KMS Technologies – KJT Enterprises Inc.

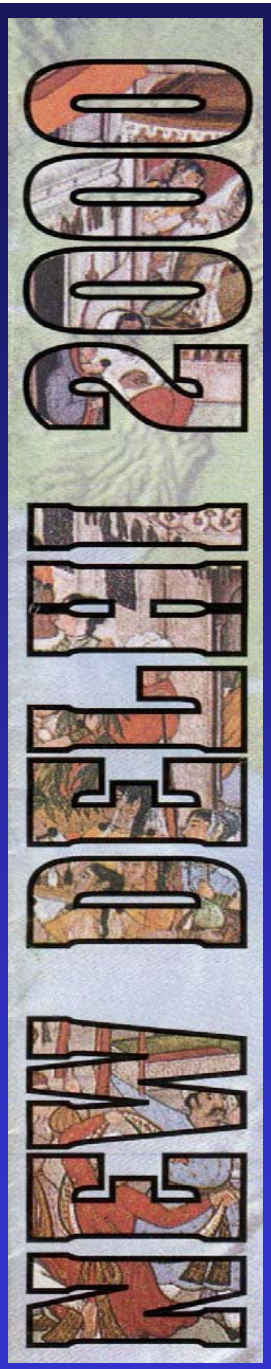
Presentation

Strack, K. – M., Guarino, G.,
(Pandey, B. P., Rao, E. P.)

2000

Exploration with LOTEM under basalt cover

Society of Petroleum Geophysicists/Society of Exploration Geophysicists
Conference & Exposition on Petroleum Geophysics, New Delhi



Exploration with LOTEM under basalt cover

K.-M. Strack [1] & G. Guarino [2]
&
(B.P. Pandey[3] & E.P. Rao [3])

Feb 2000

[1] KMS Technologies, Houston Texas
[2] Electromagnetic Instruments, Richmond, California
[3] ONGC, India

Outline

- The Method
- Basalt cover examples
- Summary

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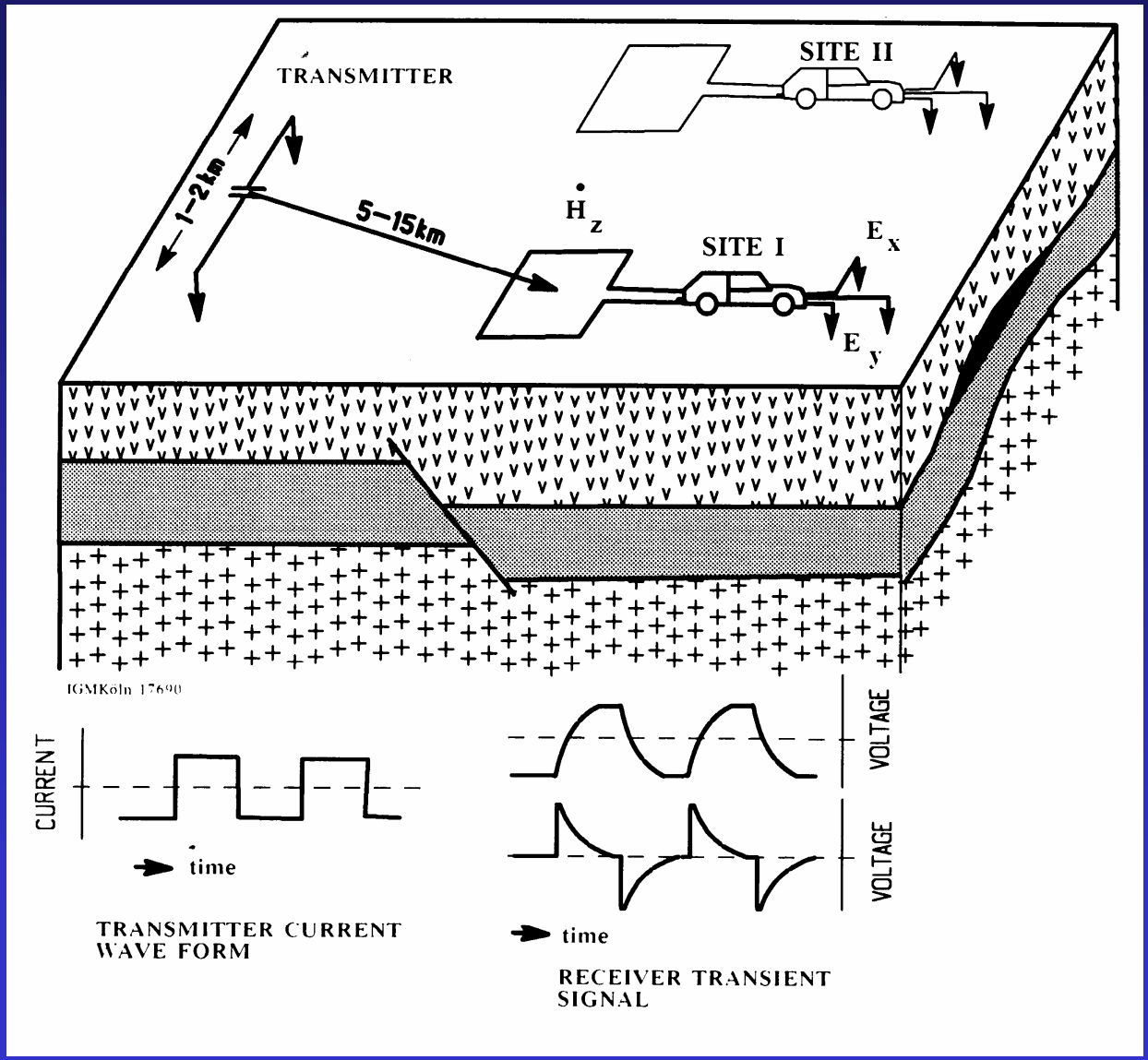
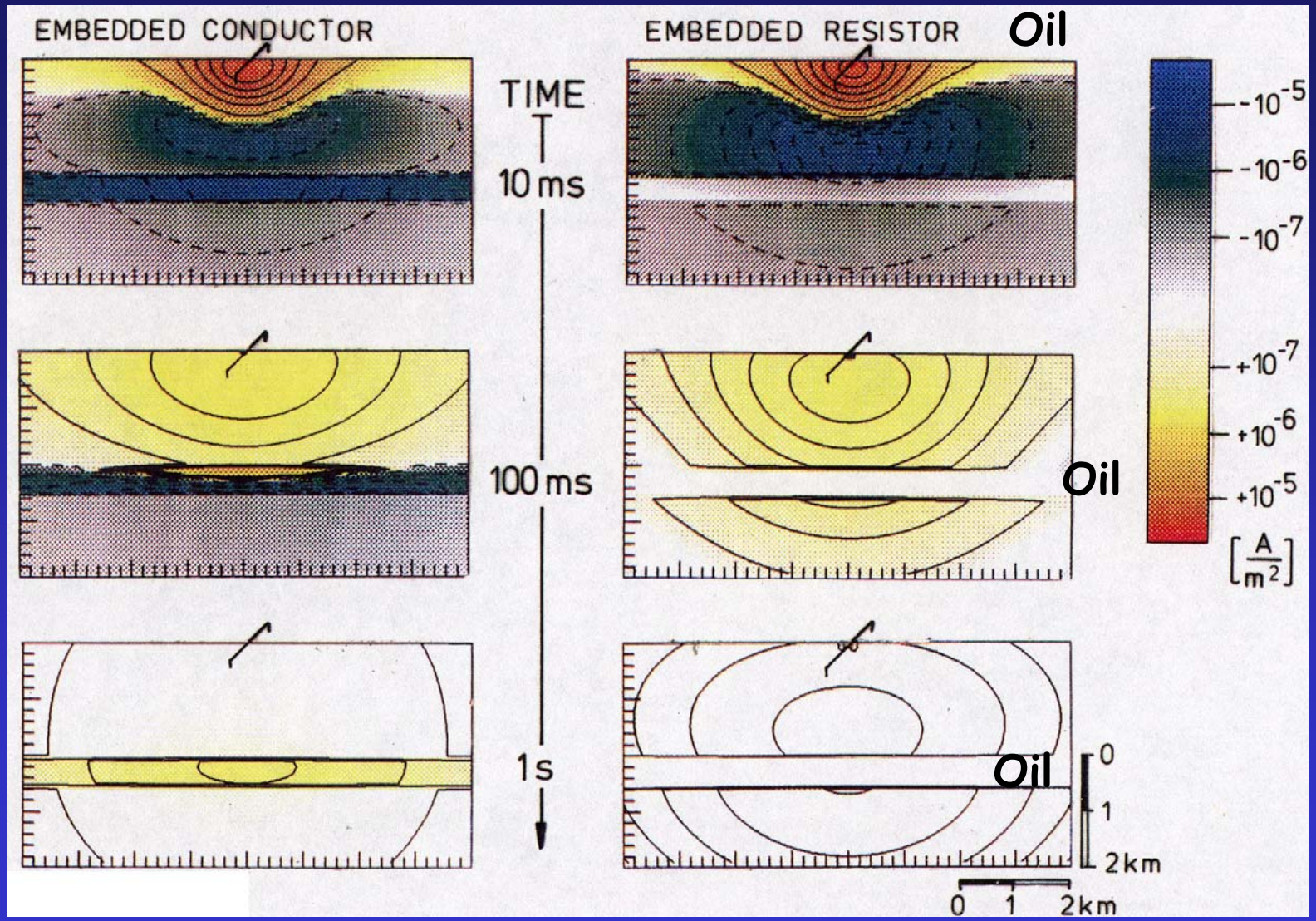
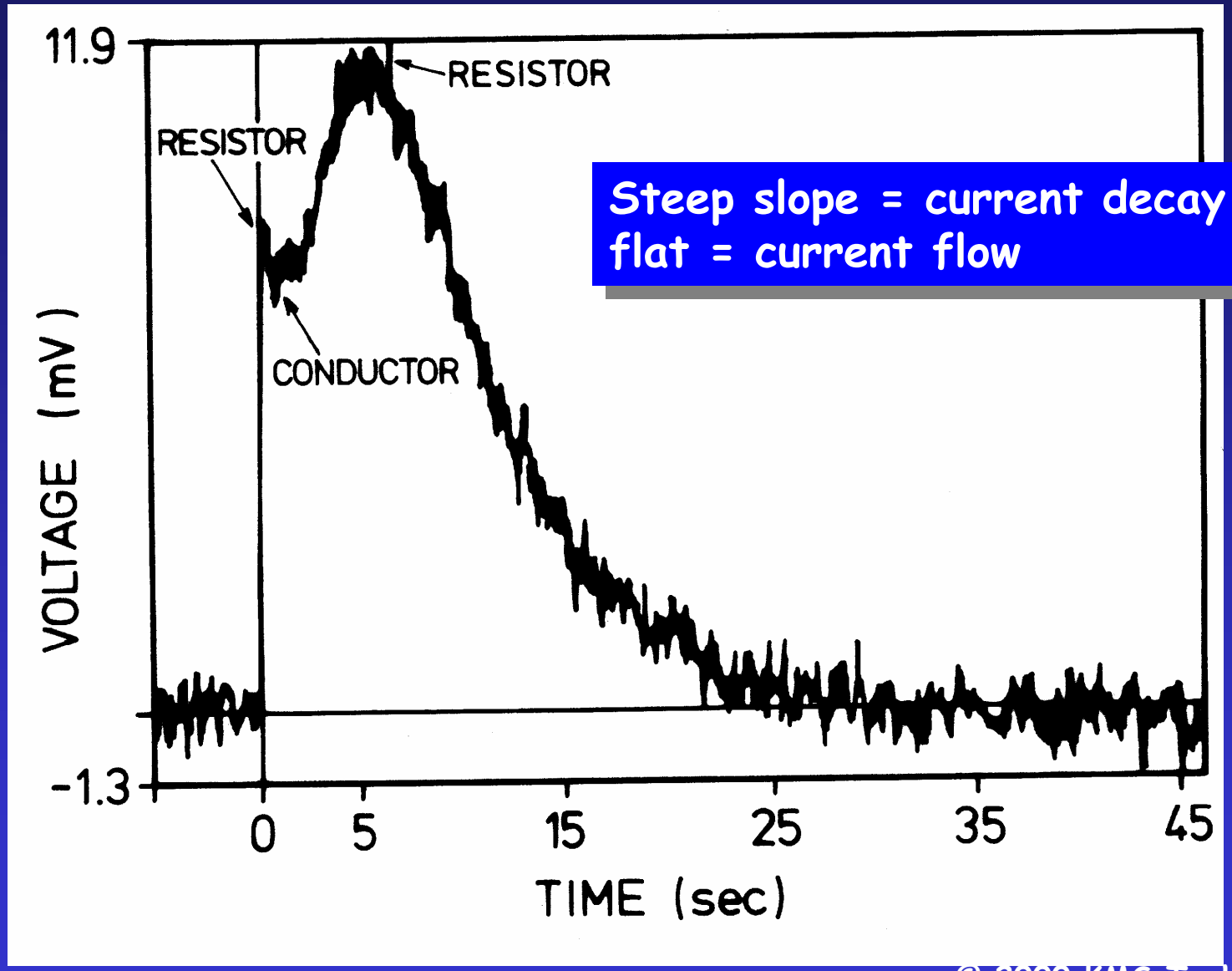
LOTEM Survey setup



