

# 19<sup>th</sup> century excavations, research program, geophysical survey and archaeological investigation: converge, complete and reinterpret

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## Abstract

We used GPR to delineate a building excavated in the 19<sup>th</sup> century. Data from old excavations and geophysical surveys are incorporated in the methodology applied to developer-led archaeology in France. The case study exemplifies the benefits of a cross-disciplinary approach as to allow a better interpretation of archaeological data.

## Keywords

developer-led archaeology; ground penetrating radar; Roman baths; trial trenches; 19<sup>th</sup> century excavations

## Introduction

Under the current village of Vieux (Calvados, Normandy, France) lies buried the Gallo-Roman city *Aregenua*. The latter has been subject of considerable excavations since the sixteenth century. The last decades have been particularly rich in ancient discoveries thanks to the archaeological investigations carried out by the *Conseil Départemental du Calvados* with various research excavations including the *forum* of the city. These data were supplemented by those from developer-led archaeology (or rescue archaeology), thus gradually filling in some of the remaining gaps. Although the overall urban fabric is known, much of the site remains to be explored. To do this, the use of geophysical prospecting as a non-invasive tool appeared to be perfectly adapted to the type of research conducted in Vieux.

Thus, in 2017 a ground penetrating radar (GPR) survey was undertaken on a private plot of land where, in the 19<sup>th</sup> century, excavations had indicated the presence of a monumental building. At the time of the survey, no excavations or subsequent investigations were planned in this area. However, a development project (building extensions and trenches for utility pipes) was applied for in 2021 and hence an archaeological investigation was required.

## The 19<sup>th</sup> century excavations

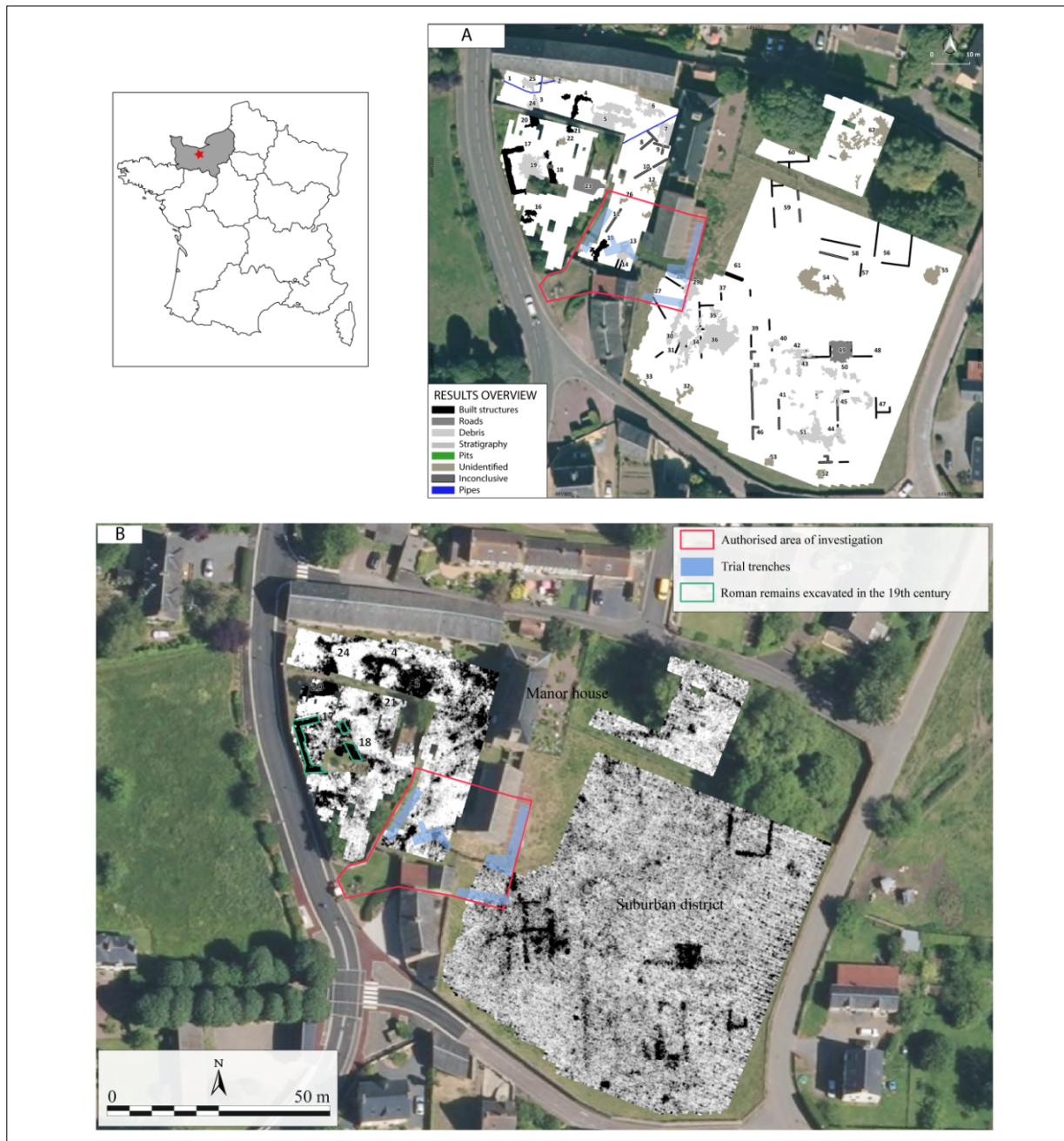
The “Manoir de la Pallu” is a building of the early seventeenth century located in the heart of the current village of Vieux. Several archaeological investigations have taken place within the grounds of the manor.

