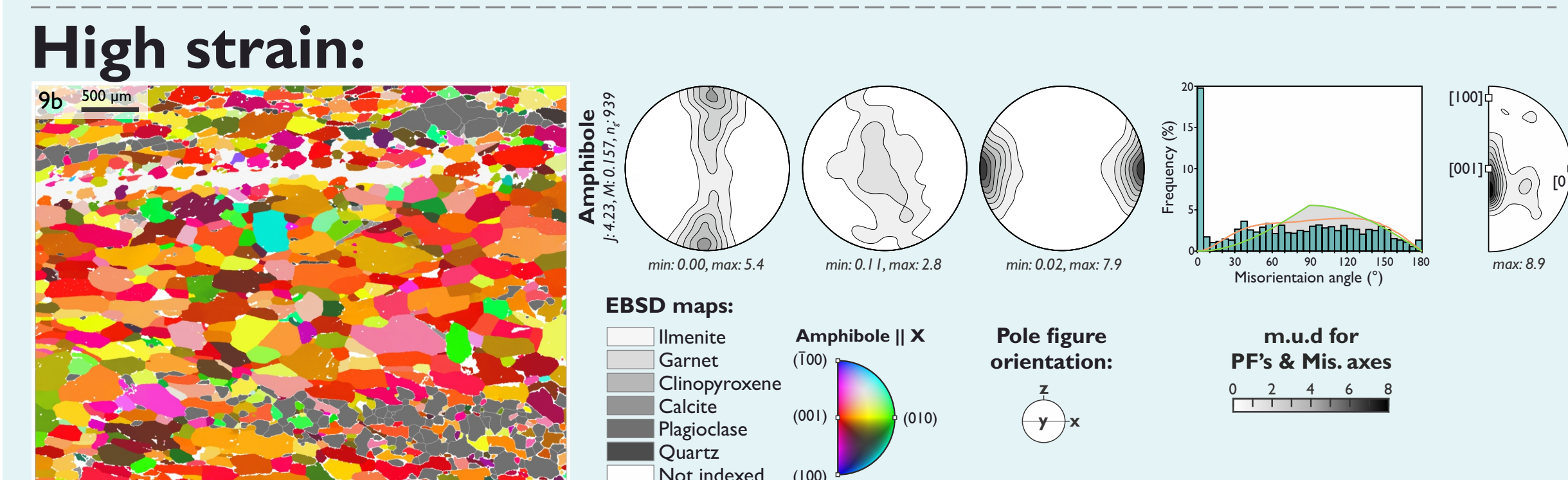
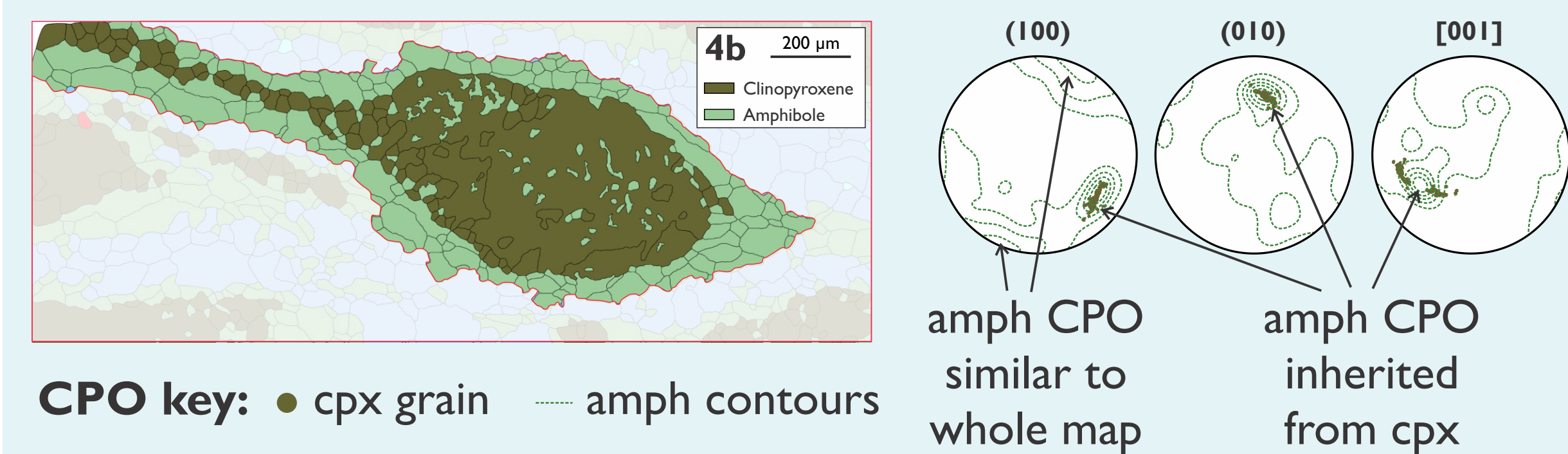
## 5. Crystallographic analysis



