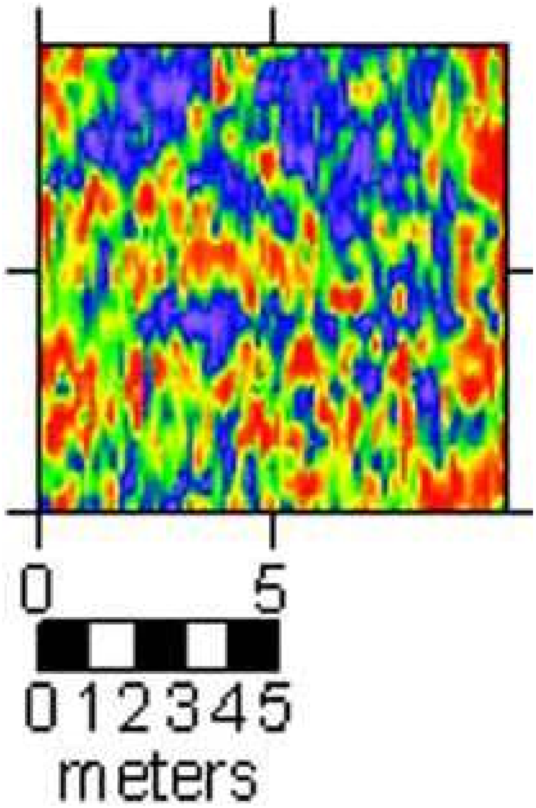
Report on Geophysical Survey Conducted at Tintagel

September 23-25, 2003



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Project Summary

Methodology

Resistance Survey

Resistance survey measures the change in the resistance of the earth. The "Twin Probe" array is used in this case where a current and potential probe are paired on a roving frame that measures the variation in resistance across a grid. A second pair of current and potential probes is fixed at a certain distance from the area being surveyed. With a fixed separation distance of 0.5 m, the roving probes map an effective volume of resistance to a depth of approximately 0.75 m, measured in Ohms.

Resistance effectively looks at the saturation level of the materials in the survey area, thus is sensitive to soil compaction, soil type, geological features and objects that may be buried with in the soil. Resistance survey can map features that include pits, trenches, foundations, compacted or disturbed surfaces, and changes in soil type. (Clark 1996)

Figure 1 RM15 resistance meter with 0.5 m spaced probes.

GPR Survey

The SIR3000 ground penetrating radar unit with a 400 MHz antenna with a survey wheel was used for survey at Tintagel. 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 2 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.