Current densities in a reservoir

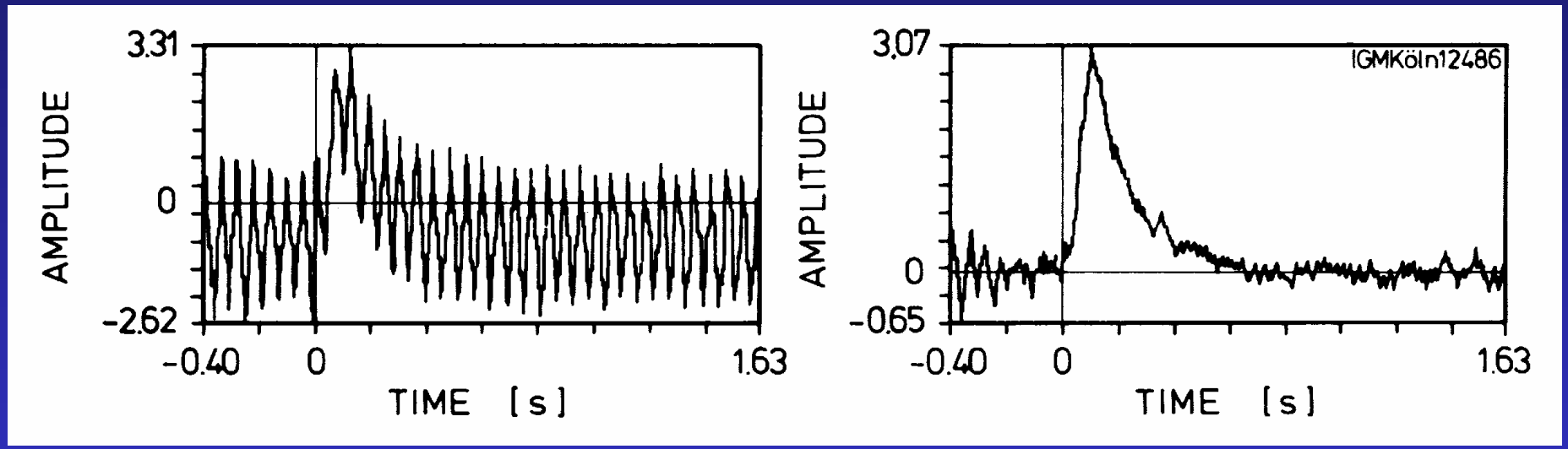


Typical transient

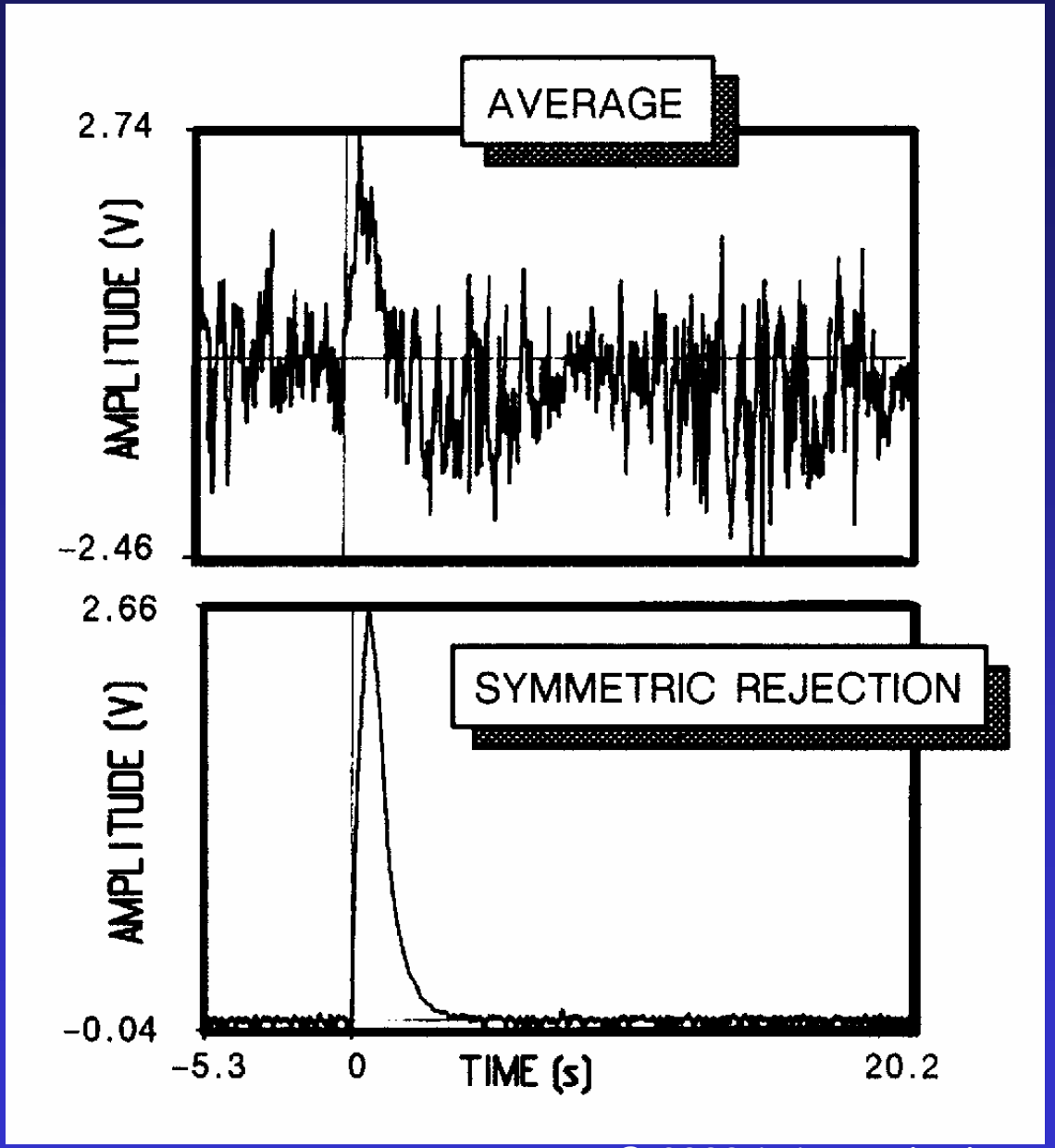


Steep slope = current decay
flat = current flow

