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Testing the Multispecimen Absolute Paleointensity Method with Archaeological Baked Clays and Bricks: New Data for Central Europe

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The domain-state corrected multiple-specimen paleointensity determination technique (MSP-DSC, Fabian & Leonhardt, EPSL 297, 84, 2010) has been tested for archaeological baked clays and bricks. The following procedure was applied: (1) Exclusion of secondary overprints using alternating field (AF) or thermal demagnetization and assignment of characteristic remanent magnetization (ChRM) direction. (2) Determination of magneto mineralogical alteration using anhysteretic remanent magnetization (ARM) or temperature dependence of susceptibility. (3) Measurement of ARM anisotropy tensor, calculation of the ancient magnetic field direction. (4) Sister specimens were subjected to the MSP-DSC technique aligned (anti-)parallel to the ancient magnetic field direction. (5) Several checks were applied in order to exclude data points from further evaluation: (a) The accuracy of orientation ($< 10°$), (b) absence of secondary components ($< 10°$), (c) use of a considerable NRM fraction (20 to 80%), (d) weak alteration (smaller than for domain state change) and finally (e) domain state correction was applied.

Bricks and baked clays from archaeological sites with ages between 645 BC and 2003 AD have been subjected to MSP-DSC absolute paleointensity (PI) determination. Aims of study are to check precision and reliability of the method. The obtained PI values are compared with direct field observation, the IGRF, the GUFM1 or Thellier results. The Thellier experiments often show curved lines and pTRM checks fail for higher temperatures. Nevertheless in the low temperature range straight lines have been obtained but they provide scattered paleointensity values. Mean paleointensites have relative errors often exceeding 10%, which are not considered as high quality PI estimates. MSP-DSC experiments for the structures older than 300 years are still under progress. The paleointensities obtained from the MSP-DSC experiments for the young materials (after 1700 AD) have small relative errors of a few or even less than one per cent, although the data points are scattered in some cases. For these sites comparison with the historical field values shows very good agreement. Small deviations could be explained by the higher cooling rates used in the laboratory. These young structures were made of bricks and the unweathered baked clay of the 2003 experimental kiln was like brick, either. The sites provided much material so that tests were done to investigate the MSP-DSC methodology further. For example it was tested, if different NRM deblocking fractions have influence on the paleointensity estimate. It seems that use of fractions lower than 20% of the NRM can lead to an underestimation of PI. Although MSP-DSC experiments carried out on different blocks of the same structure can provide very similar results, the use of several fragments from at least five different units (potshards, bricks, in situ burnt blocks or rocks) of the same structure is recommended in or to obtain a reliable estimate of the experimental errors. Five data points may define already a well constraint straight line, but for a better precision 15 ($< 2\%$) data points may be required.

For the young structures the MSP-DSC method provided reliable PI estimates which have been included into the archaeointensity data base