

The problem of deriving bulk rock behaviour of heterogeneously deforming crystalline aggregates

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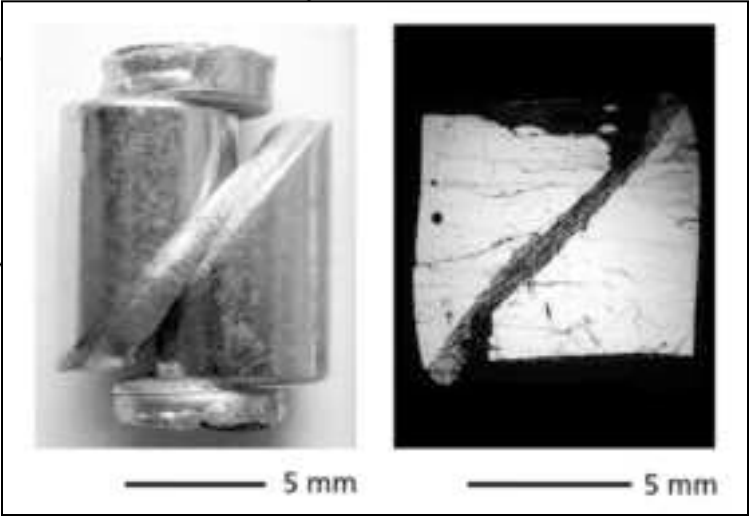
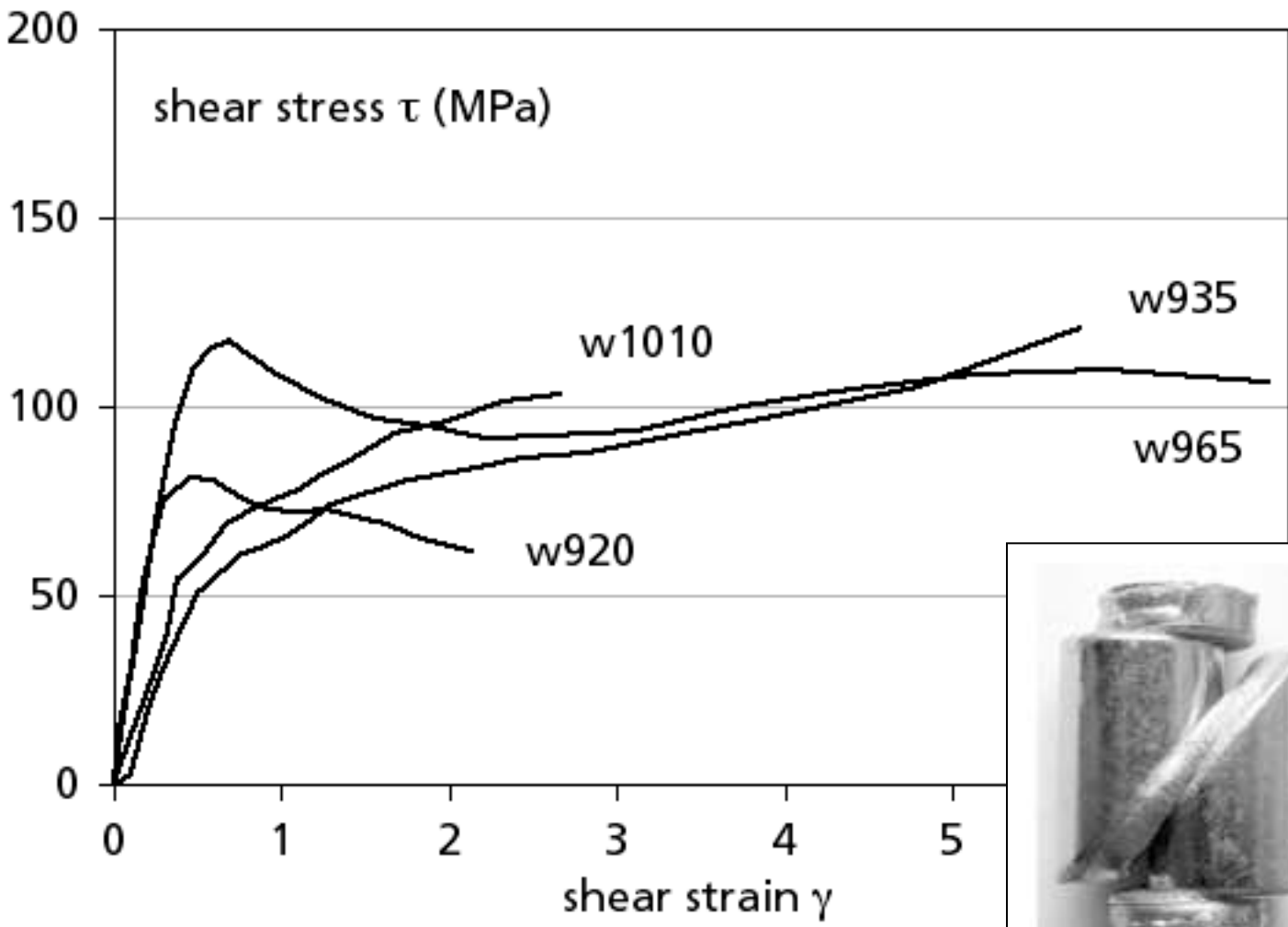
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<http://www.unibas.ch/earth/micro>

The problem of deriving bulk of heterogeneously deforming **quartz**

CPO

- 1-experimental shear deformation of quartzite
- 2-natural shear deformation of quartz in granitoid
- 3-bulk from parts
- 4-re-addressing the question

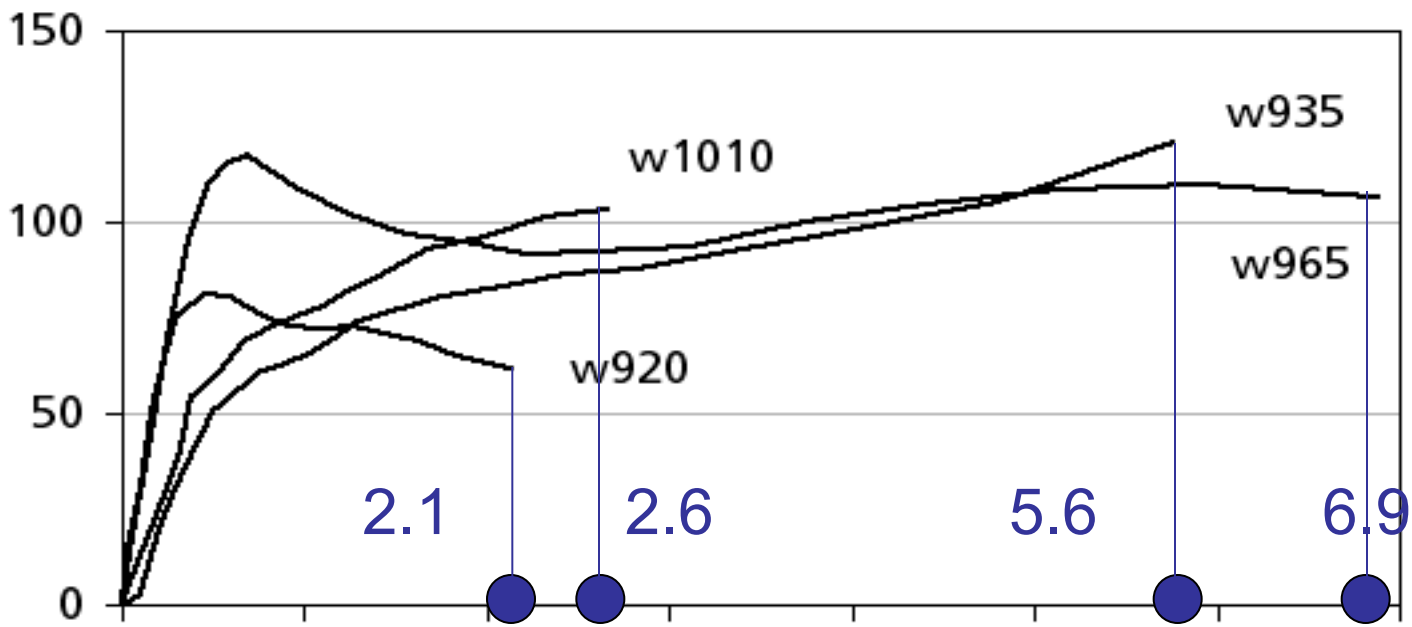
1-experimental shear deformation of quartzite



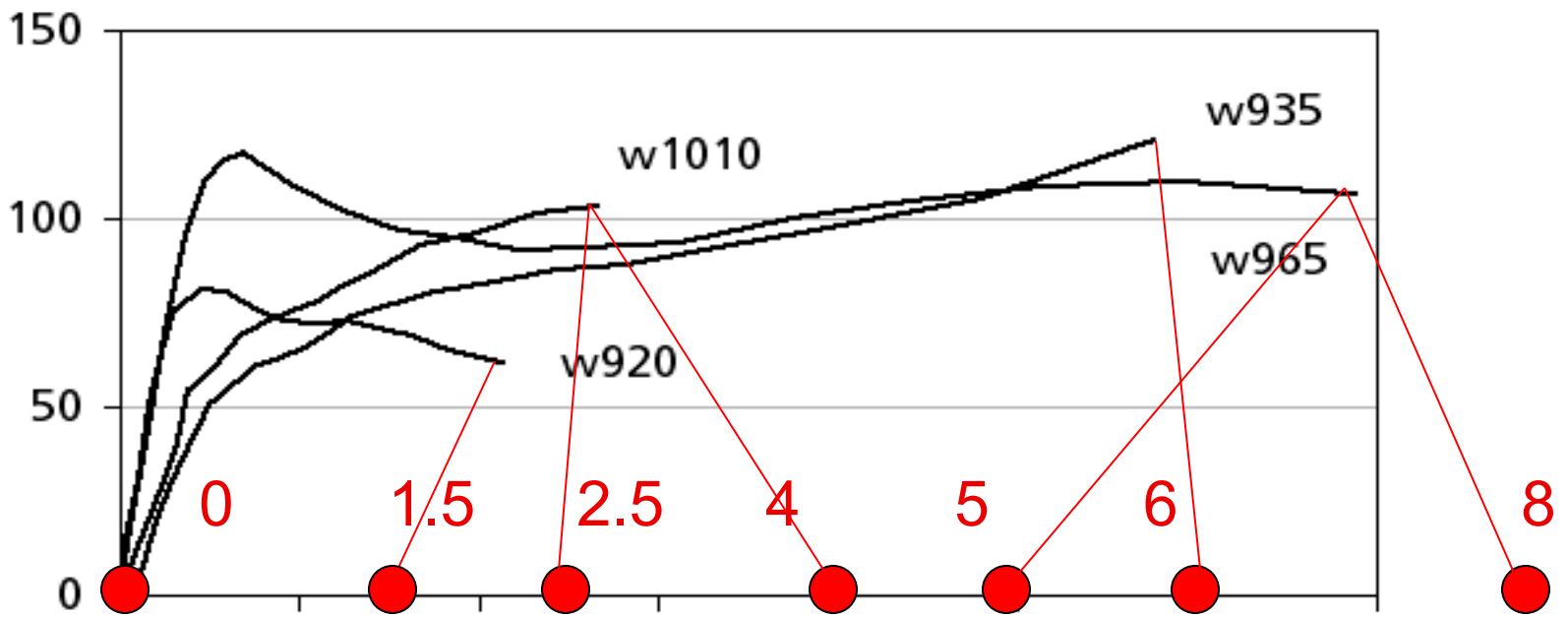
Black Hills Quartzite, $d \sim 100\mu\text{m}$
 $p_c = 1.5\text{GPa}$ (NaCl solid medium), $T = 900^\circ\text{C}$

1-experimental shear deformation of quartzite

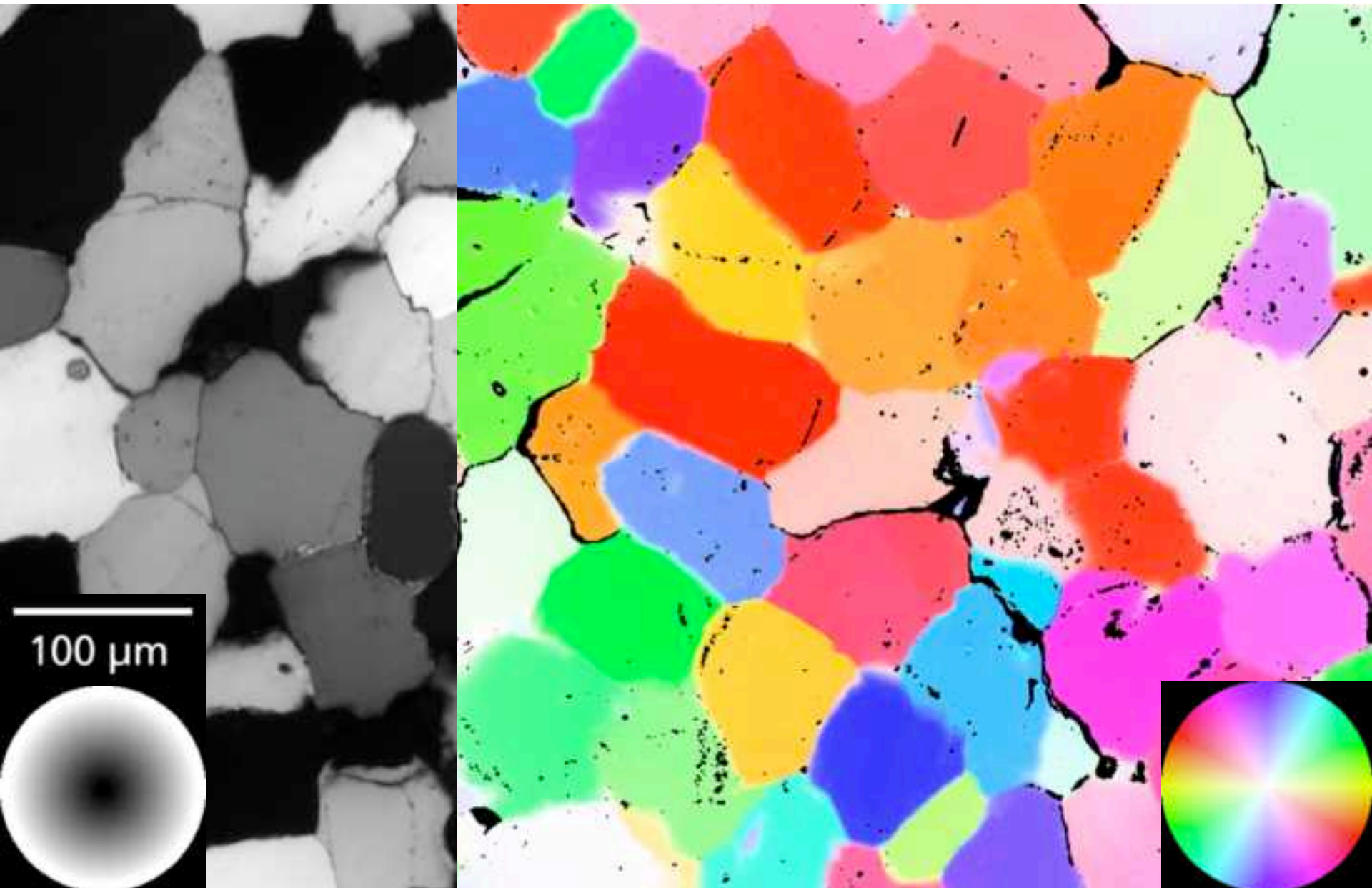
sample
(bulk)
strain



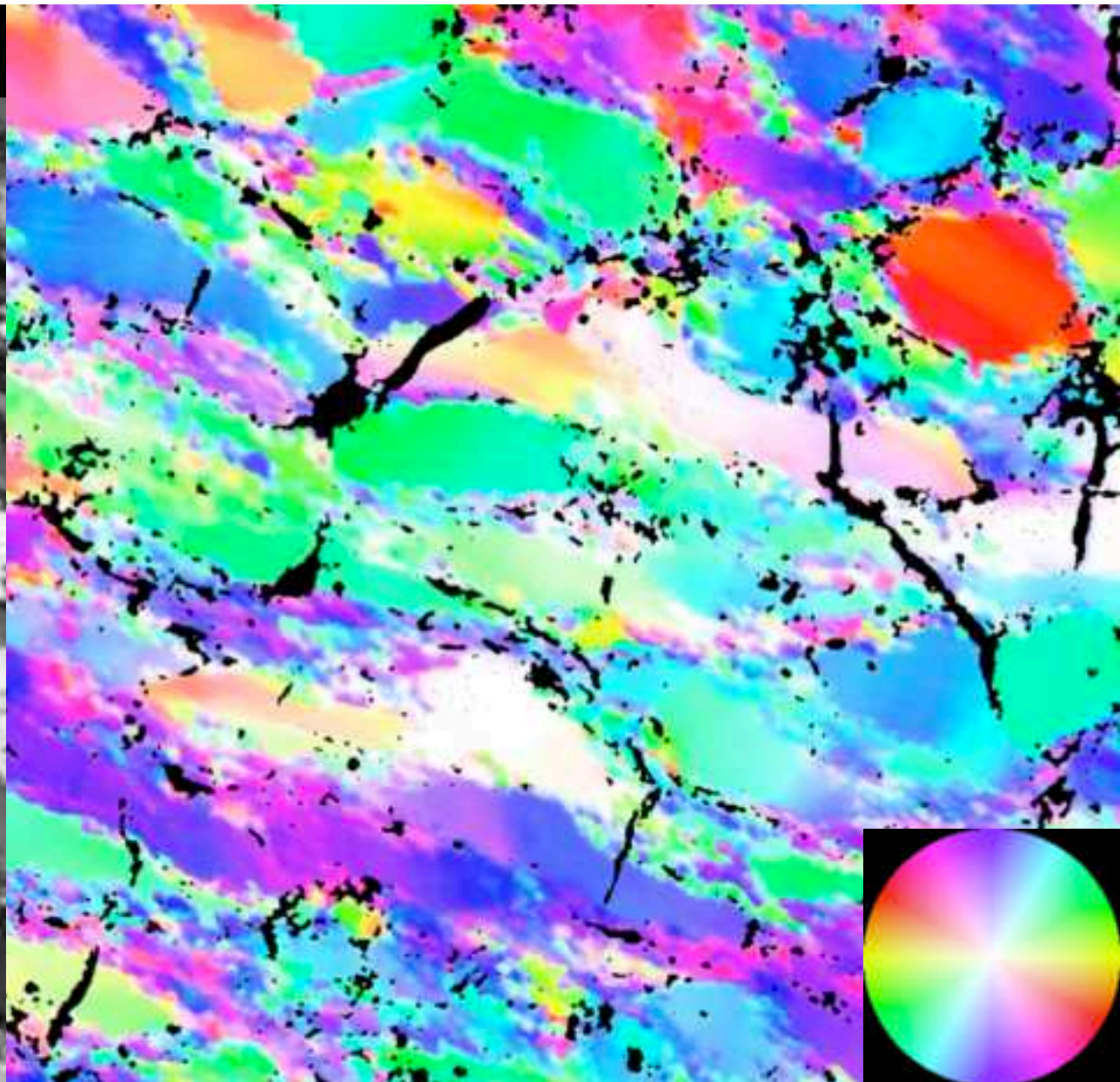
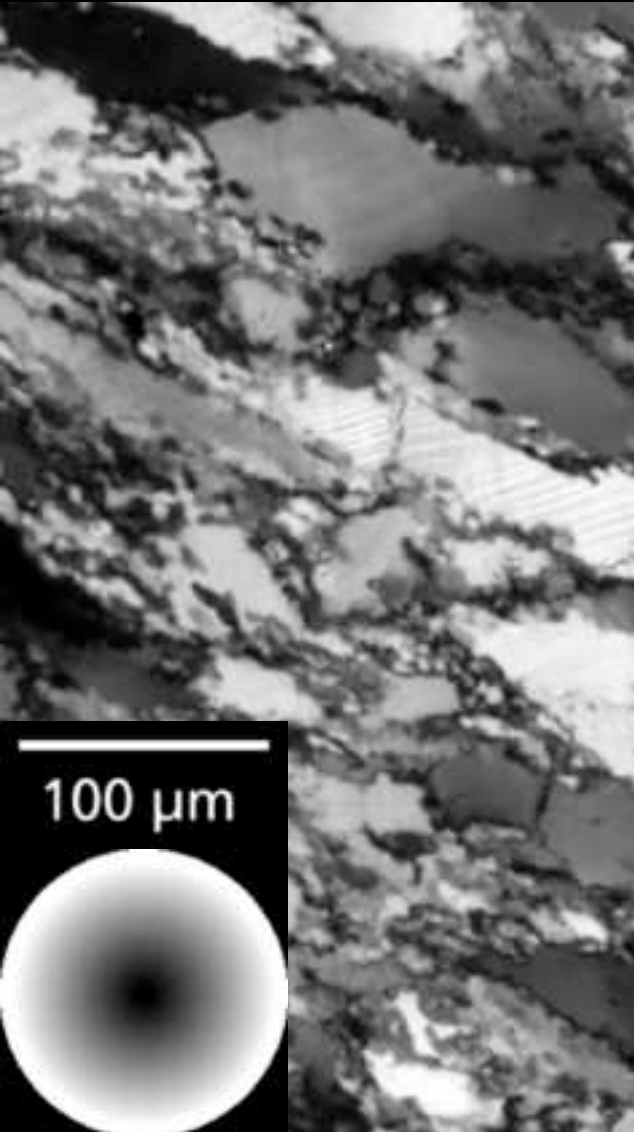
site
(local)
strain



