

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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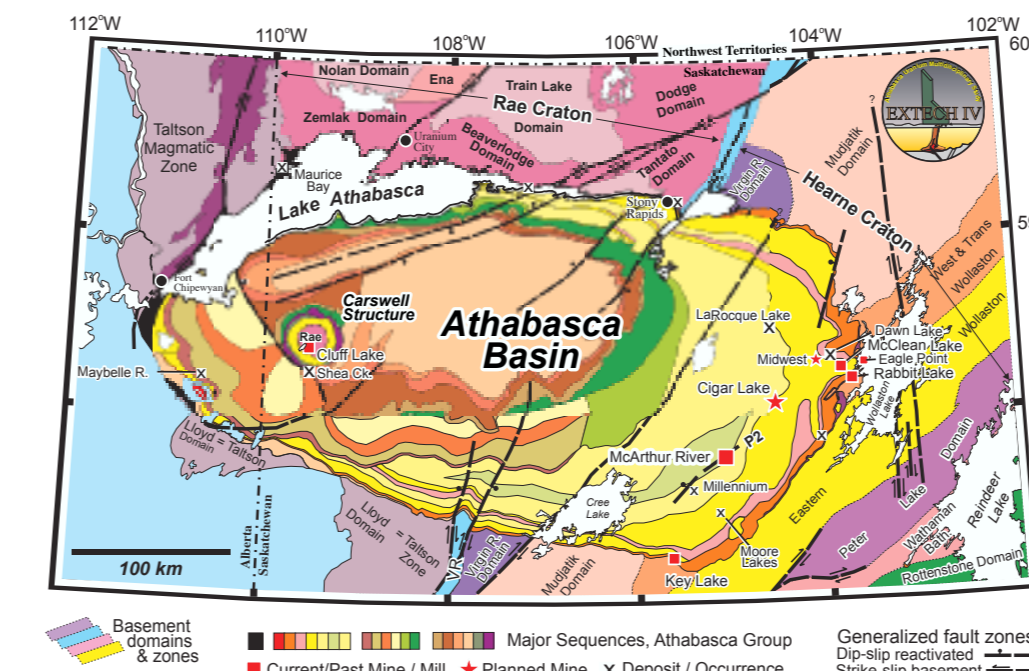
Summary

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 granitoids and supracrustals of the Wollaston-Mudjatik transition domain 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 graphitic 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.

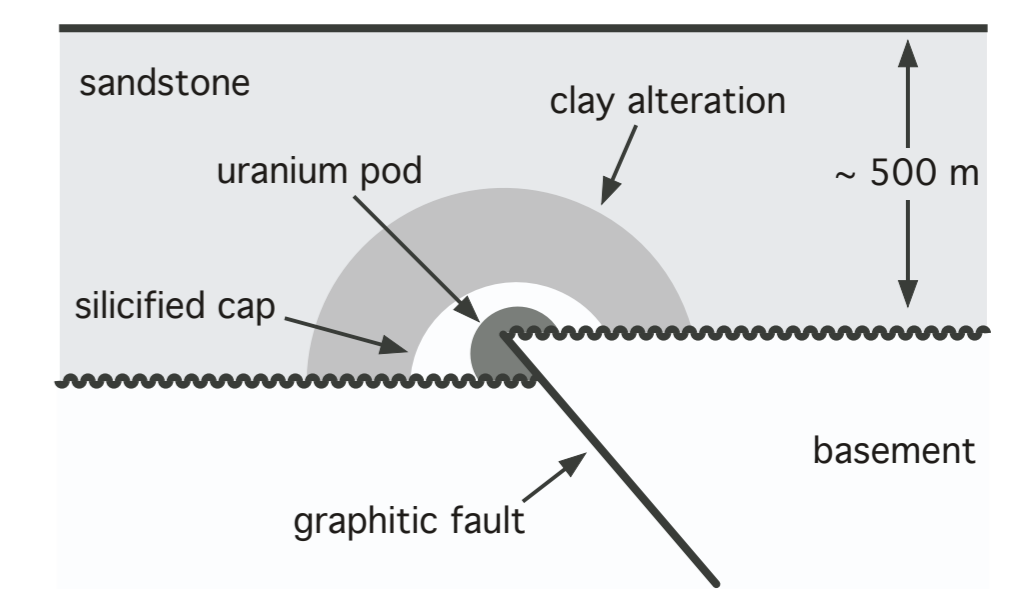
Context



Location of the McArthur River mine in Saskatchewan, Canada.