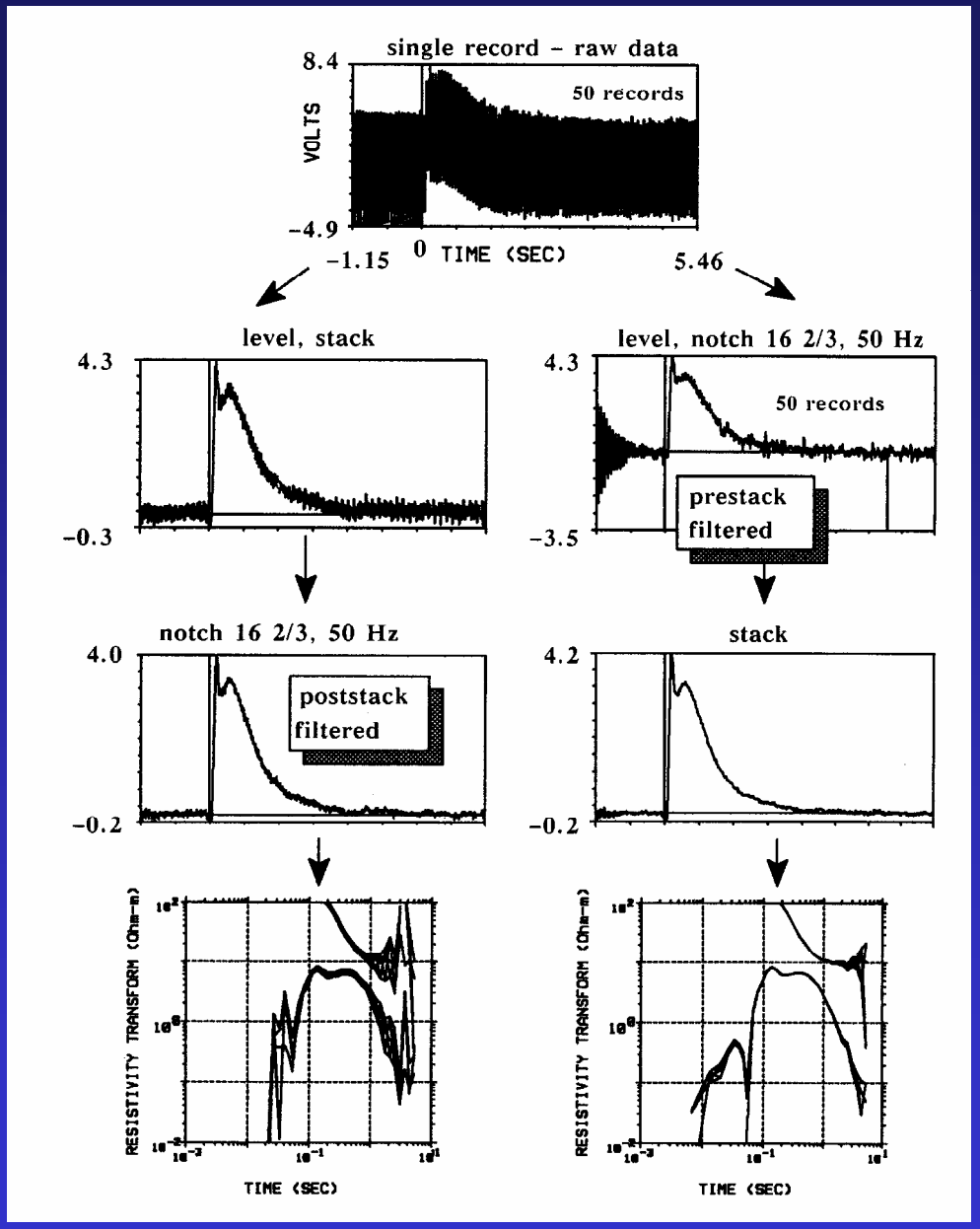
Example of digital notch filter



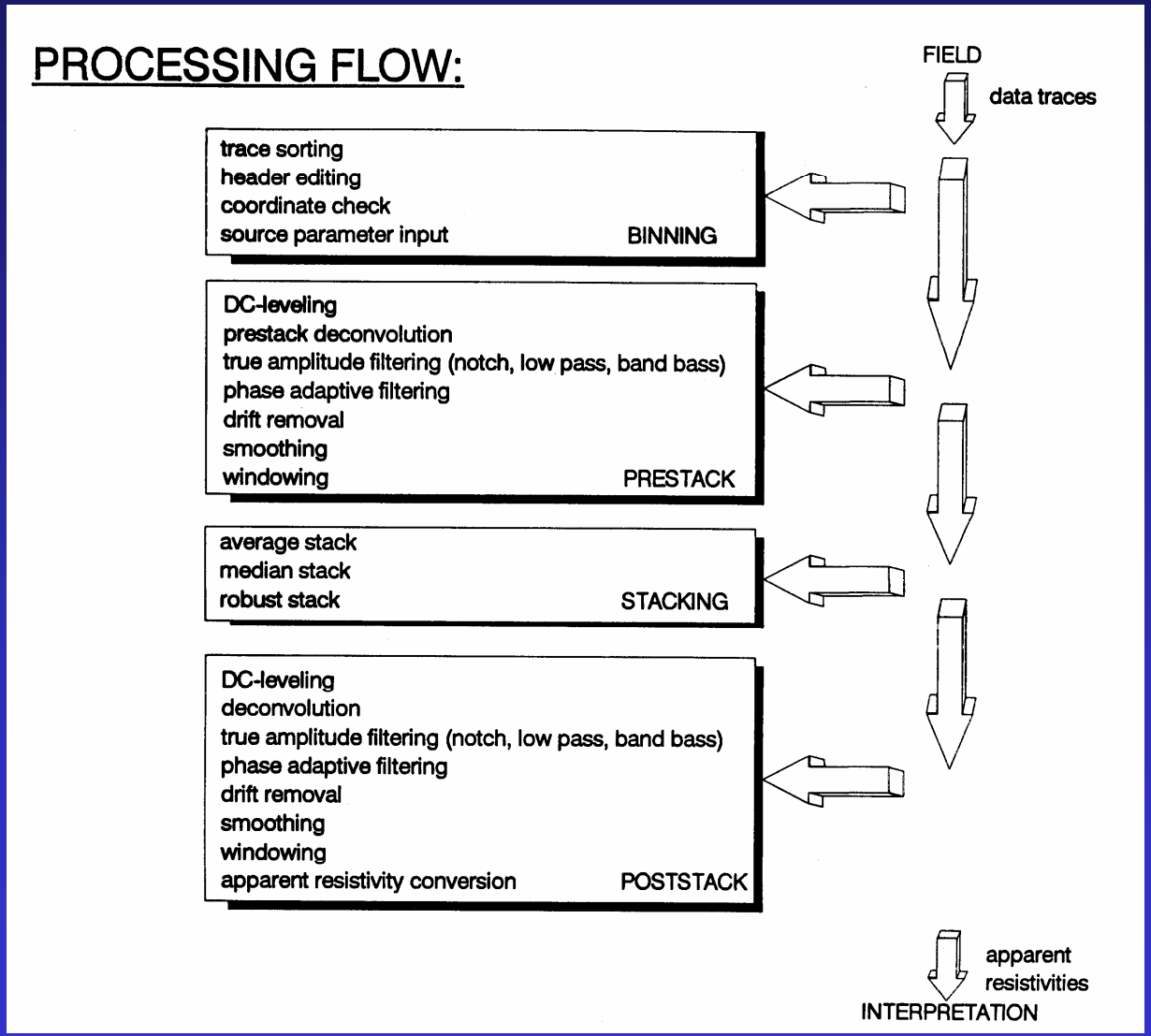
Selective stack example



Pre-stack versus Post-stack processing