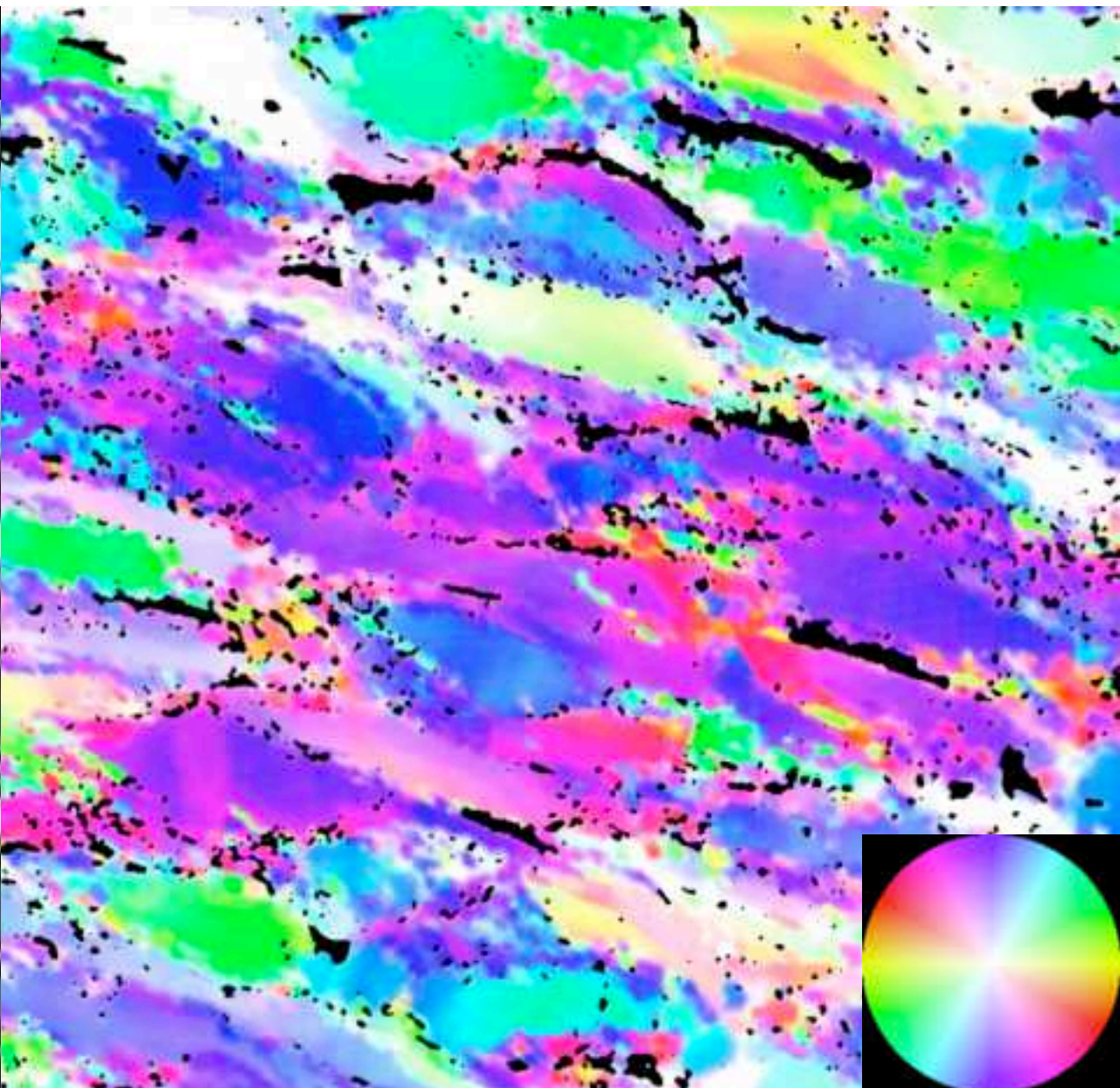
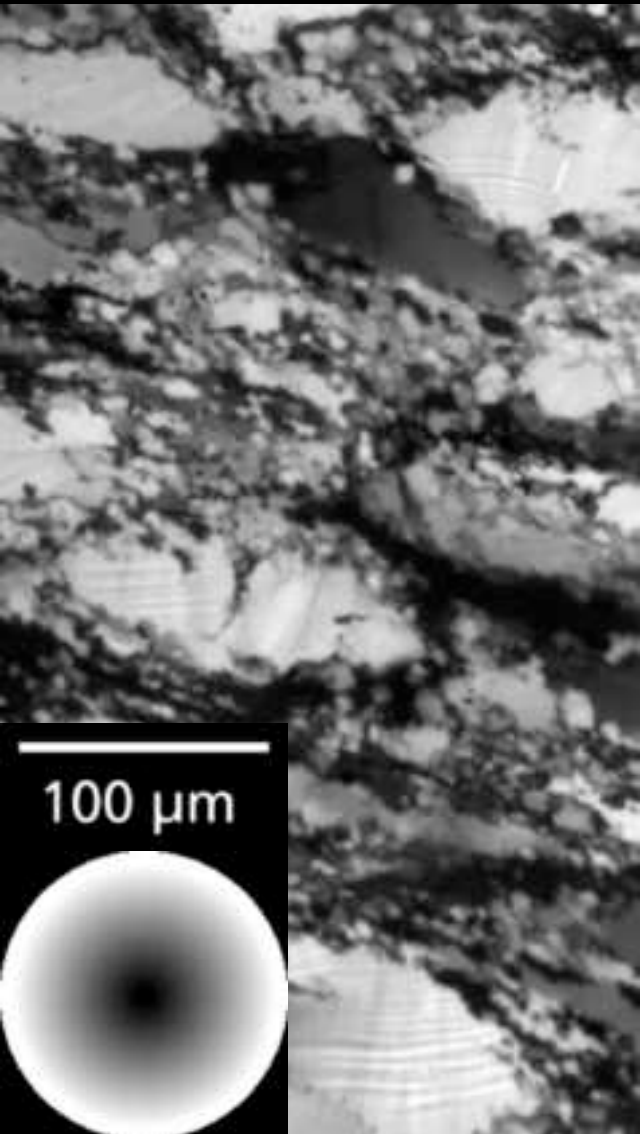
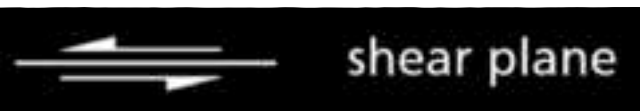
1-experimental shear deformation of quartzite



1-experimental shear deformation of quartzite

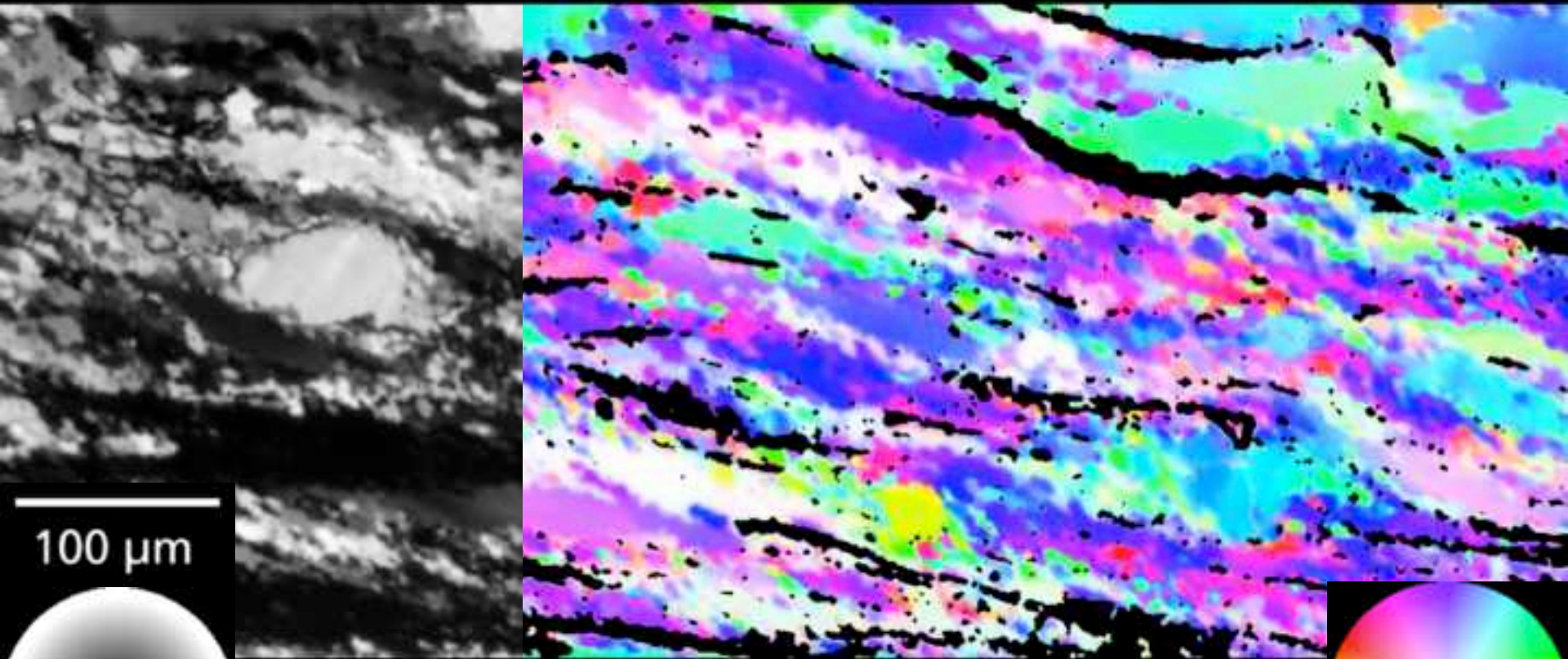


1-experimental shear deformation of quartzite



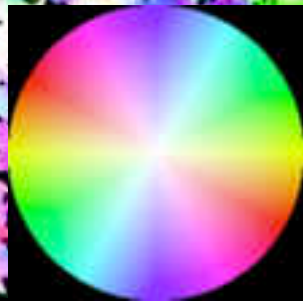
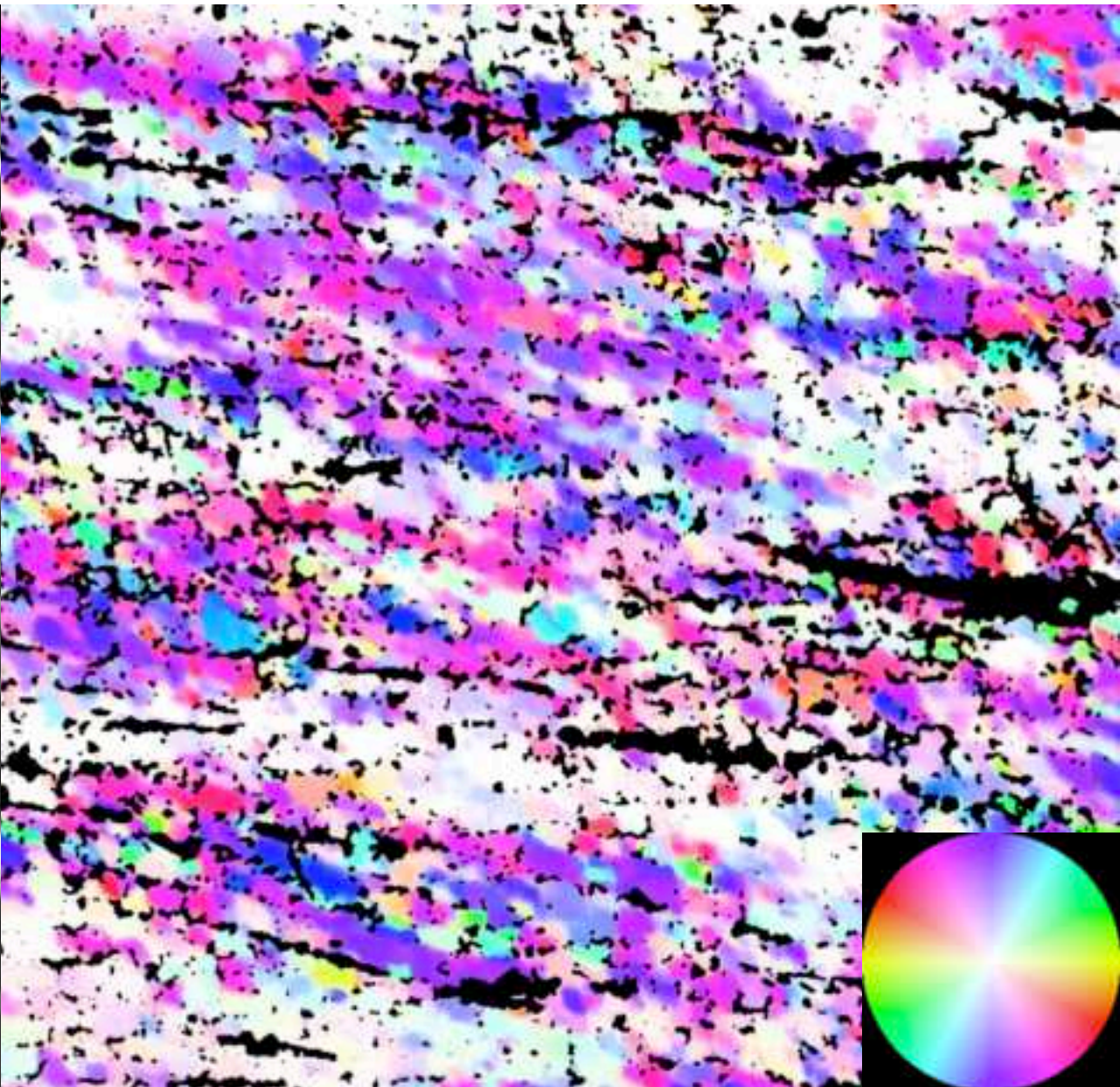
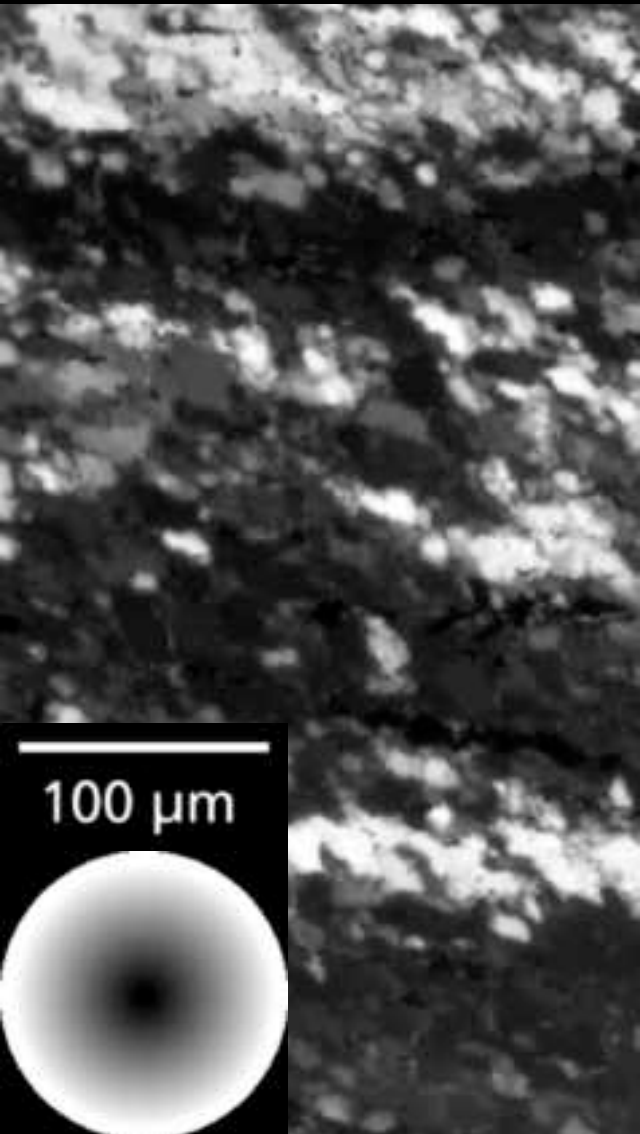
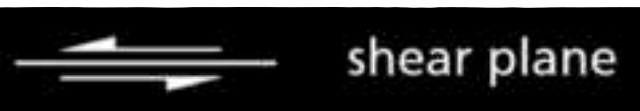
1-experimental shear deformation of quartzite

