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Successes and Failures in Detecting Buried Non-metallic Objects Using Ground (and Water) Penetrating Radar (WPR and GPR)

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Our knowledge of radar waves, applied to ground searches, is relatively new compared to other areas of physics (gravity, seismic). It was only with the advent of portable, ruggedised laptop computers through the 1980s that research into detecting actual or simulated cadavers using GPR began, amongst which were [1] Strongman (1992), who buried bear carcasses and [2] France et al. (1992) who searched for unmarked graves in a graveyard. Miller (1996: [3]) was amongst the first workers to publish an image of a human grave. Subsequent to this, many publications have shown the success of GPR in grave detection: these are biased in that no-one wants to see images of failed GPR surveys, yet these regularly occur. This can lead to a situation where search personnel do not use GPR again. Furthermore, GPR has been over used or incorrectly used on the basis that it worked well at another location, leading to an assumption that GPR (and other geophysical methods) MUST be used, as opposed to APPROPRIATELY used. As with all geophysical search assets the geology and detectability of the target must be considered before determining if GPR is appropriate. Wrapped, fresh and partially preserved human remains in peat, sand and freshwater general have high levels of potential detectability when GPR is deployed, often with associated signal loss where stratigraphy has been disturbed, as opposed to the detection of the actual target(s). In interbedded clay-loam soil and some mixed mineral soils, even fresh remains can be hard to image clearly. Unclothed or partially clothed human remains more than a few months to years old often show few distinctive anomalies on radargrams or 3D plots. A major conundrum faced by the authors is why graves from the Irish Potato Famine, some 160 – 170 years ago, are generally imaged very well [4]). The reason appears to be that such graves had significant quantities of lime (CaO) added. In the wet climate of Ireland, percolating water reacted with this lime, creating a cement carapace to the body (and sometimes a crude coffin), which eventually decayed, leaving a void. Thus the radar detects the air void, not the body. This work shows how limited the method is in certain situations, yet in others, where an air void is suspected (e.g. in limed graves, rock cuts or where bodies have been buried/hidden in concrete), then the method has a higher chance of success. Whether in soil or sediment, in freshwater or in concrete, GPR is best used following a full desktop study of the site, and in conjunction with probing/cadaver dogs. In moorland peat in the UK Pennines, the authors deployed GPR at different times, immediately following a burial control and then several years later. The results showed that older control sites favour the deployment of GPR, whereas recent burials do not favour the use of GPR, in this particular site. This possibly appears to be related to the physical changes in the reinstated peat over the passage of time. The above examples will be illustrated with both archaeological and criminalistic examples.

References:

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