**Topic:** Microstructure

**Data Sources and Publications:**

*Ward, D., Mahan, K., and Schulte-Pelkum, V., 2012, Roles of quartz and mica in seismic anisotropy of*

*mylonites, Geophysical Journal International, doi: 10.1111/j.1365-246X.2012.05528.x.*

*Ward\_etal2012\_ISRq.ctf – A text file containing EBSD data from the Ward et al. (2012), for dynamically*

*recrystallized Coal Creek quartzite mylonite sample from station location GG2.*

**Additional resources:**

*Fossen, H., 2016, Structural Geology, Cambridge University Press, Cambridge, England, 2nd edn.,*

*Chapter 11: Deformation at the microscale, and Box 11.4 on the EBSD technique.*

*Swapp, S.M., 2019, Electron backscatter diffraction (EBSD),* [*https://serc.carleton.edu/18413*](https://serc.carleton.edu/18413)*.*

*Bachmann, F., Hielscher, R., and Schaeben, H., 2010, Texture analysis with MTEX -Free and Open*

*Source Software Toolbox, Solid State Phenomena, v. 160, p.63-68,* [*https://doi.org/10.4028/www.scientific.net/SSP.160.63*](https://doi.org/10.4028/www.scientific.net/SSP.160.63)*.*

*Stipp, M., Stünitz, H., Heilbronner, R., and Schmid, S. M., 2002, The eastern Tonale fault zone: A ’natural*

*laboratory’ for crystal plastic deformation of quartz over a temperature range from 250 to 700 °C, Journal of Structural Geology, 24, 1861–1884, https://doi.org/10.1016/S0191-8141(02)00035-4.*

**Goals:**

1) To reinforce your understanding of the links between microstructural and macrostructural analysis.

2) To review deformation mechanisms and understand the relationships between dislocation creep and crystallographic preferred orientation (CPO) in deforming minerals.

3) To understand the range of slip systems that are known to be possible in quartz and how they are thought to vary with deformation temperature

4) To understand how quartz CPO patterns can vary between coaxial and non-coaxial deformation, and how they can be used to infer shear sense.

**Figures to create:**

1. Quartz c-axis pole figure. Use a software program such as MTEX to generate a pole figure (spherical projection diagram) showing the orientations of quartz crystallographic c-axes in the sample collected from station GG 2 by Ward et al. (2012). You will be recreating the middle pole figure in the top row of Fig. 2B in the Ward paper.

**Questions to Answer:**

1. Why does dislocation creep cause a crystallographic preferred orientation (CPO) to develop during deformation? Conversely, why can the observation of a CPO be used to infer that dislocation creep was a dominant deformation mechanism?
2. Can the dynamically recrystallized quartz CPO in the Coal Creek quarzite mylonite be used to infer approximate temperatures of deformation, and are the results consistent with those inferred from metamorphic petrology? Talk with the metamorphic petrology group to exchange notes.
3. Can the quartz CPO pattern be used to infer shear sense during mylonite deformation, and are the results consistent with those observed in your field mapping? Talk with the advanced structural analysis group to exchange notes.
4. How do these data and interpretations relate to other field and analytical datasets that other students groups are working with?
5. How would this additional data and your interpretations of them affect your original map and cross-section interpretation?
6. Identify some of the main sources of uncertainty in these data and interpretations and discuss some ways that they are addressed.