A comparison of two- and three-dimensional modelling of audiomagnetotelluric data collected at the world’s richest uranium mine, Saskatchewan, Canada

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Summary

Innovative 3-D modelling algorithms are becoming increasingly popular and useful for MT exploration. This study facilitates the comparison of multiple modelling algorithms by assembling the results of independent modelling studies on a grid of audiomagnetotelluric data collected in northern Saskatchewan, Canada. The survey area was directly over the world’s richest uranium deposit (190 000 tons of U grading 23%) located at the unconformity between tilted Paleoproterozoic basement granites and supracrustal rocks of the Wabigoon-Atikokan transition zone and the relatively flat-lying, unmetamorphosed but pervasively altered, Paleo- to Mesoproterozoic siliciclastic strata within the Athabasca Basin. The primary goal of the survey was to investigate the utility of MT to delineate the basement magnetic units commonly associated with high-grade U deposits and to determine the feasibility of MT to detect the alteration in the overlying sandstones associated with the mineralizing events.

Context

Location of the McArthur River mine in Saskatchewan, Canada.

Schematic geological section of the McArthur River uranium deposit. The graphic fault zone extends for several kilometres into and out of the plane of the diagram; the uranium ore body is subparallel to the fault. The extent of the clay mineralization is unknown.

2-D, Tuncer

3-D, Siripunvaraporn

3-D, Mackie

3-D, Farquharson

Data: TE & TM apparent resistivities and phases, and tipper.
Error norms: 20%, 5%, 0.005, respectively.
Static shift incorporated: yes.

Data: impedances (off-diagonal elements only, real and imaginary parts), 16 frequencies.
Error norms: 5%.
Static shift incorporated: no.
Mesh: 56x56x33, aligned with survey lines.

Data: impedance off-diagonal and diagonal elements, real and imaginary parts, 16 frequencies (1000-10kHz).
Error norms: 5% for REAL, 5% for IMAG, 20% for 2X2, 0.02 for tipper.
Static shift incorporated: yes.
Mesh: 56x44x7, aligned with survey lines.

Data: impedances (off-diagonal and diagonal elements, real and imaginary parts), 12 frequencies (1280-3.8kHz).
Errors: variance estimated from processing (i.e., variances in end file).
Static shift incorporated: no.
Mesh: 60x70x45, aligned NS-EW.