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DeformAMS: A simple toolbox for modelling magnetic fabric evolution during rock deformation

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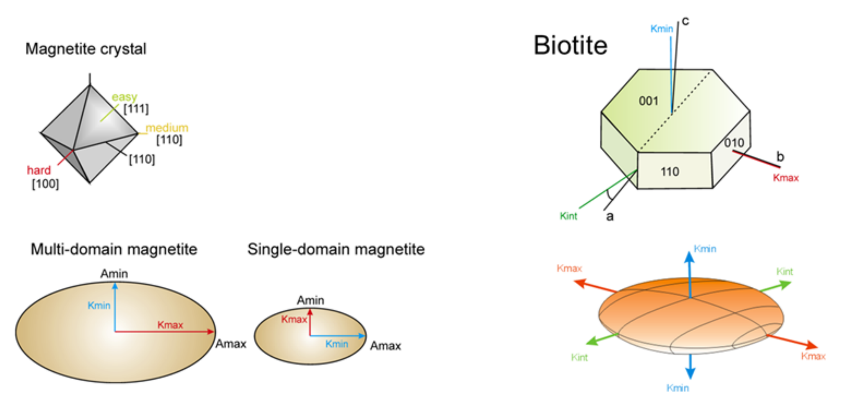
Motivation

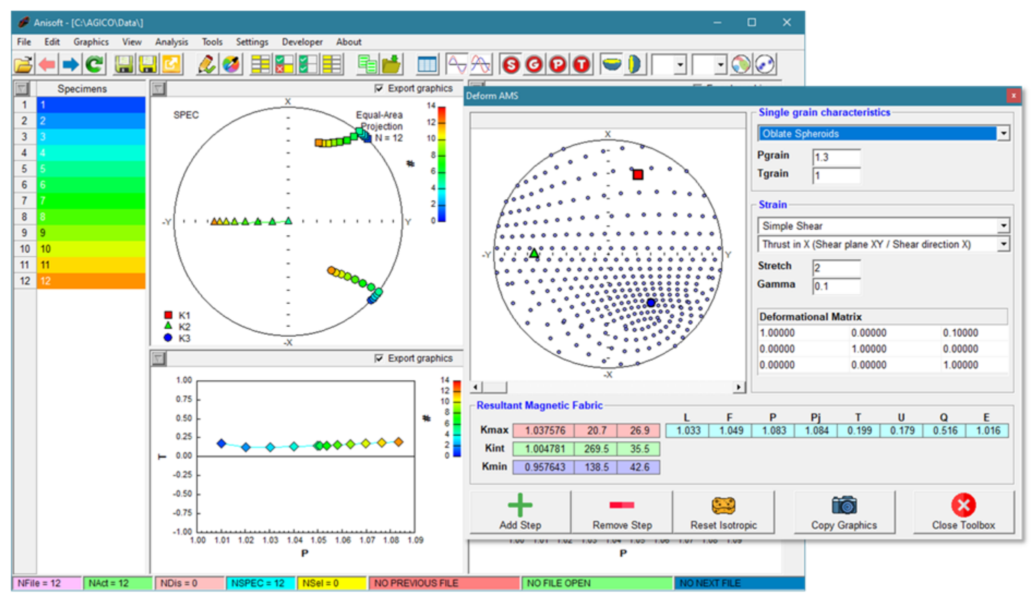
- The magnetic fabric, studied mainly by means of anisotropy of magnetic susceptibility (AMS), has become one of the well-established, fast, and reliable rock fabric proxies applied in many branches of Earth sciences.
- The magnetic fabric of rocks reflects the crystallographic or shape preferred orientation of all rock-constituent mineral grains; each mineral grain contributes to the overall fabric according to its single-grain anisotropic properties and its orientation.



