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Fabrics, Facies And Flow Through A Large-Volume Ignimbrite: Pampa De Oxaya, Chile.

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Large volume pyroclastic currents form during some of the most destructive volcanic eruptions on the planet, yet because they are underrepresented in the geological record they remain poorly understood. The Miocene Oxaya ignimbrites, exposed along the western Andean slopes in northern Chile, form one of the largest ignimbrite provinces on earth. We use anisotropy of magnetic susceptibility (AMS) in conjunction with rock magnetic measurements to investigate flow behavior and depositional processes in one of the largest members of the Oxaya succession, the Cardones ignimbrite. Despite its prominence the location of the source caldera remains unknown and fundamental processes remain poorly constrained.

During 2012 nearly 8km (7,773m) of core was recovered from the early Miocene ignimbrites in 11 holes at elevations ranging from 2336m to 3805m along the Andean escarpment east of Arica, Chile. The drill cores are remarkable in that they penetrate through the entirety of the ignimbrite sequence and into the basement below. Samples for this study were collected from a > 1 km long core drilled at an altitude 3692m. The core sampled 981 m of Cardones ignimbrite and 15 m of underlying sediments and volcaniclastics before penetrating 148 m of basement. Detailed measurements of the variation in bulk magnetic properties including natural remanent magnetization (NRM), susceptibility, ARM, and IRM, were used to monitor changes in concentration, composition and grainsize of the magnetic components though the ignimbrite. AMS in conjunction with detailed rock magnetic measurements were used to constrain flow processes.

The data reveal a well-defined flow direction and systematic variations in flow processes with depth. Low field bulk magnetic susceptibility averages 3.2x10-3 SI. Rock magnetic studies and petrographic examination indicate that magnetite is likely to be the dominant magnetic phase although paramagnetic mineral phases also contribute to the magnetic fabric. The degree of anisotropy (P) ranges from 1.01- 1.1 with high P generally associated with predominately linear fabrics and higher bulk susceptibility. Petrofabric orientations, after correction for rotation about the core axis, are well grouped and imbricated revealing a well-defined transport direction down the paleo-slope towards the SW (247°), confirming the deformed Lauca caldera as the likely source of the eruption. Systematic variations in a fabric shape (T) and intensity (P) with depth were also observed with predominately oblate fabrics near the top and towards the base of the flow, and predominately prolate fabrics in the central section of the flow. These vertical changes in fabric show that this massive, apparently homogeneous deposit has a systematic layering that can be interpreted as the combined effect of subtle changes in clast populations related to source heterogeneities, temporal changes in the flow-boundary zone during deposition, and changes in post-depositional processes with depth.