Archaeomagnetic dating of the fortification of the Veľká Morava Period in Majcichov

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A b s t r a c t: Eight archaeological samples collected from the baked fortification near Majcichov Village were studied by the Thellier's method. The following characteristics were derived from the results of the laboratory measurements: the intensity of the ancient magnetic field F = 0.71677 milli Tesla; the coordinates of the virtual geomagnetic pole VGP: $\varphi_p = 79.5^\circ$, $\lambda_p = 3.7^\circ$; the virtual dipole moment VDM = 10.4×10^{-25} Gauss·cm^{-3}. The relations of derived data with those summarized by *Bucha (1975)* for the Central Europe have allowed to suggest that the archeological object near Majcichov was baked in the end of 9$^{\text{th}}$ Century A. D. This archaeomagnetic dating has been supported also by the archeological findings of the same age.

Key words: Thellier method, baked fortification, 9$^{\text{th}}$ Century A.D.

1. Introduction

One of the important method for a solution of the problems of the archaeology is archaeomagnetic dating. This method can make an effective contribution to historical studies of the past. The research of baked archaeological materials from several localities from Slovakia was carried out in the past and results were summarized by *Orlický and Tirpák (1986)*. We have followed with the archaeomagnetic dating in order to verify the adequacy of this method and to help with the determination of the age of fortification

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of the Veľká Morava Period in Majcichov locality. The archaeomagnetic dating is the main task to solve the problem in question, but the magnetic measurements of the area and the susceptibility measurements of selected cross-section of the baked fortification were done as well.

2. Methodical procedure and basic results

Fig. 1. The photographs of the baked fortification in the part from which the samples were collected for the archaeomagnetic dating.

Veľká Morava fortification is located near of Majcichov Village; the position of Várhely, Trnava District (the geographical co-ordinates of the locality are: $\varphi_L = 48.285°$, $\lambda_L = 17.639°$). Archaeological samples were collected from the surface part of the baked fortification (Fig. 1). Hand sampling of the material was applied with respect to horizontal level and northern direction. Three samples were shaped to a cube of 20 mm edge and 6 samples were shaped to the cylinder of diameter 22 mm and the heigh of 22 mm. The Thellier method in the individual steps of 50, 100, 150, 200, 250, 300, 350, 400, 500 and 600° C for 9 individual samples was applied. In a parallel way the change of volume magnetic susceptibility of individual samples with the temperature was measured. The intensity of the remanent magnetization (RM) of samples was measured by spinner magnetometer JR–5. The detailed procedure has been described by *Orlický and Tirpák (1986)*.

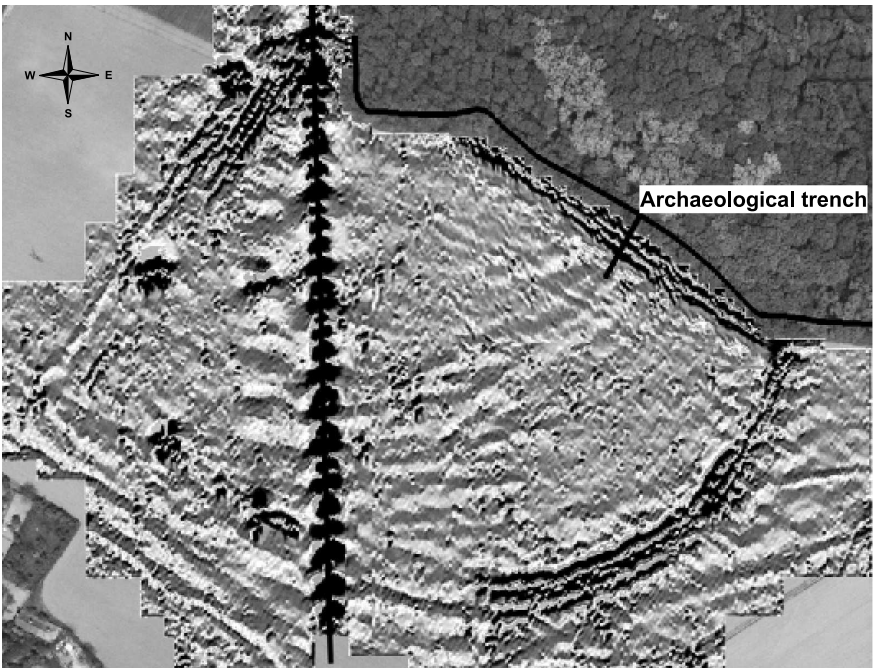

Fig. 2. The map of the residual magnetic anomalies (the measurements were done by caesium magnetometer).

