Appendix A

RES2DINV Inversion Parameters

Thesis inversion parameters

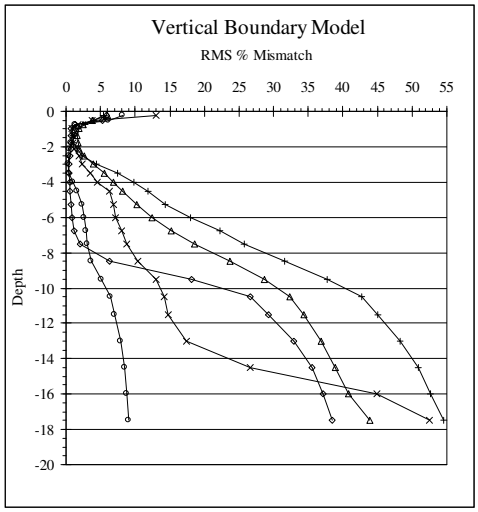
The following list shows the inversion parameters chosen for the software used in this study.

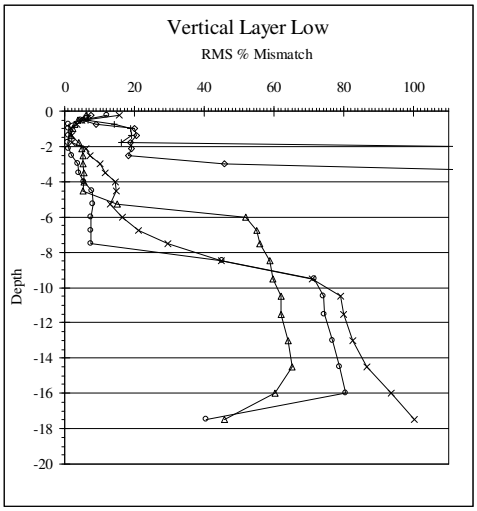
Software: RES2DINV ver. 3.51z References: Loke & Barker, 1996; Loke, 2002.

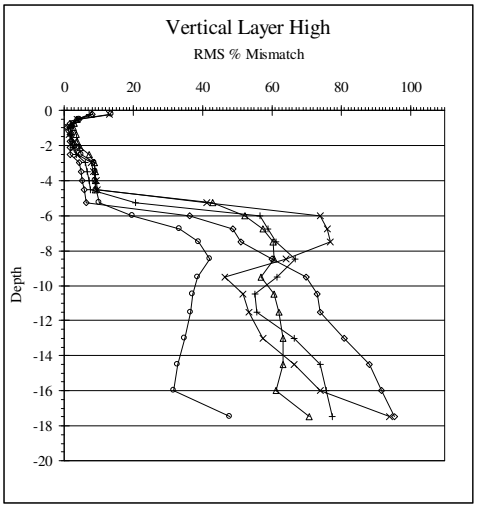
Initial damping factor is 0.1600.
Minimum damping factor is 0.0150.
Line search is always used.
Convergence limit is 1.0000.
Minimum change in RMS error is 0.4000.
Number of iterations is 20.
Vertical to horizontal flatness filter ratio is 1.0000.
User defined increase in layer thickness.
Number of nodes between adjacent electrodes is 4.
Smoothness constrain is only used directly on model resistivity values.
Number of topographical datum points is not reduced.
Topographical modeling is to be carried out.
Least-squares linear topographical trend to be removed.
Jacobian matrix is recalculated for first two iterations.
Increase of damping factor with depth is 1.0500.
Topographic modeling is not carried out.
Robust data inversion constrain is used with cutoff factor 0.0500.
Robust model inversion constrain is used with cutoff factor 0.0050.
Extended model is used.
Effect of side blocks is not reduced.
Normal mesh is used.
Damping factor is not optimized at each iteration.
No inter-model constrain is used in time-lapse inversion.
Simultaneous time-lapse inversion is used.
Thickness of first layer is 0.2500.
Factor to increase layer thickness with depth varies by array.
Finite element method is used.
Width of blocks used is 1 times the unit electrode spacing.
Model blocks can have different widths.
RMS convergence limit is 1.0 percent.
Logarithms of apparent resistivity values are used for the inversion.
Resistivity/IP data are inverted sequentially.
Do not proceed automatically in sequential IP inversion.
IP damping factor is 0.1500.
Automatic IP damping factor is not used.
Cutoff factor for borehole data is 0.00100.
Range of resistivity values are limited.
Upper resistivity cutoff limit is 20.00000.
Lower resistivity cutoff limit is 0.05000.
Average resistivity used.

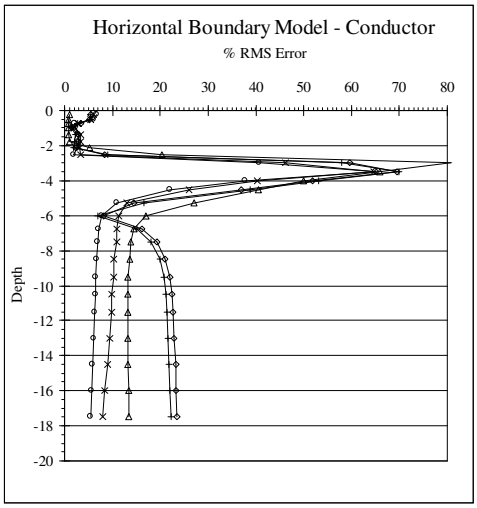
Appendix B

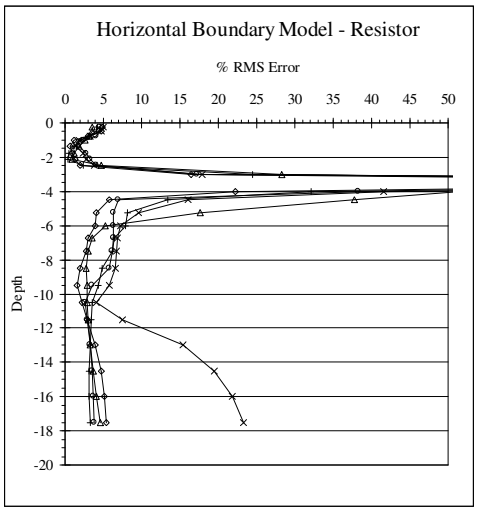
Graphs of Resistivity Mismatch as a Function of Depth For All Twelve Models

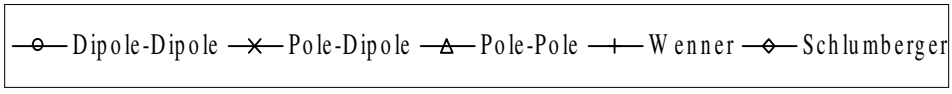




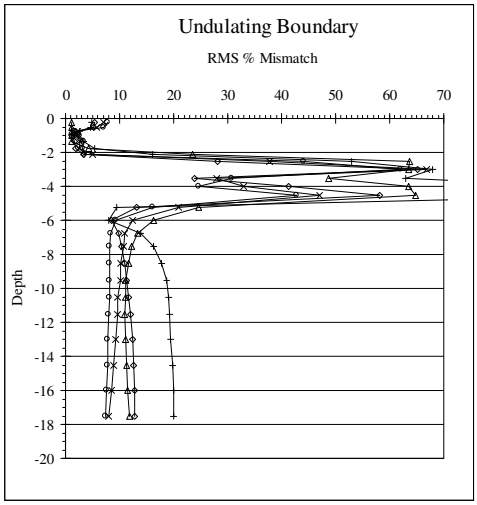


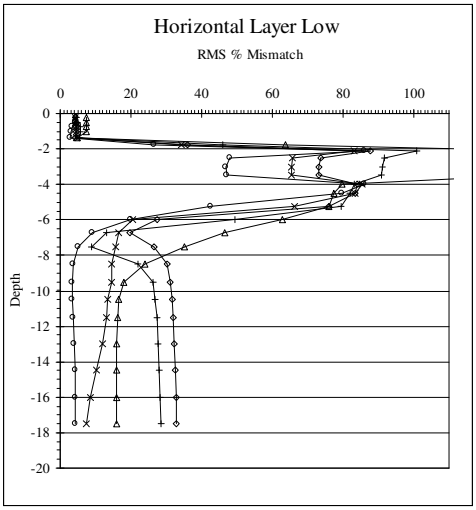


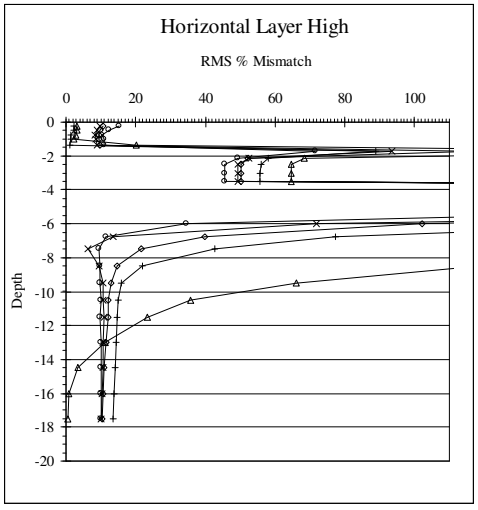


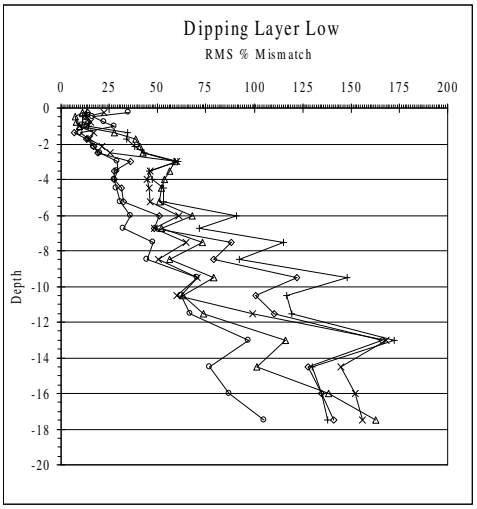


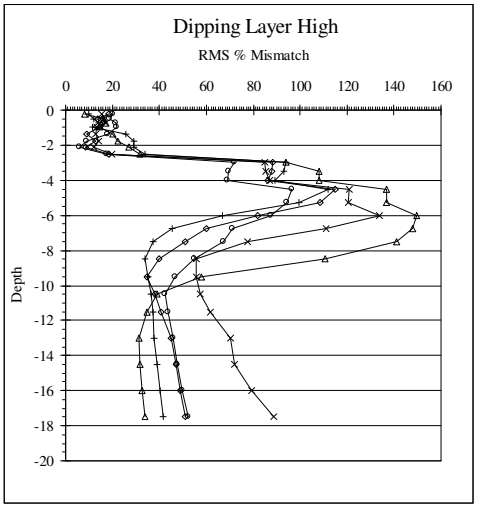
Graphs of the layer-by-layer resistivity mismatch for the five DCR arrays for the vertical boundary, vertical conductor, vertical resistor, horizontal conductor over resistor, and horizontal resistor over conductor models.

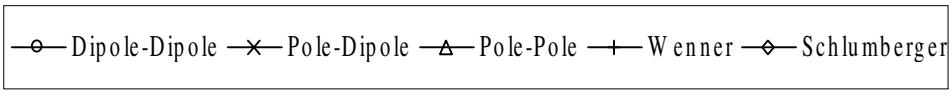




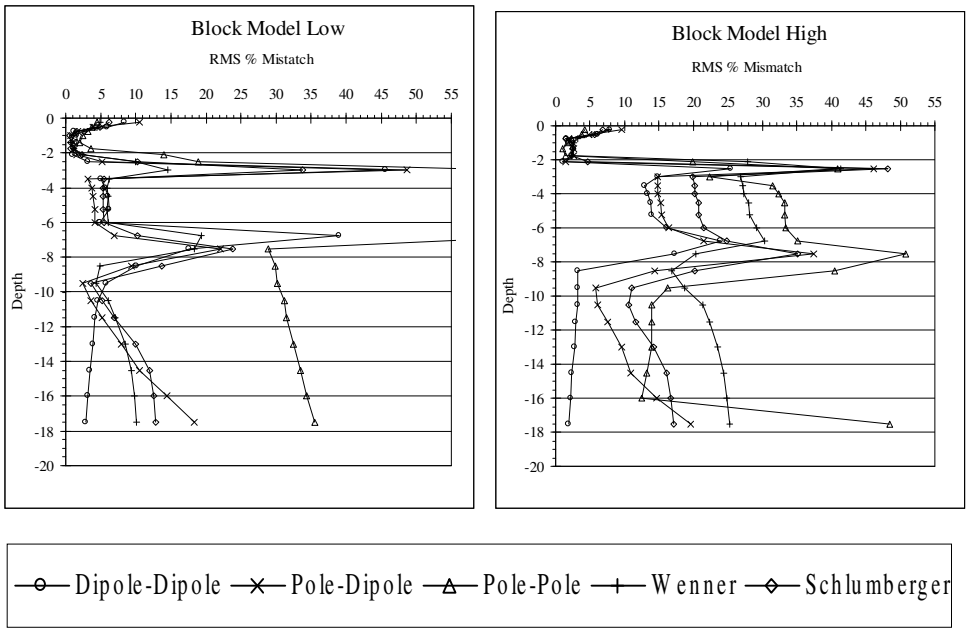








Graphs of the layer-by-layer resistivity mismatch for the five DCR arrays for the undulating boundary, horizontal conductive layer in a resistor, horizontal resistive layer in a conductor, dipping conductive layer and dipping resistive layer models.