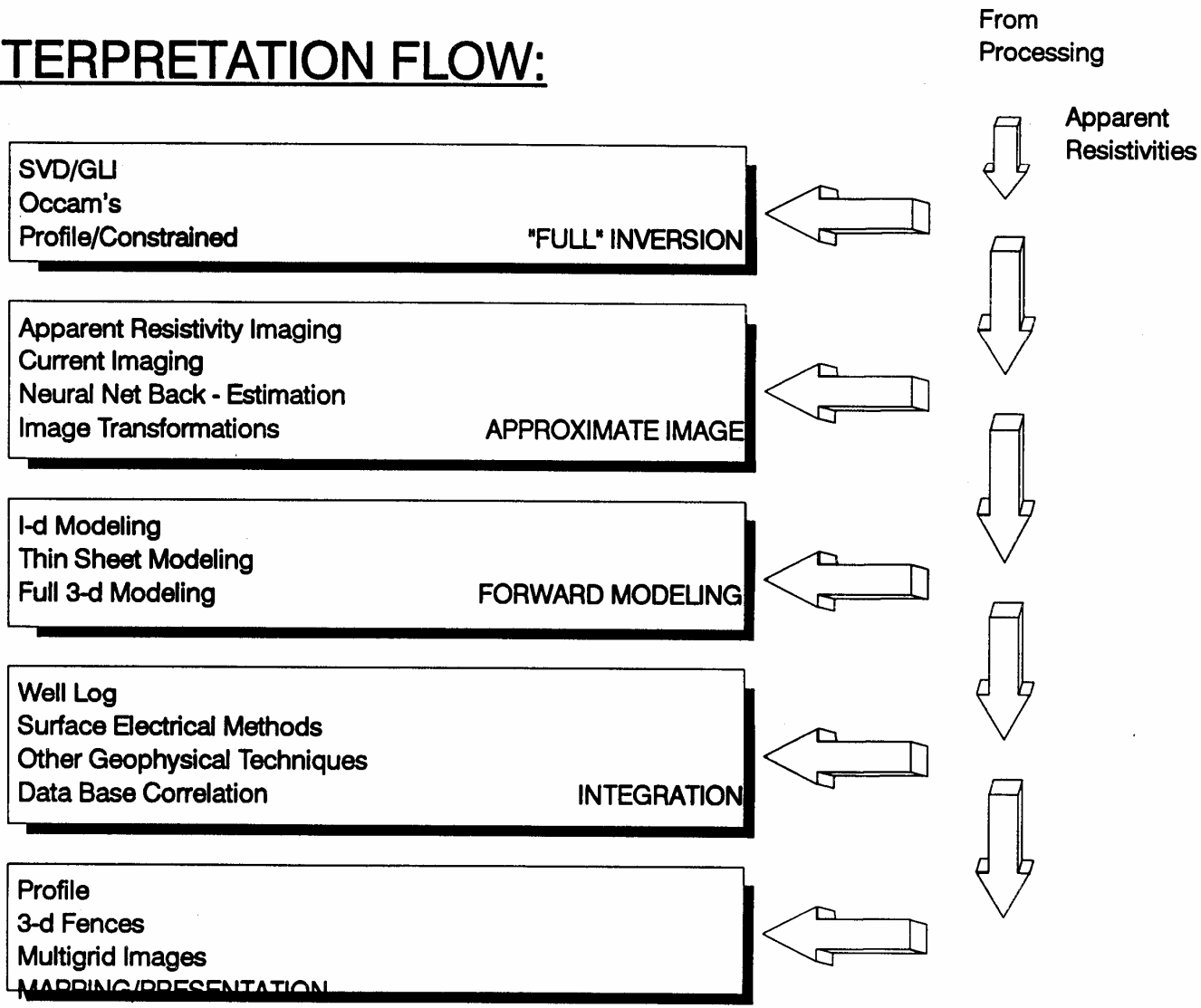


Processing flow

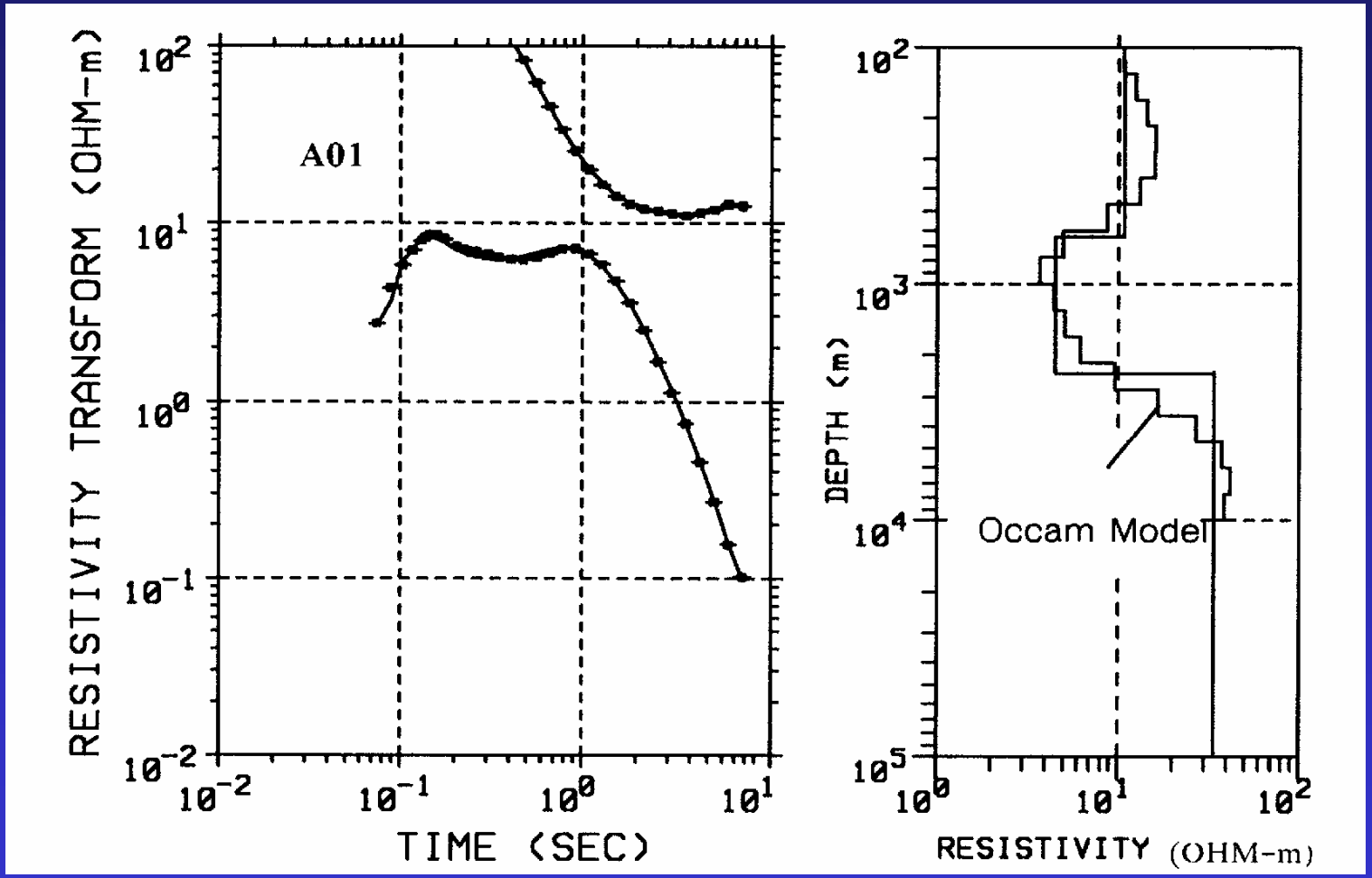


Interpretation flow

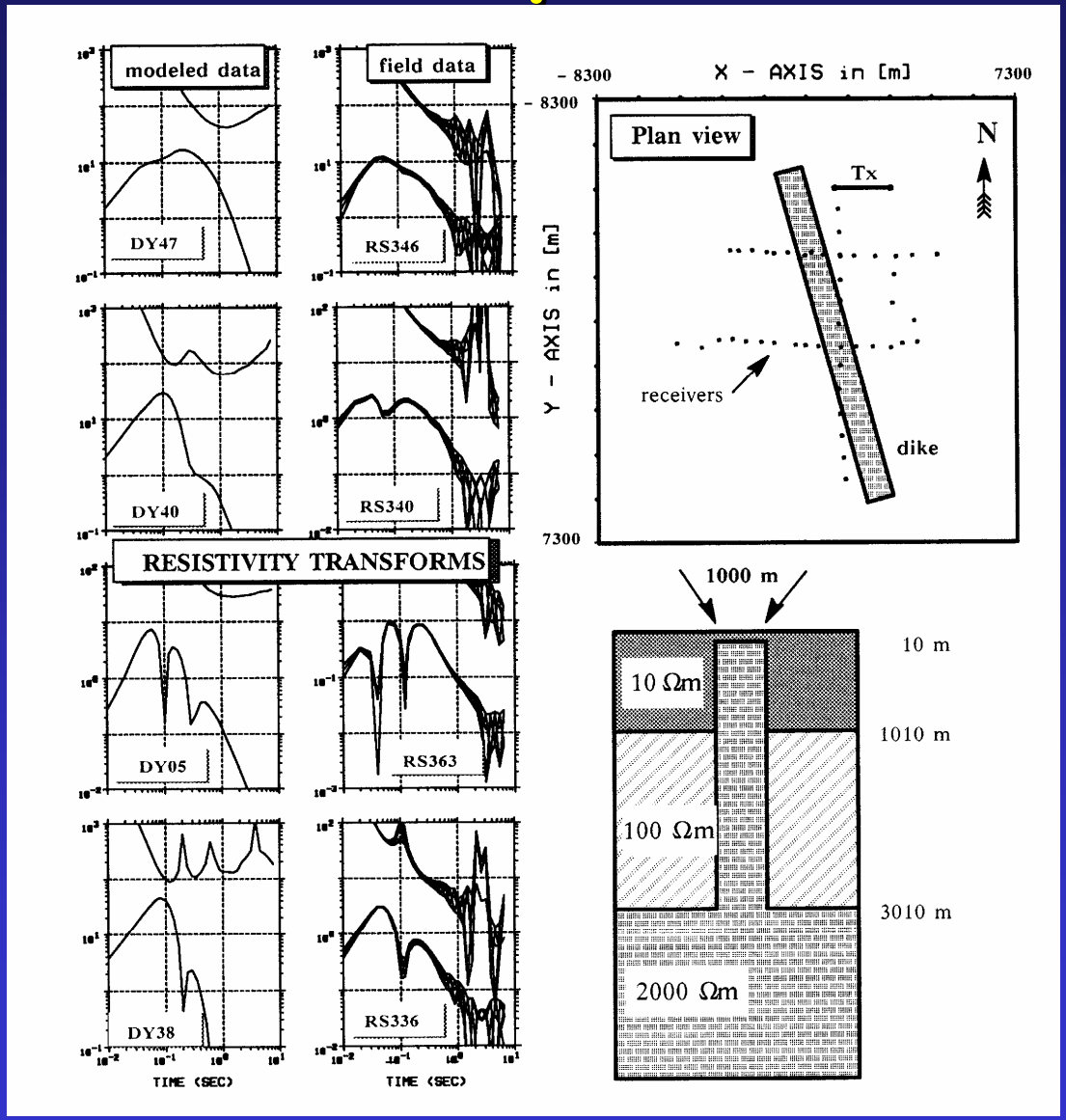
INTERPRETATION FLOW:



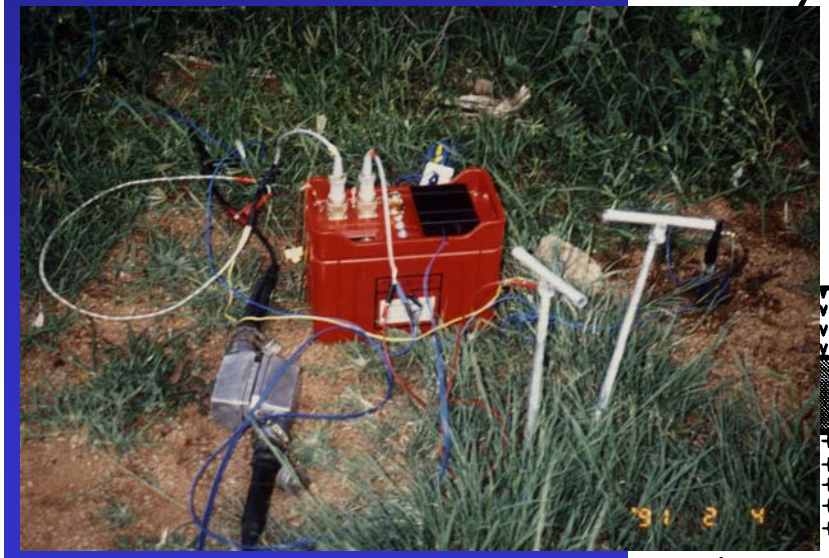
Occam's inversion example

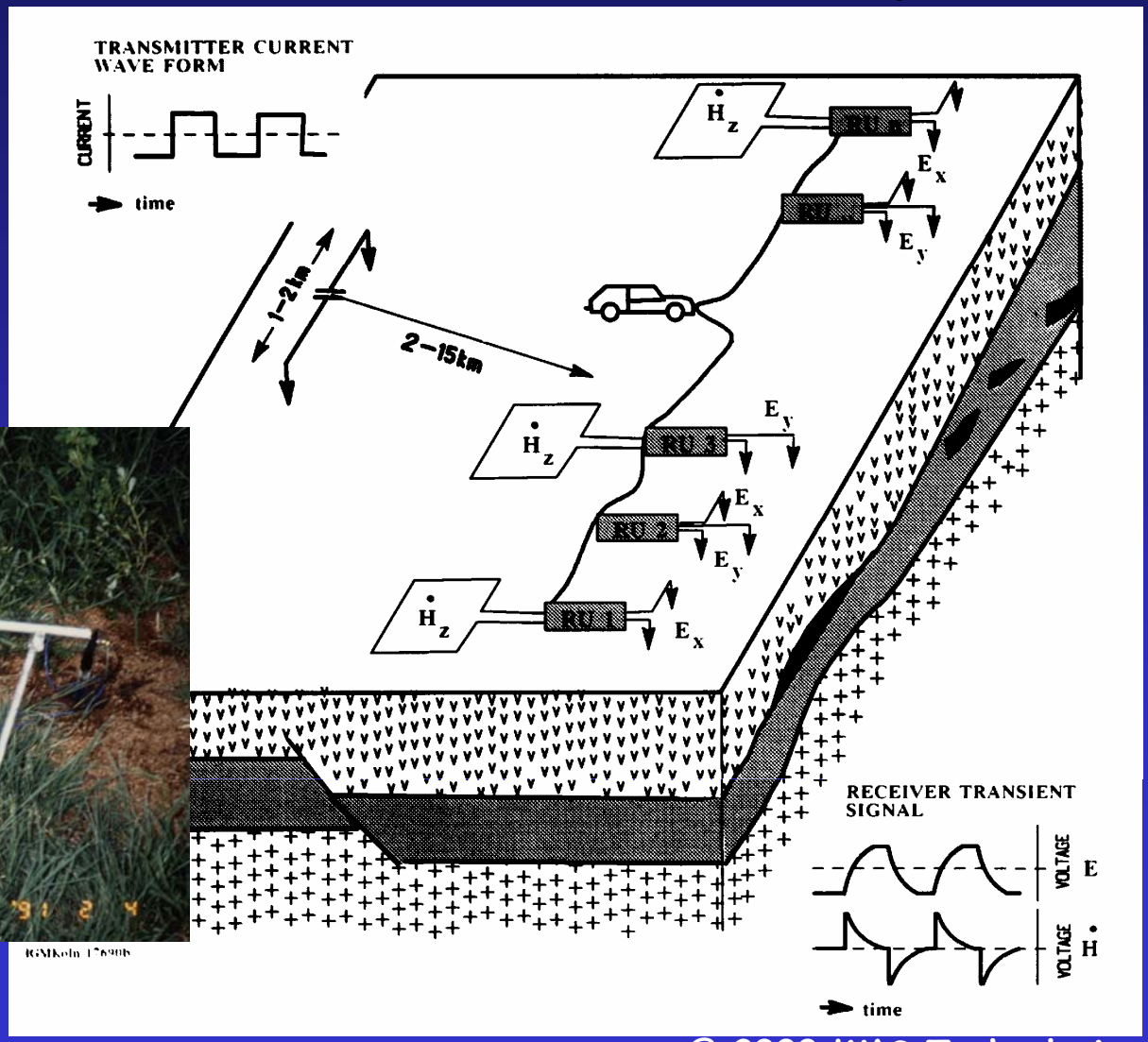


3D reversal example: axial conductor



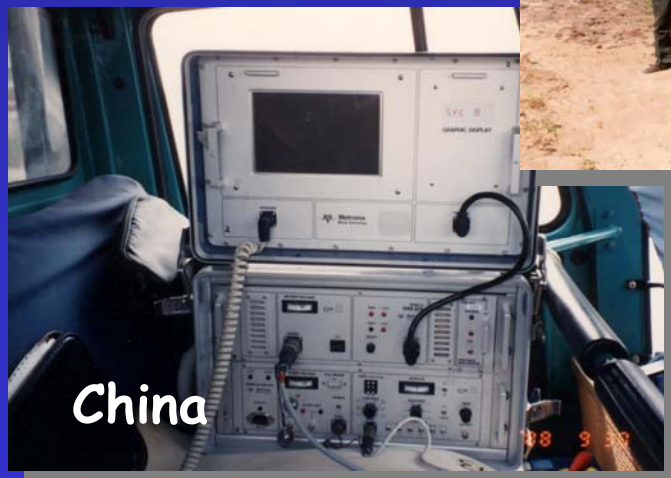
Hardware: N-channel setup





Hardware:Receiver views

India



Multi-channel: TEAMEX & USEM 24

- Fast sampling rate
- Almost NO analogue electronics
- All acquisition at receiver site
- Unlimited channel numbers
- High dynamic range
- TEAMEX built in Germany (1991-1994)
- USEM built by EMI Inc., USA

Multi-channel implementation (today)

- 156 dB (IFP + ADC), 42 dB initial gain (24 bit)
- automatic drift control between recording
- less filters, more samples (4096), higher sampling rate (8 kHz) (continuous at 40 kHz)
- synchronous recording
- multi-channels (1.5 km spread)
- small identical waterproof units

