Data Integration and Intra Site Spatial Analysis of the Castellaro del Vhò

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Abstract

The main objective of this paper is to present an intra site GIS application of the Bronze Age site Castellaro del Vhò in the municipality of Piadena, province of Cremona, Italy. The site is known since 1890; in 1995 the Archaeological Museum of Milan started the excavations and field survey. The specific goals of the analysis presented in this paper are the integration of archaeological field survey data with geomorphological prospecting, aerial photography and excavation data in order to evaluate the impact of agricultural activities on this site which extends on an area covering over 7 hectares.

Key words: Terramare, agricultural works, aerial photos interpretation, DEM, survey, Middle and Late Bronze Age, core borings, 1890-1910/12 trenches

1. Introduction

The site Castellaro del Vhò is located in the municipality of Piadena, province of Cremona, Italy. The site dated to the Bronze Age was discovered in 1890 (Castelfranco 1911, 1916). Since 1995 intensive archaeological excavations were carried out by the Archaeological Museum of Milan. The most distinctive features of this site are the embankment, the ditch and several houses built on aerial scaffoldings. The site can be considered as a typical representative of Middle to Late Bronze Age settlements in the Po plain best known as the "Terramare" culture (Frontini 1997, Degasperi and Frontini 1997a, Degasperi and Frontini 1997b, Degasperi and Frontini 1998).

The main objective of the project was to integrate all the data from previous excavation campaigns, intensive field surveys and geomorphological prospecting in order to make it easier for us to understand the site formation. The specific goals of the analysis were to evaluate the impact of agricultural activities on the site as regards the extensive soil removal in 1992, analyse the state of preservation of the site and understand the internal structures of the site without any additional archaeological excavations. The data used in the analyses was mostly based on geomorphological prospecting, archaeological field survey data, aerial photography and excavations from the end of the 19th century/beginning the 20th century.

The Castellaro del Vhò site covers around 72,800 square metres. The site is limited on its south and east side by the modern road Molino Vecchio which leads to the River Oglio; on the north and west the site is terminated by two small intersecting ditches.

2. Comparison of data from aerial photographs

The need for this analysis became especially urgent after extensive agricultural works took place on this site. Despite the fact that the land on this site was ploughed and used for crop production over numerous centuries, the 1992 levelling work was particularly destructive. At this time the entire surface of the site was altered by heavy machinery. These alterations were most problematic in sectors F-P 5-12, where the surface was lowered by approx. 19 cm. The soil from this area was deposited in sector G-Y 15 –16 (figure 1). However, digital elevation models of the site prior to this destruction could have been produced on the basis of properly recorded elevations of the site.

The aerial photos of this site were taken on two occasions, prior to and after the 1992 levelling work. On the 1988 aerial photograph (figure 2) one can clearly see the ditch (A) as a dark, 20-30 m wide soil mark. The embankment (B) is visible only in the eastern part of the site, where some traces of the ditch-embankment-ditch sequence can be seen. Lighter areas marked as C and D are interpreted as riverbeds. Other features on this aerial photograph might also have archaeological importance: Feature marked as E could represent the traces of a second ditch, while F could be another embankment. The feature marked as G is a light area, not interpretable, with sub-circular shape. The feature marked as H is a sub-elliptic brown zone not interpretable, save as depressed zone. The field survey showed that this is a zone with dense anthropic elements.

On another aerial photograph taken after the agricultural works (figure 3), one can clearly see the ditch (a) and the embankments (b1, b2 and b3). C1 and c2 are possibly traces of other ditches, while d1 could represent an entrance to the enclosure. D2 was interpreted as possible remains of the embankment. The reason for all the other soil marks is as yet not known.

On the basis of the comparison of the two aerial photographs one can fairly accurate determine the shape, location and width of the ditch as well as the later disturbance of the ditch by a watercourse (feature C in the figure 2) on the eastern side of the enclosure.

The embankment can be seen much better on the photograph from 1992. If we compare the location of the riverbeds we could be lead to the conclusion, that these are a result of later changes of the river location.

All remaining soil marks are hard to interpret and demand additional testing in the field. However, it is clear, that the soil removal which took place in 1992 destroyed traces of riverbed soil marks C and some yet unidentifiable features, especially E, F; feature H on figure 2 still remain (it is feature marked "e" in figure 3). All the other soil marks are visible on the air photograph from 1992.

