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Are systematic differences between thermal and microwave Thellier-type palaeointensity estimates a consequence of multidomain bias in the thermal results?

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A meta-analysis which directly compares 13 datasets of microwave and thermal Thellier palaeointensity measurements obtained from igneous rocks is reported. The results clearly indicate systematic differences in the measurements made using the two approaches: the thermal results tend to be higher (often by several tens of percent) and associated with slightly noisier Arai plots. Additionally, in nearly half of the cases considered, higher thermal palaeointensity estimates were reported to be calculated from the lowtemperature portions of concave-up Arai plots while microwave measurements made on specimens from the same core sample or rock unit were derived from more linear Arai plots. The most plausible explanation for the bulk of these differences appears to be that non-ideal behaviour caused by multidomain, vortex state, and/or interacting ferrimagnetic grains is exaggerated in the results of the thermal experiments over their microwave counterparts. A detailed investigation of the individual studies concludes that such effects may be adversely affecting some of the measurements (thermal and/or microwave) in 10 of the 13 datasets considered. It is probable that these non-ideal effects are enhanced in the thermal results over their microwave counterparts, at least in part, because of the different Thellier-type protocols that are used in the two types of study. The findings of this study suggest that biasing of absolute palaeointensity estimates by multidomain effects may be much more prevalent than previously thought and that this effect might be responsible for certain discrepancies that have been observed in the GEOMAGIA50 database. They also clearly indicate that, in addition to taking the steps they already do to avoid biasing from secondary overprints and thermally-induced alteration, future absolute palaeointensity studies of any type must also take great care to avoid bias from these multidomain effects.