Graphs of the layer-by-layer resistivity mismatch for the five DCR arrays for the conductive block and resistive models.

Appendix C

Tables of Resistivity Mismatch and Array Performance Grades For the Shallow, Intermediate, and Deep Portions of All Twelve Models, And Overall Array Performance Grades For All Twelve Models

VB	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	3.34	2.20	6.67	A	A	A	A
PD	4.66	6.54	25.75	A	A	B	A
PP	3.50	12.50	32.65	A	A	B	A
WN	3.77	17.33	42.56	A	A	C	B
SC	2.61	2.18	26.73	A	A	B	A

VLL	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	4.93	18.06	55.56	A	A	C	B
PD	6.78	38.11	83.71	A	B	E	C
PP	4.37	35.57	59.05	A	B	C	B
WN	109.04	176.77	209.31	E	E	E	E
SC	9.99	151.60	217.01	A	E	E	D

VLH	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	6.53	22.90	37.66	A	B	B	B
PD	5.75	38.89	61.73	A	B	D	B
PP	5.90	39.45	61.76	A	B	D	B
WN	4.33	39.36	65.74	A	B	D	B
SC	3.80	31.75	75.01	A	B	D	B

Resistivity mismatches and array performance grades for the S, I, and D portions of the VB, VLL, and VLH models, and overall array performance grade for all arrays. Depth acronyms from Table 4. Model acronyms from Table 1. Array acronyms from Figure 1.

HBL	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	22.39	25.41	5.65	B	B	A	B
PD	23.95	28.34	8.34	B	B	A	B
PP	29.84	36.46	5.46	B	B	A	B
WN	29.00	37.34	20.55	B	B	B	B
SC	29.16	37.00	21.10	B	B	B	B

HBH	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	60.44	62.67	4.38	C	C	A	B
PD	45.27	46.18	7.30	C	C	A	B
PP	31.78	34.24	6.70	B	B	A	B
WN	40.97	42.64	4.35	C	C	A	B
SC	38.33	39.17	3.66	B	B	A	B

UB	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	25.90	30.27	8.16	B	B	A	B
PD	25.88	32.73	8.40	B	B	A	B
PP	32.39	42.19	7.02	B	C	A	B
WN	34.24	57.47	18.50	B	C	A	B
SC	23.85	33.56	11.70	B	B	A	B

HLL	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	38.61	47.78	4.86	B	C	A	B
PD	46.30	56.22	12.85	C	C	A	B
PP	76.62	79.57	17.50	D	D	A	C
WN	61.16	69.37	24.66	D	D	B	C
SC	50.62	62.18	29.13	C	D	B	C

HLH	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	39.34	202.60	10.90	B	E	A	C
PD	43.81	211.74	10.73	C	E	A	C
PP	73.55	189.25	94.81	D	E	E	E
WN	45.44	203.30	31.30	C	E	B	C
SC	48.00	209.94	16.52	C	E	A	C

Resistivity mismatches and array performance grades for the S, I, and D portions of the HBL, HBH, UB, HLL, and HLH models, and overall array performance grade for all arrays. Depth acronyms from Table 4. Model acronyms from Table 1. Array acronyms from Figure 1.

DLL	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	30.40	33.59	72.57	B	B	D	C
PD	28.74	50.23	111.43	B	C	E	C
PP	35.55	56.98	98.16	B	C	E	C
WN	34.64	71.17	126.76	B	D	E	D
SC	19.17	49.16	116.42	B	C	E	C

DLH	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	35.34	73.22	53.09	B	D	C	C
PD	40.46	95.40	74.85	C	E	D	C
PP	48.94	121.32	80.24	C	E	E	C
WN	46.46	76.22	38.53	C	D	B	D
SC	41.47	79.29	46.18	C	D	C	C

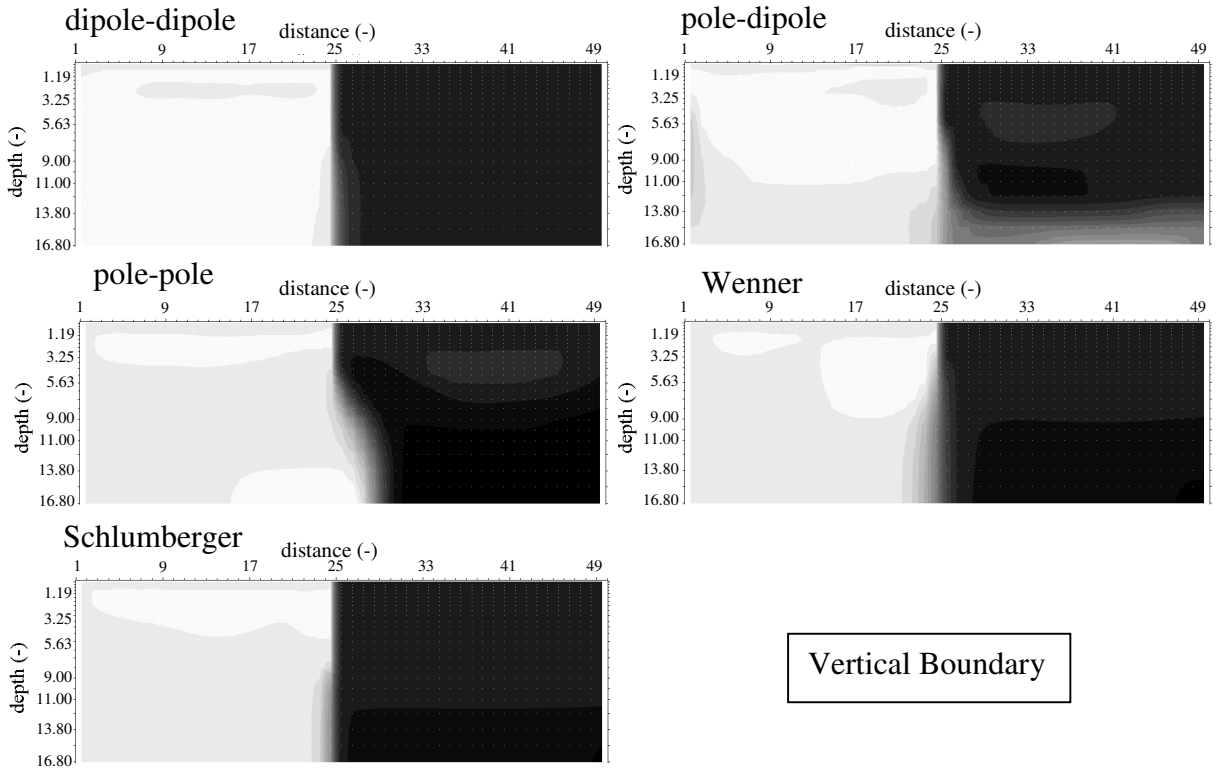
BL	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	14.96	20.44	14.29	A	B	A	A
PD	15.96	17.60	11.78	A	A	A	A
PP	29.48	56.95	37.65	B	C	B	B
WN	6.40	11.08	10.94	A	A	A	A
SC	11.62	15.02	12.30	A	A	A	A

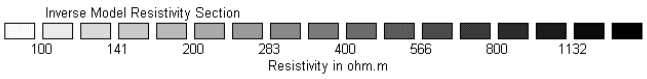
BH	Resistivity Mismatch			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	10.72	16.54	9.66	A	A	A	A
PD	16.45	23.66	17.36	A	B	A	A
PP	18.96	36.04	29.98	A	B	B	B
WN	20.13	28.19	23.05	B	B	B	B
SC	18.02	26.67	19.15	A	B	A	A

Resistivity mismatches and array performance grades for the S, I, and D portions of the DLL, DLH, BL and BH models, and overall array performance grade for all arrays. Depth acronyms from Table 4. Model acronyms from Table 1. Array acronyms from Figure 1.