 shear plane



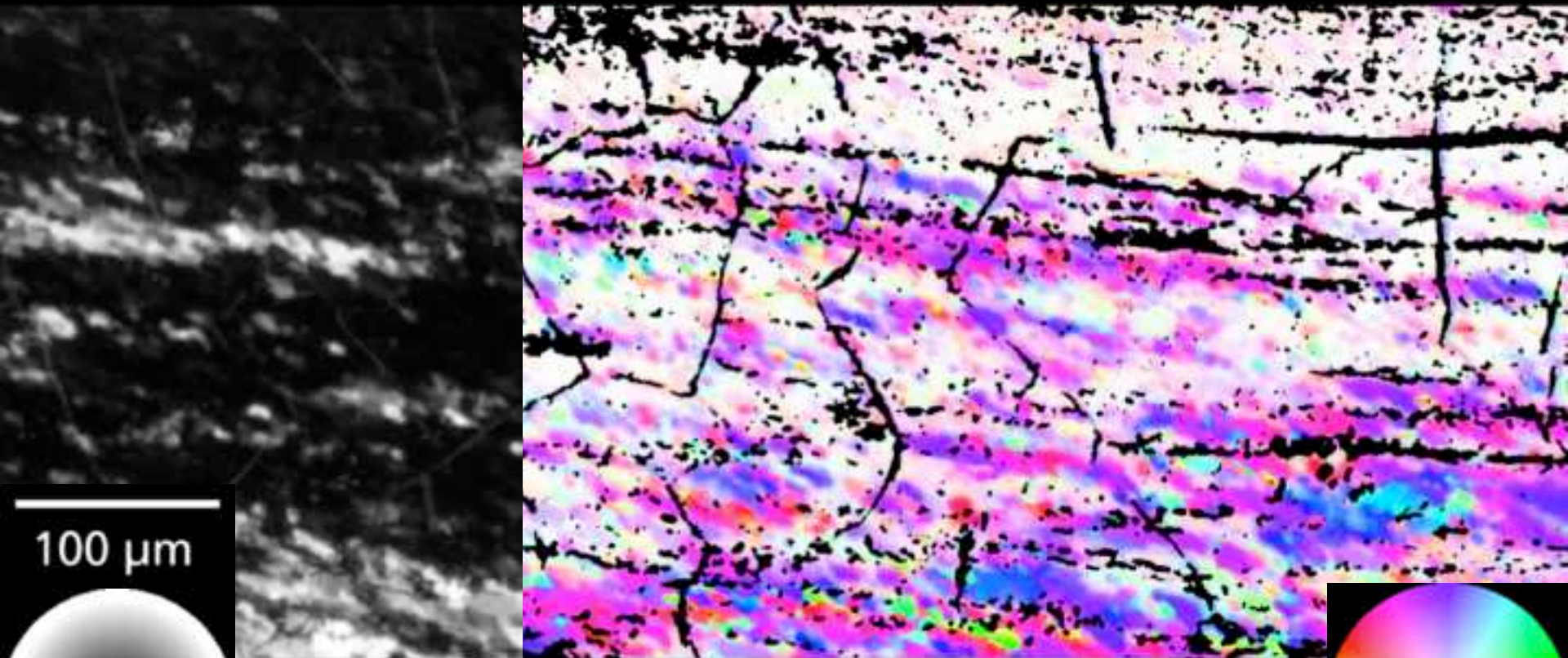
100 μm

1-experimental shear deformation of quartzite

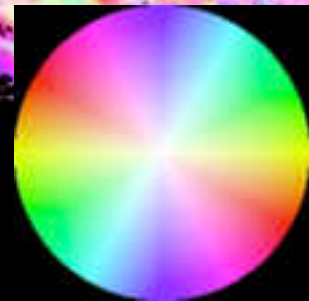


1-experimental shear deformation of quartzite

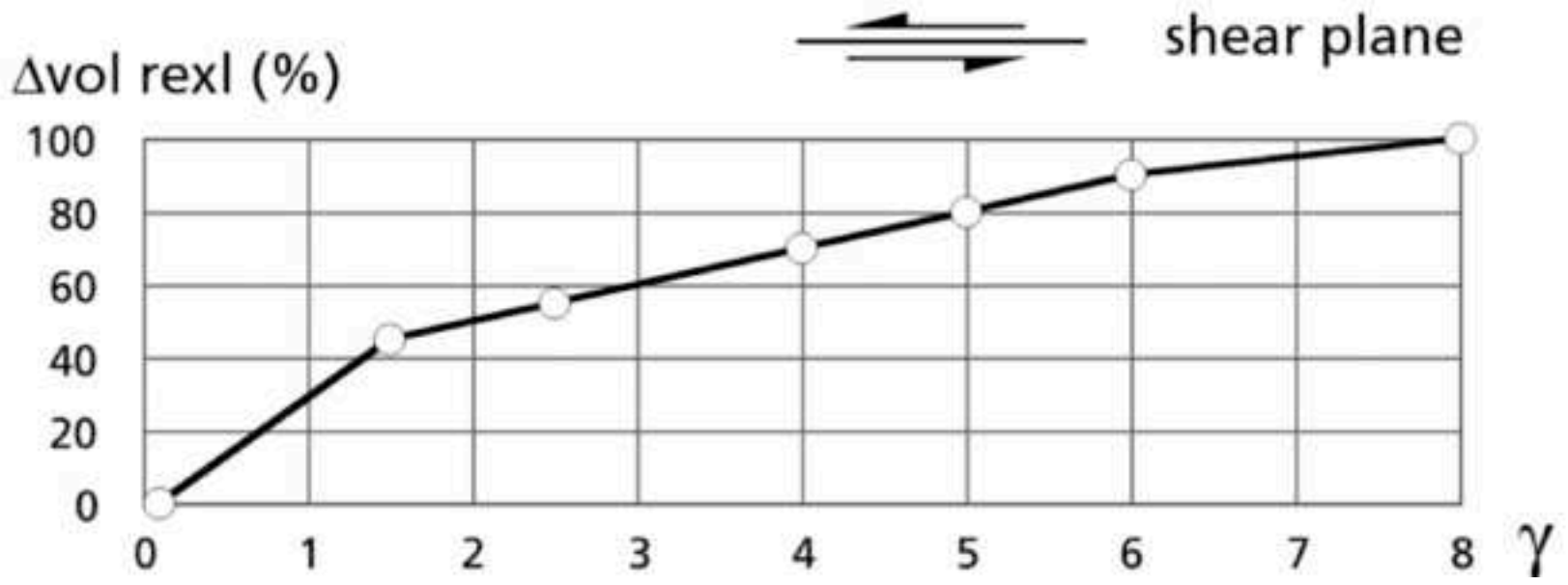
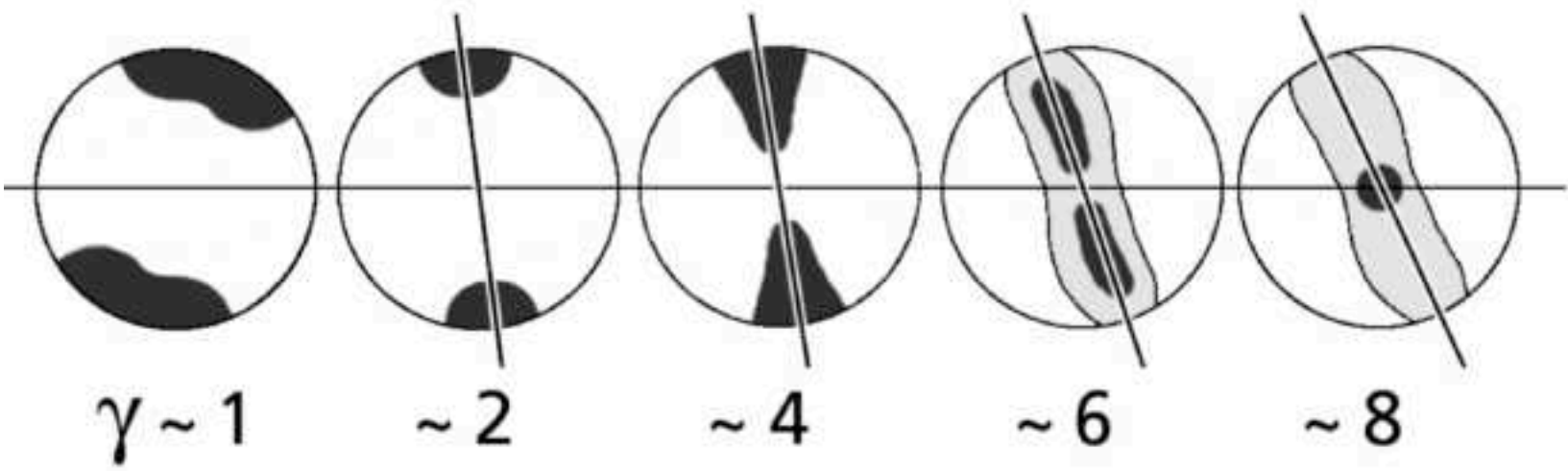
 shear plane



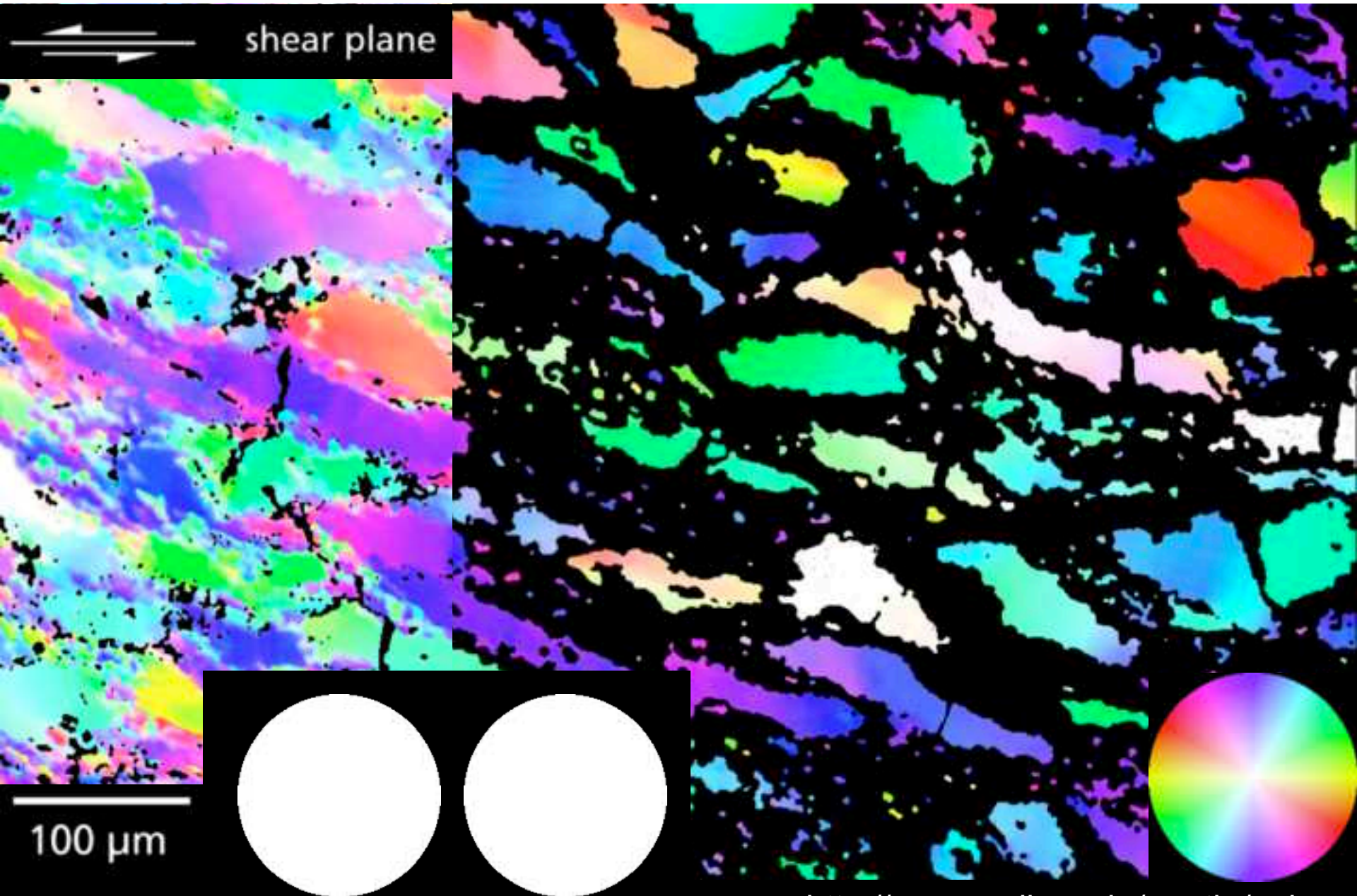
100 μm



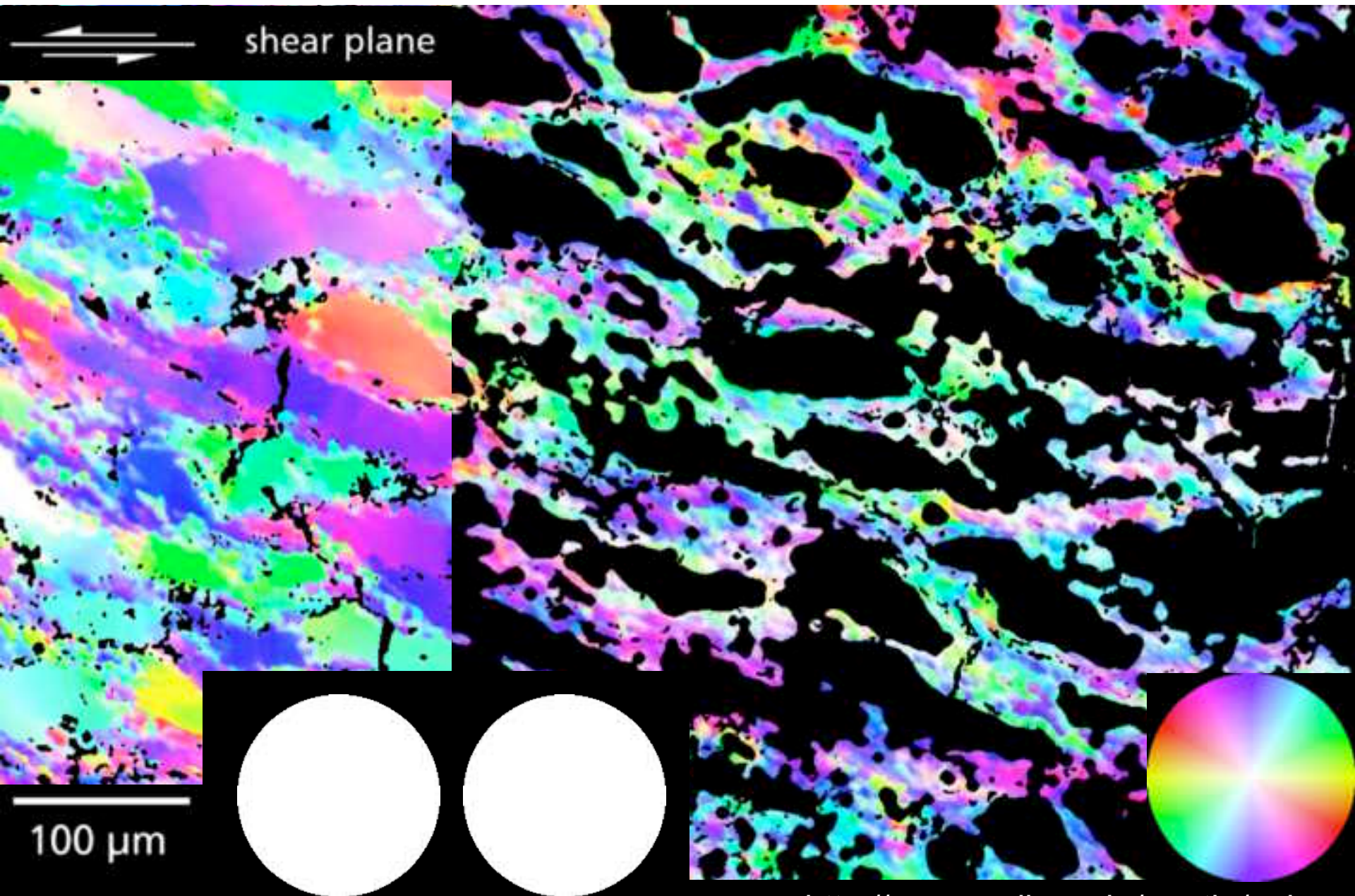
1-experimental shear deformation of quartzite



1-experimental shear deformation of quartzite



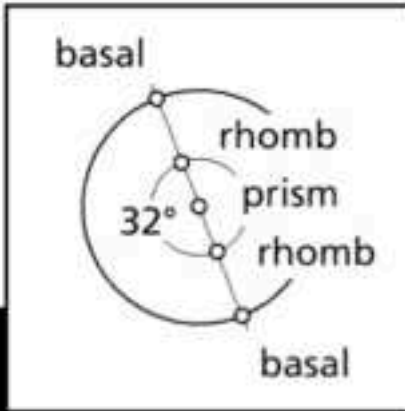
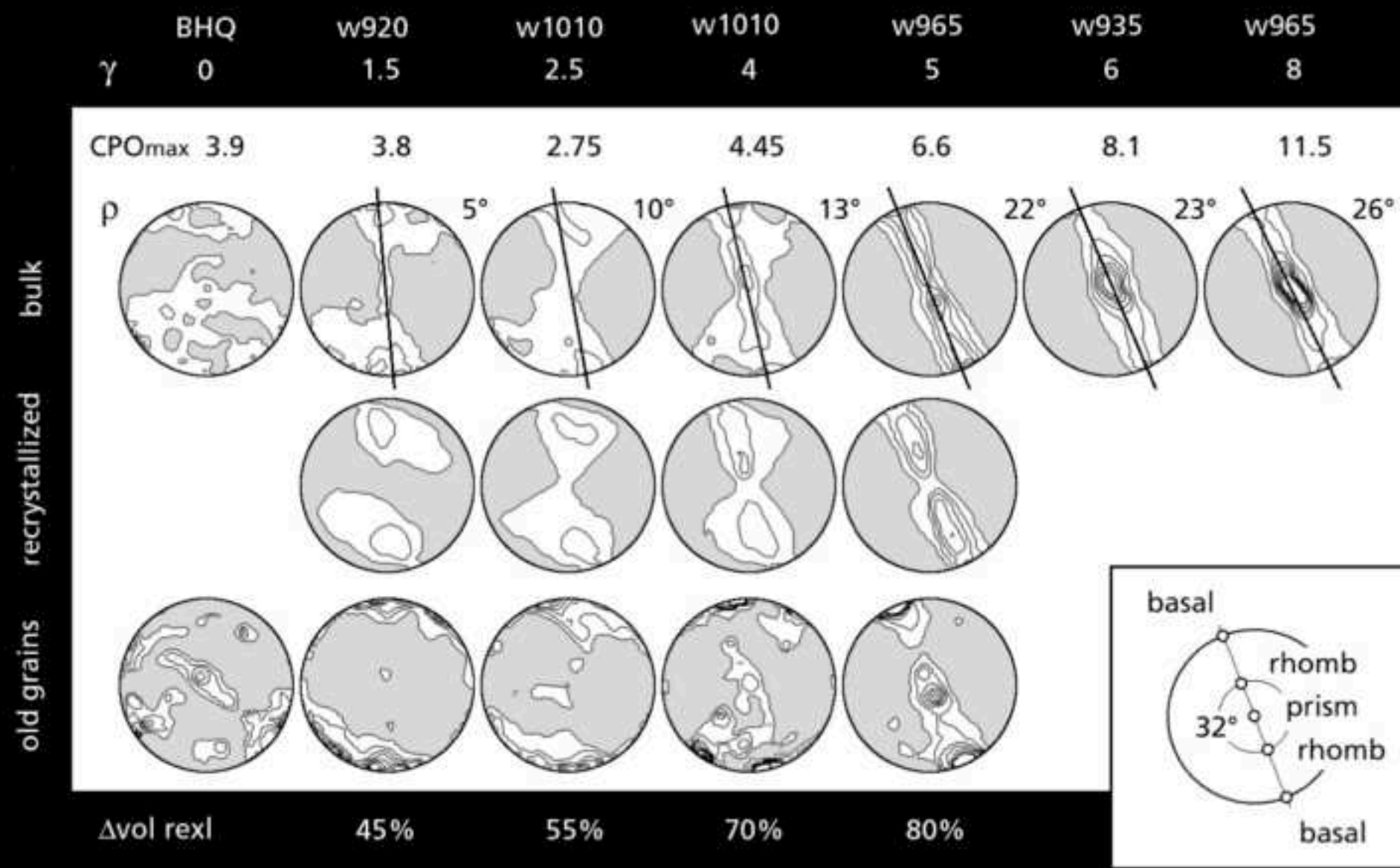
1-experimental shear deformation of quartzite



