Geophysical Research Abstracts
Vol. 19, EGU2017-3547, 2017
EGU General Assembly 2017

3-D Printing: A New Method to Investigate the Effect of Deformation on Remanent Magnetization

Ann Hirt (1), Ali Mahfuj (1), Salvador Pané (2), and Simone Gervasoni (2)

(1) ETH Zurich, Institute of Geophysics, Zurich, Switzerland (ann.hirt@erdw.ethz.ch), (2) ETH Zurich, Institute of Robotics and Intelligent Systems, Zurich, Switzerland

A fundamental assumption in paleomagnetism is that a sediment or rock retains the direction of the Earth's magnetic field over its geologic history. Sedimentary compaction or tectonic deformation can lead to the realignment of minerals, which could deflect the direction of the original natural remanent magnetization. Correction of the deflection often assumes a simple March model, in which it is assumed that the material deforms under pure shear. Sedimentary compaction and tectonic deformation involve a number of geological processes, which makes it difficult to reproduce these processes on a laboratory scale. Redepositional experiments have been carried out to examine how remanent magnetization is affected by sedimentary compaction, but little experimental data is available for the deformation of rocks. Previous experiments used deformation rigs to subject rocks to compactional or torsional deformation; however, the remanent magnetization of the rocks was often reset, due to strong magnetic fields associated with the rigs. 3-D printing opens new possibilities to create analogue rocks that can be subjected to deformation. In a proof-of-concept study, we have examined two designs to explore the applicability of the March model for simple compaction. In the first case cubes with different geometries of pore openings were printed with non-magnetic inks. The samples were then submerged in a ferrofluid and left to dry. An anhysteretic remanent magnetization (ARM) was imparted in a 50 μT DC field superimposed on a 100 mT alternating field and measured using a 2G cryogenic magnetometer. A sample holder was constructed to allow incremental, uniaxial compaction of the sample, whereby the magnetization was measured after each step. In a second set of experiments, 30 nm particles of magnetite/maghemite were incorporated into the material used to make the filament that is then used in the 3-D printer. This assures that the ferromagnetic particles are imbedded in the material that is being deformed. An ARM was imparted and the sample incrementally compacted as described above. Preliminary results in both cases indicate that the remanence does not follow a simple March model.