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Localization effect on inverse AMS fabric in marble – microstructural evidence across small-scale shear zone

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The anisotropy of magnetic susceptibility (AMS) as a volumetric method represents integrated signal of all microstructural features within sample. The AMS provides important quantitative information about rock structure. However, rock microstructure is often complex because it records multiple (if present) stages/processes of rock evolution from sedimentation to deformation. Moreover, the AMS and strain in deformed rocks do not have necessarily straightforward relationship. Therefore, the microstructural analysis is crucial for correct interpretation of AMS in deformed rocks. The aim of this study was to determine a relationship between the magnetic fabric and progressive deformation across the natural shear zone in pure marble. We document the AMS, microstructural and textural changes along two profiles in order to describe formation and evolution of AMS and its microstructural response in rocks under deformational gradient.

The rock fabric is characterized by the progressive evolution from original coarse-grained foliation towards the fine-grained foliation parallel to the $\sim$ 6 cm-wide shear zone. The main manifestation of increasing strain towards the shear zone core is increasing proportion of dynamically-recrystallized calcite grains. The recrystallization process leads to the development of porphyroclastic microstructure and to the formation of completely recrystallized fine-grained bands in the shear zone core. The crystallographic preferred orientation (CPO) of recrystallized grains as well as porphyroclasts progressively evolves with increasing strain.

The AMS of both profiles is characteristic by k1 perpendicular to rock fabric, both outside and within the shear zone. However, observed calcite <c> axes perpendicular to foliations, should resulted in k3 axis of AMS ellipsoid perpendicular to foliation. Consequently, the observed magnetic fabric is “inverse” with regard to orientation of foliation and calcite CPO. To interpret inverse magnetic fabric and observed strain-AMS relationship we have implemented numerical modelling. Models are constructed based on microstructure, CPO, modal and chemical composition of constituting minerals.