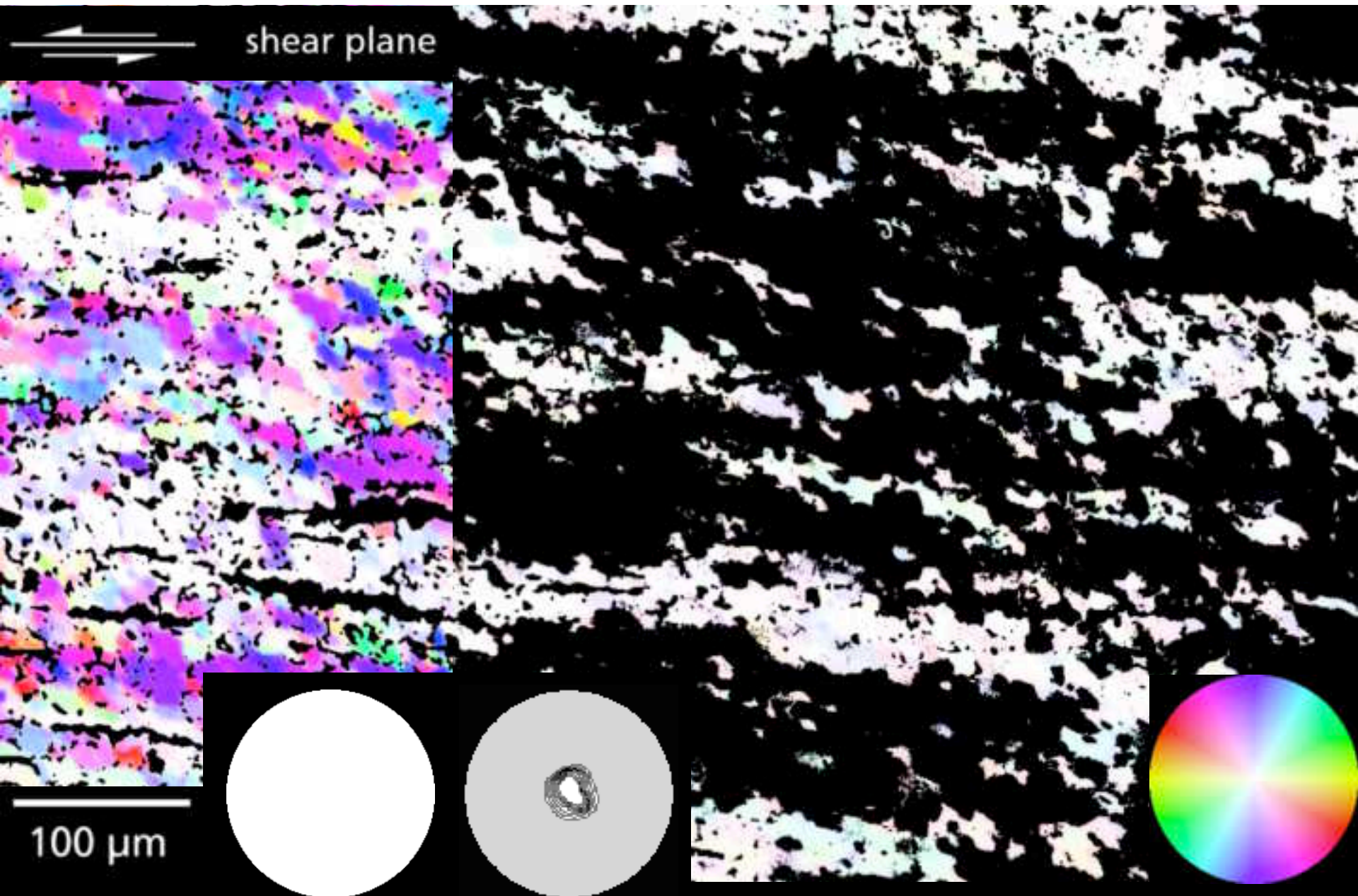
1-experimental shear deformation of quartzite



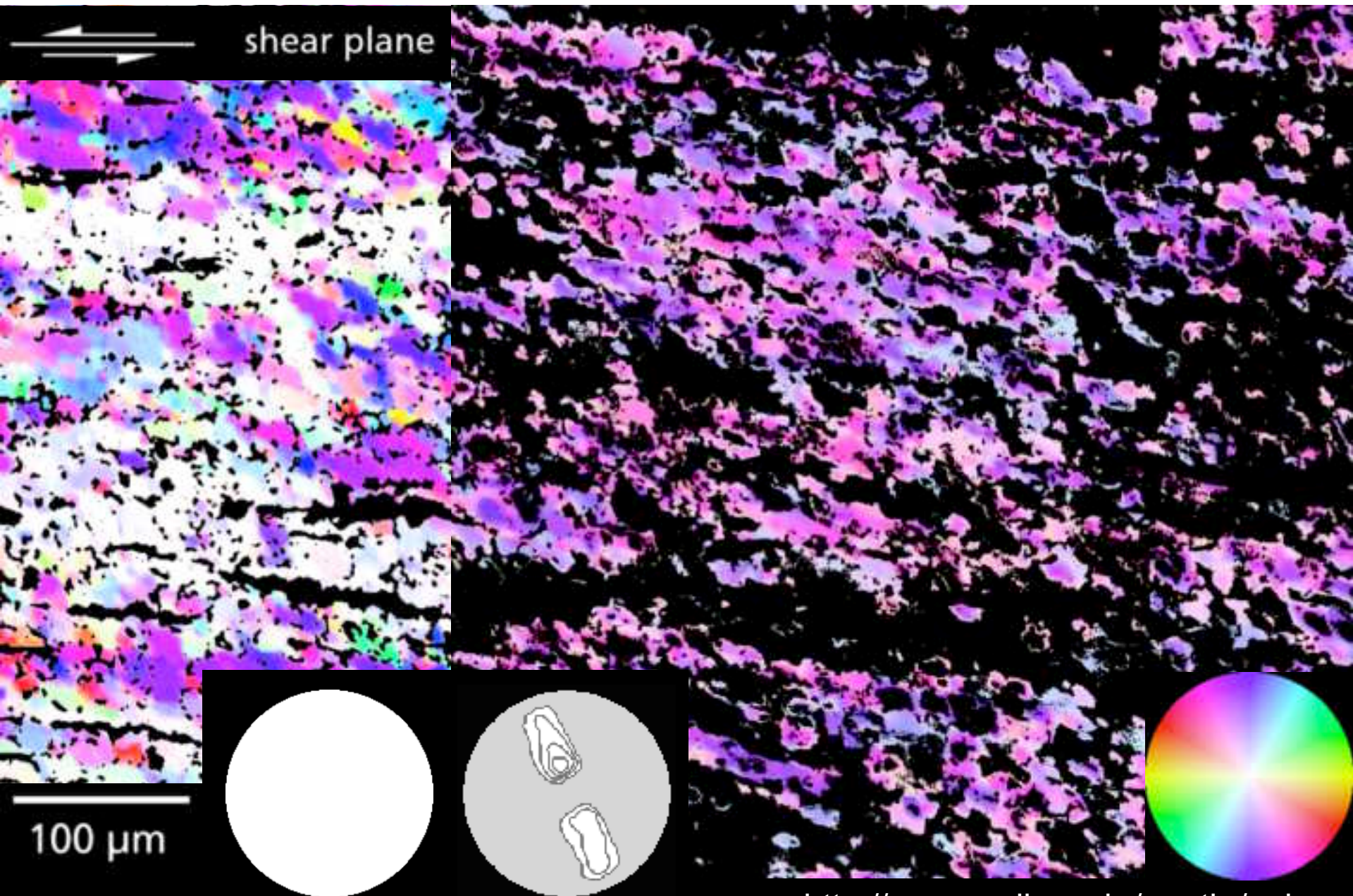
shear plane



1-experimental shear deformation of quartzite



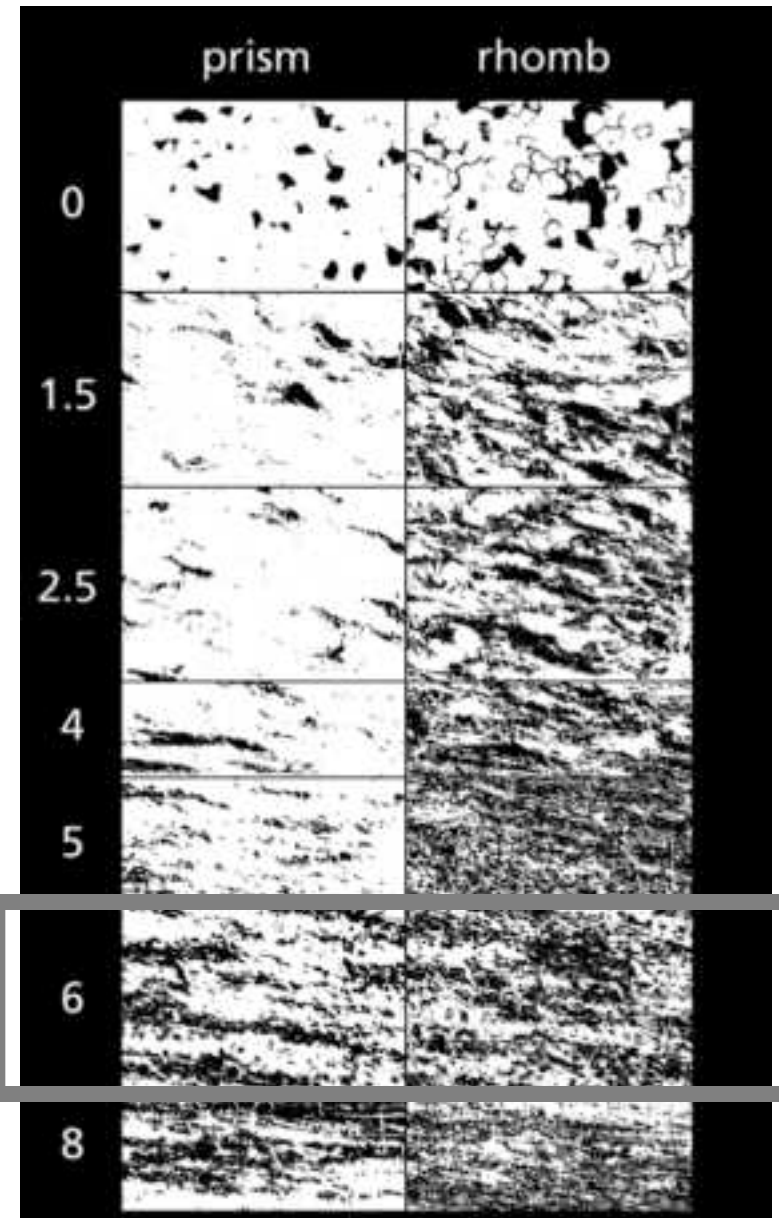
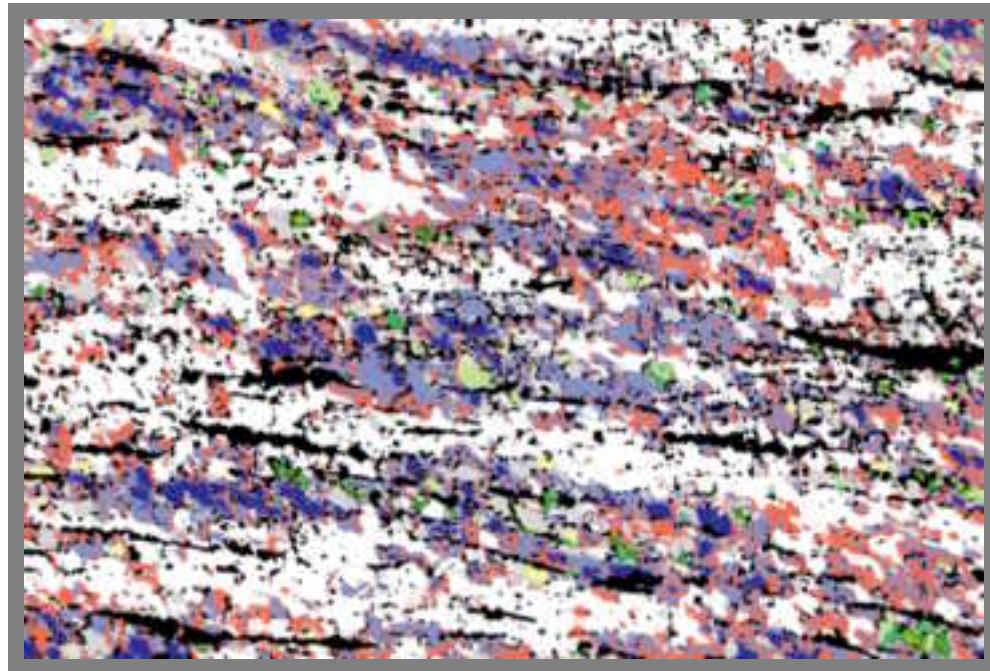
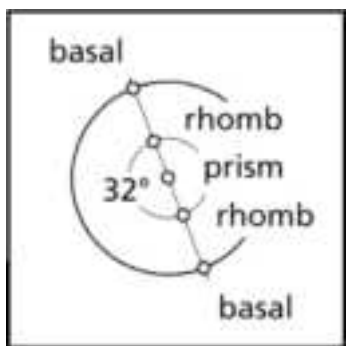
1-experimental shear deformation of quartzite



