Archaeomagnetic dating of the baked oven from an extinct medieval settlement in Nededza, near Žilina Town

O. Orlický
Geophysical Institute of the Slovak Academy of Sciences[1]

P. Bednár, K. Daňová, J. Tirpák
Archaeological Institute of the Slovak Academy of Sciences[2]

Abstract: The samples from the baked oven from the KIA - Nededza area, near Žilina Town were studied by the Thellier method. The derived ancient intensity of the field and that of virtual dipole moment data (VDM) have allowed to determine the age of the baked oven, comparing our data with those presented by *Bucha (1975)* for the Central Europe. These results have dated the existence of this object during the time of about 12^{th} - 13^{th} century AD. This archaeomagnetic dating has supported a preliminary archaeological assessment that the extinct medieval settlement in the place of todays village Nededza survived in the end of 12^{th} to the first half of the 14^{th} century AD.

Key words: archaeomagnetism, Thellier method, dating of baked oven

1. Introduction

The vast archaeological research of an extinct medieval settlement near locality KIA - Nededza was realized during 2004 to 2006. The locality is situated at the northern margin of the Žilina basin. The geographical coordinates of the locality are: $\varphi_L = 49.22°$, $\lambda_L = 18.83°$. Among of several archaeological objects the baked ovens were recovered. From one of them (Fig. 1) the samples for archaeological dating were collected. A dating of the settlement is supposed to be only preliminary, based mainly on the ceramics from some objects. Taking into account a character of the ceramic

[1] Dúbravská cesta 9, 845 28 Bratislava, Slovak Republic; e-mail: geoforky@savba.sk
[2] Akademická 2, 949 21 Nitra, Slovak Republic; e-mail: peter.bednar@savba.sk, klaudia.v@atlas.sk, jan.tirpak@savba.sk

production, the time of existence of the settlement may be dated to the end of 12^{th} to first half of 14^{th} century.

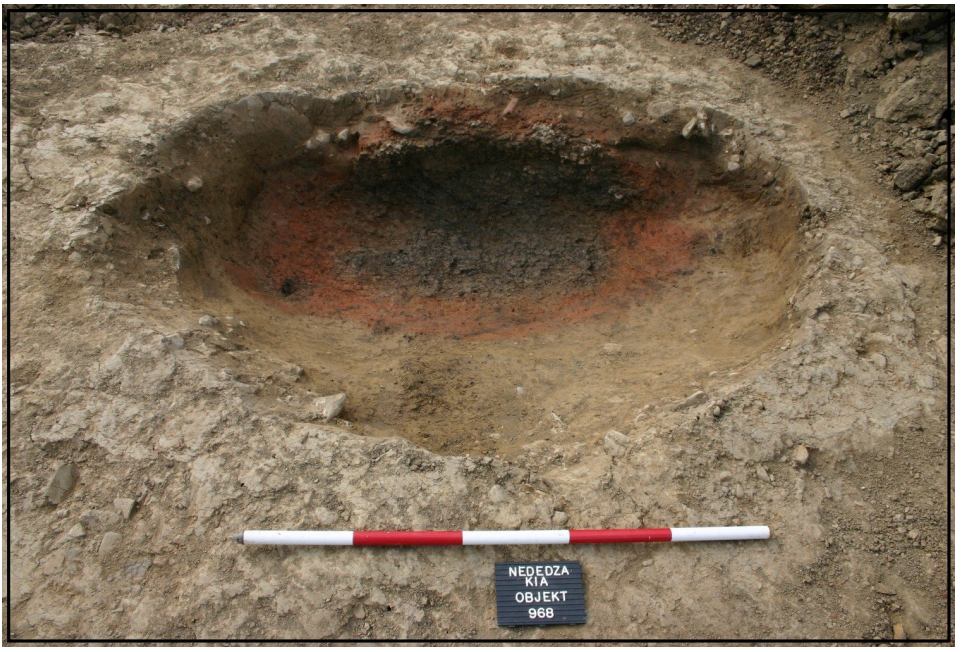

Fig. 1. The baked oven of the KIA - Nededza locality. The samples for archaeomagnetic dating were collected from this oven.