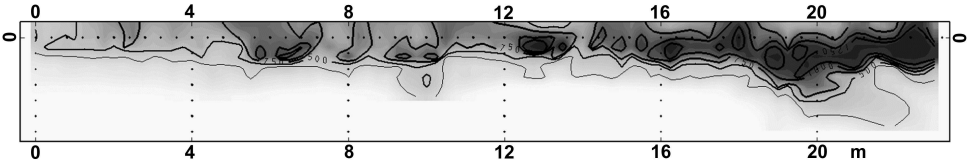

Fig. 3. The relations of magnetic susceptibility in the vertical cross-section of archaeological trench (the volume κ varied in the range 90×10^{-6} to 2020×10^{-6} SI units).

The volume magnetic susceptibility (κ) of the samples was measured by the susceptibility-meter KLY-2. The volume magnetic susceptibility for 8 samples varied in the range 1065 to 1470×10^{-6} SI units. There have been detected some differences in the values of RM among of the samples due to rather inhomogeneous material. They varied in the range of 104 to 224 nano Tesla (nT).

The geomagnetic measurements (Fig. 2) by the caesium magnetometer and the field susceptibility measurements (Fig. 3) by kappa-meter in the vertical section of the baked wall were performed except of the study of the samples.

3. The derived data and the interpretation of the results

From the map of the residual magnetic anomalies (Fig. 2) it is evident that there are stripes of baked materials with higher magnetic properties and other materials with less magnetic properties which generate more intense and less intense anomalies. We can see from Fig. 3 that the magnetic susceptibility of the baked material is different not only in a horizontal, but also in a vertical sense.

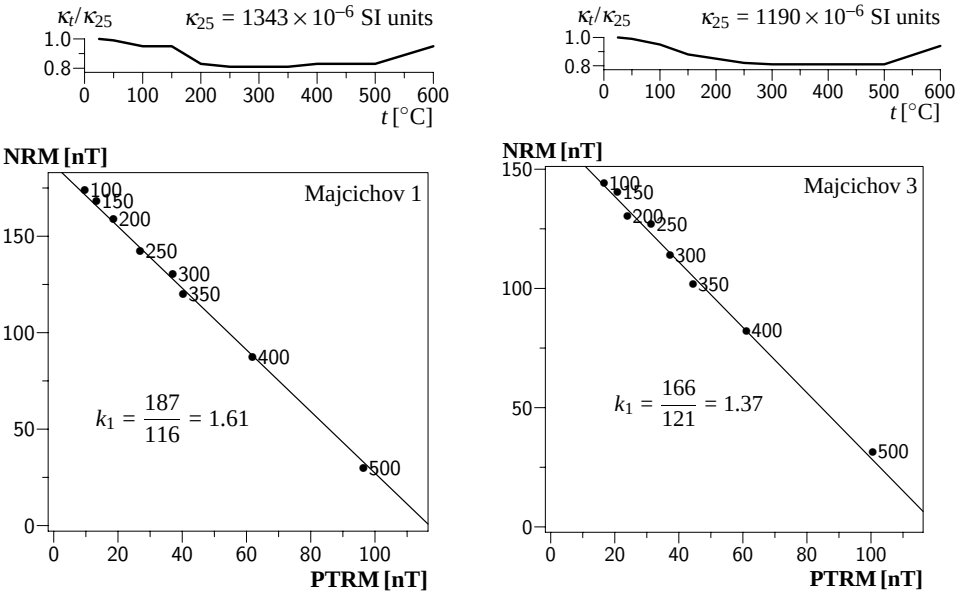

Fig. 4. Ancient magnetic field intensity determined from the Thellier's method data for the samples Majcichov 1 and Majcichov 3. k - F/F_0, F - the intensity of ancient magnetic field, F_0 - the intensity of the laboratory magnetic field.