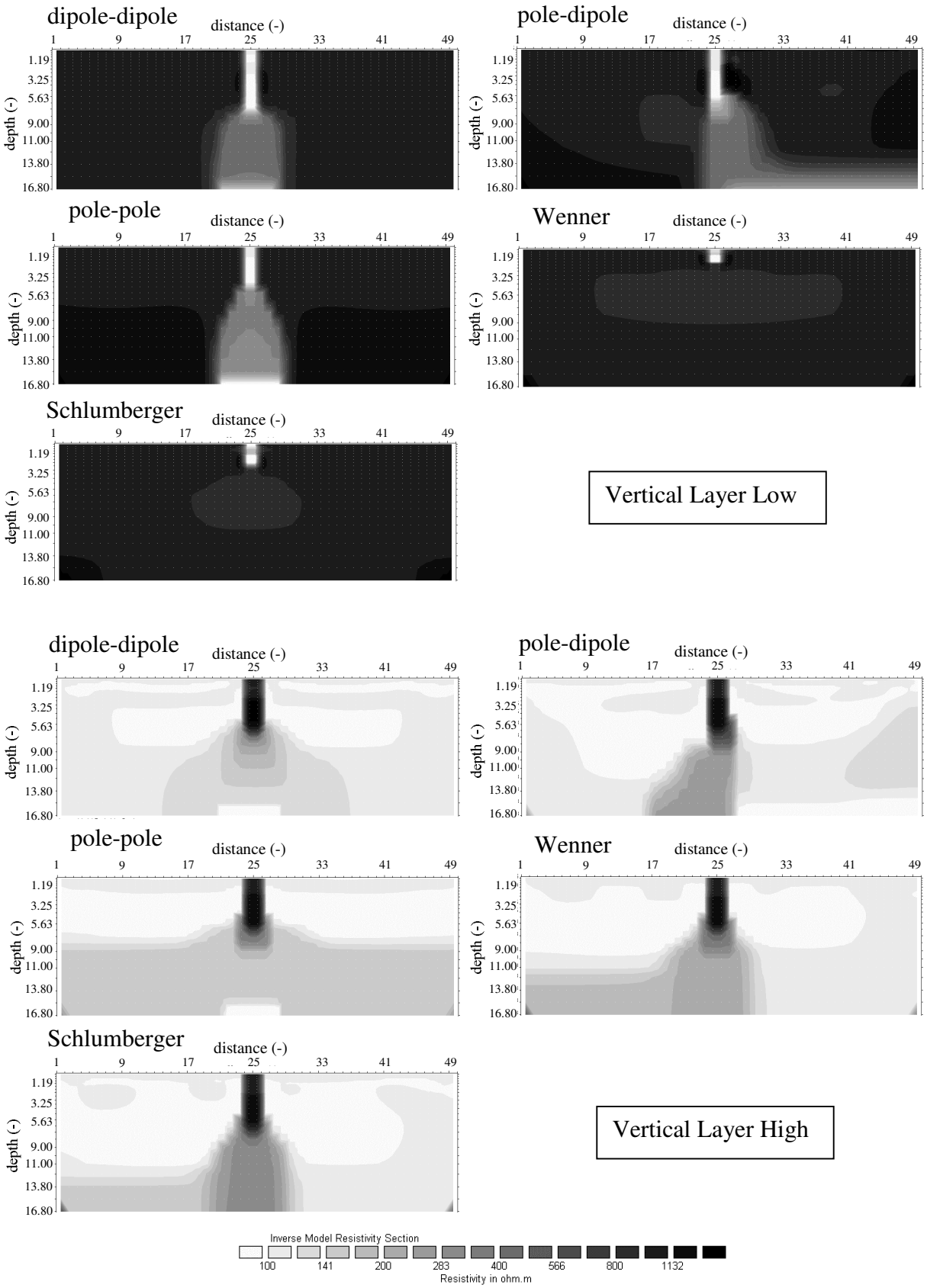
Appendix D

Inversion Results
For All Twelve Models

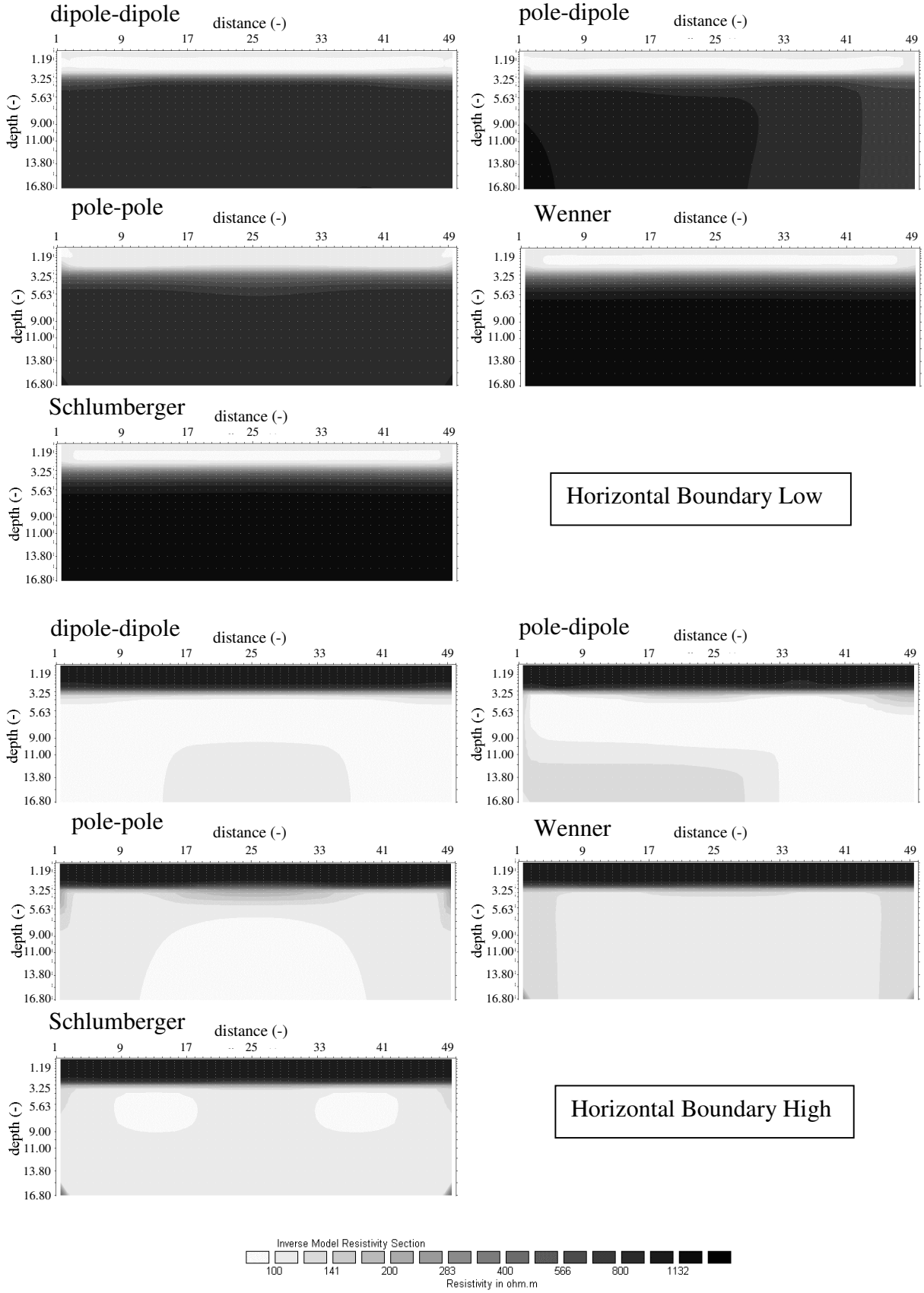




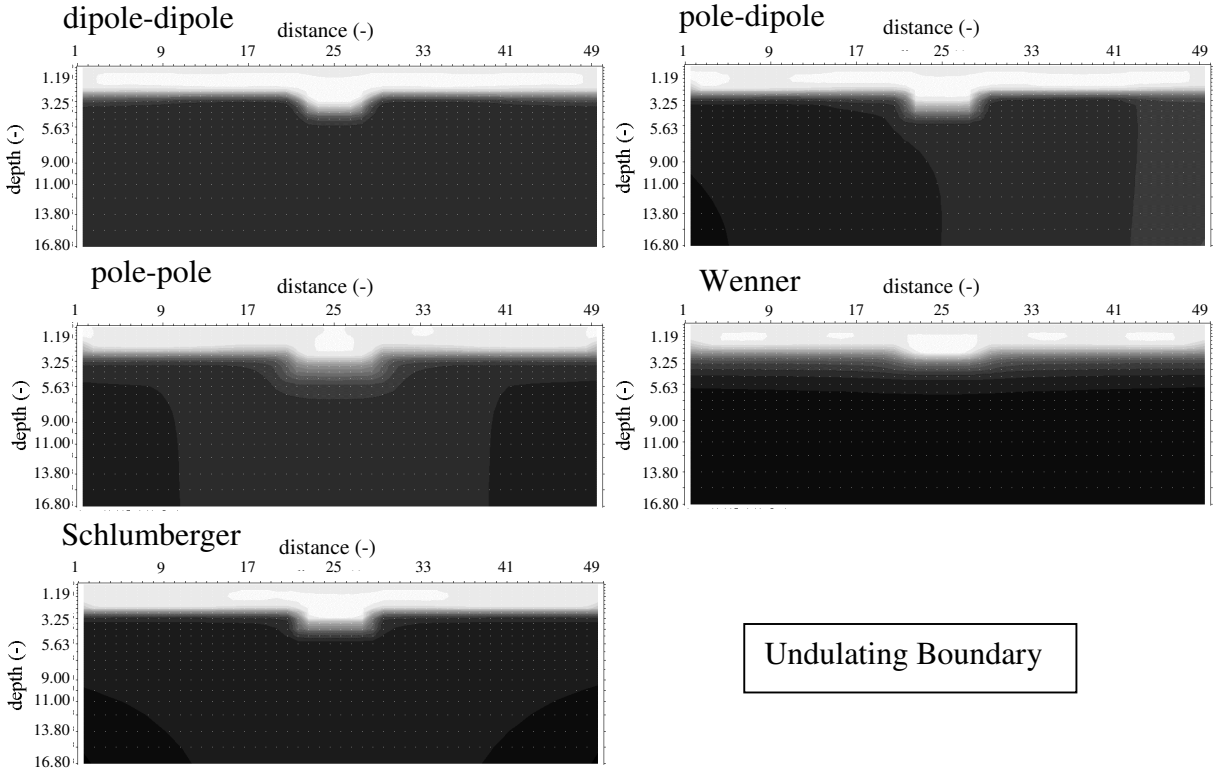
Inversion results for the VB model using the data from the DD, PD, PP, WN, and SC. Model acronyms from Table 1. Array acronyms from Figure 1. Distance and depth are dimensionless.



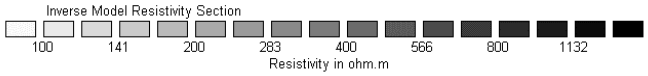
Inversion results for the VLL and VLH models using the data from the DD, PD, PP, WN, and SC. Model acronyms from Table 1. Array acronyms from Figure 1. Distance and depth are dimensionless.



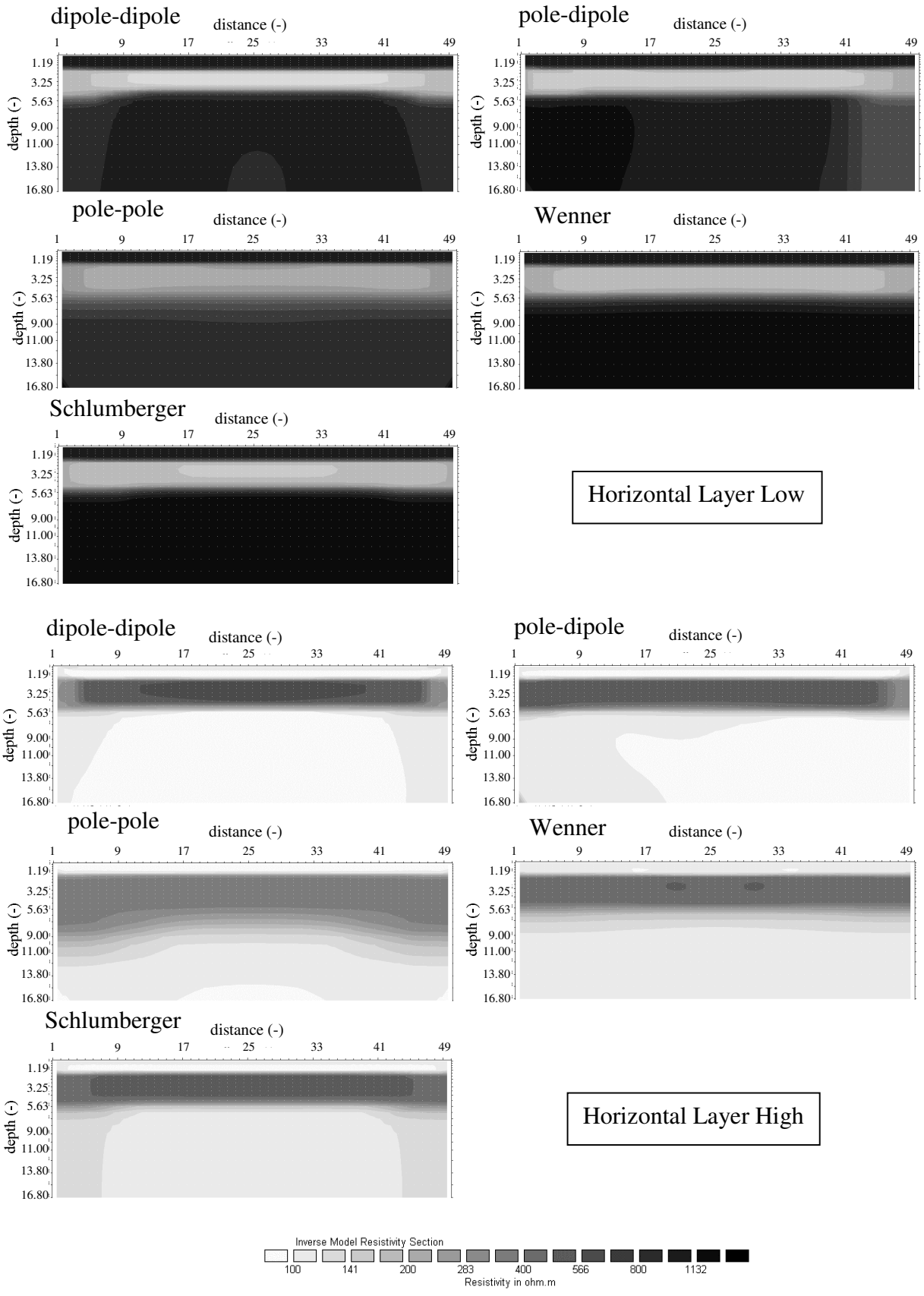
Inversion results for the HBL and HBH models using the data from the DD, PD, PP, WN, and SC. Model acronyms from Table 1. Array acronyms from Figure 1. Distance and depth are dimensionless.