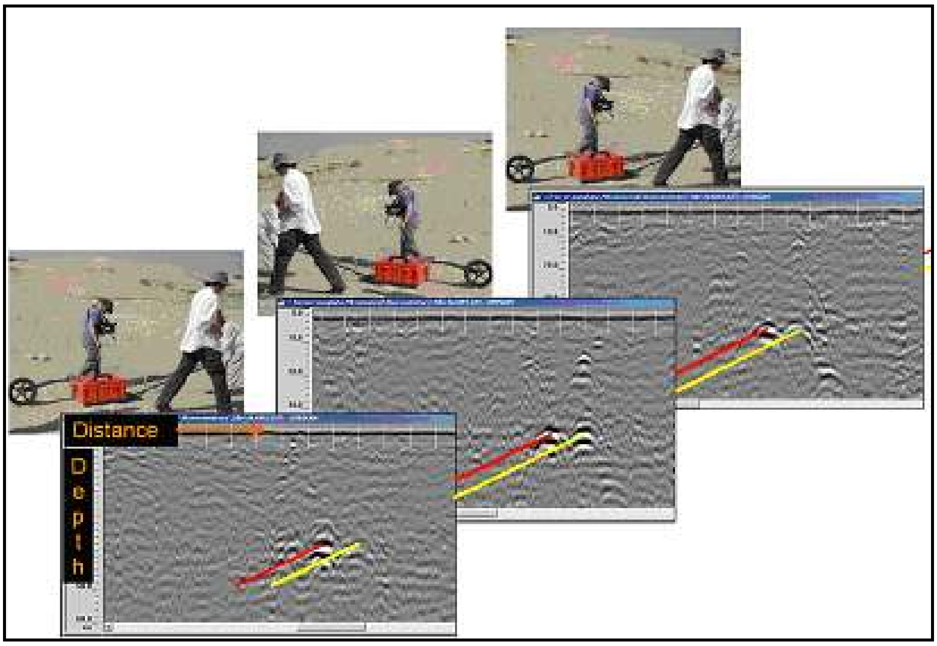

Figure 3 GPR data are collected as vertical profiles into the earth. Vertical profiles can be stacked together to create a 3D cube of information for use in data imaging and analysis.

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.

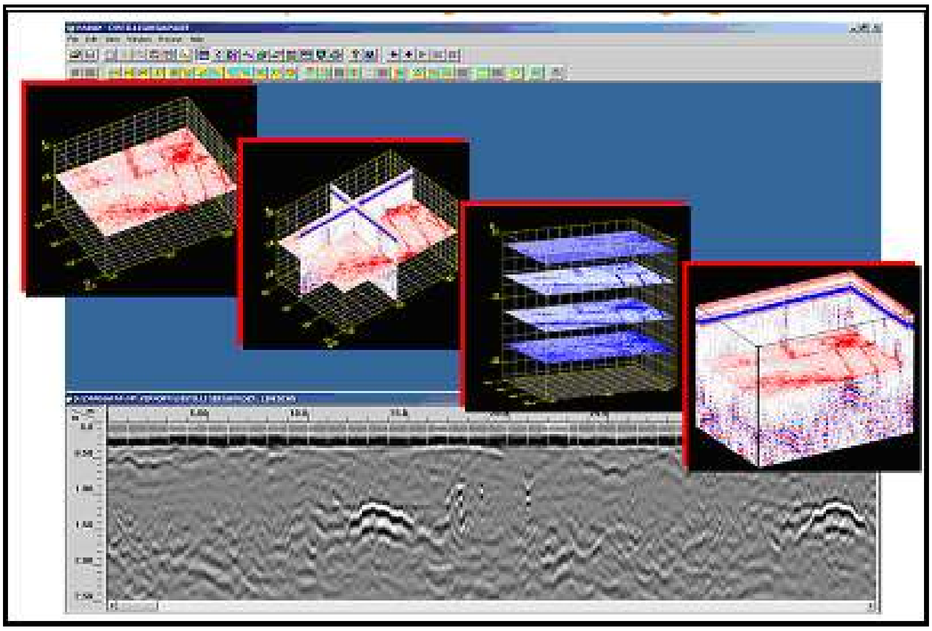

Figure 4 GPR data can be displayed as 2D vertical profiles (greyscale at the bottom of the figure), or sliced along the x, y, and z axes.

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.

Geophysical Survey Results

Resistance Survey

A RM 15 resistance meter was used with twin probe separation of 0.5 m. Data were collected with a sampling interval of 0.5m along 1m spaced transects. Post processing software for data analysis and interpretation included: Geoplot 3.0 and Surfer 8.

The resistance survey did not reveal any significant archaeological anomalies. A few anomalies were identified for further investigation as they were the closest to possible archaeological nature in pattern .