Methods

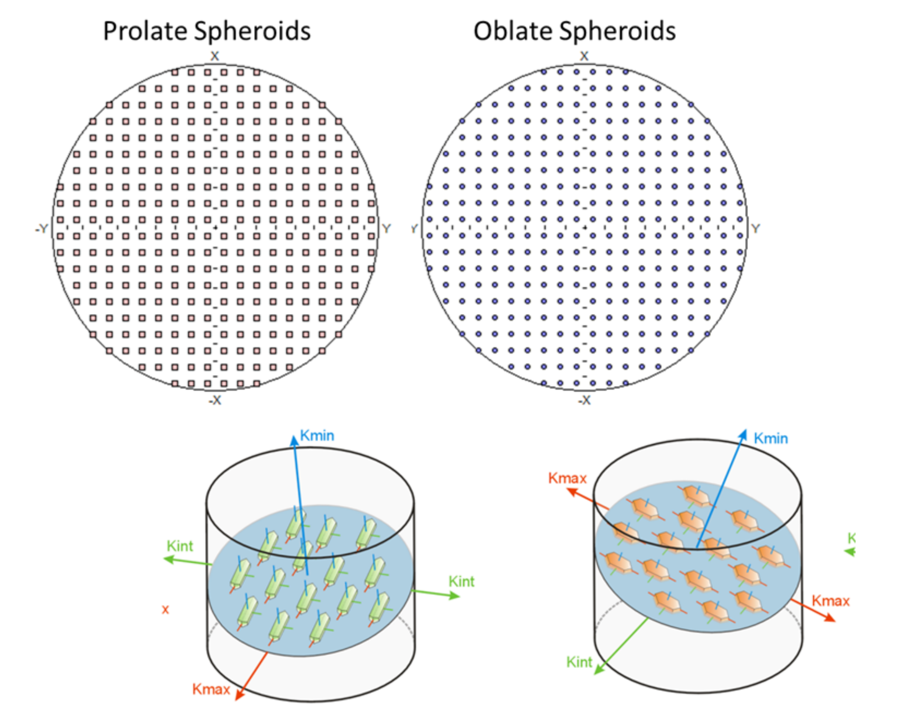
- A simple tool box is presented to model magnetic fabric evolution as a results of rock deformation.
- The toolbox works with a set of uniformly distributed model particles deformed following the so-called **line/plane model** which assumes that the particles behave as if they formed lines or planes in the deforming rock matrix; their shapes do not change in response to the imposed deformation but their orientation does.
- The pre-deformational and deformational magnetic fabrics are considered, both having originated through combined pure shear and simple shear acting in the pre-defined directions.
- The resultant magnetic fabric tensor is calculated by integrating the combined contribution of the entire set of modelled particles.
- The results are presented in terms of the principal AMS directions, degree of anisotropy, and shape of anisotropy ellipsoid.

User interface



The toolbox is part of Anisoft (ver. 6.1.02) software which enables the instant visualization of magnetic fabric changes as a function of strain.
Available at www.agico.cz/text/software/anisoft/anisoft.php

Assemblage of modelled particles



Strain types

Strain types

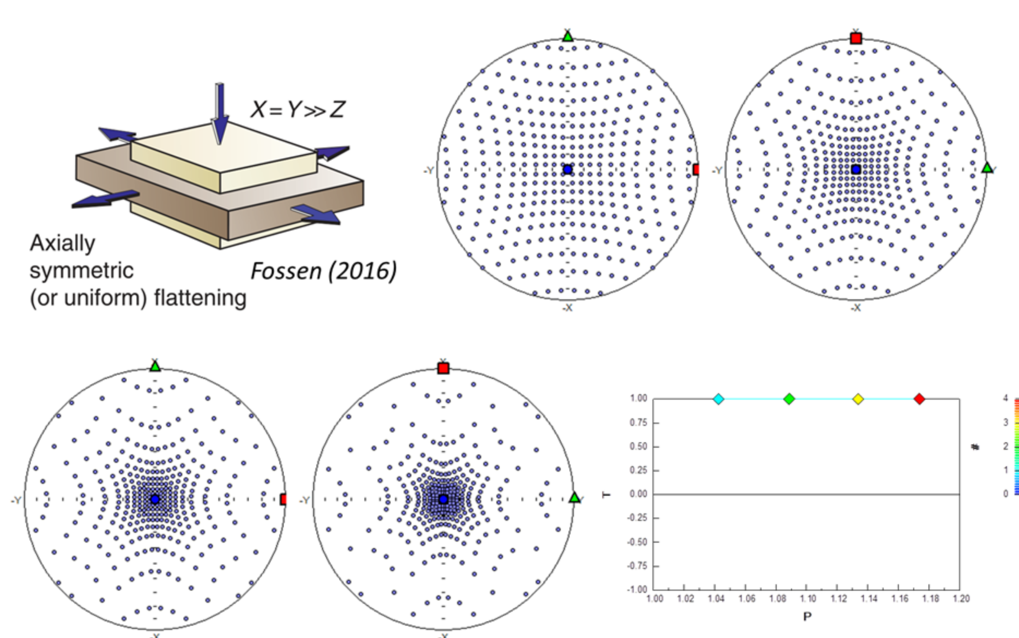
1. Uniaxial Shortening (Volume Loss)
2. Uniaxial Extension (Volume Increase)
3. Axially Symmetric Shortening
4. Axially Symmetric Extension
5. Pure Shear
6. Simple Shear
7. Transpression (Shear plane YZ / Shear direction Y)
8. Transtension (Shear plane YZ / Shear direction Y)

