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Field-dependent anisotropy of magnetic susceptibility can be represented by second-rank tensor in the fields up to 700 A/m

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Theory of the low-field anisotropy of magnetic susceptibility (AMS) assumes a linear relationship between magnetization and magnetizing field, resulting in field-independent susceptibility. This is valid for diamagnetic and paramagnetic minerals by definition and also for initial susceptibility of ferromagnetic minerals measured in very weak driving fields. However, the rock's susceptibility often shows significant variation with field even in the relatively weak fields used by common low-field AMS meters. In this case, the AMS should theoretically be described by the tensor of the higher rank than is rank two. To check this conclusion, we developed a technique for automated measurement of susceptibility in 320 directions in variable low fields ranging from 5 to 700 A/m using the KLY5 Kappabridge equipped with a special 3D rotator. This technique was applied to more than 100 specimens of various pyrrhotite-bearing and titanomagnetite-bearing rocks showing field-dependent susceptibility. It has shown that the anisotropic susceptibility can be well represented by an ellipsoid (second-rank tensor) in the field range between 5 and 700 A/m even though the ellipsoid increases its volume and eccentricity. The principal directions do not change their orientations with low-field in most specimens. In the minor specimens, the principal directions rotate with field, but the fit of an ellipsoid to the measured data remains excellent.