Geophysical Research Abstracts, Vol. 9, 03941, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03941
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Why are there similar signals for excursions and reversals?

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Records of field reversals but also of the most recent excursions are now available from sediments and lava flows. Sedimentary records of reversals frequently share common characteristics reflected by longitudinal confinement of their VGP paths, occasionally preference for some longitudes, except for a few very detailed records which exhibit much more complexity. In contrast, the VGP positions associated with reversals records from volcanic lava flows are widely scattered over the globe without any apparent coherency with the sedimentary data. They are also quite irregularly distributed with apparent fast changes opposed to clusters. Interestingly, the detailed sedimentary records recently obtained for excursions and more specifically for the Laschamp, Mono Lake and Iceland Basin events depict a large deal of similarities with the reversal records, with longitudinally confined VGP paths which describe a large looping along certain prefered longitudes. Again in this case, the configuration of the volcanic VGPs is strikingly different and shows no overlap and no apparent coherence with the data from sediments. These disparities are evidently related to the mechanisms of magnetization associated with the two kinds of records and require our full understanding before we can reach any robust interpretation regarding the geomagnetic field.

Given the configuration of the sedimentary paths it seems clear that they did not record the full variability of the field and provide us smeared information linked to their resolution. We have now a good archeomagnetic database for the past 3 ka which allows us to document the time constants and the amplitudes of the dipolar variations. The most significant difference between excursions, reversals and regular secular variation is evidently the large decrease of the dipole which prevails during the transitional periods. We performed simple simulations involving field components with the same characteristics and typical time constants as the archeomagnetic field for the past 3 kyr. We

can thus explore different situations depicting the secular variation of the archeomagnetic field in presence of low dipole field, compare the morphological characteristics of the field with those of the volcanic records, and explore the amount of smoothing required in sediments to display similar characteristics as those found in the paleomagnetic records.