Amph and cpx CPO are correlated  
(100) = max subnormal to the shear direction, [001] = max subparallel to the shear direction



Amph and cpx CPO are weakly correlated  
(100) = max subnormal to the shear direction, [001] = max subparallel to the shear direction

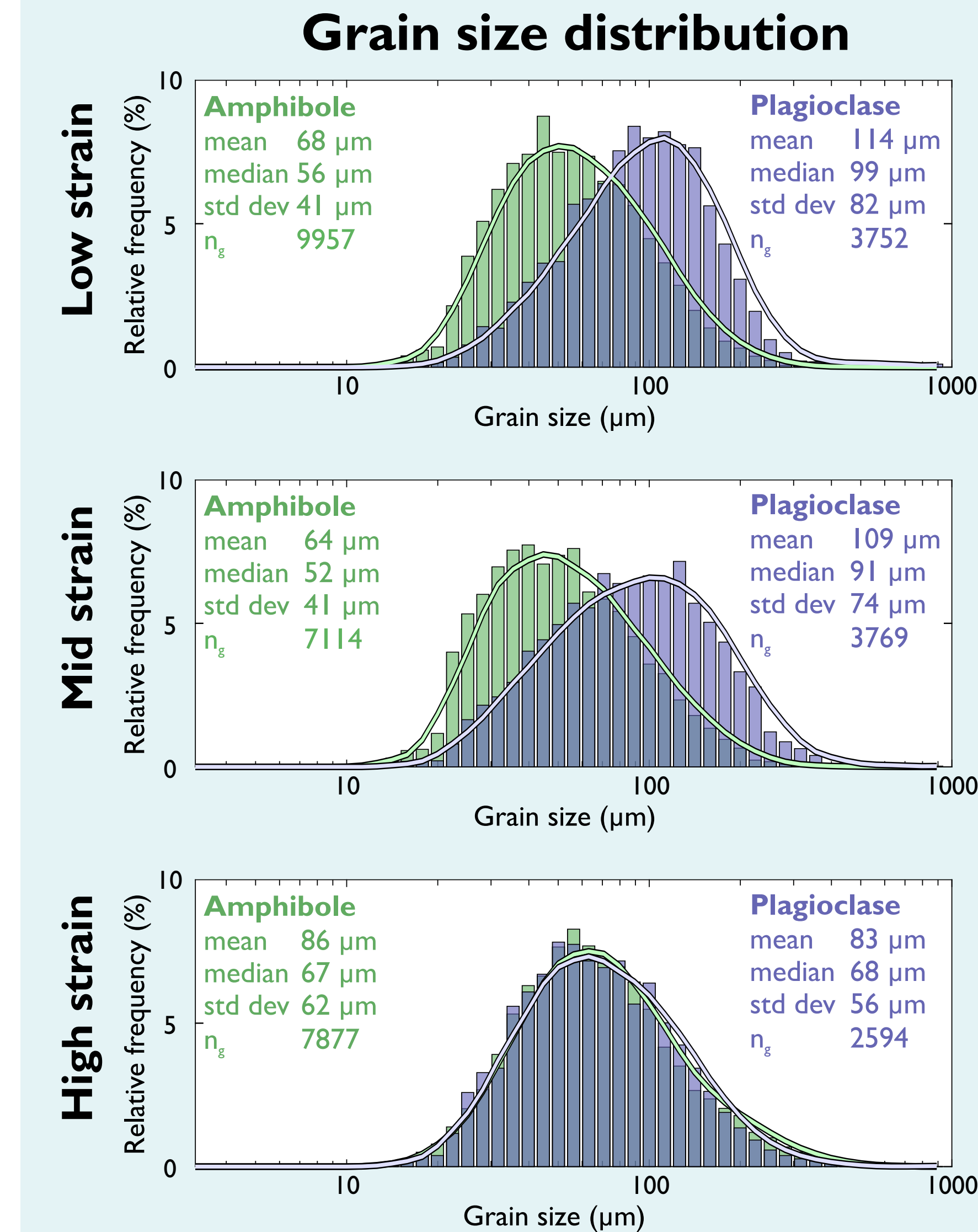