a. Along X
b. Along Y
c. Along Z

a. Shorten X / Extend Z
b. Shorten X / Extend Y
c. Shorten Y / Extend X
d. Shorten Y / Extend Z
e. Shorten Z / Extend X
f. Shorten Z / Extend Y

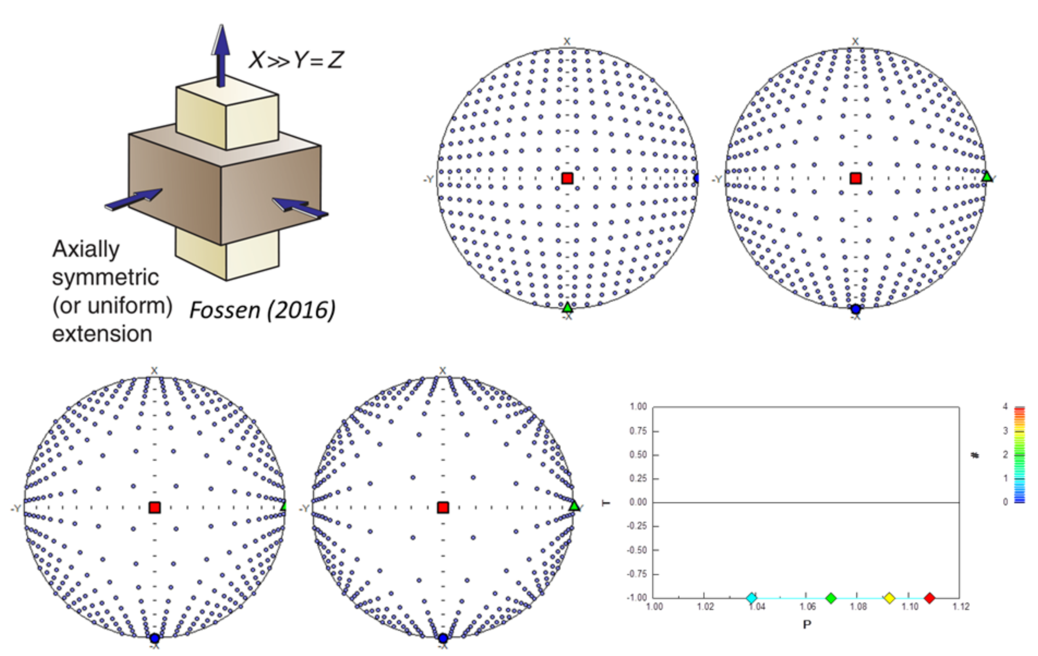
a. Strike-slip (Shear plane XZ / Shear direction X)
b. Strike-slip (Shear plane YZ / Shear direction Y)
c. Thrust in X (Shear plane XY / Shear direction X)
d. Thrust in Y (Shear plane XY / Shear direction Y)

