ARCHEOCLUB DI SAN SEVERO

36° CONVEGNO NAZIONALE

sulla

Preistoria - Protostoria - Storia
della Daunia

San Severo 15 - 16 novembre 2015

A T T I

a cura di
Armando Gravina

SAN SEVERO 2016

Il 36° Convegno Nazionale sulla Preistoria, Protostoria, Storia della Daunia è stato realizzato con il contributo di: **Ministero per i Beni e le Attività Culturali – Direzione Generale per i Beni Librari e gli Istituti Culturali – Sez. III; Regione Puglia; Fondazione Banca del Monte "D. Siniscalco-Ceci" di Foggia**

Finito di stampare nel mese di settembre 2016 presso Centro Grafico S.r.l. - Foggia – www.centrograficofoggia.it

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The Archaeometry of Tavoliere Neolithic ceramics: a project update

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Abstract (English)

This paper presents an update on the progress of the project "Pots and People of the Tavoliere Neolithic". We describe our ceramic study methodology and the current status of our database. We also present a brief case study involving clays and ceramics from the site of Serra di Cristo. Finally, we present results of geophysical and near infrared (NIR) survey at the site of Posta Barone Grella I.

Abstract (Italiano)

Questo intervento fornisce un aggiornamento sullo sviluppo del progetto "Ceramica e Gente del Tavoliere Neolitico". Si descrive la nostra metodologia per lo studio della ceramica e lo status attuale del nostro database. Si presenta anche un breve caso di studio sull'argilla e sulle ceramiche provenienti dal sito di Serra di Cristo. Sipresentano infine irisultati delle indagini geofisiche e con fotografia quasi infrarossa condotte nel sito di Posta Barone Grella I.

ISBN-978-88-96545-71-3 Atti – 36° Convegno Nazionale sulla Preistoria, Protostoria, Storia della Daunia. San Severo 2015.
In A. Gravina (ed.), 2016, pp. 33-44

Introduction

The project "Pots and People of the Tavoliere Neolithic" began in 2013 and has now completed three field seasons. A preliminary report (Alexander *et al.*, 2014) was made at the 2013 San Severo "Convegno Nazionale sulla Preistoria, Protostoria e Storia della Daunia" and the current paper serves to summarise the two field seasons undertaken since.

The aim of the project is to reconstruct the sourcing and distribution networks of ceramics during the Neolithic of the Tavoliere. This period and place are crucial in European prehistory, representing the first dense, large scale agricultural society in Western Europe with more than 800 settlements (Whitehouse, 2013) of a distinctive type: C-shaped ditches surrounding habitations and, often, elliptical boundary ditches surrounding the scatter of C-ditches.

Previous archaeometric work had focussed primarily on the area around Foggia (see, e.g., Cassano *et al.*, 1994, Cassano *et al.*, 1995a, Cassano *et al.*, 1995b, Laviano and Muntoni, 2004, Laviano and Muntoni, 2006, Muntoni, 1999) so one of our project aims has been to create a geographically representative sample of sites, ceramics and clays for the entire Tavoliere zone.

Methodology

Sites identified from the UCL Mass Survey records and the Carta dei Beni Culturali della Puglia are field walked after the harvest. Ceramic and lithic (especially obsidian) finds are georeferenced with a hand held GPS and bagged and tagged with the code used in the GPS. Finds are subsequently cleaned and then analysed using a portable X-ray fluorescence (pXRF) spectrometer, which measures the concentration of trace elements in the sample.

Riverine clay samples are also gathered and are analysed with the pXRF spectrometer both after air-drying and after firing at 650 C.

In both the clay samples and the ceramics we measure the concentrations of niobium, rubidium, strontium, yttrium and zirconium. Subsequent analyses - ongoing at the time of writing - involve the use of statistical methods such as discriminant function analysis (DFA) and principal components analysis (PCA) to assess the likely clay sources used to produce the Neolithic ceramics.

During the 2015 field season the team also undertook remote sensing analyses and geophysical prospecting at several sites as part of preparations for possible targeted excavations. These analyses are detailed below.

Additional samples collected and analysed

A further 16 sites were field walked post-harvest to collect ceramic and lithic (especially obsidian) samples. These additional sites mean that we now have a geographically representative sample of Tavoliere Neolithic sites (fig. 1).

In addition, we analysed ceramics excavated by the Soprintendenza Archeologia della Puglia from the sites of Masseria Pantano, Serra di Cristo and ex-Palestra GIL (in Foggia).

