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Micromorphological evidence of water management and well abandonment phases in the "Terramara Santa Rosa di Poviglio" (N Italy)

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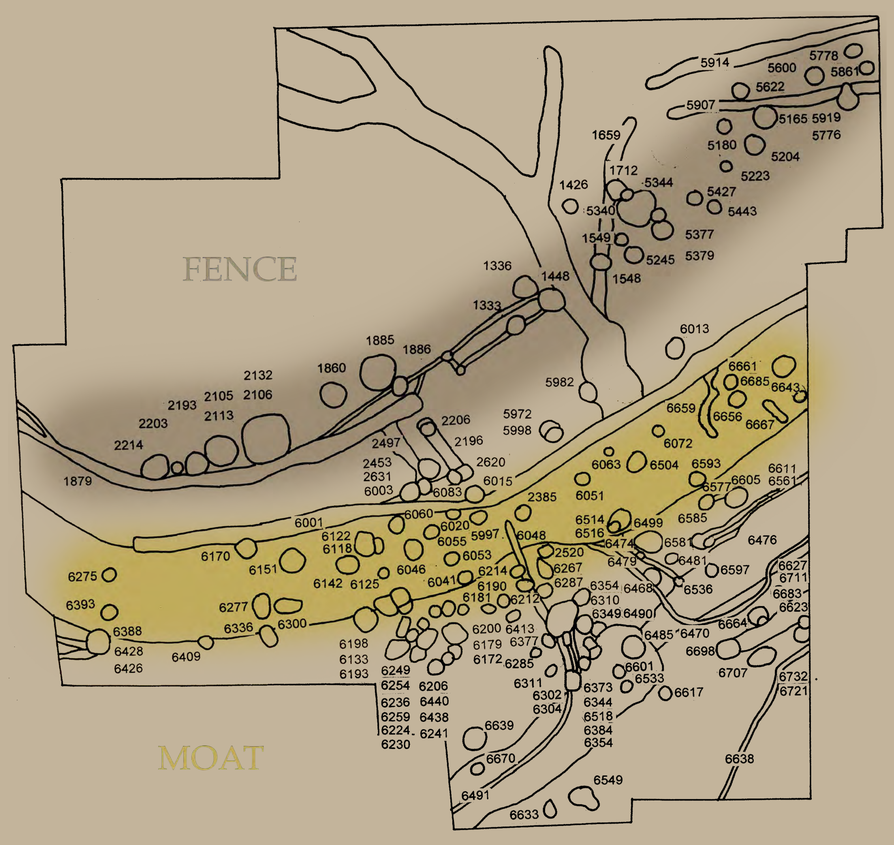
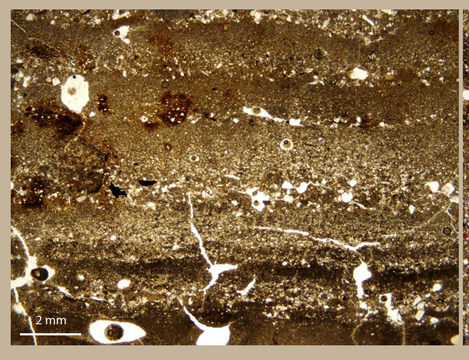
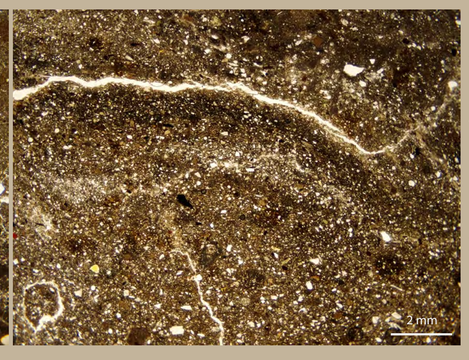
Soil micromorphology in thin section was applied to the study of processes in the water management of the "Terramara Santa Rosa" located in Fodico di Poviglio (N Italy). In this site belonging to the Terramare culture have come to light numerous structures and wells intended to draw and distribute water between the late Middle Bronze age (ca. 1300 BC) and the late Recent Bronze age (ca. 1150 BC). Their number, size and complexity show precise planning, a considerable investment of time and work to achieve them and a particular attention to the exploitation of water resources. Well structures could be divided into two main areas on the site: those opened around the elevated fence, near the village, and those on the dry bed of the old moat below, in a more external location.



From the microscopical analysis of the well infillings it was possible to recognise multiple life phases of the hydraulic structures on the site, from their use to a progressive abandonment. The differences between areas can be related to changes in water management in time. The moat well system in particular seems related to a later period during which arid conditions forced the settlement to rapid adaptations to maintain water availability.

FENCE

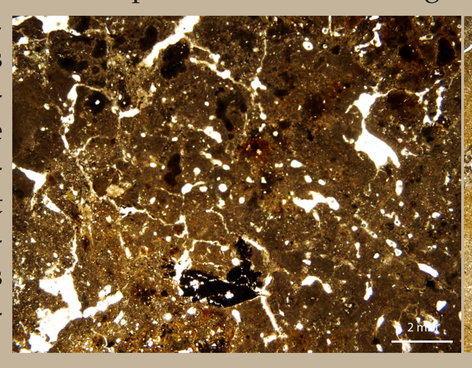




The stratigraphic units of the well infillings show a blocky or massive silty clayey microstructure with Fe-Mn nodules and mottles. Calcite coatings and impregnations are few, as well as gastropods shell fragments and charcoals.

Units at the bottom show well developed laminations of coarse and fine material, well sorted and often directly graded. These are usually planar, but sometimes are found broken or showing convolutions. Scarce soil fragments are also present in the groundmass.