Too few cpx grains in high strain areas to construct CPO  
(100) = girdle normal to the shear direction, [001] = max parallel to the shear direction

## 6. Grain shape parameters

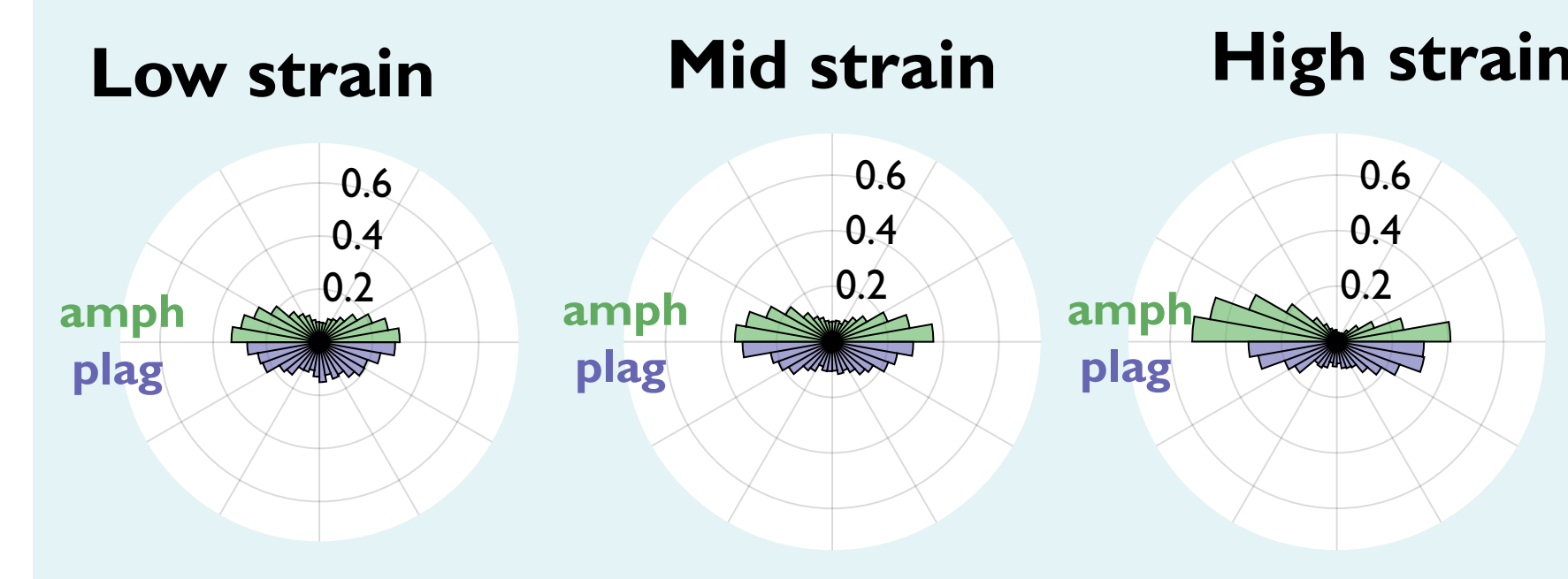
**Amphibole:**  
Grain size increases as strain increases.  
Grains become more elongated at high strains.