Further river clay samples were also collected, again in such a way as to give a balanced geographical representation (fig.2). Since our last report in this forum, we have also fired the clay samples collected in 2013 and 2014 and then reanalysed them. There are no major systematic changes in the trace element profiles before and after firing.

Summary of data set

At this point, our database contains 1,220 pieces of Neolithic pottery (see fig. 3) along with the coordinates of their find spots, trace element composition and descriptive data/photographs. As can be seen in Table 1, slightly more than half of the ceramic samples analysed are of non-diagnostic form, usually coarsewares. The commonest diagnostic find type is Impressed ware, followed closely by Masseria La Quercia ware. Other diagnostic types are considerably less common and the relative abundance of Passo di Corvo ware is heavily influenced by the presence in the database of 30 samples from the Soprintendenza's excavations at ex-Palestra GIL in Foggia.

See Figure 4 for examples of finds from the field in the two most recent seasons.

There are also a total of 76 samples of (largely) riverine clay, also georeferenced.

Table 1 - Samples by type

Type	Number	Percentage
Burnished ware	113	9.3
Impressed ware	207	17.0
Masseria La Quercia ware	196	16.1
Matera scratched ware	6	0.5
Passo di Corvo ware	53	4.3
Polychrome Passo di Corvo ware	4	0.3
Other forms	641	52.5

An interesting case study

The site of Serra di Cristo in the Apennine foothills was excavated by the Soprintendenza Archeologia della Puglia in 2013 (Tunzi *et al.*, 2014). The team visited the site as guests of the Soprintendenza along with co-author Muntoni and took a sample of geologic clay from just a few metres away from the C-ditch. Subsequently, we analysed a range of ceramic samples collected during the excavation.

The trace element data were investigated using Principal Components Analysis (PCA), a statistical technique that allows one to visualise the structure of multidimensional data sets in just two or three dimensions. The quality of the representation can be judged from the share of total sample variation represented by the axes considered. Samples that are closer together are more similar in terms of trace elements than those that are farther apart.

The very interesting result here is that the geologic clay from the site (bottom left in fig. 5) is very different in its chemistry to the ceramics found at the site: it would appear that the Serra di Cristo people were not using clay that was, quite literally, at hand. Instead, the clay chemistry resembles, in most cases, that of the Candelaro river system.

The quality of the representation in two dimensions is high, encompassing more than 88% of the total variation in the data.

Remote sensing and geophysical prospection work undertaken

The core team was joined by current co-authors Manuel Hofer of Graz University of Technology, Austria and Tommaso Mattioli and Andrea di Miceli of ArcheoRes (www.archeores.com) of Perugia, in collaboration with SMAArt (Scientific Methodologies applied to Archaeology and Art, University of Perugia). Hofer brought a SenseflyeBee (www.sensefly.com) fixed wing UAV (unmanned aerial vehicle) and Mattioli and Di Miceli brought geophysical prospection equipment including a differential GPS (DGPS), electrical resistance tomography (ERT) equipment and a magnetometer. The UAV was equipped with a near infrared (NIR) camera rather than a visible light camera, the choice being based on the success reported by Verhoeven (2012) at using digital NIR imagery for site prospection.

The Soprintendenza Archeologia della Puglia identified several sites in the vicinity of Lucera that seem likely to be relatively undamaged by agricultural activity. In addition, the team opted to survey the site of Posta Barone Grella I, southwest of Cerignola. During field walking of this site we found significantly larger than usual (fig.4 for examples) Neolithic ceramic fragments, suggesting that deep ploughing was less frequent than usual. A conversation with the owner's foreman also supported the conclusion that ploughing to date had tended to be relatively shallow.

The data from the UAV were turned into a high-resolution (25 cm/pixel) NIR 3D

digital surface model (DSM) using Structure from Motion algorithms (Irschara *et al.*, 2007). The model was georeferenced using recently-developed algorithms (Rumpler *et al.*, 2016) to process data from the UAV's on-board GPS unit.

Of the four sites identified by the Soprintendenza, one proved impossible to fly because of the presence of wind turbines while another was simply too windy at all the times of day that we visited (the UAV cannot fly in winds above 45 km/h). The other two sites - Posta del Giudice and a site without official designation that we chose to call Lucera 2, 3.6 km southwest of Posta del Giudice - were successfully mapped. The site of Posta Barone Grella I was also successfully mapped, as was a segment of Passo di Corvo.

