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Discussion

Reply to comments by G. Kletetschka on "The origin of high magnetic remanence in fault pseudotachylites: Theoretical considerations and implication for coseismic electrical currents"

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We welcome Kletetschka's comment as an opportunity to clarify certain aspects of our contribution. This comment also gives us a chance to cite important references that we had unfortunately neglected to mention.

1) The primary objective of our article is to speculate on theoretical aspects of pseudotachylite magnetization and not to discuss actual NRM measurements or magnetization processes. In that respect, Kletetschka is right that our point is a speculation; but it is not only a speculation and some of the objections that he raises do not appear valid.
2) The NRM in natural pseudotachylites is not only anomalous in intensity but also in orientation (e.g., Enomoto and Zheng, 1998).
3) The magnetization of geological materials by electric currents on Earth often concerns rocks far different from the magnetic oddities that are lodestones and meteorites. To start with, lodestones represent an extreme case of magnetic material in which practically 100% vol. of the rock can be permanently magnetized. This type of material is not a good analog of pseudotachylites in which 1% vol. of the rock can acquire a remanence. Comparison with meteorites is also potentially unrealistic as long as we do not really understand the magnetization processes that may affect meteoritic material upon entry in the atmosphere. The extreme temperatures experienced during fall may cause the formation of a plasma and its possible effects on NRM acquisition are unknown.
4) The relationship between magnetizing field (*H*) and induced remanent magnetization (Mr) is by all means complex, particularly if strong magnetizing fields should be involved. One of the most sophisticated method to investigate this relationship is to perform paleointensity studies in which both the intensity and the direction of the NRM are reproduced by applying a field of known strength and orientation. The kind of the experimental field may or may not reproduce the natural magnetization conditions (alternating vs. continuous field). Similarly, the length of time during which the magnetization experiment is conducted is usually considerably shorter than that involved in NRM acquisition. A cruder way of determining the magnetizing field intensity is to perform IRM acquisition experiments in which the orientation of the field is primarily not taken into consideration.

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In the case of lightning-induced remanent magnetization (LIRM), the most appropriate method for paleointensity determination is that using the normalized derivative of NRM and IRM (Verrier and Rochette, 2002). The empirical method proposed by Wasilewski and Kletetschka (1999), using the REM ratio (total NRM/IRM), can erroneously lead to REM ratios of 0.01 for a LIRM (Verrier and Rochette, 2002).