Exploration Geophysics (1995) ***26****, 549*

Discussion on: Conductivity-depth transform of GEOTEM data

by Peter Wolfgram, *Exploration Geophysics* **26** (1995), 179-185

P. Wolfgram

Geoterrex, 7-9 George Place Artarmon 2064.
Phone (61 2) 418 8077 Fax (61 2) 418 8581

I was brought to my attention that the publication on the conductivity-depth transform of GEOTEM data by Wolfgram and Karlik (1995) included a rather sparse literature review. I acknowledge that there are some related publications that should have been mentioned although a comprehensive literature review was never intended. The following addendum throws light on the history of the technique and includes references to similar developments.

The deconvolution is based on an expansion of the response into exponential basis functions. The idea of this expansion has been used for rapid Fourier transformation of electromagnetic (EM) data (Lamontagne, 1975; Holladay, 1981). I am not aware of any publications on the use of this idea for a parametric deconvolution of EM data such as detailed in Wolfgram and Karlik (1995) with the exception of my co-author's Ph.D. thesis (Karlik, 1995).

There is no unique closed expression for the conductivity of a halfspace in terms of the data (voltage) measured in transient EM techniques. This preempts a simple transofrmation of multichannel TEM data into pseudo sections of apparent conductivity. The roots of some approaches to a fast conductivity depth imaging technique lie in various estimations of apparent conductivity and skin depth or 'depth to equivalent current filaments' (Lee, 1977; Kameneckij and Porstendorfer, 1983; Raiche and Gallagher, 1985; Spies and Eggers, 1986; Fullagar, 1989).

The method reported in Wolfgram and Karlik (1995) uses the idea of conductivity depth imaging via fitting the static magnetic field of a receding image dipole to field data. This idea appeared first in unpublished notes by Lamontagne Geophysics and was subsequently eleaborated in several publications (Polzer, 1986; Macnea and Lamontagne, 1987; Eaton and Hohmann, 1989; Macnae et al, 1991; Smith et al, 1994). Street and Roberts (1995) show a conductivity depth section for airborne EM data that may have been generated by a similar algorithm.

Liu and Asten (1993) avoid the deconvolution of airborne EM data by fitting the amplitudes measured at two adjacent channels directly to the thin sheet solution for the given transmitter waveform. The result is a conductance depth section which can be differentiated into a conductivity depth section.

Bergeron et al (1989) applied complex image theory (Thomson and Weaver, 1975) to airborne frequency domain data, and Christensen (1995) uses an approximate Frechet kernel of the homogeneous halfspace for his rapid inversion technique of transient EM data.

REFERENCES

Bergeron, C.J. Jr, Ioup, J. and Michel, G.A II. 1989, Interpretation of airborne electromagnetic data using the modified image method: Geophysics **54**, 1023-1030.

Christensen, N.B., 1995, Imaging and inversion of transient electromagnetic soundings, in: Bell, R.S. (ed.), Proceedings of the syposium on the application of geophysics to engineering and environmental problems, Orlando, Florida, 1995.

Eaton, P.A. and Hohmann, G.W., 1989, A rapid inversion technique for transient electromagnetic soundings: Physics of the Earth and Planetary Interiors **53**, 384-404.

Fullagar, P.K., 1989, Generation of conductivity-depth pseudo-sections from coincident loop and in-loop TEM data: Exploration Geophysics **20**, 43-45.

Holladay, J.S., 1981, YVESFT and CHANNEL: a subroutine package for stable transformation of sparse frequency domain electromagnetic data to the time domain: Research in Applied Geophysics **17**, Univ. of Toronto.

Kameneckij, F.M. and Porstendorfer, G., 1983, Die Skin-Tiefe in der Magnetotellurik und bei elektromanetischen Sondierungen mit kuenstlichen Quellen in der Fernzone, Gerlands Beitr: Geophysik **92**, 465-470.

Karlik, G., 1995, Eine schnelle and direkte Inversionsmethode fuer transient elektromagnetische Data, Mitteilungen aus dem Institut fuer Geophysik und Meteorologie der Universitaet zu Koeln **101**, Univ. Cologne.

Lamontagne, Y., 1975, Applications of wide-band, time-domain EM measurements in mineral exploration, Research in Applied Geophysics **7**, Univ. of Toronto.

Lee, T., 1977, Estimation of depth to conductors by the use of electromagnetic transients, Geophysical Prospecting **25**, 61-75.

Liu, G. and Asten, M., 1993, Conductance-depth imaging of airborne TEM data, Exploration Geophysics 24, 655-662.

Macnae, J. and Lamontagne, Y., 1988, Case studies and modelling advances in producing conductivity-depth sections, Exploration Geophysics **19**, 309-316.

Nekut, A.G., 1987, Direct inversion of time-domain electromagnetic data, Geophysics **52**, 1431-1435.

Polzer, B.D., 1986, The interpretation of inductive transient magnetic sounding data, M.Sc. thesis, Univ. of Toronto.

Raiche, A.P. and Gallagher, R.G., 1985, Apparent resistivity and diffusion velocity, Geophysics **50**, 1628-1633.

Smith, R.S., Edwards, R.N., and Buselli, G., 1994, An automatic technique for presentation of coincident-loop, impulse-response, transient, electromagnetic data, Geophysics **59**, 1542-1550.

Spies, B.R. and Eggers, D.E., 1986, The use and misuse of apparent resistivity in electromagnetic resistivity in electromagnetic methods, Geophysics **51**, 1462-1471.

Street, G.J. and Roberts, G.P., 1995, SALTMAP - high resolution airborne EM for electrical conductivity profiling, in: Bell, R.S. (ed.), Proceedings of the symposium on the application of geophysics to engineering and environmental problems, Orlando, Florida, 1995.

Thomson, D.J. and Weaver, J.T., 1975, The complex image approximation for induction in multi-layered earth, J. Geophys. Res. 80, 123-129.

Wolfgram, P. and Karlik, G., Conductivity-Depth Transform of GEOTEM Data, Exploration Geophysics **26**, 179-185.