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Anisotropies of field-dependent in-phase and out-of-phase magnetic susceptibilities of some pyrrhotite-bearing rocks

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Pyrrhotite shows strong and non-linear variations of both the in-phase and out-of-phase magnetic susceptibilities with magnetizing field unlike to magnetite and paramagnetic minerals whose susceptibility is field independent if measured in low fields. Consequently, the magnetic sub-fabric of pyrrhotite unaffected by magnetite/paramagnetics can be directly investigated either through the anisotropy of field-dependent in-phase susceptibility (hdAMS) or through the anisotropy of out-of-phase susceptibility (opAMS). If the driving fields used for the susceptibility measurement are really low, within the range of validity of the Rayleigh Law, both the field-dependent component of the hdAMS and the opAMS are represented by the field-independent second rank Rayleigh Tensor. The determination of the Rayleigh Tensor via hdAMS requires the AMS measurements in several fields within the Rayleigh Law range, while in the determination of the Rayleigh Tensor via opAMS the measurement in one field is sufficient. It should be noted that if the AMS is measured by the KLY5 Kappabridge, the opAMS is measured simultaneously with standard in-phase AMS (ipAMS) during one measuring process. The Rayleigh Tensors determined by the above two methods should be more or less identical provided that the opAMS of pyrrhotite is dominantly due to weak field hysteresis, virtually unaffected by electrical eddy currents or viscous relaxation.
In a collection of various pyrrhotite-bearing rocks, both the hdAMS and opAMS were investigated using the KLY5 Kappabridge and the correlations between the Rayleigh Tensors determined by the above two methods were made in terms of the anisotropy degree, shape parameter, and the orientations of principal directions. Reasonable correlations were found indicating that the pyrrhotite opAMS is dominantly due to weak field hysteresis. As the opAMS is measured automatically and simultaneously with standard ipAMS, the advantage of the opAMS in the determination of the pyrrhotite sub-fabric compared to hdAMS is obvious.