Example 1: Flattening



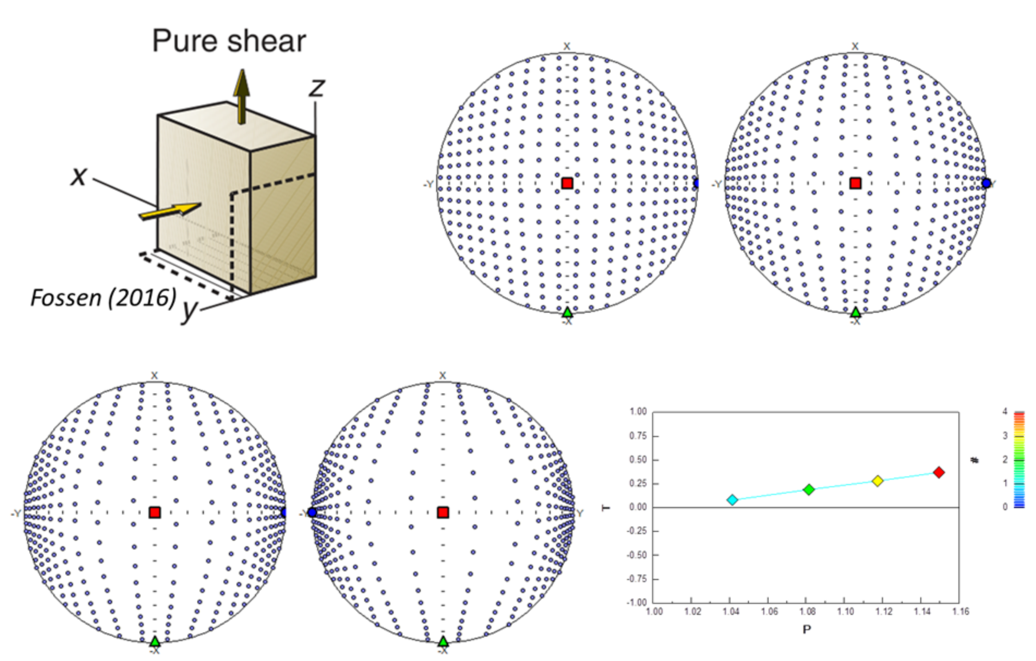
Oblate Grains /Axially Symmetric Shortening / Along Z / Stretch Increment = 1.5

Example 2: Extension



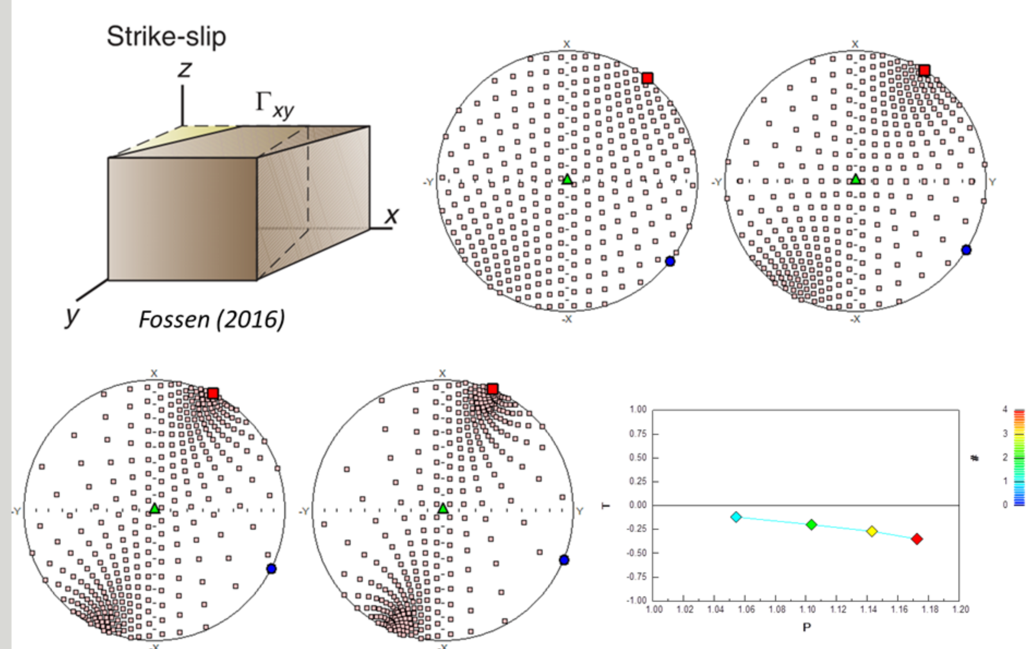
Oblate Grains / Axially Symmetric Extension / Along Z / Stretch Increment = 1.5

