21 MAGNETOSTRATIGRAPHY OF THE KYPARISSIA AND CHOREMI STRATIGRAPHIC SEQUENCES (MEGALOPOLIS BASIN): PRELIMINARY RESULTS

Serena Perini[1,*], Giovanni Muttoni[1], Vangelis Tourloukis[2,3]

[1]*Department of Earth Sciences "Ardito Desio", Università degli Studi di Milano, Milan, Italy*
[2]*Paleoanthropology, Institute of Archaeological Science, Senckenberg Centre for Human Evolution and Palaeoenvironment, Department of Geosciences, Eberhard Karls University of Tübingen, Tübingen, Germany*
[3]*Department of History and Archaeology, School of Philosophy, University of Ioannina, Ioannina, Greece*
**serena.perini@unimi.it*

http://dx.doi.org/10.15496/publikation-97640

Keywords: Magnetostratigraphy; Rock-magnetism; Pleistocene; Megalopolis; Greece

21.1 INTRODUCTION

During the 2020 research campaign of the Megalopolis Palaeoenvironmental Project, 8 oriented core samples were collected for paleomagnetism from the archeological site of KYP4. In 2021, a more extensive paleomagnetic sampling campaign was conducted across the 22 m-thick Kyparissia-4 and 28 m-thick Choremi-6 sections, located stratigraphically the former above the latter in the Kyparissia and Choremi mines, respectively (Fig. 1). Each stratigraphic section was subdivided into different sub-sections (8 subsections for Kyparissia-4 and 6 subsections for Choremi-6), in order to cover the stratigraphy homogeneously. We sampled every 20-30 cm collecting a total of 103 oriented core samples (69 at Kyparissia-4 and 34 at Choremi-6). Cores were then cut into standard-sized ~10cc cylinders to perform different magnetostratigraphic and rock-magnetic analyses from the same stratigraphic level.

The primary objective was to determine the geomagnetic polarity recorded in the sediments and perform correlations at the basin scale using primarily the Brunhes-Matuyama boundary dated to 0.773 Ma (Channell et al., 2020), which represents the most recent reversal of the Earth's magnetic field. We also aimed at identifying short reversals that could potentially improve the magnetochronology of these sections.

21.1.1. MATERIALS AND METHODS

The 8 samples from the KYP4 archeological site and the 103 samples from the Kyparissia-4 and Choremi-6 sections have undergone thermal demagnetization experiments in order to deter-

S. Perini: https://orcid.org/0000-0002-6545-2193
G. Muttoni: https://orcid.org/0000-0001-7908-1664
V. Tourloukis: https://orcid.org/0000-0002-9527-2708

Figure 1: Satellite image (source: GoogleEarth™) of the Megalopolis Basin, with the position of Kyparissia 4 and Choremi 6 sections and constituting sub-sections.

mine the characteristic remanent magnetization (ChRM) component directions, representing the registry of the magnetic polarity at the time of rock formation. The analyses were performed from room temperature up to ~450°C (for samples from Choremi-6) and 625°C (for samples from Kyparissia-4) in steps of 25°C with an ASC thermal demagnetizer, and the natural remanent magnetization (NRM) signal was measured after each temperature step with a 2G Enterprises 755 DC-SQUID cryogenic magnetometer located in a magnetically shielded room. The magnetic susceptibility was also measured with a Bartington MS2B susceptibility bridge after each step of demagnetization to monitor the mineralogic stability in function of heating. The magnetic component directions were subsequently determined through least-square analysis (Kirshvink, 1980). Samples were then subjected to thermal demagnetization of a three-component isothermal remanent magnetization-IRM (Lowrie, 1990) in fields of 0.12 T, 0.4 T, and 1.5 T using a pulse magnetizer (ASC IM-

10-30) to determine the ferromagnetic mineralogy carrying the primary paleomagnetic signal.

