Geophysics 699 - Magnetotelluric data processing

Assignment 1

(1) Papers to read

(a) Read the follow papers that describe the early history of the MT method. A ZIP file of the PDFs will be distributed by e-mail. Be prepared to give a brief summary in class.

Tikhonov, A.N., On determining electrical characteristics of the deep layers of the Earth's crust, Proceedings of Academy of Sciences (USSR) Doklady, 83, 2, 295-297, 1950.

Cagniard, L., Basic Theory of the magneto-telluric method of Geophysical Prospecting, *Geophysics*, **18**, 605-635, 1953.

Wait, J.R., On the relation between telluric currents and the Earth's magnetic field, *Geophysics*, **19**, 281-289, 1954.

Cantwell, T., T.R. Madden, Preliminary report on crustal magnetotelluric measurements, *J. Geophys. Res.*, **65**, 4202-42-5, 1960.

Niblett, E.R., and C. Sayn-Wittgenstein, Variation of Electrical conductivity with depth by the Magnetotelluric method, *Geophysics*, **25**, 998-1008, 1960

Price, A.T., The theory of Magnetotelluric methods when the source field is considered, *J. Geophys. Res.*, **67**, 1907-1918, 1962.

T.R.Madden and P. Nelson, A defense of Cagniard's magnetotelluric method, ONR report, 1963.

(2) Computation

(a) Write a MATLAB script to calculate the 1-D MT response of multi-layer Earth, using the method described in A1.3 of the class notes.

(b) Validate the algorithm for some simple 1-D models (1 layer, 2 layer and 3 layer)

(3) Research

MT apparent resistivity curves for a 2-layer Earth demonstrate a resonance phenomena. Is this a real phenomena, or just an artefact of the processing? Look at Spies and Eggers (1986) to get an idea of the debate.

(a) Summarize the arguments of Spies and Eggers (1986) on this topic.

(b) Modify your code developed in (2) to investigate this question for a two layer Earth. Make a plot of the electric fields in each layer. Plot the up and down going waves separately.

(c) Is it a resonance phenomena? What is your opinion?

Spies BR, DE Eggers, The use and abuse of apparent resistivity in electromagnetic methods, Geophysics, 51, 1462-1471, 1986.

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