Beyond single model and single domain : Using big data to answer fundamental questions in rock magnetism

Leslies Nagy¹, Wyn Williams², Lisa Tauxe¹, Adrian Muxworthy³, and Karl Fabian⁴
¹Scripps Institution of Oceanography, University of California, San Diego, United States of America
²School of GeoSciences, The University of Edinburgh, Edinburgh, United Kingdom
³Royal School of Mines, Imperial College, London, United Kingdom
⁴Norges Geologiske Undersøkelse, Norges Teknisk-Taturvitenskaplig Tniversitet, Trondheim, Norway

Interpretation of palaeointensity measurements is difficult since natural samples are made up of magnetic grains of different size, shape and chemical composition. Néels single-domain (SD) model is the main theoretical tool used to understand paleomagnetic measurements, but it is limited since it only applies to uniformly magnetized grain assemblies.

Recent work has shown that the single-vortex (SV) state is not only significantly more common than SD as it occupies a much larger range of grain sizes but is also surprisingly thermally stable [1]. As these grains likely account for the majority of the signal measured in the laboratory, they must also be responsible for the range of observations that lead to large inaccuracies in measurement, for example, pTRM tails. Additionally, if we have a clear understanding of the SV state, can we account for the true cooling rate dependence of grain assemblies, and also find a physical link between magnetic coercivity and blocking temperature.

We present a framework of tools for paleomagnetists to interpret measurements in the light of advances in numerical modelling and the increase in speed of modern computers. We hope that these tools will advance our understanding of the basic mechanisms by which samples record and preserve the Earth's magnetic field and so will allow for the quantification of errors observed in real samples.
