Phosphorus-mappings in Protohistoric and Roman settlements, sacred and funerary sites in Belgium and Northern France. Methods and combinations for the future

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Throughout the past decade, different members of the research team ROOTS have conducted pedological research on archaeological excavations and collaborated with other specialists. One of the applied research methods is the use of phosphorus mapping, where a lateral grid is laid out over the excavation and samples analysed accordingly. The present contribution aims at introducing the protocol and to outline its potential contribution of phosphorus-mapping to future Roman sites that are uneroded and not affected by any high water table. It especially contributes to fundamental archaeological questions related to the interpretation of the mapped structures, but also to the relationship with the broader environment, both on and beyond the concerned sites.

The detailed phosphorus mappings have been conducted on a number of sites with different settings. In summary following variables have been included:
1) different occupation levels, such as settlements with several houses, individual houses, sacred and funerary sites, 2) several archaeological periods, 3) on different textures of soil parent material, 4) with variable pH environments, from acid to calcareous soils, and in non to strongly leaching soil climates.

The studied examples are the following:
- A Roman ditched village on decalcified loess with levels of phosphorous contamination that vary inside a longhouse, between the different large pits and inside the living surface of the village (Saint-Brice-sous-Forêt, Val d'Oise, France, archaeol : Vanessa Rouppert, Jean-Yves Dufour). A stable, a pit for collecting dung and an area related to cattle are reconstructed in this enclosure, contrasting with other areas, including a gardening area.
- A Roman cemetery surrounded by walls (Antoing, Hainaut, Belgium, archaeol.: Anne-Cécile Ghigny) : the correlation with P-mapping is less evident except for minor spots correlated with the corners of the cemetery enclosure. There might be funerary areas related to bones (cremation ?) and an empty area related to the former presence of a platform or a tumulus.
- A late Iron Age and Roman ditched village is installed on a dry valley floor, characterised by gravel, marl and limestone, with local preservation of the humiferous palaeo-surface (Champfleury, Marne, France, archaeol: Hervé Boquillon). These lateral changes explain that only the map of *inorganic* P was well correlated with archaeological limits of the enclosure, confirming the dating of this pollution. Inside the

enclosure, the individual buildings show significantly higher or lower total P-levels, allowing to propose particular uses.

- The Late Iron Age sanctuary of Ribemont-sur-Ancre, Somme, France, archaeol: Gerard Fercoq de Leslay, Jean-Louis Brunaux), on decarbonated loess, has preserved the humiferous surface horizon under the upfills of the Roman sanctuary. In this surface, P mapping shows a correlation of high total P with high calcium contents. The mapping of all the pedological, malacological and palynological indicators allowed to map specific activity sectors of the sanctuary, including former Iron Age bone deposits and the supposed former Iron Age and Roman "sacred forest".

Two earlier sites are presented for their methodological interest:

- A well preserved middle Neolithic long house on marl and limestone becomes more easy to interpret thanks to comparison of P results with magnetic susceptibility and data treatment (Dampierre-le-Château, Marne, France, archaeol : Fred Dugois). As in Saint-Brice-sous-Forêt, a stable is reconstructed for one extremity of the house. A statistical data treatment was successfully applied here, as in other Neolithic houses.

- One of many examples of potential sites for an application: a humiferous surface related to a Late Bronze Age housing area has been destroyed by the excavation before asking for an adequate sampling strategy (ideal for P, parasites, phytoliths). Only a limited part of the surface was still accessible to a study. Here, it was possible to materialise the shape and the orientation of the houses, in combination with a map provided by electric resistivity (Thillois, Marne, France, in a dry valley on decarbonated loess).
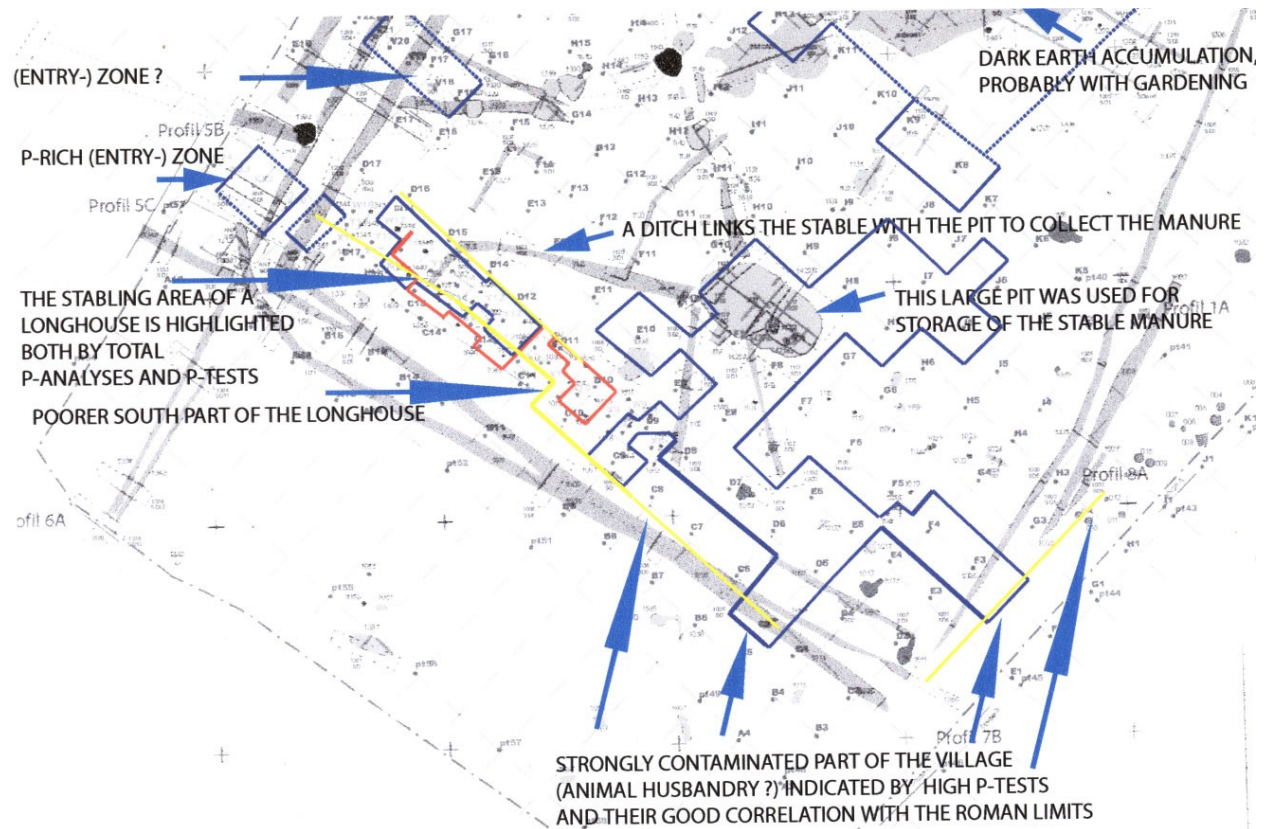
As a conclusion, good results are obtained on different types of soils, including acid and calcareous sands (respectively Roman stable of Brecht, Antwerp, Belgium and Iron Age buildings and enclosures of Savigny-le-Temple, Yvelines, France). This wouldn't' have been possible without taking into account *15 pedological parameters* before starting any sampling and analytical steps. Different P-methods and laboratories have been tested, often on the same sample set, giving an interesting insight into the best combinations to be used in the future for this promising research topic.