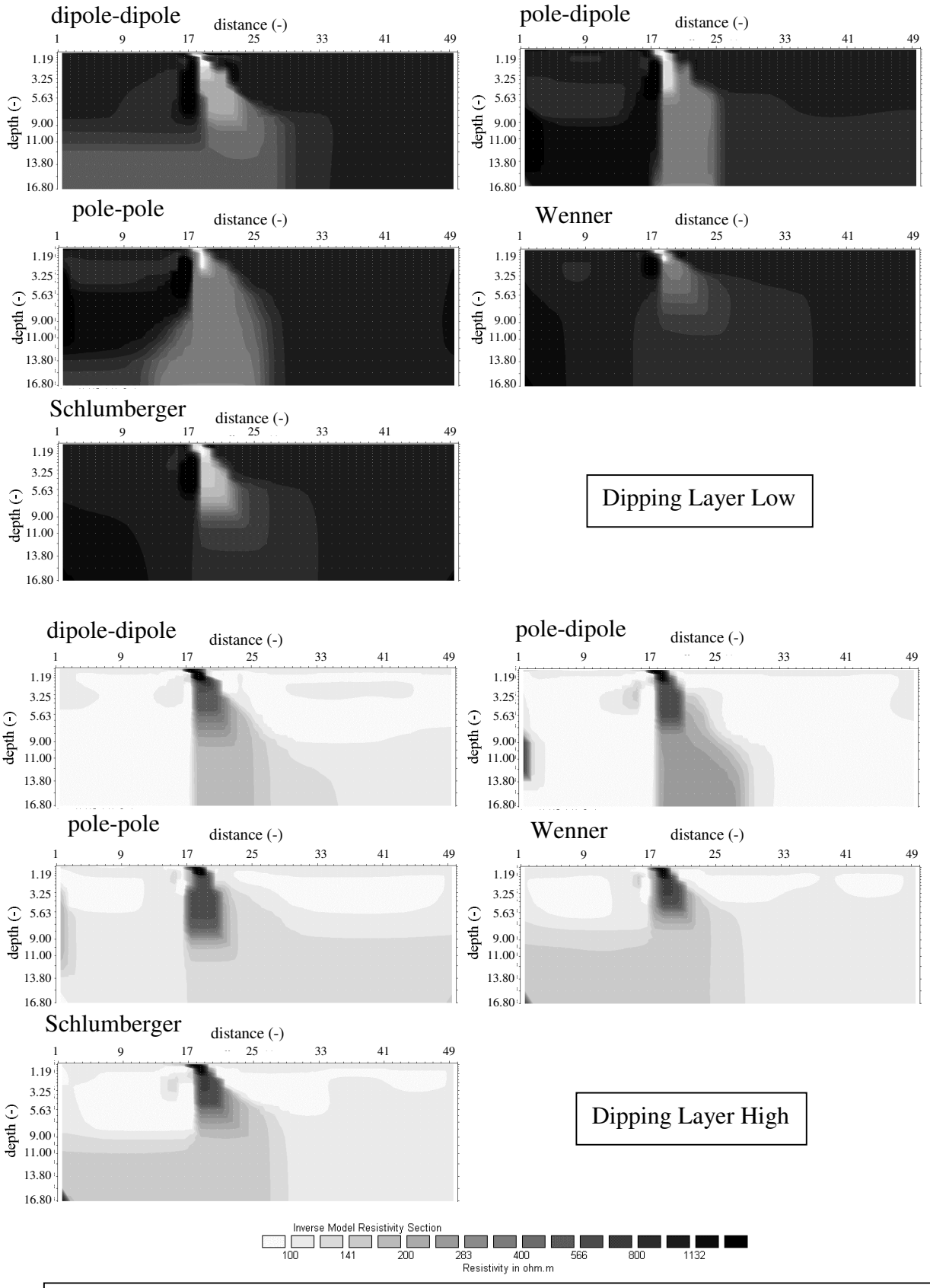
Undulating Boundary



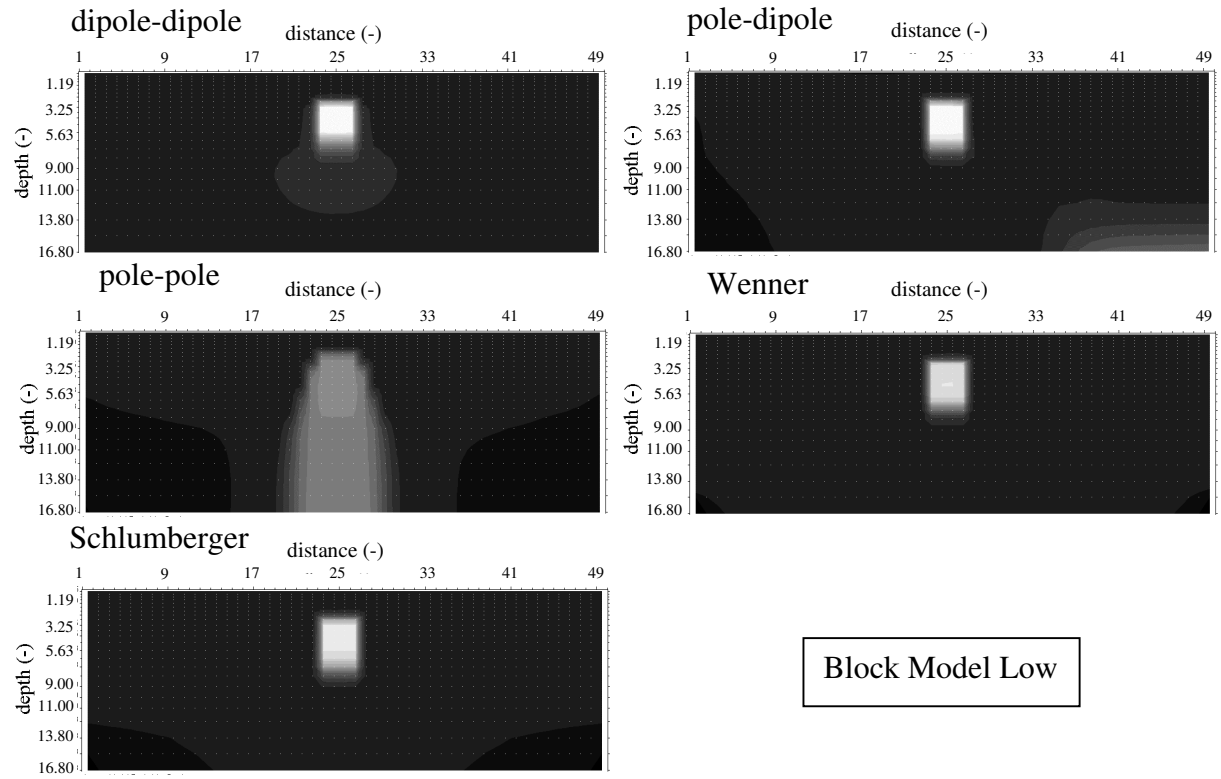
Inversion results for the UB model using the data from the DD, PD, PP, WN, and SC. Model acronyms from Table 1. Array acronyms from Figure 1. Distance and depth are dimensionless.



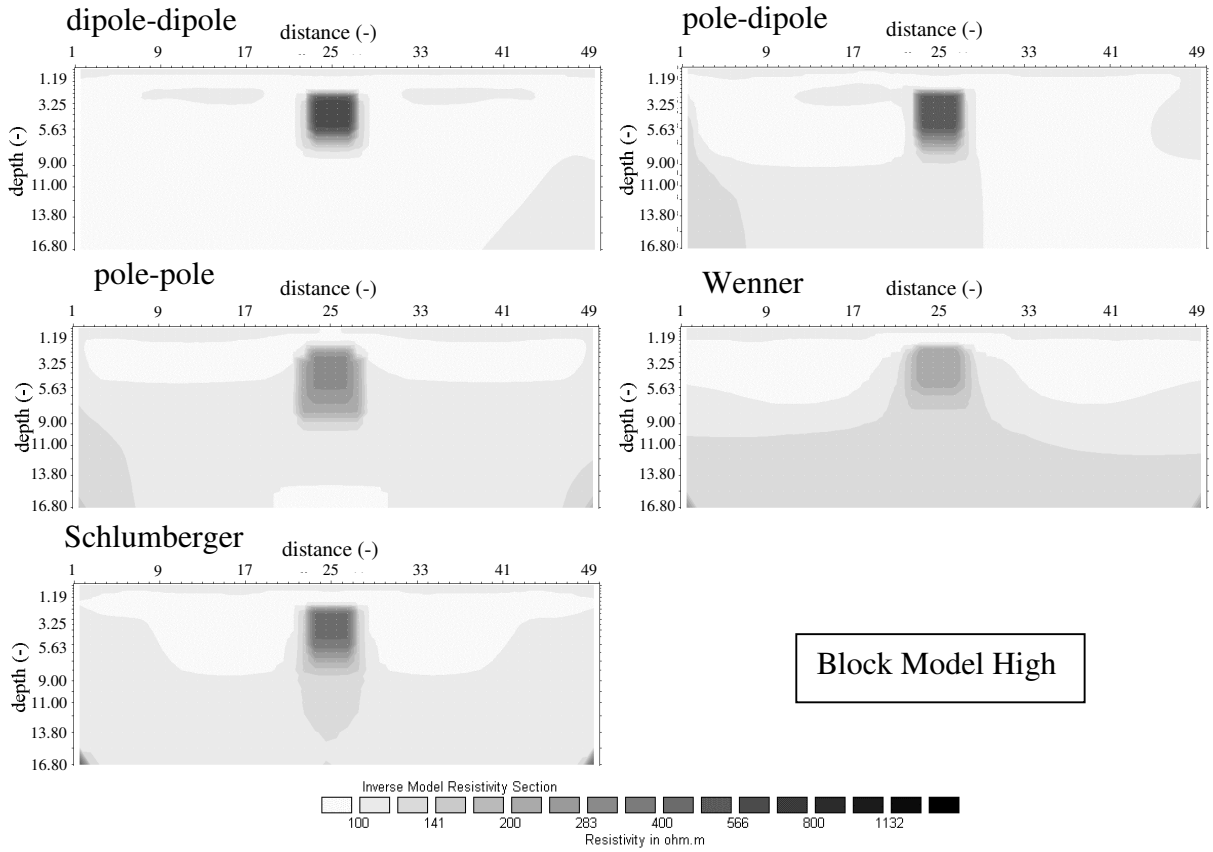
Inversion results for the HLL and HLH models using the data from the DD, PD, PP, WN, and SC. Model acronyms from Table 1. Array acronyms from Figure 1. Distance and depth are dimensionless.



Inversion results for the DLL and DLH models using the data from the DD, PD, PP, WN, and SC. Model acronyms from Table 1. Array acronyms from Figure 1. Distance and depth are dimensionless.



