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Emplacement temperatures of pyroclastic flows using palaeomagnetic techniques: Láscar, Chile

G. Paterson (1), J. Viramonte (2), A. Roberts (1)

(1) National Oceanography Centre, University of Southampton, European Way, Southampton, SO14 3ZH, UK, (2) Instituto Geonorte, Universidad Nacional de Salta, Buenos Aires 177- 440 Salta, República Argentina (gap1@noc.soton.ac.uk)

Valuable insights into volcanic processes and hazards can be obtained if the emplacement temperature of pyroclastic deposits is known. Direct determination of emplacement temperatures can be difficult and dangerous. Direct measurements require specialist equipment and mobilisation shortly after an eruption, with the attendant dangers of working on a recently erupted explosive volcano. Indirect measurement methods reduce this danger, and can allow estimation of past and pre-historical emplacement temperatures. Non-magnetic methods rely on the presence of material such as wood, grass or man-made items such as plastic bottles. The major limitation of this approach is that in remote or high altitude areas with sparse vegetation, these materials either may not be present or may have been completely destroyed by the eruption. In addition, many materials have a limited useful temperature range; for example, the melting point of most man-made plastics is typically 200-300˚C. Likewise, for modern eruptions, satellite measurements of irradiance enable temperature estimation, but saturation above 250˚C prevents estimation at the high-temperature end of the spectrum, which is often the most important in volcanic hazard assessment. Palaeomagnetic methods allow emplacement temperature estimation from lithic clasts that are incorporated into a flow during eruption. Samples can be collected over an entire deposit to give an understanding of the temperature structure of a flow. We have palaeomagnetically determined emplacement temperatures from the 1993 eruption of Volcán de Láscar in Chile. Láscar is one of the most active volcanoes in the Central Andes. The two-day eruption sent columns of ash 22 km above the crater rim, with light ashfall reported in Buenos Aires, some 1,500 km to the SE. Subsequent column collapse generated pyroclastic flows to the north and south that extend 8.5 km from the sum-

mit. Emplacement temperature estimates of lithic clasts from within these pyroclastic deposits indicate that all parts of the flows on the northern and southern flanks of Láscar were erupted at high temperatures that exceed the Curie temperature of magnetite (580˚C). While we have not detected any variations in the temperature structure of the pyroclastic deposits, these measurements highlight the considerable hazard associated with high-temperature, explosive eruptions of this type.