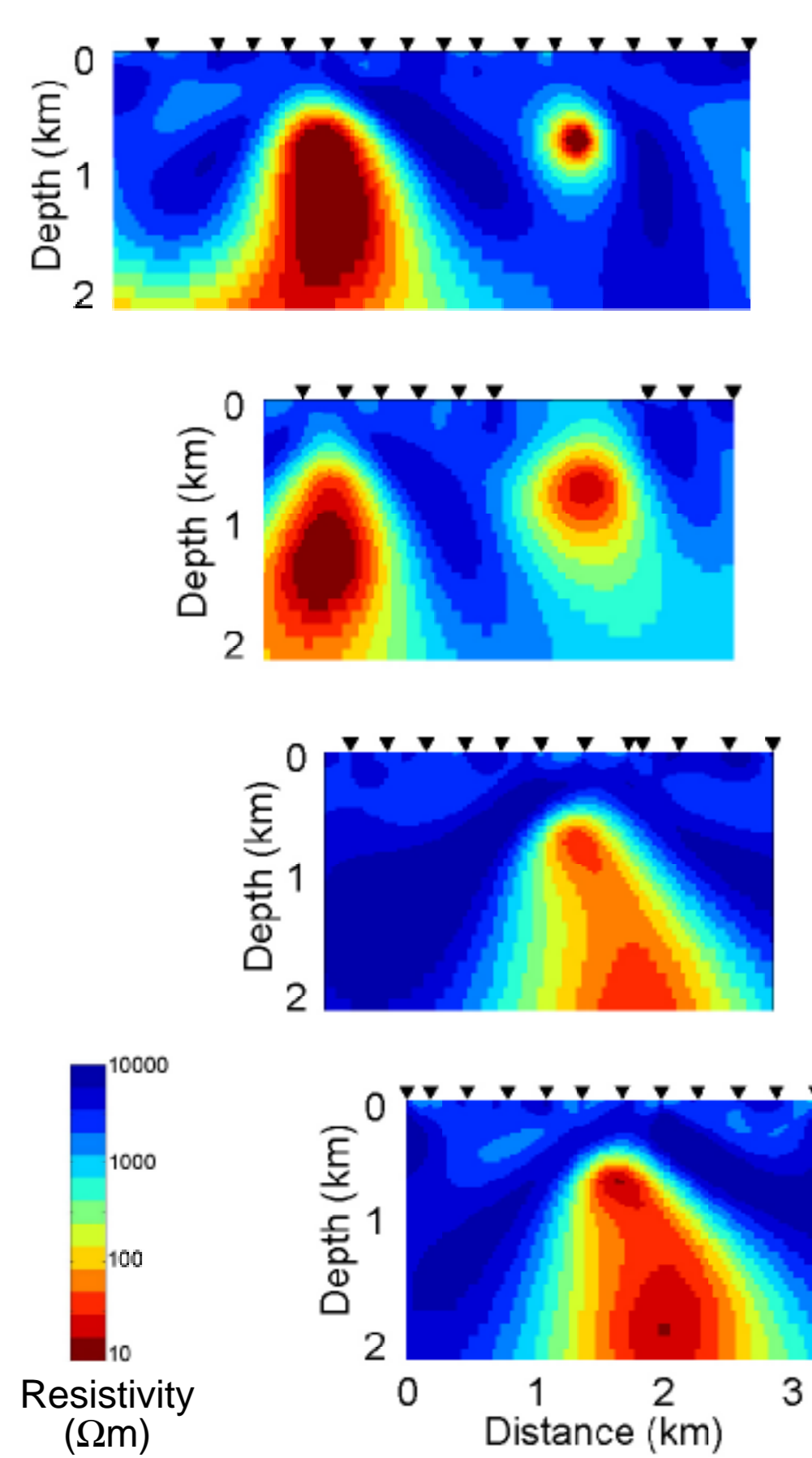


Geological map of the Athabasca Basin.