In 1841, excavations were carried out by the *Société des Antiquaires de Normandie* in the garden of the manor. Three walls were unearthed to form a building with dimensions of 12.66 m x 10.66 m x 5 m, with a preserved elevation of 2.66 m. The hypothesis favored was that of a bathhouse, similar to the one excavated in the seventeenth century (Gervais 1841). Other historians and archaeologists considered it to be the *forum* of the ancient city (Pilet 1983).

The discovery and excavation of the forum made this latter proposal obsolete and the building excavated in 1841 was hence still awaiting identification.

## Materials and methods

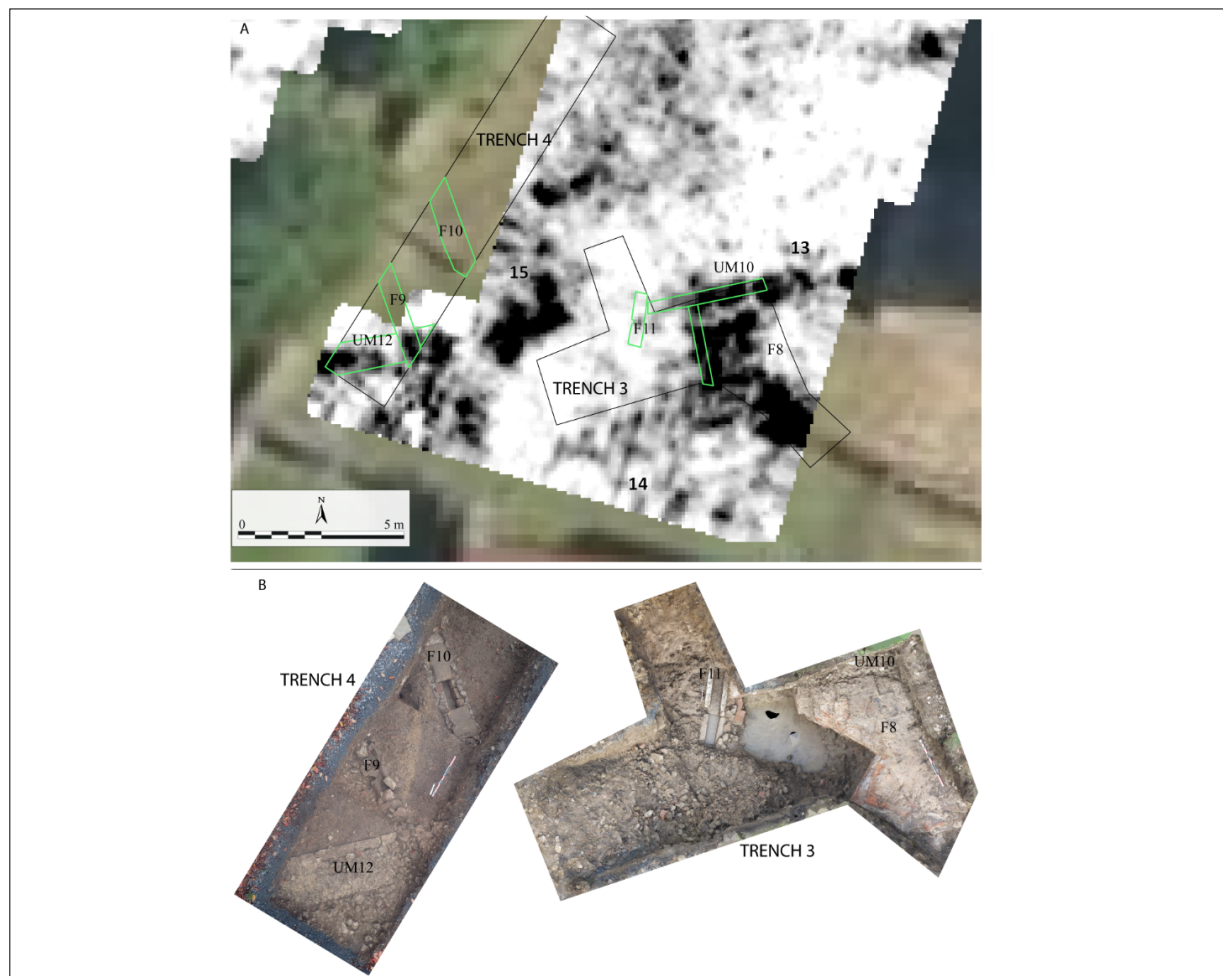
Three geophysical survey grids were placed in the site of the “Manoir de la Pallu” (GP-5.1, GP-5.2 and GP-5.3) with



**Fig. 1:** a) Overview of the results of the GPR survey (SOT Prospecció Arqueològica) (base map: ©IGN 2012 (CD14)), b) Slice 19 (depth between 1.05 m and 1.17 m) of the survey in the manor grounds (base map: ©IGN 2020 (CD14)).

a total area of 6116 m<sup>2</sup>. The GPR survey was carried out with an IDS custom system based in the Fast-Wave GPR module, using a stack of 5, 600 MHz independent antennae. The data had a spatial resolution of 0.02 m x 0.20 m (parallel profiles of 0.20 m separation and readings every 0.02 m) over the entire extension explored. Following their acquisition, the data were filtered and then integrated into a three-dimen-

sional block using the “GPR-Slice” software. This block allowed the creation of a sequence of 24 depth slices of reflectivity of 0.12 m thickness for depths between 0 and 1.46 m. The depth estimations were based on a reference velocity of 0.1m/ns. This appeared to be too optimistic considering the archaeological results.



**Fig. 2:** Detail of the results in the southern part of the manor’s courtyard, trenches 3 and 4. a) Slice 15 (depth between 0.82 m and 0.95 m) of the survey superimposed with the outlines of the excavated structures (base map: ©IGN 2020 (CD14)). b) Digital orthophotographies (© Pierre Rohée) of the excavated trenches 3 and 4.

