



Excavation has always been central to the practice of archaeology – it uncovers structures and provides artefacts and material for analysis and dating. Unless remains survived above ground though, knowing where to place trenches was always a problem. So the various methods of geophysical survey were developed. They allow archaeologists to see below the ground before, or instead of, digging. They are collectively known as ground-based remote sensing techniques.

The first reliable method to be pioneered was resistivity survey. This involves sending a low level electrical current downward through the soil between two probes. They are set at the ends of a hand held frame which is walked and placed at set intervals along a grid. The resistivity meter measures the varying degrees of resistance to the current passing between the electrodes: the fill of ditches and pits is less compacted than surrounding natural geology so current passes more easily (lower resistance); buried stone foundations are harder (high resistance). The technique is particularly effective for locating pits and ditches dug into chalk and gravel subsoils that are naturally dry. On moisture retaining soils it is much less effective. Its principal drawback has been that it is slow, requiring the operator to place the frame with the probes into the soil every metre along a grid. A major recent development, however, has been the production of mobile systems with probes mounted on wheels.

Magnetometry measures slight distortions to the earth's background magnetic field caused by fires (hearths and kilns that can fix the reorientation of grains of iron oxide) and by pits and ditches whose contents have greater magnetic susceptibility than that of the surrounding subsoil. Measurements can be taken with a variety of instruments, the most commonly used being the fluxgate gradiometer. This comprises two sensors in a light hand held instrument that can be rapidly walked across a site. It produces a continuous output and records differences of magnetic intensity. Ease and speed of use,

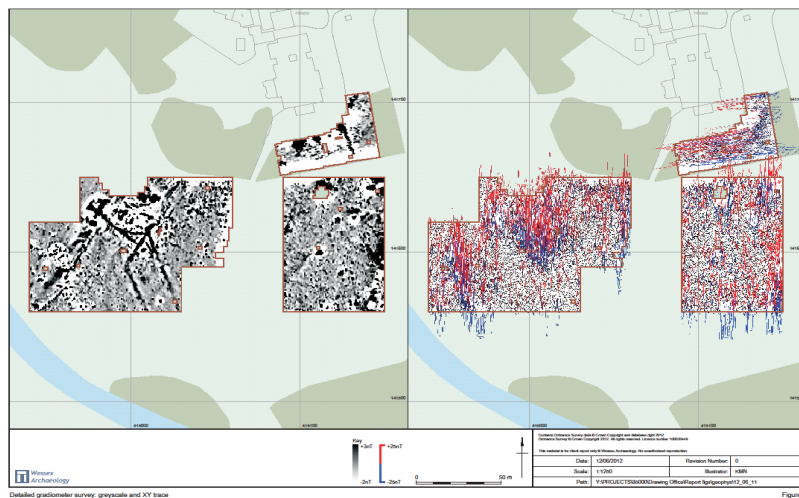
coupled with responsiveness to a wide range of features, has led to its widespread use in archaeological surveys. The weakness of the method lies in the need to be clear of all metal objects such as fences lines that will cause major disturbances. As with resistivity survey, data are commonly presented as dot density or greyscale maps – darker shading representing the highest anomalies in the local magnetic field. These two methods can produce clear plans of buried features rather like slightly fuzzy black and white photographs. Image processing enables the highlighting of anomalies to clarify the picture.

Ground penetrating radar survey takes remote sensing a stage further. It adds a third dimension. The depths and profiles of buried pits and ditches are established along with a clear site plan. The process involves sending short radio pulses (radar waves) from a hand pulled transmitter through the soil and logging the varied travel-time of their return in terms of nanoseconds. Since wave velocity is known, thousands of individual reflections can be separated into horizontal slices corresponding to depth. These data are presented as 'time-slices' – in essence virtual horizontal excavations at a number of specified depths. These 'time-slices' (depths below the surface) are usually presented in colour with blue indicating areas with little or no subsurface reflection (e.g. the fill of pits and ditches) and red those with high reflection (e.g. stone banks and walls).

Ground penetrating radar (GPR) survey then results in virtual excavation but cannot furnish the vital artefacts, dating material and environmental samples that are needed to confirm a site's interpretation and to understand its function. Recent advances in the speed and ease of remote sensing data collection has, however, enabled whole landscapes to be recorded (e.g. around Stonehenge) and is, along with aerial photography, progressively revealing an atlas of prehistoric Britain to be tested by excavation.



*Gradiometer survey undertaken by Wessex Archaeology at Old Sarum, Wiltshire and examining geophysical survey results. Images © Wessex Archaeology*



*Geophysical survey results plotted. Image © Wessex Archaeology*

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