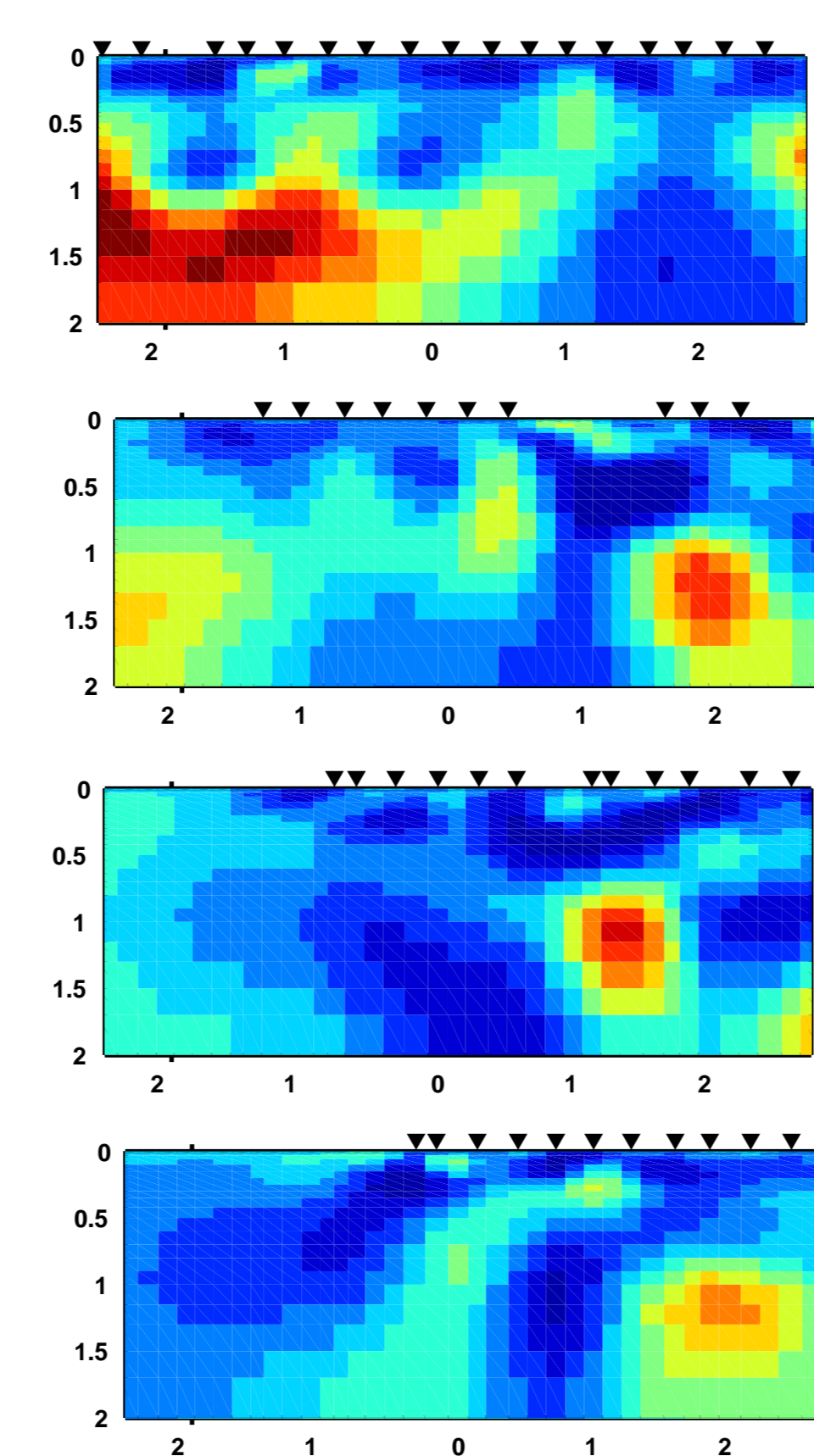


Schematic geological section of the McArthur River uranium deposit. The graphitic fault zone extends for several kilometres into and out of the plane of the diagram; the uranium pod and silicified cap only extend tens of metres into and out of the diagram. The extent of the clay mineralization is unknown.