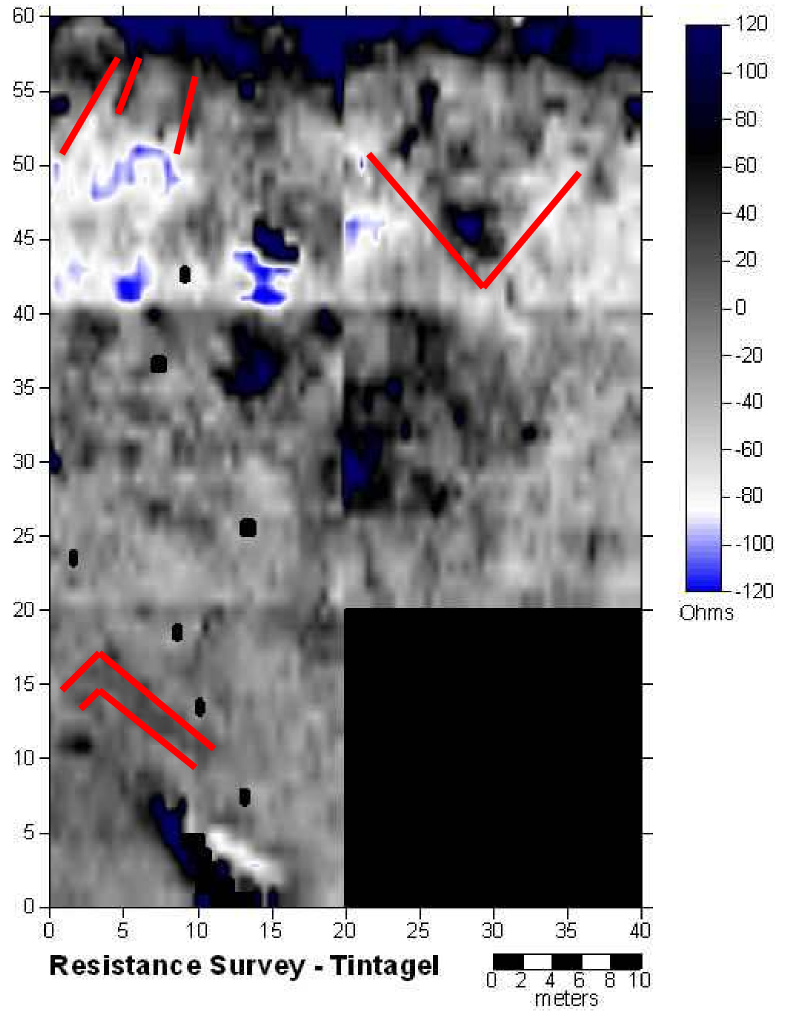

Figure 5 Resistance survey results at Tintagel. Red lines define features marked for further investigation.

GPR Survey

GPR survey was conducted over the targets of interest identified in the upper left corner of the survey area. The grid was 10 x 10 m and GPR transects were collected along 0.5 m transects.

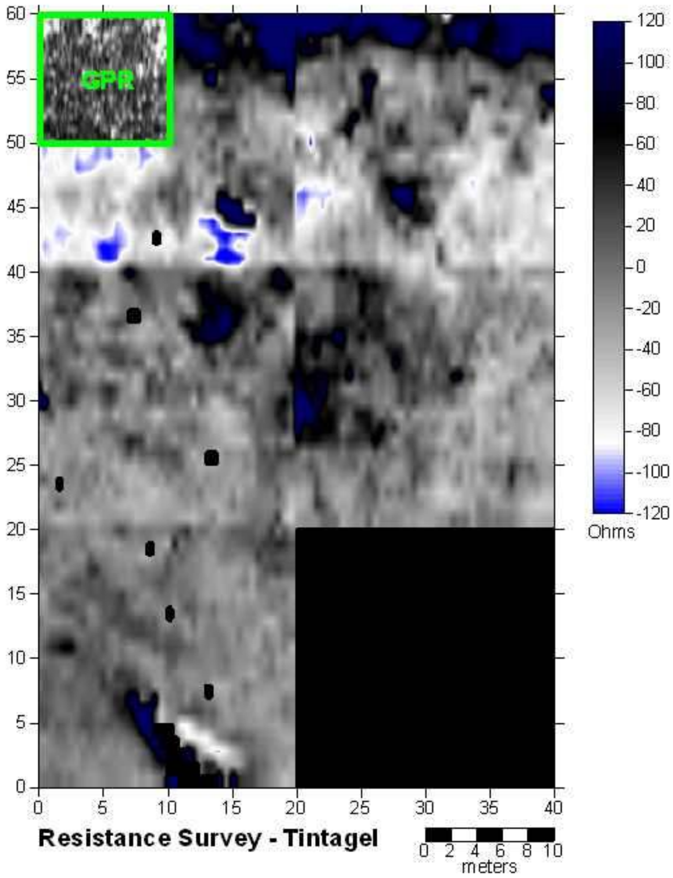

Figure 6 GPR survey at Tintagel. The GPR grid is positioned over resistance features of interest.