Geophysical prospection was undertaken at Posta del Giudice and Posta Barone Grella I. At the first of these sites, a 20 x 160 m transect was investigated with both the magnetometer and the electrical resistance tomography equipment. At Posta Barone Grella I we employed only the magnetometer. At both sites, the magnetometer transects were chosen to include boundary ditches and, at Posta Barone Grella I, a suggestive set of Impressed Ware finds from field walking that appeared to form a C-shape and thus might indicate an internal C-ditch.

The subsurface maps from the magnetometer survey and the DSM from the UAV were combined in an ArcGIS database. At both sites, the magnetometer identified ditches. The greatest success was at Posta Barone Grella I where the magnetometer picked up both boundary and apparent internal ditches while the NIR photogrammetry shows parts of two boundary ditches. This latter was unexpected because NIR - working from temperature differences - usually reveals most when there are standing crops but the field in which the site lies had been harvested a week or two prior. Unfortunately, it appears that the apparently circular distribution of Impressed Ware was, in fact, purely random as it lies about 15 m away from the nearest circular ditch segment identified by the magnetometer.

Analyses in progress

We are currently finalising a DFA model that allows us to infer the clay source used to make a particular piece of Neolithic pottery on the basis of, in essence, a comparison of the trace element profiles. The model is performing well and details will be published in the near future.

We are also currently looking at the use of network models to investigate distribution/trade patterns as has been previously done for obsidian in the Maya area (Golitko *et al.*, 2012).

The NIR photogrammetry is being further analysed with various filtering techniques to try to bring out more detail of the subsurface structures.

Finally, we are working on ways to incorporate the uncertainty resulting from experimental error into the analysis of pXRF data, using both network and simulation-

based approaches. The network approach was presented in a very preliminary form at the San Severo 2015 conference but is not yet ready for publication.

Conclusions and future research

Our database of Neolithic Tavoliere ceramics is larger than any previously assembled and sophisticated statistical analysis of the data is beginning to yield insights into the production and exchange of pottery. One such insight - that the Neolithic people of Serra di Cristo apparently did not use locally available geologic clay sources - has been presented. We have also demonstrated the potential of remote sensing technologies and geophysical prospection for the identification of sites and their internal structure in the particular conditions of the Tavoliere.

At this point, we plan to finish and publish the analyses referred to above whilst simultaneously searching for sources of funding to excavate, in collaboration with the Soprintendenza Archeologia della Puglia, promising sites such as Posta Barone Grella.

Acknowledgements

We acknowledge the support of the Soprintendenza Archeologia della Puglia in granting us permission to undertake our work. The 2014 and 2015 field seasons were supported by the British Academy, the McDonald Institute for Archaeological Research (University of Cambridge), the University of South Florida and Prof. T. & Mrs. K. A. Brown. We dedicate this paper to the memory of dott. Stefano Zezza (1946-2015) of Cerignola and Roma. Dott. Zezza owned the land on which the site of Posta Barone Grella is found. He was deeply interested in our research and very supportive of our work. We regret that our acquaintance was so short.

BIBLIOGRAPHY

Alexander, C., Brown, K. A., Muntoni, I. M. & Tykot, R. H. 2014, *Archaeometry of Neolithic Tavoliere ceramics: preliminary results of a new project*, in A. Gravina, ed., *34° Convegno sulla preistoria-protostoria e storia della Daunia*, San Severo (FG), Italia, pp. 131-140.

Cassano, S. M., Curci, A., Gratziu, C., Meucci, C. & Muntoni, I. M. 1994, *Programma di analisi technologiche delle ceramiche neolitiche del Tavoliere di Puglia*, in F. Burragato, O. Grubessi & L. Lazzarini, eds., *1st European workshop on archaeological ceramics*, Roma, Italia, pp. 401-409.

