

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

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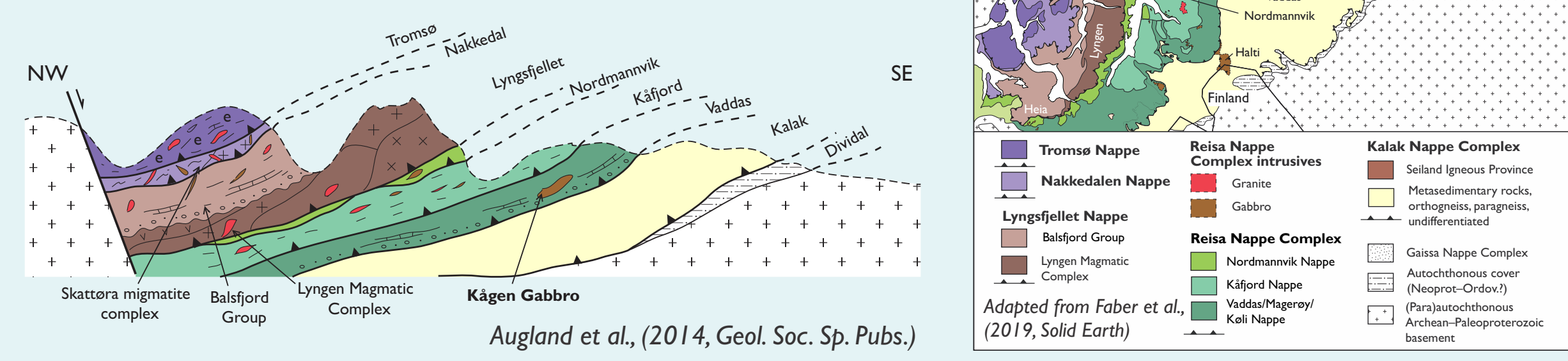


1. Background

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.

