Ferromagnetism of magnetite-bearing plagioclase from oceanic gabbro

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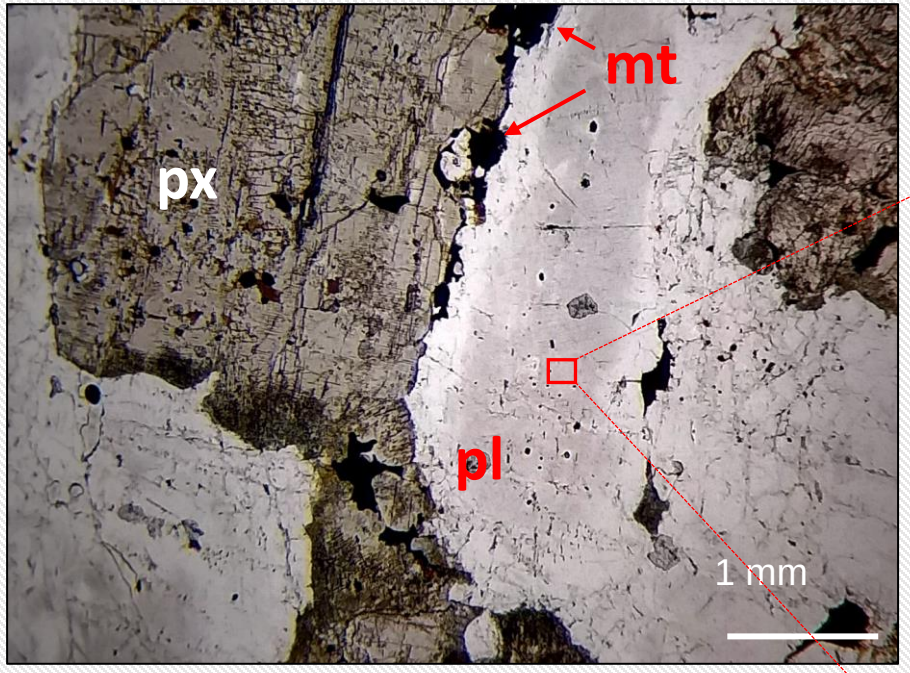
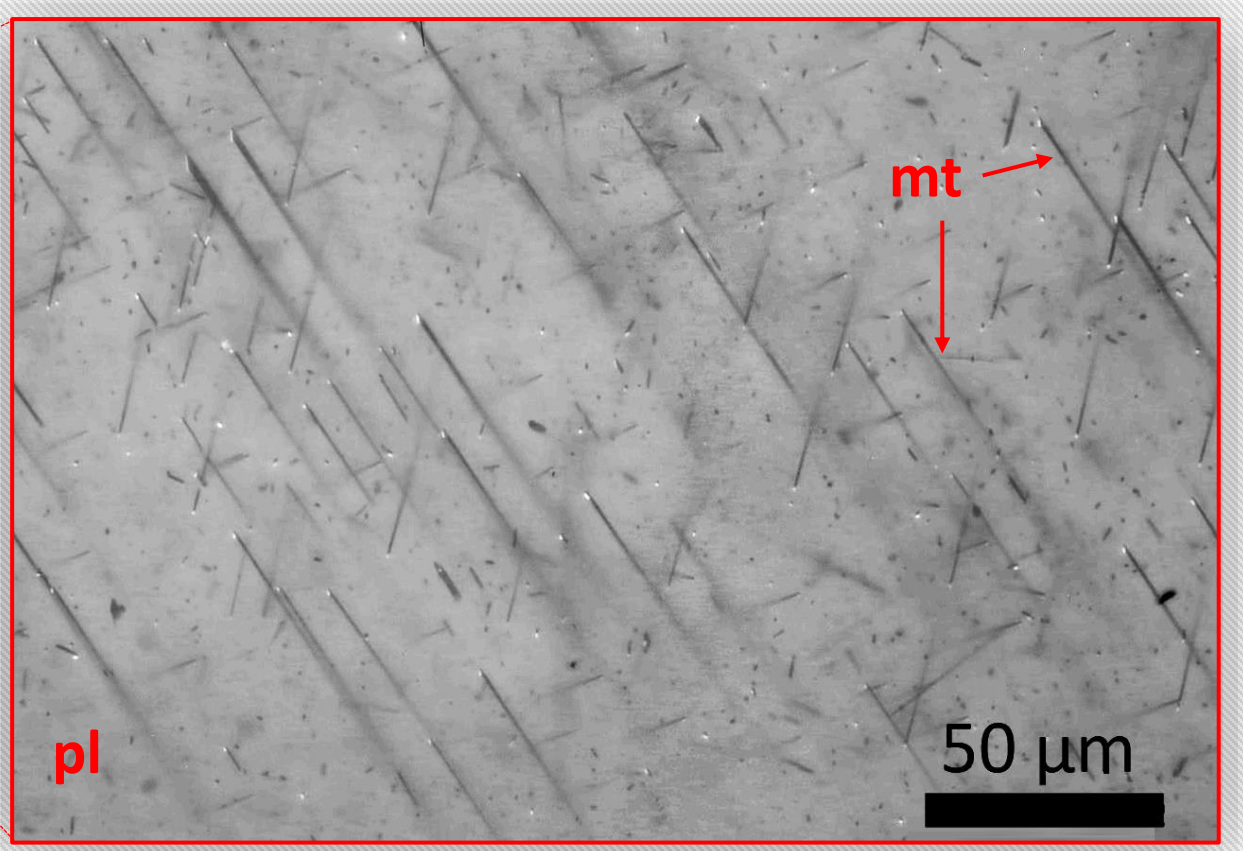


a



b

Magnetite in oceanic gabbro:
(a) individual grains; (b) micron-sized inclusions in silicates

Task:

Correlation between shape orientation of the magnetite inclusions and magnetic anisotropy of plagioclase-host

Material:

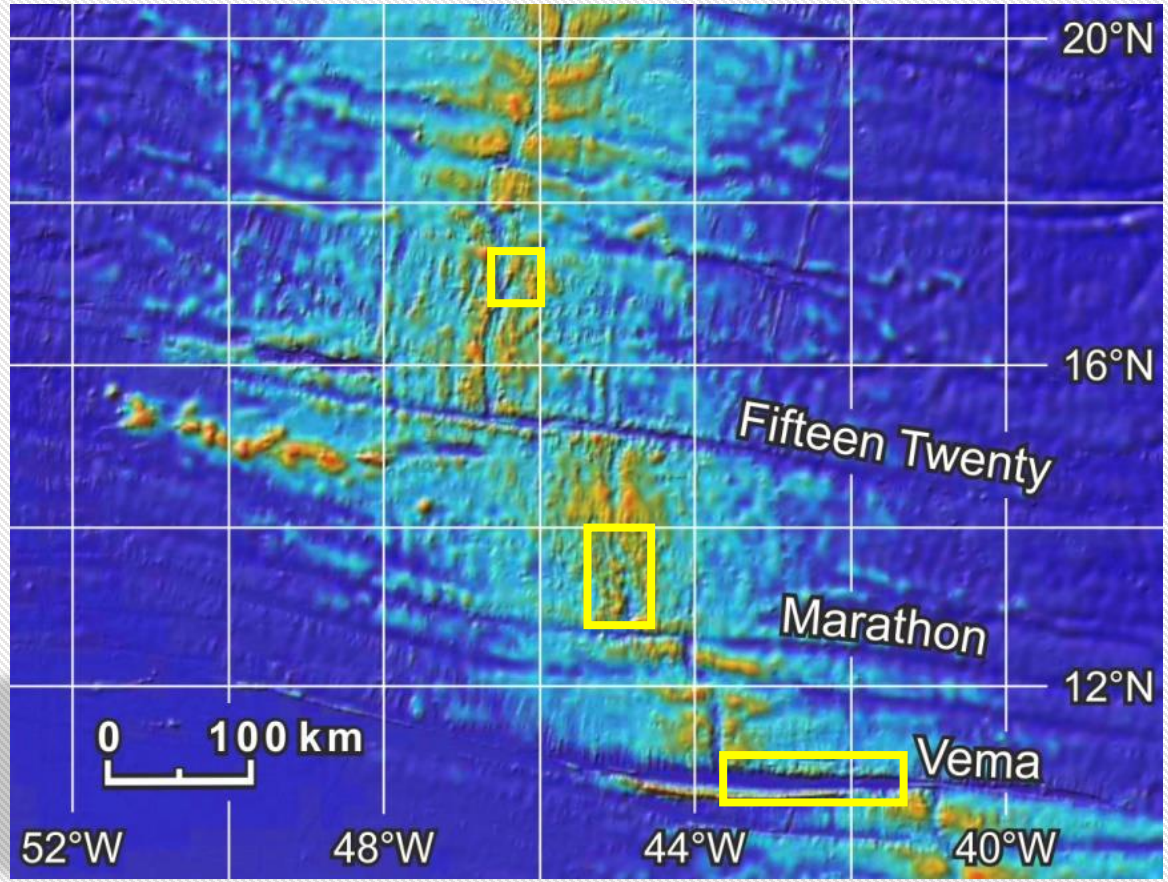
Oceanic gabbros from Mid-Atlantic Ridge (11°-17°N)
26 samples

Methods:

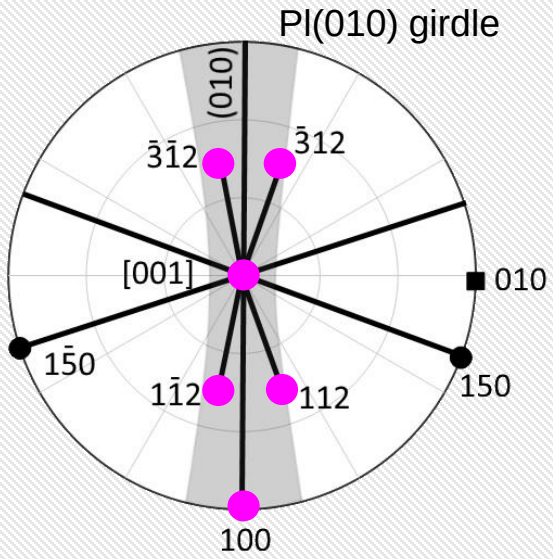
Optical microscopy with Universal stage
26 samples of gabbro

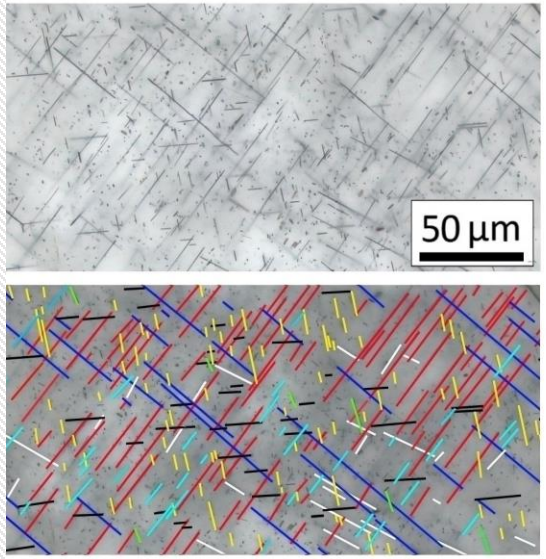
Electron Backscatter Diffraction analyses (EBSD)
~1200 inclusions in 54 plagioclase grains (from 7 samples of gabbro)

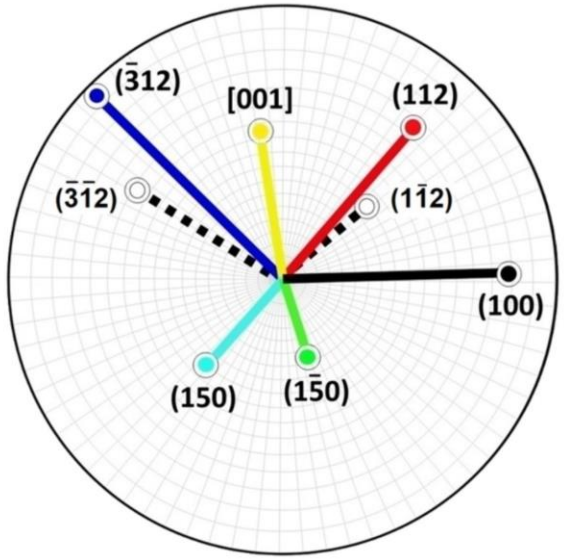
Anisotropy of magnetic remanence (AMR), AF demagnetization – *8 single plagioclase grains from 4 samples of gabbro)*



1. Regular orientation relations with PL host

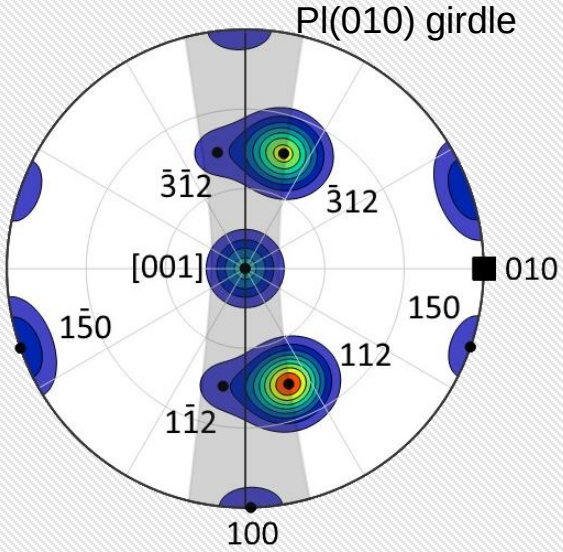






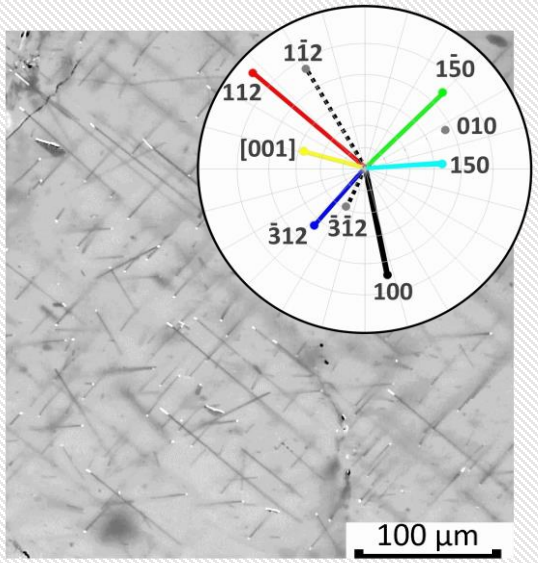
Orientation classes	MT
pl(112)n-MT	[111]
pl($\bar{3}$12)n-MT	
pl(150)n-MT	
pl(1$\bar{5}$0)n-MT	
pl(100)n-MT	
pl(1$\bar{1}$2)n-MT	
pl($\bar{3}\bar{1}$2)n-MT	
pl[001] -MT	[011]

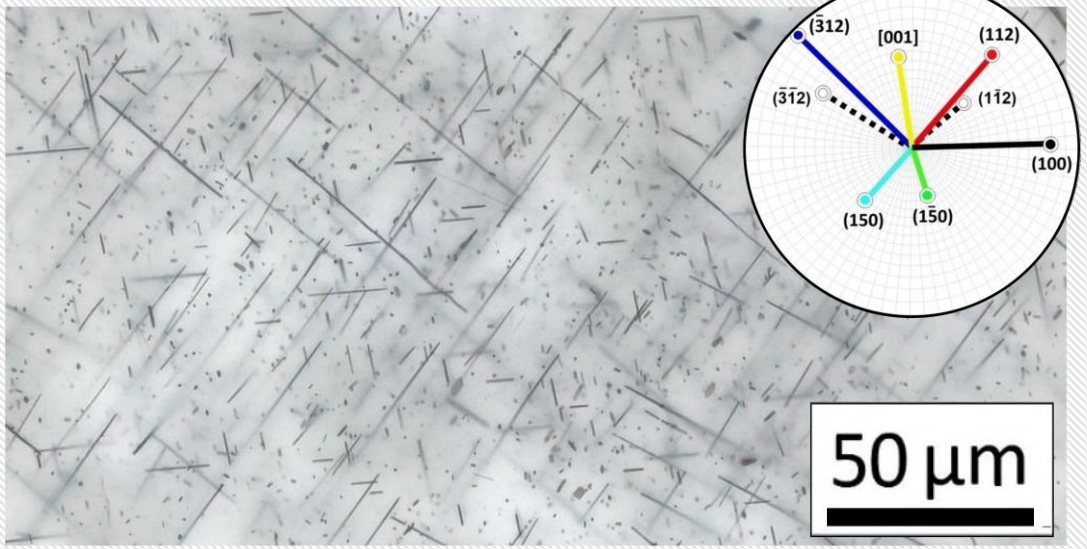
2. Distribution of the oriented inclusions in PL host

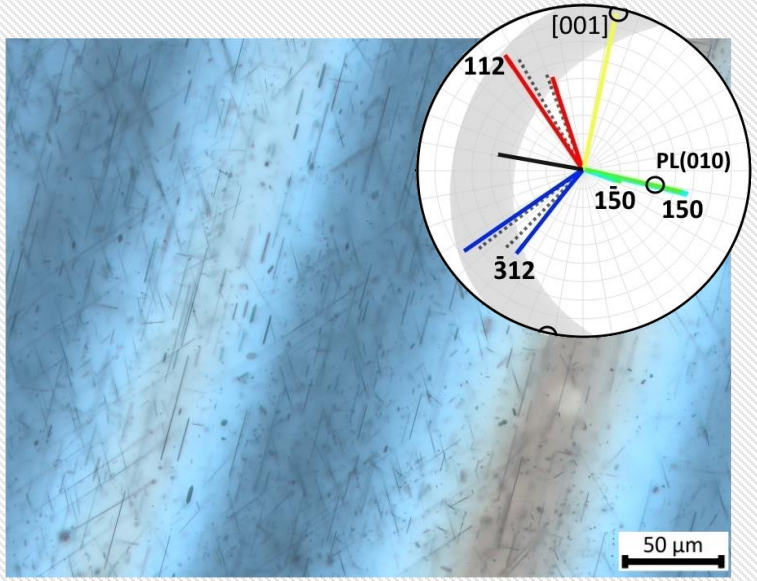


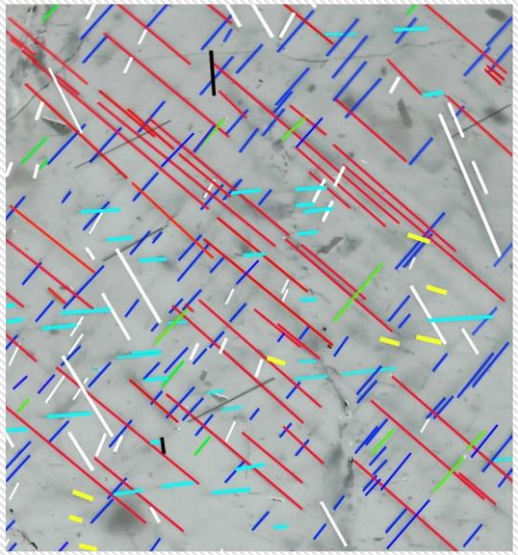
Orientation class	A	B	C	"Pl(010) girdle"
pl(112)-mt	45	35	-	+
pl($\bar{3}$12)-mt	25	15	-	+
pl(1$\bar{5}$0)-mt and pl(150)-mt	15	2	-	-
pl($\bar{3}$12)-mt and pl(1$\bar{1}$2)-mt	10	3	-	+
pl(100)-mt	-	5	-	+
pl[001]-mt	**5**	**40**	**100**	**+**

