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Solar activity record from archaeomagnetic data

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Abstract. Here we show that archaeomagnetic measurement confidence interval (α_{95}) may serve as a new proxy for the past solar activity estimation. This proxy is compared with sunspot numbers during 1700-2000 yr and with other proxies during 1500–2000 yr.

1. Introduction

It is widely known that each of the solar activity (SA) proxies (^{10}Be, ^{14}C, naked eye sunspot observations and ancient aurora observations) is contaminated by additional factors and has dating and amplitude uncertainty increasing to the past see e.g. Ogurtsov *et al.* (2002). We suppose that as much as possible independent proxy records should be used together to correct SA reconstructions from separated proxies. We propose here that dispersion of arhaeomagnetic data may contain information about quick geomagnetic perturbations. In this case it may serve us as a new independent proxy of SA changes. These data were never used before in this sense probably because of archaeomagnetic data their self serve mostly to follow slow secular variations of geomagnetic field, which are caused by processes in Earths interior. Measured historical components of geomagnetic field have large dating and amplitude uncertainty and no information about SA. Only dispersion of separate measurements is an exact parameter, which is able to fix the magnetic perturbation as short as few days in duration.

2. Method and results

We used the IAGA Archeomagnetic Directional Database by Tarling & Dobson (1995) for our investigation. During the investigation, we had to remove data with age uncertainty (DE) greater than 30 years. Data with no α_{95} estimation were also removed. We calculated average confidence interval (mM) within 30-yr-long (DE) sliding window. Outsiders of value $M\alpha_{95} = 160/mM$ appearing due to inhomogeneous data coverage were removed by smoothing spline.

In figure 1 we present the comparison of $M\alpha_{95}$ with sunspot number set extension 1090-1950 by Nagovitsyn (1997) compiled by Nagovitsyn (1997) and Antarctic ^{10}Be data compiled by Bard *et al.* (2000). The correlation coefficient between smoothed sunspot numbers ($< W >_{30}$) and $M\alpha_{95}$ is ($r = 0.8$) during the period (1700–2000) yr. Archeomagnetic $M\alpha_{95}$ also shows the SA secular variation during (1500–1700) yr (figure 1). During this period we can see that all the information should be used to reconstruct the most confident SA curve. Unfortunately it is not enough now well dated α_{95} measurements befor 1500yr to build the continues curve of $M\alpha_{95}$ in ancient centuries.

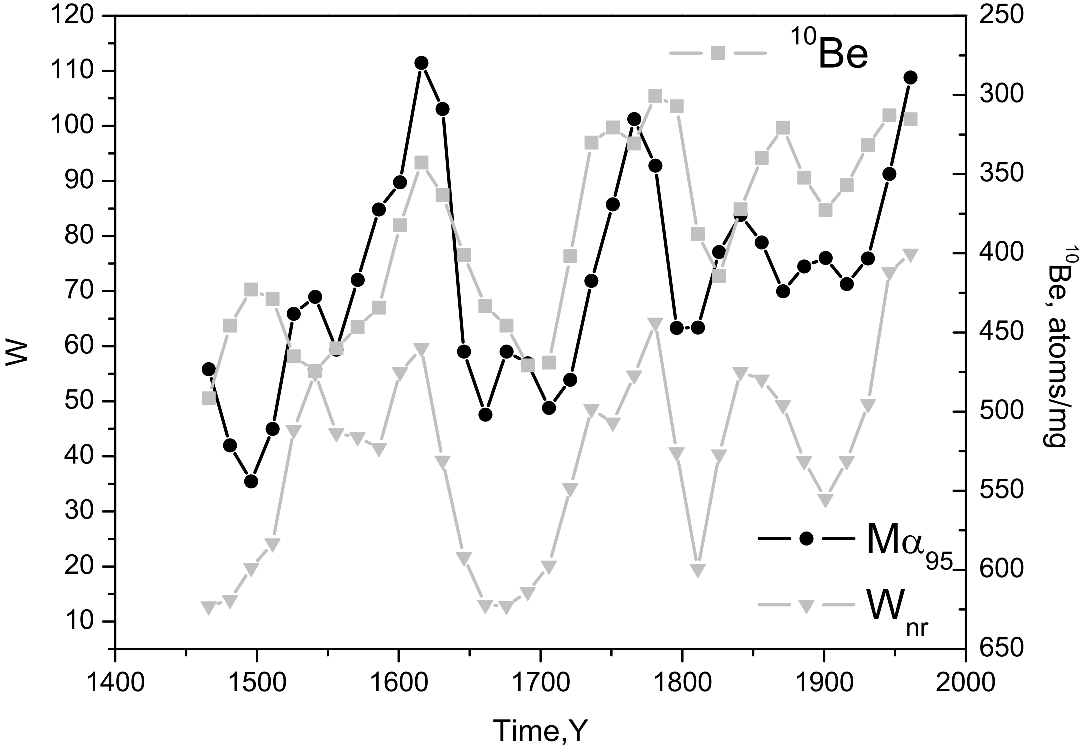

Figure 1. Solar activity from different proxies

3. Conclusions and discussion

We conclude that archaeomagnetic $M\alpha_{95}$ proxy fits the average SA level as well as other SA proxies. The main source of the measured dispersion is the old magnetic domains structure, because of it is actually not completely removed after heating of the archaeomagnetic sample. The majority of these old magnetic structures are unstable near the Curie point and even small geomagnetic disturbances could probably destroy these structures.

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