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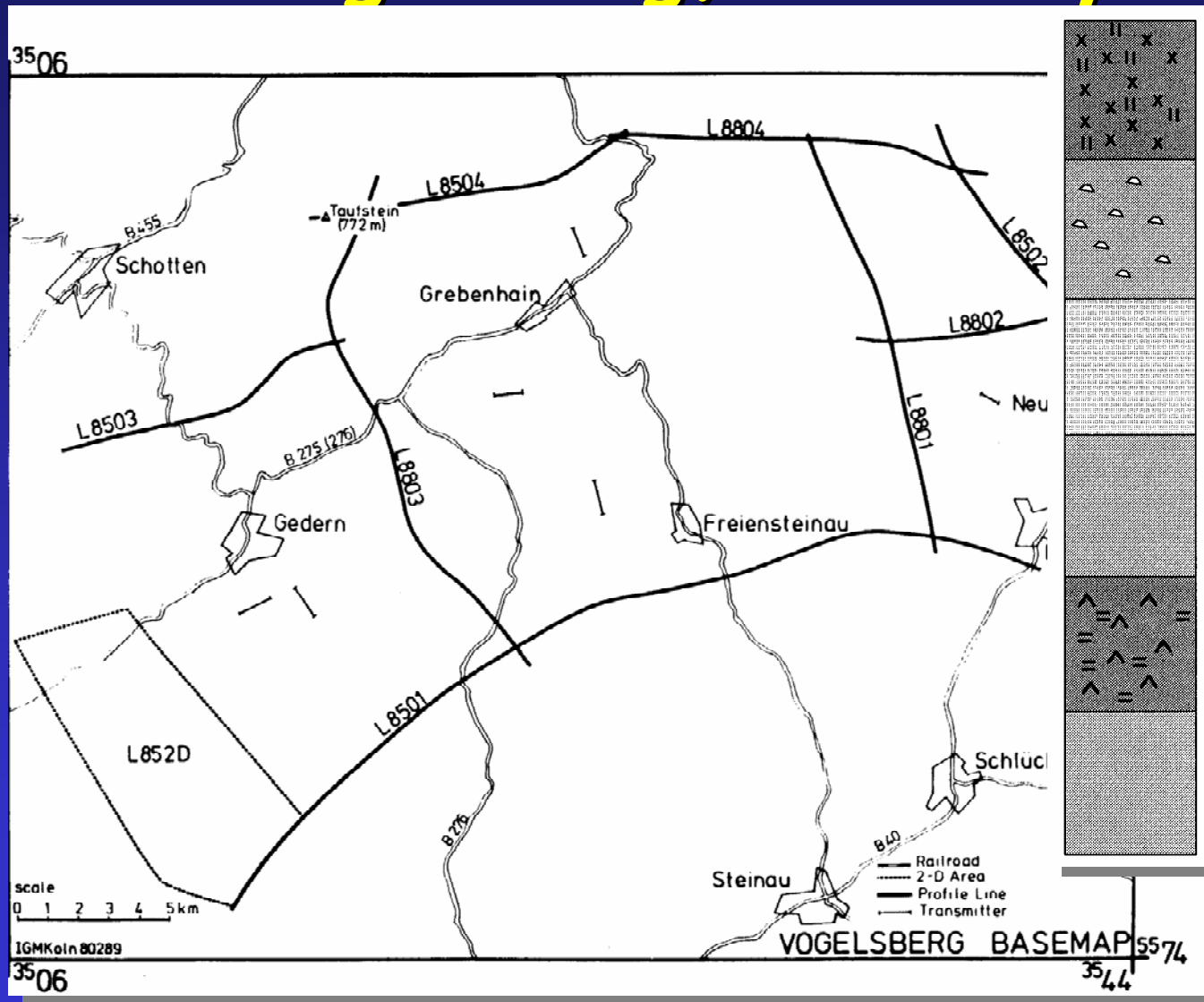
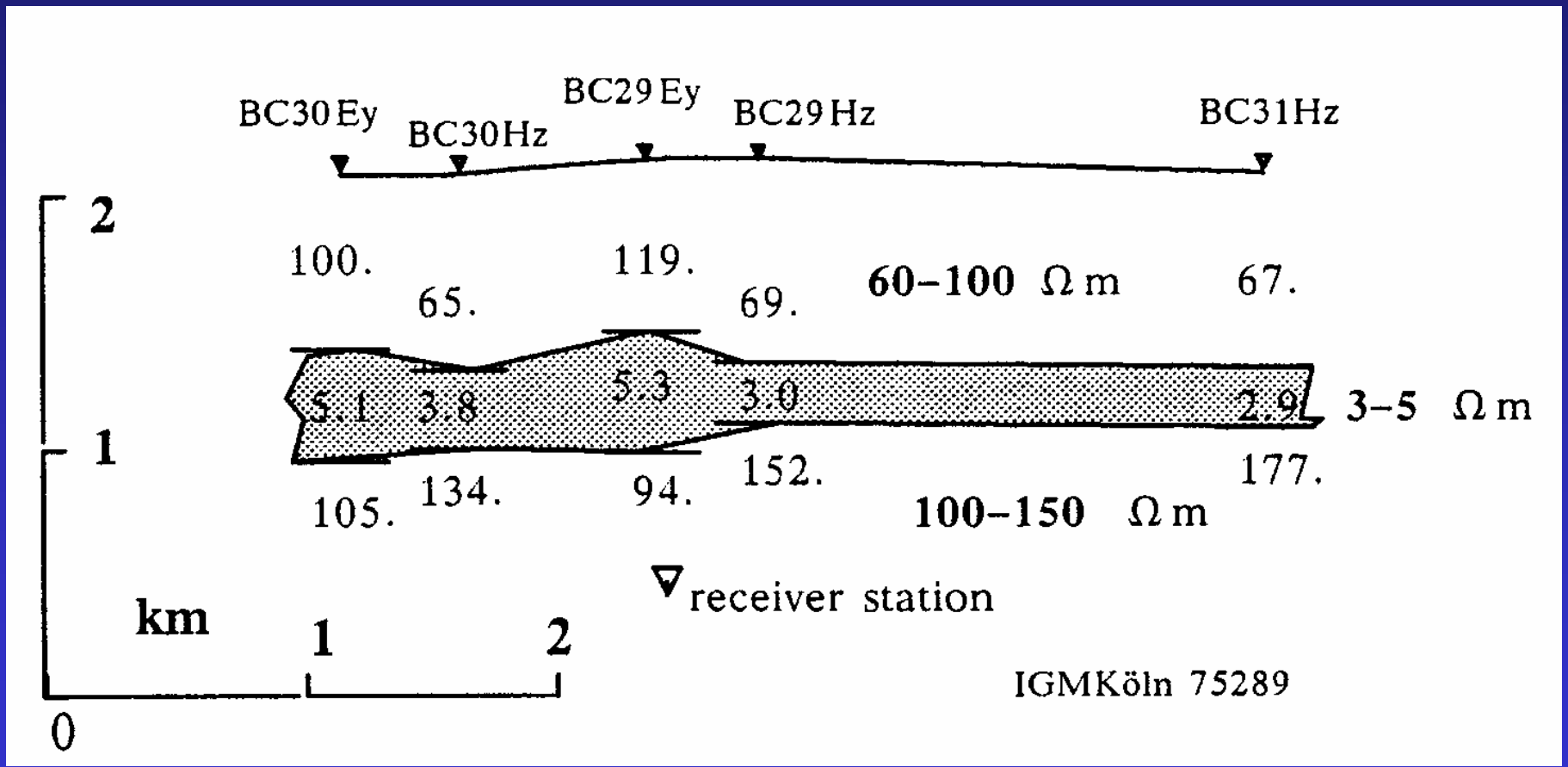
Vogelsberg, Germany basemap



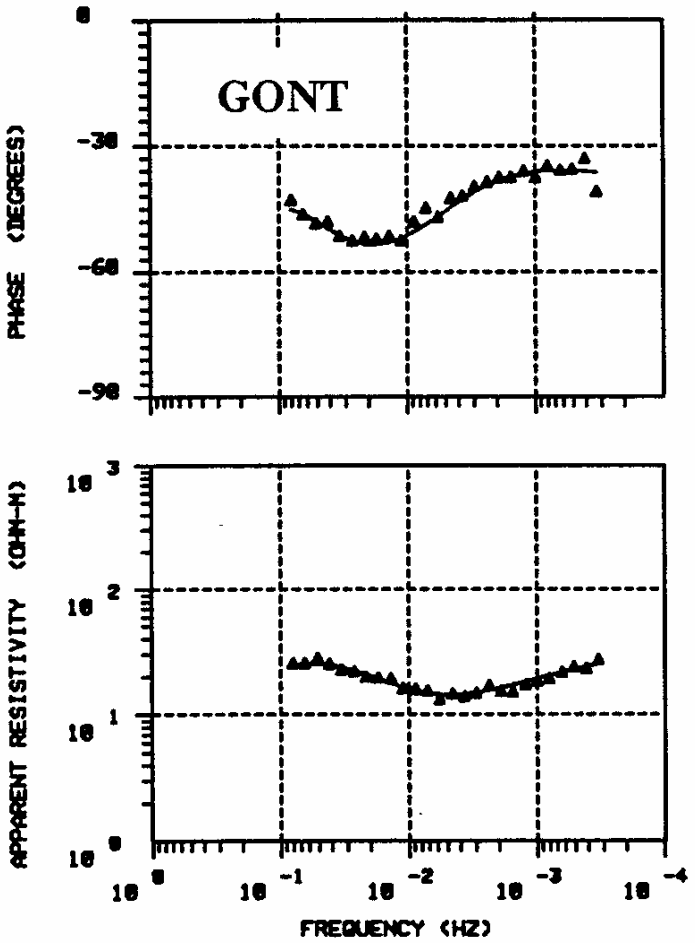
- Quarternary sediments
  basalt, lava, tuff
  (up to 800 m)
- Tertiary sediments
  fluvial gravel and sand
  (0 – 50 m)
- Middle triassic sediments
  limestone, dolomite, marl
  (0 – 140 m)
- Lower triassic sediments
  mostly sandstone of fluvial origin
  (400 – 600 m)
- Upper permian sediments
  anhydrite, limestone, marl
  (up to ca. 160 m)
- Lower permian sediments
  mostly sandstone of fluvial origin