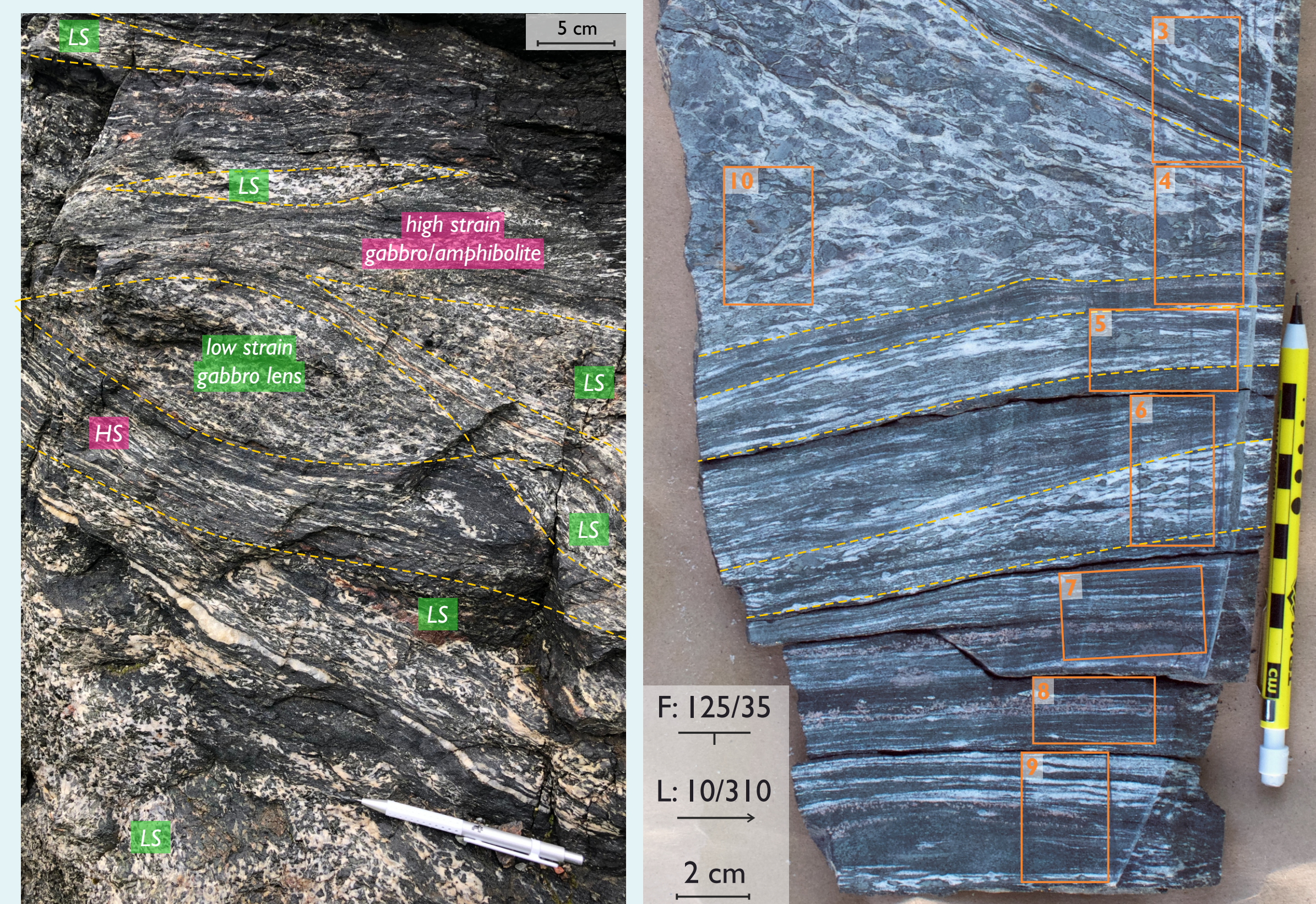
2. Geological context

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^3).

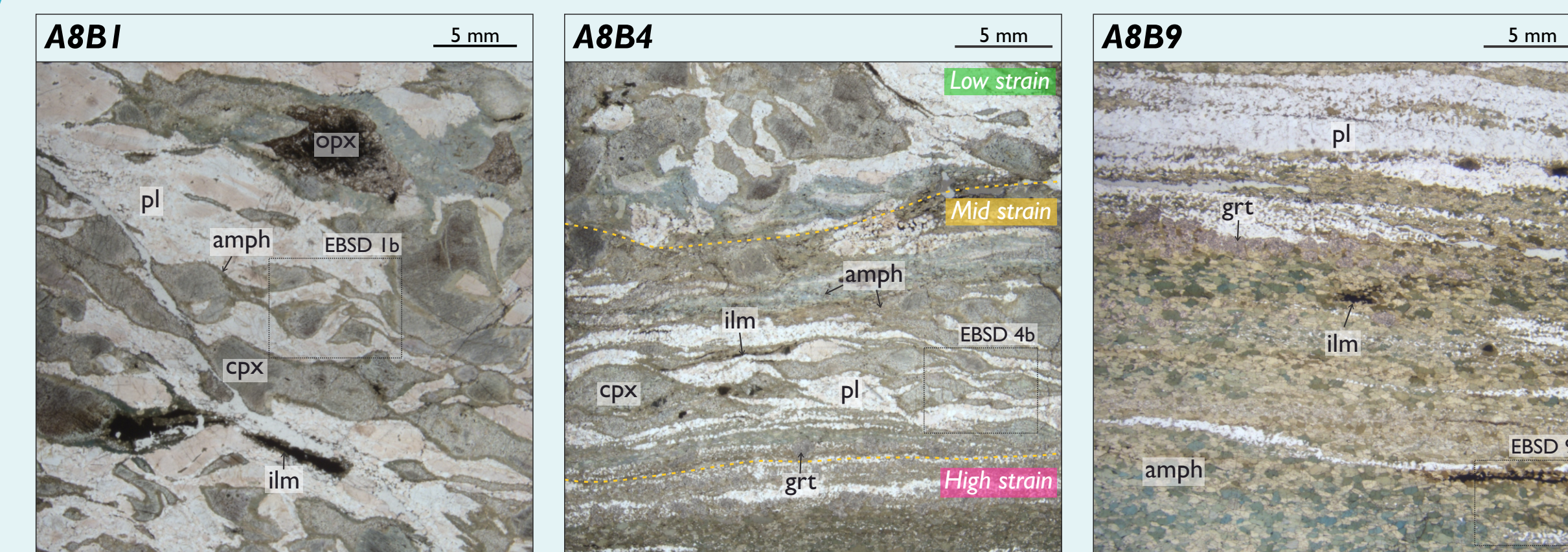


3. Sample description

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 amphib rims.