21.1.2. RESULTS AND FUTURE PERSPECTIVES

Thermal demagnetization analysis on the 8 samples from the KYP4 archaeological site indicates the exclusive presence of normal magnetic polarity (ChRM component directions oriented to the north with positive [downward] inclinations) attributable to the Brunhes Chron (C1n), suggesting an age of less than 0.773 Ma for this site. The 69 samples collected from the Kyparissia-4 section, extending stratigraphically above the site KYP4, yielded dominant normal magnetic polarity attributed to the Brunhes Chron interrupted by a thin ~1.2 m-thick interval of reverse magnetic polarity (ChRM component directions oriented to the south with negative [upward] inclinations) attributed to a short reversal of Earth's magnetic field occurring during the Brunhes Chron (e.g., Big Lost at 0.54 Ma), which, however, needs further investigation in light also of the lithological complexity of the section consisting of reworked silty clays and mud flows characterized by marked chromatic variations ranging from red-brownish to light blue. The thermal demagnetization of a three-component IRM performed on 8 selected samples from Kyparissia-4 shows that the magnetic mineralogy reflects these color changes whereby the IRM is carried mainly by magnetite in the light blue intervals and by hematite in the red-brown intervals. On the other hand, 2 additional samples revealed that for greyish clay of Choremi 6 the remanence is carried by sulphides.

Thermal demagnetization analysis on the 34 samples from the Choremi-6 section showed a clear change of magnetic polarity from reverse at the base to normal toward the top, indicating the presence in this section of the Brunhes-Matuyama boundary (0.773 Ma). Future analyses will focus on correlations at the basin scale using this valuable magnetochronological boundary that was previously identified in the Choremi mine area of the Megalopolis Basin by Tourloukis et al. (2018).

Future activity will involve performing detailed rock-magnetic experiments on selected samples from both Kyparissia-4 and Choremi-6, including thermomagnetic and hysteresis experiments, backfield acquisition curves of isothermal remanent magnetization (IRM), and first order reversal curves (FORC) using a Microsense EZ7 vibrating sample magnetometer. Our aim is to investigate potential links between sediment color and environmental factors, like paleoclimate variations (e.g., periods of warmer climate promoting weathering and oxidation to give red-brownish color, and periods characterized by more reducing conditions, to give the light blue color). Hysteresis loops of magnetization will be used to determine values of coercivity [Hc], saturation magnetization [Ms], and saturation remanence [Mr] after correcting for paramagnetic components, while the parameter coercivity of remanence [Hr] will be obtained from IRM backfield acquisition curves performed on the same samples. The Hc/Hr and Ms/Mr ratios will be plotted on Day diagrams (after Day et al., 1977 and subsequent modifications), allowing the identification of the domain state of the ferromagnetic grains in the sediments, as well as providing a generic indication of their size.

ACKNOWLEDGMENTS

This research was conducted under a permit granted to the Ephorate of Palaeoanthropology-Speleology, Hellenic Ministry of Culture, and the American School of Classical Studies at Athens. It was supported by the ERC Consolidator Grant ERC-CoG-724703 ("CROSSROADS") awarded to K.H. K.H. is also supported by the ERC Advanced Grant ERC-AdG-101019659 ("FIRST-

STEPS"). We thank the reviewers M. Maron and Z. Jacobs for their comments that helped improve this manuscript.

REFERENCES

Channell, J.E.T., Singer, B.S., Jicha, B.R., 2020. Timing of Quaternary geomagnetic reversals and excursions in volcanic and sedimentary archives. Quaternary Science Reviews, 228, pp. 106–114.

Day, R., Fuller, M. and Schmidt, V.A., 1977. Hysteresis properties of titanomagnetites: grain-size and compositional dependence. Physics of Earth Planetary Interiors 13 (4), pp. 260–267.

Kirshvink, J.L., 1980. The least-squares line and plane and the analysis of palaeomagnetic data. Geophysical Journal International, 62, pp. 699–718.

Lowrie, W., 1990. Identification of ferromagnetic minerals in a rock by coercivity and unblocking temperature properties. Geophysical Research Letters, 17(2), pp. 159–162.

Tourloukis, V., Muttoni, G., Karkanas, P., Monesi, E., Scardia, G., Panagopoulou, E. and Harvati, K., 2018. Magnetostratigraphic and chronostratigraphic constraints on the Marathousa1 Lower Palaeolithic site and the Middle Pleistocene deposits of the Megalopolis Basin, Greece. Quaternary International, 497, pp. 154–169.