Geophysical Research Abstracts, Vol. 9, 00752, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00752

A Review of the Microwave Palaeointensity Method

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Absolute palaeointensity methods rely on being able to simulate in the laboratory the natural thermal remanence acquisition process. A major problem with conventional methods is that thermo-chemical alteration often occurs during laboratory heating so that the samples' capacity to acquire remanence changes and thus it is not possible to deduce the ancient magnetic field intensity. Reducing laboratory induced alteration was the motivation for the group at Liverpool in the 1990s (led by John Shaw and Derek Walton) to start experimenting with using microwaves to demagnetise and remagnetise samples rather than heating using conventional ovens. The microwaves directly excite the magnetic system so that it is not necessary to heat the whole bulk sample and excite the magnetic system via lattice vibrations. Thus, using microwaves minimises sample alteration and the success rate of palaeointensity experiments can be increased. As with conventional methods, the non ideal effects of grain size and naturally altered remanence must still be addressed. The development of the microwave palaeointensity technique from the early experiments using a domestic microwave oven, to the current systems operating at 14 GHz will be described. The current systems allow a laboratory field to be applied in any specified direction and the recent improvement in reproducibility of microwave power absorption mean that it is possible to perform any methodological protocol. There have been 16 publications in the last 5 years reporting studies utilising the microwave palaeointensity method. Results from studies that compare conventional thermal (Thellier) and microwave techniques, using both artificial and natural remanence will be described as well as palaeointensity results obtained using the microwave palaeointensity method from archaeological, geological and even extra terrestrial material. Finally, future developments and applications of the method will be discussed.