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# A Combined Approach Using GPR and Trial Trenches in Cherbourg for Archaeological Evaluation

Laurent PAEZ-REZENDE<sup>a</sup> and Guillaume HULIN<sup>b</sup>

## Highlights:

- *Urban archaeology in Cherbourg (France).*
- *Ground-Penetrating Radar for urban archaeology.*
- *Comparison of GPR and trial trenching for archaeological evaluation.*

**Keywords:** archaeological feedback, GPR, preventive archaeology, trial trenching, urban archaeology.

A development project on the Notre-Dame car park in Cherbourg-en-Cotentin led to an archaeological evaluation (Fig. 1). This area was regularly investigated between 1976 and 1995, and revealed the ducal castle, described by Vauban in 1686, which was destroyed in 1689 and a former parish church and its cemetery. Roman features (from the 1<sup>st</sup> to the 5<sup>th</sup> century) linked to the settlement of Corialo, mentioned on the Peutinger Table, were also observed.

With a 4 meter stratigraphy and disturbances due to the urban environment, an appropriate strategy of investigation had to be implemented for the study of this 5000 m<sup>2</sup> area. Firstly, A GPR survey was performed with a GSSI 350MHz Hyperstacking combined with a robotic total station for a real time positioning. The sample interval was 1 cm in-line with a 50 cm line spacing. The processing was carried out with GPRslice with a standard sequence *i.e.* time zero calibration, AGC, bandpass and background filters and Kirchoff migration (Fig. 2). Secondly, trial trenches were implemented according to the geophysical results to provide both spatial and stratigraphic information. In such a context, GPR data is a valuable tool, as a complement to trenches and their limitations (size, utility network, traffic...). The back and forth between geophysical data and archaeological observations from trial trenches on GIS allows to upgrade

both approaches and provides an exhaustive view of the archaeological context. For the archaeologist, this has made it possible to extend the archaeological observations and, for the geophysicist, it has made it possible to better estimate the ground velocity for the GPR data which is always a difficult exercise.

As expected, the five trial trenches give information on the remains and the stratigraphy of the castrum, the castle, the church and the cemetery, in an almost continuous chronology from the beginning of the 1st century up to the present day. The remains appear at a depth of 20 to 50 cm, just under the asphalt of the car park.

For the Antiquity, the occupation between the 1<sup>st</sup> and 3<sup>rd</sup> century is more consistent and developed than in the earlier excavations, with a 1.4 m archaeological sequence with artefacts, post holes and walls. Large walls corresponding to the castrum, and also to a probable fortress (plan completed with the GPR) were partially taken over by the medieval castle (Fig. 3 top).

Several remains of the ducal castle were observed in trenches, in particular two almost completely destroyed towers. Some parts of the southern rampart and remains of pebble and schist floorings were also revealed. The larger tower, about 15 m in diameter, is clearly visible on the radar

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Figure 1. Location of trial trenches on the Notre-Dame car park – Cherbourg (drone photography: O. Morin).

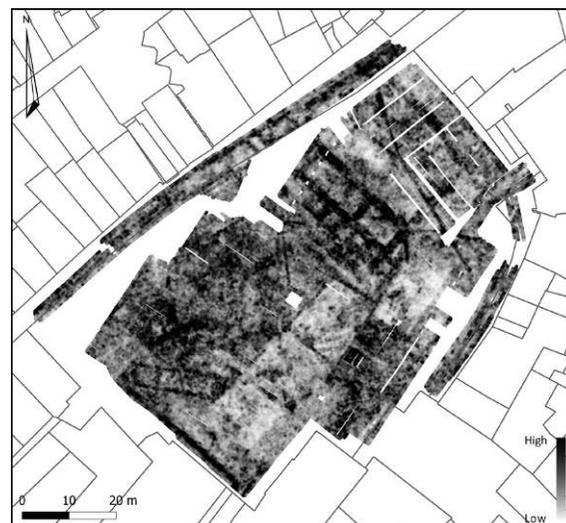
data in the middle of the car park and does not correspond to any of the towers on the known plans and engravings of the donjon from the 17<sup>th</sup> century. It could correspond to an older tower.

