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A Global Synthesis with implications
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Coastal changes in the Coppa Nevigata area (Tavoliere Plain, Puglia, Italy) during the Late Holocene: natural or anthropic?

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Introduction

We present the results of a study carried out in the Palude Frattarolo area, in particular in vicinity of the archaeological site of Coppa Nevigata. The Coppa Nevigata settlement was in existence since the Neolithic to the Iron age. The site (41°33'26"N, 15°50'00"E), nowadays some five kilometres from the modern coastline, is located between the foot of the Gargano headland and the eastern part of the Tavoliere plain (Fig.1).

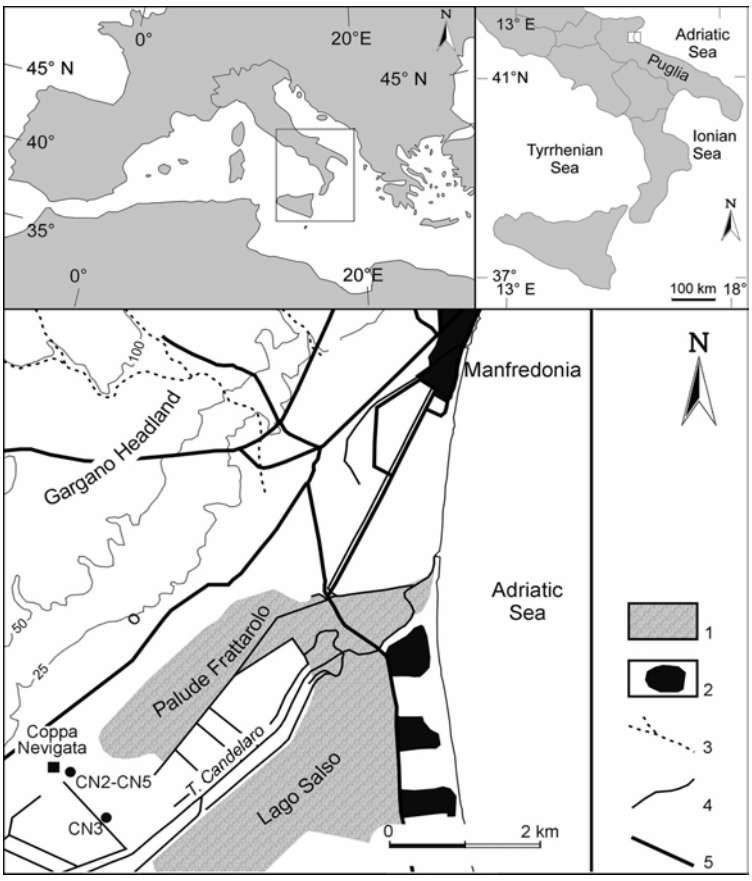

Figure 1. Geographical position of studied area. 1): present day wetlands; 2): present day settlements; 3): ephemeral rivers; 4): main artificial channels; 5): main roads

Studies carried out onto the eastern margin of this plain have demonstrated the existence, during the Holocene, of a lagoon. This coastal basin, during periods of maximum extension, stretched some 40 km from the town of Manfredonia to the Ofanto River delta (Caldara and Pennetta, 1990, 1992; Caldara et al., 2002). In spite of the many studies (Delano Smith, 1976; Ciaranfi, 1983; Caldara and Pennetta, 1990, 1992; Caldara et al., 2002) it is still not clear when the oldest lagoonal phases took place. After the many archaeological studies it is certain that the lagoon was already in existence during the early Neolithic (e. g. Deith, 1987; Ronchitelli, 1988; Hedges et al., 1989; Conati Barbaro, 1996). Since the Neolithic, the configuration of the lagoon has changed many times (Boenzi et al., 2001; Caldara et al., 2002). Notwithstanding the numerous transformations, due to natural and anthropogenic causes, several coastal basins were still in existence at the beginning of the XX century, when radical reclamation activities began.