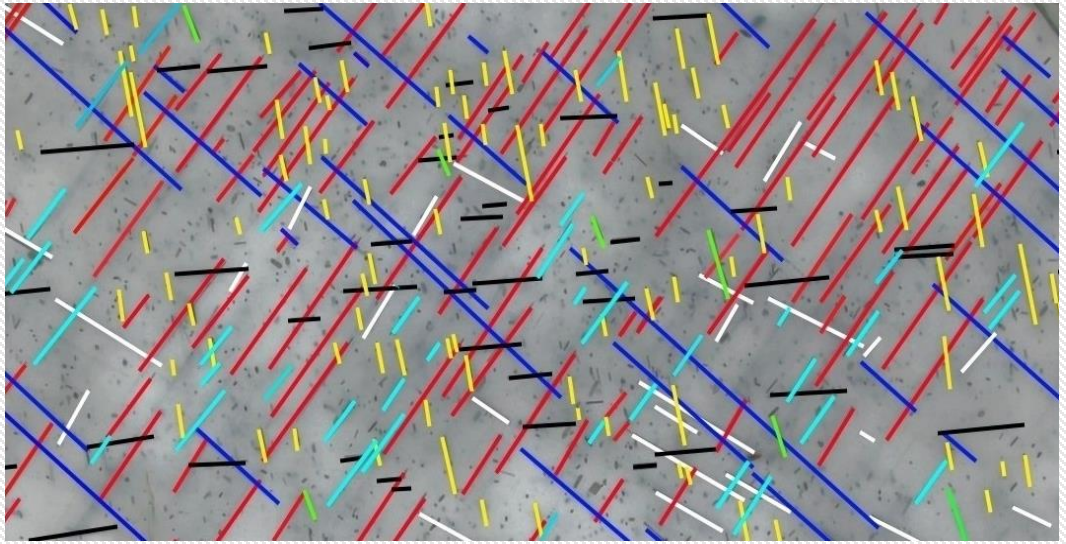
2. Distribution of the oriented inclusions in PL host

