On The Use of Anisotropy of Magnetic Susceptibility on Volcanic Rocks

Prof. Michael Ort
Northern Arizona University, Flagstaff, Arizona, USA

The direction in which volcanic currents flow, or the shear fabrics in the deposits they make, can tell us a great deal about the processes by which they move. Are particles deposited singly or en masse? Are grains aligned parallel or perpendicular to flow? Is the flow turbulent or laminar? This information, in turn, can have hazards implications. However, field or laboratory measurements of elongated particles are difficult and/or time consuming to do. Anisotropy of magnetic susceptibility (AMS) is a fast and statistically robust method to determine fabrics in volcanic rocks and deposits. It uses the *alignment of magnetic particles* (NOT the magnetic field measured in 'conventional' remanent magnetism) to determine the fabric of the rock. This lecture will concentrate on basaltic lava flows and dikes and ignimbrites, on which many studies have been carried out, but will touch on recent work on less well studied silicic lava flows and surge deposits. AMS on basaltic lava flows reveals a great deal about folding and shear within the flows, while AMS on dikes describes the stress fields and magma flow directions within the dikes as they form. In ignimbrites, AMS has been used extensively to identify vent locations. In the past 15 years, some researchers have turned to using AMS to study depositional processes from pyroclastic flows, which in turn informs us about the overriding flows. Results show that some flows are density stratified, with the basal depositing portion being denser and gravity controlled while the overriding transporting flow traveling more or less radially from the vent. AMS on pyroclastic flows from Vesuvius shows complex interactions with human structures leading to turbulence in the lower portion of the flows. In the Campanian Ignimbrite, there is some evidence that the flows were chaotic and poorly organized near the caldera but settled into more laminar flow farther out. Preliminary AMS work on surge deposits from maars reveals a similar pattern, with chaotic directions at the maar boundary but with more flow-parallel directions farther out, and finally a foliated but non-lineated fabric where the flow became dilute and lofted into the air.