Cassano, S. M., Gratziu, C., Marini, S., Meucci, C. & Muntoni, I. M. 1995a, *Analisi*

tecnologiche di impasti ceramici dal villaggio neolitico di Masseria Candelaro (FG), Scienze dell'Antichità - Storia, Archeologia, Antropologia 8-9**,** pp. 39-57.
Cassano, S. M., Laviano, R. & Muntoni, I. M. 1995b, *Pottery technology of Early Neolithic communities of Coppa Nevigata and Masseria Candelaro (Foggia province, southern Italy)*, in B. Fabbri, ed., *Fourth Euro ceramics vol 14: The ceramic cultural heritage*, Faenza (RA), Italia, pp. 137-148.
Golitko, M., Meierhoff, J., Feinman, G. M. & Williams, P. R. 2012, *Complexities of collapse: the evidence of Maya obsidian as revealed by social network graphical analysis*, Antiquity 86**,** pp. 507-523.
Irschara, A., Zach, C. & Bischof, H. 2007, *Towards Wiki-based Dense City Modeling*, inAA.VV., ed., *11th International Conference on Computer Vision*, Piscataway, NJ, USA, pp. 1-8.
Laviano, R. & Muntoni, I. M. 2004, *Le argille e l'archeometria delle ceramiche: scelte tecnologiche delle comunità neolitiche in Puglia ricsotruite con moderne methodiche analitiche*, in E. Ingravallo, ed., *Il fare e il suo senso: dai cacciatori paleo-mesolitici agli agricoltori neolitici - atti del ciclo seminariale, Lecce 2002*, Galatina (LE), Italia, pp. 114-164.
Laviano, R. & Muntoni, I. M. 2006, *Materie prime e scambi nella produzione ceramica del Neolitico apulo: il contributio delle analisi archeometriche*, in AA.VV., ed., *Atti della XXXIX riunione scientifica dell'IIPP - Firenze 25-27 novembre 2004 - Materie prime e scambi nella preistoria italiana*, Firenze (FI), Italia, pp. 1023-1035.
Muntoni, I. M. 1999, *Le ceramiche neolitiche del Tavoliere in uno studio archeometrico*, in E. Ingravallo, ed., *Fonti di informazione e contesto archeologico: manufatti ceramici e neolitizzazione meridionale*, Galatina (LE), Italia, pp. 75-92.
Rumpler, M., Tscharf, A., Mostegel, C., Daftry, S., Hoppe, C., Prettenthaler, R., Fraundorfer, F., Mayer, G. & Bischof, H. 2016, *Evaluations on multi-scale camera networks for precise and geo-accurate reconstructions from aerial and terrestrial images with user guidance*, Computer Vision and Image Understanding 146**,** pp. In press.
Tunzi, A. M., Lo Zupone, M. & Di Lieto, M. 2014, 2014, *L'insediamento neolitico stagionale di Serra di Cristo (Biccari - FG)*, in A. Gravina, ed.,, *34° Convegno Nazionale sulla Preistoria-Protostoria e Storia della Daunia*, San Severo (FG), Italia, pp. 53-80.
Verhoeven, G. J. 2012, *Near-Infrared Aerial Crop Mark Archaeology: From its Historical Use to Current Digital Implementations*, Journal of Archaeological Method and Theory 19**,** pp. 132-160.
Whitehouse, R. 2013, *The chronology of the Neolithic ditched settlements of the Tavoliere and the Ofanto valley*, Accordia Research Papers 13**,** pp. 57-78.

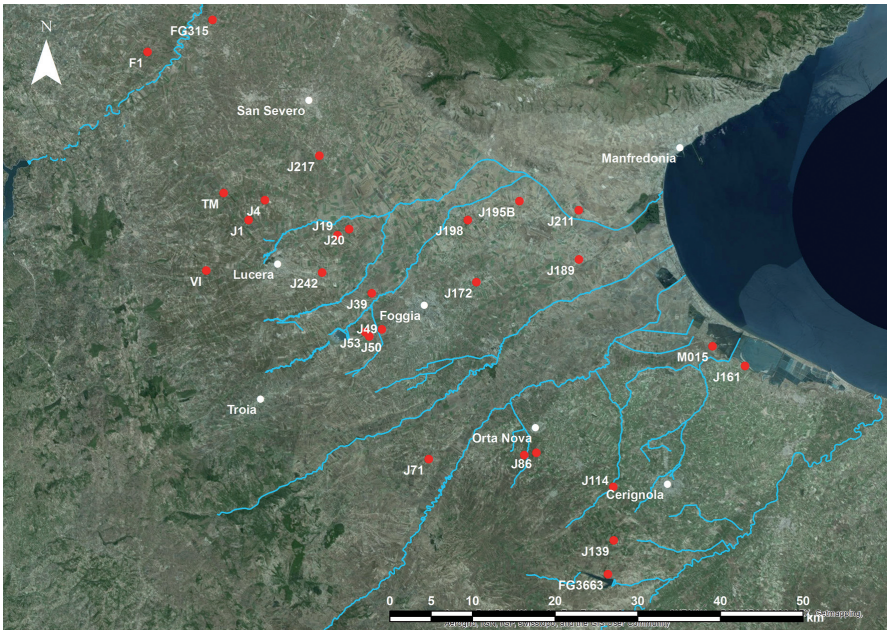

Fig. 1 – Sites where field survey was undertaken.