Example 3: Pure Shear



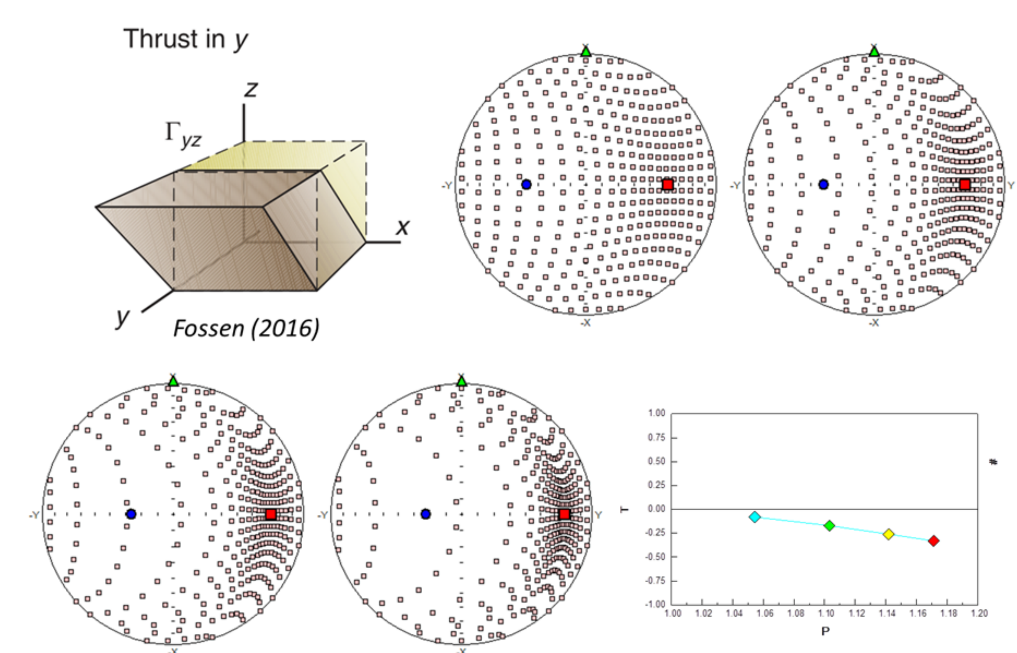
Oblate Grains / Pure Shear / Shorten Y – Extend Z / Stretch Increment = 1.5