Human settlement resumed around the end of the 7<sup>th</sup> century with the first burials in the necropolis. It became a parish cemetery surrounding the church of Notre-Dame from the 9<sup>th</sup>-10<sup>th</sup> centuries. Despite the abandonment of the cemetery in the 11<sup>th</sup> century, a few burials were still done in the church until the 16<sup>th</sup> century. This building was not directly studied with the trial trenches, but its cross-shaped plan was clearly recognised through the GPR map (in the south of the area; Fig. 2 – depth slice: 160-180 cm), as well as numerous anomalies which may correspond to burials in coffins covered with slabs of schist which were observed in a trench (Fig. 3 bottom).

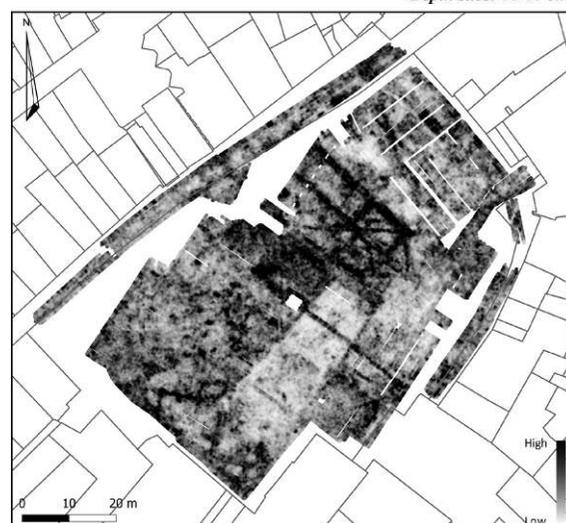
After the destruction of the castle in 1689, the land was progressively reinvested by dwellings and became a part of the city served by lanes and passages typical of the old Cherbourg before the demolition during the 1970s.

The GPR survey and the preventive trial trenches allowed us to document the remains in the Notre-Dame car park area. The extent of the remains and the archaeological levels studied since 1976 has been largely confirmed, as well as the quantity, the variety and the excellent state of conservation of the material (ceramics, fauna, instrumentum, coins, etc.) associated with the different occupation phases of the site.

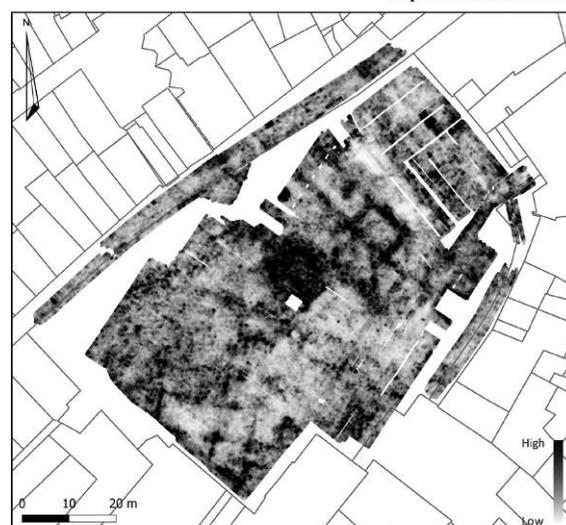
Although the GPR method is ideal here, it is still subject to numerous limitations that can only be overcome by trial trenches. For example, some archaeological features are clearly not visible on the geophysical map, especially burials made without slabs of schist. The excavations showed this kind of burial corresponds to the majority of features pre-



Depth slice: 60-80 cm



Depth slice: 100-120 cm



Depth slice: 160-180 cm

Figure 2. GPR results on the Notre-Dame car park – Cherbourg.

sent in the burial ground. The implementation of such an approach is still rather expensive for this phase of the preventive archaeology process. This approach must therefore

be used in a well- reasoned manner, as a complement to test trenches and only in specific cases where favorable prior knowledge exists about archaeological and soil context.