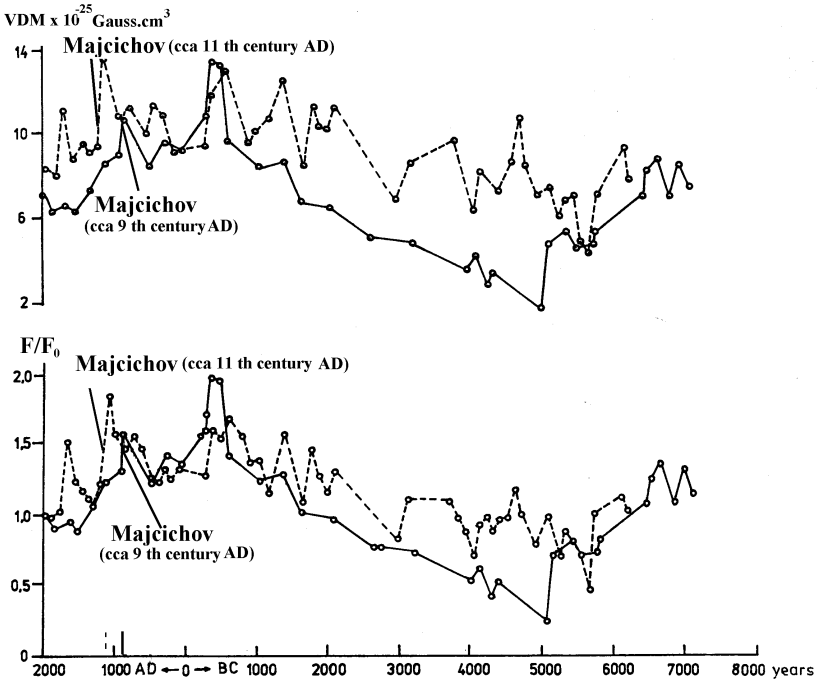

Fig. 5. Variations of the intensity of the field (F/F_0) and the fluctuations of the virtual dipole moment (VDP) of the whole world data published by *Bucha (1975*; solid lines) and *Kovacheva (1980*; dashed lines) and a comparison of the derived F/F_0 and VDM of the results of Majcichov locality with these data.

Two examples are presented of the graphical derivation of the k coefficient (F/F_0; F, F_0 - the intensity of the ancient magnetic field and that of the laboratory magnetic field, respectively) in Fig. 4. The coefficients k of 8 samples were used for the computation of the average value of k. The individual values of k were in the range k = 1.31 to k = 1.64. The average k_{av} = 1.464. The intensity of the magnetic field in the laboratory is F_0 = 0.4896 milli Tesla (mT), so the intensity of the ancient field is F = 0.71677 mT. The direction (the inclination I° and declination D°) of the ancient magnetic field was derived from the data of individual 8 samples of the baked body of the fortification. They are I = 72.9° and D = 355.2°. The co-ordinates of the virtual geomagnetic pole (VGP) were derived. They

are: $\varphi_p = 79.5^\circ$, $\lambda_p = 3.7^\circ$. A virtual dipole moment (VDM) was computed from known values of F and I. Its value is VDM = 10.4×10^{-25} Gauss·cm^{-3}.

Comparing the results of F/F_0 and VDM derived for the fortification near Majcichov archeological object with those presented by *Bucha (1975)* for the Central Europe (Fig. 5, solid lines) we see that both these parameters delineate the time of 9$^{\text{th}}$ Century A.D. It means that the baked fortification near Majcichov Village was constructed during the end of 9$^{\text{th}}$ Century A.D. This archaeomagnetic dating has been supported also by the archaeological findings of the same age.

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