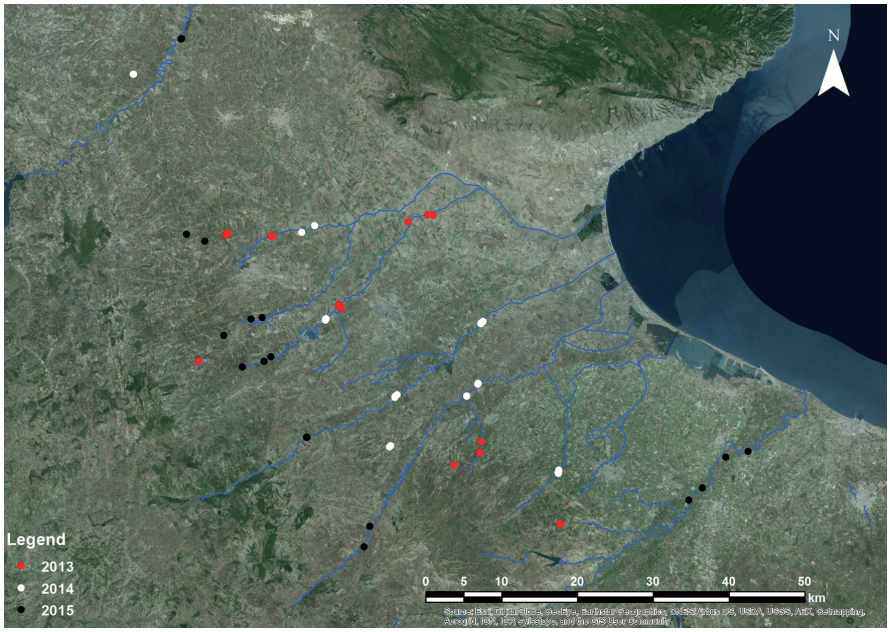

Fig. 2 – Clay sampling sites.

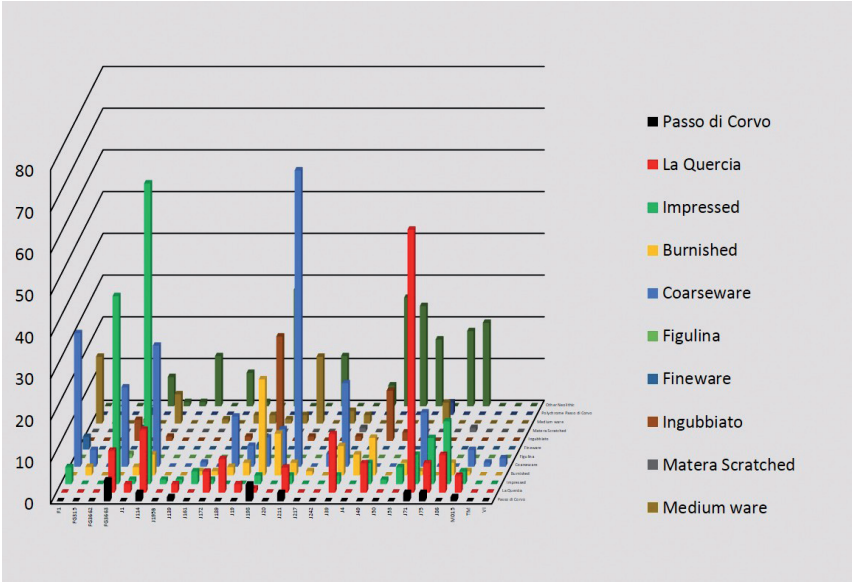

Fig. 3 – Overall distribution of field samples.