Mid strain

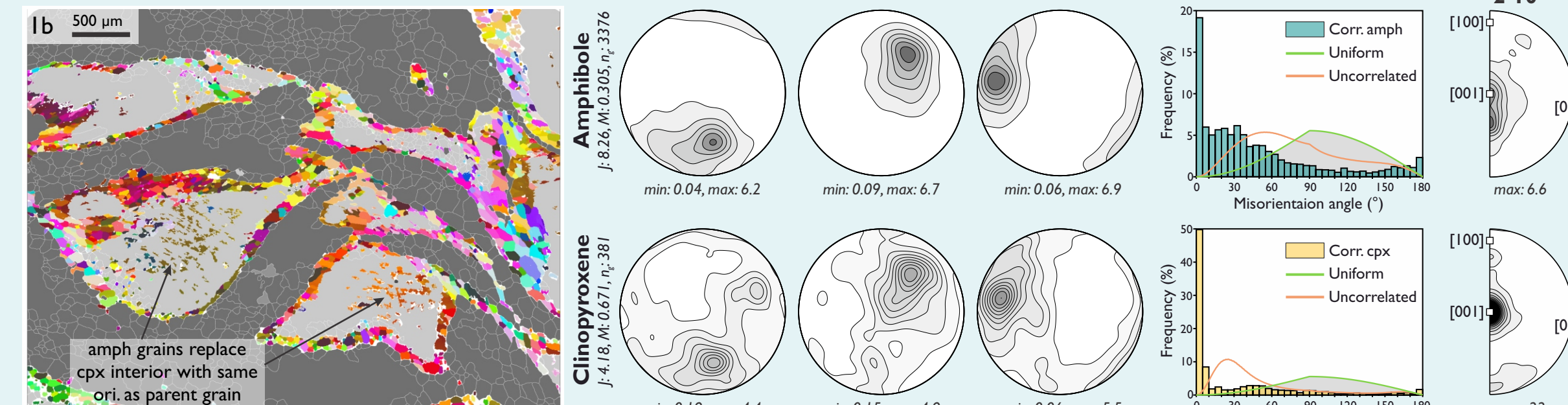
Cpx grains more elongated with more amphib replacement.

High strain

Alternating amphib and plag layers, cpx completely replaced.

5. Crystallographic analysis

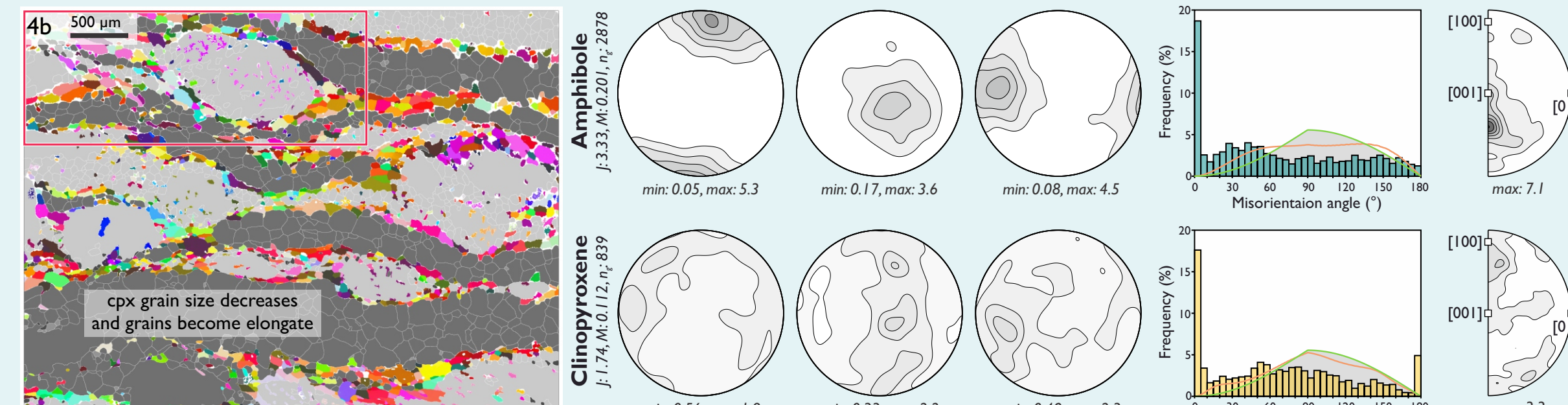
Low strain:



