A low cost portable rock magnetic lab: why and how?

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Résumé

A full classic rock magnetic laboratory, allowing to measure in particular low field susceptibility (Klf) and its frequency dependence, natural and artificial remanence (e.g. IRM), saturation magnetization (Ms) and high field susceptibility (Khf), at variable high and low temperature, costs a minimum of circa 300 k€, using instruments available on the market and currently present in established labs. It requires a specific environment and is notably heavy thus rarely displaced once purchased. Being able to measure those parameters, at least at room temperature, with a low-cost portable set has several applications: it can be moved during a mission to a collection site or to the field, when it is not possible to transport to the lab the full sample set planned to be measured. It can also allow academic researchers, hired in low-income countries after a PhD in a classic rock magnetic lab, to pursue independently publishable experimental research once in position.
We will present here a scheme to reach this objective at a cost of only a few tens of k€, on standard 10 cc samples and smaller ones. Klf can be measured with a 10-7 SI noise level at variable frequency with the commercial SM150 system for a cost < 8 k€ (1). Remanence can be measured with a home-made spinner based on flux gate with a noise level of less than 1 mA/m (2). IRM acquisition can be performed in Halbach cylinders (few k€ cost), that can also be used to obtain Ms and Khf using a precision balance (at 0.1 mg) and a home-made set up described in (3). Noise levels below 10-6 SI and 0.1 A/m were reported on Khf and Ms, respectively. One can also perform thermomagnetic curves with such setting and a home-made oven (4). Thanks to the interface solutions available today, the realization of these non-commercial devices needs a computer, a few components for < 1k€, and engineering time.
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