The aim of our study is to outline the environmental changes, natural and/or human-induced, that have occurred during the Holocene in the neighbourhood of the Coppa Nevigata archaeological site, in the Palude Frattarolo basin (east side of the Tavoliere Plain). In 1997 five cores were drilled in vicinity of the Coppa Nevigata site (Caldara et al., 1999; Caldara et al., 2001; Caldara et al., in press). The drillings were carried out to establish the relationship between the settlement and the evolution of the adjacent basin. To date have been studied only three of the five cores drilled. These are: the CN2 and CN5 cores, the nearest to the site (Caldara et al., in press), and the CN3, the most distant (paper in preparation). The CN3 drilling site is situated in the ancient lagoon circa 0.8 km south-east from the Coppa Nevigata settlement.

The interpretation of data obtained from the cores nearest to the site, integrated with the archaeological record, gave information on the relationship between the human occupation at the site and the lagoonal changes.

By the analysis of the CN3 core we were able to reconstruct the palaeoenvironmental changes driven substantially by natural processes.

The CN2 and CN5 cores

The study of the fossiliferous assemblages and archaeology at the Coppa Nevigata site has revealed a series of past environmental phases. During the Bronze Age a close relationship is apparent between the nature of the lagoon environment and the evolution of the settlement. In particular, from the beginning of the Middle Bronze Age a lagoon was present at the margin of the settlement. This lagoon progressively retreated during the end of the Middle Bronze Age. In this period the two core sequences record a great quantity of organic, plant and animal remains connected with the activities carried on in the settlement. The nature and genesis of the sediment led us to attribute this layer, whose lateral continuity is not clear yet, to human activities. The low mechanical resistance of the material found in this deposit and the excellent state of preservation of the organic remains leads us to propose two transport hypotheses.

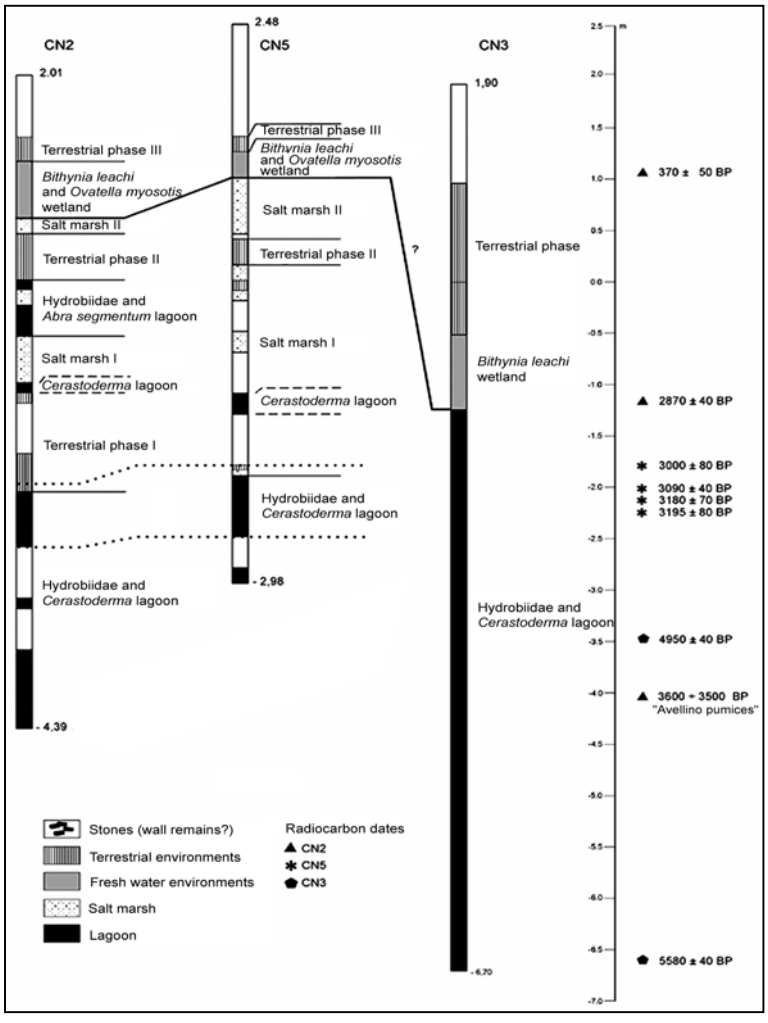

Figure 2. Schematic representation of the succession of the environments in vicinity of Coppa Nevigata