Amph and cpx CPO are correlated

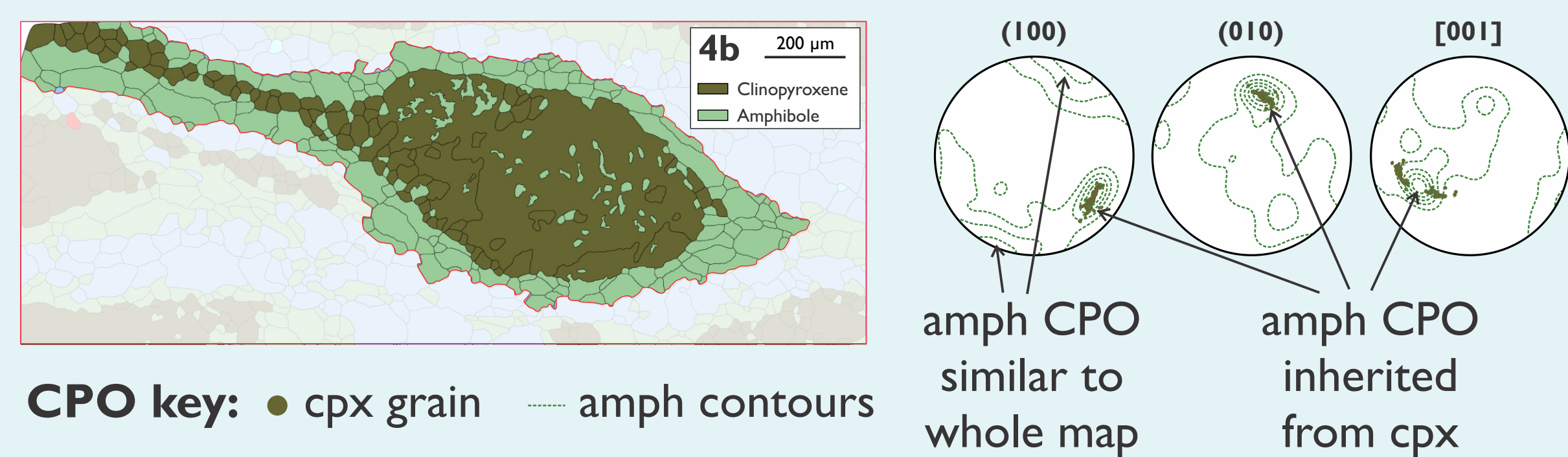
(100) = max subnormal to the shear direction, [001] = max subparallel to the shear direction

Mid strain:

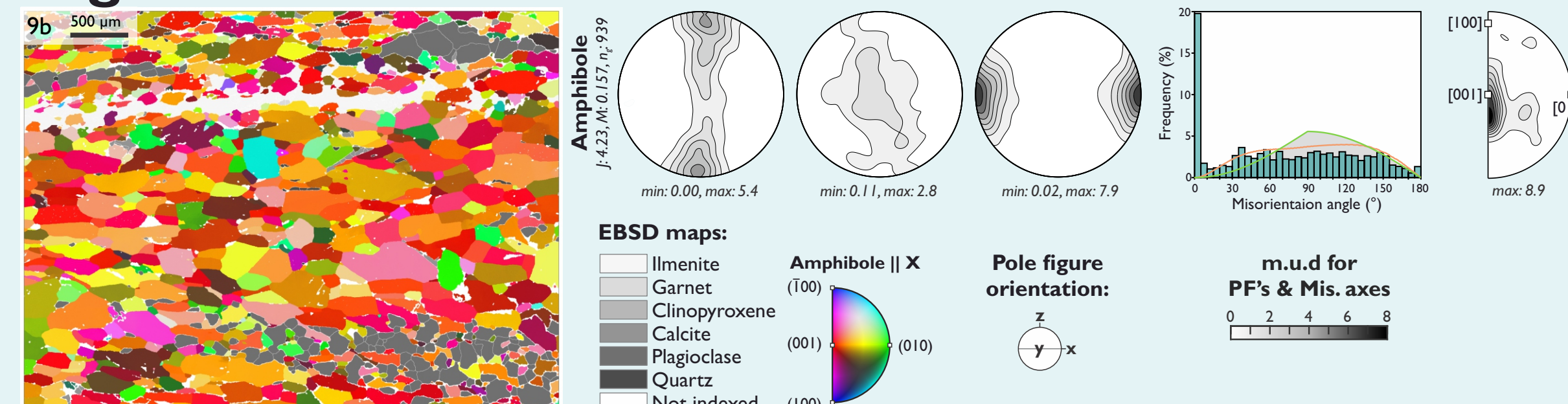


Amph and cpx CPO are weakly correlated

(100) = max subnormal to the shear direction, [001] = max subparallel to the shear direction



High strain:



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.

