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Importance of selecting archaeomagnetic data for geomagnetic modelling: example of the new Western Europe directional and intensity secular variation curves from 1500 BC to 200 AD

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At the regional scale, the dispersion between archaeomagnetic data and especially archaeointensities suggests that some of them may be biased. As a consequence, it appears necessary to perform a selection of available data before to compute mean regional secular variation curves or geomagnetic models. However the definition of suitable selection criteria is not obvious and we need to know how to manage “old” data acquired during the 60-70s.

The Western Europe directional and intensity data set from 1500 BC to 200 AD allows to discuss these issues. It has recently been enhanced by 39 new archaeodirections and 23 new archaeointensities (Hervé et al., 2013a and 2013b data sets and 5 unpublished data). First, the whole Western Europe data set was selected but the strong dispersion restricted the accuracy and the reliability of the new Western Europe secular variation curves at Paris. The causes of the dispersion appear different between archaeodirections and archaeointensities. In the directional data set, the main problem comes from some age errors in the oldest published data. Since their publication their archaeological dating may have changed of 50 years or more. For intensity data that were acquired much more recently, the dispersion mainly results from the use of unreliable archaeointensity protocols. We propose a weighting approach based on the number of specimens and the use of pTRM-checks, anisotropy and cooling rate corrections. Only 63% of available archaeodirections and 32% of archaeointensities were used to build the new Western Europe secular variation curves from 1500 BC to 200 AD. These curves reveal that selecting the reference data avoids wrong estimations of the shape of the secular variation curves, the secular variation rate, the dating of archaeomagnetic jerks... Finally, it is worth pointing out that current geomagnetic global models take into account almost all the data that we decided to reject. It could partly explain why their predictions at Paris do not fit our local secular variation curves.

Hervé, G., Chauvin, A. & Lanos, P., 2013a. Geomagnetic field variations in Western Europe from 1500BC to 200AD. Part I : Directional secular variation curve, Phys. Earth Planet. Inter., 218, 1-13.

Hervé, G., Chauvin, A. & Lanos, P., 2013b. Geomagnetic field variations in Western Europe from 1500BC to 200AD. Part II : New intensity secular variation curve, Phys. Earth Planet. Inter., 218, 51-65.