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Spatial distribution of quartz recrystallization microstructures across the Aar massif (Swiss Central Alps)

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In the Aar massif, main foliation and major deformation structures were developed during NW-SE compression associated with the Alpine orogeny (Steck 1968). To be precise, shearing at the brittle to ductile transition may have initiated at different stages between 22-20 Ma and 14-12 Ma, followed by purely brittle deformation at around 10 Ma (Rolland et al. 2009). In light of the onset of dynamic recrystallization in quartz, Bambauer et al. (2009) defined a quartz recrystallization isograd in the northern part of the Aar massif. To the south, the grain size of recrystallized grains increases due to an increase of metamorphic temperatures from N to S. The aim of the current project is to carry out quantitative analysis on changes of the dynamic and static recrystallization behavior of quartz.

Across the Aar massif, two general types of microstructures have to be discriminated:
(i) weakly to moderately deformed host rocks and (ii) intensely deformed mylonites to ultramylonites out of high strain shear zones. In (i), volume fraction and size of recrystallized quartz grains increase towards the S showing grain size changes from around 5 μm up to ca. 200 μm. Southern microstructures are characterized by complete recrystallization. In terms of recrystallization processes, a transition from bulging recrystallization in the N to subgrain rotation recrystallization in the S occurs. Such a change in dynamic recrystallization processes combined with a grain size increase points towards reduced differential stresses with increasing temperature. This temperature gradient is also corroborated by a switch in the active glide systems in quartz from basal to rhomb dominated glide.
In contrast to the granitic host rocks, the mylonites and ultramylonites (ii) show smaller recrystallized grain sizes due to enhanced strain rates. However, they also reveal a general increase of recrystallized grain sizes from N to S.

In the S, microstructures from (i) and (ii) show equidimensional grains with 120° triple junctions and straight grain boundaries. Such microstructures are typical for static annealing. For that reason, we propose a post-deformational temperature pulse mainly affecting the southern part of the Aar massif. This annealing stage might correlate with the fluid pulse between 12-10 Ma suggested by Challandes et al. (2008). We will present constraints on the grade of deformation based on grain size data and CPO analyses, supporting the hypothesis that various deformation stages are well preserved in statically recrystallized structures.

REFERENCES

Bambauer, H.U., Herwegh, M., Kroll, H. 2009: Quartz as indicator mineral in the Central Swiss Alps: the quartz recrystallization isograd in the rock series of the northern Aar massif. Swiss Journal of Geosciences, 102, 345-351.
Kohn, M.J., Northrup, C.J. 2009: Taking mylonites‘ temperatures. Geology, 37, 47-50.
Rolland, Y., Cox, S.F., Corsini, M. 2009: Constraining deformation stages in brittle–ductile shear zones from combined field mapping and 40Ar/ 39Ar dating: The structural evolution of the Grimsel Pass area (Aar Massif, Swiss Alps). J. Struct. Geol., 31, 1377-1394.
Steck, A. 1968: Die alpidischen Strukturen in den Zentralen Aaregraniten des westlichen Aarmassivs. Eclogae geol. Helv., 61, 19-48.
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. J. Struct. Geol., 24, 1861-1884.
Stipp, M. & Tullis, J. 2003: The recrystallized grain size piezometer for quartz. Geophysical Research Letters, 30 (21).