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Investigating the use of pyroclastics for palaeointensity determinations

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Palaeointensity experiments are time consuming and prone to failure, making it difficult to obtain good data. This limits the global palaeointensity database, which has inadequate spatial and temporal resolution. Developing reliable yet efficient experimental techniques is important for improving data quality, as is expanding the range of materials to investigate. By characterizing and understanding the behaviour of different materials, such as lithic clasts found within pyroclastic flows, we can assess their potential usefulness as palaeomagnetic recorders. Pre-existing lithic fragments are reheated as they are incorporated into pyroclastic density currents (PDCs) and their subsequent deposits. This partially resets their magnetization to record the ambient field at the time of eruption. The explosive nature of volcanic eruptions associated with PDCs frequently results in a wide range of lithic fragments in such deposits and the high temperatures involved (up to $\sim$1200°C) can allow acquisition of an entirely new magnetization. We have studied the pyroclastic deposits of three historic volcanoes: Láscar in the Chilean Andes, Colima in Mexico, and Mount St. Helens, USA. At Láscar, the emplacement temperature of the deposits exceeds the Curie temperature of the magnetic minerals, which maximizes the potential temperature range for obtaining palaeointensity determinations. Triple heating palaeointensity experiments, with strict selection criteria, yield a mean palaeointensity of 23.9$\pm$1.8 μT (N=20), which is in

good agreement with the expected value of 24 μT. This indicates that the method has some promise. The use of multiple lithologies in a single palaeointensity determination also provides confidence that the result is not biased by alteration within one of the lithologies. Working with pyroclastic materials is not without its pitfalls, however, as is illustrated by data from Colima. Discrimination between hot pyroclastic deposits and cold mudflow deposits based on field observations alone can be extremely difficult. Inconsistent palaeomagnetic directions recorded by samples from Colima suggest that they are mudflow deposits, the cold nature of which precludes them from meaningful palaeointensity analysis.