

Recovering ancient magnetization of rocks from measurements of the magnetic field they produce

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Abstract: When rocks are heated (typically when they are formed, or after subsequent alteration), they can become magnetized by the ambient magnetic field. This remanent magnetization is used to study important processes in Earth sciences, since it provides records of past variations of the geodynamo. It has been used, e.g., to study motion of tectonic plates and geomagnetic reversals.

This magnetization itself produces a weak magnetic field. SQUID microscopes are sensitive instruments, able to measure the field produced by thin slabs of magnetized rocks. More precisely, it can measure the normal component of the magnetic field on a plane slightly above the sample, with a good spatial resolution.

We will present on-going research on the inverse problem consisting in recovering the magnetization distribution of the sample, from the measurements given by a SQUID microscope. We will characterize the so-called *silent sources*, i.e., the magnetizations that produce no field outside the sample (in other words, the kernel of the magnetization-to-field operator) and show on examples how ill-conditioned the problem is.

Instead of the complete distribution of the magnetization inside the sample, one might be interested in recovering weaker information such as the total net moment of the magnetization. This is already an important information for geoscientists, and not easy to measure with usual magnetometers. The net moment seems to be less ill-conditioned a problem and we will present some ideas to numerically recover it.