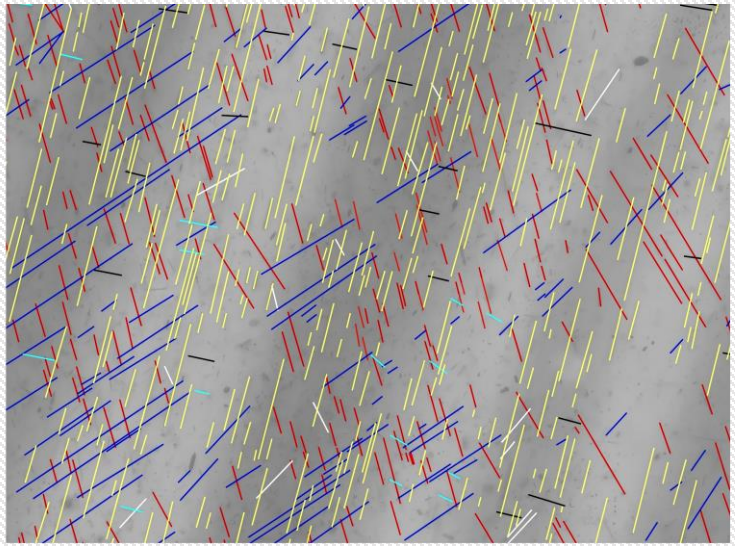












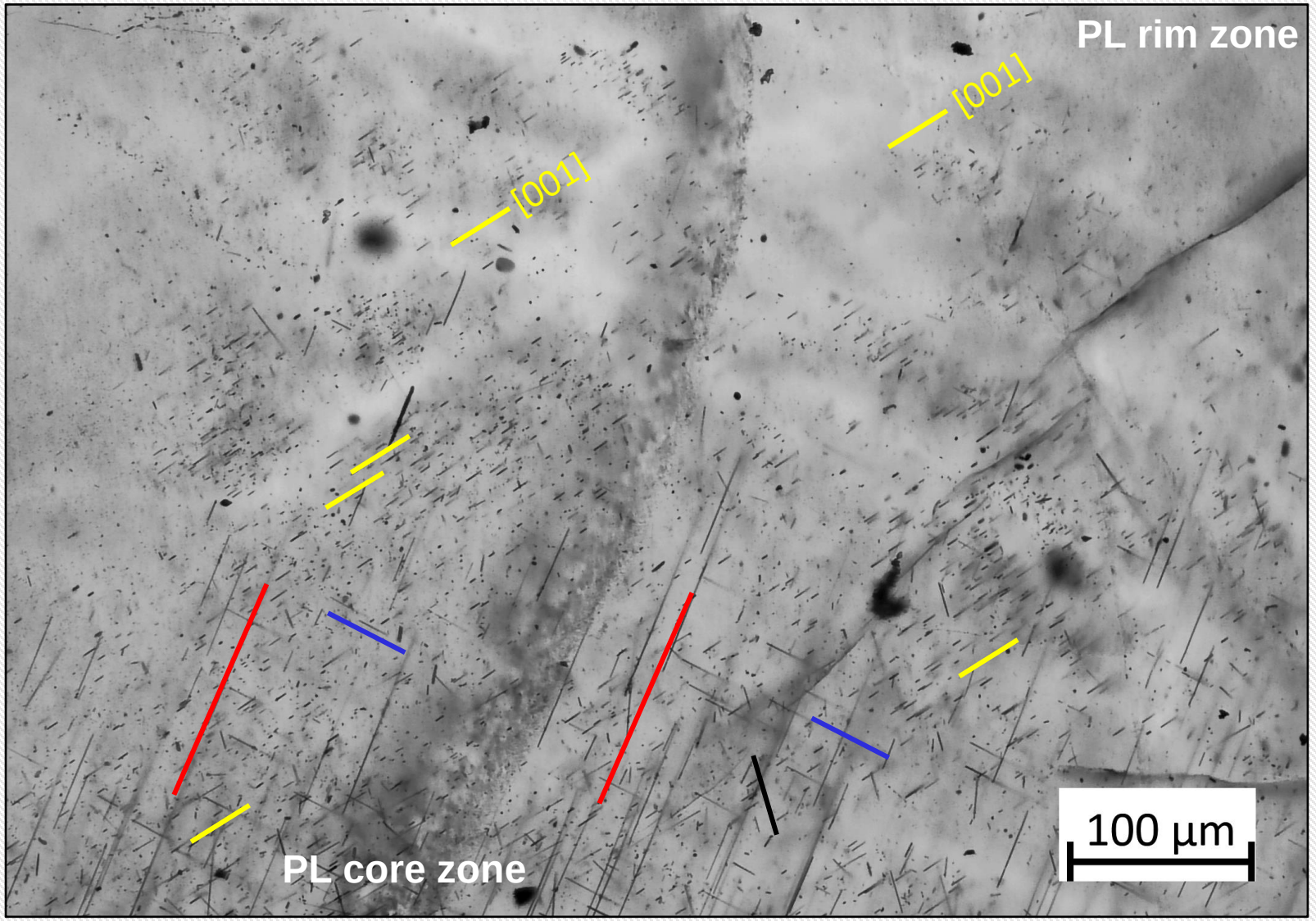
pl[001]-mt: < 5%

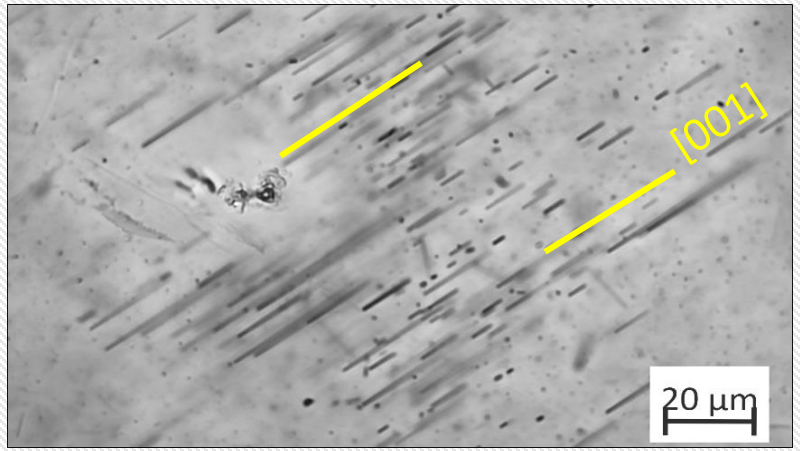
pl[001]-mt: 15%

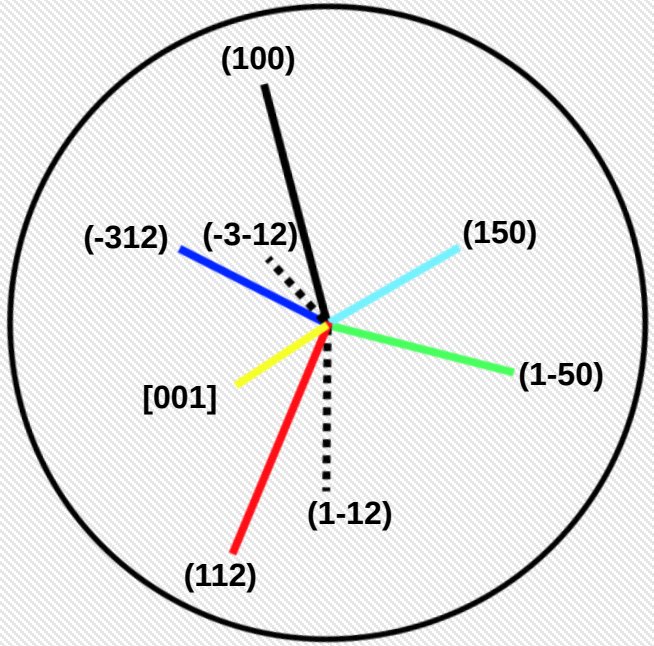
pl[001]-mt: 40%

2. Distribution of the oriented inclusions in PL host

pl[001]-mt: 40-100%



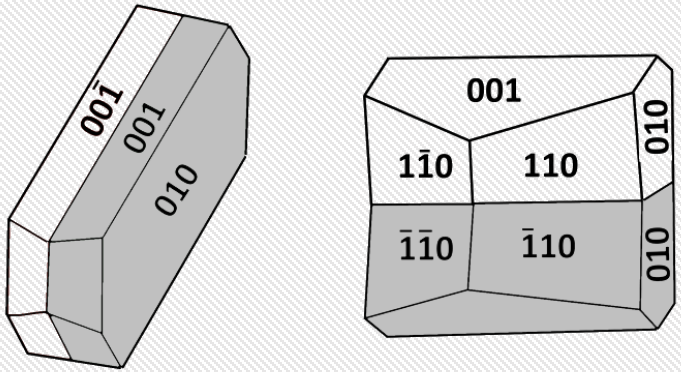




3. Influence of PL twinning

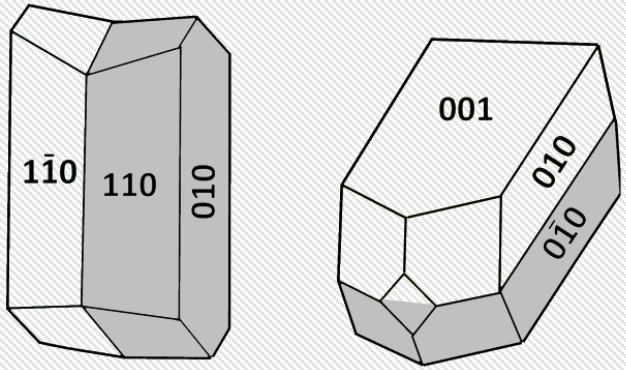
Albite (Ab) **Pericline (Pe)**

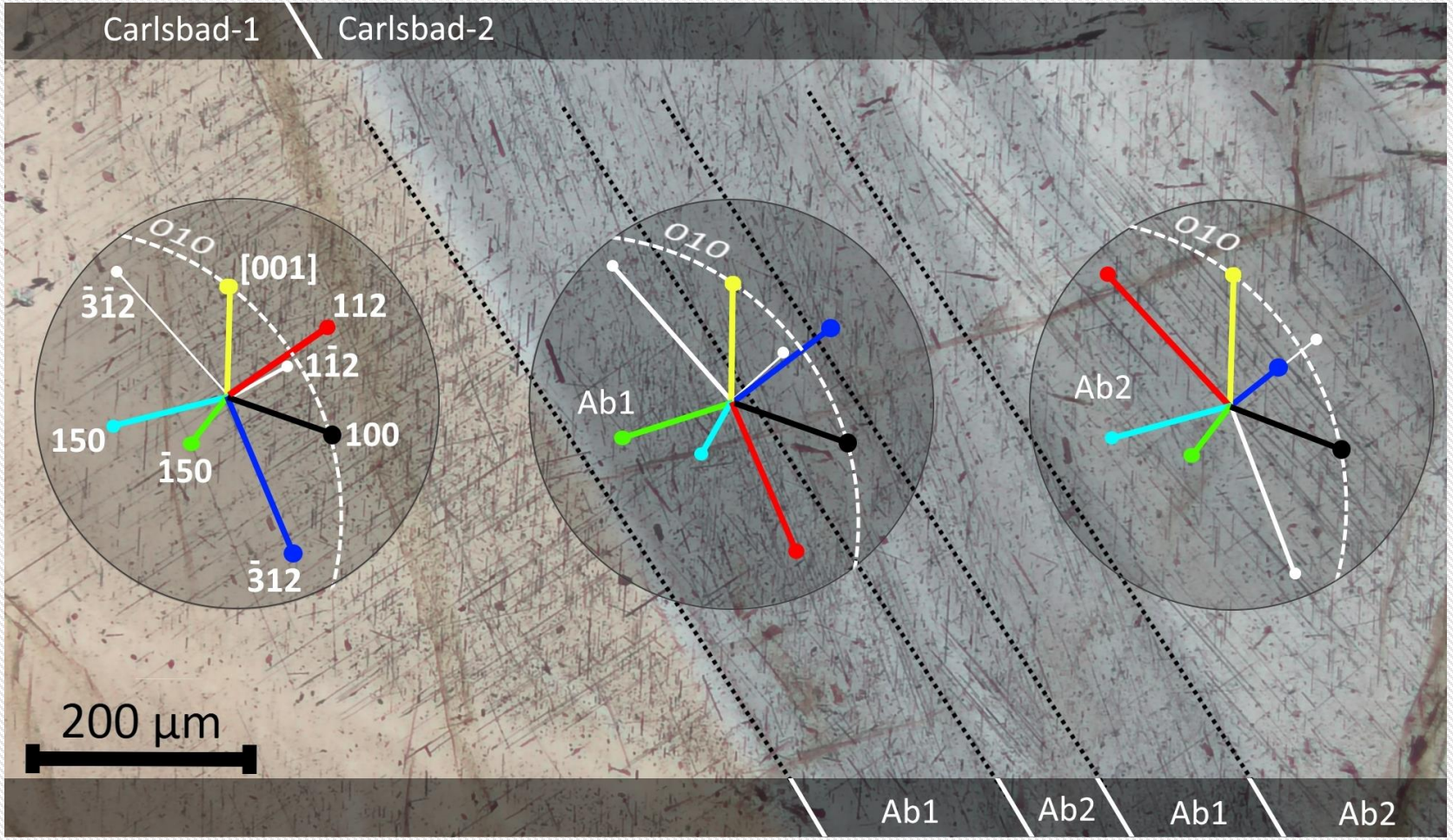
(transformation or deformation twins)



Carlsbad (Cb) **Manebach (Mb)**

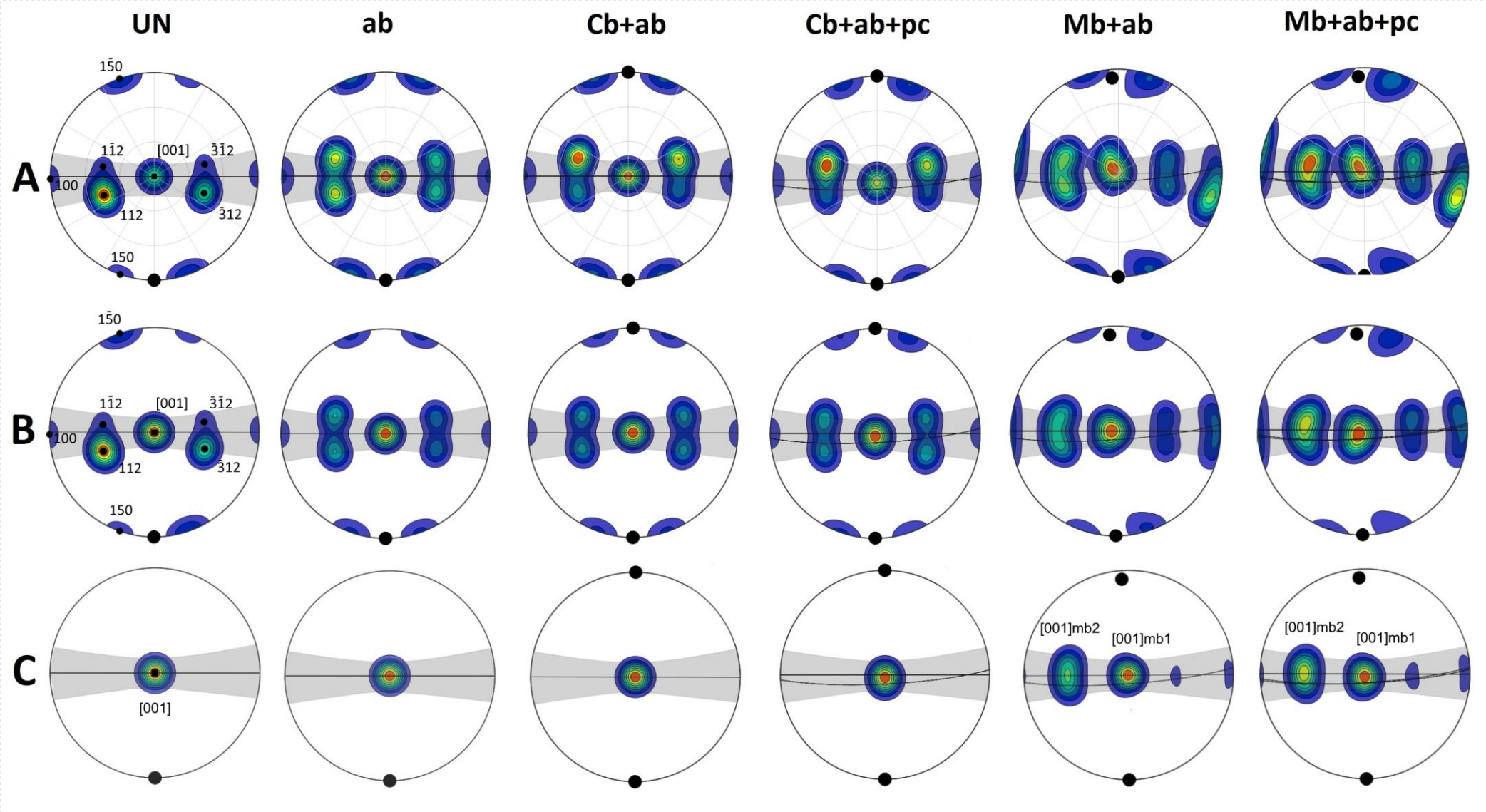
(grow twins)



