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Magnetic paleointensities recorded in fault pseudotachylytes and implications for earthquake lightnings

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Fault pseudotachylytes commonly form by frictional melting due to seismic slip. These fine-grained clastic rocks result from melt quenching and may show a high concentration of fine ferromagnetic grains. These grains are potentially excellent recorders of the rock natural remanent magnetization (NRM). The magnetization processes of fault pseudotachylytes are complex and may include the following: i) near coseismic thermal remanent magnetization (TRM) acquired upon cooling of the melt; ii) coseismic lightning induced remanent magnetization (LIRM) caused by earthquake lightnings (EQL); iii) post seismic chemical remanent magnetization (CRM) related to both devitrification and alteration.

Deciphering these magnetization components is crucial to the interpretation of microstructures and the timing of microstructural development. Hence the paleomagnetic record of fault pseudotachylytes provides an independent set of new constraints on coseismic and post-seismic deformation.

Fault pseudotachylytes from the Santa Rosa Mountains, California host a magnetic assemblage dominated by stoichiometric magnetite, formed from the breakdown of ferromagnesian silicates and melt oxidation at high temperature. Magnetite grain size in these pseudotachylytes compares to that of magnetites formed in friction experiments. Paleomagnetic data on these 59 Ma-old fault rocks reveal not only anomalous magnetization directions, inconsistent with the coseismic geomagnetic field, but also anomalously high magnetization intensities. Here we discuss preliminary results of paleointensity experiments designed to quantify the intensity of coseismic magnetizing fields. The REM' paleointensity method is particularly well suited to investigate NRMs resulting from non-conventional and multiple magnetization processes. The anomalously high NRM recorded in a few, but not all, specimens points to LIRM as the dominant origin of magnetization.