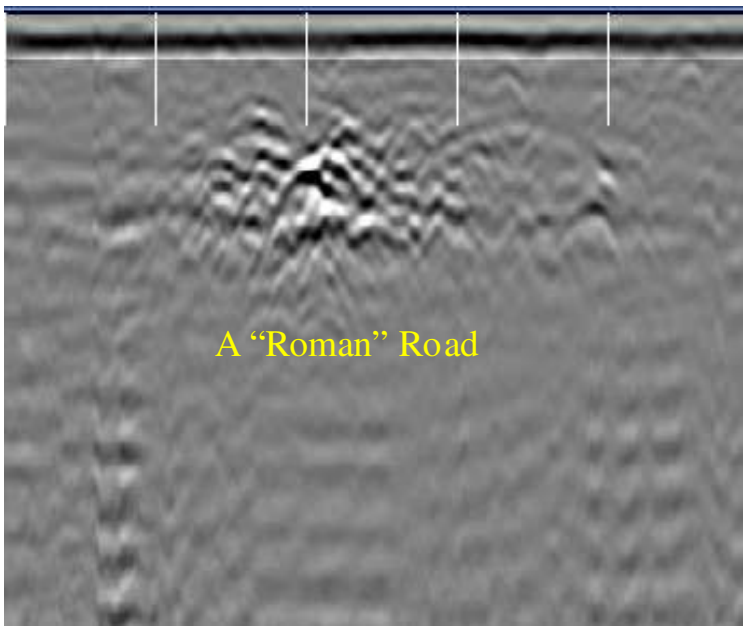
Report on Geophysical Survey Conducted at Chepstow

August 12-14, 2003



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Project Summary

A ground penetrating radar (GPR) survey was conducted as part of the archaeological investigations at Chepstow during August 2004. The GPR survey focused on 1 main objectives: To map and identify a Roman road.

Methodology

GPR Background

The SIR3000 ground penetrating radar unit with a 400 MHz antenna with a survey wheel was used at Chepstow. 70 scans were collected per meter along 0.5 m spaced transects. Post processing software used for data analysis and interpretation is RADAN 5.0.0.6.

Figure 1 SIR3000 GPR with 400 MHz antenna and survey wheel.

GPR maps the form of contrasting electrical properties (dielectric permitivity and conductivity) of a soil or other materials below the ground surface. The stronger the difference between the electrical properties of two materials, the stronger the reflected signal in the GPR profile. The conductivity of soils and buried features has the primary control on the attenuation, or loss, of the GPR signal that impacts the effectiveness of GPR survey. Though a highly conductive material will attenuate the GPR signal, it can also be an effective mapping tool contributing information to the nature of the subsurface and features within it. (Daniels 1996, Conyers and Goodman 1997)

GPR records information on the amplitude, phase and time related to the capture and induction properties of the antenna in addition to the energy propagation, scattering and reflection off of subsurface features. Unlike resistance or other archaeological-based geophysical methods, GPR data are collected as 2D vertical profiles into the earth. The 2D profiles are made up of a number of traces (or scans) at a particular location (x, y) that record the response of sub-surface properties to the radar's electromagnetic wave at discrete points at a particular time (or depth) in the earth. The horizontal axis represents surface distance along the transect with the vertical axis recording time (often referred to as two-way travel time.) The time is recorded in nanoseconds (ns). Time can be easily converted to depth in two ways: the first is by having a known dielectric permitivity value for the material in the survey area, the second through having a known depth to a feature that appears in the radar profile. The more accurate of these two methods is the latter but this requires digging or

coring. It must be kept in mind that earth properties are not constant and can change drastically over an area. Depth conversion should be checked at intervals across a site if possible.

GPR data are collected along a grid as vertical slices into the ground. Grid lines (transects) are collected in parallel lines typically spaced 0.5 to 1m apart. Due to the form of the beam of radar wave propagation into the earth, survey transects are most effective if oriented perpendicular to known archaeology.

Initial data review is conducted on these vertical profiles. Anomalies can be identified in individual profiles and are best defined and interpreted through time slicing.