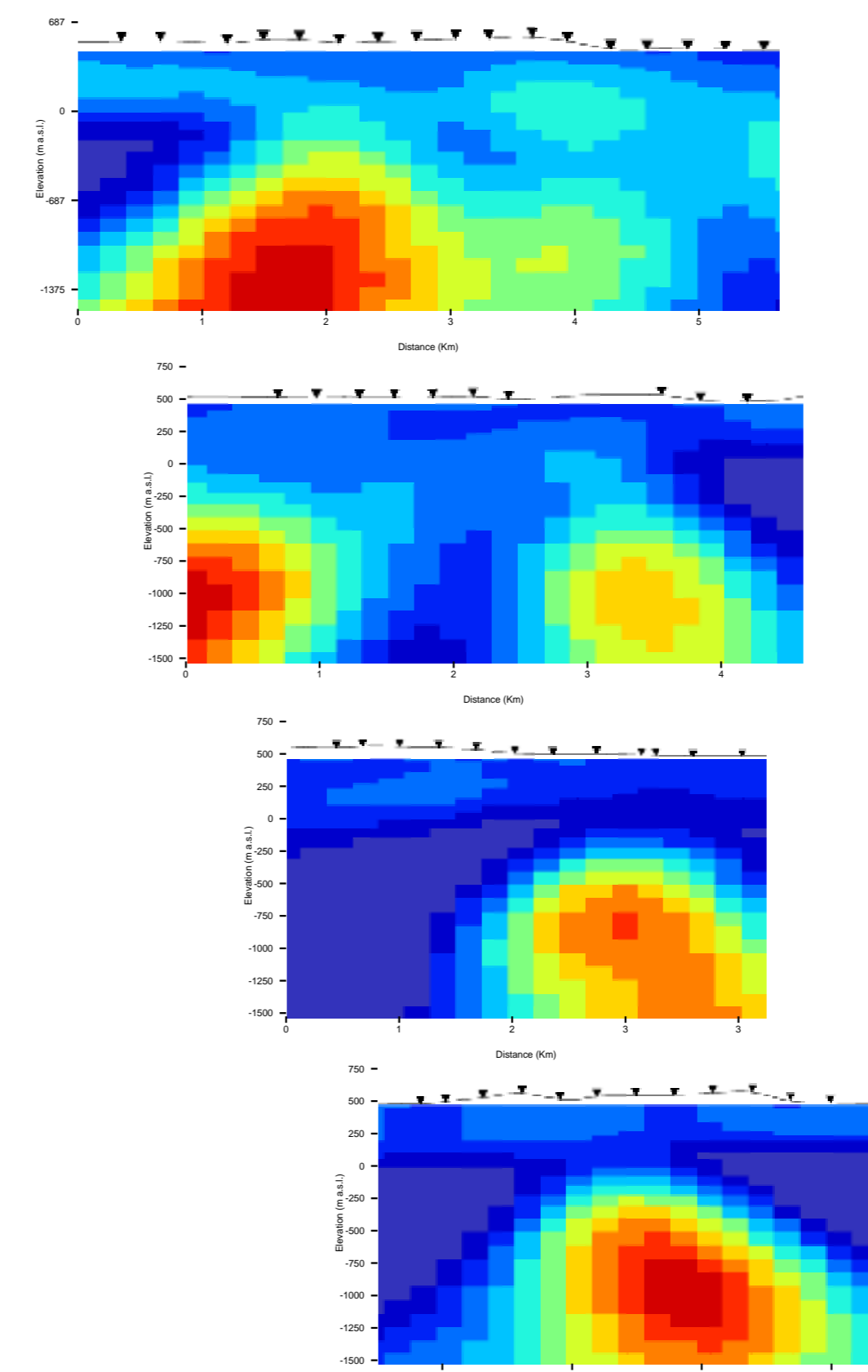
2-D, Tuncer



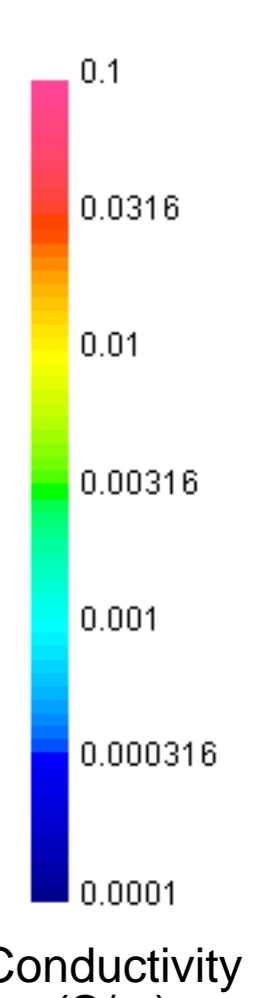