## Results

### The geophysical survey

The data collected show a rectangular building whose dimensions are very close to those given by the antiquarians: 0.25 cm below the current level and at a minimum depth of 1.50 m. Another anomaly (group 20-24 – Fig. 1) emerges north of this building. This anomaly has a reflectivity similar to that of the monumental building and seems to follow the same orientation. It is not difficult to imagine that it belongs to the same complex or, at least, that they are contemporary. A third built structure (group 4-5-21 – Fig. 1), has a different orientation from the groups already described but aligns with the buildings of the “Manoir de la Pallu”. It is thus suggested that these elements are contemporary with the latter. The field to the east of the manor also shows

many radar responses that delineated remains following the ancient urban fabric, hence suggesting a peripheral or suburban district of the ancient capital.

In the courtyard of the manor, below the garden, several diffuse anomalies are indicated without forming a coherent whole (Fig. 1 group 13-14, anomalies 15, 11, 26).

### Trial trenching in 2021

The objective of archaeological trial trenches is to excavate shallow trenches in order to assess the archaeological potential and prepare a possible full excavation. In the case of the manor, the antiquarians’ data and the geophysical survey made it possible to estimate the density of the remains. The trenches were thus positioned according to these data and with regard to the planned construction, part of which was unfortunately outside the already sur-

veyed area. Four trenches revealed many built remains as well as a graveled surface (road or courtyard).

## Discussion: data comparison

The only excavated structures that appear clearly in the GPR data are the wall UM10 and the platform F8 in trench 3 (anomaly 13, seen between 0.82 m and 1.50 m deep on the GPR data – Fig. 2). These anomalies are clear and contrasting, with outlines and orientation identical to the portions of structures unearthed. On the other hand, the depths of appearance of these built elements do not correspond with the depths of the geophysical slices. The platform F8 and the wall UM10 were found directly under the topsoil layer, about 0.55 m thick, while they appear around 0.80 m deep in the radar data, showing an overestimation of the velocity of GPR pulses. On the other hand, its thickness of at least 1 m indicated by the survey was confirmed.

This trench also made it possible to observe the interruption of UM 10 on its western limit, forming an opening. Slice 15 indicates a void at this location over a length of 3.4 m, overlooking a new anomaly (anomaly 15 – Fig. 2) which draws an angle whose southern wall shares the same axis as UM10. This anomaly could therefore be the continuity of UM12 observed in trench 4. This void corresponds to the passage of the F11 aqueduct (- 1.20 m) whose continuity is observed beyond trench 3 (group 14 – Fig. 2), confirming its extension to the south.

The wall UM12 does not appear clearly in the geophysical data although it lies only 0.15 m below the current ground level. Indeed, its signal is quite diffuse and its outline can only be guessed thanks to its excavation, unlike group 15. South of the latter, the low reflectivity could indicate occupation/abandonment surfaces related to UM12.


Some built structures identified in the geophysical survey were not excavated in the trenches, anomalies 27 and 30 in particular (Fig. 1). On the other hand, the aqueduct F10 does not appear in the GPR data while having been uncovered in trench 4 (Fig. 2).

## Conclusion

The comparison of excavation and geophysical data makes it possible to affirm the presence of an important complex (UM10, F8, F11, UM12 and groups 15 and diffuse signal south of UM12), which is extending southwards. This com-

plex lies in the same orientation as the building excavated in 1841, indicating that they may be contemporary. The remains found during the investigation - several aqueducts, a platform built in waterproof Roman cement (a possible bath chamber) - , compared with the data from the 19th century excavation indicate that this is a large thermal building (1450 m<sup>2</sup>), which quite certainly includes groups 17-18-19, 15-14-13 and 20-24-25 of the radar data.

In the technical side of the GPR survey, the case shows two interesting issues to be noted: the estimation of GPR velocity in urban and sub-urban environments could be difficult, as soils are too variable in composition and therefore susceptible to important imprecisions when using a general estimation.

A second issue is the lack of shallow structures or horizontal features in the time-slice sequences. This shows the importance of time-slice parameters and metrics (previous data-processing, lapse of time/depth, magnitude, real data resolution). The interesting case of wall UM12, despite laying only at 0.15 m depth, was not clearly defined in the time-slices sequence used on the report. It would be probably visible using slightly different parameters in the time-slice creation. 

## References

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