**Plagioclase:**  
Grain size decreases as strain increases.  
Grains become slightly more elongated at high strains.

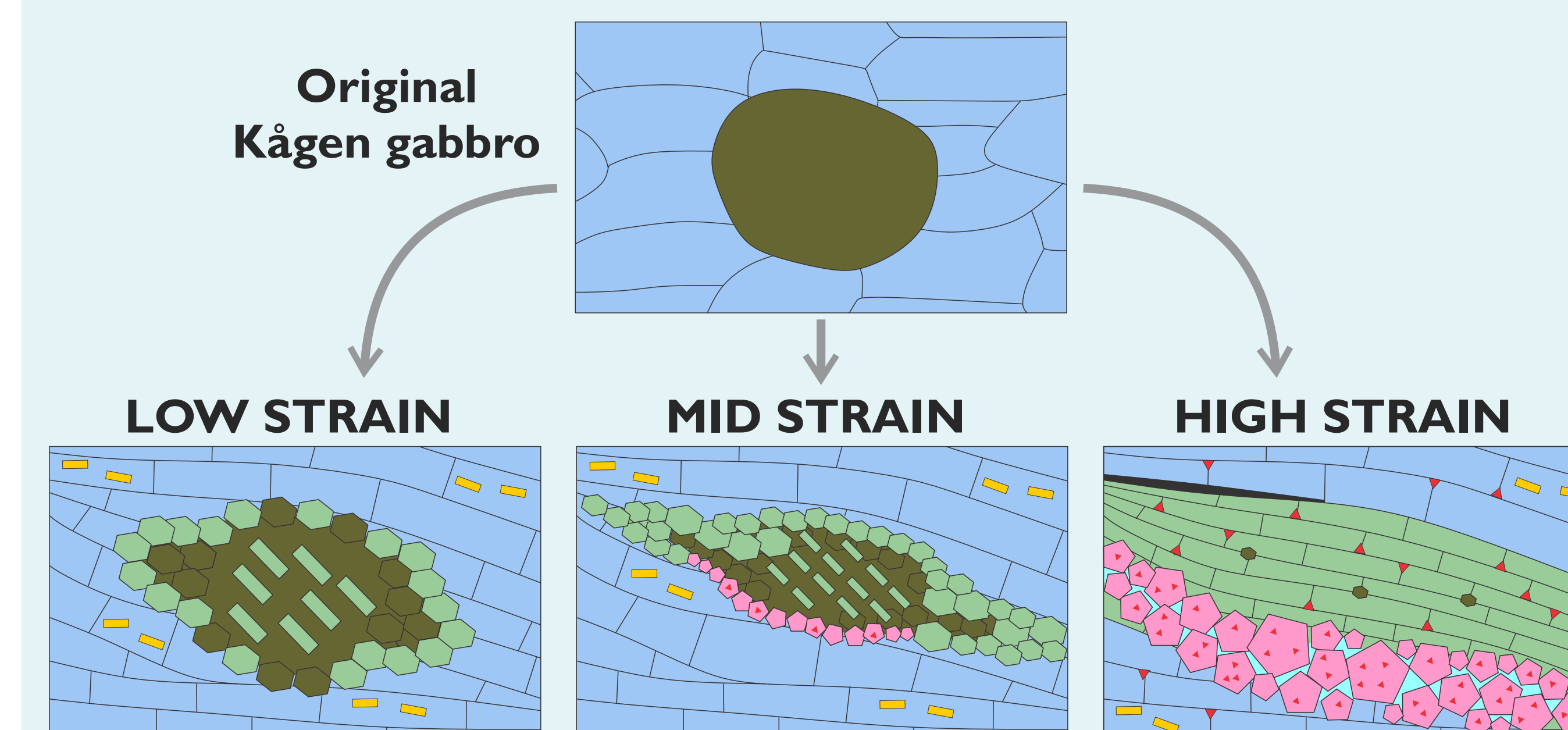


Amphibole and plagioclase reach grain size equilibrium in the high strain areas.