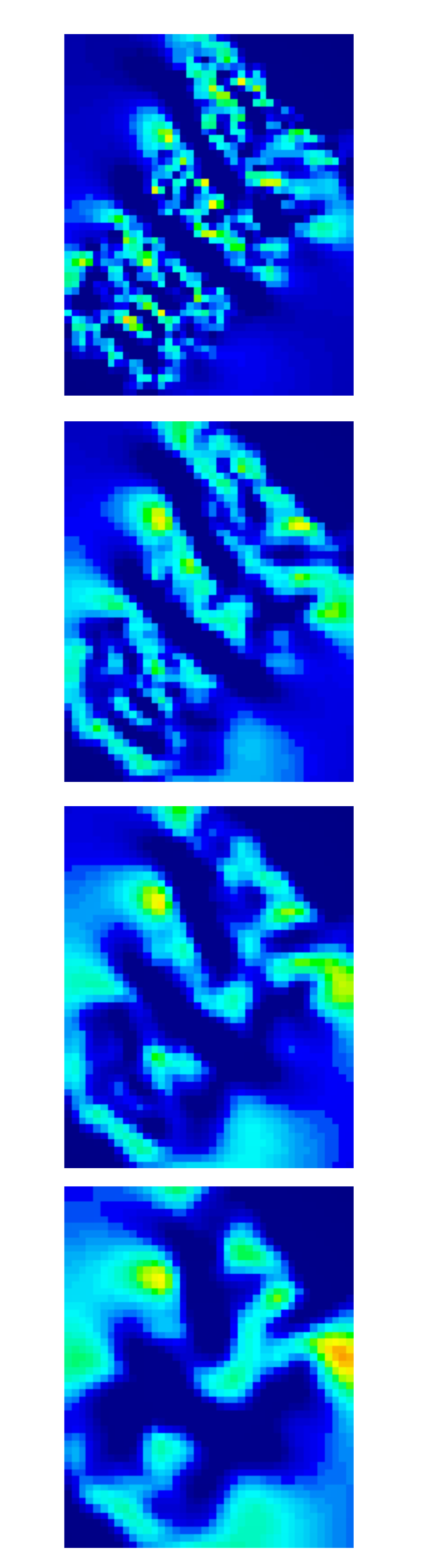
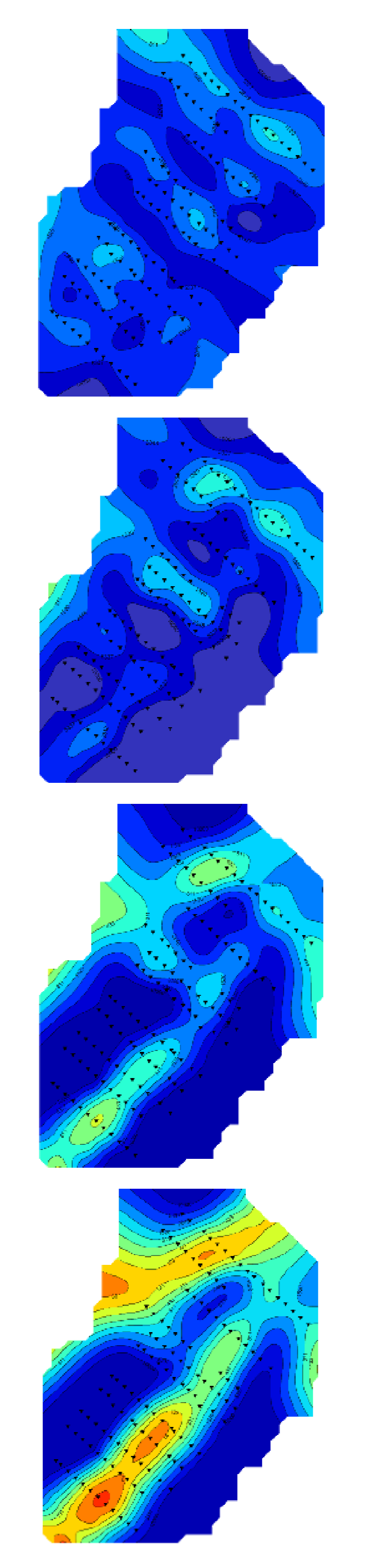