Results of the GPR survey further investigate the linear anomalies identified in the resistance data. Anomalies mapped with GPR are evident in the data but cannot be conclusively interpreted as archaeological in nature. Because the survey area is adjacent to the cliff face at the top of the survey area, anomalies may be geological in nature.

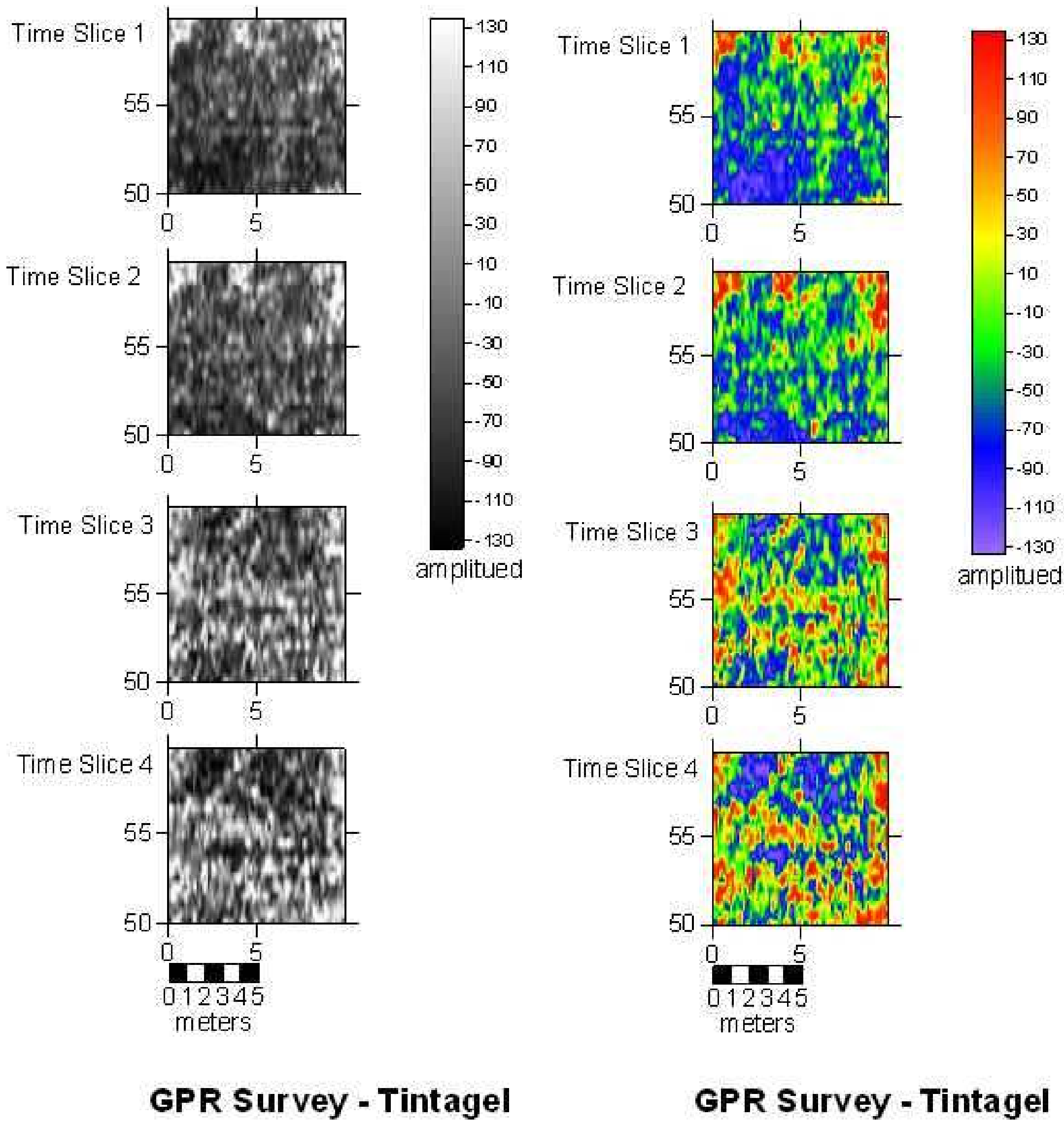

Figure 7 Greyscale and colour time slices of the GPR survey grid. Time slices are approximately 0.25 m thick.

