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Interactive comment on "Microscale strain partitioning? Differential quartz lattice preferred orientation development in micaceous phyllite, Hindu Kush, northwestern Pakistan" *by* K. P. Larson et al.

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This manuscript is based on an analysis of quartz c-axis (optic axis) orientations in a single quartz + muscovite + chlorite phyllite sample from the Chitral region of NW Pakistan. The main result of interest is that there is a different quartz CPO in the more phyllyosilicate-rich matrix compared to the more quartz-rich bands, with the matrix quartz grains showing a subsidiary concentration of c-axes around the mineral grain-shape lineation direction. The fundamental critical points I have with regard to the manuscript are:

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1) I am a little worried that the maximum parallel to the lineation is an artefact. Uniaxial grains go into extinction when the optic axis (c-axis in quartz) is parallel to either the EW or the NS direction of the polarizers and the measurements and software of the Fabric Analyser have to distinguish between these two possibilities. I could easily conceive that the Fabric Analyser could more likely have difficulties in distinguishing when the grain size of the quartz is finer and when it is more intimately intergrown with muscovite/chlorite in the matrix areas. This is clearly not a problem with EBSD and it could also be checked with the Universal Stage – if c-axes are oriented EW they will go out of extinction on tilting around the NS axis. If they stay in extinction during this tilting then they are parallel to the NS axis.

2) The grain size variation in the quartz between thicker and thinner quartz layers and versus the matrix almost certainly reflects the pinning effect of second phases, for example see the review of Herwegh et al. (2011, J. Struct. Geol., 33, 1728-1750). It is not possible to use a recrystallized grain size "piezometer" in such a case. The calibration of such piezometers (and their intended use) is in monomineralic materials, where the "steady-state" recrystallized grain size may indeed reflect the flow stress during dynamic recrystallization.

3) The kinematic framework of the sample is not established. It is implied that it reflects shearing and if the fabric was developed in a shear zone, the shear stress on any parallel layer must be the same. If the dynamically recrystallized grain size reflected this shear stress and all developed at the same time then it should be approximately constant throughout the sample. As noted above, the variation in grain size could reflect the pinning effect of second phases. It could also reflect different deformation and recrystallization mechanisms in the more quartz-rich layers and in the mica-rich matrix. If the c-axis maximum parallel to lineation fabric in the matrix is real, the interpretation of Hippertt (1994) that this reflects dissolution and re-precipitation of grains rather than any GBR recrystallization could indeed be reflected in a different average grain size (and shape).

4) Even if one accepts that the opening angle of the crossed girdle pattern can be used to determine temperature of deformation / recrystallization, there are not many points defining the opening angle in Fig. 4d and it is not very well defined. In Fig. 4c there are a few individual measurements that also hint at such a weakly defined crossed girdle. On the basis of the presented data, it is a big step to use these patterns to determine temperature.

In summary, the arguments for determining the differential flow stress and temperature from the recrystallized quartz grain size and the c-axis CPO are not very convincing, which makes the attempt to determine strain rate in Fig. 5 even more questionable. What I do find very interesting is the tendency for a preferred orientation of c-axes parallel to the lineation in the more mica-rich matrix. If this is real (see comment 1 above) then this could indicate different deformation and re- / neo- crystallization mechanisms in the more monomineralic quartz layers compared to the mica-rich matrix, and could confirm observations made by Hippertt (1994). Results from more than one sample would support this better of course, and an EBSD study would allow the full 3D CPO to also be determined.

Other points:

1) I agree with Chris Wilson in the preference for using CPO rather than LPO in this manuscript, but this is semantics I admit.

2) References to other papers describing and using different optical c-axis "Fabric Analysers" should be included. The rig employed in this study is not the only one available, e.g. Heilbronner and Pauli (1993, J. Struct. Geol., 15, 369-382), Feuten and Goodchild (J. Struct. Geol., 23, 895-902), Pajdzik and Glazer (2006, J. Appl. Cryst. 39, 326–337).

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