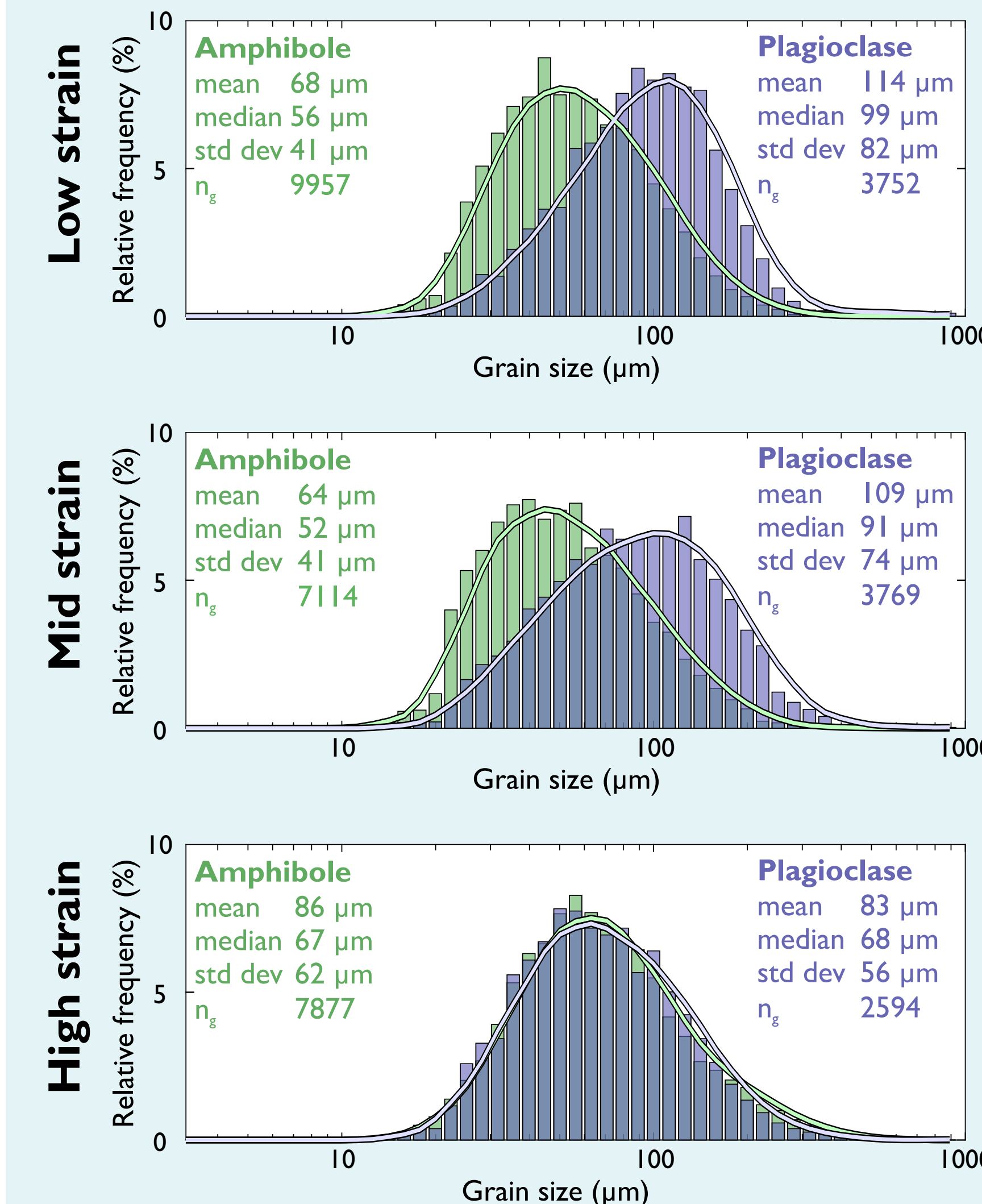
Grains become more elongated at high strains.

Plagioclase:

Grain size decreases as strain increases.