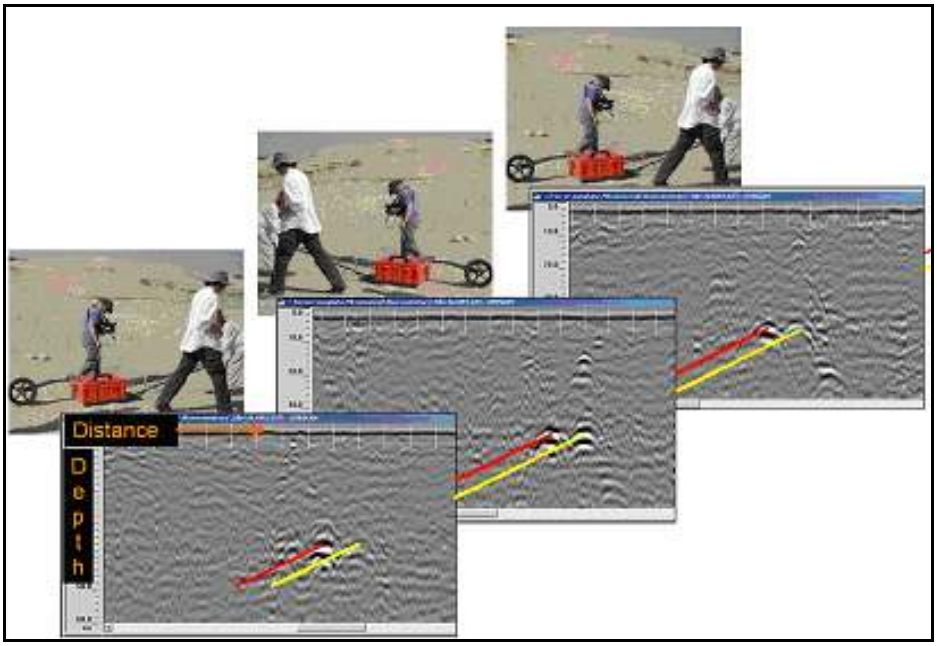

Figure 2 GPR data are collected as vertical profiles into the earth. Vertical profiles can be stacked together to create a 3D cube of information for use in data imaging and analysis.

Time slicing is when the vertical slices are stacked next to each other and interpolated to form a cube of data. This cube is then sliced on the horizontal plane to create plan views of the area. As GPR data records the nature of the subsurface to a certain depth, a number of time slices can be created that depict the nature of the subsurface at given depths. Further assistance in feature mapping can be achieved in displaying all three axes of the GPR cube x, y, and z. This helps define feature shape and volume.

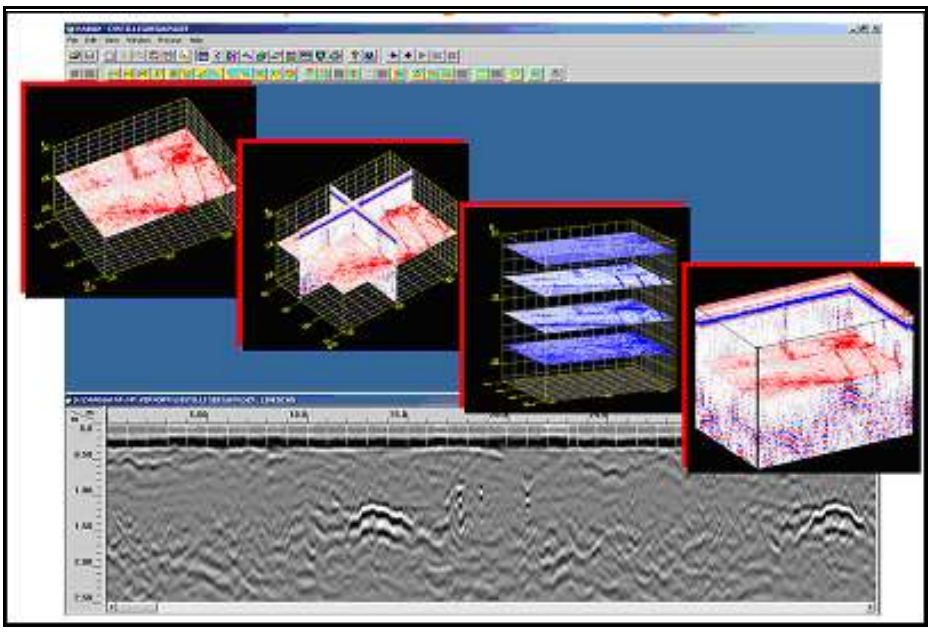

Figure 3 GPR data can be displayed as 2D vertical profiles (greyscale at the bottom of the figure), or sliced along the x, y, and z axes.

