Geophysical Research Abstracts
Vol. 21, EGU2019-18990, 2019
EGU General Assembly 2019
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Anisotropy of magnetic remanence: Empirical guidelines towards an efficient acquisition protocol

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In last few decades, magnetic anisotropy has become a well-established method of fabric analysis with numerous applications in structural geology, tectonic, volcanology, sedimentology and environmental magnetism. Magnetic fabric studied mainly by anisotropy of (low-field) magnetic susceptibility (AMS) integrates the shape and/or crystallographic preferential orientation of all rock-constituent minerals, i.e. ferromagnetic (s.l.), paramagnetic, and diamagnetic. In many cases, such integration does not pose a problem since the magnetic signal is dominated by one phase only. In other cases, however, it may be very important to separate the ferromagnetic fabric from the whole-rock fabric. This may be especially desirable when magnetic fabric is used (1) to correct for deflections paleomagnetic vectors, (2) to decipher the coaxial and non-coaxial fabrics being acquired in different tectonic regimes, and (3) to overcome the effects of inverse fabric carried by single domain ferromagnetic grains.
Among techniques of ferromagnetic fabric analysis, anisotropy of anhysteretic remanent magnetization (AARM) and anisotropy of isothermal remanent magnetization (AIRM) are the most common because they can be usually performed using a combination of instruments available in most paleomagnetic laboratories. Despite this fact, ferromagnetic fabric analyses are performed not as frequently as desired, mainly due to the fact that AARM and AIRM protocols involve a wide range of (sometime not well understood) experimental parameters controlling which ferromagnetic sub-fabric is to be measured and considerably influencing the quality and speed of fabric acquisition. In addition, unless one is equipped with an automatic system, AIRM or AIRM techniques are composed of many steps which are quite laborious, time-consuming and require a high degree of operator's concentration.
Here, we present some experimental examples of ferromagnetic fabric acquisition of selected sedimentary, igneous and metamorphic rocks. We mainly focus on the following factors: (1) how the viscous decay influences the measured remanence, (2) how the anhysteretic magnetization is distributed in different coercivity windows, (3) how DC bias field influences the acquired fabric, and (4) how many and which magnetizing directions are necessary to obtain reliable and statistically sound anisotropy of magnetic remanence tensors.