

## **Integrated archeomagnetic and thermoluminescence studies as a tool for dating of ancient brick buildings in Poland.**

Many ancient brick buildings or constructions with brick elements are preserved in Poland. During archeological works, bricks are found in the places of ancient temples and fortifications. The age of these objects, as well as the age of their rebuilding and reconstructions, are defined more or less precisely, basing mostly on historical notes, radiocarbon dating, and dendrochronology of the wooden elements or scaffolds. More recently, the bricks dating experiments are developed using thermoluminescence methods. However, in many cases, the date of building or rebuilding of the object is not much precisely known, and recognition of the proper historical context of these events is difficult. Especially, if the subject of investigations are ruins or foundations, exposed during the archeological works. Ceramic elements such as bricks or tiles are bringing a great opportunity to test new precise dating method basing on their magnetic properties.

One of the characteristic features of ceramics is the presence of relatively easy to read Earth-magnetic field properties, which were recorded during baking and cooling to room temperatures. Among three parameters, which define the geomagnetic field: intensity, declination and inclination, first and second of them can be easy reconstructed in ceramics. Intensity and direction (declination and inclination) of the geomagnetic field are characteristic to a given geographic region, and they are changing continuously. Owing to investigations of magnetic properties of ancient ceramics, and, especially, on geomagnetic field intensity changes in the past (reconstructed in a few regions), it was possible to establish the age of the ceramic elements of some objects in southern and western Europe (Spain, France, Bulgaria, Greece, Italy). Cooperation between geophysics and archeologists results in development of interdisciplinary research called archeomagnetism.

In spite of the presence of many brick objects, as well as early and great tradition of brick building in Poland, this region is still "Tabula Rasa" on the map of current archeomagnetic investigations. The aim of this project is to recognize changes of intensity and inclination of the geomagnetic field during XIV - XVII centuries in Poland, and define preliminary reference curves of these parameters. The brick buildings or objects with brick elements with well known dates of construction will be the subject of investigations. The obtained referent curves will be used for dating of ancient ceramics (bricks, tiles), which ages are not known or known only approximately. The results of the project will bring also a knowledge on geomagnetic field behavior during last millennium, especially, in the context of its postulated incoming reversion. Samples using for archeomagnetic study will be cut in bricks from the lowermost storeys of at least 50 ancient objects of known construction dates. These will be castles, churches, palaces, eventually bridges and mansions. Three oriented samples – cylinder cubes 1 inch diameter and 2 – 3 inches long – will be derived from each object. The ancient geomagnetic field intensity will be laboratory measured and calculated basing on the Thellier method (IZZI protocol). This method assumes that measured magnetization of a sample (a brick for example) is different – to less or too high – from magnetization, which could be produced, if the samples will be magnetized in the present-day field. The Thellier method rely on gradual replacing of the remnant magnetization produced by baking by thermal magnetization produced in laboratory in step-increasing temperatures in known magnetic field (more often present-day Earth magnetic field). The inclination parameter is much more simple to establish and it will be reconstructed using standard paleomagnetic methods, including thermal demagnetization, measurements of magnetization components and calculation of characteristic directions.

When the reference curves of intensity and inclination during 400 years (XIV-XVII c.) will be created, some ceramic material of not well known age will be dated by the means of archeomagnetic parameters and TL method.