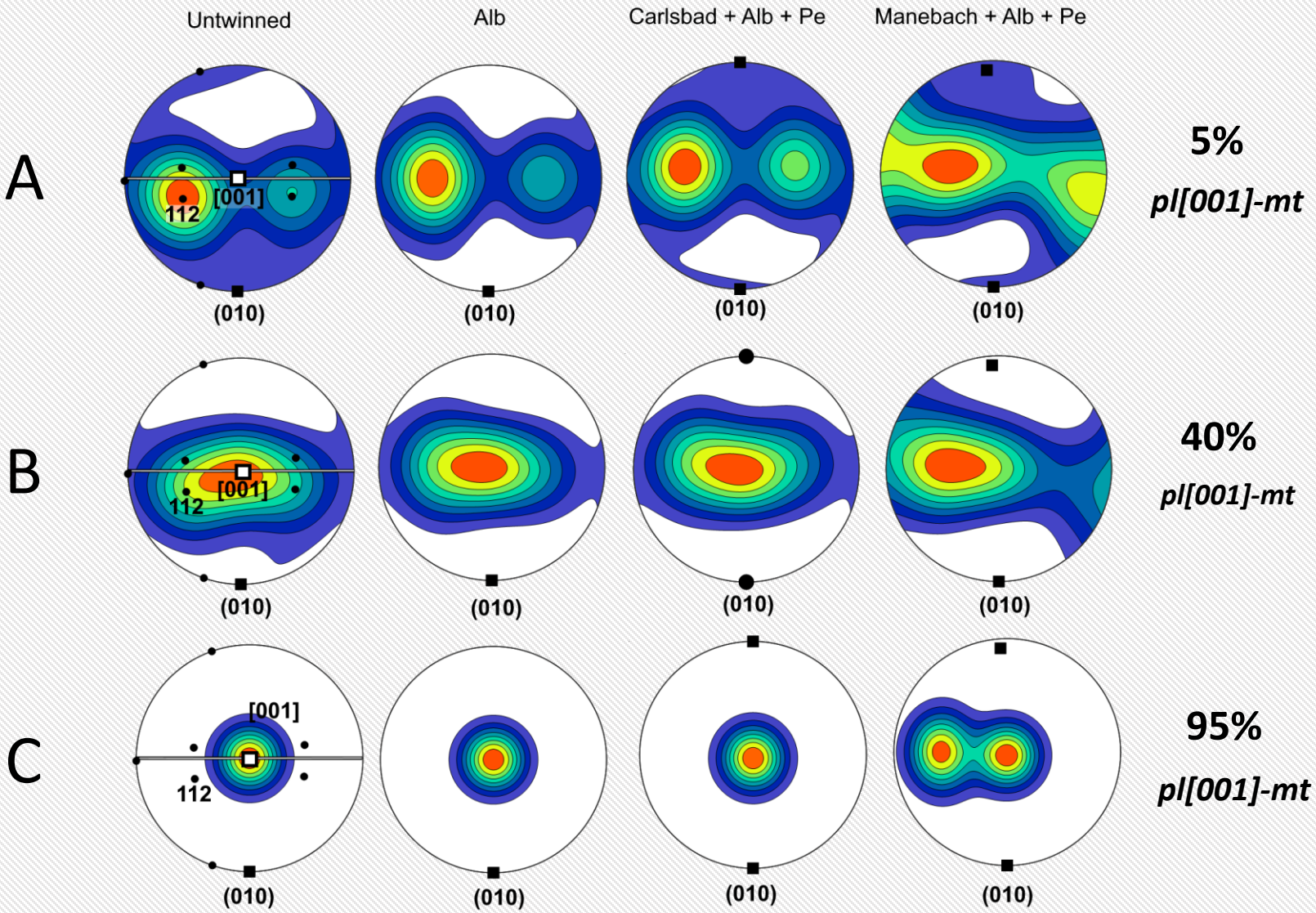


Fragment of plagioclase grain twinned according to Carlsbad and albite laws with magnetite inclusions. Optical image.