IGMKöLN 77289

Germany - Vogelsberg: resistivity section



Germany -Vogelsberg MT data



Inversion result

ρ_1 = 22.7 Ωm ●	h_1 = 13505 m ●
ρ_2 = 3.07 Ωm ●	h_2 = 2967 m ●
ρ_3 = 41.5 Ωm ●	

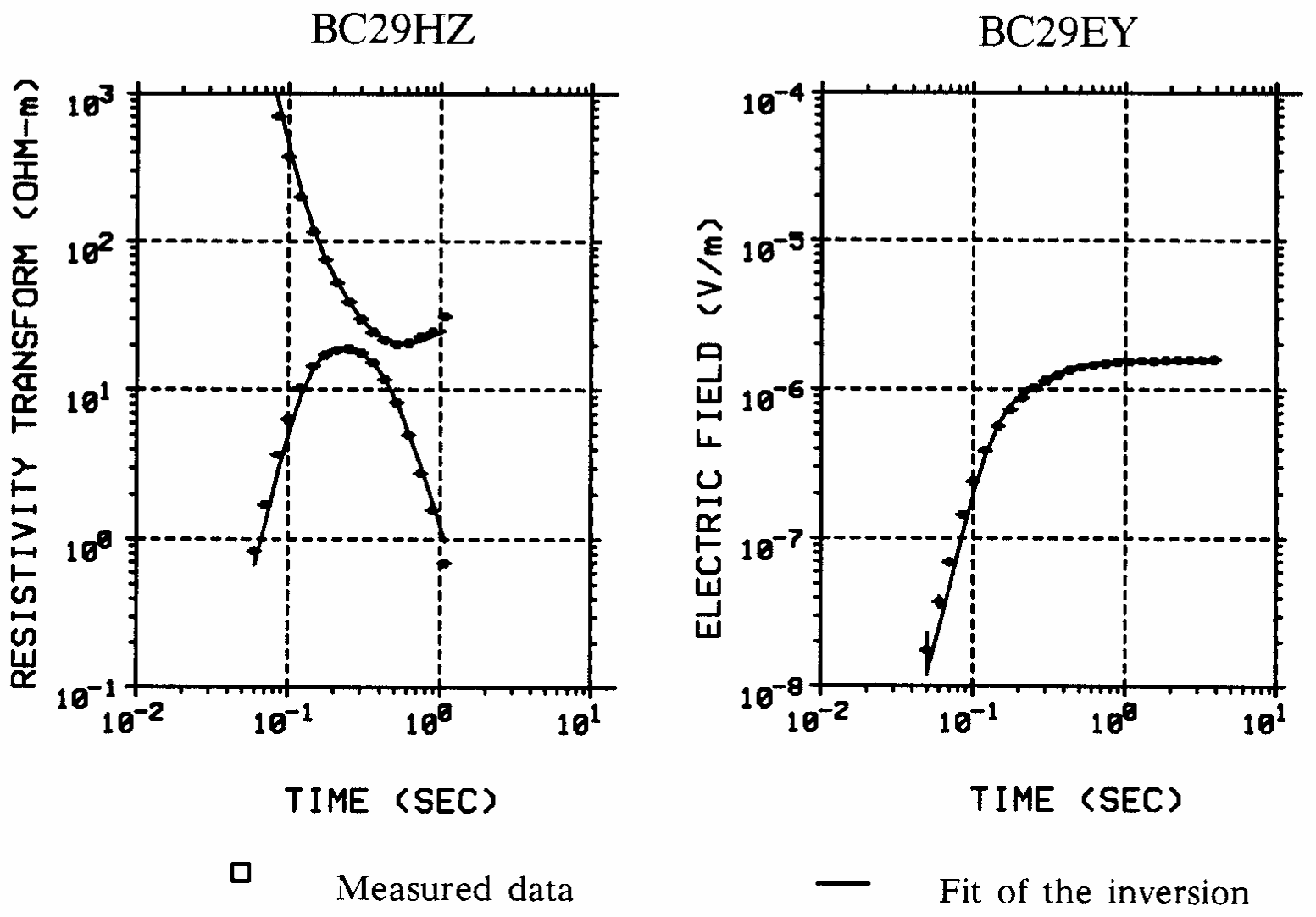
IGMKöln 75489

● important ● unimportant

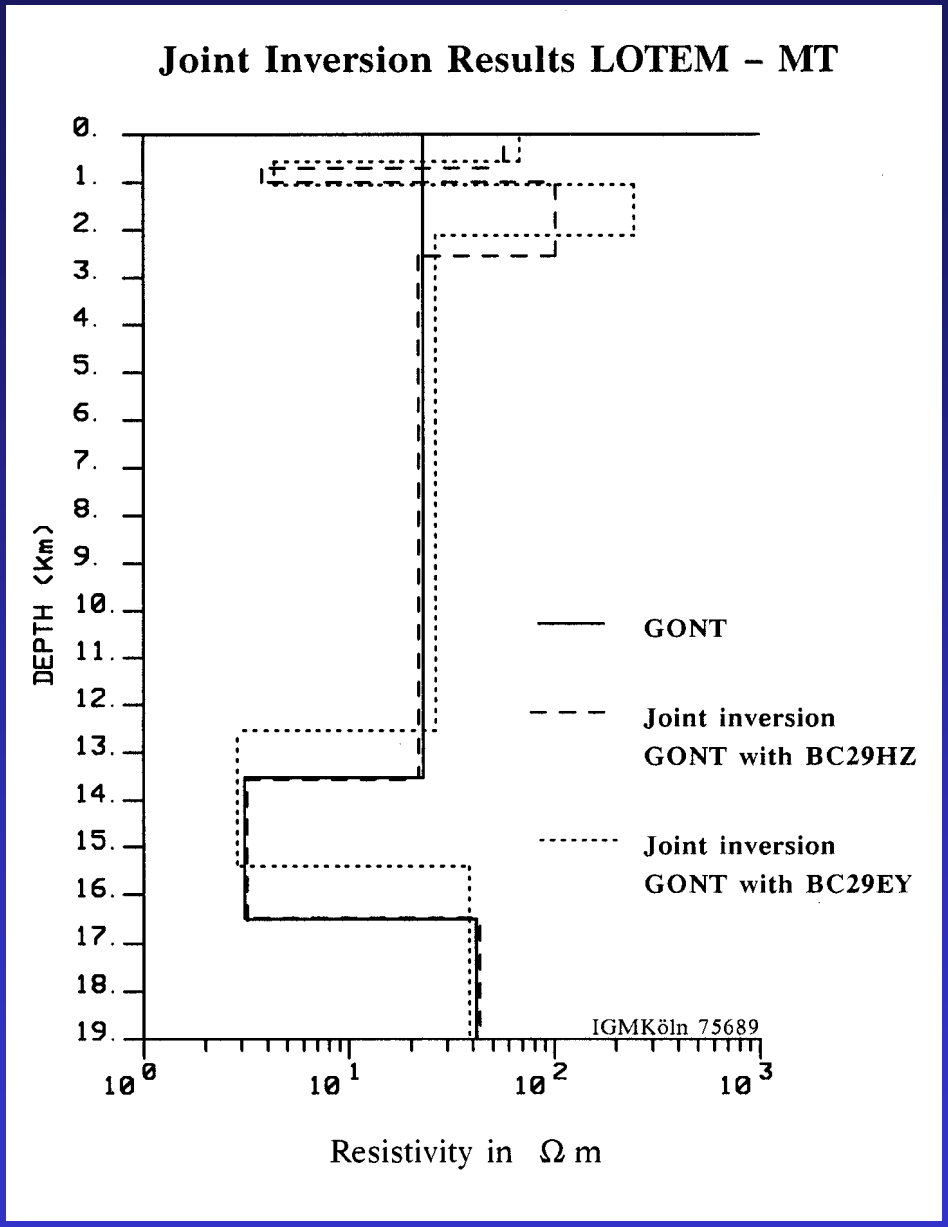
• irrelevant

χ = 1.80

Germany -Vogelsberg LOTEM data



Germany - Vogelsberg: well log comparison



Germany - Vogelsberg: joint inversion

Inversion Statistics LOTEM – MT Joint Inversion

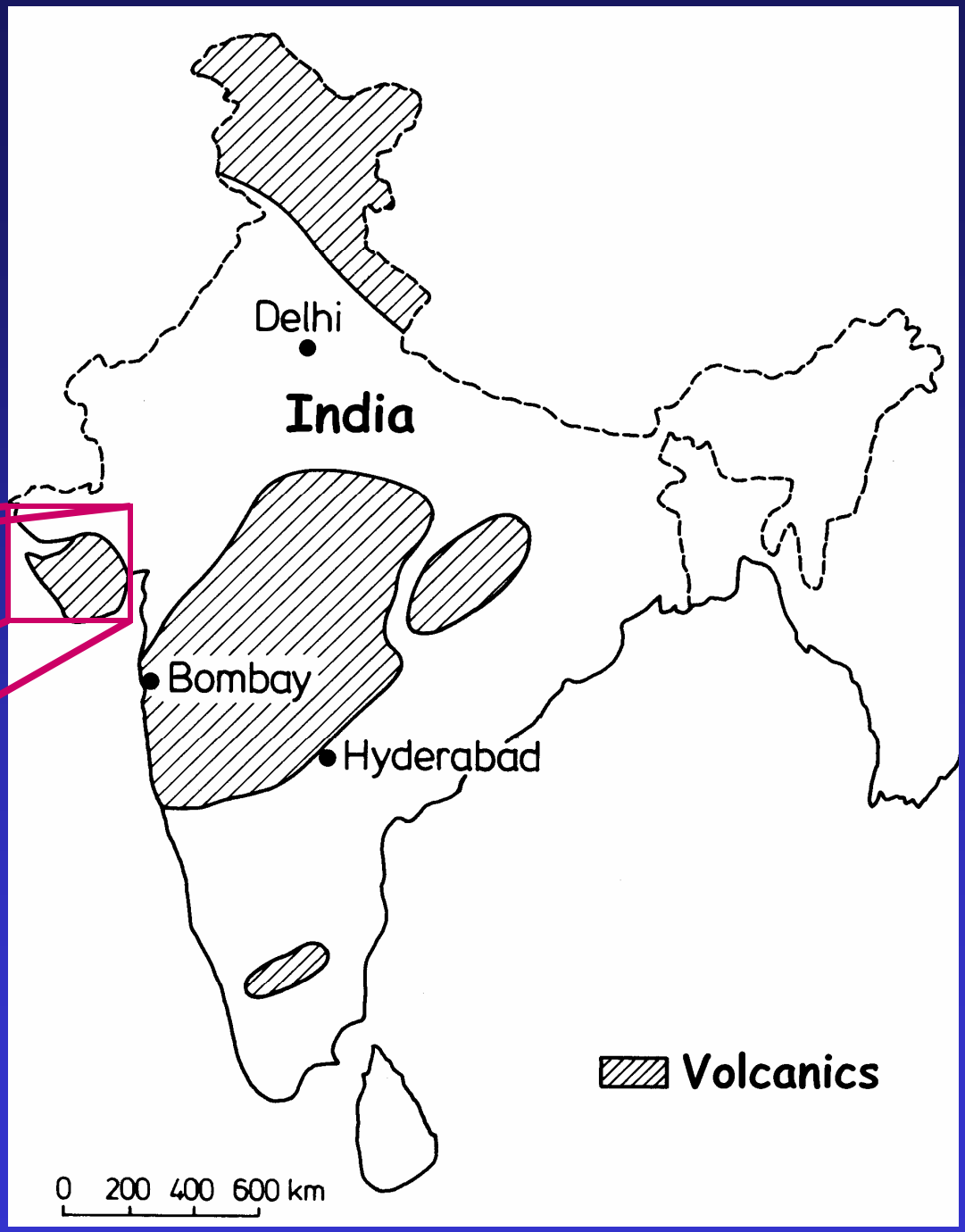
	GONT with BC29HZ scale factor free		GONT with BC29EY scale factor fixed	
	Inversion result	Importance	Inversion result	Importance
ρ_1 (Ωm)	56	●	66	●
ρ_2 (Ωm)	3.8	●	4.1	●
ρ_3 (Ωm)	101	•	251	●
ρ_4 (Ωm)	21	●	26	●
ρ_5 (Ωm)	3.1	●	2.8	●
ρ_6 (Ωm)	42	●	40	●
h_1 (m)	730	●	692	●
h_2 (m)	274	●	374	●
h_3 (m)	1609	●	1082	●
h_4 (m)	10918	●	10426	●
h_5 (m)	2958	●	2740	●
Scale factor	1.13	●	1.02	—
Number of effective parameters	8.5		7.5	
χ^*(MT)	5.26 (sep.: 5.35)		4.80 (sep.: 5.35)	
χ^*(LOTEM)	6.63 (sep.: 4.24)		1.69 (sep.: 1.69)	

