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Deviation of paleomagnetic directions on basaltic lava flows determined by rock magnetic fabrics

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Some paleomagnetic works conducted in lava flows retrieve characteristic remanent directions that shows an inclination shallowing relatively to the expected Geocentric Axial Dipole. Contributions of non-dipole components to the resultant Earth magnetic field and/or deficient time covering of the paleosecular variation are the most pointed causes for such shallowing. Another, but often overlooked source of shallowing, is the magnetic anisotropy carried by lava flows. In order to bring more insights about this research topic, four historical basaltic lava flows (corresponding to nine sampled sites) from Azores (Terceira and Pico islands) were studied. Detailed paleomagnetic and magnetic fabric analyses (anisotropy of magnetic susceptibility AMS and of anhysteretic remanence AARM) were complemented by petrographic observations of oriented thin sections. Our study shows that the majority of the analysed sites display a low degree of anisotropy (corrected degrees of anisotropy, Pj, lower than 1.03), sometimes accompanied by exchanges between principal axes of the magnetic susceptibility ellipsoid. For such cases the corresponding paleomagnetic directions are well grouped with a Fisher distribution. The sites, where Pj is higher than 1.03 (reaching 1.15), present a triaxial magnetic susceptibility ellipsoid and the paleomagnetic directions show a lengthened distribution. Spatial distribution of AMS and AARM ellipsoids axes are very similar. Petrographic observations show flow structures that agree with AMS and AARM ellipsoid. Comparing AMS and main paleomagnetic directions retrieved for lava flows with the highest anisotropy, 20º variation in inclination of paleomagnetic directions is observed. This inclination varies almost linearly with the degree of anisotropy through an inverse correlation. A shift of paleomagnetic declinations is also observed, which agrees with changes in the direction of the maximum principal axes of AMS ellipsoid. These results clearly show that paleomagnetic directions on basaltic rocks can be strongly deviated from the field direction. Accordingly, preliminary analyses of rock fabrics (magnetic and microstructural) are fundamental for such kind of paleomagnetic works. The author wish to acknowledge REGENA project (PTDC/GEO-FIQ/3648/2012) for its major contribution without which this work wouldn't be possible. Publication supported by project FCT UID/GEO/50019/2013 - Instituto Dom Luiz.