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Modeling magmatic flow in a sill using AMS techniques

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The intrusion mechanism and internal structure of sills are still not well understood. Here we present a detailed and high resolution AMS study of a Cretaceous sill from Portugal in order to better constrain the magmatic flow along a vertical profile. We also conducted rock magnetic analysis in order to identify the nature and grain size of magnetic carriers. Our results show different magnetic fabrics in function of the location within the sill: (1) the borders show low anisotropy suggesting low velocity gradient between magma and host-rocks attributed to the roughness of the surface into which the magma was intruding; (2) the center of the sill, where magma flow was not disturbed by the walls, also present low anisotropy reflecting minimum shear flow and magma transport close to pure translation; and (3) intermediate zones between the borders and the center present high anisotropy values which are interpreted as corresponding to maximum shear zones. The distribution of K1 azimuths (lineation), assumed here to be a proxy of the magma flow direction, yielded a mean value of 330º, which is similar to the direction of elongation of macroscopic carbonate-filled vesicles. The sense of the magmatic flow was inferred to be from WNW to ESE, by the imbrication of both magnetic lineation and vesicles in the borders. These features are in agreement with a magmatic source located some tens of kilometers to the NW of the sill, where strong magnetic anomalies are observed. These results bring new insights to better constrain emplacement mechanisms of sills and also have implications regarding the geodynamic evolution of Iberia at Cretaceous.