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Improving our knowledge of the rapid geomagnetic field intensity variation observed in Europe around 800 AD: new archeointensity data from Visigothic Spanish potteries

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Despite the increase in archeomagnetic studies in the past few years, the number of reliable archeointensity data is still limited. For example there are only four published archeointensity data for Western Europe for the period between the 8th and the beginning of the 10th centuries. Based on available data a sharp directional variation and an intensity maxima have been identified in Western Europe during this period (the maximum archeointensity is achieved around 800 AD) and a strong decrease by around 30% between the first half of the 9th century and the 12th (7 μT per century) has been proposed. However, new archeointensity data are still necessary in order to obtain a robust description of this rapid geomagnetic field intensity variation. This contribution deals with this problem and investigates the behaviour of the geomagnetic field intensity by analysing 13 precisely dated Visigothic Spanish pottery fragments with ages ranging from 750 to 900 AD. The samples were collected at the Visigoth settlement of El Tolmo de Minateda (Hellín, Albacete, in eastern central Spain). The thirteen pottery fragments were each divided into four specimens that were subjected to Thellier experiments. The original Thellier method with partial thermoremanent magnetization (pTRM) checks every two temperature steps was used. TRM anisotropy and TRM cooling rate dependence were taken into account to correct the archeointensity values. Nine to fifteen temperature steps were performed between 150ºC and 590ºC. Two types of behaviour during Thellier experiments have been observed. For most of the specimens we observed a well-defined single component of magnetization going toward the origin, which likely corresponds to the TRM acquired during the manufacture of the pottery fragments. The unblocking temperatures observed range between 410ºC and 540ºC. For these specimens linear plots in the Arai diagram have been observed and high quality intensity data have been obtained. The second type shows a more complex behaviour, with two components of magnetization in the Zijdelverd diagrams. A low temperature component isolated at temperatures up to 470º but generally lower than 330º (indicating that these ceramics were partially refired) and a high temperature component up to 540ºC. The low temperature component is generally better defined than the high one and is considered to have been acquired during the pottery usage in a domestic context. The high temperature component represents the "primary" remanence associated with the original firing of the potteries during the manufacturing processes. 43 specimens out of 52 analyzed yield reliable absolute intensity determinations. From this, three new high quality mean intensities (based on samples containing a single component of remanence) are now available for Western Europe for ages ranging from 750 to 800 AD, from 775 to 800 AD and from 800 to 900 AD, respectively. Additionally, two mini cores per fragment were drilled for use with the 14 GHz microwave and Tristan magnetometer system. One specimen underwent microwave demagnetisation in order to determine remanence characteristics and the powers needed to demagnetise the samples. The sister specimens then underwent the Coe variant of the Thellier method. In general, microwave-derived paleointensity results are consistent with thermal results, but some important differences were also observed. The new archeointensity data obtained are in good agreement with the few available data and confirm the existence of intensity maximum around 800 AD. The observed fluctuation is comparable to the one described by Genevey and Gallet (2002) but it is now better defined.