## Grain orientation



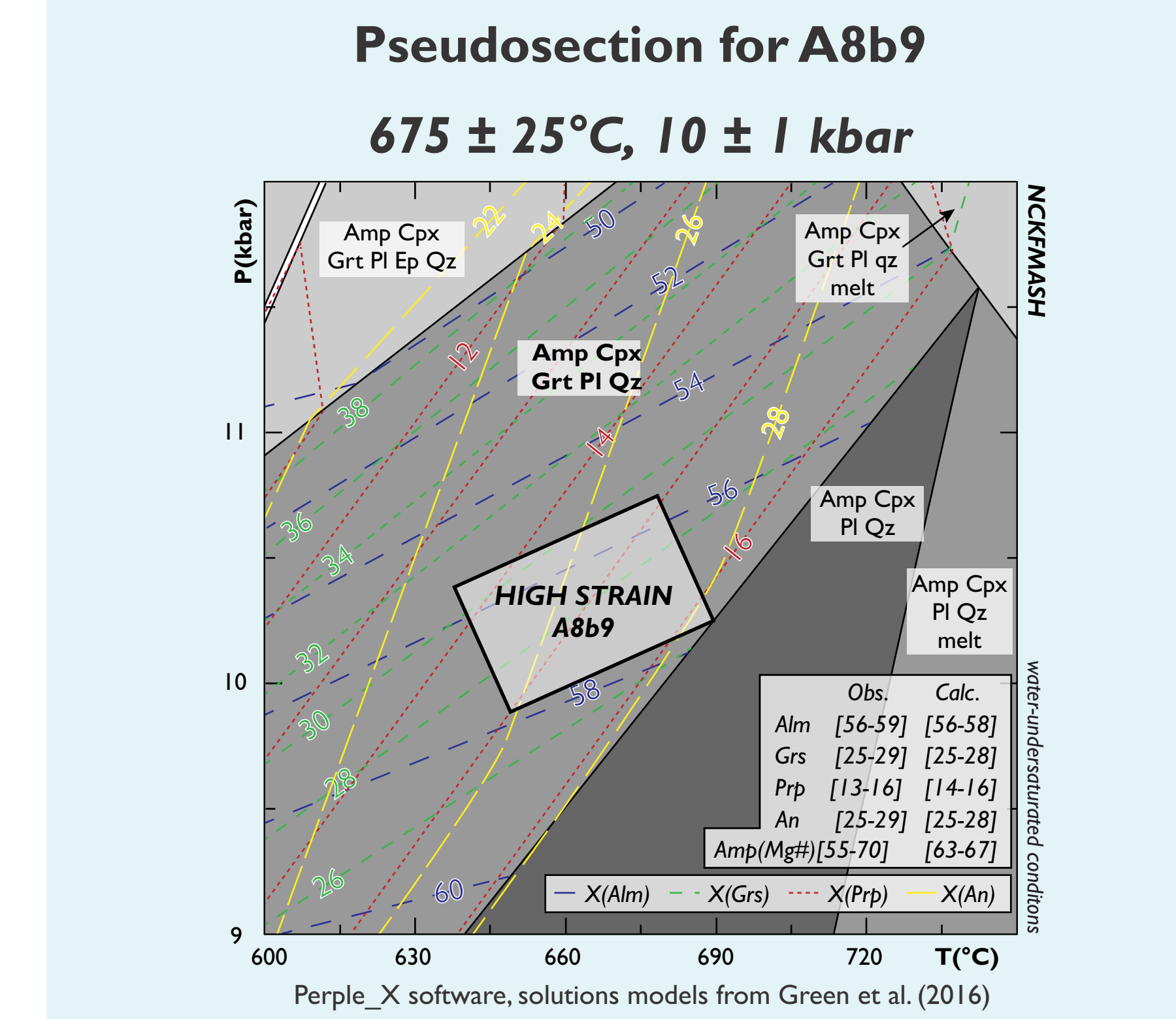
