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Technical Note TN-11

USE OF EM31 INPHASE INFORMATION

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The Geonics EM31 measures the quadrature-phase component of the induced magnetic field, since this component of the magnetic field is linearly related to the ground conductivity and hence most readily interpretable in terms of the geological structure.

Another major use of the EM31 is for carrying out surveys of ground-water contamination by mapping the electrically conductive (or in some cases the highly resistive) contaminant plumes. These waste disposal sites however often contain buried metal containers of hazardous waste which can generally be detected by the EM31 (or metal detectors or magnetometers) if they are not buried too deeply.[1,2]

Other users, such as archaeologists and treasure seekers, are also interested in the detection of buried metallic targets.

The detectability of these large metal objects and more specifically the detection of buried metal drums can be greatly enhanced by measuring the inphase component of the induced magnetic field. This component can be readily measured by the EM31 by simply taking the reading with the mode switch in the COMP position. The procedure for doing this is to set the mode switch to the COMP position and then adjusting the COARSE and FINE COMPENSATION controls so that a deflection of about 20% of full scale deflection is obtained. This is usually carried out with the RANGE switch set to the 30 mmho/m position, although less sensitive ranges can also be used. The survey is then carried out exactly as if the conductivity were being measured.

Experiments at Geonics have indicated that the EM31 will detect a single 45 gallon oil drum out to distances of about 3.7m (12 ft) using the inphase component, whereas Koerner, et al will only be able to detect drums to a depth of 2m (6 ft) using the quadrature-phase component.

Two points will have to be considered however when surveying in the COMP position mode. The first is that the true zero level of the inphase component is not known since the reference level is arbitrarily set as described earlier. Generally this is not a problem since when operating in this mode, one is looking for relatively localized meter deflections indicative of the presence of metallic objects. The second point is that if the instrument is suddenly jarred the inphase zero level may change and settle down at a new value. This fluctuation in the zero level should not cause any serious difficulty or confusion in the interpretation, since the detection of buried metal objects will generally be recognized by a single pulse or series of pulses corresponding to the number of buried objects and their spacing.

Overall, these two disadvantages are relatively insignificant when compared with the increase in sensitivity of the EM31 for detecting buried metal objects which puts the EM31 in a class by itself relative to the magnetometer and metal detectors.

For some surveys it is useful to record both the inphase and quadrature-phase components simultaneously. In this case the EM31 can be modified to provide both outputs for an analog chart recorder.

References

(1) Evans, Roy B. Currently Available Geophysical Methods for Use in Hazardous Waste Site Investigations, Risk Assessment at Hazardous Waste Sites, 8. Geophysical Methods for Investigations p.93-115. ACS Symposium Series, No. 204.

(2) Koerner, Robert M. et al Drexel University, Use of NDT Methods to Detect Buried Containers in Saturated Silty Clay Soil, 1982 National Conference on Management of Uncontrolled Hazardous Waste Sites, Site Investigation, p.12-16.