1-experimental shear deformation of quartzite

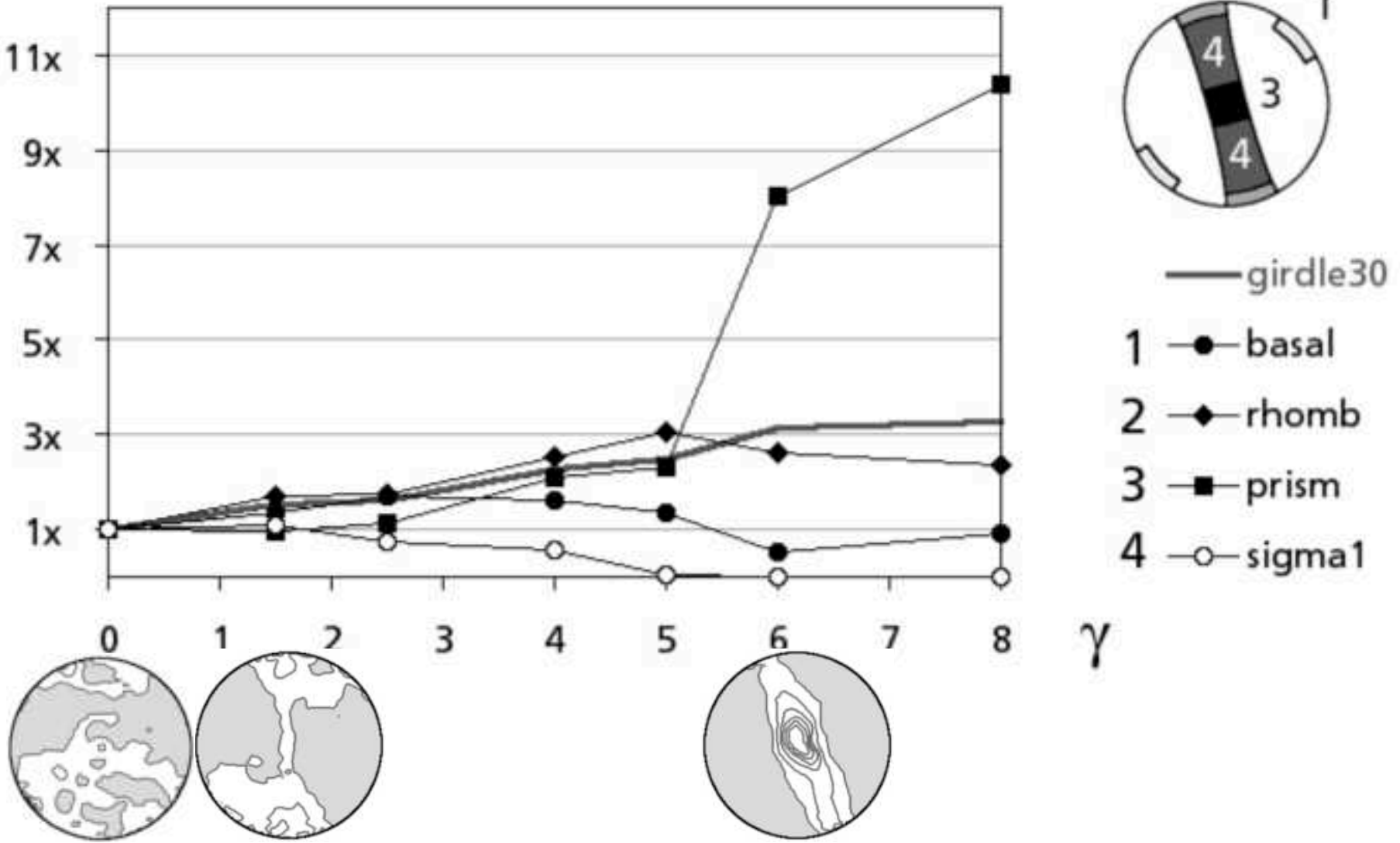


texture domains

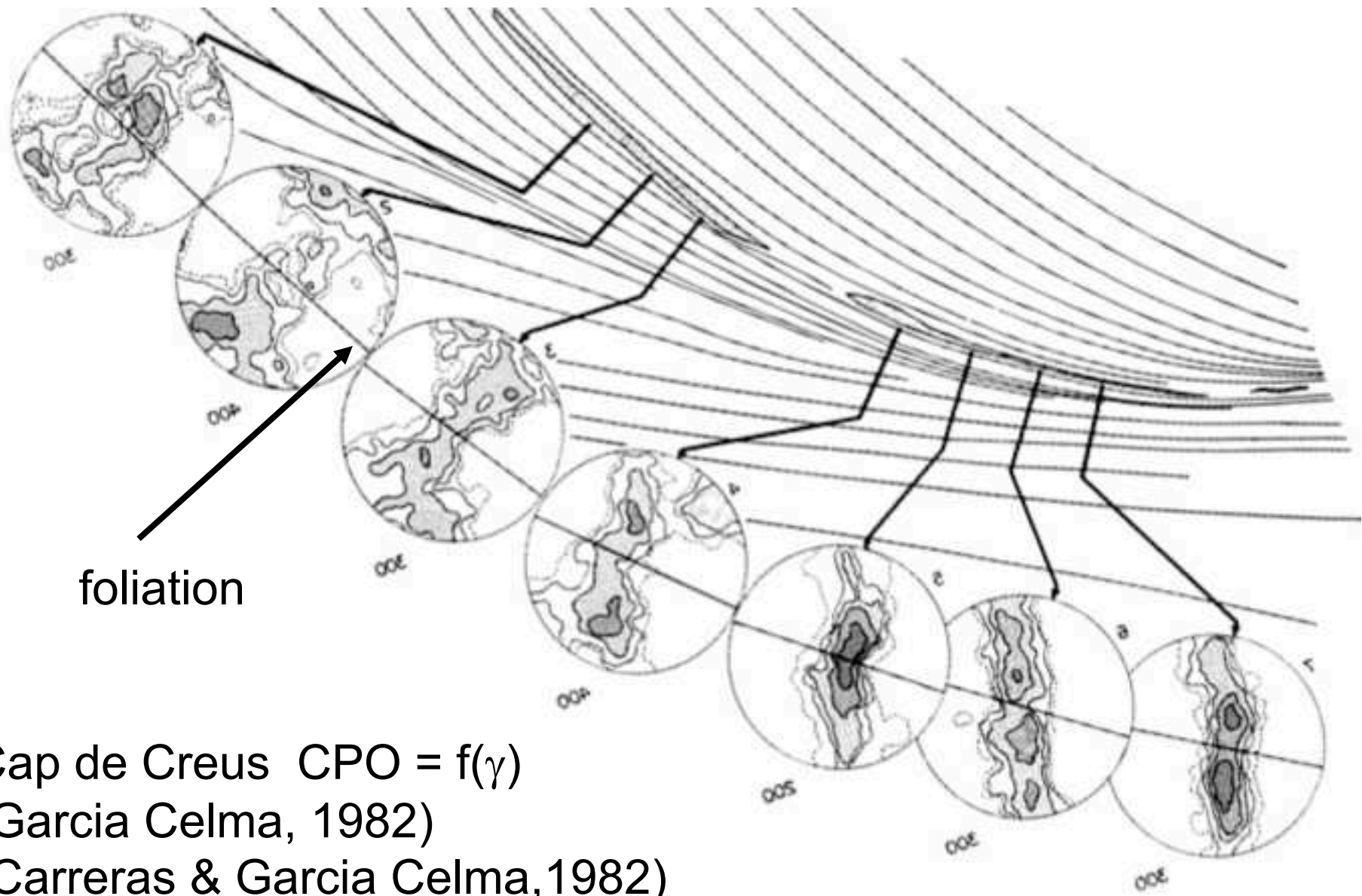


1-experimental shear deformation of quartzite

Change of density in texture domains w/r to uniform

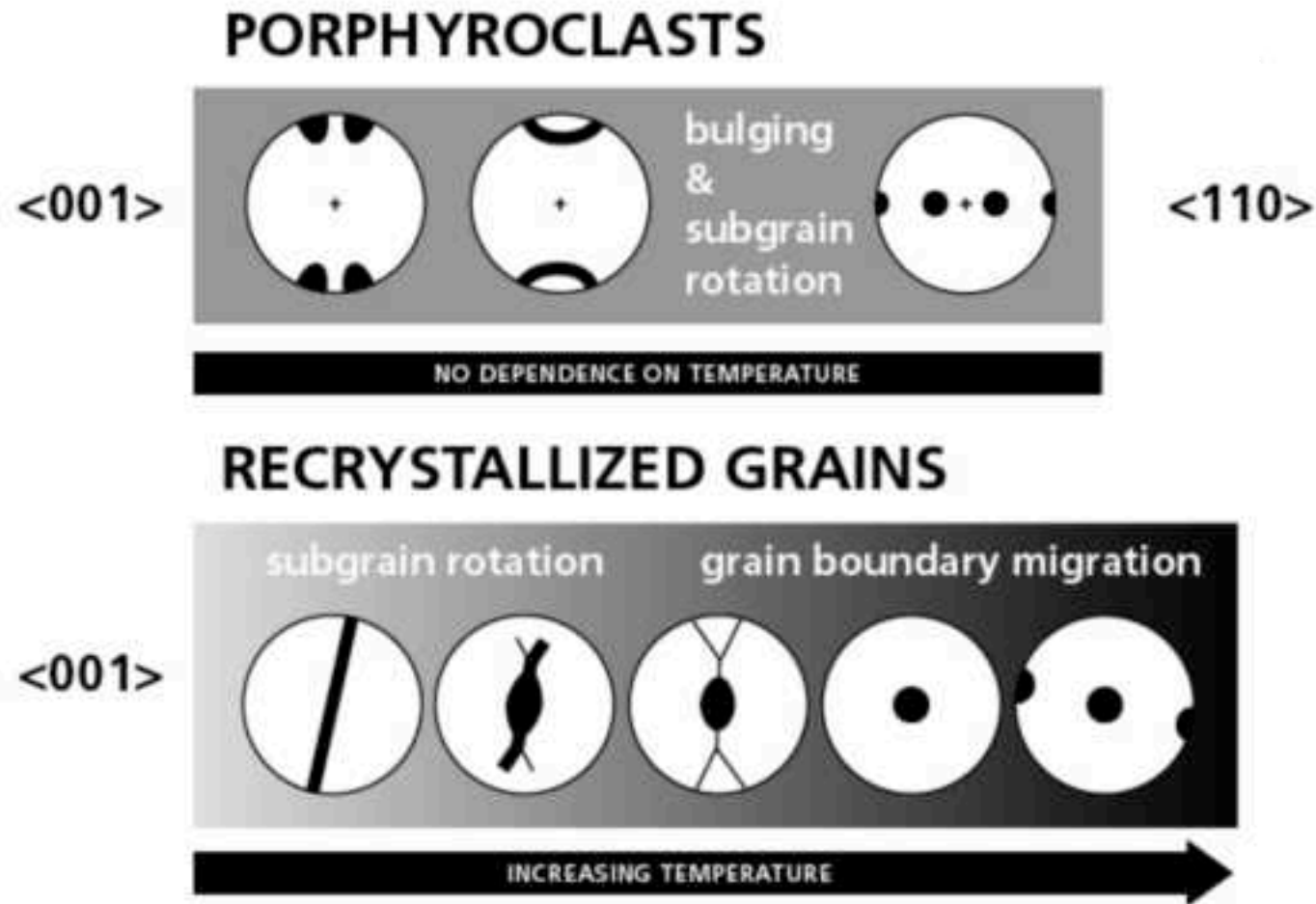


1-experimental shear deformation of quartzite



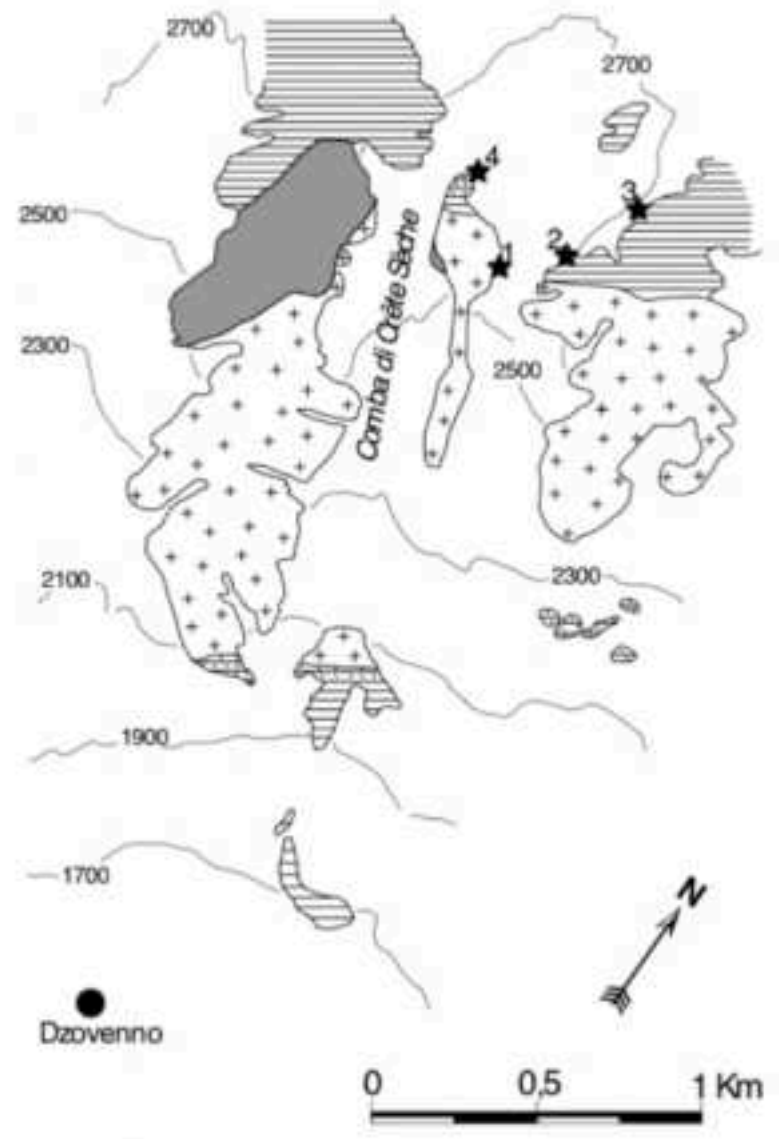
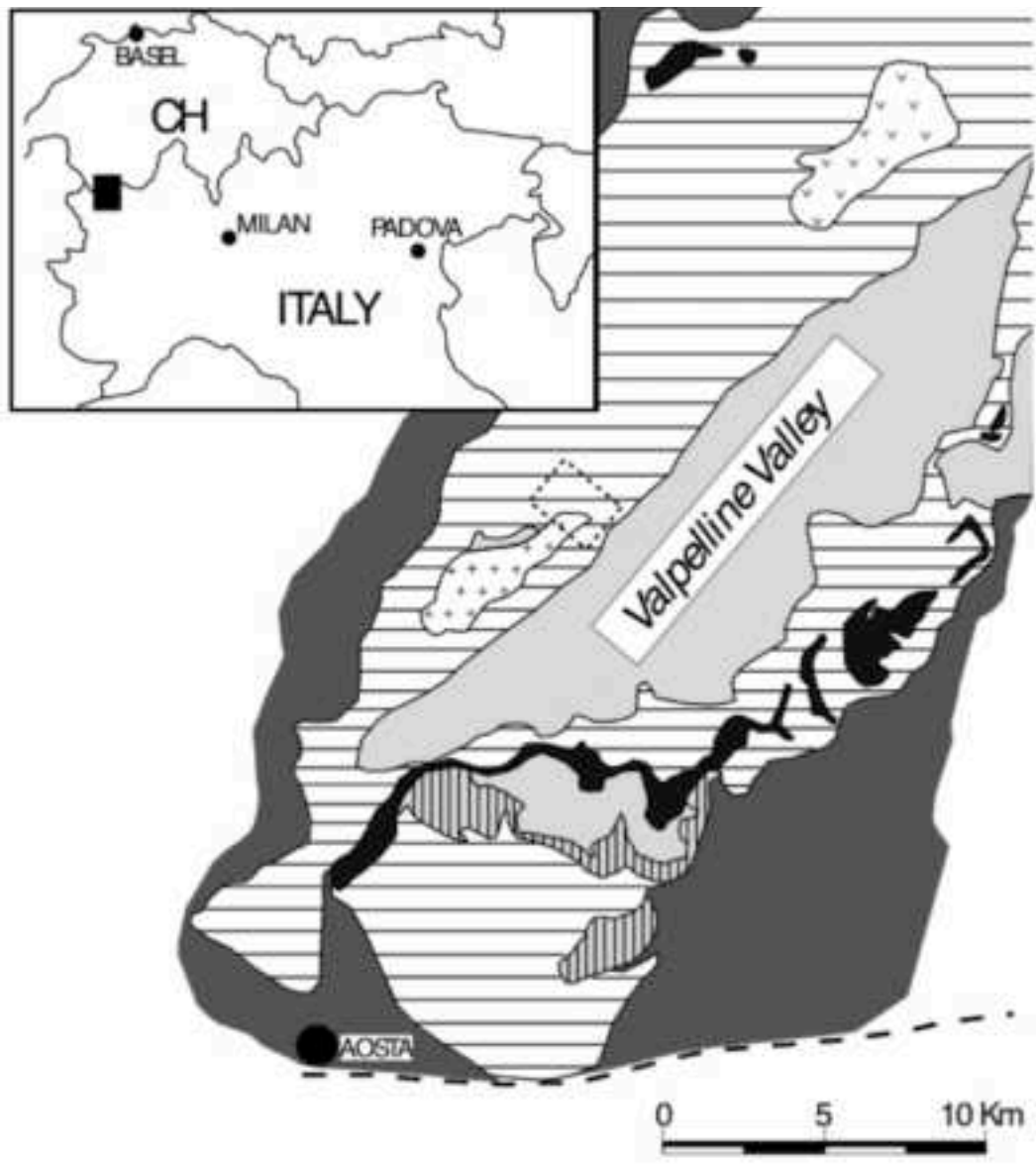
Cap de Creus $CPO = f(\gamma)$
(Garcia Celma, 1982)
(Carreras & Garcia Celma, 1982)

1-experimental shear deformation of quartzite

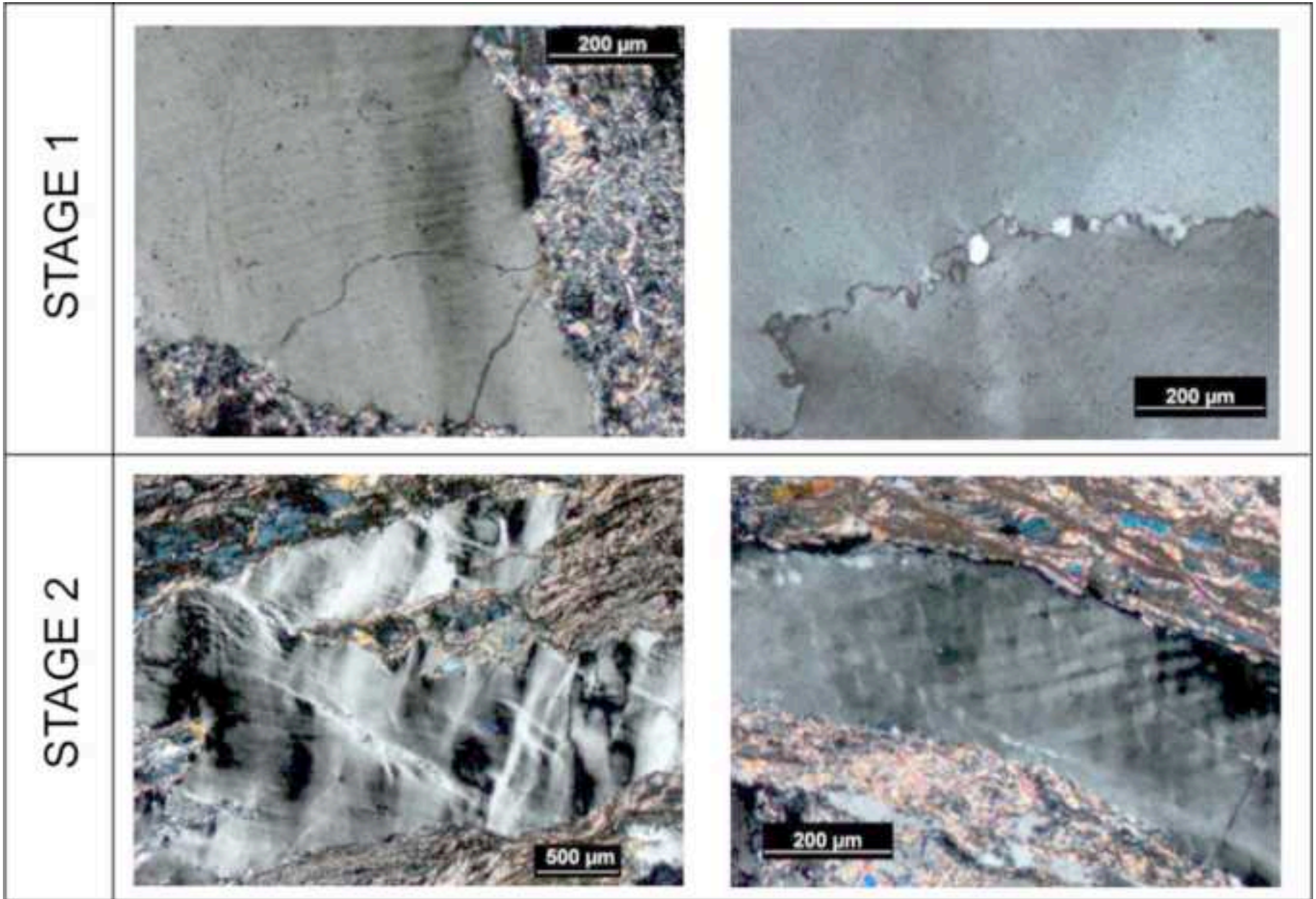


Tonale CPO = f(T)
(Stipp, Stünitz, Heilbronner & Schmid, 2002)

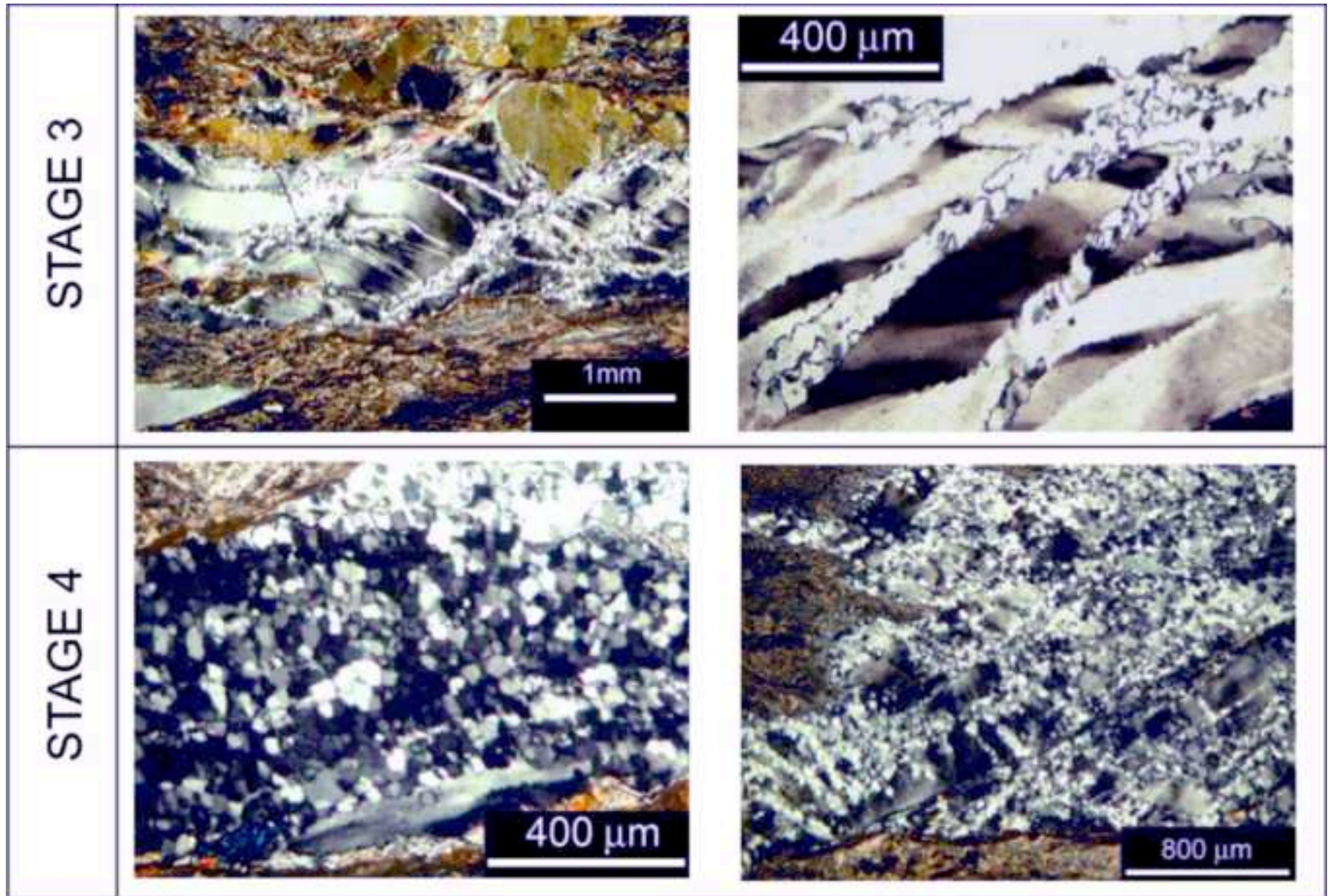
2-natural shear deformation of quartz in granitoid



