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Archaeomagnetic investigations in the Eastern Mediterranean: New directional data and archaeomagnetic dating in Cyprus

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Introduction

Improving the temporal and spatial distribution of the archaeomagnetic reference data is necessary to increase the reliability and accuracy of current geomagnetic field models and to provide information on the past evolution of the Earth's magnetic field. Even though Europe is characterized by the highest density of archaeomagnetic data compared to other continents, there are still some geographical areas that are poorly covered by reliable and high-quality geomagnetic field records, such as the Eastern Mediterranean. Actually, apart from Greece and Bulgaria that have a long history of archaeomagnetic investigations, and Israel that has recently published a catalogue with archaeomagnetic directions, the available directional data from Turkey, Cyprus, Syria and Lebanon are still scarce. In this study we present new directional archaeomagnetic results from four archaeological sites in Cyprus, and also explore the feasibility of archaeomagnetic dating in the island.

Materials and Methods

The material studied comes from four archaeological sites situated at Idalion (35.02º N, 33.45º E), Malloura 35.03º N, 33.02º E), Marki-Alonia (35.02º N, 33.33º E) and Agios Georgios Hill, Lefkosia (35.16º N, 33.35º E). In all cases baked clays from ancient hearths were sampled, after being oriented in situ using a magnetic as well as a sun compass, and an inclinometer. Sampling was carried out by gluing 25 mm diameter polycarbonate discs on the cleaned surface of the baked clay, using small quantities of instant adhesive (Fig. 1). Between 7 and 19 independently oriented samples were collected from each structure.

(a) **(b)**

Figure 1. Photos of the hearths sampled at the archaeological sites of a) Idalion and b) Agios Georgios (PA.SY.DY, structure 13). Archaeomagnetic sampling was performed using plastic discs glued on the baked clay and in situ oriented using a compass and an inclinometer.

Standard alternating field (AF) demagnetization procedures were applied to stepwise demagnetize the samples and isolate the Characteristic Remanent magnetization (ChRM) acquired during the last heating of the baked clay. Thermal demagnetization was not possible due to the plastic discs used during sampling.

Results

The results obtained after demagnetization are very well defined for all of the structures studied, with linear orthogonal projection diagrams. Mean directions were calculated assuming a Fisherian distribution based on at least 7 independently oriented samples for each baked clay structure (Fig. 2). The new directions coming from the sites of Marki-Alonia and Agios Georgios can be used as reference points to improve the directional dataset of Cyprus, as they have a well-defined independent dating. The baked clay sampled at Marki-Alonia is dated at 2300-2000 BC while the structure sampled at Agios Georgios (PA.SY.D.Y, structure 13) is dated at 305-107 BC. The hearth sampled at Idalion can be dated at 1200-700 BC but for the moment no other archaeological evidences are available to better constrain its dating. Finally, for the hearth studied at Mallura (MLR2) a reliable archaeological date is not at present available.

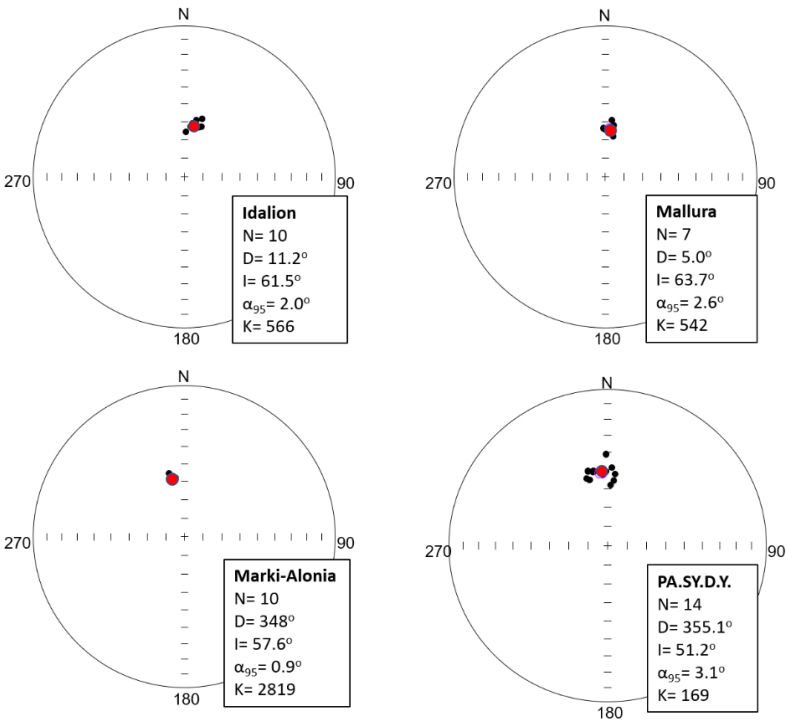

Figure 2. Equal area projections of the ChRM directions at sample level, together with the mean direction (red dot). D and I are the mean declination and inclination; α_{95} is the 95% angle of confidence; K is the precision parameter; N is the number of independently oriented samples considered for the calculation of the mean direction.

The data obtained from Marki-Alonia and Agios Georgios were compared with other available data from Cyprus (Tema et al., 2018) and nearby areas (Brown et al., 2015; Shaar et al., 2018), as well as with global geomagnetic field models. Instead, the directions from Idalion and Mallura that were not well dated, have been used for the archaeomagnetic dating of these two structures after comparison with the predictions of the SHA.DIF.14k (Pavón-Carrasco et al., 2014) global geomagnetic field model. It would appear that the Idalion structure was heated for last time in an interval 925-819 BC, if the 1200-700 BC time period is considered, while the Mallura hearth was used for the last time at 853-782 BC or 712-610 BC, taking into consideration the last millennium BC in the calculation of its age at 95% of probability.

Conclusions

Four new well-defined archaeomagnetic directions from Cyprus are presented. Two of them come from well dated archaeological structures, while for the other two data the available archaeological dating is poor. These two structures were therefore archaeomagnetically dated after comparison with the predictions of the SHA.DIF.14k model calculated at the geographic coordinates of the sites. The results obtained show that archaeomagnetic dating in Cyprus is possible, but the enrichment of the local dataset with new data is still necessary to improve the reliability of the global models' predictions in the area.

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