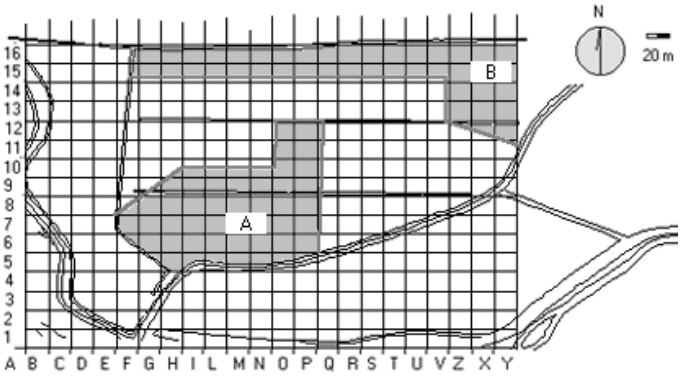

Figure 1: 1991 deeper areas of agricultural works.

3. Intensive archaeological field survey and interpretation

The main objective of the 1998 field survey was to determine the major archaeological activity areas on the site. More precisely, we wanted to determine the number and the density distribution of the prehistoric pottery appearing in the field as well as record the structures which were visible on aerial photographs. We took attention at the datable material too.

After the initial processing of the field survey data, it was realised that the site distribution has to be analysed in two parts. The first one represents the area which has been to a large extent destroyed by agricultural activities, while the second part is represented by the area which was only slightly damaged. The agricultural activities have influenced the surface artefact distribution in such an extent, that if they were analysed as a single area, no relevant information would be gained.

The processing was fairly simple and straightforward. The arithmetic mean of the number of shards per quadrant was calculated for the northern and the southern part of the site. In figure 4 we have displayed the density of shards in all quadrants which have a higher density than the mean density in the analysed zone. One can clearly see that the high density areas coincide with the structures on aerial photographs. In the north part, these are the built-up area, the ditch on the western side of the site and an area in the eastern part of the site that correspond to the feature “e” in figure 3 and “H” in figure 2. But in the western side the agricultural works were intensive, not so intensive in the eastern side. In the south part the shards density correspond to the structures, but we haven’t high density areas, because here there are many negative structures. The archaeological stratigraphy that grows in a negative structure normally stoops down, and for this reason the agricultural works less easily damage them.

The DEM analysis and the 1995 core borings show that the built-up area was built on a hillock with a slope in S direction more marked than today, so we can suppose that the south zone was more preserved from agricultural works (at least untill 1992). We can conclude that, in spite of all the activities of ploughing, sowing, and levelling works imposed on the Castellaro del Vhò during the last 50 years, the surface data can still offer useful information for the understanding of the buried stratification.

During the field survey 45 datable artefacts were collected. They were grouped in the following periods:

- Middle Bronze 1 initial and Middle Bronze 2 initial,

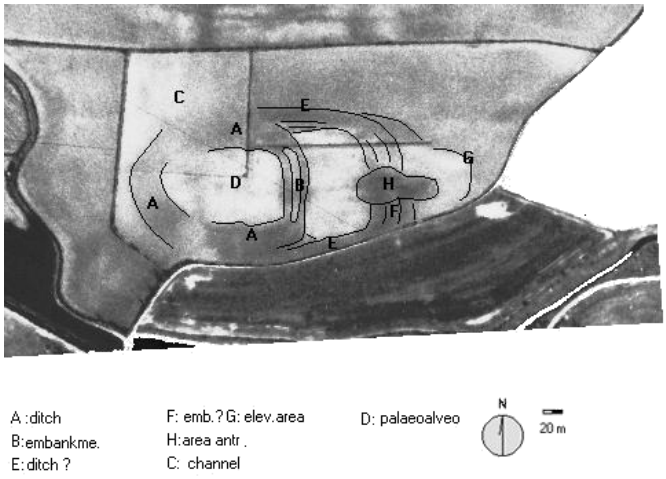

Figure 2: Photo ‘88: The Castellaro field prior to the agricultural works: interpretation of tracks (photograph by: Dr J.Tirabassi, of Museo Archeologico di Reggio Emilia, filtered with histogram equalisation by M. Pessina, interpreted by J.Tirabassi and M. Pessina).