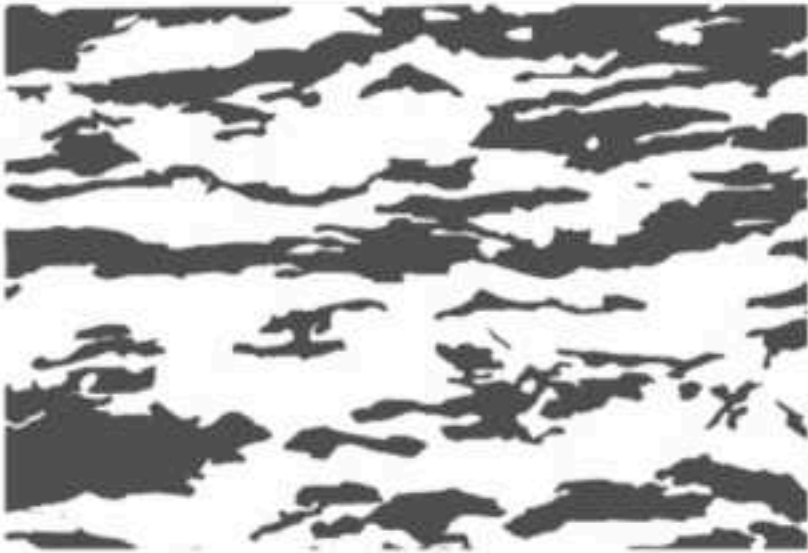
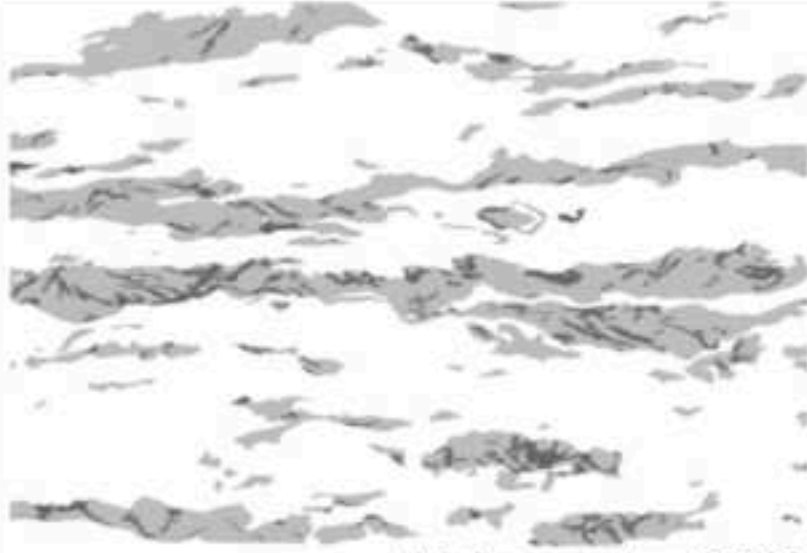
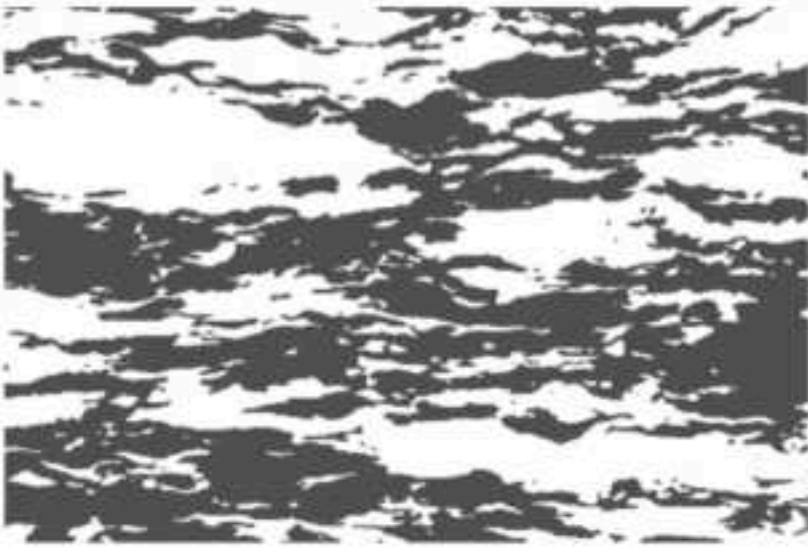
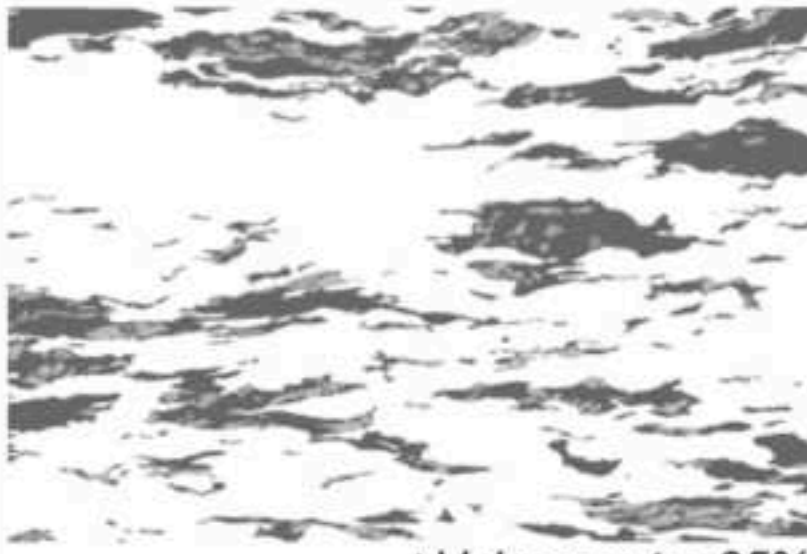
2-natural shear deformation of quartz in granitoid



2-natural shear deformation of quartz in granitoid

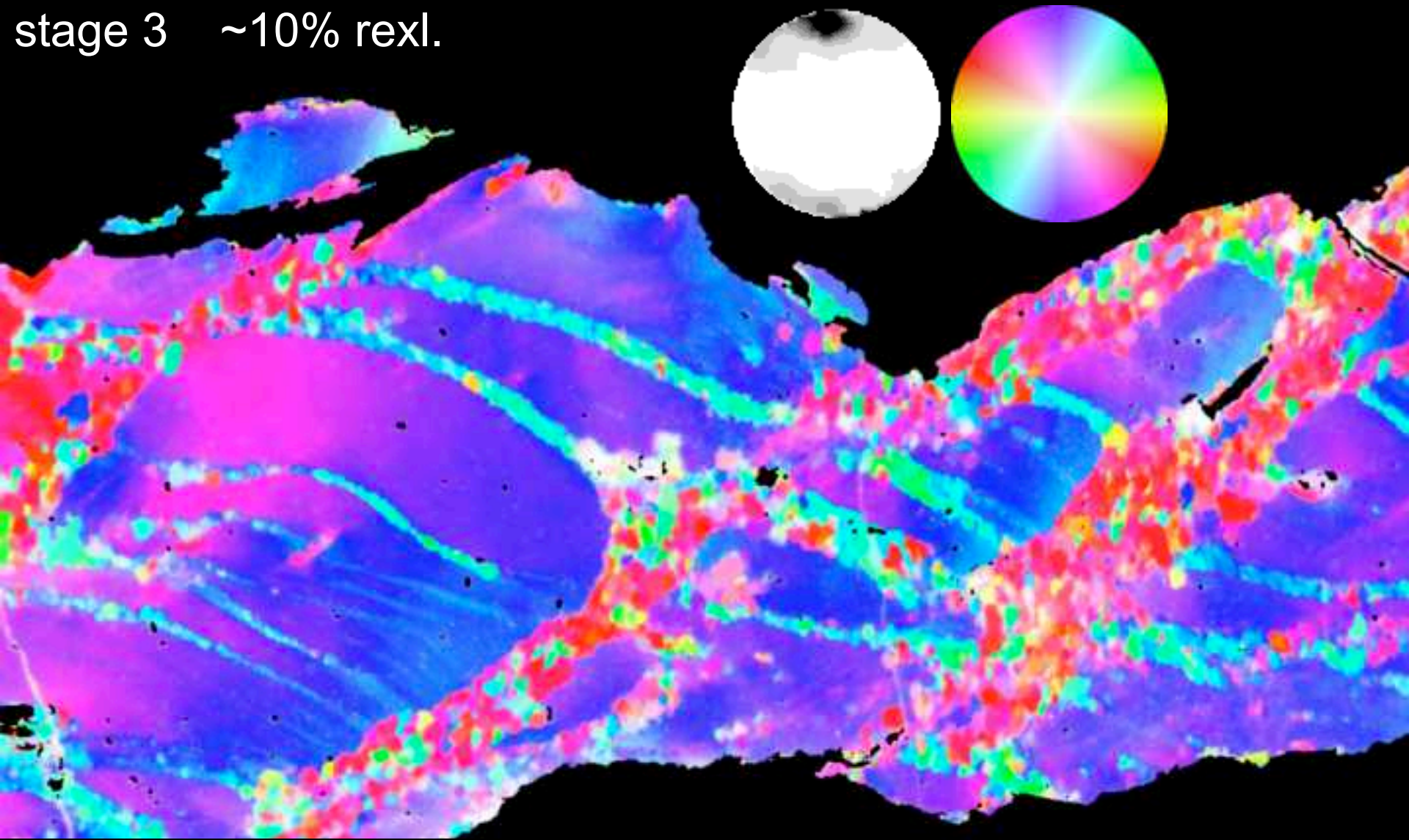


2-natural shear deformation of quartz in granitoid

| | | |
|---------|--|---|
| STAGE 3 |  |  <p>$\Delta\text{Vol rexx qtz}=8.5\%$</p> |
| STAGE 4 |  <p>epidote-sericite aggregate</p> |  <p>quartz</p> <p>$\Delta\text{Vol rexx qtz}=85\%$</p> |

2-natural shear deformation of quartz in granitoid

stage 3 ~10% rexl.



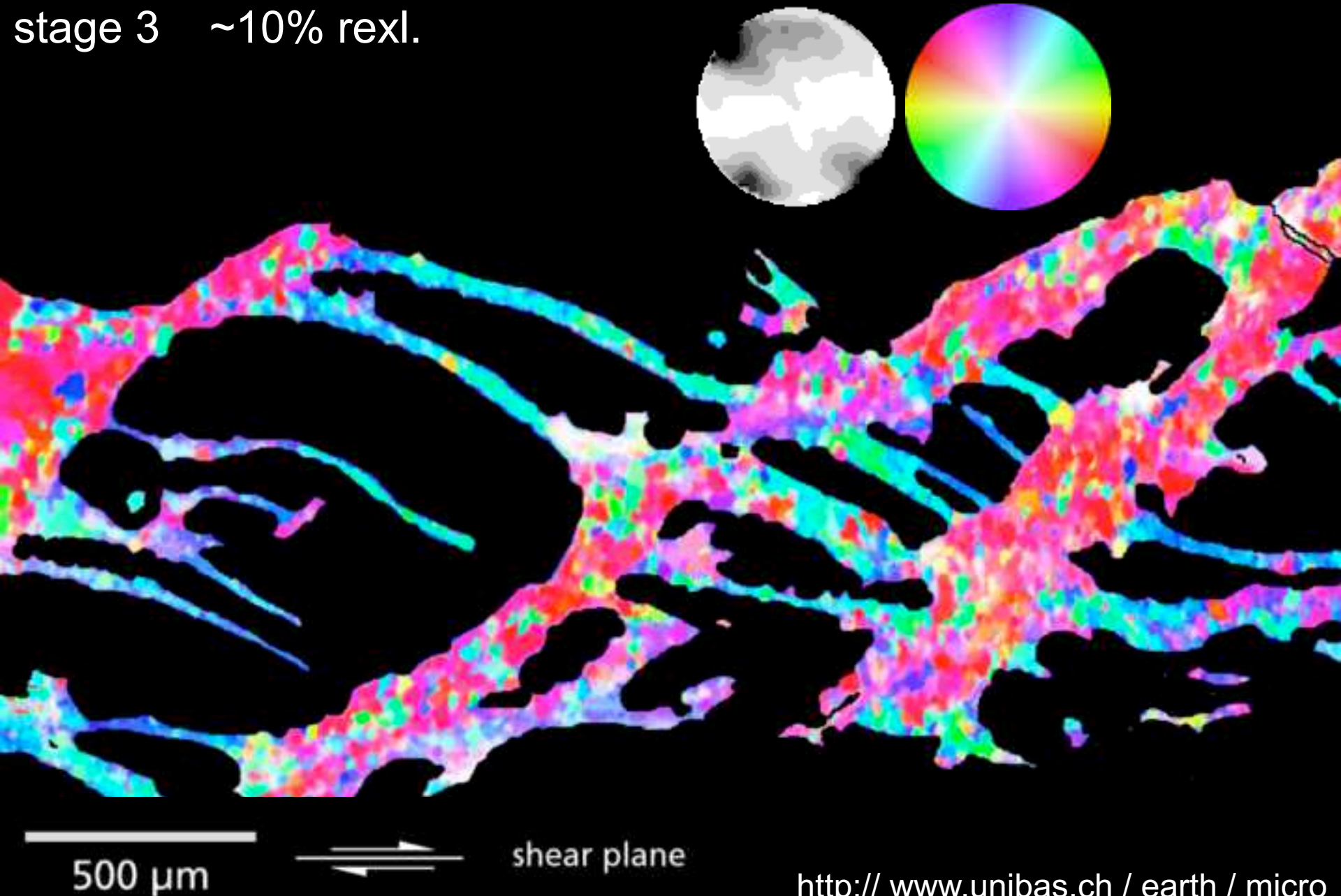
500 μm



shear plane

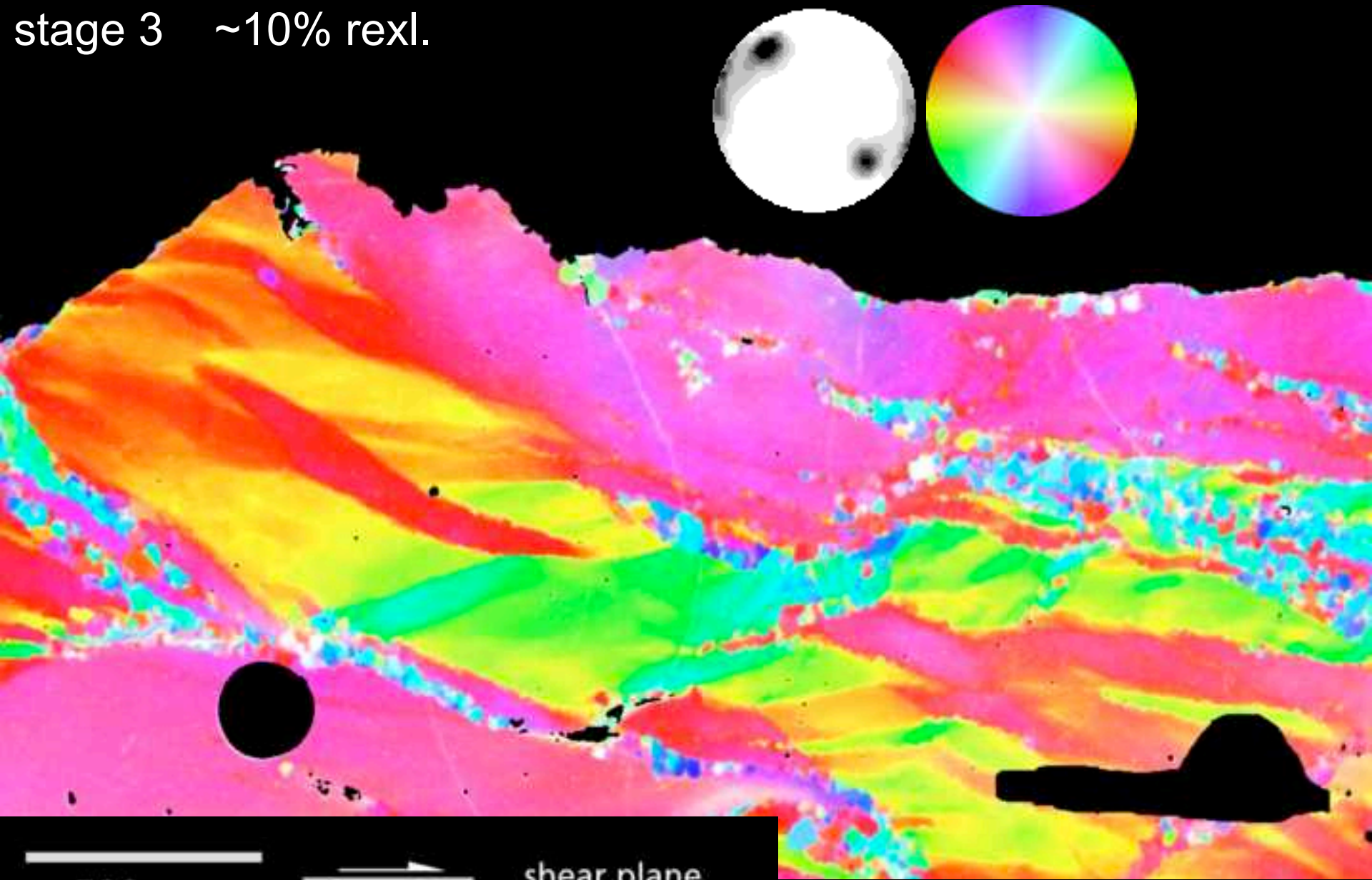
2-natural shear deformation of quartz in granitoid

stage 3 ~10% rexl.



2-natural shear deformation of quartz in granitoid

stage 3 ~10% rexl.