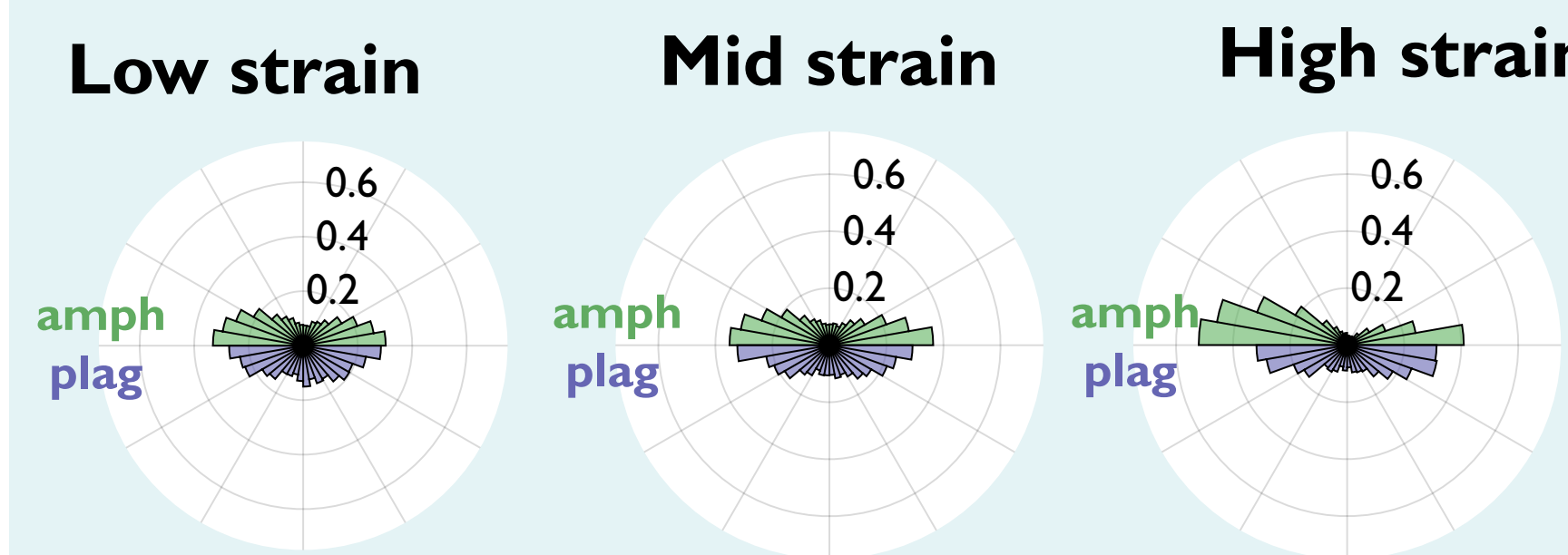
Grains become slightly more elongated at high strains.