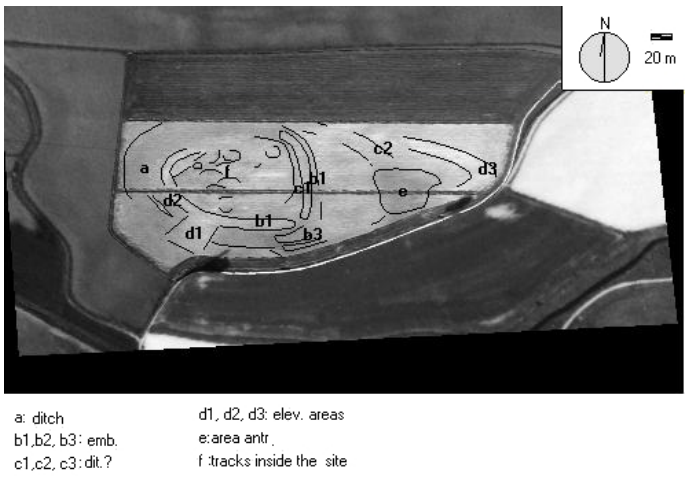

Figure 3: Photo ‘91: The Castellaro field after the agricultural works: interpretation of tracks (photograph by: Dr J.Tirabassi, of Museo Archeologico di Reggio Emilia, interpreted by J.Tirabassi and M. Pessina).

- Middle Bronze 2 and Middle Bronze 2 middle,
- Middle Bronze 2 middle-advanced and Middle Bronze 2 advanced,
- Middle Bronze 2 late and Late Bronze.

The positioning of each quadrant containing datable artefacts was correlated to the features identified on the aerial photographs. The Middle Bronze 1 initial and Middle Bronze 2 initial quadrants are concentrated in the central part of the site and areas where the agricultural levelling works were highly destructive (figure 5). Only 3 evidences dated Middle Bronze 2 and Middle Bronze 2 middle are in the south field zone, where the levelling works were more incisive.

The others are in the north zone, 3 in the built up area, 5 eastwards.

Middle Bronze 2 middle-advanced and Middle Bronze 2 advanced artefacts were most prominent in the northern and north-eastern part of the site. Finally all the Middle Bronze 2 late and Late

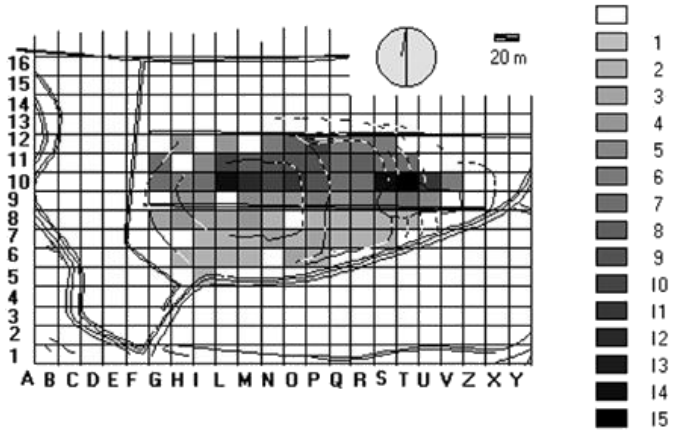

Figure 4: Medium and maximum values of pottery distribution in the southern and northern area and tracks on aerial photographs: the evidences have been sorted on a scale of 15 levels (each level corresponds to 100 shards).

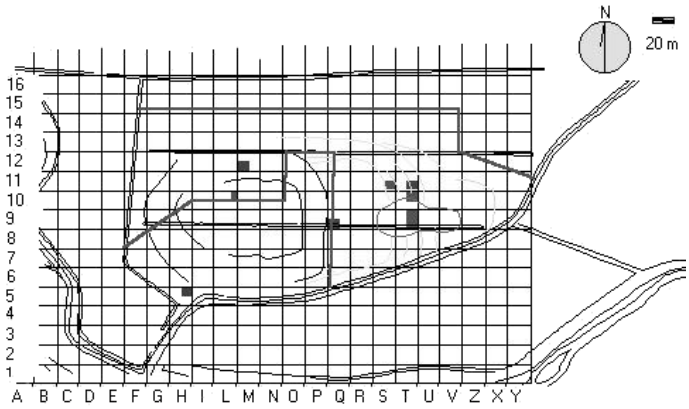

Figure 5: Distribution of datable Middle Bronze 2 initial and Late Bronze artefacts with the boundaries of deeper areas of agricultural works and the tracks on aerial photographs.

