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Paleointensities of silicic volcanic glass: Influence of emplacement rotations and devitrivication

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A paleomagnetic study on natural silicic volcanic glass from three different geological settings is presented. The glass transition temperature and natural cooling rates were determined by relaxation geospeedometry. Paleointensity determinations were performed with a modified Thellier technique using checks for alteration and domain state. Additionally, measurements of the anisotropy of the thermoremanence and the magnetic cooling rate dependency were included into the measurement protocol of each specimen. Rock magnetic investigations show that the main remanence carriers are low-titanium titanomagnetites that are within or close to the single domain range. At two geological settings, a 750 kyr old outcrop on Tenerife, Spain and a lava flow at the probably 95 kyr old Blahnukur in Iceland, different degrees of hydration were present. Obtaining good quality paleointensity data was impossible as thermal alteration was observed in all measurements. Systematic changes of paleomagnetic alteration indices within the profiles suggest the presence of a chemical remanence which was acquired during devitrifiction of parts of the flow. Samples from the third geological setting, 2000 yr old obsidians from Tenerife, unblock at about 400°C and are characterized by extraordinary thermal stability. Paleointensity determinations are of very good quality. The samples are characterized by strong magnetic anisotropy and the anisotropy of thermoremanence requires intensity corrections of up to 30% for individual specimens. Emplacement rotations/movements during TRM acquisition of the glass flow while cooling are present in this site. At a squeezing structure this effect is verified using paleodirections, which move further and further away from average site direction when approaching the side borders and thus the faster cooled parts of the squeezing structure. Thus the anisotropy tensor of the magnetic minerals is rotating while cooling in a (widely) constant magnetic field. This effect will not be correctly accounted for in standard anisotropy correction and thus can lead to hidden failures of paleointensity.