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The Quasi-perpendicular method of absolute palaeointensity determination: application to multidomain samples

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It is extremely rare that the remanence of rocks studied for absolute palaeointensity purposes is carried exclusively by ideal single domain grains. However, numerous theoretical and empirical studies have indicated that when this is not the case, there is a significant risk of the determinations being biased. Here further evidence of this danger will be presented using samples from 20th Century basaltic lava flows from Mt Etna with hysteresis properties typical of 'pseudo-single domain' grains. When subject to conventional Thellier analyses, these samples can produce linear sections on Arai plots which pass selection criteria but produce overestimates of the palaeointensity by upwards of 30%.

Such big problems can largely be overcome in three different ways. Firstly, in experiments involving double heating steps (such as those employing most variants of the Thellier method), a set of five simple measures can simultaneously reduce the effects of multidomain (MD) grains whilst also making it easy to detect them (Biggin, 2006, Earth Planet. Sci. Lett, 245, 454-470). Secondly, the Thellier method may be abandoned altogether in favour of the 'multispecimen parallel differential pTRM method' which has been demonstrated to produce results largely unbiased by multidomain grains (Dekkers & Boehnel, 2006, Earth Planet. Sci. Lett, 248, 507-516).

I present a third alternative: a new 'Quasi-perpendicular' method which largely eliminates multidomain biasing but retains the intra-specimen consistency check which has made the Thellier and Thellier method so popular in the past. The effectiveness of the new method is demonstrated using a group of samples from Mount Etna. Whilst the conventional Coe-modified Thellier method produces results which are uniquely higher than the expected value, the results of the Quasi-perpendicular method cluster

around the correct palaeointensity and are of higher technical quality. Consequently, the new method produces a reliable, accurate mean palaeointensity determination whereas the standard method produces an untrustworthy overestimate. A further advantage of the Quasi-perpendicular method is that, since the experiments require only one heating treatment to be made at each temperature, they are a great deal faster to perform than those made using other Thellier protocols.