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Clash of Porphyroblasts – Mechanical and chemical interaction of strong objects in a weak deforming matrix and the acceleration of dissolution precipitation creep

Hagen Bender (1), Benjamin Huet (2), Bernhard Grasemann (2), and Ralf Schuster (3)

(1) Department of Geological Sciences, Stockholm University, Svante Arrhenius väg 8, SE-106 91 Stockholm, Sweden, (2) Structural Processes Group, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria, (3) Geological Survey of Austria, Neulinggasse 38, A-1030 Vienna, Austria

The presence of porphyroblasts in metamorphic rocks has a strong influence on the microstructures that develop during deformation. Valuable as gauges for the sense of shear, single isolated porphyroblasts and -clasts have attracted enormous attention and vigorous discussion in the geological community. Naturally, however, porphyroblasts often occur in populations. Therefore, the understanding of multi-porphyroblast interaction is of great significance.

We use amphibolite-facies garnet mica schists from the Upper Austroalpine Wölz Complex for a case study. The microstructure of mm-cm sized, densely distributed garnet porphyroblasts indicates interference of the blasts. Blasts are subjected to convergence parallel to the instantaneous shortening axis, causing (i) accumulation and deformation of strain caps, (ii) fracturing of the garnets and (iii) dissolution of garnet at collision sites. Parallel to the instantaneous stretching axis, (i) cone-shaped strain shadows are linked between neighbouring garnets and (ii) separation of garnet clusters occurs preferably.

Dissolution precipitation creep accommodates the major part of deformation. Consequently, the matrix separates due to the dense population of porphyroblasts. The matrix differentiates to dissolution sites and precipitation sites in the respective quadrants of stretching and shortening around the blasts.

Quantitative chemical analysis and thermodynamic modelling are utilised to examine compositional variations in minerals within the stretching and shortening domains. The results show that the present-day assemblage in these rocks records no deviations from lithostatic pressure.