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Linking Anisotropy of Magnetic Susceptibility (AMS) to transport direction: The Gavarnie Thrust, Axial Zone, Pyrenees

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This work deals with the application of the anisotropy of magnetic susceptibility (AMS), structural analysis and microstructural analysis to the study of shear zones. Mylonitized fault rocks have been sampled in the Gavarnie Trust, one of the main structures of the Pyrenean Axial Zone, which was structured as a south-verging antiformal stack during the Alpine Orogeny. In the studied area, the Gavarnie Unit (Silurian-Carboniferous, low grade metasedimentary rocks) overthrust the Millares and Bielsa Units (Permian and Cretaceous cover, Cambro-Ordovician medium grade metamorphic rocks and granitoids), with a minimum horizontal displacement of 12km.

Three profiles of the shear zone were studied with the goal of observing changes in the transport direction, the strain distribution and the orientation of the magnetic ellipsoid., One profile is parallel to the basal thrust plane, where the core zone has been identified, and the other two are vertical transects (profiles 1 and 2), perpendicular to the thrust plane.

The shear zone, developed into the hangingwall phyllitic Silurian and Devonian units, is at least 30 m wide. The structural analysis reveals that the Silurian rocks are the local detachment level, which becomes thinner and pinchs out completely towards the South, where the detachment level is within the Devonian units (Fourche de la Sede Fm.). In both vertical profiles, the shear zone shows a decrease in the strain from the contact with the Cretaceous limestones at the footwall, towards the upper limit of the shear zone. This is evidenced by the lower development of mylonitic foliations and SCC' structures and the upwards increase of brittle deformation. The transport direction inferred from SC structures (stretching lineations in S and C planes) is constant in all sites, with an average of N190E.

AMS data are in perfect agreement with the structural analysis, being the magnetic foliation parallel to the S or C planes of the SC structures. The magnetic lineations are, in most sites (horizontal profile and profile 1) parallel to the stretching lineation and therefore can be used as a confident kinematic indicator. Nevertheless, where the Silurian detachment level accommodates most of the strain (profile 2), the Devonian phyllites and limestones show a notable decrease of strain (observed under optical microscope), lacking well-developed SC structures and developing magnetic lineations perpendicular to the transport direction (E-W). Two possible interpretation are here proposed: 1) A direct relationship between the strain degree and the orientation of the magnetic lineation and 2) the influence of previous fabrics, related to different stages of thrust activity or even the Paleozoic (Variscan) tectonic fabric, not completely overprinted in the damage zone. Textural analysis (EBSD studies) on calcite crystals have to be performed to try to interpret correctly the magnetic lineation.