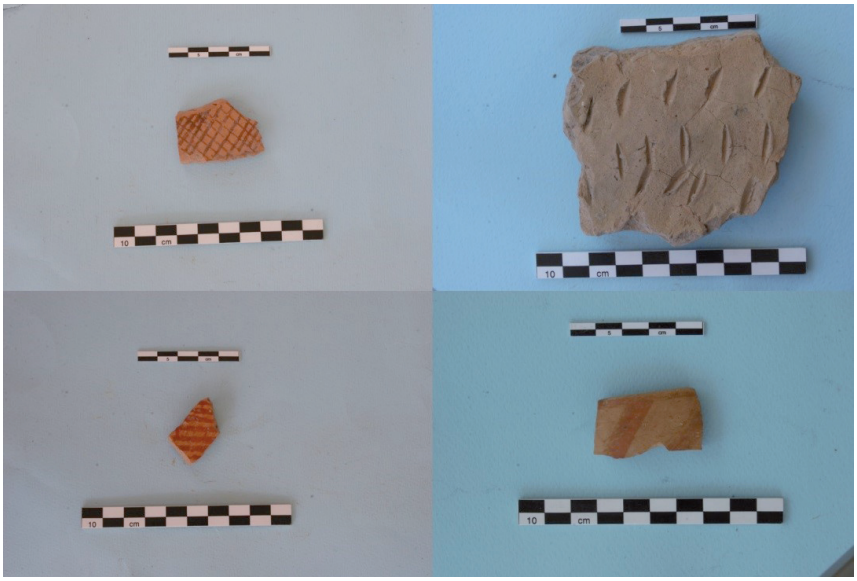

Fig. 4 – Examples of field finds from 2014 and 2015 (clockwise from top right: Impressed ware from Posta Barone Grella I, Passo di Corvo ware from Posta Barone Grella I, Masseria La Quercia ware from Masseria Bongo,Masseria La Quercia ware from Masseria Bongo).

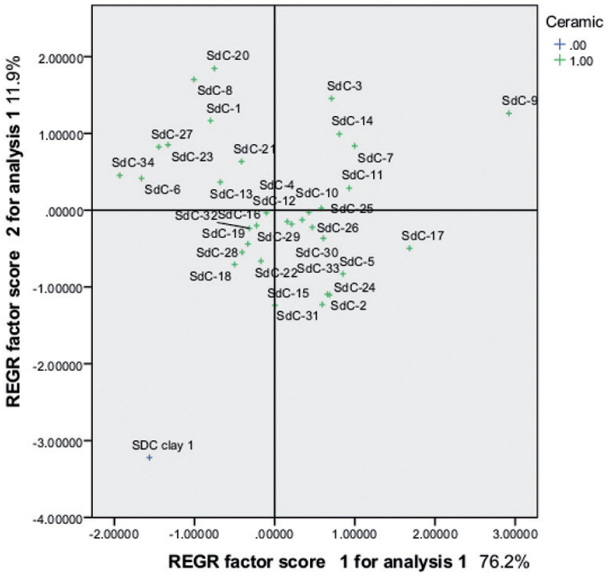

Fig. 5 – PCA of Serra di Cristo samples.

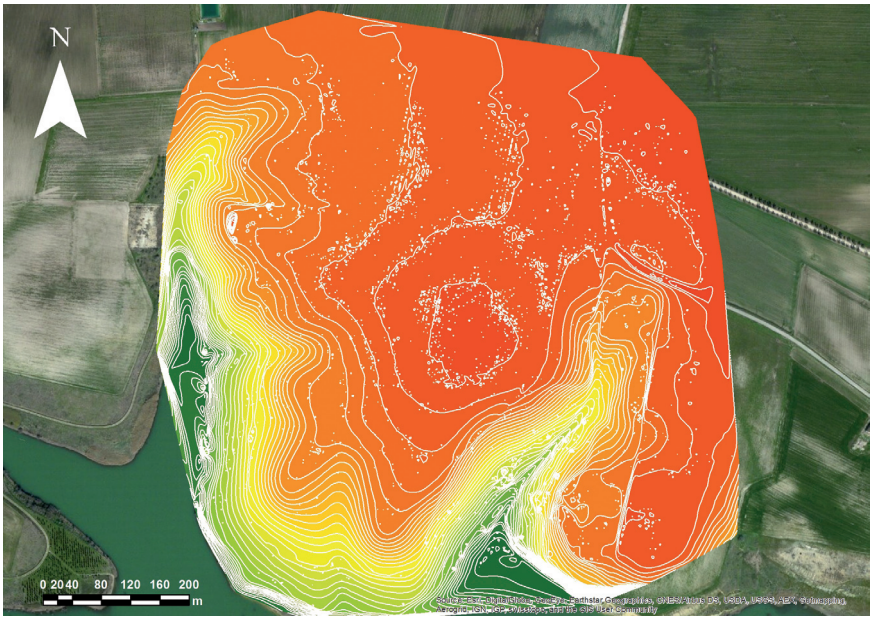

Fig. 6 – DSM of Posta Barone Grella I.

