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ARCHAEOMAGNETIC INVESTIGATION OF LATE ENEOLITHIC FURNACES UNDER THE ANCIENT BRONZE AGE VILLAGE OF CROCE DI PAPA, NOLA (ITALY)

Claudia Principe[1], Simone Arrighi[1,2], Marina Devidze[3], Daniele Giordano[1,4], Maxime Le Goff[5], Avto Goguitchaichvili[6,7*], Sonia la Felice[1]

[1] Istituto di Geoscienze e Georisorse – CNR, Archaeomagnetic laboratory ARCHEO_Lab, Villa Borbone, Viareggio (LU), ITALY

[2] Provincia di Pisa – Settore Bonifiche Ambientali, Pisa Italy

[3] M. Nodia Institute of Geophysics, Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia

[4] Dipartimento di Scienze della Terra, Università degli Studi di Torino, Italy

[5] Institut de Physique du Globe de Paris, Laboratoire de Geomagnetisme, Saint Maur des Fossés, Cedex, France

[6] Laboratorio Interinstitucional de Magnetismo Natural, Instituto de Geofisica, UNAM, Morelia, Michoacan, Mexico

[7] Departamento de Física, Escuela Politécnica Superior, Universidad de Burgos, Burgos, Spain

ABSTRACT

The Copper Age marks the first stage of human's use of metal. Eneolithic is commonly assumed to begin in the early 4th millennium BC in Southeastern Europe and at least 1,000 years earlier in the Middle East, where the majority of copper mines exploitation started. This study provides a chronological contribution to this matter. Our finding allows dating the beginning of the use of metal in the Campanian plain to the first half of the 3rd millennium BC.

Keywords: Eneolithic Arqueomagnetism dating, 3 rd and 4th millenium BC, Copper Age, Croce di Papa

Introduction

Croce di Papa is located at the easternmost margin of the Nola Plain (Italy); a flat area limited on the northern and western side by carbonate reliefs and by Vesuvius slopes from the South. To the west, near Acerra, a morphological smoothed ridge bound the Nola Plain, forming a barrier with a minimum altitude of 27 m a.s.l. which inhibits efficient water outflow from the plain (Favalli *et al* 2006).

Despite the existence of this system the morphologically depressed portion of the Nola Plain, also in historical times, was repeatedly inundated by huge secondary mud flows associated to the main explosive Vesuvius eruptions (*e.g.* in 1631, Rosi *et al*. 1993). For this reason, this area is still at present considered, within the framework of Civil Protection purposes, an area at risk for flooding and invasion from volcanic debris secondary flows (Barberi *et al*. 1995).

Positioned at the Eastern margin of this depressed area, the Nola hill emerges, resulting in the piling of 20-30 m of remobilized pyroclastic deposits on top of theithoid deposit. The sedimentological sequence that has been found during the archaeological excavation testifies that the Croce di Papa locality was "land", and not marsh, at least for all the stratigraphical record exposed by the archaeological excavation.

The oldest written evidence of a human settlement in the Nola area refers to the fortified city of Nola, positioned on a hill *ca*. 42 m a.s.l. which, according to the ancient writers seems to be founded in the beginning of the VIII century BC by the Ausones, few decades before the foundation of Rome, and passed in the VI century B.C. under Etruscan domination. Only recently, the discovery of several new archeological finds, associated to the "Palma Campana" culture (*e.g.* the human settlements of Palma Campana, San Paolo

Belsito, and Afragola) showed that in the Early Bronze age, the Nola plain was a densely inhabited territory, crossed by long-lived roads and subject to well-organized agricultural exploitation (Albore Livadie *et al*. 2005). It is thanks to the occurrence of the violent explosive event, whose pyroclastic deposits covered this territory with a thick layer, that the ancient settlement settings could be preserved until the present days.

