

Mines and bombs

Using geophysics to expose buried hazards

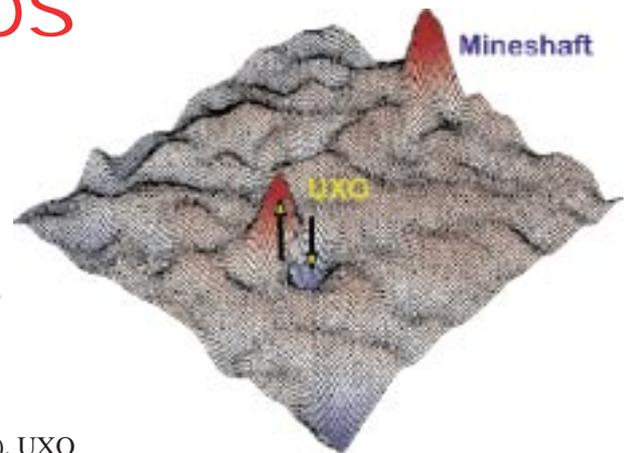
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For those of us called upon to investigate the near surface, the maxim 'always expect the unexpected' is often appropriate. Potential hazards can lie just a few feet below our buildings, roads and fields. The BGS was recently commissioned to undertake a geophysical survey across playing fields prior to the construction of a new sports complex. The area is a typical urban setting in north-east England. It was known that, during the last war, a number of bombs had been dropped in the vicinity; up to six 1000 lb bombs were indicated. Surveys to locate such objects are necessarily non-invasive (!) and are conducted using geophysical techniques.

Second World War bombs are part of the wider problem of the detection of

Unexploded Ordnance (UXO). UXO detection is a highly developed science and different problems are presented by, for example, small arms munitions and mortars. The U.S. Army and Department of Defence have excellent information on the subject on their web pages at <http://www.jpg.army.mil/>. A variety of geophysical screening tools can be used to locate UXO at depths of up to about six metres, depending on size, geometry and material type. A 1000 lb bomb is considered a high visibility target. Due to the iron-based material of the shell, a magnetometer can be used to locate the object by detecting irregularities in the Earth's magnetic field.

The playing fields were surveyed using a combined sensor that measures both the magnetic field and its gradient to a



The magnetic field across an area of 100x100 metres shows two main anomalies (high values in red). The smaller up-down anomaly is due to the large bomb; the second anomaly is due to the mineshaft.

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very high accuracy. The survey results revealed a typical dipole (up-down) anomaly that would be associated with a large concealed bomb. In addition to the signature from the bomb, a much larger anomaly, of unknown origin, was also detected. Historical maps and records dating back to the previous century were consulted. It then became clear that our anomaly was likely to be associated with the Burdon or Collingwood Main collieries that ceased operation in the 1820s. The prime suspect became a shaft associated with the Hopewell Pit that penetrated a number of coal seams to a depth of 169 metres.

UXO clearance is always left to munitions specialists; the larger engineering problem was, in fact, the mine. A drilling contractor excavated the large anomaly. A few feet below the surface of the running track lay a thin, ageing concrete raft sitting across original timbers. Both were scraped away to reveal a three metre-diameter open shaft that continued to a depth of at least 50 metres. The Victorian engineering of the shaft was impressive but then so was the scale of the potential hazard they left.

Excavation of the large anomaly reveals the 3 metre-diameter open shaft of the Hopewell Pit that closed in the 1820s.