Block Model Low

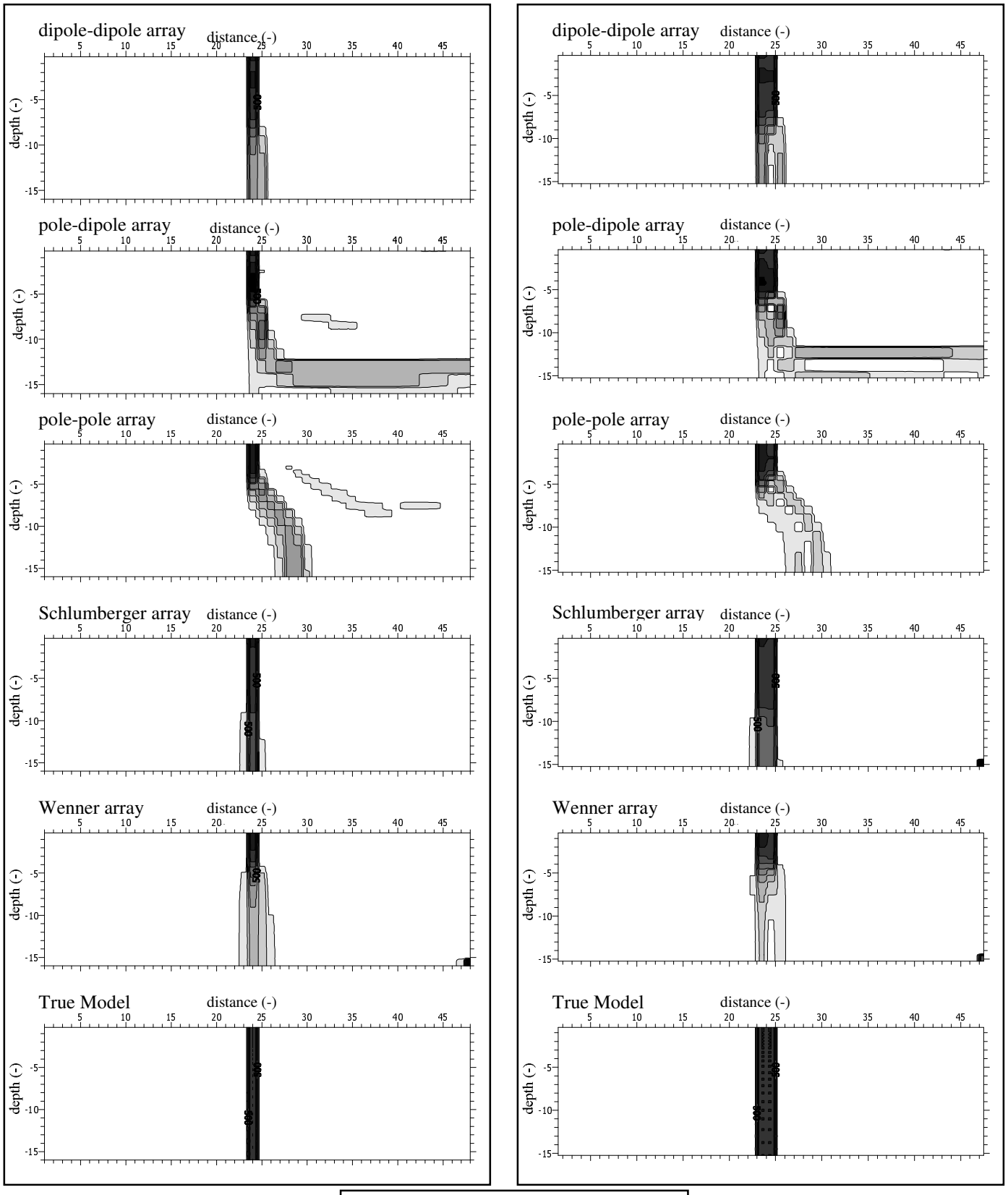


Block Model High

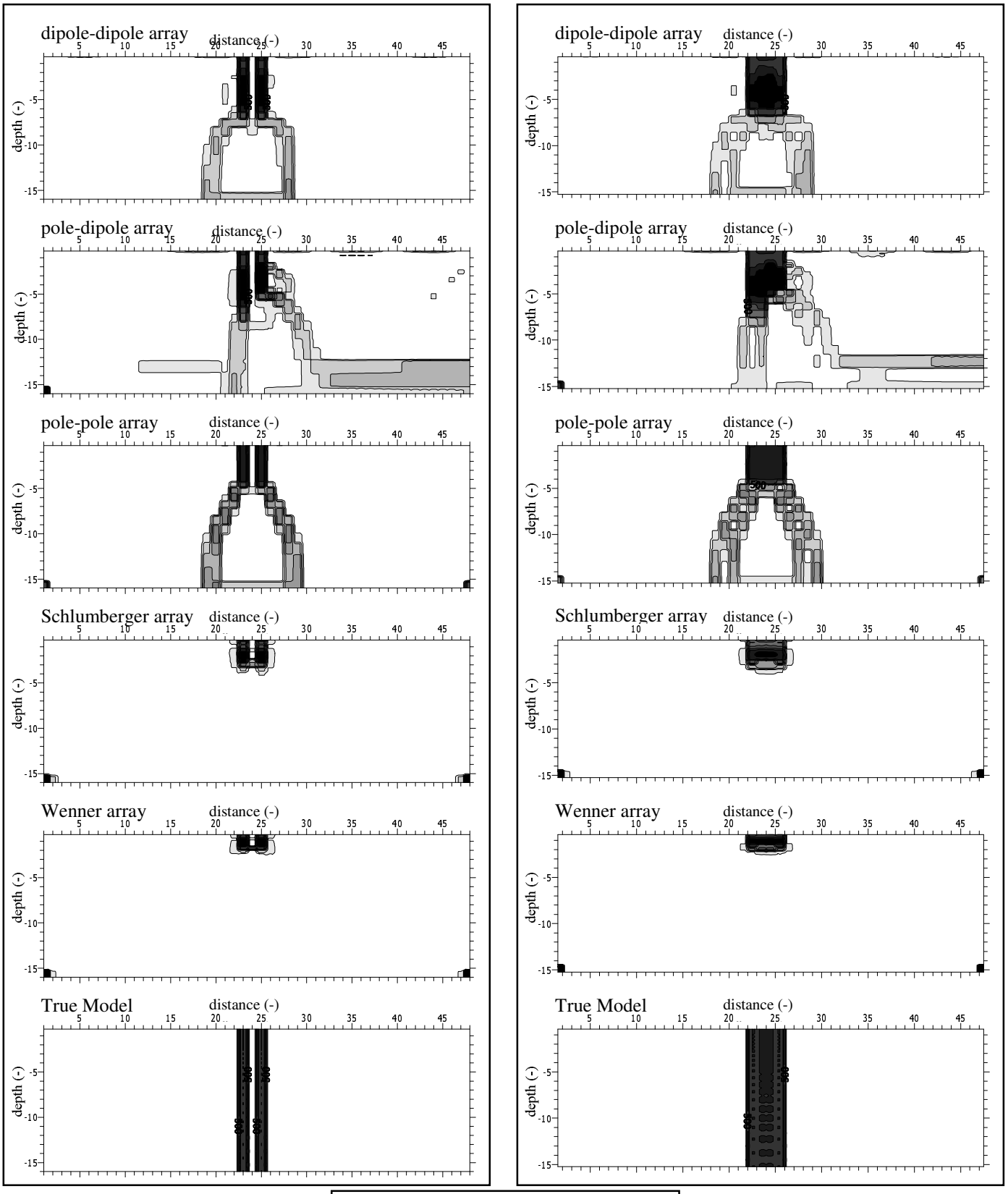
Inversion results for the BL and BH models using the data from the DD, PD, PP, WN, and SC. Model acronyms from Table 1. Array acronyms from Figure 1. Distance and depth are dimensionless.

Appendix E

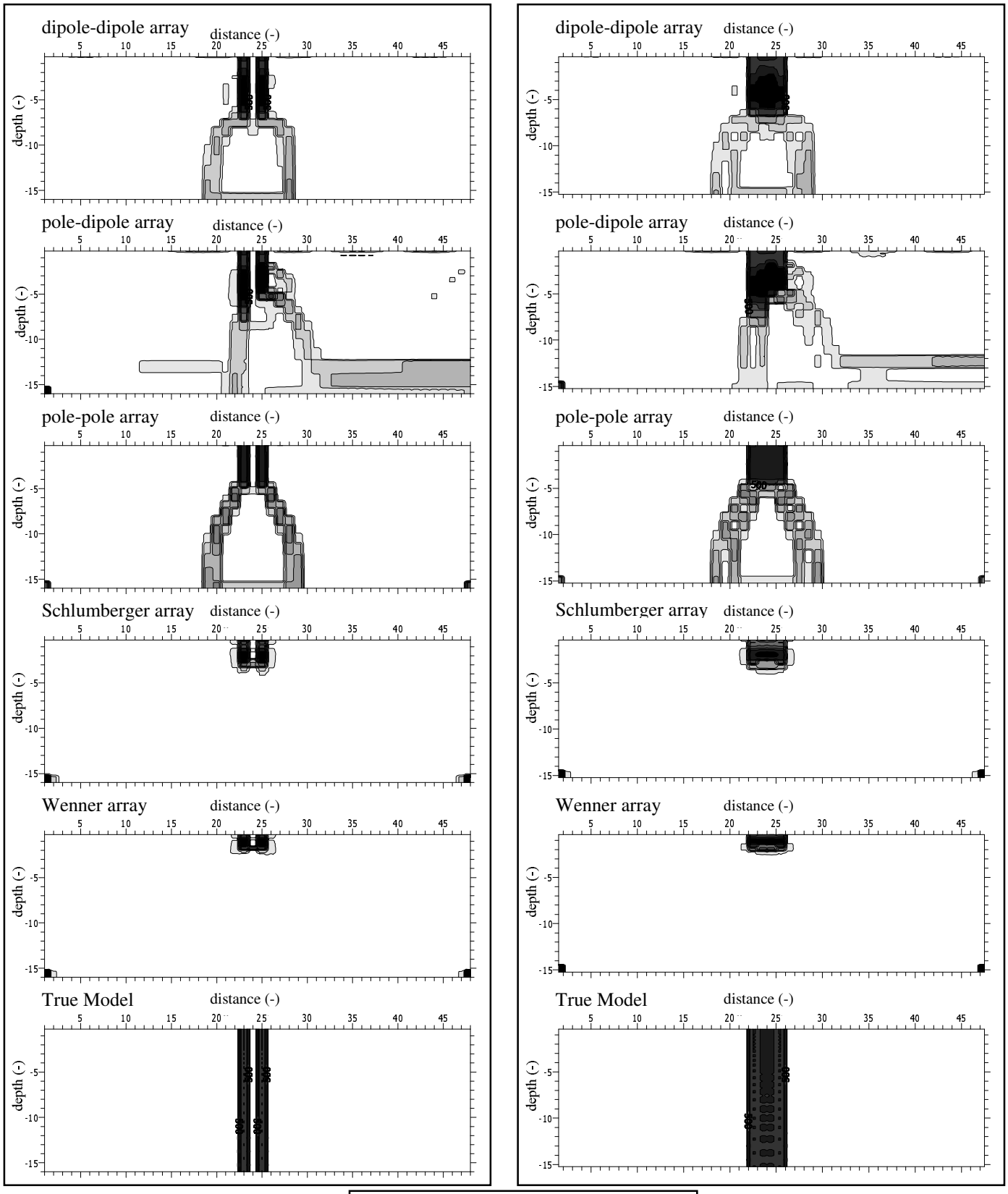
Plots of 2D Spatial Gradient and 2D Spatial Laplacian Of the Inversion Results For All Twelve Models



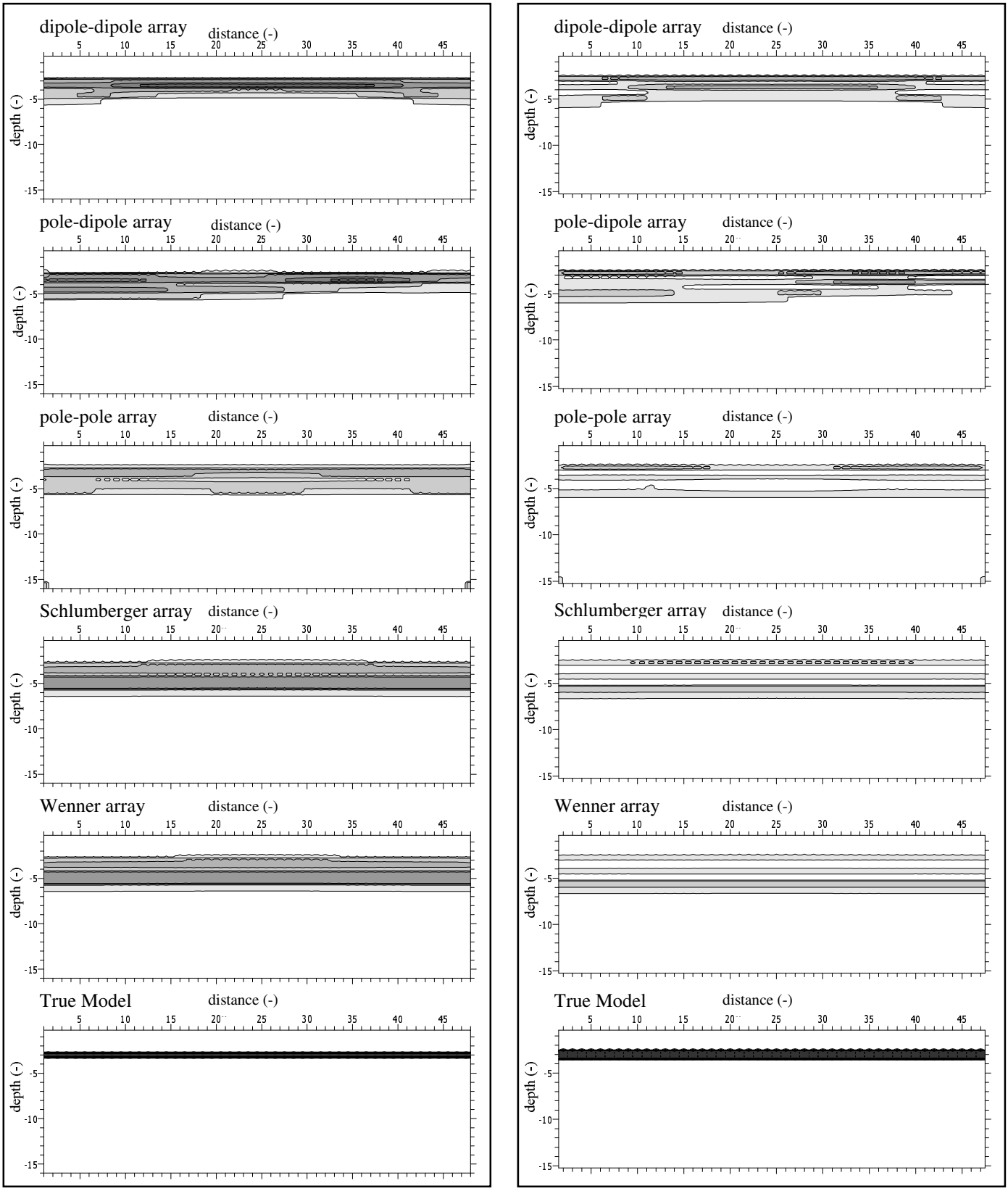
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of VB model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



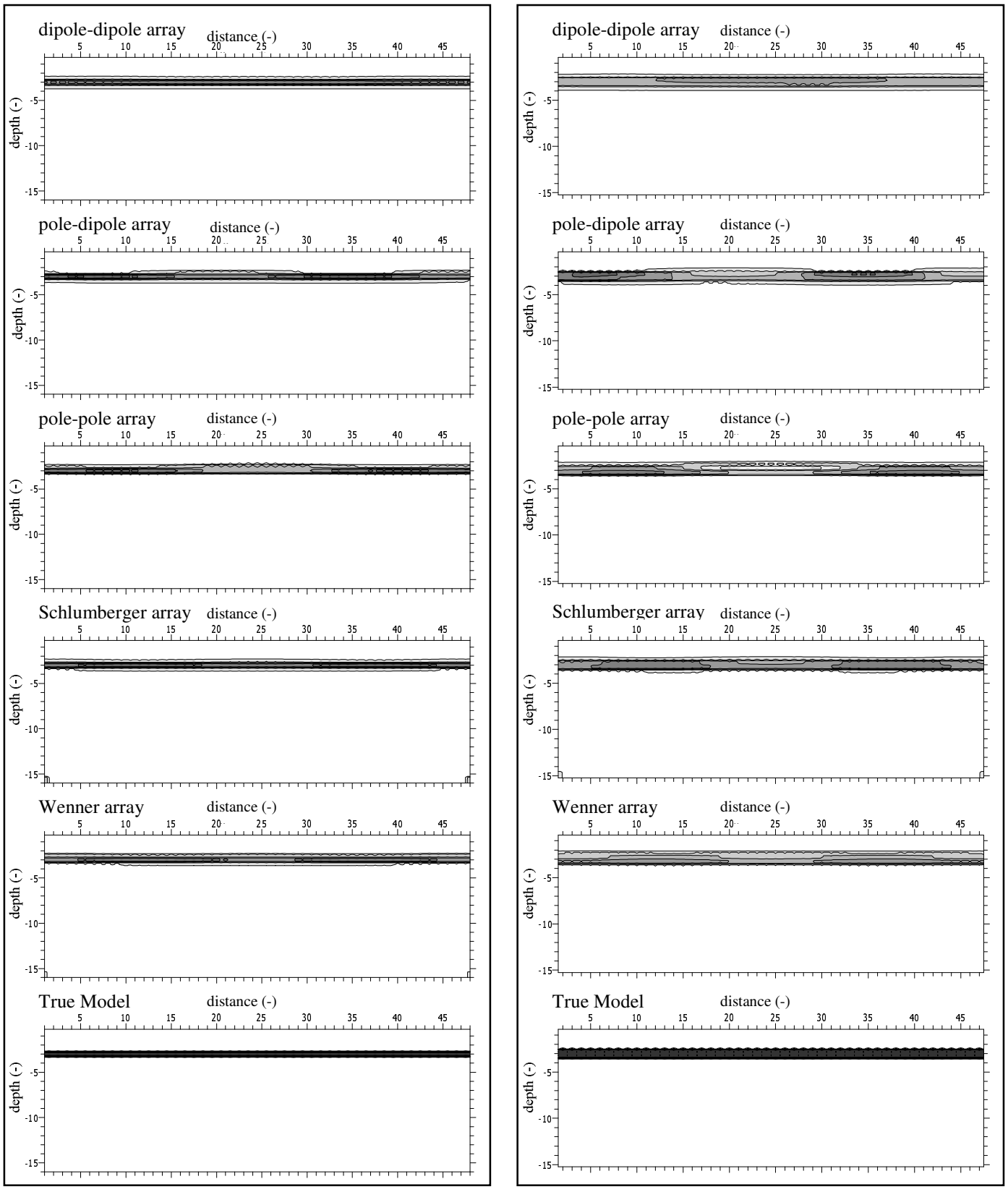
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of VLL model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