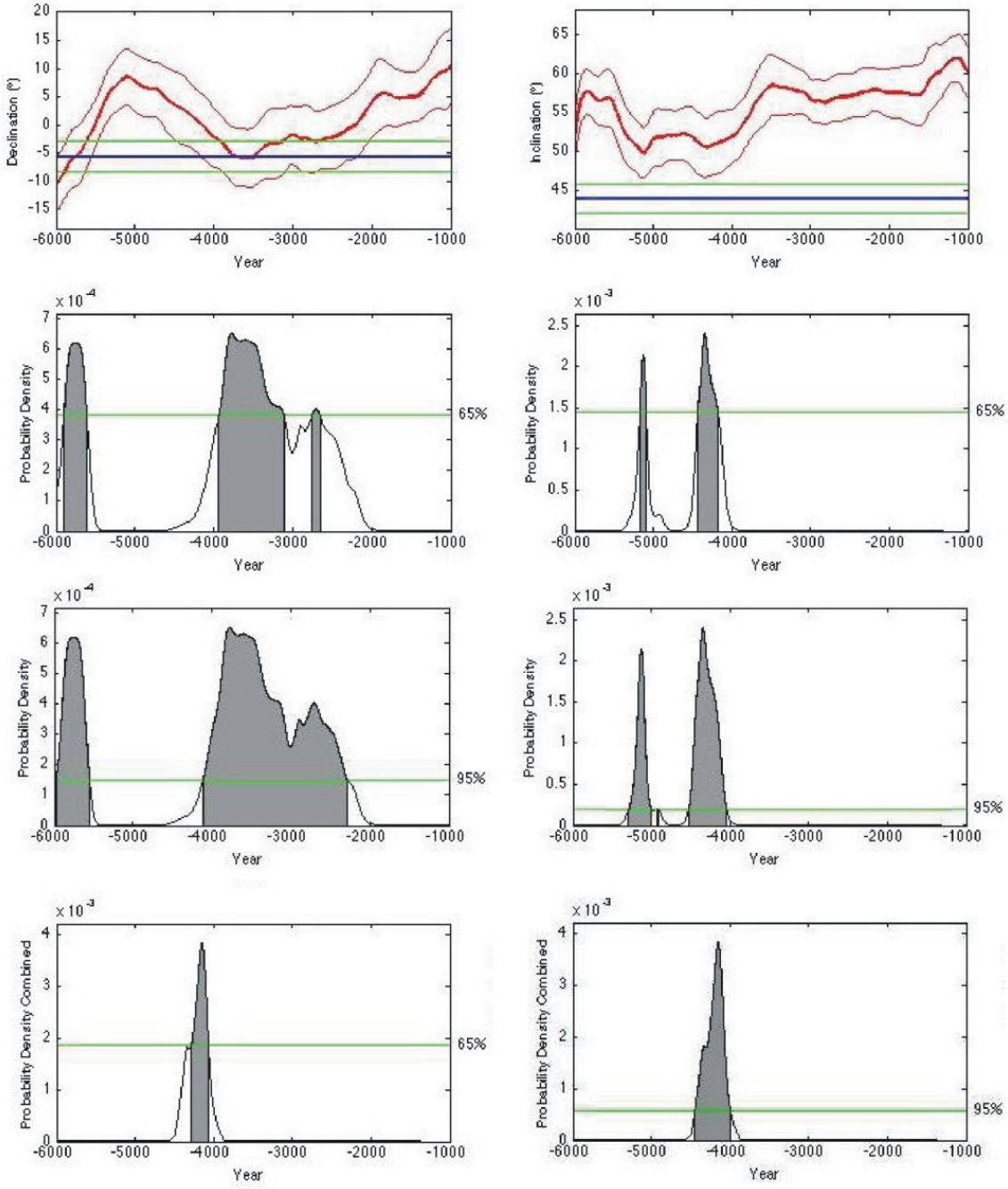

Figure 1. The probability densities at the 95% 2σ and 65% 1σ confidence level of possible dates on the basis of the declination and inclination result are shown as shaded areas along the time axis. Graphic output from the Mat-lab tool by Pavón-Carrasco *et al*., 2011. The Geomagnetic Secular Variation Curve (SVC) adopted is that generated by the regional geomagnetic model SCHA.DIF.8K.

Archeomagnetic Dating

Sample collection was performed on the two better preserved structures, found at the lowermost level of the archaeologic excavation, and was performed on January 2002. The structure remnants were poorly readable and largely incomplete. Only for one of the two furnaces we could measure an approximate diameter of about 70 cm, which is in general agreement with the common dimensions of furnaces built for metallurgic purposes (Giardino, 2010). A total of sixteen samples of an approximate size of 8 x 8 x 4 cm were collected. A perfectly horizontal and plaster plane was constructed for all samples which were then oriented by means of a solar compass.

The archaeomagnetic measurements were performed with the large cell induction magnetometer available at the IPGP Laboratoire de Geomagnetisme in Saint Maur des Fossés (Paris, France) and the magnetometer available at the IGG - CNR ARCHAEO Lab housed at Villa Borbone, Viareggio (Lucca, Italy) according to experimental procedure published by Tanguy *et al*. 2003. The measurements were performed in three different stages. The first series of direct and reverse measurements were performed in 2003 (Arrighi, 2003) and repeated in 2008, whereas the inverse set of analyses were repeated in 2012, when also an alternating field demagnetization procedure up to a maximum step of 25 mT was applied.

For all samples, a stable and single paleomagnetic component was retrieved. A minor secondary, likely viscous, component was easily removed applying a 10 mT peak alternating field. The median destructive fields (MDF) for these samples range mostly from 20 to 25 mT, suggesting 'small' pseudo-single domain grains as remanent magnetization carriers.

By using an archaeomagnetic technique we dated (fig. 1) structures discovered at the lowermost stratigraphic level inside the archaeological site of Croce di Papa, near Nola (NA, Italy). The ages obtained fall, with the 95% confidence limit, within the interval 1,900 BC. This archaeomagnetic age date the presence of the Early Bronze Late Eneolithic) culture in Campania. The combination of the available chronological, geological and archaeological data allows us to establish the main lines of the geo-environmental evolution of the Nola Plain in the late Holocene.

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