Towards a quantitative evaluation of the degree of coincidence between the orientation of a magnetic fabric of deformational origin and the stress tensor calculated from microtectonic measurements

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In the geophysical and geological literature both the magnetic susceptibility tensor (k) used for the evaluation of magnetic susceptibility anisotropy (AMS) measurements and the stress tensor (T) of fault tectonics determined by inversion methods are associated with the deformation of the material in some extent. Although the relation of these tensors to the strain tensor is widely debated, results of AMS and tectonic measurements on identical or close localities from the Transdanubian Range demonstrated fairly good agreement between the directions of the extension calculated from the results of the two independent approaches. Beyond the graphical similarity of the stereograms (especially the directions of the principal axes associated with the ellipsoids of the tensors) we aim to establish a statistical framework to provide a quantitative comparison.

The main difficulty in the quantitative comparison is that the number of computed parameters is typically different for the two tensors: while it is 6 for the AMS tensor, it is less or equal to 6 for the stress tensor (the exact value depends on the specific inversion method used to determine the stress). This fact permits to apply such transformations, when one, ore more (maybe all the three) tensor invariants of T and k coincide. By this transformation in hand we accommodate Hotelling's T-squared distribution to establish a multivariate test to investigate our null hypothesis stating T=k. As long as the computed significance level exceeds the conventional 5%, the null hypothesis is accepted. This approach can be extended to provide a quantitative comparison between a vector and one of the principal directions of a tensor. For example, in case of extensional deformation, which is the dominant mode of tectonic deformation during Cenozoic in the Transdanubian Range, it is possible to investigate the degree of coincidence between the principal axis of the minimal compressive stress (i.e. the direction of the tension) and the direction of the magnetic lineation (i.e. the principal axis with the largest eigenvalue of k). Several examples for such applications will be presented for Eocene and Oligocene clay rich localities with well-developed magnetic fabric from the Transdanubian Range.

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