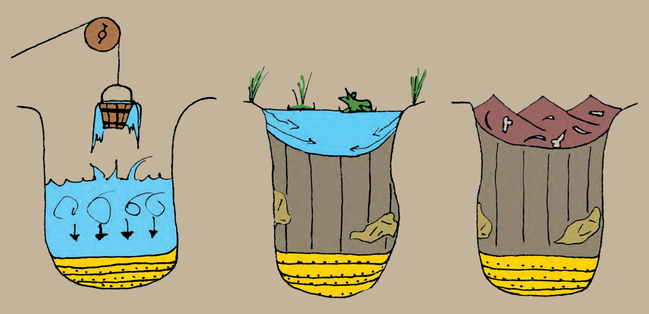
In the units above them the deposits are more homogeneous and chaotic forming a massive microstructure, with no laminations besides sporadic discontinue coarse lenses. Soil fragments are frequent and signs of bioturbation can appear as well as groups of vesicles.



The *"laminated"* facies at the bottom is compatible with the use phase of the wells, when continuous extraction of water kept enough movement in the system to cause turbidity and consequently gradation in the deposition of coarse and fine particles, which provenience is probably from the eroded sides of the well itself. Broken laminations inside these units can be identified as events of periodical maintenance and cleaning practices of the bottom of the wells.

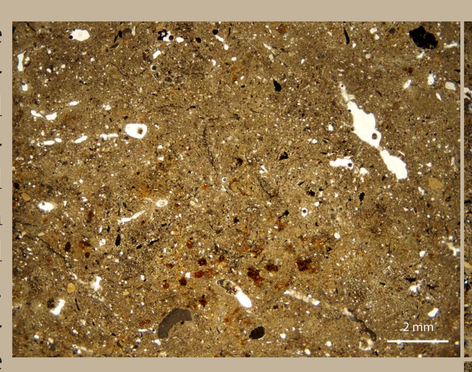
The formation process for the upper *"decantation"* facies is related instead to the abandonment phase, when conditions of stagnant water in wells no longer used favoured the deposition of less sorted material from the surroundings, with the occasional side collapse producing coarse lenses. The filling process was relatively fast, considering the scarcity of organic remains and staining in the groundmass, frequent enough though to produce vesicles from the development of gas trapped in the waterlogged sediment matrix.

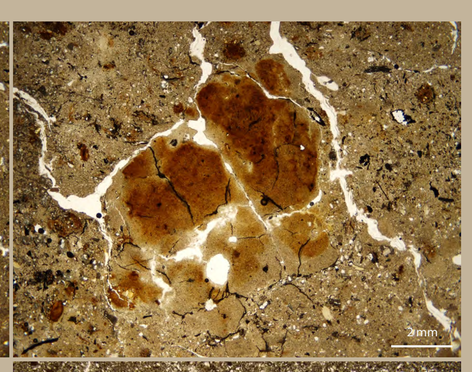
Wells in this area were probably abandoned while still functional, and then rapidly filled by debris and covered by the overlaying anthropogenic deposits.

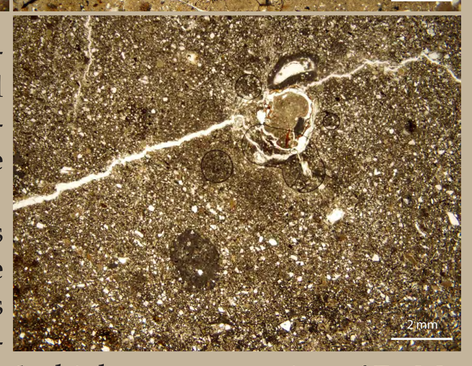


MOAT

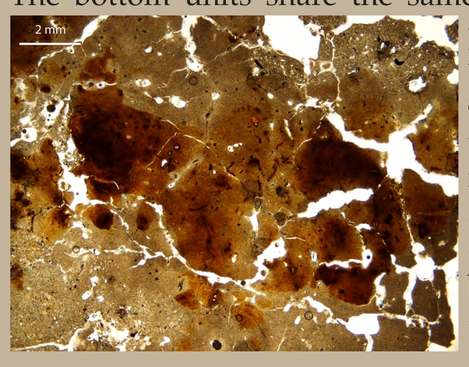
In the moat area the matrix and microstructure of the well infillings are noticeably more clayey and poorly sorted, with fewer coarse material and higher porosity. Coatings are frequent, both as calcite features and as fabric (clay or coarse), more concentrtated in the upper units. Mottling is always present, and other Fe-Mn pedofeatures are found in every stratigraphic unit. Organic matter is scarce and often in the form of organic staining.







The bottom units share the same laminated features present in the fence wells, but with less expressed laminations often broken and a higher concentration of Fe-Mn mottles. Above them the matrix becomes more blocky and angular, with concentrations of soil fragments and calcite features, as well as finer clay coatings. Sorting becomes poorer and the aggregates show traces of staining and weathering at their borders.



In these wells the *"laminated"* facies is still found, though the signs of disturbance and the less expressed aspect of the laminations found in the micromass suggest different conditions, possibly a shorter use of these structures. In this phase, processes were essentially similar to those happening in the wells on the fence above.

The upper part of the infilling is instead occupied by a *"clayey"* facies: features such as the high frequency of intact soil fragments, showing sometimes laminations, the angular microstructure and the scarcity of organic matter suggest that deposition happened in dry conditions inside already exhausted wells. Whole fragments from the soil around wound have been traslocated intact inside the well structures and then subject to post-depositional processes.

A direct human intervention could be suggested in the filling process, as the result of dumping material from the digging of new wells, This kind of infilling and the quantity of well structures found in the area can in fact be explained by the effort of following a rapidly lowering water table.

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