It must be stated that the depth to this point is assumed based on the input dielectric value for the area soils. Excavating down to a noticeable anomaly in a GPR profile then a measurement to that surface can be taken can do a depth calibration. A simple equation or software can quickly convert all data for appropriate depth.

GPR Survey Results

GPR survey was conducted from the fence by the river's edge into the field directly behind it. A survey of approximately 35 x 40 m followed the field boundaries in attempt to find traces of a possible Roman road. With the hypothesis that the wooden feature in the river was a bridge footing, evidence of a road would provide confirmation of the possible nature of the feature.

Survey began at the bottom of the field next to the fence. Profiles were collected in a zig-zag manner with 1 m transect spacing. The 4th transect collected mapped what appeared to be a very strong 2-3 m long anomaly approximately 0.5 m from the ground surface. Initial interpretation defined this as a possible road.

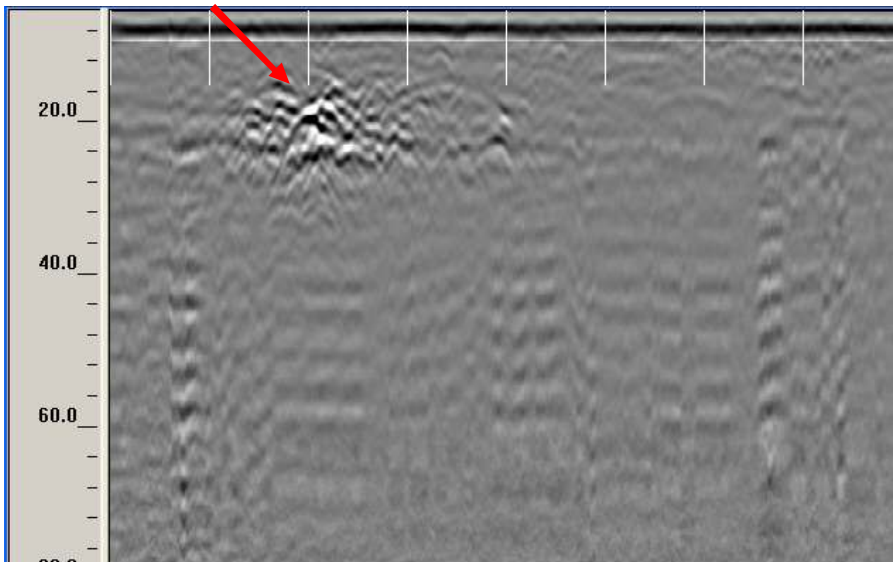

Figure 4 Probable Roman road feature.

This feature could be traced for approximately 20 m into the field where it appeared to possibly break into two different directions. Subsequent excavation identified this as a corbled road surface, though any evidence for dating was absent from the excavation finds, wood samples from the feature in the riverbed suggests this surface may date to the Roman period.