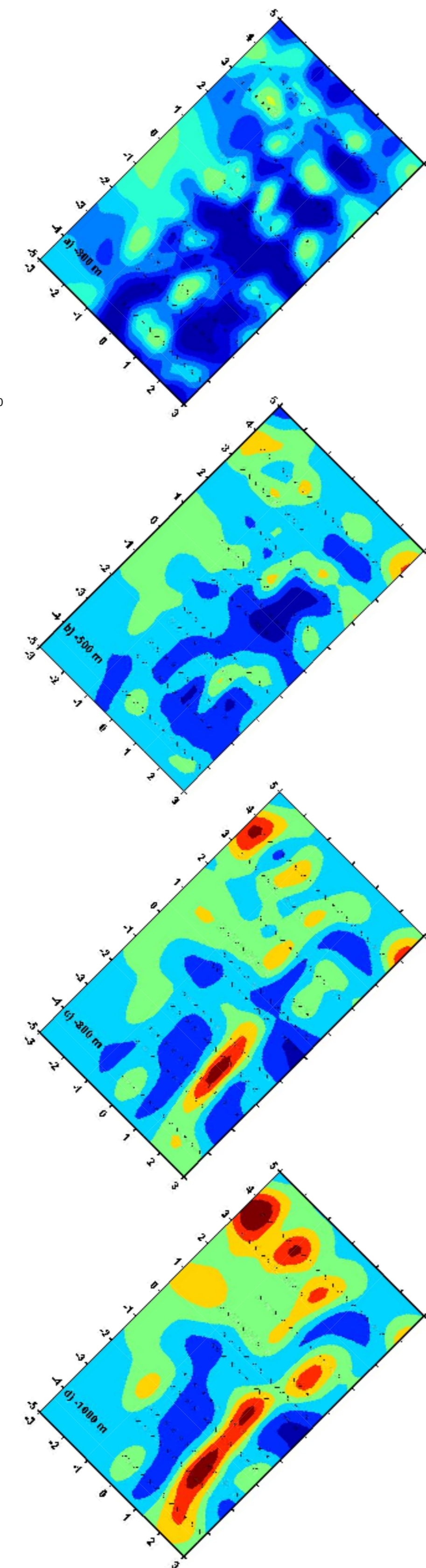
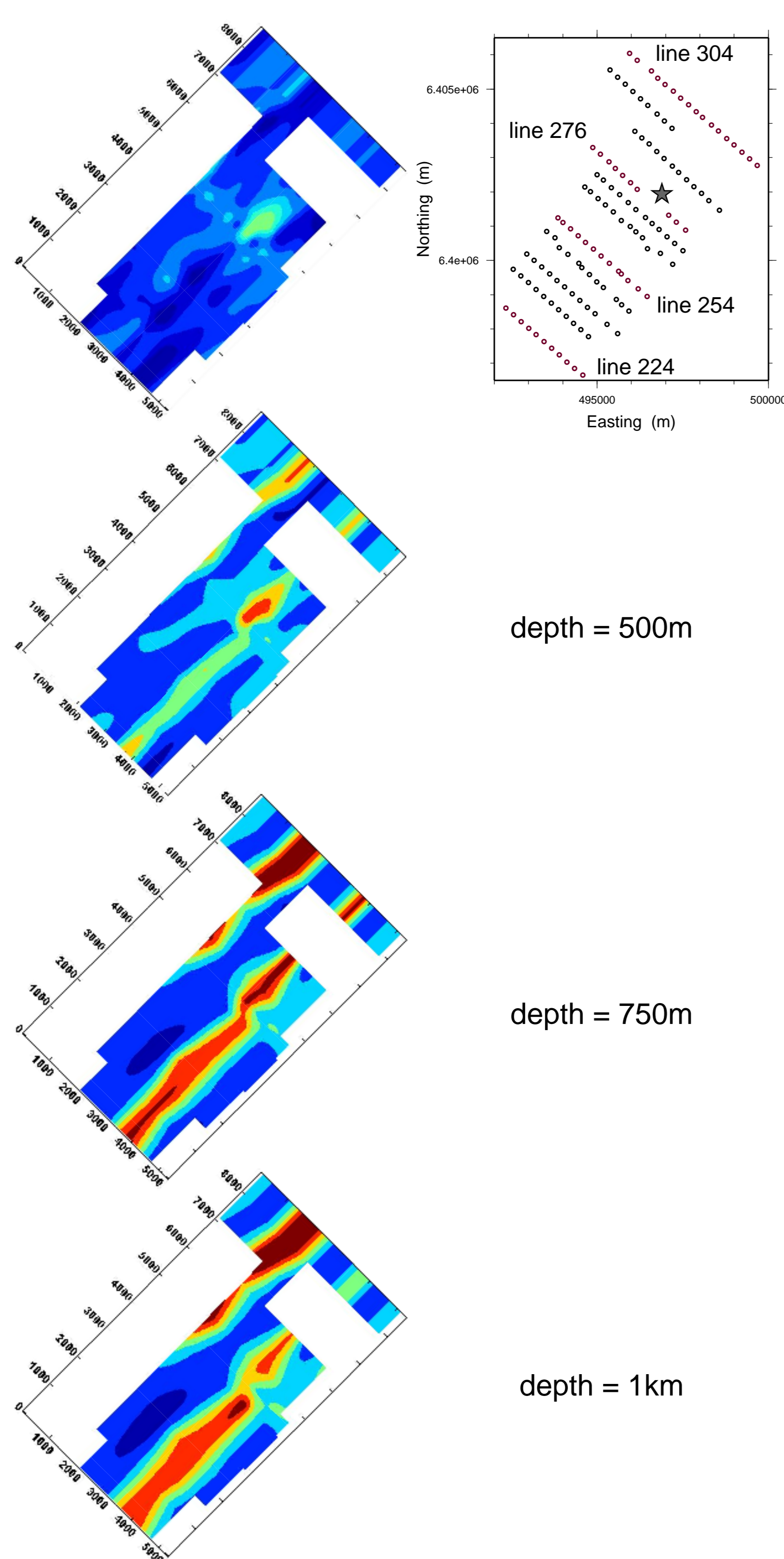
