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SUBJECT TITTLE: Remanence acquisition and remagnetization mechanism in continental aeolian sediments

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Remanence Acquisition and Remagnetization Mechanism in Continental Aeolian Sediments

Since the pioneering work of Heller and Liu (1982), it is known that loess deposits are effective recorders of geomagnetic field. Initial studies recovered the Matuyama/Brunhes (M/B) geomagnetic reversal boundary in Chinese loess within paleosol S8 in good agreement with the occurrence of the M/B boundary within interglacial stage 19 in marine sediments. However, subsequent studies at other locations within the Chinese Loess Plateau recovered the M/B within the overlying loess interval L8 (Liu et al., 1988; Rolph et al., 1989; Rutter et al., 1990; Spassov et al., 2001; Sun et al., 1993; Zhu et al., 1994). Delayed remanent magnetization acquisition due to post-depositional or chemical remanence acquisition would push the M/B boundary stratigraphically downward into L9 and not upwards to L8 (Spassov et al., 2003). Wang et al. (2006) and Liu et al. (2008) proposed that the paradox stemmed from an erroneous positioning of paleoclimate boundaries. Astronomical tuning of loess sequences is achieved through magnetic susceptibility time series, a parameter influenced by pedogenic alteration. Liu et al. (2008) demonstrated that if considering modal grain size variations in quartz grains, which are unaffected by pedogenic alteration, to pinpoint the transition between glacial and interglacial periods, the S8 to L8 paleoclimate boundary is pushed stratigraphically upwards and the recovered M/B boundary thus lies in the upper parts of S8 in agreement with marine sediments.

The above highlights the lack of knowledge we have concerning:

1) Remanent magnetization acquisition mechanism of loess deposits;
2) Remagnetization processes induced by mineral alteration in response to climate and environmental change.

To date there are only two experimental studies on loess (or any other continental deposit) that have attempted addressing the important question of remanence acquisition and remagnetization mechanism (Wang and Lovlie, 2010; Zhao and Roberts, 2010). These two

studies have brought limited answers leaving a still vast and dominantly unexplored research area.

Starting from the postulate that loess during its deposition acquires a natural remanent magnetization in the presence of the geomagnetic field, with what fidelity is the geomagnetic field recorded (both in direction and intensity)? After deposition a loess deposit will undergo burial, eventually pedogenesis (i.e. soil-formation) and potentially hydromorphic processes. It has been shown that all three of these processes lead to neo-formation, alteration and / or dissolution of Fe-bearing minerals and specifically iron oxides recorders of the geomagnetic field (Maher and Taylor, 1988; Taylor et al., 2014; Till et al., 2015; Till et al., 2014; Zhou et al., 1990) Can we quantify the impact of these processes on the paleomagnetic signal acquired at deposition?

The project aims to study the remanence acquisition and remagnetization process in loess and paleosol deposits. This will be reached by:

1) Acquiring paleomagnetic records from previously sampled loess deposits primarily in Europe;
2) Conducting controlled laboratory experiments to evaluate the remagnetization efficiency of naturally occurring diagenetic and pedogenic alteration processes;
3) Numerically modelling the evolution of the paleomagnetic signal from loess-paleosol sequence as a function of accumulation rates and the timing of mineral alteration induced by post-depositional processes.

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