2. Methodical procedure and basic results

Hand sampling of the baked material was applied with respect to horizontal level and northern direction. Eight samples were shaped to a cube of 20 mm edge. The Thellier method in the individual steps of 50, 100, 150, 200, 250, 300, 350, 400, 500 and 600°C of all samples was applied (a detailed procedure has been described by *Orlický and Tirpák (1984)*. In a parallel way the change of volume magnetic susceptibility of individual samples with the temperature was measured (see in Fig. 2). The intensity of the remanent magnetization (RM) of the samples was measured by spinner magnetometer

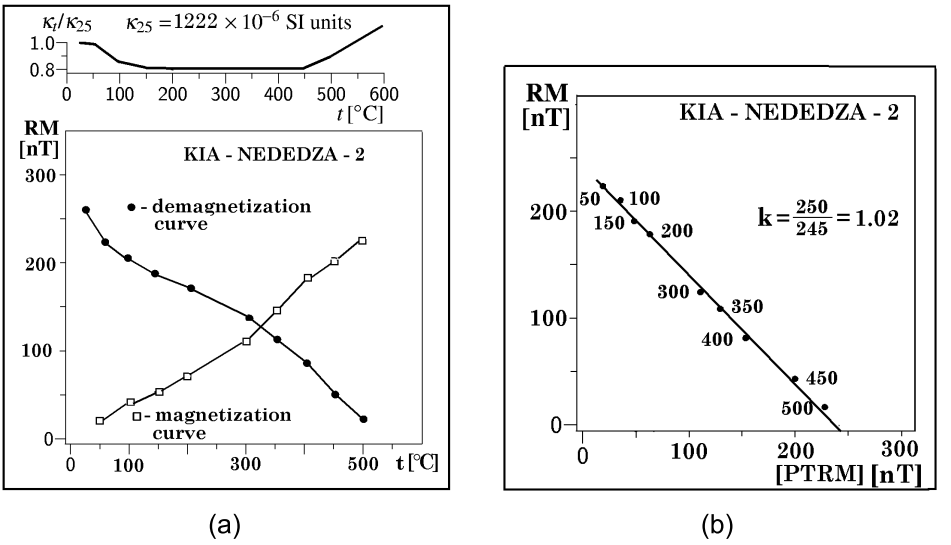

Fig. 2. Thermal demagnetization and magnetization curves (a); (heating to a maximum temperature of 600°C); a variation of κ with the temperature (κ_T) - magnetic susceptibility at T, and at 25°C ($\kappa_2 5$), respectively; the direction delineated by the RM and PTRM coordinates at the respective temperatures (b).

JR-5. 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 935 to 1395 $\times$ 10^{-6} Si units, with the average value of 1236 $\times$ 10^{-6} Si units. There have been detected some differences in the values of NRM among of the samples due to rather inhomogeneous material. They varied in the range 94 to 275 nano Tesla (nT). The average value of NRM = 229 nT. We see from Fig. 2 that there is evident change of magnetic susceptibility of the sample with temperature during thermal treatment. We assume that this behaviour reflects some changes of original magnetic minerals during heating and cooling of the sample.

3. The derived data and the interpretation of the results

The example of the graphical derivation of the **k** coefficient is presented in Fig. 2 (F/F$_0$; F, F$_0$ = the intensity of the ancient magnetic field and that