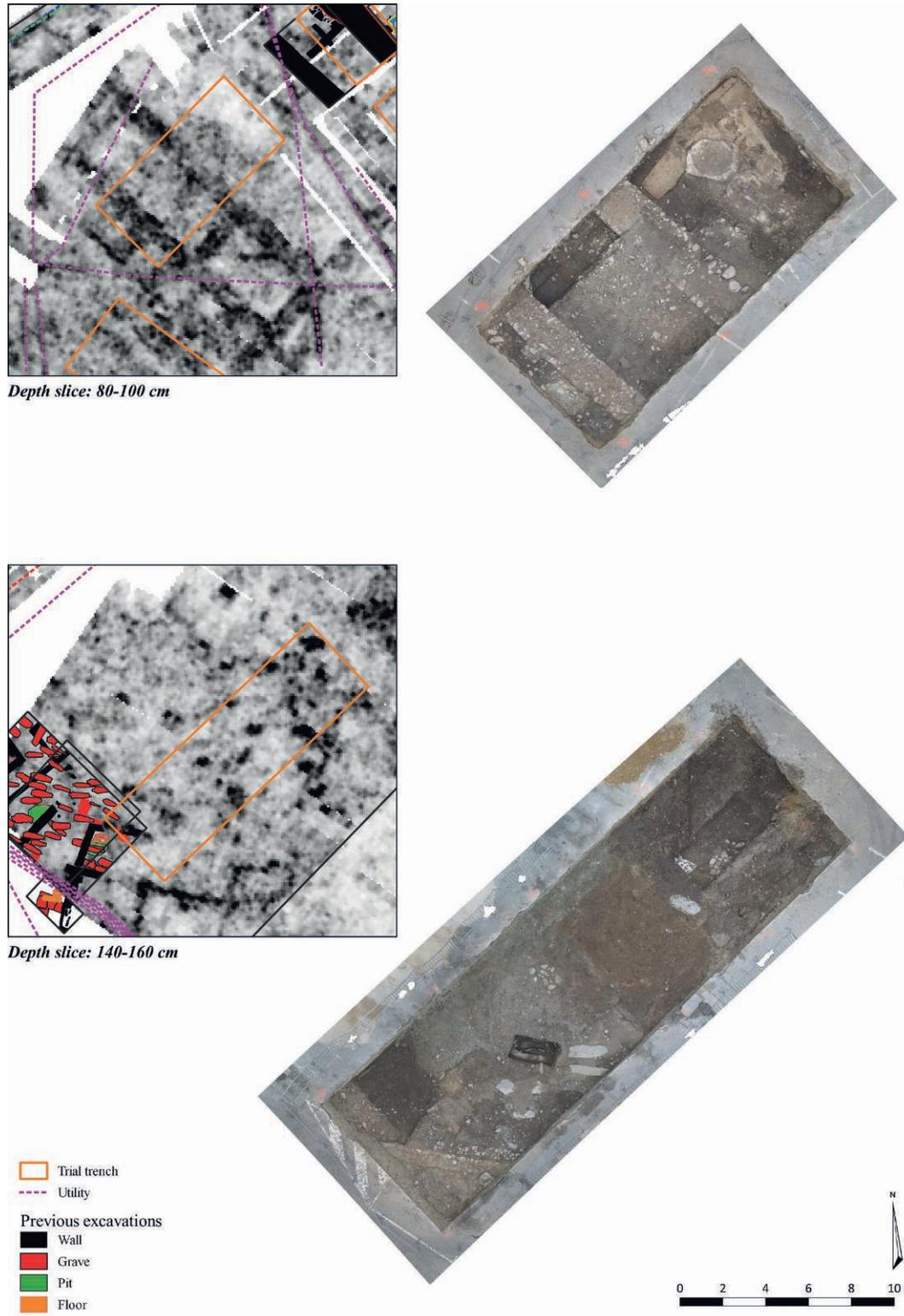


Figure 3. Comparison of GPR and trial trenching (drone photography: O. Morin).