Geophysical Research Abstracts
Vol. 17, EGU2015-7009, 2015
EGU General Assembly 2015

The magnetic fabric of fault rocks

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The magnetic fabric of rocks generally informs about principal strain directions and strain magnitude. The main prerequisites for such fabrics to be deemed meaningful is to be carried by a sufficiently large number of grains and for the grains to be uniformly distributed throughout the volume of deformed rock. Clearly these conditions tend not to be met in fault rocks which is the main reason why magnetic fabrics are typically applied to materials that have undergone continuous and plastic strain, such as magmatic rocks. New advances in our understanding of magnetic fabrics now allow to expand their application to discontinuous, brittle strain and consequently to track deformation in fault rocks.
Here we present a review of three case studies exemplifying the applications of the anisotropy of magnetic susceptibility (AMS) in fault rocks.
1. The Bitterroot shear zone in Montana shows spectacular quartzofeldspathic C-S mylonites from Montana. These rocks, deformed in conditions ranging from high-temperature magmatic to cataclastic constitute an excellent example to monitor the variations of the magnetic fabric (principal axes, degree of anisotropy, shape parameter) in a context in which the kinematic directions remain constant while temperature decreases.
2. The carbonate ultracataclasites from the Heart Mountain detachment in Wyoming represent a case of catastrophic, large-scale slide approaching seismic velocities. While the dominant deformation mechanism is cataclastic flow, synkinematic breakdown of pyrrhotite and recrystallization into magnetite results in surprisingly consistent AMS fabrics.
3. The pseudotachylytes of the Dora Maira Massif in Italy display coherent AMS fabrics that are oblique with respect to the seismic slip plane. The combination of fabrics in the host-rock and pseudotachylyte veins provides a full kinematic solution (slip plane, slip direction, slip sense) for a single seismic event.
While the magnetic fabric of fault rocks has received far less attention than that of continuously deformed rocks, it holds significant promise for kinematic analysis and a better understanding of deformation mechanisms.