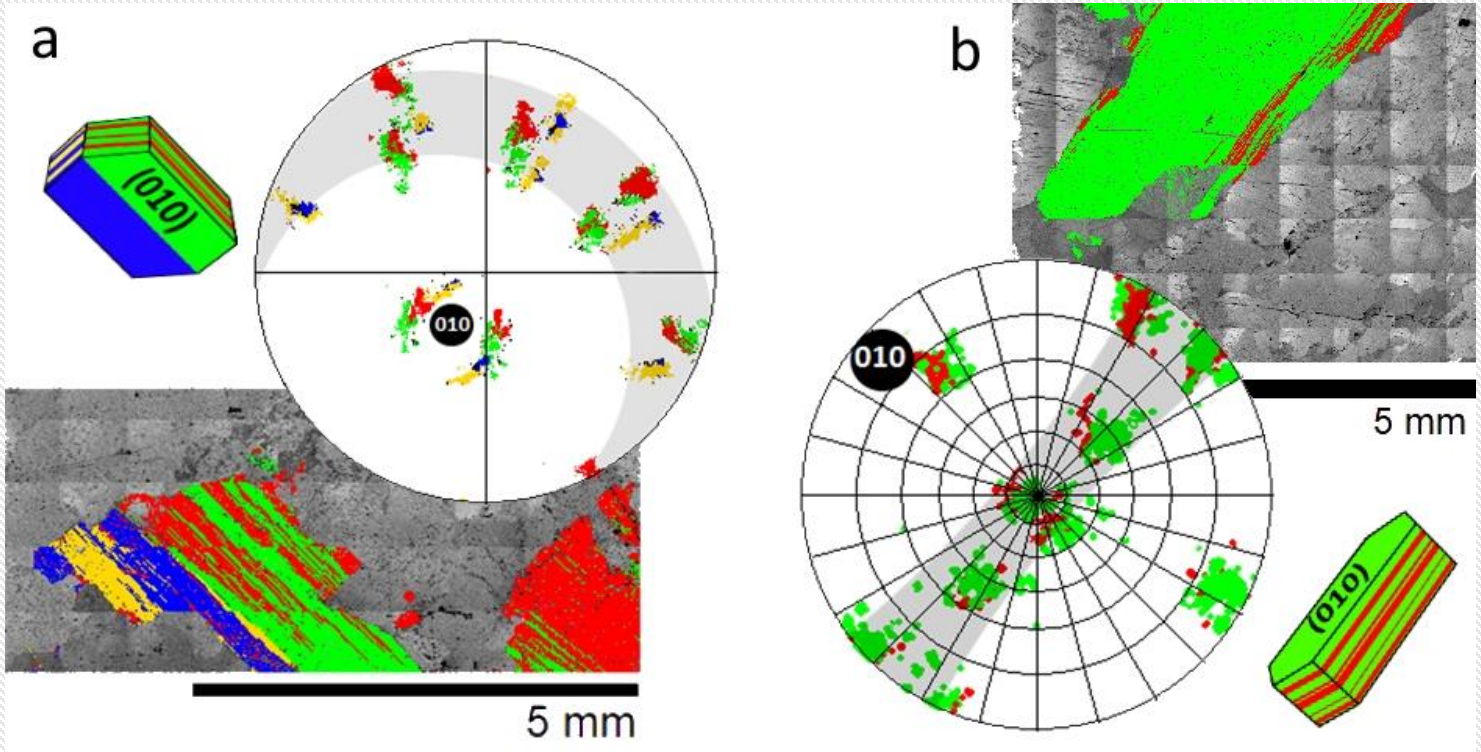
3. Influence of PL twinning



3. Influence of PL twinning

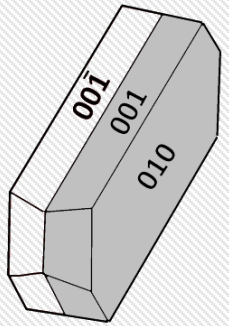


3. Influence of PL twinning

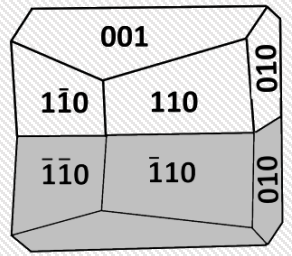


a. Manebach and albite twins

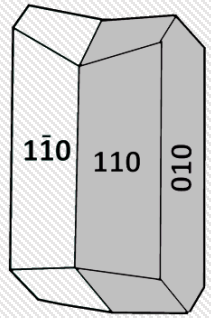
b. Albite twins



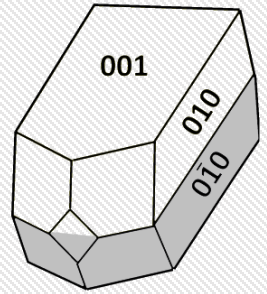
Albite twins



Pericline twins

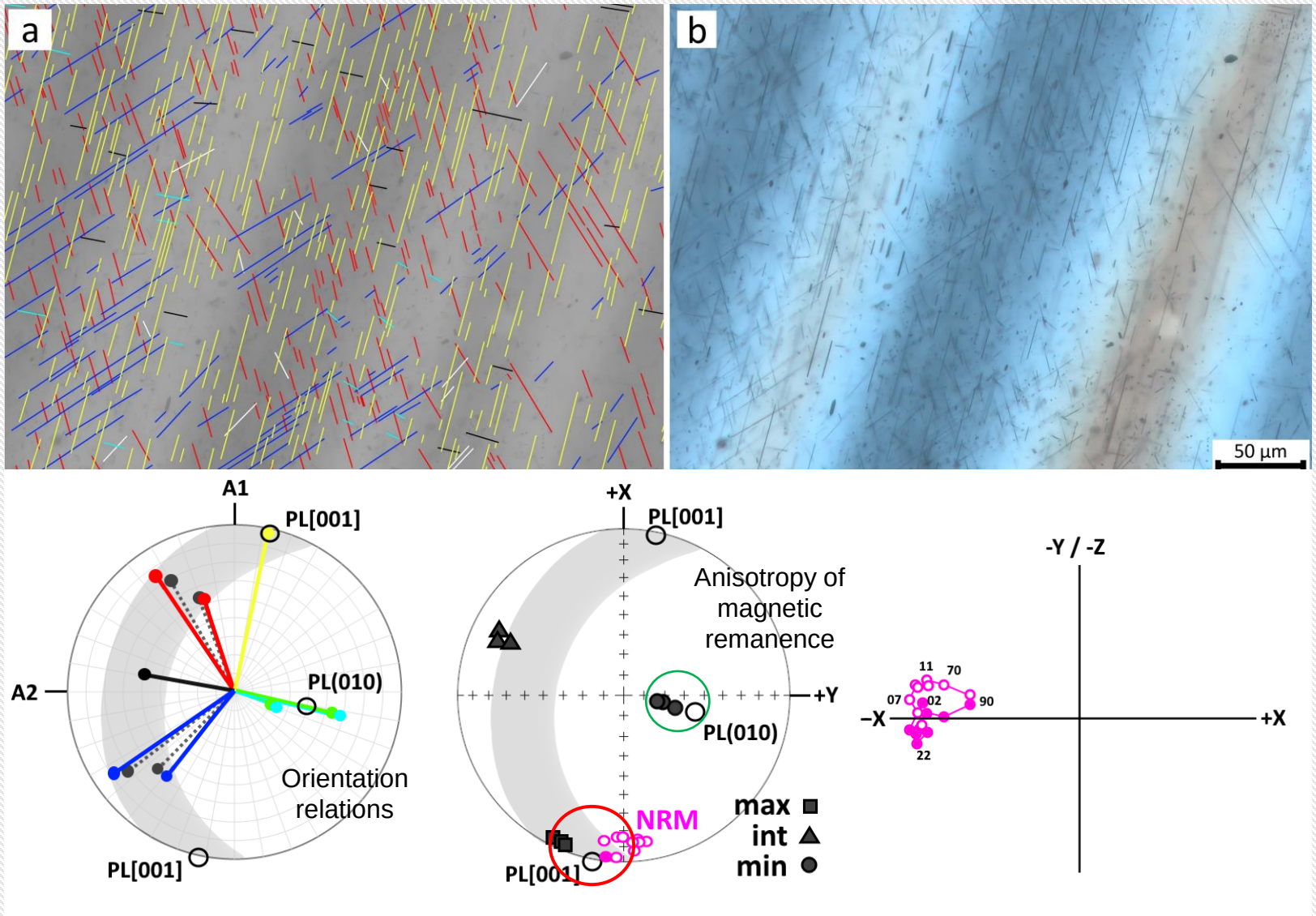


Carlsbad twins



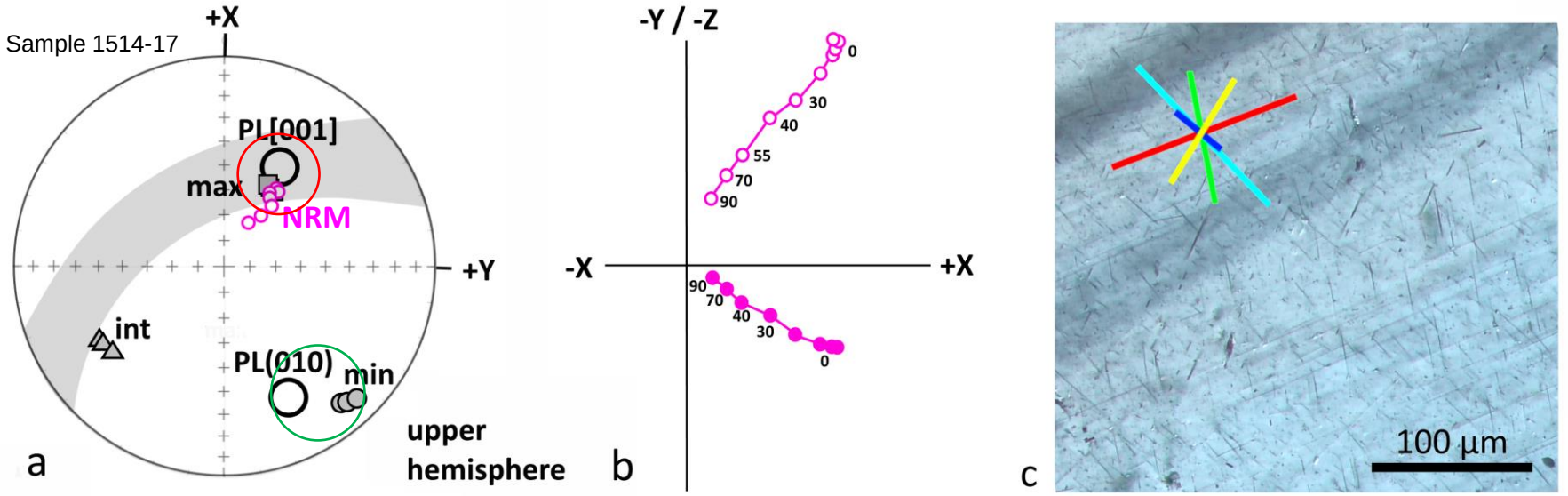
Manebach twins

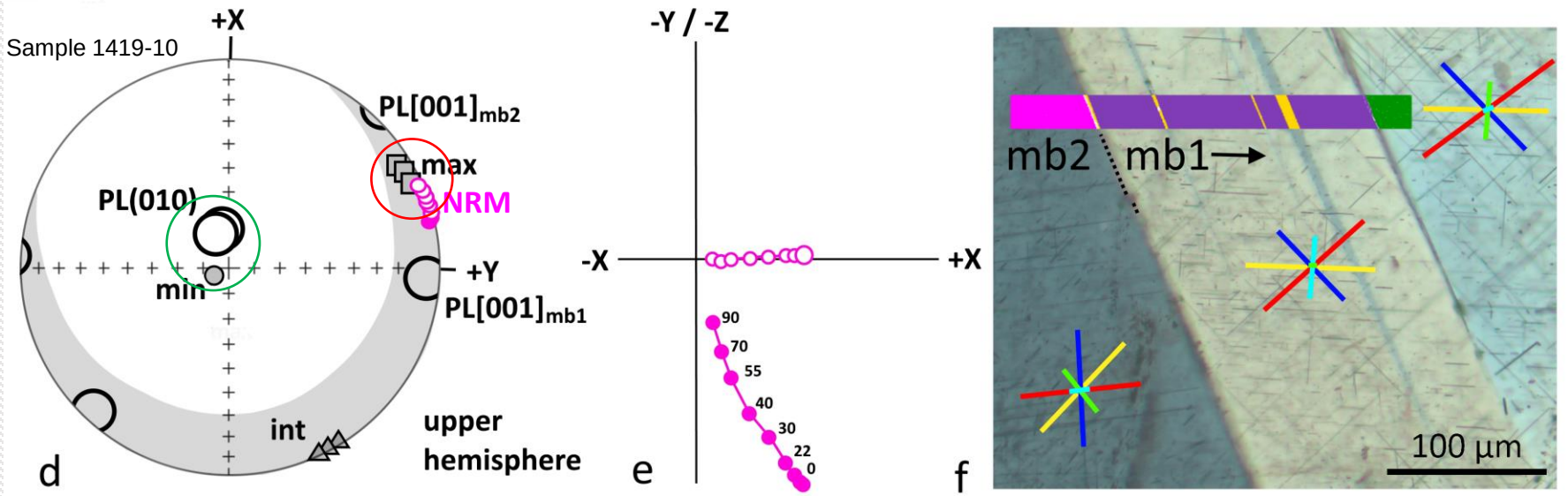
4. Bulk magnetic anisotropy

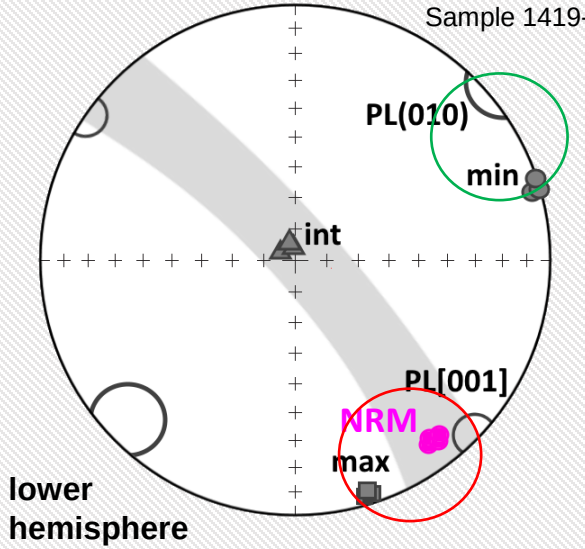