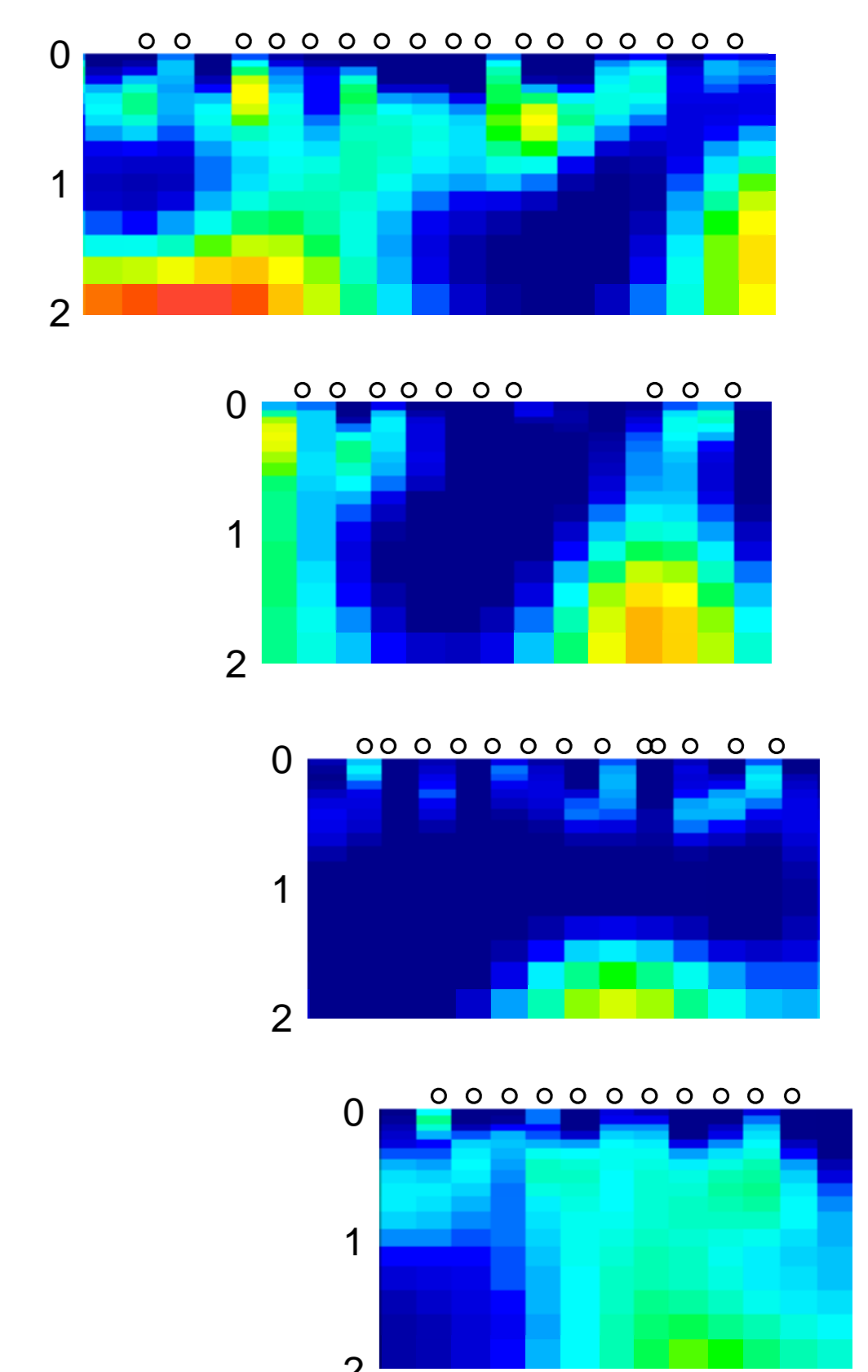
3-D, Siripunvaraporn