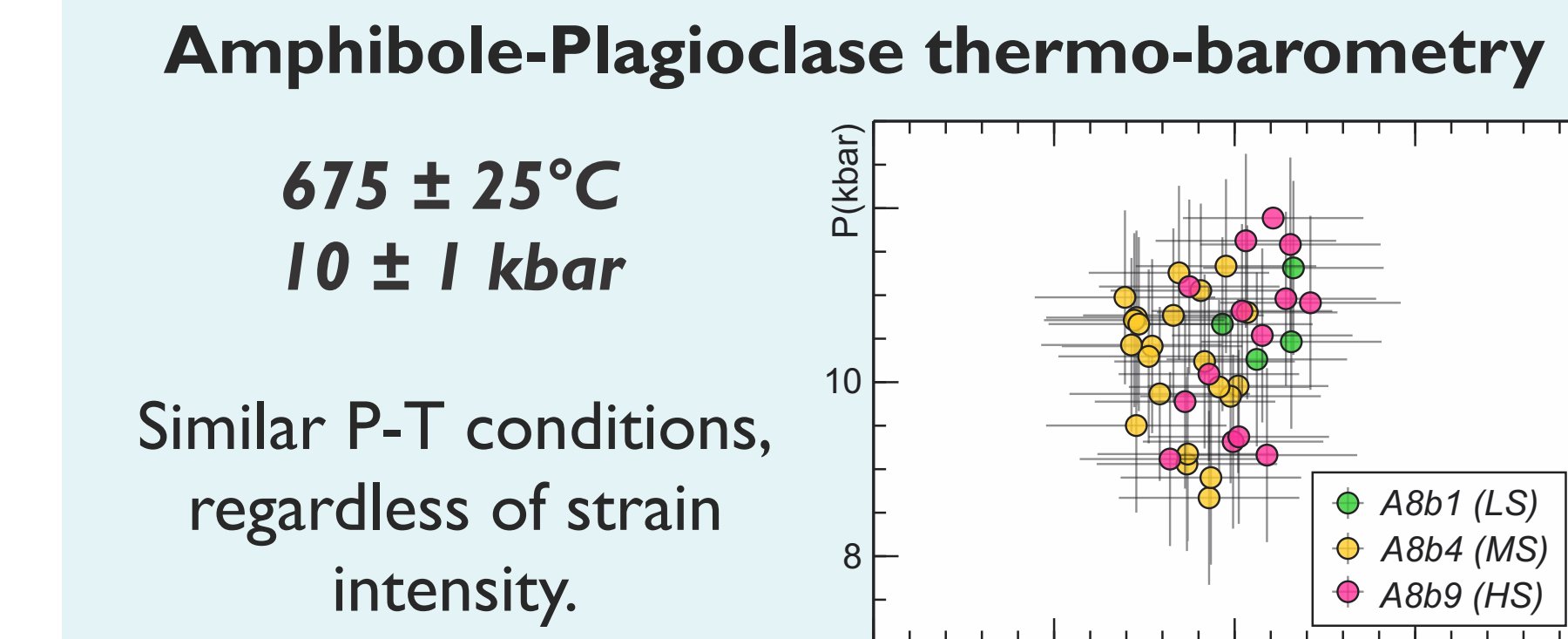
## 8. Kågen gabbro evolution