Example 4: Strike-slip



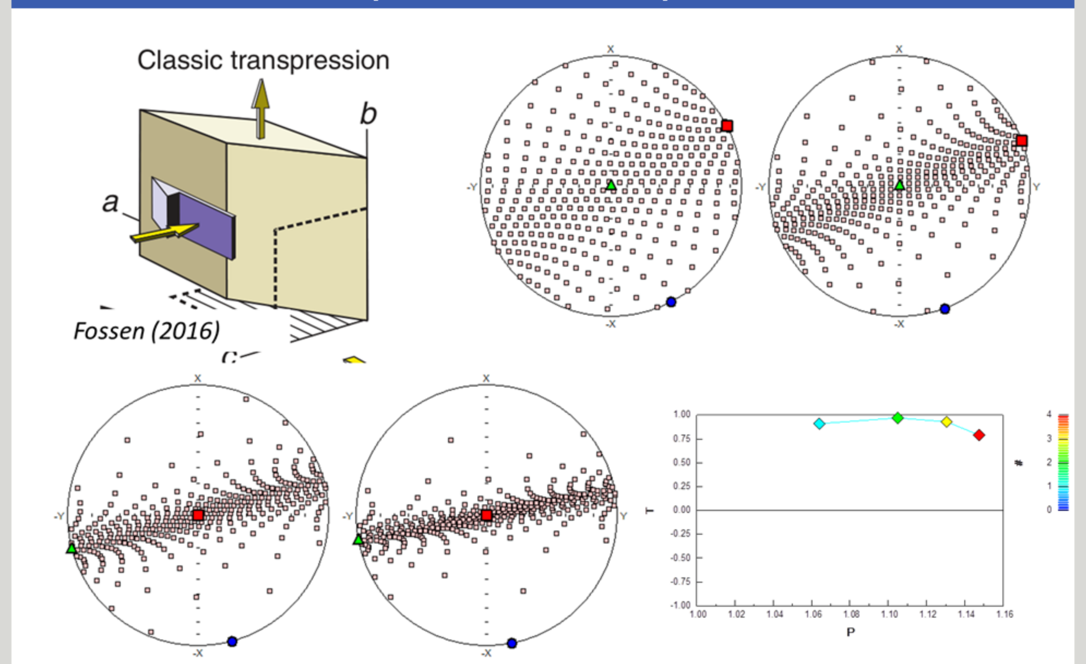
Prolate Grains / Strike-slip (Shear plane XZ / Shear direction X) / Gamma Increment = 0.5

Example 5: Thrust



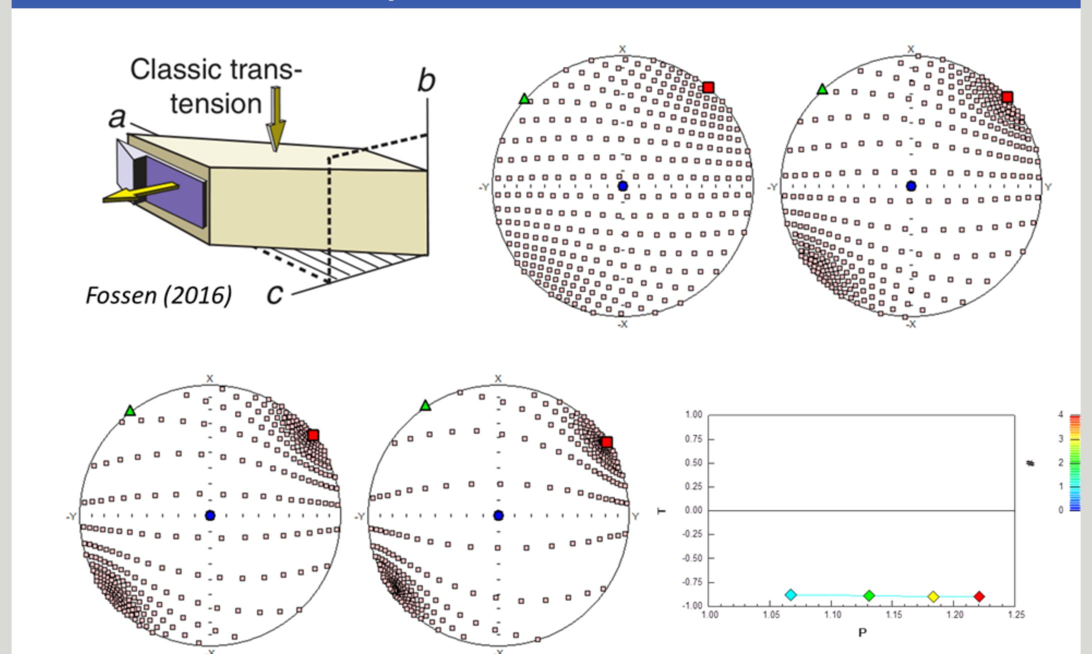
Prolate Grains / Thrust in Y (Shear plane XY / Shear direction Y) / Gamma Increment = 0.5