Bronze artefacts were located in the eastern part of the site, in the area marked "e" in figure 3 and H in figure 2.

This analysis marks that the evidences of the first two groups are concentrated in the zone where the agricultural works were more incisive and where the ancient hillock was more exposed: here the archaeological stratification is almost completely destroyed.

The third group in the north zone is out of the zone where the agricultural works were more incisive, in the south instead is in this zone maybe because here the presence of more negative structures allowed a better the stratification preservation.

The most interesting group is the fourth because the recent evidences are grouped in an area where:

- the agricultural works haven't been incisive
- there weren't archaeological excavations
- there has been found an archaeological stratification *in situ* during sections cleaning of a modern small ditch
- there is the highest distribution density of prehistoric pottery.

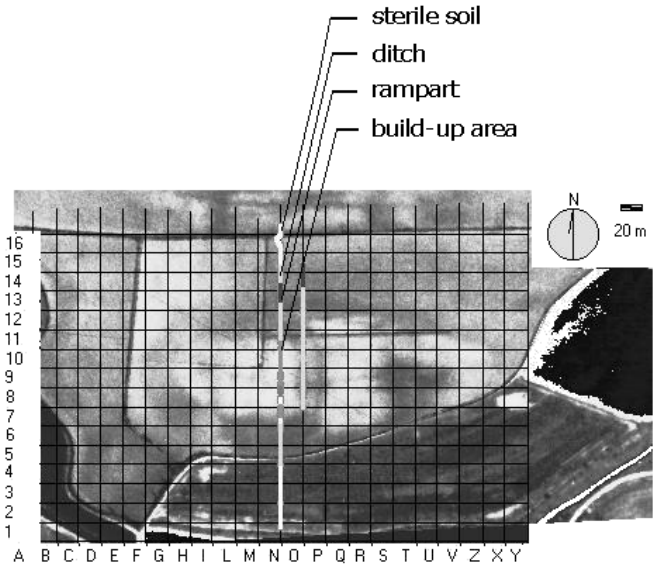

Figure 6: 1995 core borings; line N-O, -260 cm elevation; line O-P –260 cm elevation.

4. Geo-archaeological core borings

Since we wanted to gain some insight into the sub-surface geology and the relation between archaeological features and geology, we decided to make a series of core borings on the site. So, in 1995, a set of core borings were made, crossing the Castellaro del Vhò in the S-N direction.

The first analysis (Bassetti 1997), made without aerial photographs, identified the palaeo river bed presence, flowing in the E-W direction, which later on moved from the southern zone to the north. This change is marked by the meander cut causing marshy conditions which were later on dried out by the modern canal. Core borings proved the presence of a hillock (marked by the sands layer) with a slope in the N-S direction. Over this hillock the prehistoric built-up area was set. We also managed to determine the presence of negative evidences in the stratification sections with core borings.

Core borings enabled detail insight into the interpretation of the stratigraphy of the site, especially when the results are compared to the aerial photographs.

The highest elevation of both cross sections measuring 210 cm and 220 cm below the arbitrary reference point represents the plough soil. Deeper, at –260 cm traces of the ditch are already visible in the core borings (figure 6). Here we can see a sequence of the ditch and rampart on both cross sections with the built up area in its centre. The longer section is concluded by sterile soils.

If we look deeper (figure 7), at -300 cm elevation the most significant change is the substitution of the built up area in the centre by sterile soils. We can still follow the ramparts and the ditches in both cross sections. The clay soils in the southern part of the section are probably not the ditch remains but most probably belong to the palaeo riverbed.

At lower elevations of -380 cm and –350 cm sterile soils start dominating both cross sections. Only remains of the palaeo river beds can be traced. This is repeated for all deeper elevations up to -440 cm where we reach sterile soils along both cross sections.

