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Accurate paleointensities – the multi-method approach

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The accuracy of models describing rapid changes in the geomagnetic field over the past millennia critically depends on the availability of reliable paleointensity estimates. Over the past decade methods to derive paleointensities from lavas (the only recorder of the geomagnetic field that is available all over the globe and through geologic times) have seen significant improvements and various alternative techniques were proposed. The 'classical' Thellier-style approach was optimized and selection criteria were defined in the 'Standard Paleointensity Definitions' (Paterson et al, 2014). The Multispecimen approach was validated and the importance of additional tests and criteria to assess Multispecimen results must be emphasized. Recently, a non-heating, relative paleointensity technique was proposed –the pseudo-Thellier protocol– which shows great potential in both accuracy and efficiency, but currently lacks a solid theoretical underpinning.

Here I present work using all three of the aforementioned paleointensity methods on suites of young lavas taken from the volcanic islands of Hawaii, La Palma, Gran Canaria, Tenerife, and Terceira. Many of the sampled cooling units are <100 years old, the actual field strength at the time of cooling is therefore reasonably well known. Rather intuitively, flows that produce coherent results from two or more different paleointensity methods yield the most accurate estimates of the paleofield. Furthermore, the results for some flows pass the selection criteria for one method, but fail in other techniques. Scrutinizing and combing all acceptable results yielded reliable paleointensity estimates for 60-70% of all sampled cooling units – an exceptionally high success rate. This 'multi-method paleointensity approach' therefore has high potential to provide the much-needed paleointensities to improve geomagnetic field models for the Holocene.