Example 6: Transpression



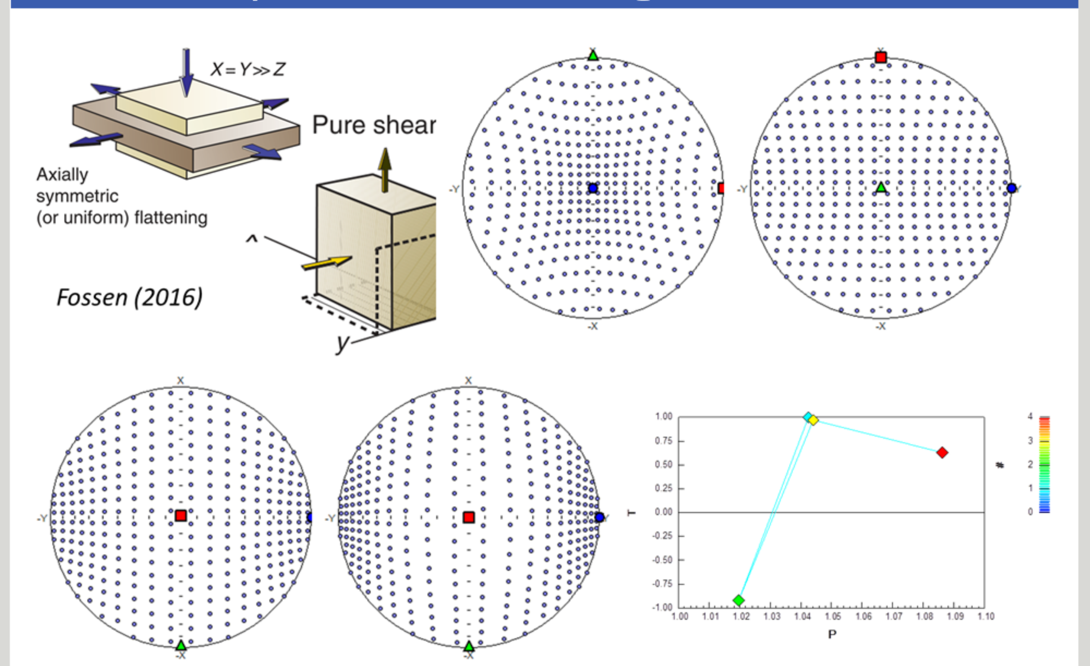
Prolate Grains / Transpression (Shear plane YZ / Shear direction Y) / Stretch Increment = 1.5, Gamma = 0.5

Example 7: Transtension



Prolate Grains / Transtension (Shear plane YZ / Shear direction Y) / Stretch Increment = 1.5, Gamma = 0.5

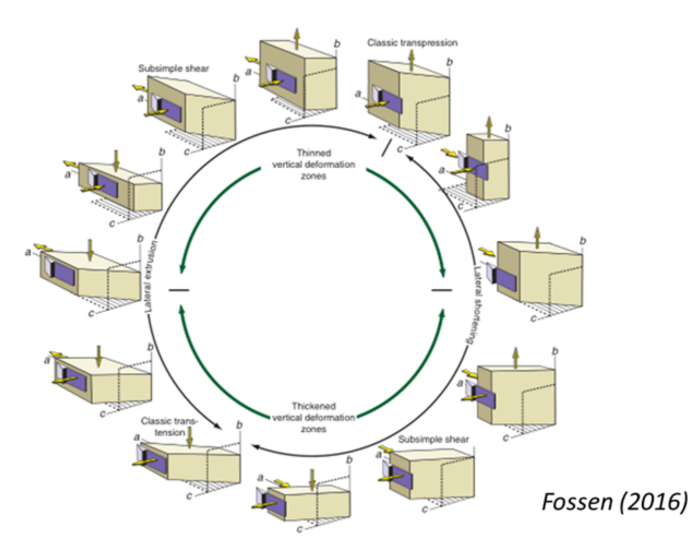
Example 8: Flattening + Pure Shear



Oblate Grains / Flattening + Pure Shear

Future Prospects

1. Simultaneous deformation matrix for Pure Shear and Simple Shear
2. Shear in arbitrary directions
3. Rotation along arbitrary axis between strain increments



Literature & Acknowledgement

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Available at
www.agico.cz/text/software/anisoft/anisoft.php