Grain size distribution

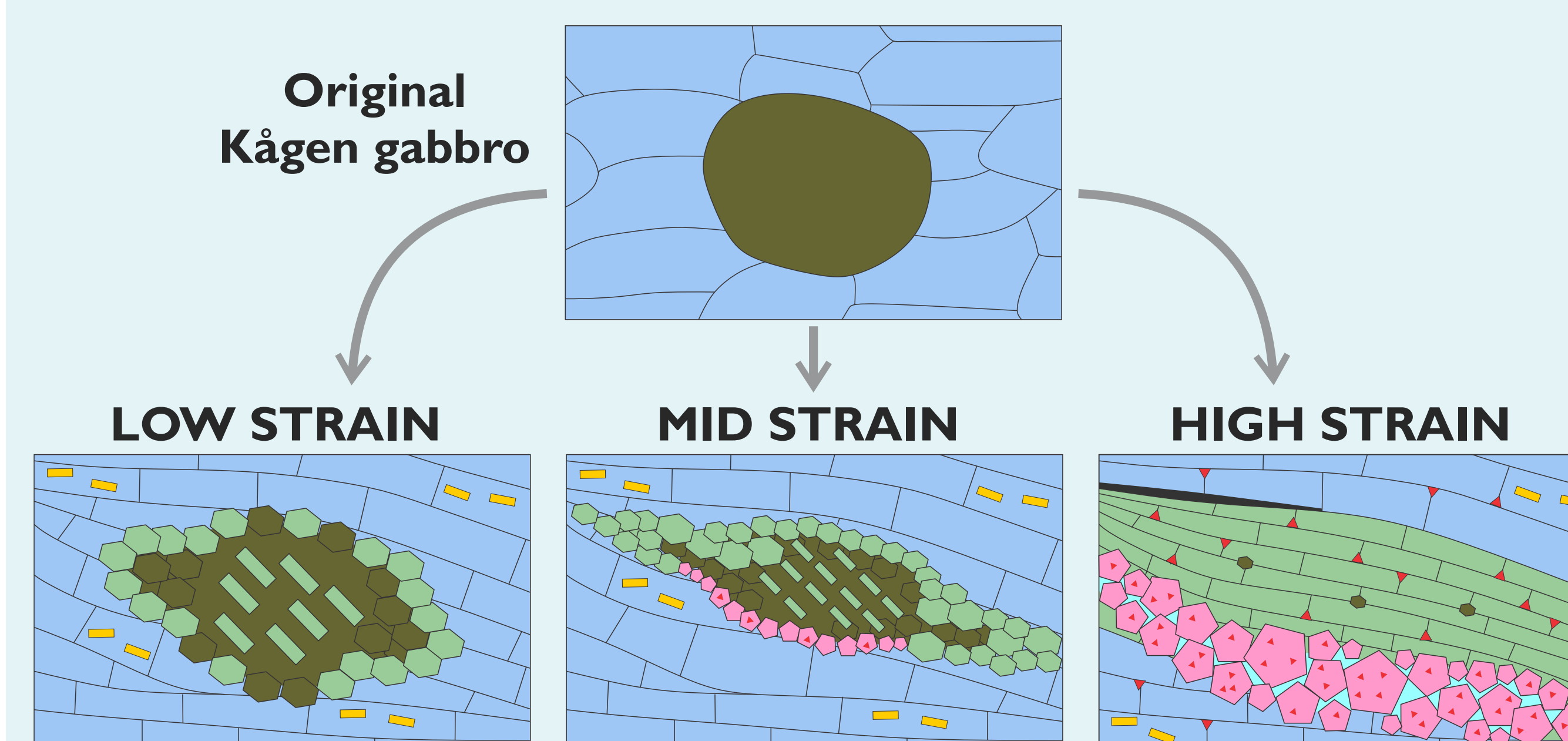


Amphibole and plagioclase reach grain size equilibrium in the high strain areas.

Grain orientation



8. Kågen gabbro evolution



INCREASING WATER CONTENT
INCREASING DISSOLUTION-PRECIPITATION CREEP

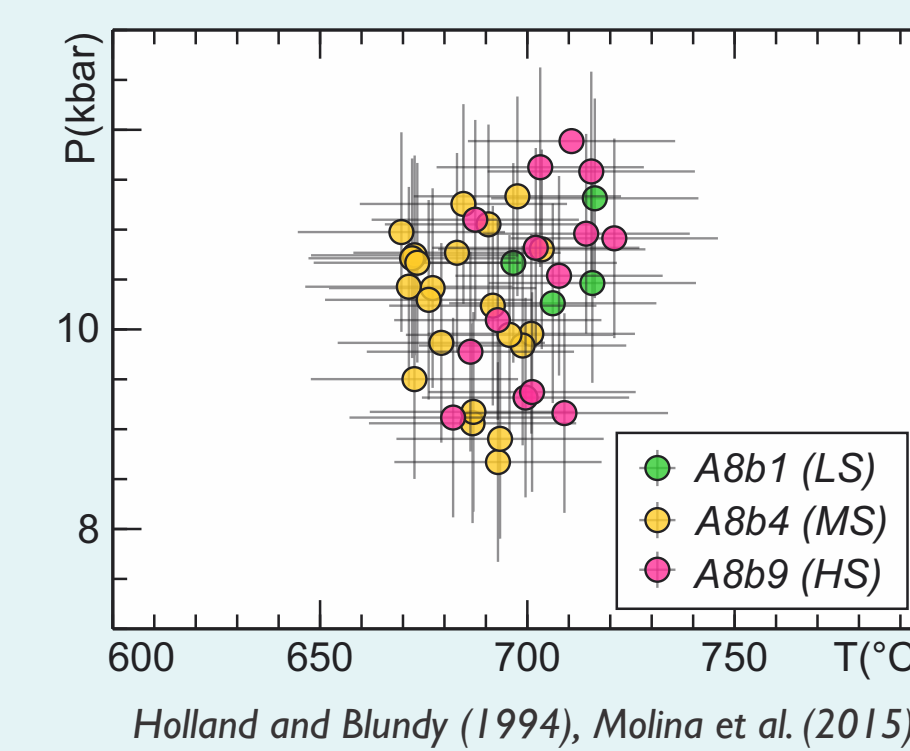
Phase key: ● cpx, ● plag, ● amph, ● grt, ● qtz, ● cct, ● ilm, ● zo