The first is that the site was used as an intentional dumping ground; in this case the deposit could be described as a midden. The second hypotesisis that the material originated after short, none-turbulent, sheet wash processes resulting in a rapid accumulation; in this case this horixzon could be compared to a colluvial deposit. At the beginning of the Late Bronze Age (3000 years BP circa) The core sediments show a phase of retreat of the lagoon in vicinity of the settlement. This transformation may have been simply the result of the volume of the material being deposited in this area at this time. Once this part of the lagoon was infilled, the settlement expanded to incorporate it. This phase of "urban" development, occurred between the radiometric dates of 3000 ± 80 BP and 2870 ± 40 BP. Subsequently, the wetland was subjected to several changes whose chronology is still not clear. In particular, During the Final Bronze Age a salt marsh developed in the area facing the settlement. In this period there was a reduction in the occupation of the site.

The upper parts of the CN2 and CN5 cores show a series of paralic deposits, indicating a connection to the open sea, alternating with fresh water deposits, controlled by rivers flowing in the lagoon. Moreover part of the lagoon near the settlement sometimes fell dry. The last wet phase (fresh water environments) started is 370±50 BP.

The reconstructed succession of the environments in vicinity of Coppa Nevigata is shown in Fig. 2.

The CN3 core

The CN3 succession was studied on the basis of the changing molluscan and foraminiferal associations. The core shows a shoaling-upwards sequence characterised by three different environments. These are:

a) near-closed lagoon;
b) closed water body influenced by a freshwater input;
c) dry grassland.

Those three environments were respectively called "Hydrobiidae spp. and *Cerastoderma* Lagoon", "*Bithynia leachi* Wetland" and "Terrestrial Phase". The near-closed lagoon, occurring in the lower part of the core (- 8.6 to - 3.2 m), is characterised by an *Ammonia beccarii* foraminiferal association in its lower part (up to - 5.8 m) and by the dominance of *Haynesina germanica* in its upper part. The molluscan fauna is dominated by the Hydrobiidae spp. and *Cerastoderma glaucum*. The variations in the mutual abundances of the taxa found suggest that several salinity changes occurred. Nevertheless, these were limited to the range of 18 - 27‰.

The "*Bithynia leachi* Wetland" phase spans from - 3.26 to - 1.36 m. The fossil record is characterised by the almost total absence of foraminifera and by a freshwater molluscan assemblage. The most frequent species is *Bithynia leachi*.

In the final phase only terrestrial organisms occur. The unique species we identified in the molluscan assemblage is *Cernuella virgata*. The rest of the assemblage is constituted by unidentifiable fragments of Helicidae.

Given the palaeontological content of these horizons we think that the "Terrestrial Phase" was characterised by an open and dry area, in which the vegetation was prevalently herbaceous. Two *Cerastoderma* specimens from the "Hydrobiidae spp. and *Cerastoderma* Lagoon" phase have radiocarbon ages of 5580 ± 40 BP and 4950 ± 40 BP respectively (Fig. 2).

Conclusions

Studies carried out starting from different sampling areas, even if in the same basin, give different data that, if separately considered, could drive the researchers to different conclusions about the changes in the physical environment. In particular, data collected from cores drilled in vicinity of an archaeological site (e. g. CN2 and CN3 cores), even if they fit in a satisfactory way the archaeological information, could give erroneous conclusions about the natural evolution since the marked anthropic influence. On the other hand, the collection of palaeoenvironmental data far from any anthropic influence (the CN3 core) could permit a reliable reconstruction of the events that characterised the evolution of the area near the sampling site. In fact the data collected from the CN2 and CN5 cores, integrated with the archaeological information, show a relatively complex succession of environments alternating between the near-closed lagoon and the terrestrial. Given the marked anthropic activities in the nearby of the settlement at some times, it is hard to understand if the changes in the physical environment are due to natural or human factors. On the other and, the study of the CN3 succession shows that the changes in the Coppa Nevigata area occurred gradually and linearly.

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