J. O. Parra. *Effects of pipelines on spectral induced-polarization surveys*

The formal electromagnetic coupling solution for a dipole-dipole electrode array configuration has been modified to include cultural coupling in a uniform conducting half-space. Solutions are obtained for survey lines oriented at an arbitrary position and angle with respect to a cylindrical structure. The convergence properties of the general mutual impedance solution are analyzed using a low-frequency approximation which is useful in predicting cultural anomalies in the frequency range of spectral IP surveys as long as all significant dimensions are less than one skin depth. Both interfacial polarization and induced currents in the cylindrical conductor are considered in examining the behaviour of the overall spectrum as seen by an external observer. Spectral responses for dipole-dipole arrays oriented perpendicular and parallel to the buried conductor show that the phase shift is the most diagnostic parameter for pipe depth and survey data distortion. The results also show that field survey procedures can be devised to minimize such interference effects when the pipe position is known.

I. M. Johnson. *Spectral induced-polarization parameters as determined through time-domain measurements*

A method for the extraction of Cole-Cole spectral parameters from time-domain induced polarization data is demonstrated. The instrumentation required to effect the measurement and analysis is described. The Cole-Cole impedance model is shown to work equally well in the time domain as in the frequency domain. Field trials show the time-domain method to generate spectral parameters consistent with those generated by frequency-domain surveys. This is shown to be possible without significant alteration to field procedures. Cole-Cole time constants of up to 100 s are shown to be resolvable given a transmitted current of a 2 s pulse time. The process proves to have added usefulness as the Cole-Cole forward solution proves an excellent basis for quantifying noise in the measured decay.

C. D. Hardwick. *Important design considerations for inboard airborne magnetic gradiometers*

The advantages of magnetic gradiometry as an adjunct to total field mapping are generally recognized and a few aircraft have been equipped with gradiometers. These gradiometers are derived from high-sensitivity total-field magnetometer systems that are in themselves subject to certain errors that can usually be tolerated in conventional surveys. However, in a gradiometer, where very large total-field values are differenced, these errors can, in many cases, greatly exceed the basic accuracy required of the system. There are two principal sources of error in inboard gradiometry systems. The first, and most significant, results from the inevitable magnetic interference of the aircraft or from the inability of currently available compensation systems to deal with the magnetic interference adequately. Passive methods of compensation are not sufficiently comprehensive for gradiometry and the active compensation systems currently in use, which were designed for military applications, cannot guarantee compensation at zero frequency (dc) or at the very low frequencies of interest to the geophysicist concerned with long-wavelength anomalies. The second source of error is the frequency-counting technique usually employed to convert a Larmor frequency to ambient total field. The counting process is somewhat analogous to digital sampling at a relatively low rate and as such affords little protection against aliasing from higher frequency interference sources, including components at aircraft maneuvering frequencies. This paper, using examples, illustrates the two types of error. A list of design criteria is presented and several techniques are described for realizing these criteria. Finally, compensation and survey line results are shown for a three-axis gradiometer system in the National Research Council of Canada's Convair 580. This aircraft uses nonoriented cesium magnetometers, one in each wingtip and one at the tip of the tail fin. Compensations over the entire normal maneuver envelope of the aircraft on all headings give typical standard deviation errors of 3 mγ/m from dc to 1 Hz. Thus, the system is capable of measuring gradients down to nongeologic background levels.

R. Nagendra and N. Laxminarayana. *The principle of complex frequency scaling—applicability in inclined continuation of potential fields*

A remarkable property of Fourier transforms, especially applicable to inclined continuation of potential geophysical fields, is the principle of "complex frequency scaling". Briefly stated, let $f(x)$ be the (gravity/magnetic) field due to a two-dimensional structure along a principal profile and $F(\omega)$ be its Fourier transform. The field along a profile passing through the same reference origin and tilted by an angle δ in the counterclockwise direction ($+X$ to $-Z$) is obtained by inverse Fourier transforming $F[\omega \exp(-i\delta)]$ for positive ω. The complex scaling property and proof of the resulting space-frequency domain relationship are presented, introducing the total field as the analytic signal of the horizontal component. The applicability of the complex scaling principle is illustrated by considering selected geometric models. This principle can be advantageously applied for continuation of two-dimensional potential fields onto inclined planes.

C. D. Hardwick. *Non-oriented cesium sensors for airborne magnetometry and gradiometry*

Optically pumped magnetometers are characterized by an optimal angle between their optical axes and the direction of the magnetic field they are sensing. Departure from the optimal angle causes a shift in the Larmor frequency with a corresponding error in the scalar value of the magnetic field being measured. To minimize this error, magnetometers are conventionally either mounted in multiple sensor clusters such that the errors tend to cancel, or they are mechanically oriented to maintain the optimal angle with respect to the magnetic field vector. Recent cesium vapor magnetometers using a split-beam technique have a sufficiently flat error characteristic that they can be flown in a non-oriented or "strap-down" configuration. This configuration has advantages with respect to conventional methods in terms of reduced size and weight and of greatly reduced cost. This paper describes two fixed orientations for a particular split-beam