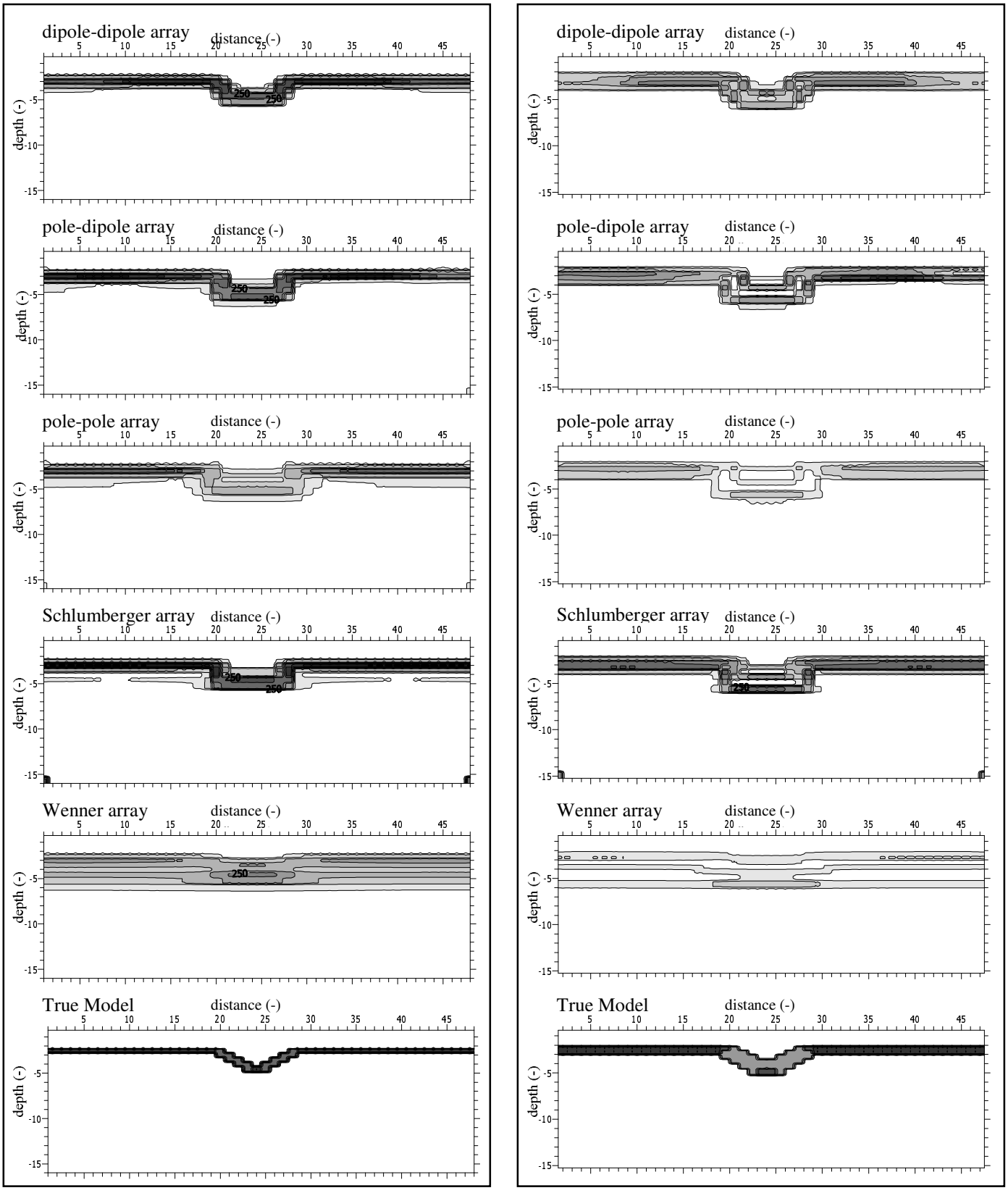
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of VLH model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



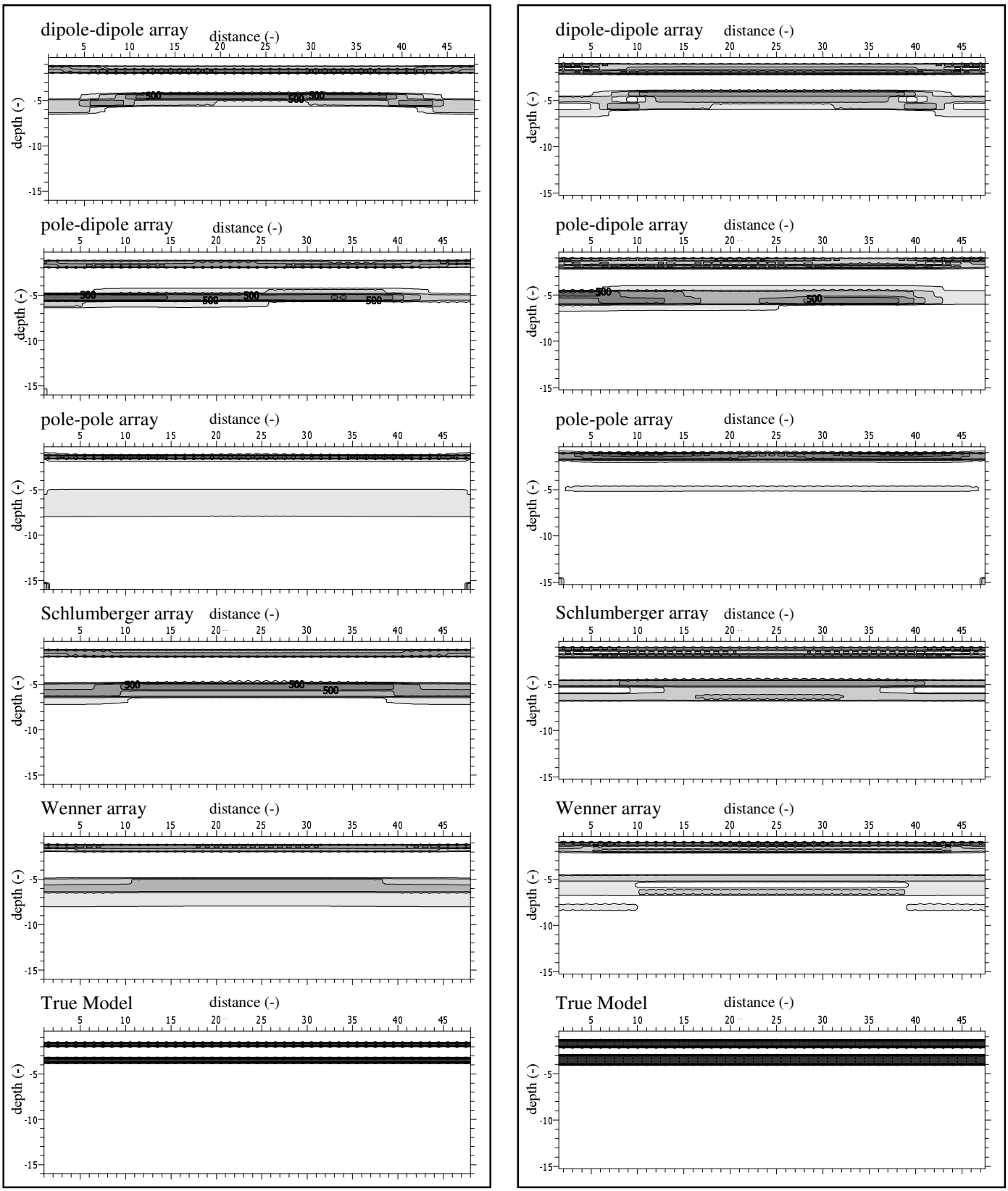
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of HBL model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



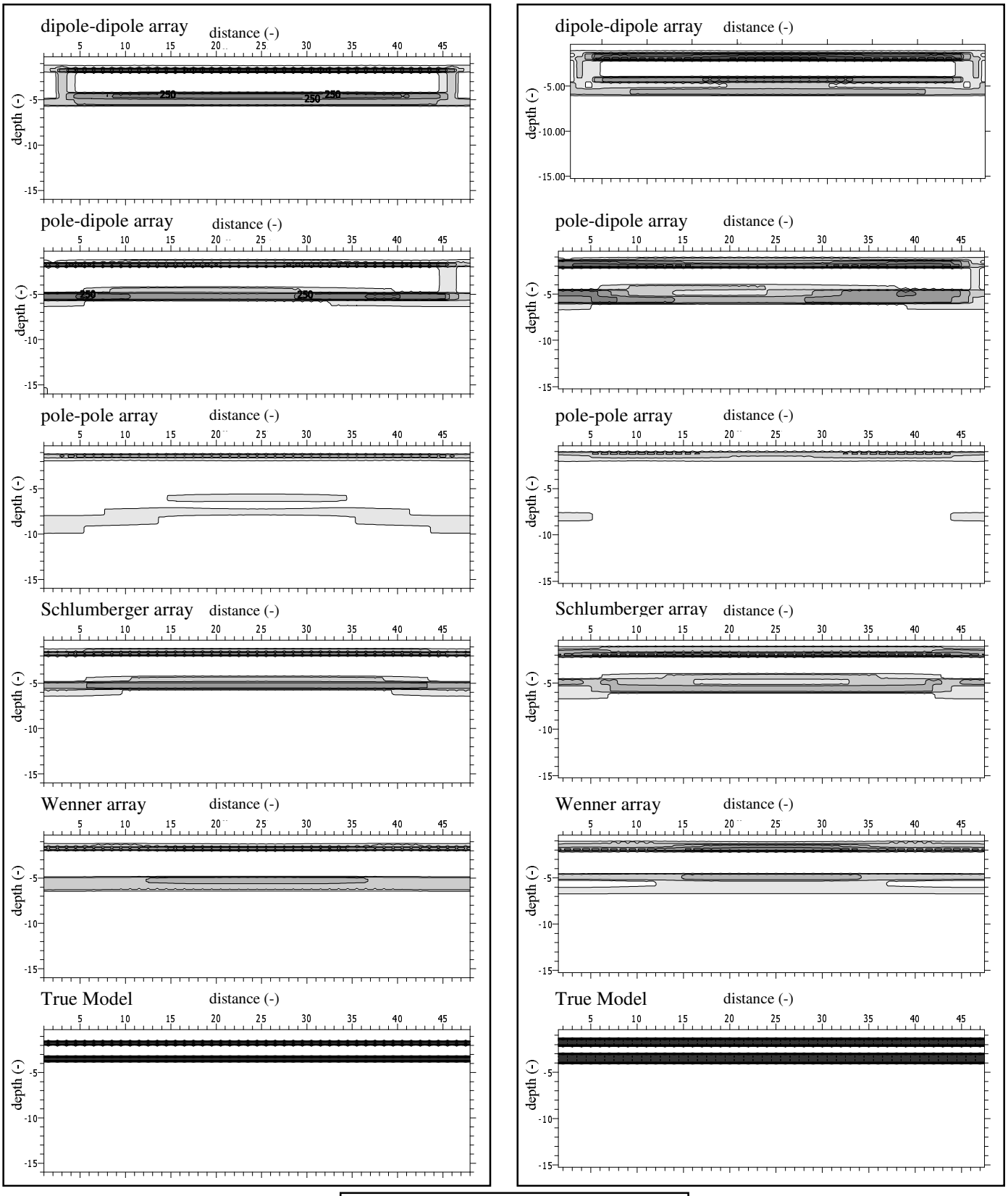
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of HBH model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



