

Analyzing the reliability of volcanic and archeomagnetic data by comparison with historical records

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Records of the past geomagnetic field are obtained from historical observations (direct records) on the one hand, and by the magnetization acquired by archeological artifacts, rocks and sediments (indirect records) on the other hand. Indirect records are generally less reliable than direct ones due to recording mechanisms that cannot be fully reproduced in the laboratory, age uncertainties and alteration problems. Therefore, geomagnetic field modeling approaches must deal with random and systematic errors of field values and age estimates that are hard to assess. Here, we present a new approach to investigate the reliability of volcanic and archeomagnetic data, which is based on comparisons with historical records. Temporal and spatial mismatches between data are handled by the implementation of weighting functions and error estimates derived from a stochastic model of secular variation. Furthermore, a new strategy is introduced for the statistical analysis of inhomogeneous and internally correlated data sets.

Application of these new analysis tools to an extended database including direct and indirect records shows an overall good agreement between different record categories. Nevertheless, some biases exist between selected material categories, laboratory procedures, and quality checks/corrections (e.g., inclination shallowing of volcanic records). These findings can be used to obtain a better understanding of error sources affecting indirect records, thereby facilitating more reliable reconstructions of the geomagnetic past.