3-D, Mackie



3-D, Farquharson



Algorithm: Rodi & Mackie, 2001, Geophysics, 66, 174-187.
Data: TE & TM apparent resistivities and phases, and tipper.
Error floors: 20%, 5%, 0.025, respectively.
Static shift incorporated: yes.

Algorithm: Siripunvaraporn, Egbert, Lenbury & Uyeshima, 2005, PEPI, 150, 3-14.
Data: impedances (off-diagonal elements only, real and imaginary parts), 16 frequencies.
Error floors: 5%.
Static shift incorporated: no.
Mesh: 56x56x33, aligned with survey lines.

Algorithm: Mackie, Rodi & Watts, 2001, SEG Expanded Abstracts, 20, 1501.
Data: $\ln Z_{xy}$ & $\ln Z_{yx}$, Z_{xx} & Z_{yy} , tipper, 9 frequencies (1000-10Hz).
Error floors: 5% for $\ln Z_{xy}$ & $\ln Z_{yx}$, 20% for Z_{xx} & Z_{yy} , 0.02 for tipper.
Static shift incorporated: yes.
Mesh: 56x44x79, aligned with survey lines.

Algorithm: Farquharson, Oldenburg, Haber & Shekhtman, 2002, SEG Expanded Abstracts, 21, 649.
Data: impedances (off-diagonal and diagonal elements, real and imaginary parts), 11 frequencies (1280-3.8Hz).
Errors: variances estimated from processing (i.e., variances in edi file).
Static shift incorporated: no.
Mesh: 60x70x40, aligned NS-EW.