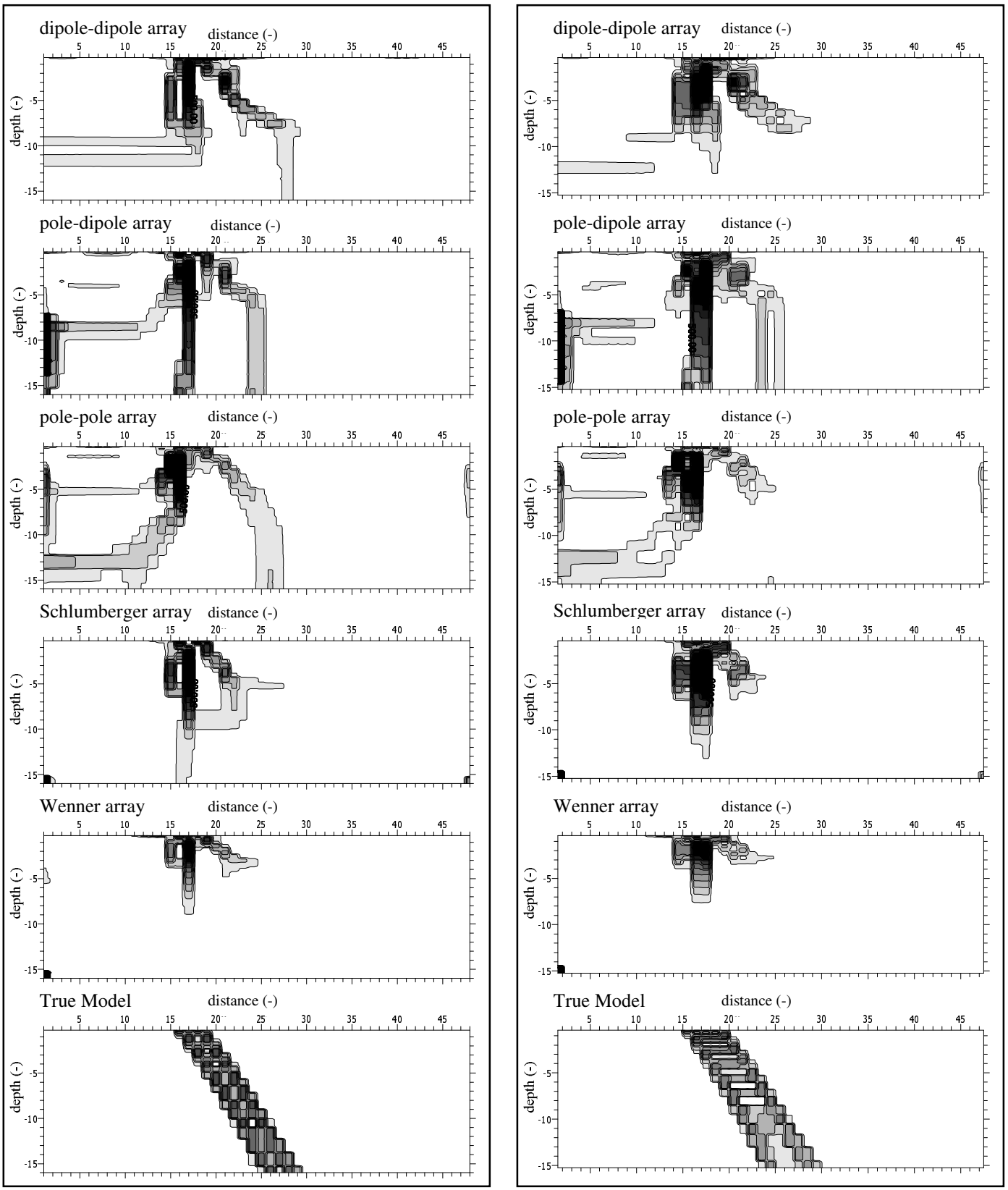
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of UB model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



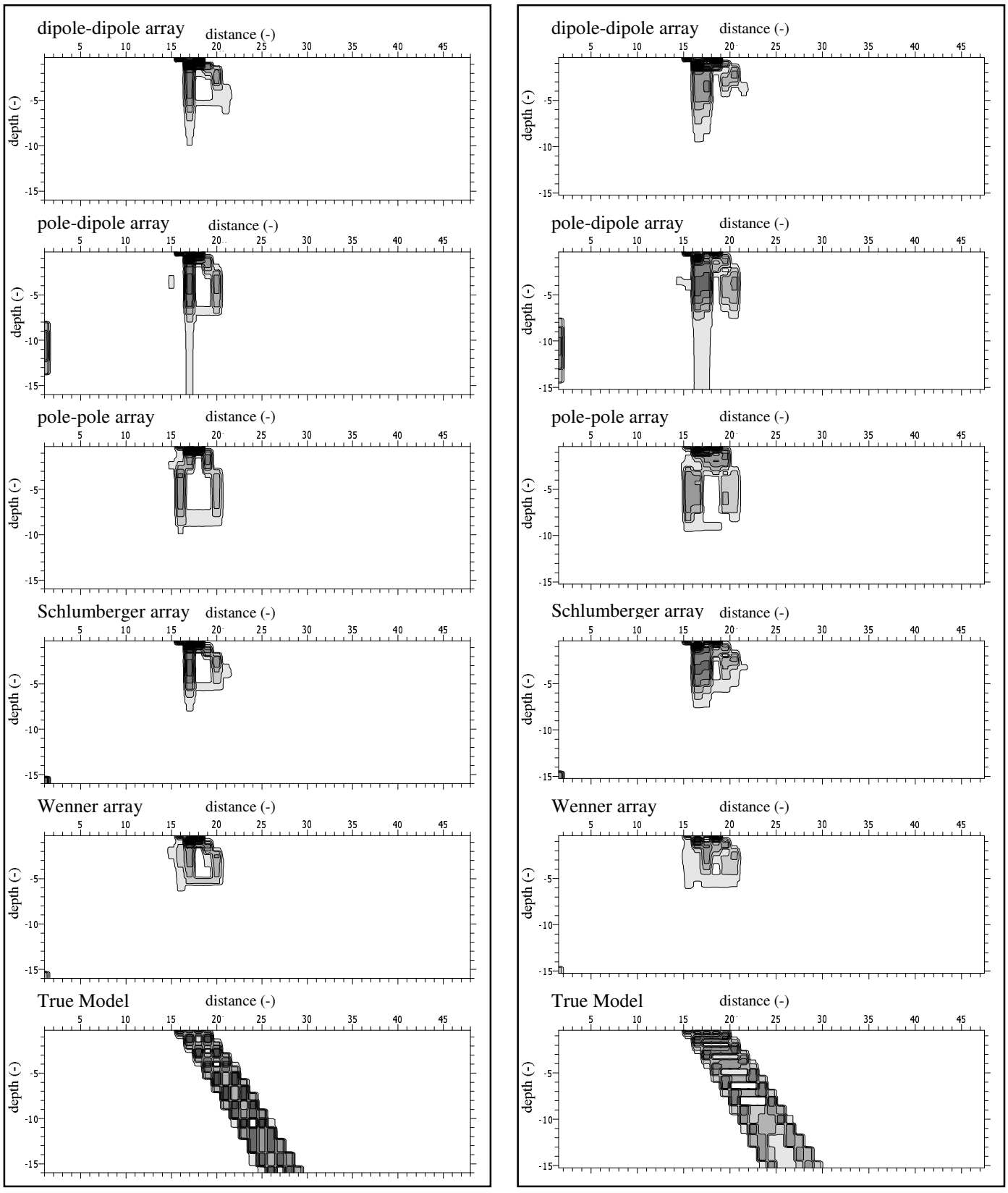
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of HLL model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



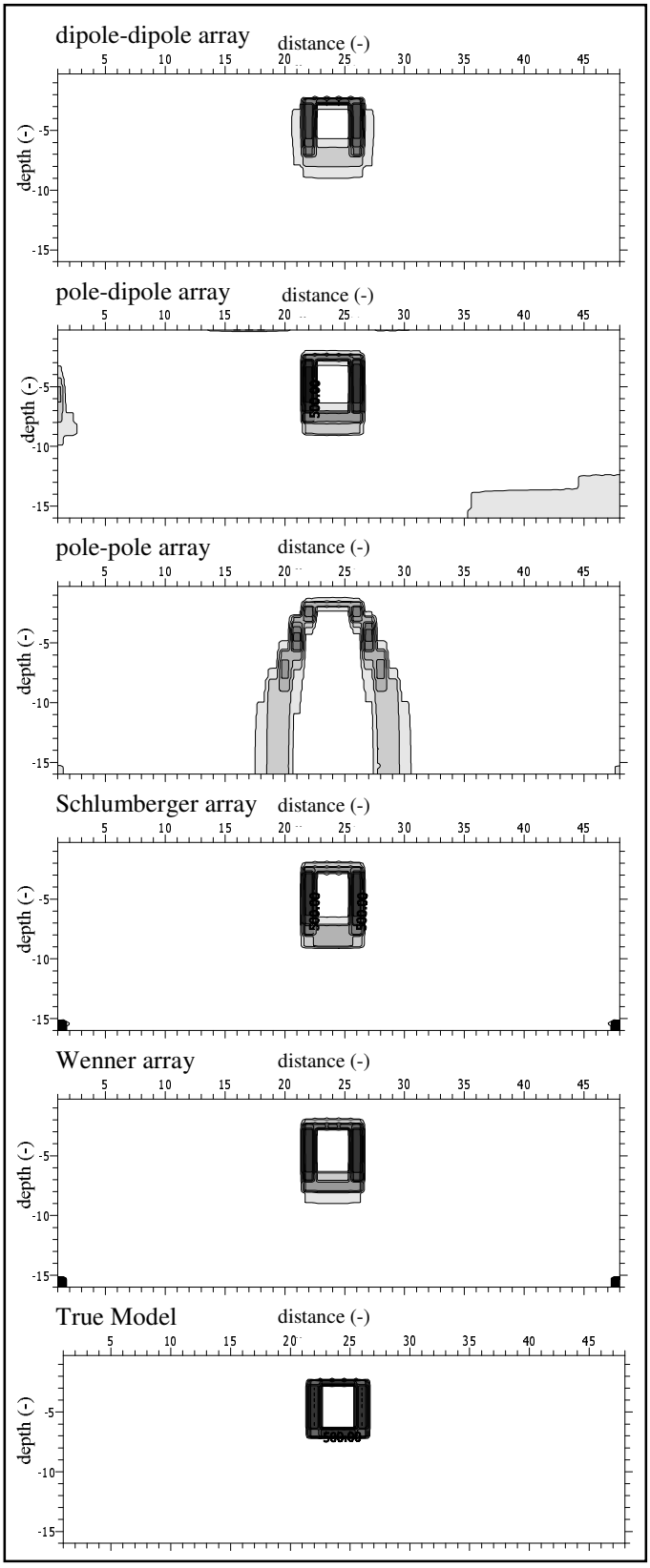
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of HLH model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.

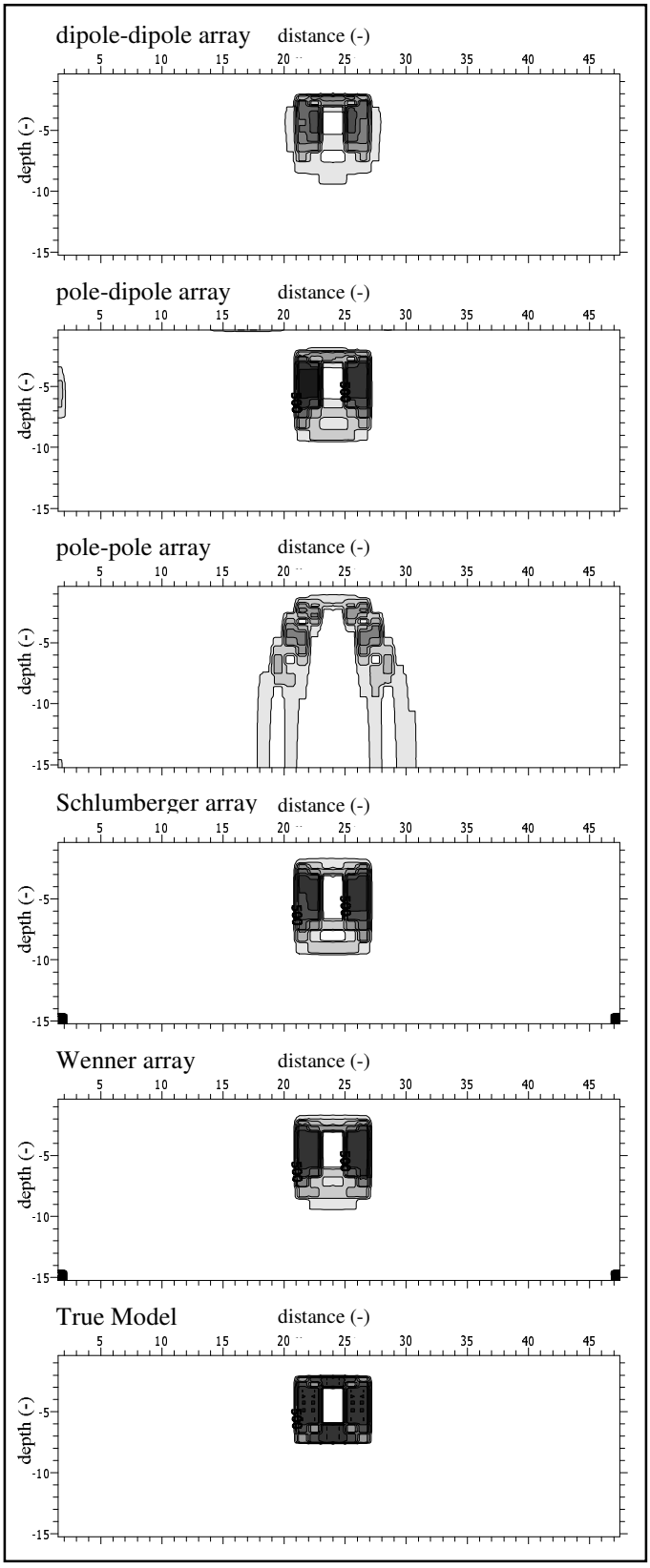


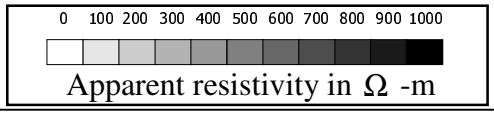
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of DLL model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