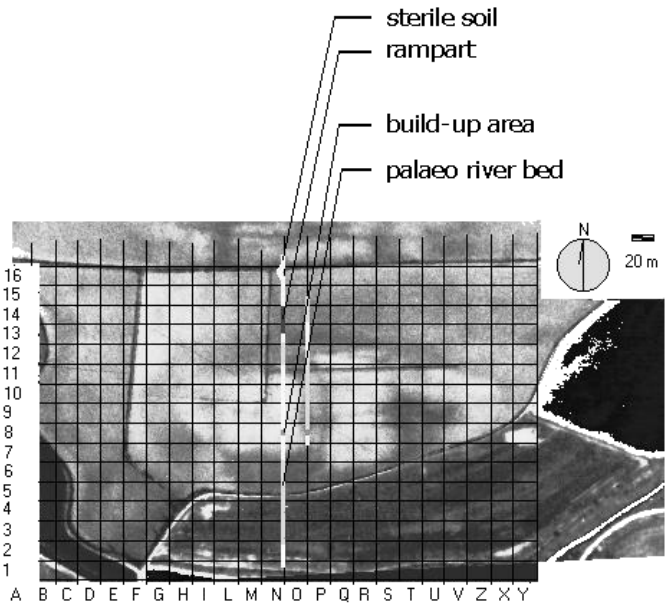

Figure 7: 1995 core borings; line N-O, -300 cm elevation; line O-P –300 cm elevation.

The core boring analysis helped in the interpretation of the aerial photographs, especially of the ditch and the built-up area inside the enclosure and it also aided the explanation of the negative tracks seen in the aerial photographs. However, for a higher detail analysis, archaeological excavations will be needed.

5. Data from archaeological excavations in 1890-91 and 1910-12

Since we wanted to obtain a more detailed insight into the interpretation of the site we decided to incorporate data also from the previous excavations. Unfortunately, integrating this data into our work was not as easy as first thought. The original location of the excavations in 1890-91 is not known (Castelfranco 1911, 1916). The reports mention the presence of built structures as well as traces of a ditch and an embankment. The grey sterile sands were 150 cm below the topsoil. The later reports also state that these excavations were located on the opposite side of the 1910 excavations: which can lead us to the conclusion that the 1890-91 excavation trenches were located in sectors O-R 8.

With the data from the excavations conducted in 1910-12 we had much less of a problem and this data was incorporated in our interpretations without any major difficulties. When we positioned the 1910-12 trenches onto the aerial photographs, we obtained a better understanding of some conclusions drawn by the archaeologists and we were able to add new data to the site analysis. Despite the fact that seven trenches measuring several hundred meters were made, and the centre of the built up area was identified, the ditch-embankment sequence was never detected. The reason for this was that all trenches made for detecting ditches were located outside the enclosure or in the ditch, where the sequence isn't visible; the only one was located between the built-up-area and the ditch was in a area very confuse by the Oglio river floods. The presumable absence of the ditch lead the archaeologists to not interpret the Castellaro del Vhò as a terramara.

6. Conclusions

Integration of various data, ranging from digital elevation data through aerial photography, archaeological field survey and excavation data to geo-archaeological core borings enabled us to have a detailed interpretation of the Castellaro del Vhò site. By using digital elevation models we could analyse the relation between paleo geomorphology and the original terrain prior to the major disturbance of the site in 1992. On the basis of the comparison of the archaeological surface survey data, aerial photographs and the digital elevation model the extent of the 1992 disturbance can be defined. This can also help us to establish the chronological period of the layers removed by this activity.

The interpretation of the tracks which can be seen in the aerial photographs has proved the existence of a large site surrounded by a ditch and an embankment. The presence of additional structures can also be seen on aerial photographs. From the structures on the eastern part of the site (outside the settlement surrounded by the ditch-embankment-ditch sequence and a recent fluvial canal crossing) special attention should be paid to the centre of the site. The existence of settlement traces outside the central part of the site was additionally proved by positioning the location of trenches excavated in 1910-12 onto aerial photographs. Last but not least, the analysis of the layers sequence in the core borings compared with the aerial photographs has evidenced the tracks of a structure inside the central part of the site as well as tracks of the palaeo river beds. We also hope that this case study did not only lead to a better interpretation of the Castellaro del Vhò site, but has also demonstrated how geographical information systems can be used for integrating various data types in the intra site analyses.

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