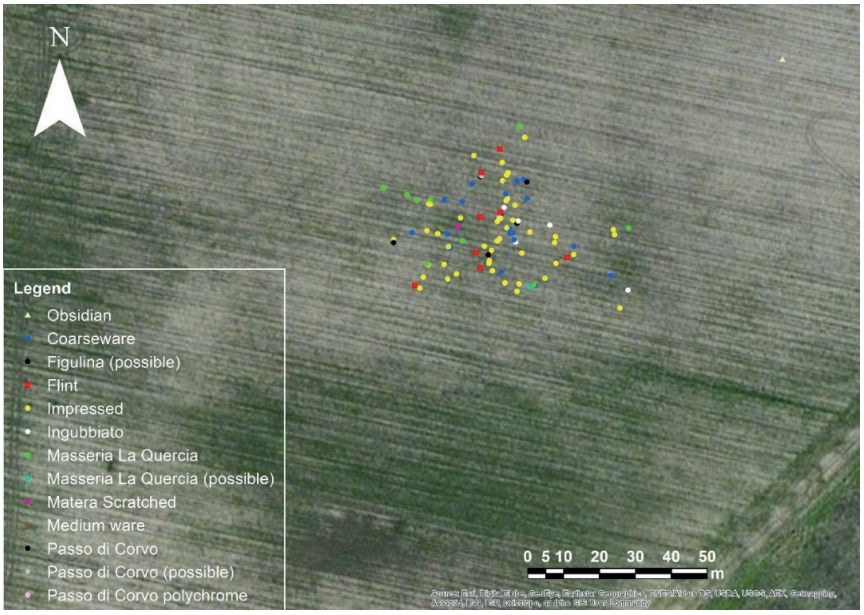

Fig. 7 – Find spots at Posta Barone Grella I.

Fig. 8 – Magnetometer map of Posta Barone Grella I.

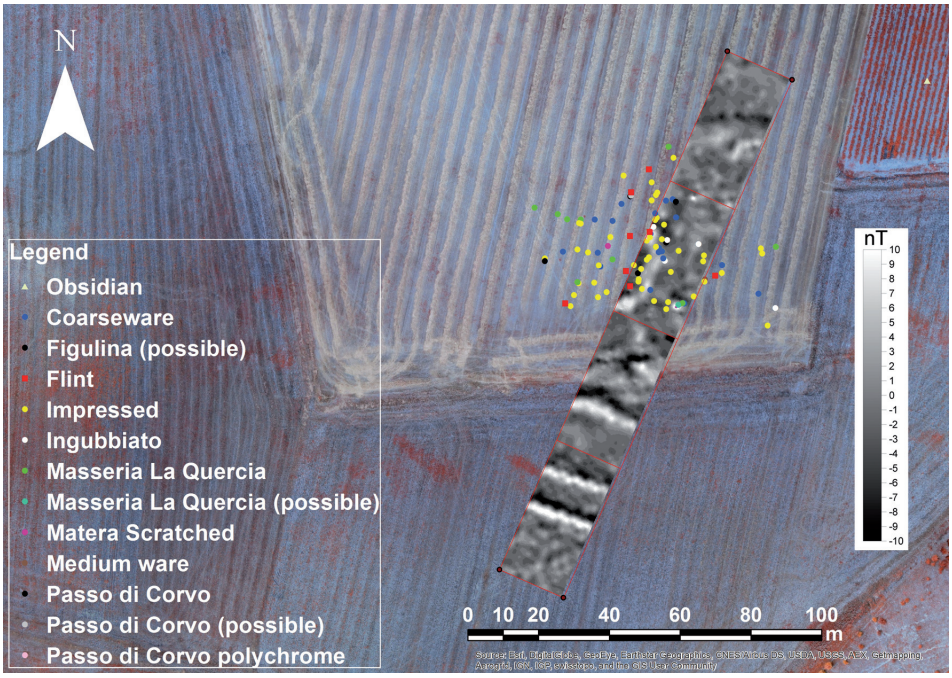

Fig. 9 – Field walking data, NIR photogrammetry and magnetometer map of Posta Barone Grella I.