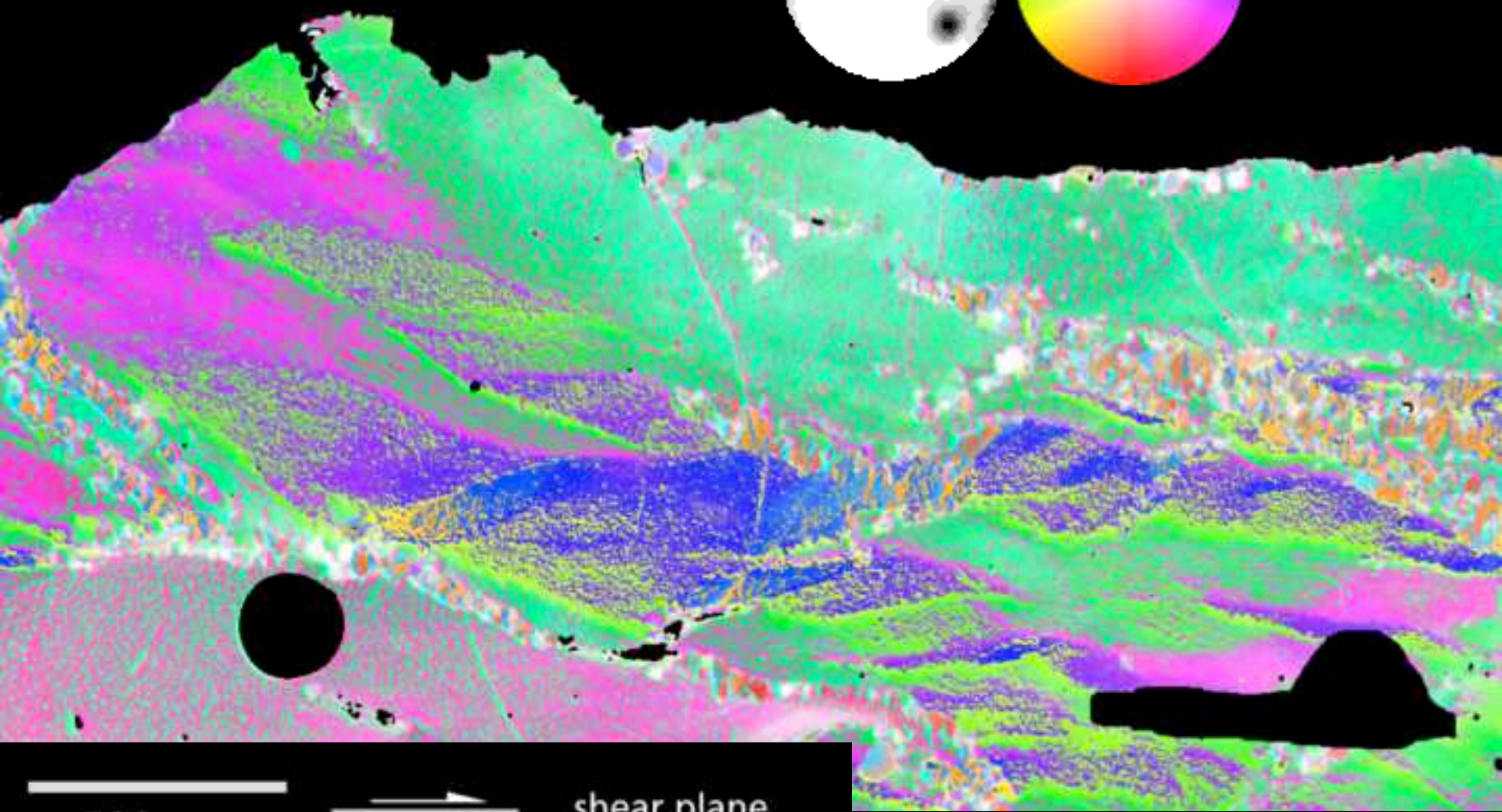
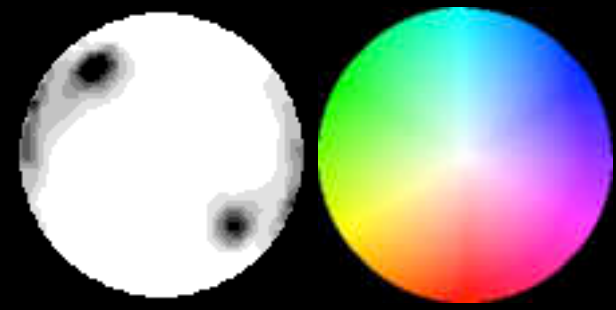
500 μm



shear plane

2-natural shear deformation of quartz in granitoid

stage 3 ~10% rexl.



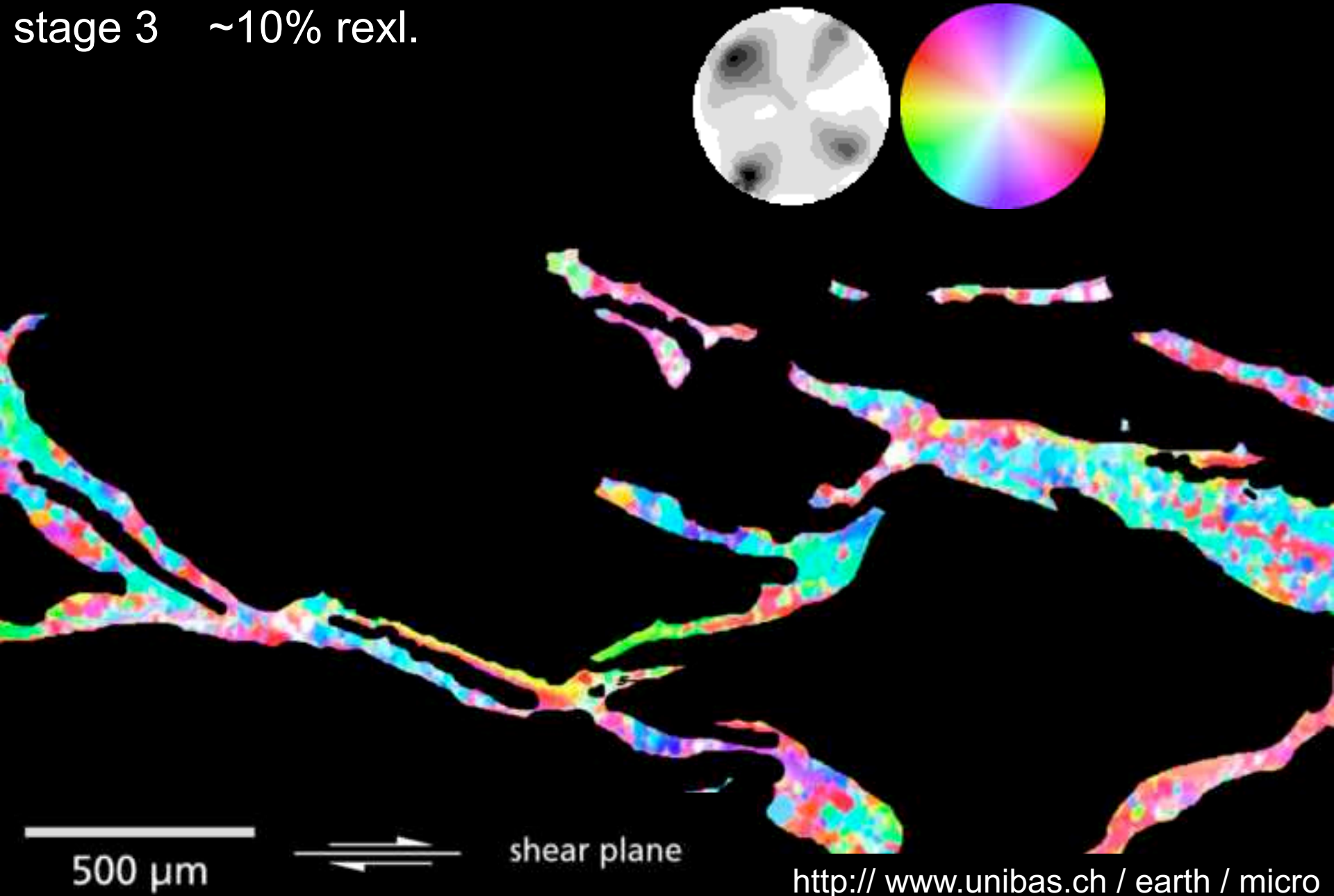
500 μm



shear plane

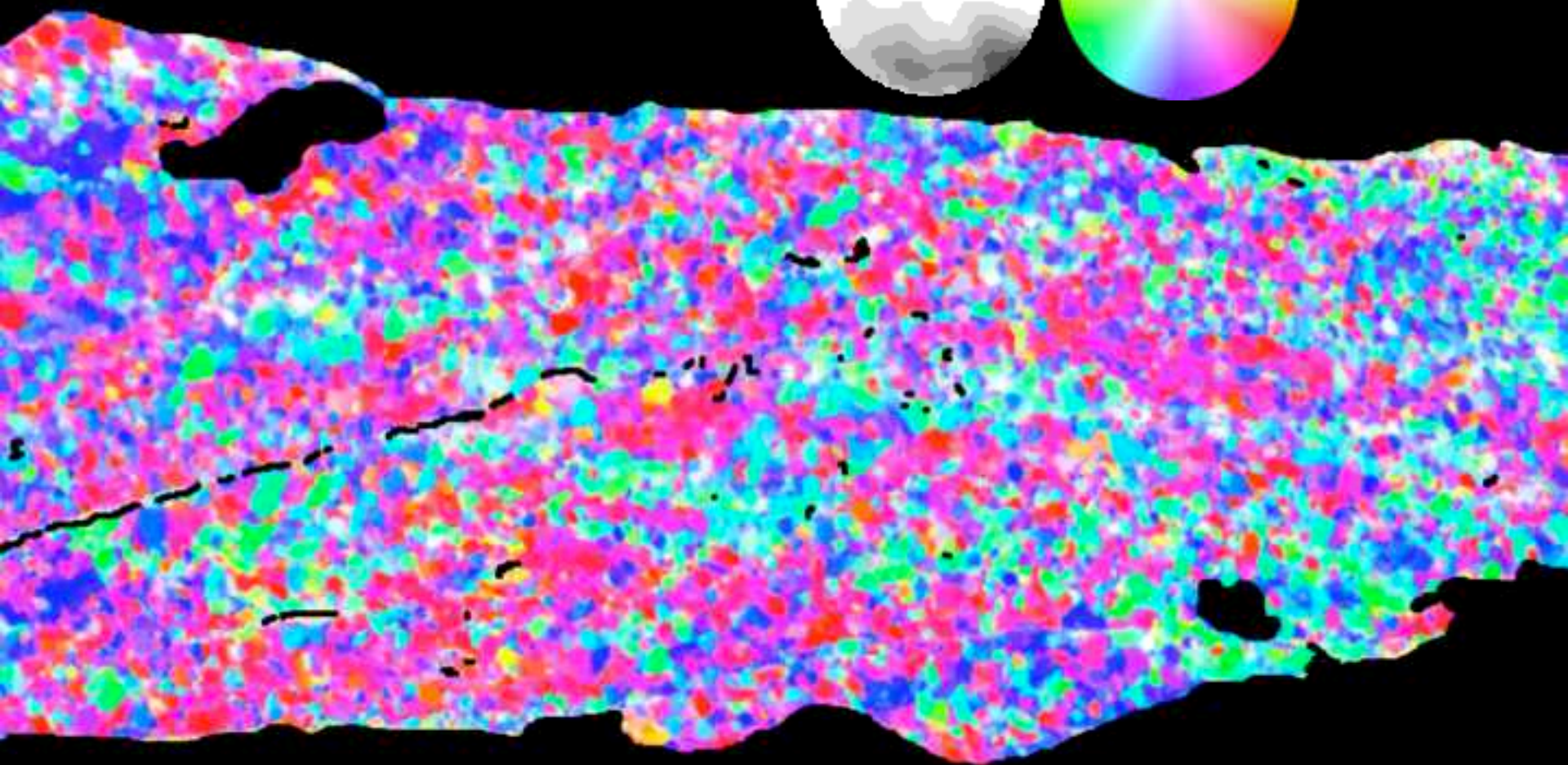
2-natural shear deformation of quartz in granitoid

stage 3 ~10% rexl.



2-natural shear deformation of quartz in granitoid

stage 4 ~85% rexl.



500 μm

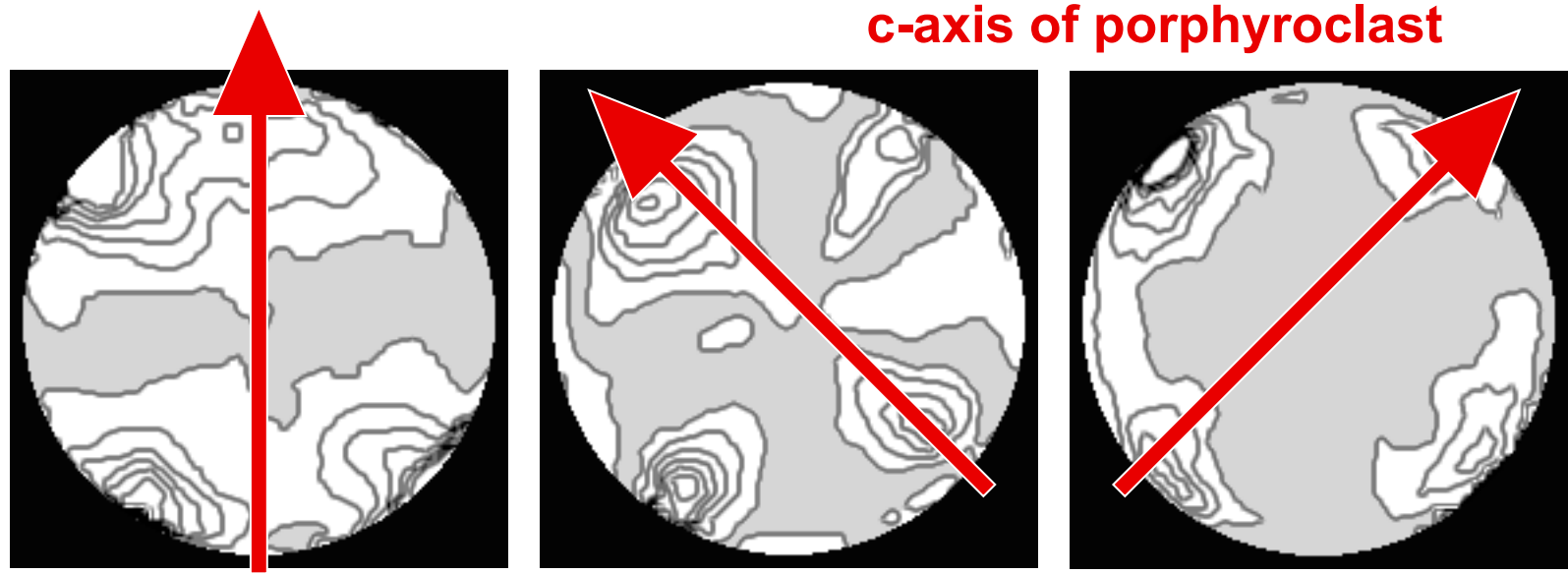


shear plane

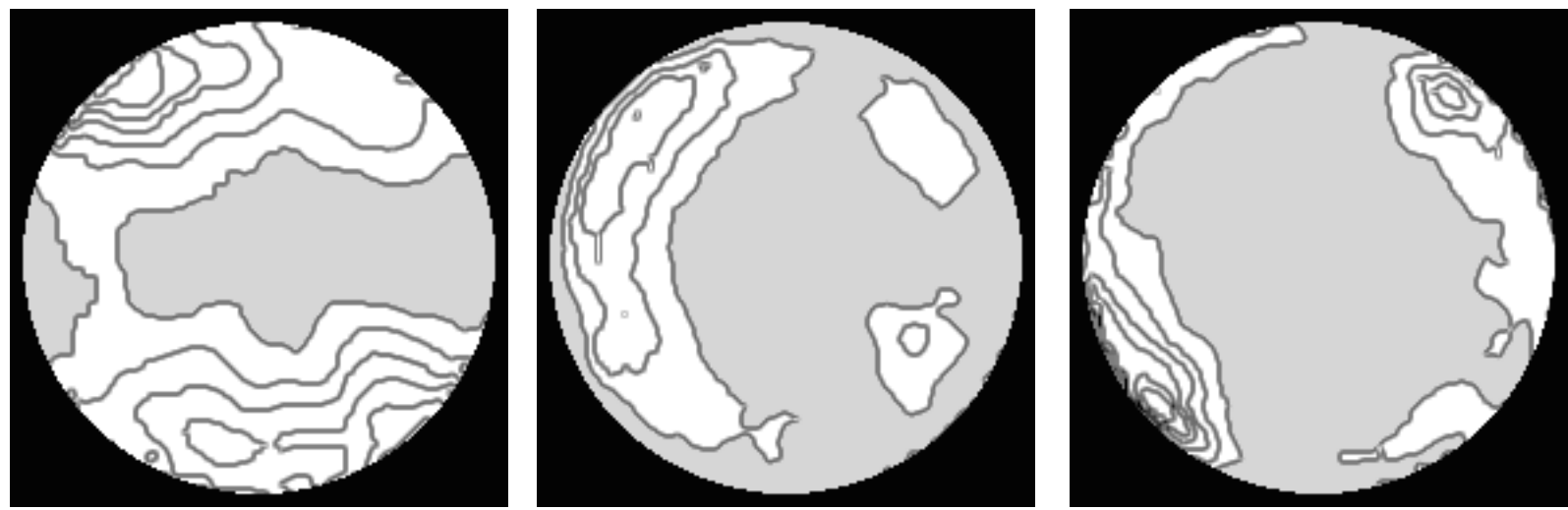
2-natural shear deformation of quartz in granitoid

c-axis of porphyroclast

3

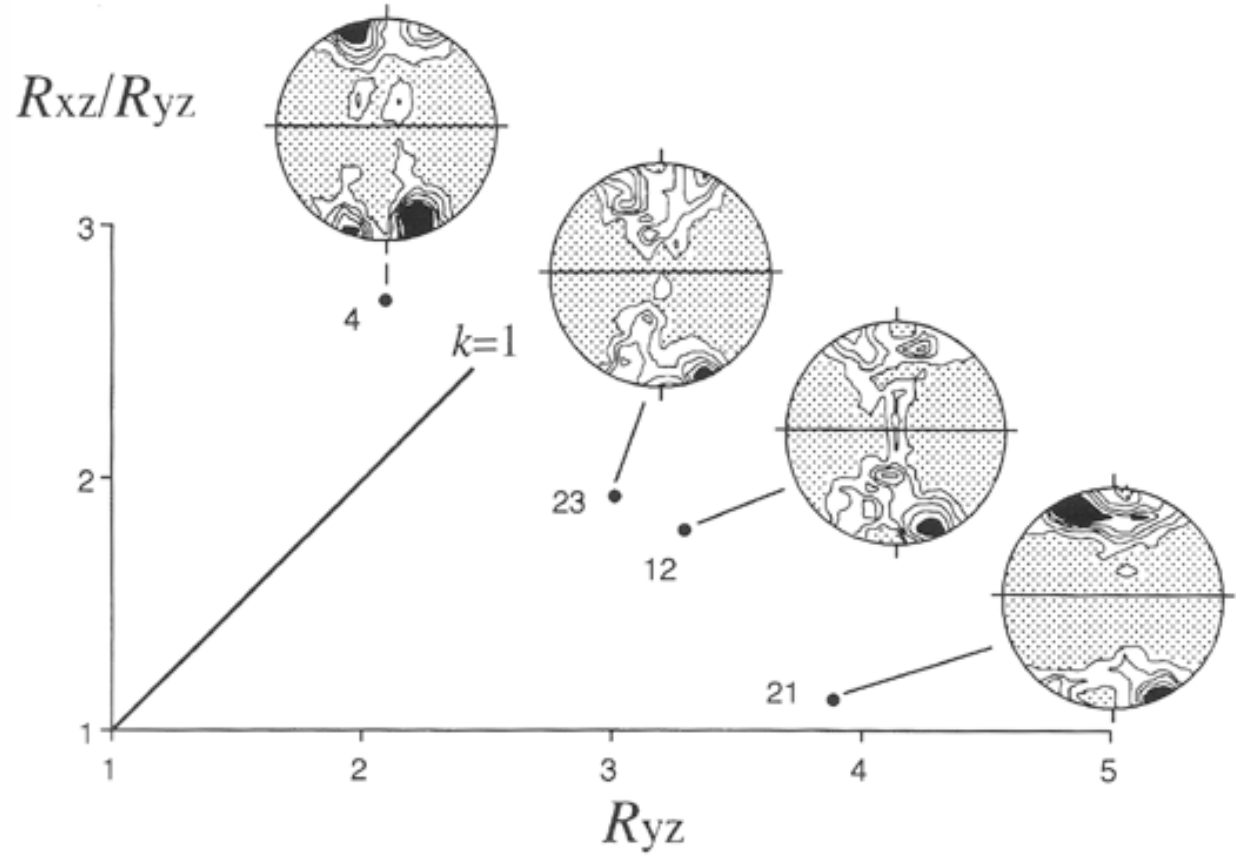
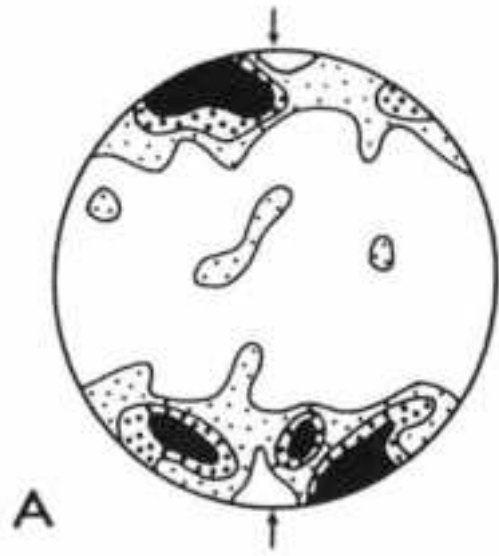


