ANISOTROPY OF MAGNETIC SUSCEPTIBILITY IN VARIABLE LOW-FIELDS: A REVIEW

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Theory of the Anisotropy of Magnetic Susceptibility (AMS) of rocks is based on the assumption of the linear relationship between magnetization and magnetizing field, resulting in field-independent susceptibility. This assumption is valid for diamagnetic and paramagnetic minerals by definition and empirically was found valid also for magnetite. As the AMS meters use relatively weak fields, they were long time considered to measure the field-independent initial susceptibility also in ferrimagnetic and antiferromagnetic minerals. However, pyrrhotite, hematite and titanomagnetite may show significant variation of susceptibility in common measuring fields. Consequently, the use of the linear theory is in principle incorrect in the last cases.

However, recent model and empiric investigations have shown that using linear theory does not necessarily give rise to inaccurate results in all AMS aspects. Namely, the variations of the principal directions and of the AMS ellipsoid shape with field are weak, negligible with respect to common measuring errors. Consequently, if one is primarily interested in the orientations of magnetic lineation and foliation and in the symmetry of the AMS ellipsoid, and this is the case of most geological applications, one can use the simple and illustrative linear theory without danger of the loss of accuracy. On the other hand, the degree of AMS may show conspicuous variation with field and, if one wants to make precise quantitative fabric interpretation, it is desirable to work with the AMS of the initial susceptibility that is field-independent.

Three methods were developed for simultaneous determination of the field-independent susceptibility tensor and the initial susceptibility tensor of MD ferromagnetic fraction, all based on standard measurement of the AMS in variable fields within the Rayleigh Law range. The former tensor reflects possible effects of diamagnetic and paramagnetic minerals, pure magnetite, SD ferromagnetic minerals, and initial susceptibility of MD ferromagnetic minerals. The initial susceptibility tensor of MD ferromagnetic fraction does not however reflect the effect of the entire fraction, because the effect of the SD sub-fraction contributes to the field-independent susceptibility tensor.

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