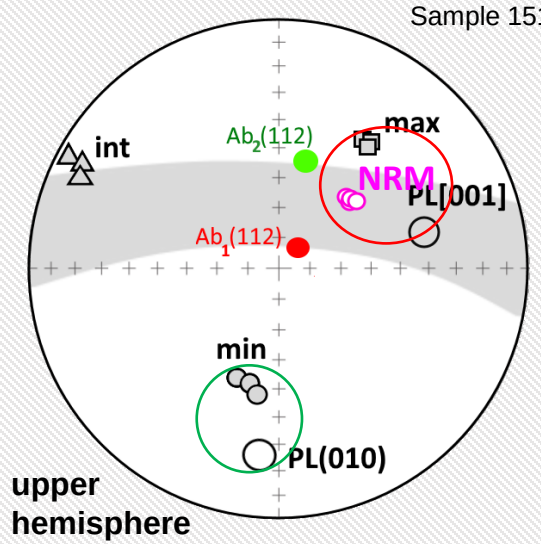
Sample L32-277-7

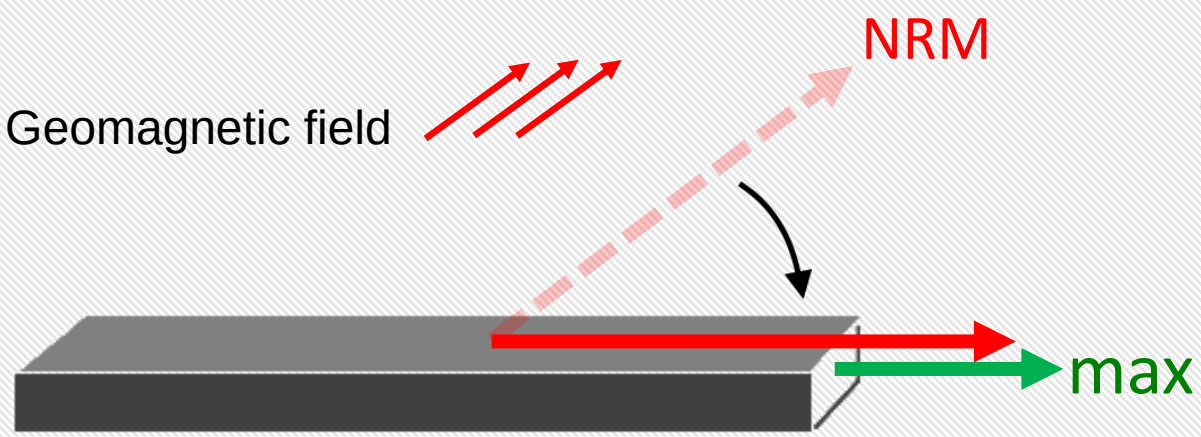
4. Bulk magnetic anisotropy

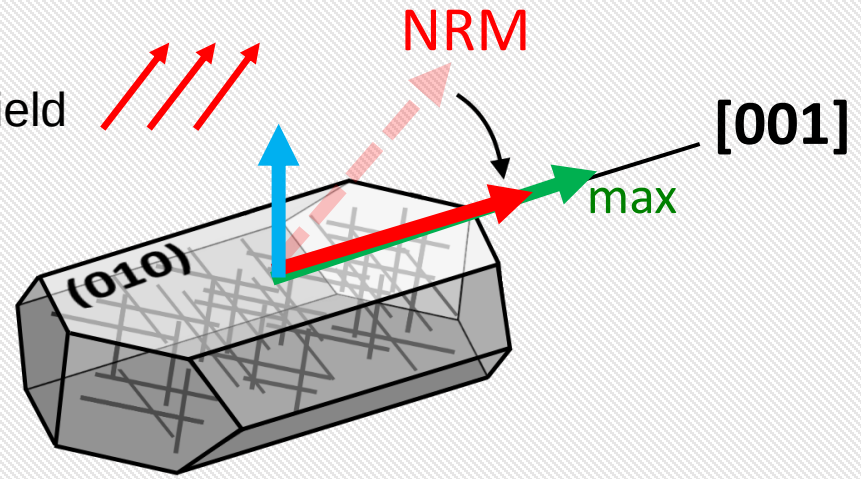


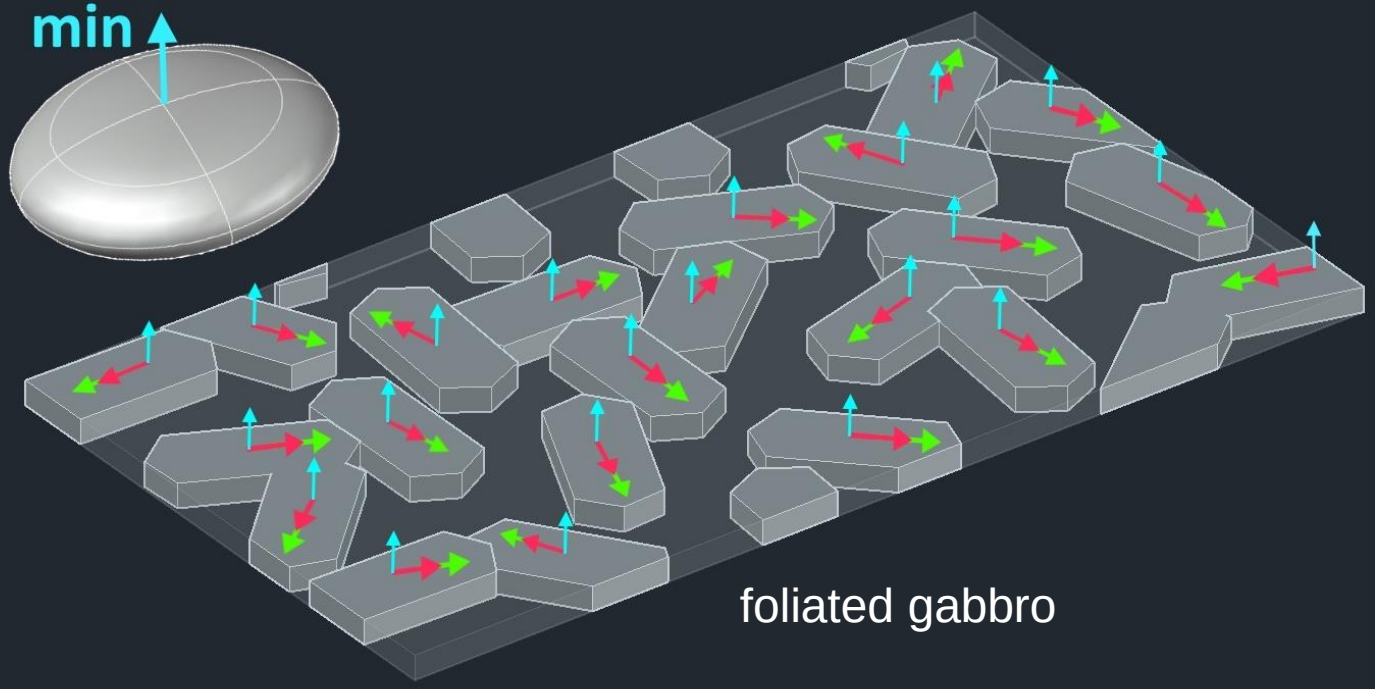




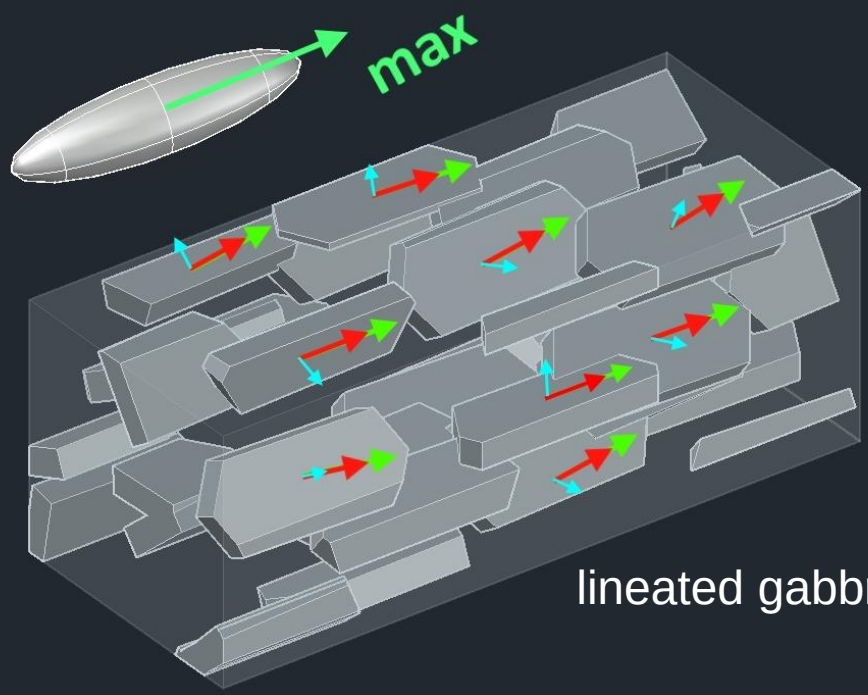




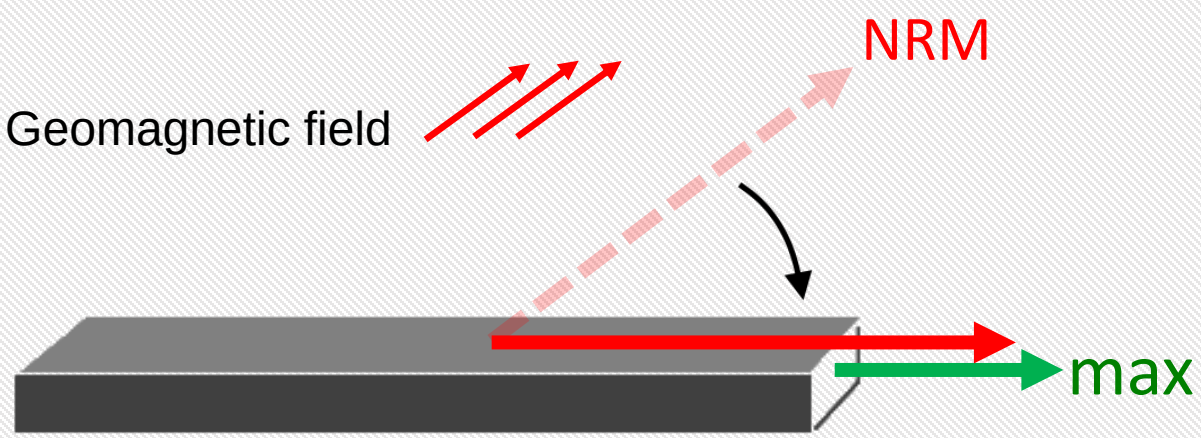


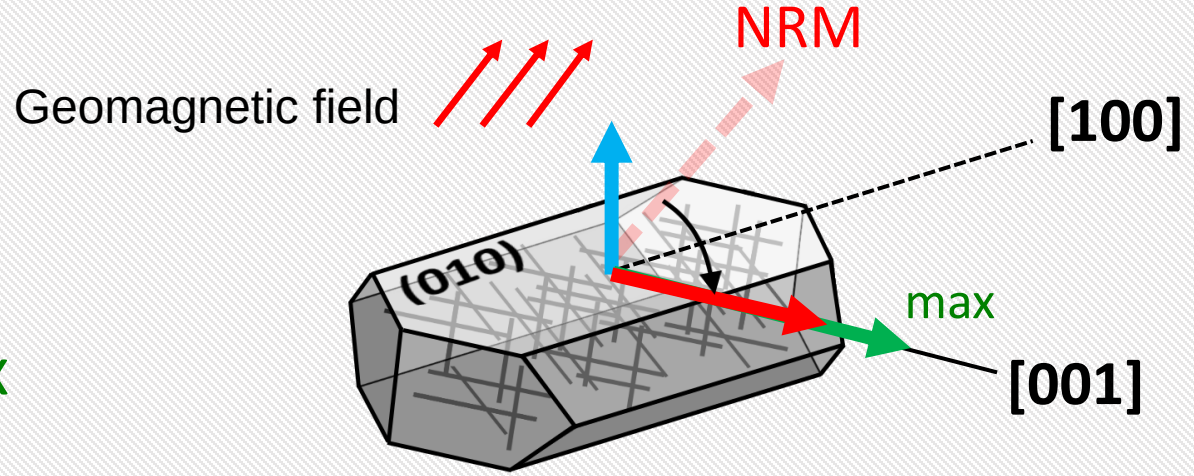


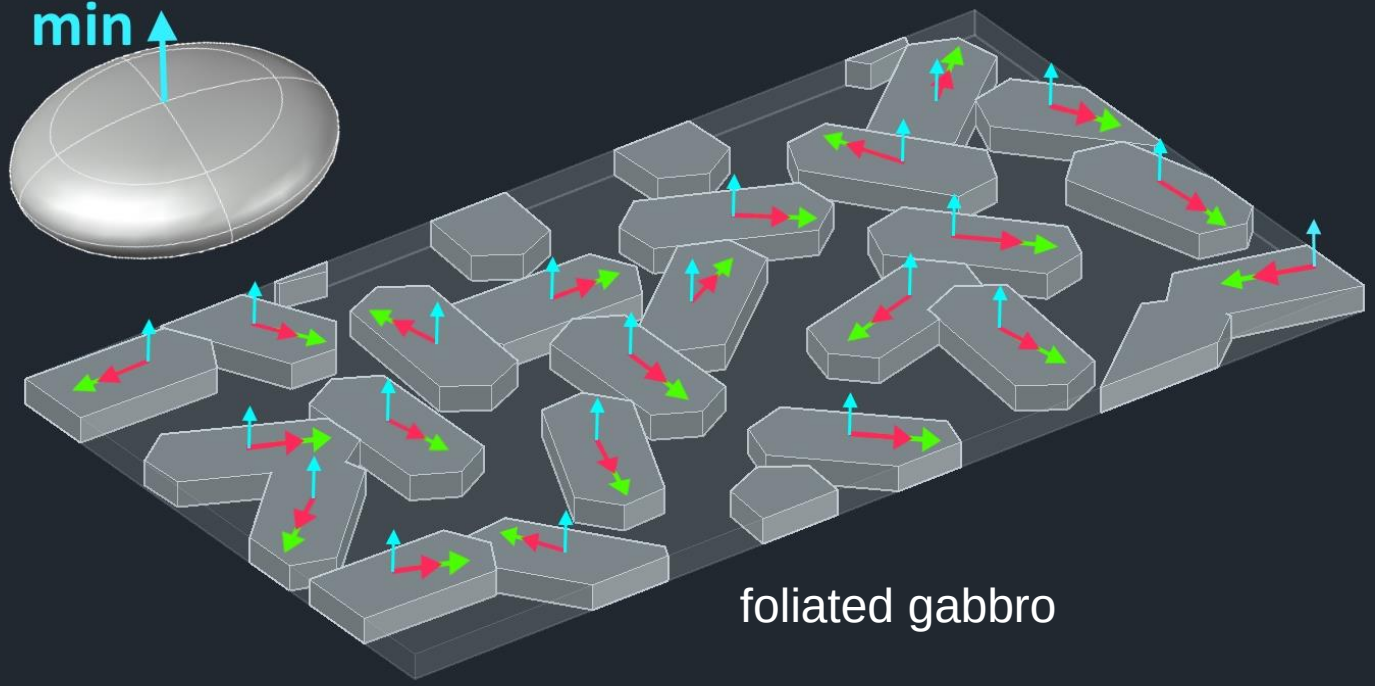
foliated gabbro

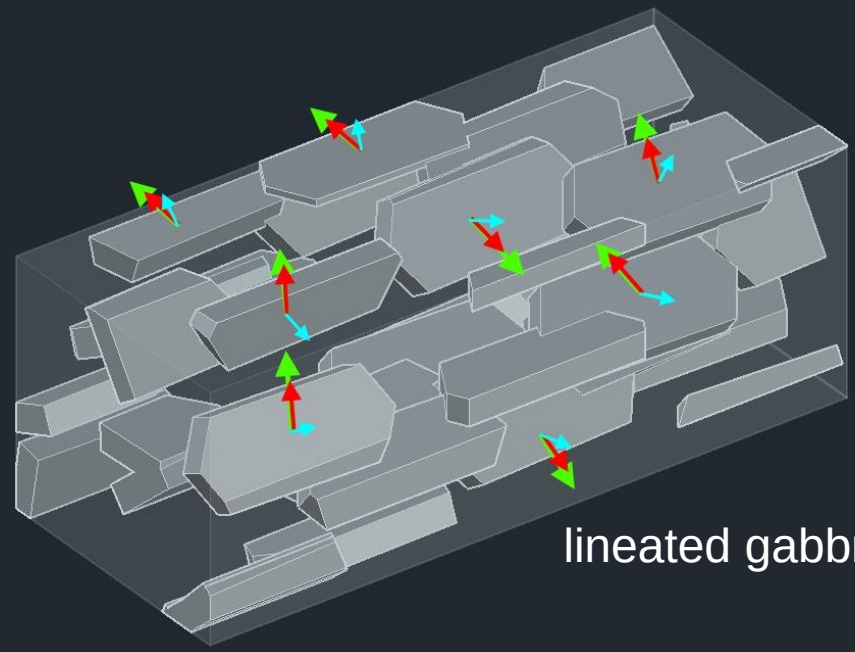


lineated gabbro


Geomagnetic field
NRM
max


Geomagnetic field
NRM
[100]
(010)
max
[001]


min
foliated gabbro


lineated gabbro

Anisotropy in shape orientation of the magnetite inclusions causes ferromagnetic anisotropy in plagioclase host and results in deflection of vector of natural remanent magnetization.

In oceanic gabbro with preferred alignment of plagioclase grains, the inclusions may form or contribute to bulk-rock ferromagnetic fabric.

Publication:

Ageeva, O., Habler, G., Gilder, S. A., Schuster, R., Pertsev, A., Pilipenko, O., Bian, G. & Abart, R. (2022). Oriented magnetite inclusions in plagioclase: Implications for the anisotropy of magnetic remanence. *Geochemistry, Geophysics, Geosystems*, – 2022. – Т. 23. – №. 2.