4



shear plane

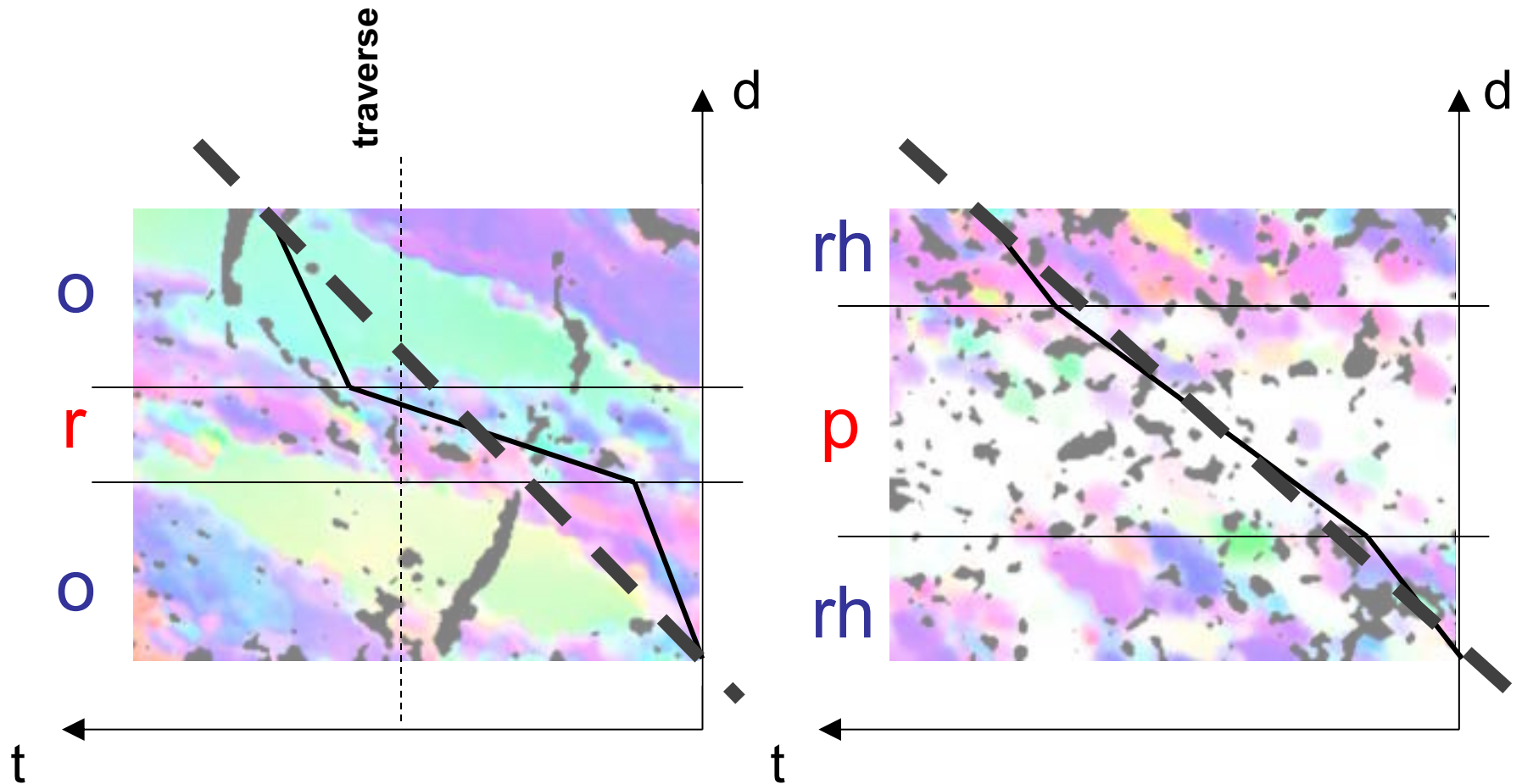
2-natural shear deformation of quartz in granitoid



axial compression experiment
(Tullis, 1977)

Sambagawa quartzite
(Tagami&Takeshita, 1998)

3-bulk from parts



o

r

o

rh

p

rh

rexl. grains

old grains

high γ

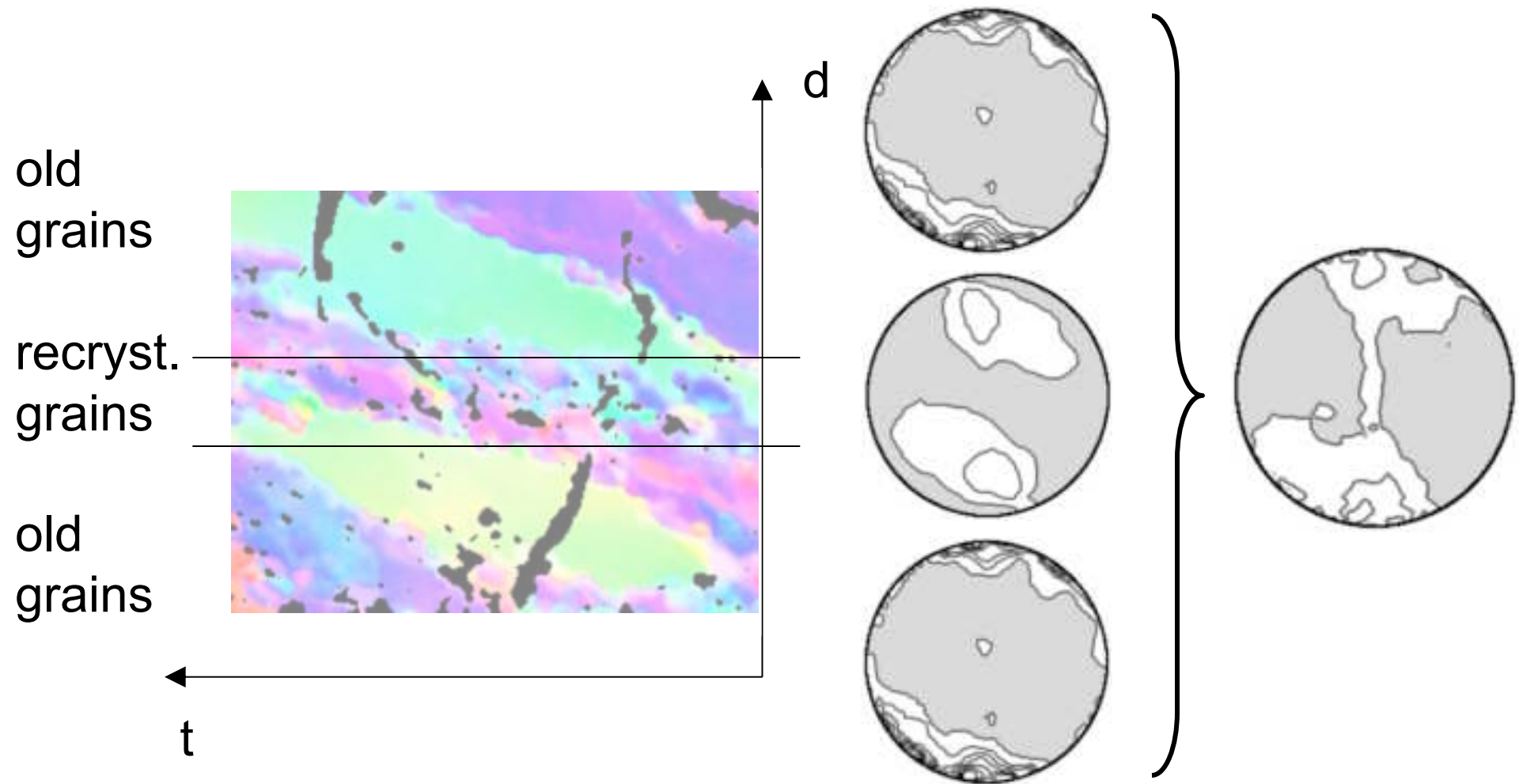
low γ

average γ

prism domain

rhomb domain

3-bulk from parts

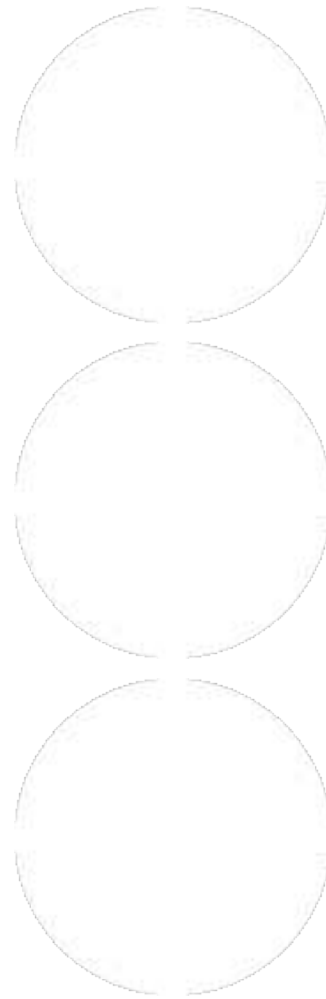
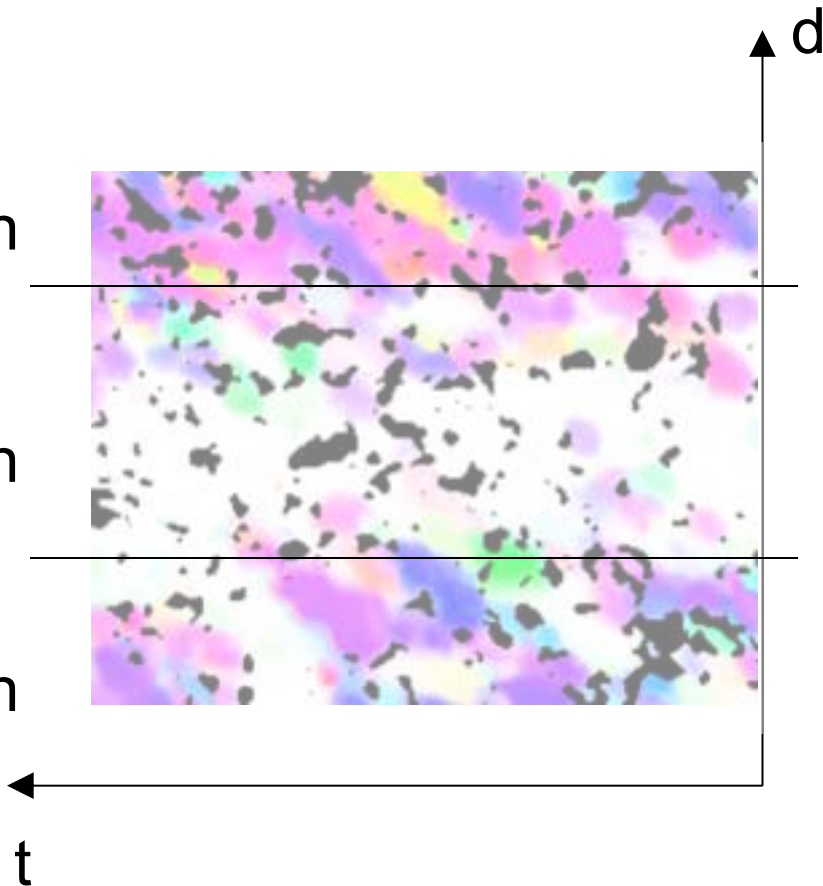


3-bulk from parts

rhomb
domain

prism
domain

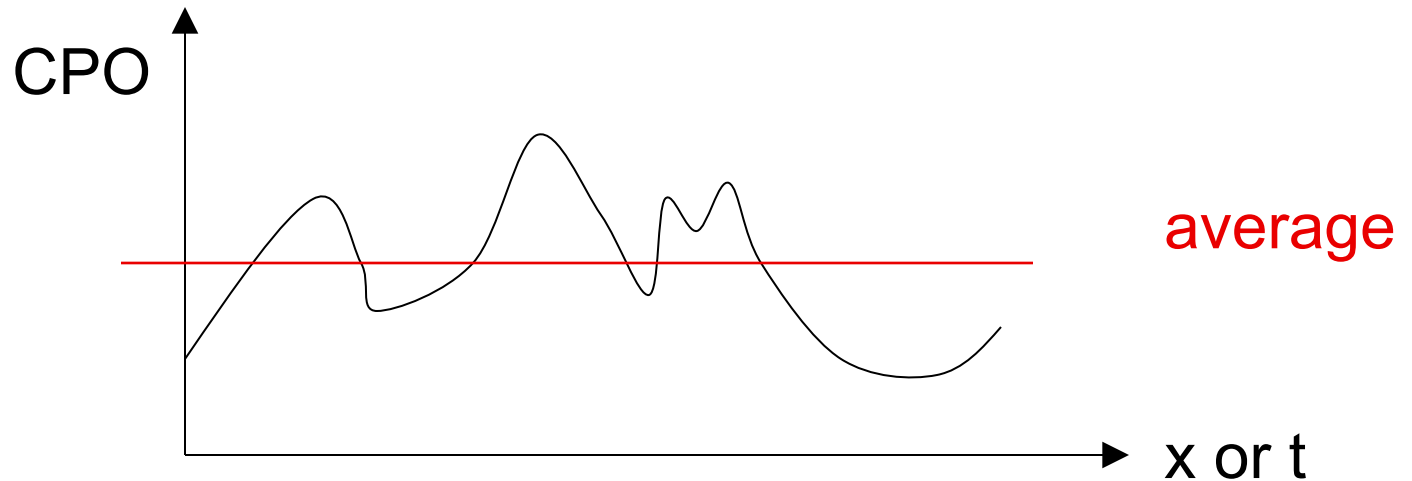
rhomb
domain



4-re-addressing the question

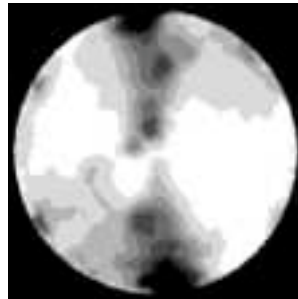
"The problem of deriving bulk properties of heterogeneously deforming crystalline aggregates"

BULK = $\left\{ \begin{array}{l} \text{integration} \\ \text{summation} \end{array} \right\}$ of $\left\{ \begin{array}{l} \text{properties} \\ \text{CPO} \end{array} \right\}$ w/r to $\left\{ \begin{array}{l} \text{space} \\ \text{time} \\ \text{both} \end{array} \right\}$



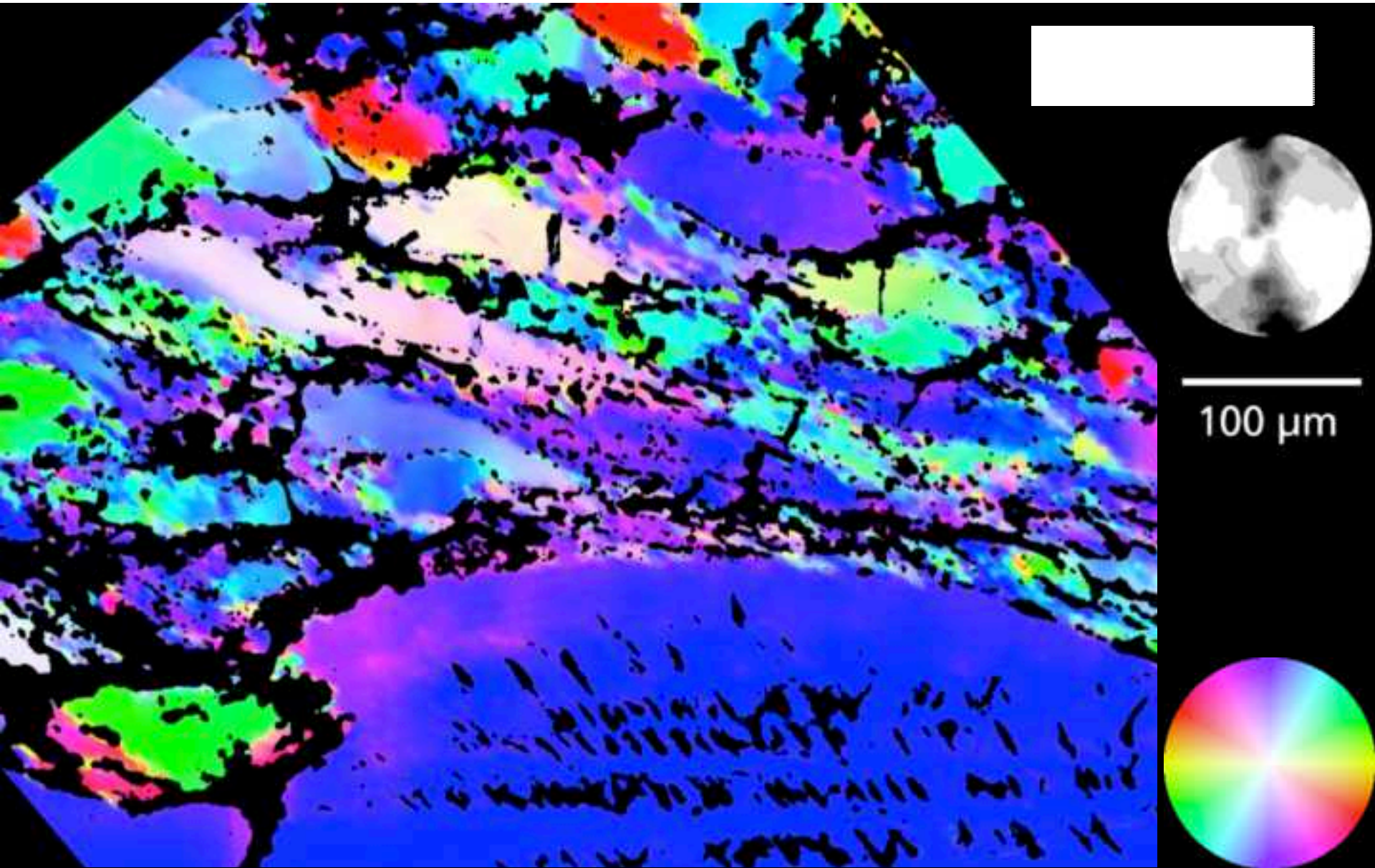
4-re-addressing the question

this is a bulk texture:



...so?

4-re-addressing the question



5-re-addressing the question

PhD project starting April 1st, 2006 !!

Single and bicrystal deformation of quartz

Deformation of quartz in polymineralic rocks