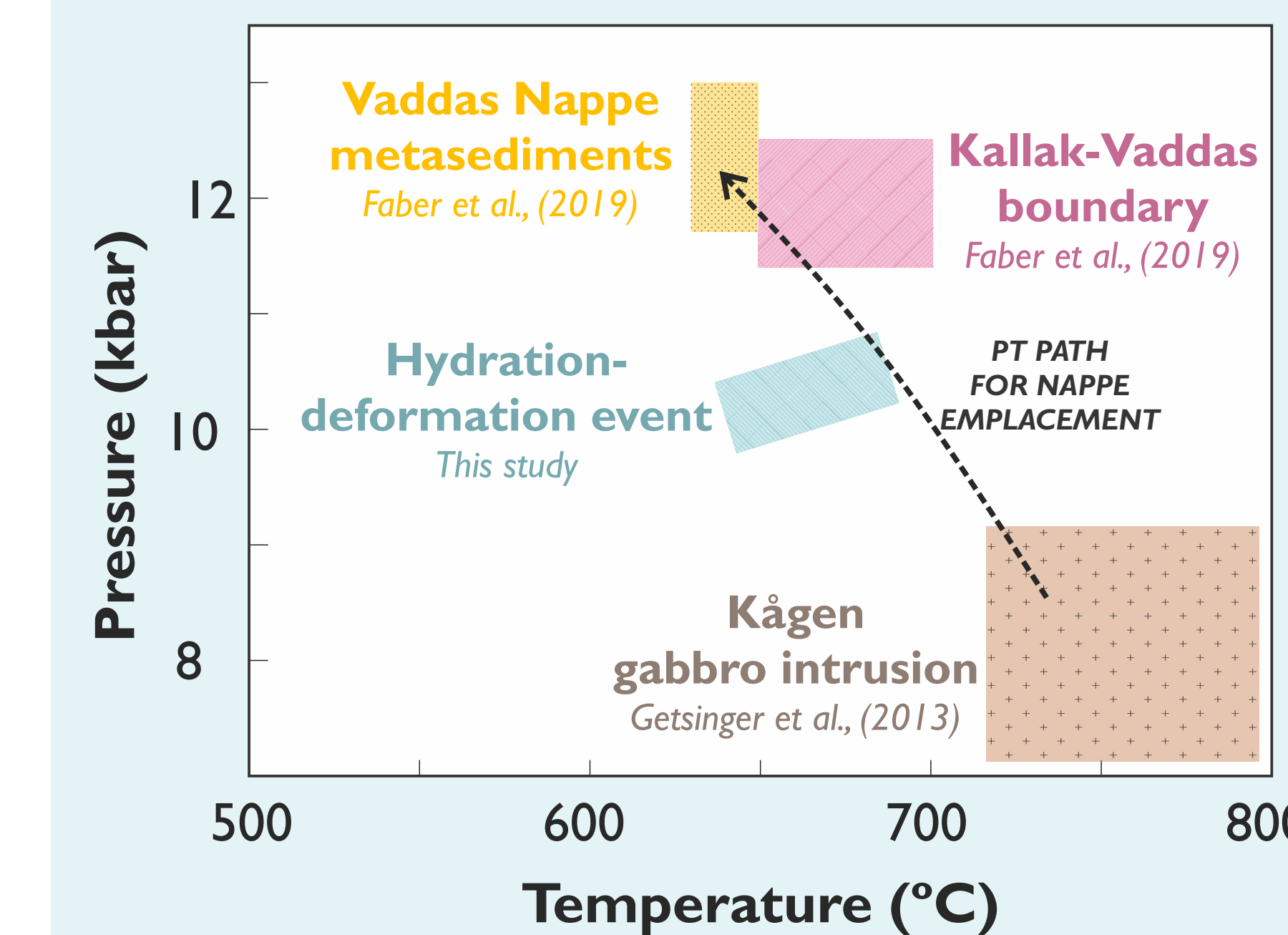
INCREASING WATER CONTENT  
INCREASING DISSOLUTION-PRECIPITATION CREEP

Phase key: cpx, plag, amph, grt, qtz, cct, ilm, zo

## 7. P-T conditions



## Kågen gabbro & Vaddas Nappe P-T evolution



When deformation and mineral reactions occur simultaneously, strong rocks can become mechanically weak.

Processes like dissolution precipitation creep allow the rocks to deform plastically at lower temperatures.

Furthering our understanding of the deformation mechanisms active in mafic rocks allows us to better understand the processes that may be occurring deep in the crust in actively deforming areas.