Note in time slice 4, well-defined rectangular features appear at approximately 1 – 1.25 m deep.

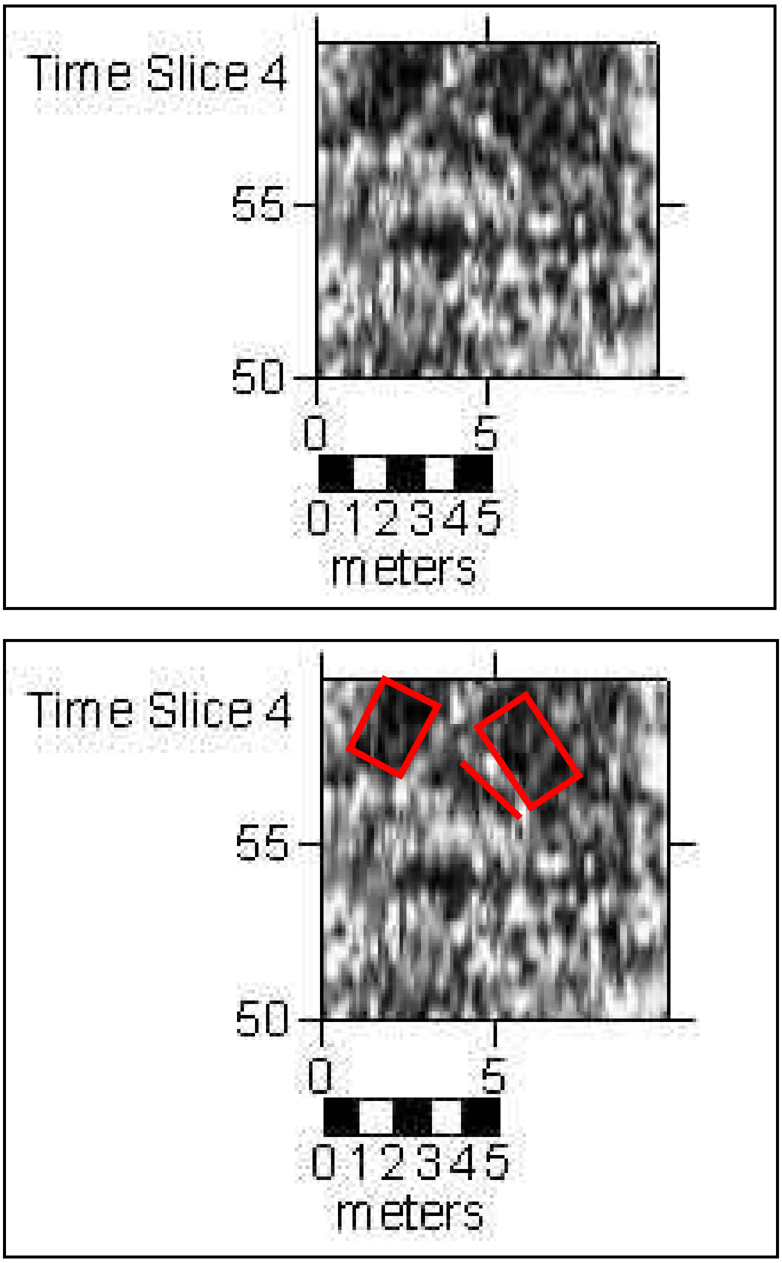

Figure 8 detail of time slice 4 identifying rectangular anomalies.

Conclusions

The resistance and GPR surveys identified a number of anomalies that could be archaeological in nature. Further investigation through excavation will enable absolute identification of these anomalies. It is important to remember that this site is on a steep slope at the base of a cliff. The topsoil is shallow and many anomalies in the resistance and GPR data may reflect the geological background of the survey area.

Bibliography

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