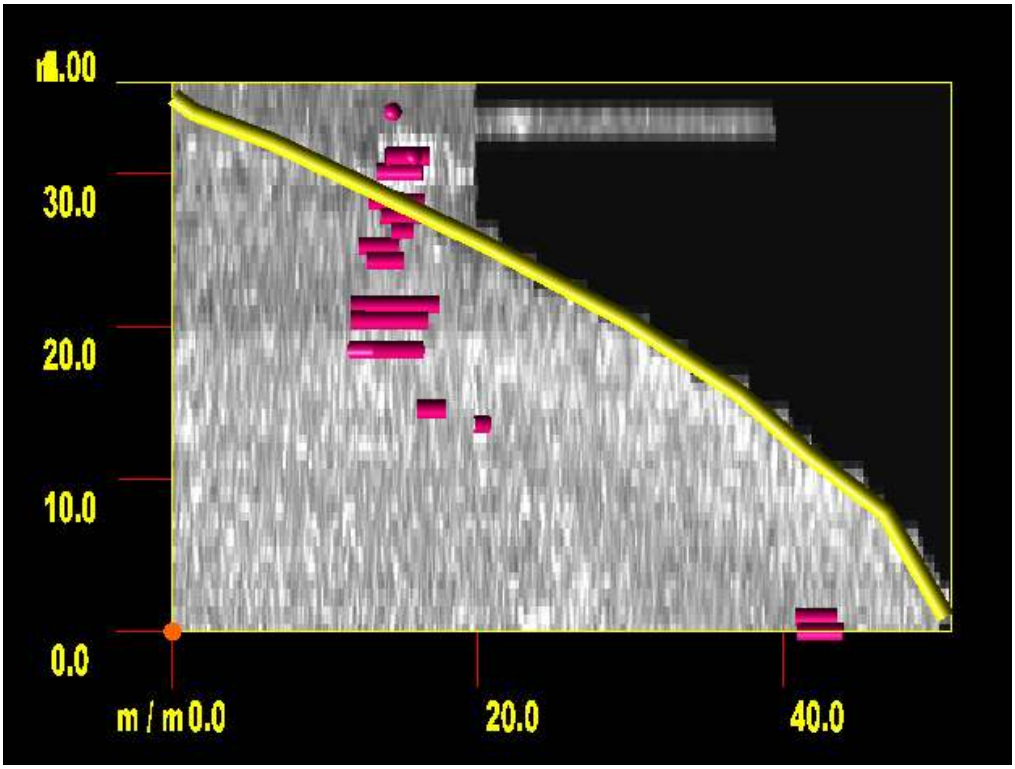

Figure 5 Time slice view of GPR survey results at Chepstow. Red lines represent possible Roman road surface. The yellow line defines field ploughing traces.

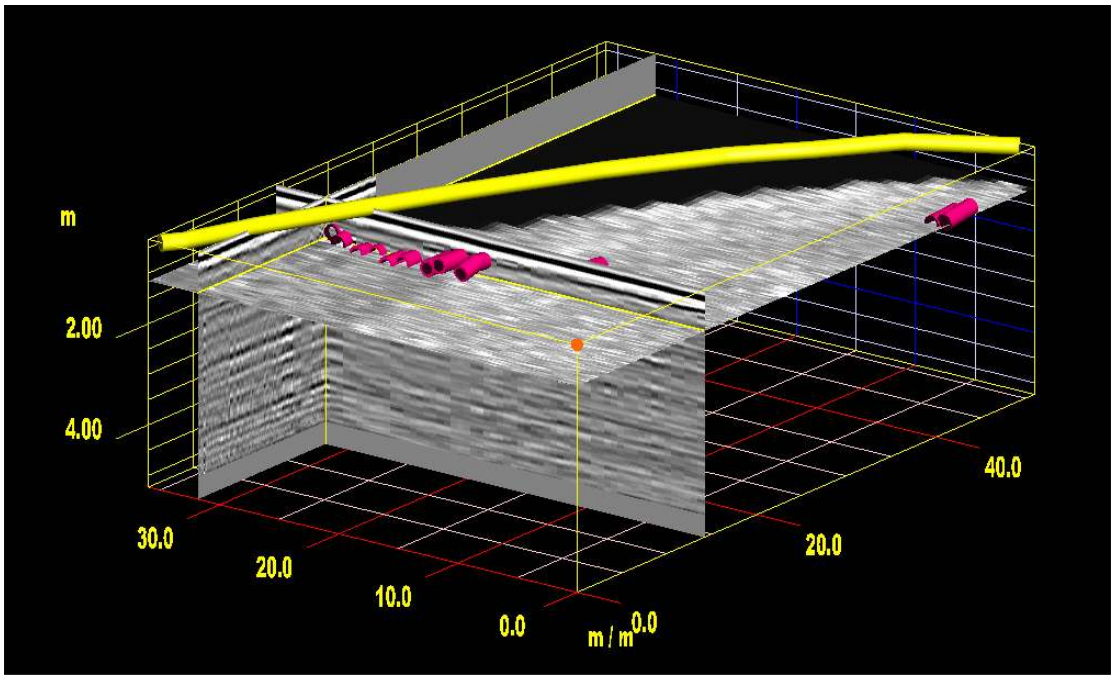

Figure 6 GPR data cube with fence diagram displays the 3D aspect of GPR data interpretation. The red road surface appears to have a changing depth relative to the ground surface. This may be the result of past and current land use.

Conclusions

GPR survey quickly and successfully identified the desired target, a road surface. The date of the road surface can only be determined through archaeological evidence.

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