7. P-T conditions

Amphibole-Plagioclase thermo-barometry

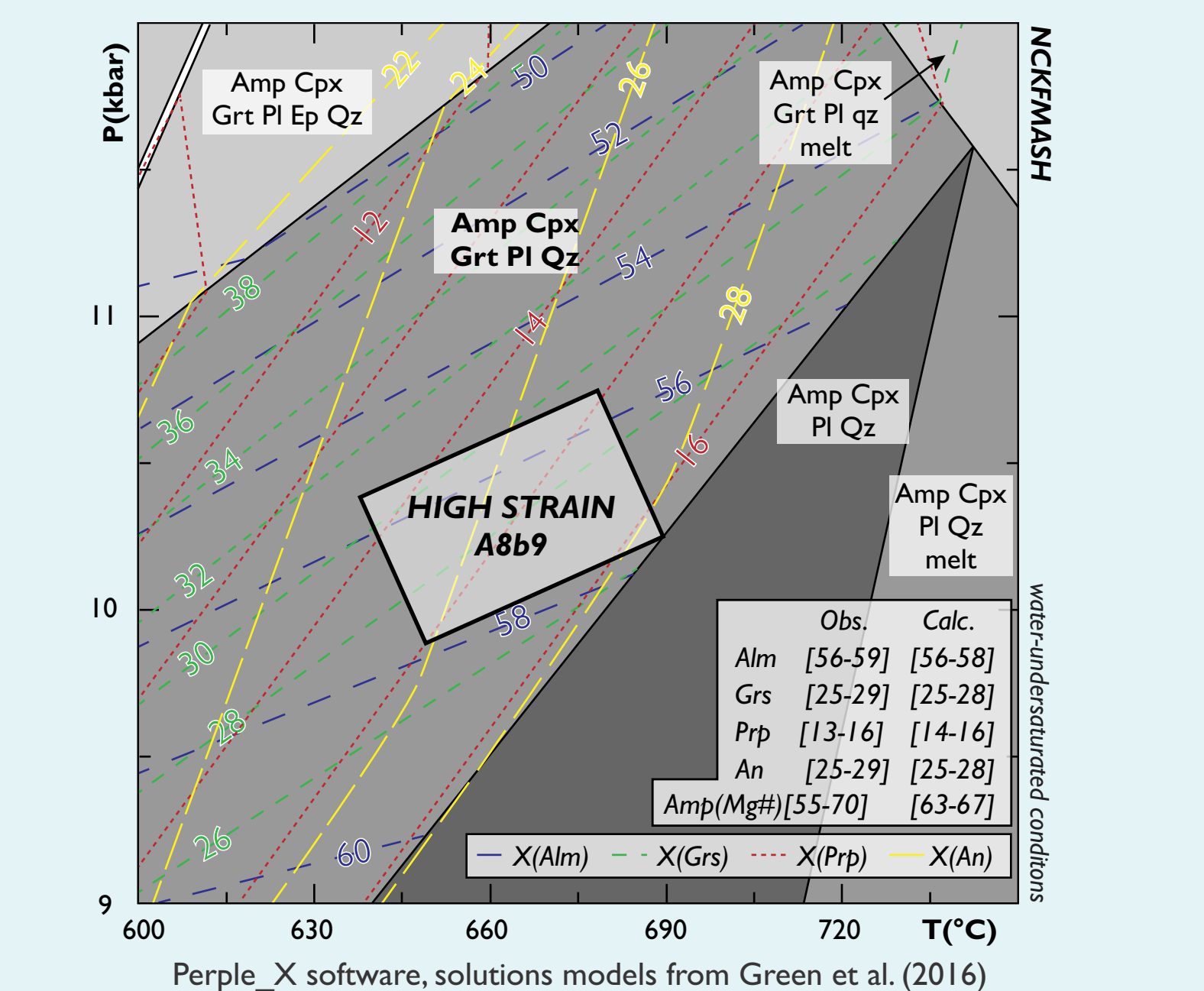
$675 \pm 25^\circ\text{C}$
 $10 \pm 1 \text{ kbar}$

Similar P-T conditions, regardless of strain intensity.



Pseudosection for A8b9

$675 \pm 25^\circ\text{C}$, $10 \pm 1 \text{ kbar}$



Kågen gabbro & Vaddas Nappe P-T evolution

