The significance of initial fabric during deformation

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Abstract

The initial fabric of sedimentary rocks is influenced by the mode of deposition of the sediments. In this contribution, we study the impact of mode of deposition on deformation using analogue modelling. It is a common practice to prepare sand-box models by sieving the sand or pouring with scraping individual sand layers. In this study, we compare the two methods by building models with mixed magnetite with quartz sand and measuring the anisotropy of magnetic susceptibility (AMS) on small samples taken from the two models. Preparing layers by sieving creates an initial fabric (S_0) that is similar to a sedimentary (aggradation/fall out) fabric in nature. In contrast, preparing layers by pouring and scraping produces an aligned initial fabric with oriented grains parallel to the scraping direction (Fig. 1). Such aligned fabric can be compared to sediments deposited in fluvial environments such as rivers, turbidites or eolian dunes.

During shortening of both types of models (Fig. 1), simulating a fold-and-thrust belt, the grains were aligned mainly in association with the evolving structures (folds and shear zones). However, a pervasive/penetrative fabric developed throughout the compacted part of the foreland away from individual structures (Fig. 1b). The orientation and magnitude of this penetrative fabric (S_1) differs throughout the model and depends on the initial fabric (S_0) and the amount of shortening. Nevertheless, the intensity and orientation of the penetrative fabrics developed in a “sieved” versus “scrapped” model are roughly comparable (Schöfisch, 2023).

We conclude that applying magnetic fabric analyses to sand-box-models provides insights into 1) penetrative (invisible) strain in contractional domains, and 2) influence of the initial anisotropy on any superimposed tectonic fabric (Schöfisch, 2023).

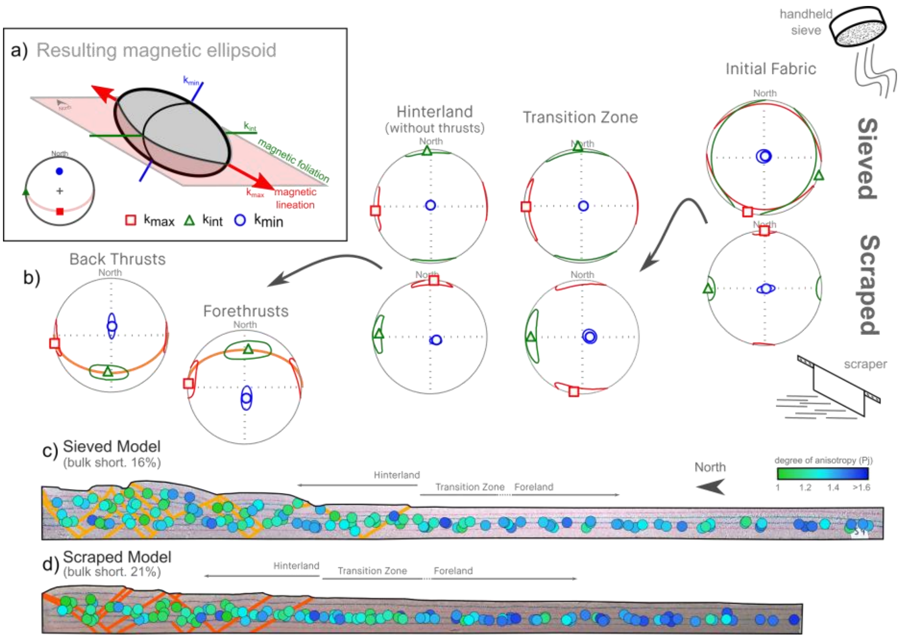

Fig. 1: a) The resulting magnetic ellipsoid with principal axes from magnetic fabric measurements of a sample. b) Principal axes realignment for different areas within the models that are associated with increasing deformation. c) and d) Distribution of the degree of anisotropy ($P = k_{max}/k_{min}$) for each model.

References

Schöfisch, T., 2023: Revealing invisible strain: Magnetic Fabric Analysis as Strain Indicator in Analogue Models and Nature. *PhD dissertation, Acta Universitatis Upsaliensis.* Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-503305