Characterization of archaeomagnetic Jerks in Europe

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1. Introduction
Abrupt changes in the movement of directional secular variation (SV) of the Earth’s magnetic field (EMF) are called archaeomagnetic jerks (AMJs). Gallet et al. (2005) suggested that AMJs correlate with high archaeointensities obtained from French and Syrian pottery. In order to test this hypothesis the much larger European archaeomagnetic data set, direction and intensity, has been investigated.

2. The archaeomagnetic data set
- Directional data base2 updated until 2007(4, 5, 6, 7, 8, 9, 10)
- Five subsets (Fig. 1) for independent SV curves.
- Calculation with RenCurve1.
- Western European intensity data set1, 3, 4, 5, 6, 7, 8, 9, 10 (Fig. 1) updated4, 11, 12, 13, 14.
- Classification of Chauvin15 assigned for all data.
- SV intensity curve has been calculated for the whole set and a selection with RenCurve.

3. Characterization of archaeomagnetic jerks
Marginal curves (Fig. 2) show:
- Very similar declination
- Similar characteristics in inclination
- Strong dipolar contribution is seen in inclination
- Agreement not so well for times BC

Stereographic projection (Fig. 3) of directional curves show:
- Similar SV patterns for all European regions
- Cusps or loops where SV slows down
- EMF vector changes direction of movement15 (Fig. 4).

Mathematically an AMJ can be characterised by a minimum in velocity and maximum in curvature of the SV curve (Fig. 4).

4. Archaeointensity data in Europe
Compared to 1251 archaeodirections from regions NW, SW, NC and SC only 226 archaeointensity determinations exist. Data from region SE have not yet been investigated. Using the weighting proposed by Chauvin12 a high quality (HQ) data set has been selected (weight >12). These are only 130 data points (Fig. 5).

5. Do archaeomagnetic jerks correlate with high intensity?
Gallet et al. suggested a correlation between AMJs, high archaeointensity (Fig. 5, blue curves and data points) and centennial climate change (Fig. 5, blue bars).
- Complete intensity data set is very scattered and gives a wiggled curve.
- Curve from selected data set supports Gallet curve obtained from few data.
- Preliminary new archaeointensities (Fig. 5, green data) support obtained curve.
- Only two strong maxima in intensity are found at 500 BC and 800 AD (4 data)
- Caution is necessary, because there are many temporal gaps.

The sites RK and GL correspond to the AMJ around 800 BC, they do not give high archaeointensities. Interestingly, they have directions (see Fig. 3, D=30-75°, I=72°) that are close to the directions found in several excursions in the WE volcanic field (D=90°, I=75°).

6. Conclusion
Archaeomagnetic jerks can be characterized by low velocity and strong curvature of the directional SV curve. Five AMJs occur contemporaneous in Europe during the past 3000 a. Evidence for high intensity during AMJ is weak. The SV pattern at 900 BC seems to look similar to the early Brunhes chron excursional field configuration.

References