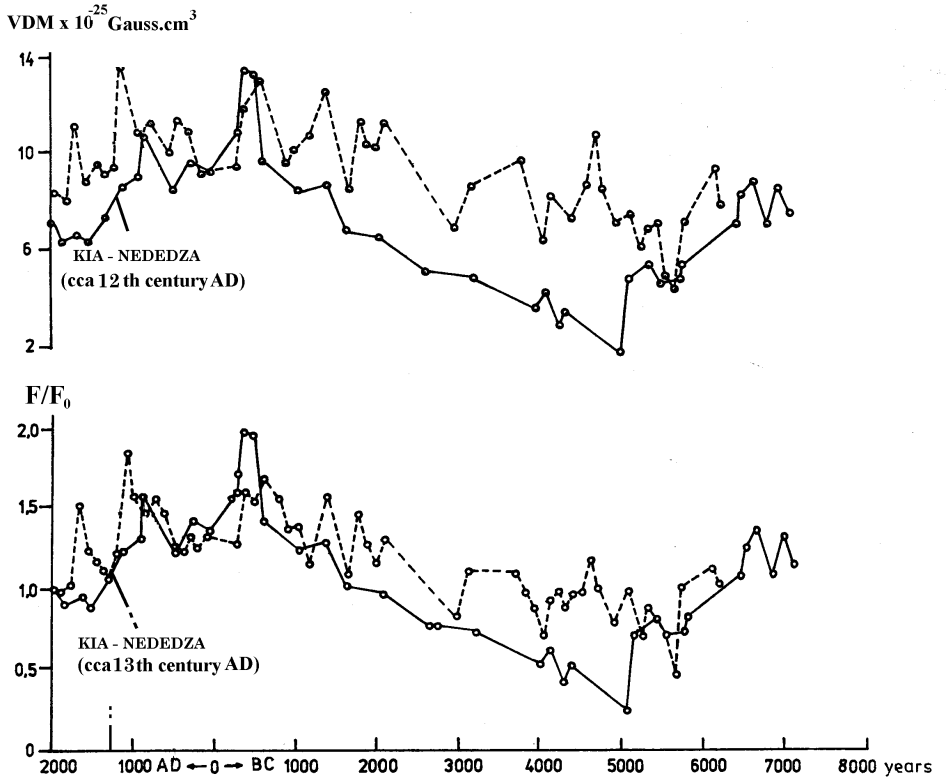

Fig. 3. Variations of the intensity of the field (F/F_0) and the fluctuations of the virtual dipole moment (VDP) of the whole world data published by *Bucha, 1975* (solid lines) and *Kovacheva, 1980* (dashed lines) and a comparison of the derived F/F_0 and VDM of the results of KIA - Nededza locality with these data.

of the laboratory magnetic field, respectively). Only 5 samples were appropriate for the study of the magnetic characteristics by the Thellier method. From the graphical dependence of the demagnetization and magnetization data of 5 samples, the coefficients **k** for 5 samples was used for computing the average value of $\mathbf{k} = 1.12$. From the basic data the inclination I $= 67.9°$ and the declination D $= 0.5°$ were derived. These data, including the geographical coordinates were used to compute the coordinates of the virtual geomagnetic pole (VGP, the position of the geomagnetic pole) for the time of last burning in the baked oven. They are: $\varphi_p = 88.2°$(N),

$\lambda_p = 29.3°$(E) [the position of the VGP for the nearest time 1540 year, AD, derived from the first registered observatory data *(Bott, 1972)* and re-computed for the geographical coordinates of the locality in question ($\varphi_L = 49.22°$, $\lambda_L = 18.83°$), is $\varphi_p = 84.08°$(N), $\lambda_p = 63.8°$(E)]. We see that the position of VGP was rather nearer to the geographical pole in the time of existence of the respective baked oven, comparing it with that for 1540 year, AD.

The virtual dipole moment (VDM) was derived from the inclination of RM of the baked oven, I = 67.9° and a known value of the ancient field F = 0.5484 mT. The intensity of the ancient field was derived from a known value of the geomagnetic field in the laboratory $F_0 = 0.4896$ mT. The derived VDM = 8.45×10^{-25} Gauss.cm^{-3}.

By comparing the data of F/F_0 for the baked oven of the KIA - Nededza locality with those presented by *Bucha (1975)* for the Central Europe (Fig. 3), it has been possible to assess the time of last manufacturing in the mentioned oven. It was probably in the 13$^{\text{th}}$ century AD [it is derived from both curves, one constructed by Bucha and the second one constructed by *Kovacheva* (Fig. 3) in *Bucha (1975)*]. According to the VDM value, the time of the last use of the baked oven was probably in the 12$^{\text{th}}$ century AD. Both these derived ages are in good agreement with the evidenced archaeological data. According to a type and a character of the ceramic materials it has been possible to assess the time of survival of the settlement. It was supposed to be in the end of 12$^{\text{th}}$ to the first half of the 14$^{\text{th}}$ century AD.

4. Conclusion

The results of the study of magnetic properties, the Thellier's method and the derived VDM value of material from the baked oven in the KIA - Nededza area have dated the existence of this object during the time of about 12$^{\text{th}}$ - 13$^{\text{th}}$ century AD. This archaeomagnetic dating has supported a preliminary archaeological assessment that the extinct medieval settlement in the place of todays village Nededza survived in the end of 12$^{\text{th}}$ to the first half of the 14$^{\text{th}}$ century AD.

Acknowledgments. The authors are grateful to the Slovak Scientific Grant Agency (grant No. 2/4042/24) for the partial support of this work.

References

Bott A. H., 1972: The Interior of the Earth, London.

Bucha V., 1975: Geomagnetic field and its contribution to the explanation of the development of the Earth, ČSA, Praha (in Czech).

Orlický O., Tirpák J., 1984: Application of the archaeomagnetism for a solution of the archaeological tasks of the localities Cífer, Radzovce and Chotín, AIA III, 318–331 (in Slovak).