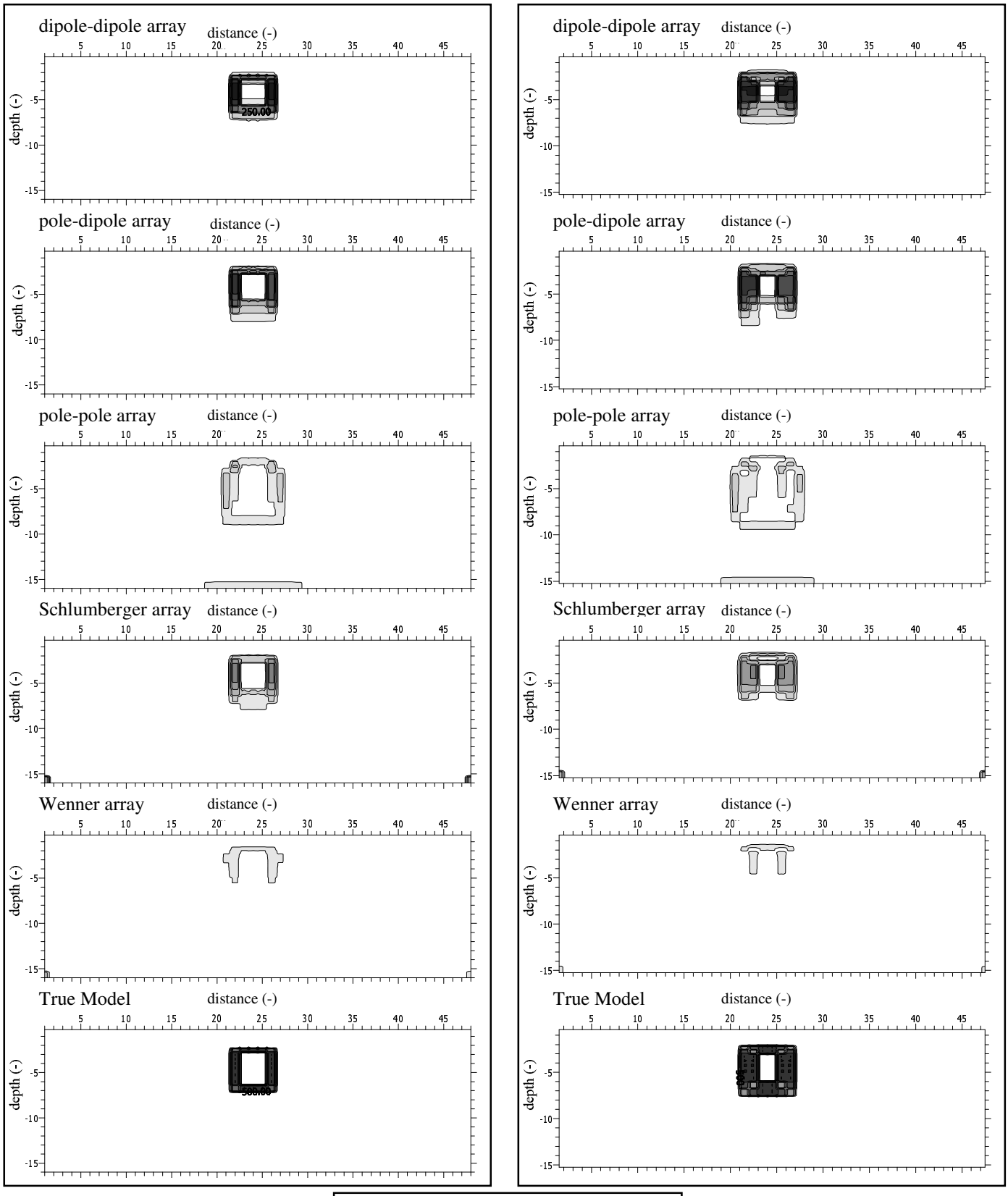
Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of DLH model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.







Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of BL model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.



Plots of the spatial gradient (left) and spatial Laplacian (right) of the inversion results of BH model for the five DCR arrays and the true model. Model acronym from Table 1. Distance and depth are dimensionless.

Appendix F

Tables of Combined Boundary Mismatch and Array Performance Grades For the Shallow, Intermediate-depth, and Deep Portions of All Twelve Models, And Overall Array Performance Grades For All Twelve Models

VB	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	0.00	0.00	0.64	A	A	A	A
PD	0.00	0.72	10.94	A	A	C	B
PP	0.00	2.61	14.67	A	A	C	B
WN	0.00	0.29	1.29	A	A	A	A
SC	0.00	0.00	0.00	A	A	A	A

VLL	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	0.00	0.60	9.86	A	A	B	A
PD	0.00	3.23	16.79	A	A	D	B
PP	0.00	2.86	12.03	A	A	C	B
WN	23.61	92.03	100.00	E	E	E	E
SC	0.00	61.65	100.00	A	E	E	D

VLH	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	0.00	8.42	67.00	A	B	E	C
PD	0.00	0.68	42.11	A	A	E	B
PP	0.00	3.98	52.80	A	A	E	B
WN	0.00	0.75	65.83	A	A	E	B
SC	0.00	0.38	62.16	A	A	E	B

Combined mean boundary mismatches and array performance grades for the S, I, and D portions of the VB, VLL, and VLH models for all arrays. Depth acronyms from Table 4. Model acronyms from Table 1. Array acronyms from Figure 1.

HBL	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	4.53	4.53	*	A	A	*	A
PD	5.66	5.66	*	B	B	*	B
PP	8.77	8.77	*	B	B	*	B
WN	14.28	14.28	*	C	C	*	C
SC	14.17	14.17	*	C	C	*	C

HBH	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	0.00	0.00	*	A	A	*	A
PD	0.00	0.00	*	A	A	*	A
PP	0.55	0.55	*	A	A	*	A
WN	0.00	0.00	*	A	A	*	A
SC	0.00	0.00	*	A	A	*	A

UB	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	5.17	5.30	*	B	B	*	B
PD	5.20	5.81	*	B	B	*	B
PP	5.63	6.35	*	B	B	*	B
WN	14.17	13.07	*	C	C	*	C
SC	5.74	6.14	*	B	B	*	B

HLL	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	8.72	10.96	*	B	C	*	B
PD	13.07	14.03	*	C	C	*	C
PP	22.03	14.27	*	E	C	*	D
WN	19.88	17.97	*	D	D	*	D
SC	14.51	16.80	*	C	D	*	D

HLH	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	7.16	10.64	*	B	C	*	B
PD	11.76	13.65	*	C	C	*	C
PP	30.33	45.01	*	E	E	*	E
WN	13.49	12.08	*	C	C	*	C
SC	13.19	13.49	*	C	C	*	C

Combined mean boundary mismatches and array performance grades for the S, I, and D portions of the HBL, HBH, UB, HLL and HLH models for all arrays. Depth acronyms from Table 4. Model acronyms from Table 1. Array acronyms from Figure 1. (*) indicates that no boundary is present in the depth range.

DLL	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	3.65	15.41	45.78	A	D	E	C
PD	3.26	10.83	17.29	A	C	D	C
PP	7.20	21.73	44.69	B	E	E	D
WN	8.06	38.35	89.98	B	E	E	D
SC	4.58	18.80	50.05	A	D	E	C

DLH	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	1.59	25.19	82.37	A	E	E	D
PD	1.58	13.68	53.63	A	C	E	C
PP	2.55	12.86	67.67	A	C	E	C
WN	1.35	33.61	98.83	A	E	E	D
SC	1.43	29.25	92.14	A	E	E	D

BL	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	0.45	1.12	5.84	A	A	B	A
PD	0.00	1.68	8.68	A	A	B	A
PP	6.89	17.99	77.77	B	D	E	D
WN	0.00	0.69	3.71	A	A	A	A
SC	0.37	2.47	13.12	A	A	C	B

BH	Combined Position & Width			Performance Grade			
Array	S	I	D	S	I	D	Overall Grade
DD	0.45	11.80	8.11	A	C	B	B
PD	0.37	13.80	17.87	A	C	D	C
PP	14.67	40.18	86.67	C	E	E	D
WN	97.11	100.00	100.00	E	E	E	E
SC	1.18	11.65	57.80	A	C	E	C

Combined mean boundary mismatches and array performance grades for the S, I, and D portions of the DLL, DLH, BL, and BH models for all arrays. Depth acronyms from Table 4. Model acronyms from Table 1. Array acronyms from Figure 1.

Appendix G

Data Misfit, Model Mismatch and Rank For All Twelve Models

Vertical Boundary			
Array	Data RMS	Model RMS	Rank
DD	0.13	4.58	1st
PD	0.2	14.82	2nd
PD	0.24	19.34	4th
WN	0.23	25.61	5th
SC	0.12	15.43	3rd

Vertical Layer Low			
	Data RMS	Model RMS	Rank
DD	0.15	36.87	1st
PD	0.19	43.45	3rd
PD	0.16	37.27	2nd
WN	0.5	161.21	5th
SC	0.28	142.08	4th

Vertical Layer High			
	Data RMS	Model RMS	Rank
DD	0.18	26.14	1st
PD	0.17	39.03	2nd
PD	0.23	46.79	4th
WN	0.29	41.07	3rd
SC	0.18	49.29	5th

Horizontal Boundary Low			
	Data RMS	Model RMS	Rank
DD	0.25	17.04	1st
PD	0.09	19.1	2nd
PD	0.28	24.22	3rd
WN	0.15	26.7	5th
SC	0.09	26.59	4th

Horizontal Boundary High			
	Data RMS	Model RMS	Rank
DD	0.18	40.26	5th
PD	0.13	30.83	4th
PD	0.13	23.01	1st
WN	0.22	28.24	3rd
SC	0.13	25.98	2nd

Undulating Boundary			
	Data RMS	Model RMS	Rank
DD	0.25	20.44	1st
PD	0.1	21.94	2nd
PD	0.26	28.34	4th
WN	0.24	39.21	5th
SC	0.12	22.94	3rd

Data misfit and model mismatch statistics, and relative array rank based on the model mismatch statistics (units are %) for the VB, VLL, VLH, HBL, HBH, and UB models for all arrays. Models acronyms from Table 1. Array acronyms from Figure 1.

Horizontal Layer Low			
	Data RMS	Model RMS	Rank
DD	0.37	33.45	1st
PD	0.18	42.16	2nd
PD	0.44	60.58	5th
WN	0.35	52.73	4th
SC	0.2	47.8	3rd

Horizontal Layer High			
Array	Data RMS	Model RMS	Rank
DD	0.2	134.57	3rd
PD	0.23	140.61	5th
PD	0.37	130.37	1st
WN	0.57	134.44	2nd
SC	0.34	139.83	4th

Dipping Layer Low			
	Data RMS	Model RMS	Rank
DD	0.23	49.57	1st
PD	0.21	66.79	3rd
PD	0.28	65.74	2nd
WN	0.37	82.96	5th
SC	0.19	71.2	4th

Dipping Layer High			
	Data RMS	Model RMS	Rank
DD	0.22	53.96	1st
PD	0.18	71.37	4th
PD	0.24	81.79	5th
WN	0.3	54.8	2nd
SC	0.21	56.78	3rd

Block Model Low			
	Data RMS	Model RMS	Rank
DD	0.18	13.72	4th
PD	0.14	12.83	3rd
PD	0.21	40.71	5th
WN	0.21	8.31	1st
SC	0.13	10.98	2nd

Block Model High			
	Data RMS	Model RMS	Rank
DD	0.15	11.17	1st
PD	0.16	16.6	2nd
PD	0.17	26	5th
WN	0.26	22.52	4th
SC	0.14	18.89	3rd

Data misfit and model mismatch statistics, and relative array rank based on the model mismatch statistics (units are %) for the HLL, HLH, DLL, DLH, BL, and BH models for all arrays. Models acronyms from Table 1. Array acronyms from Figure 1.