IGMKöln 75589

● important ● unimportant • irrelevant

KMST000017x

India Basalt cover map



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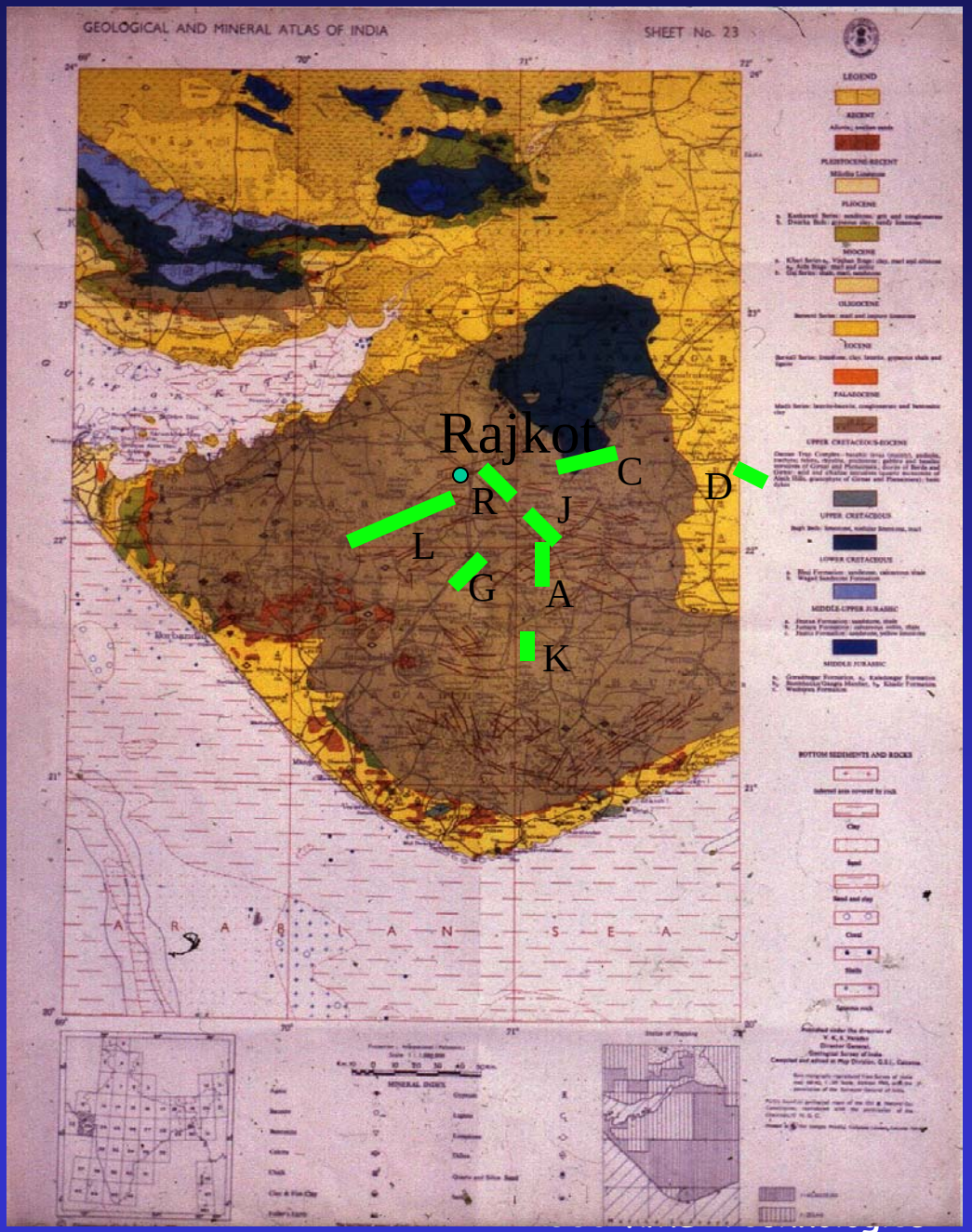
Geologic map of Gujarat



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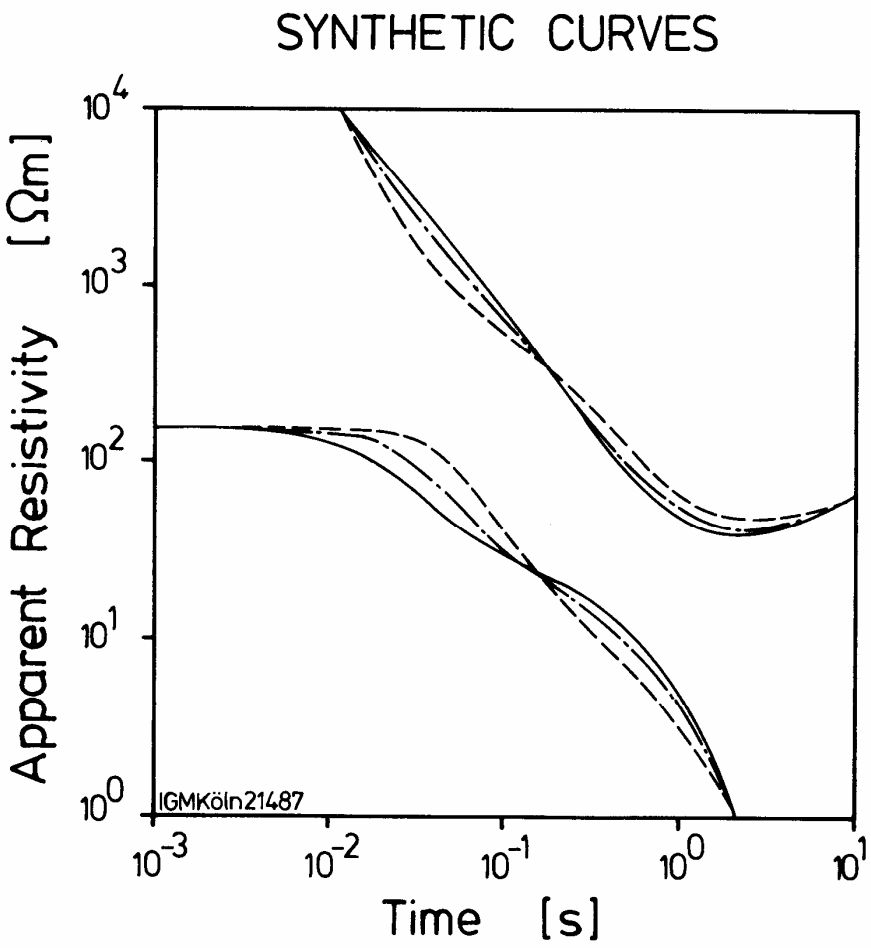
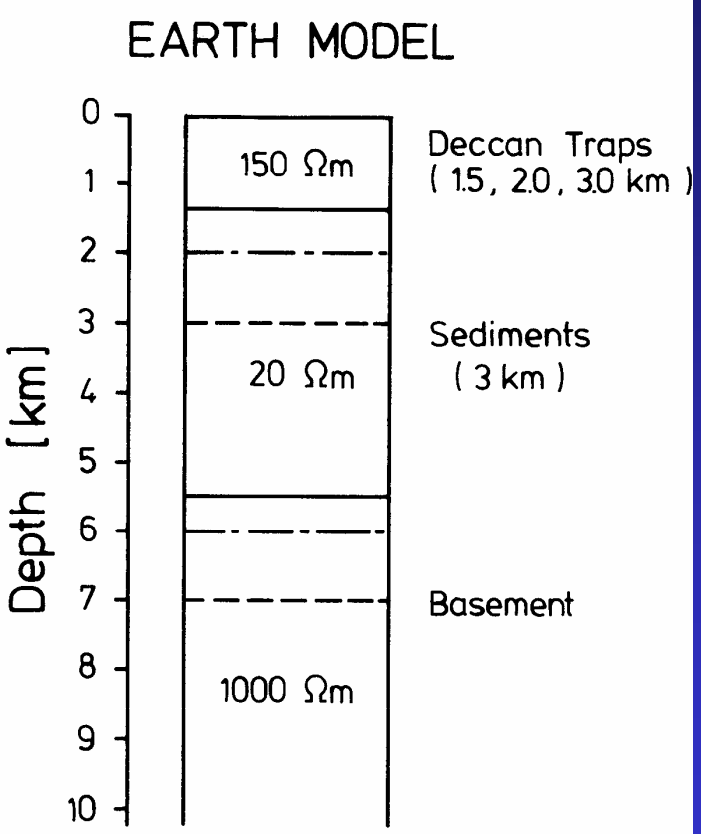
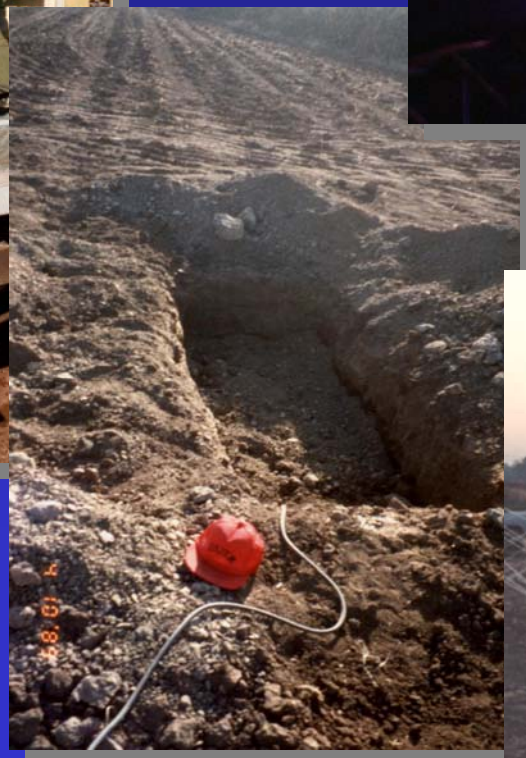
Synthetics before survey





Varied : 1st layer thickness
Offset : 10 km

India: Transmitter sites



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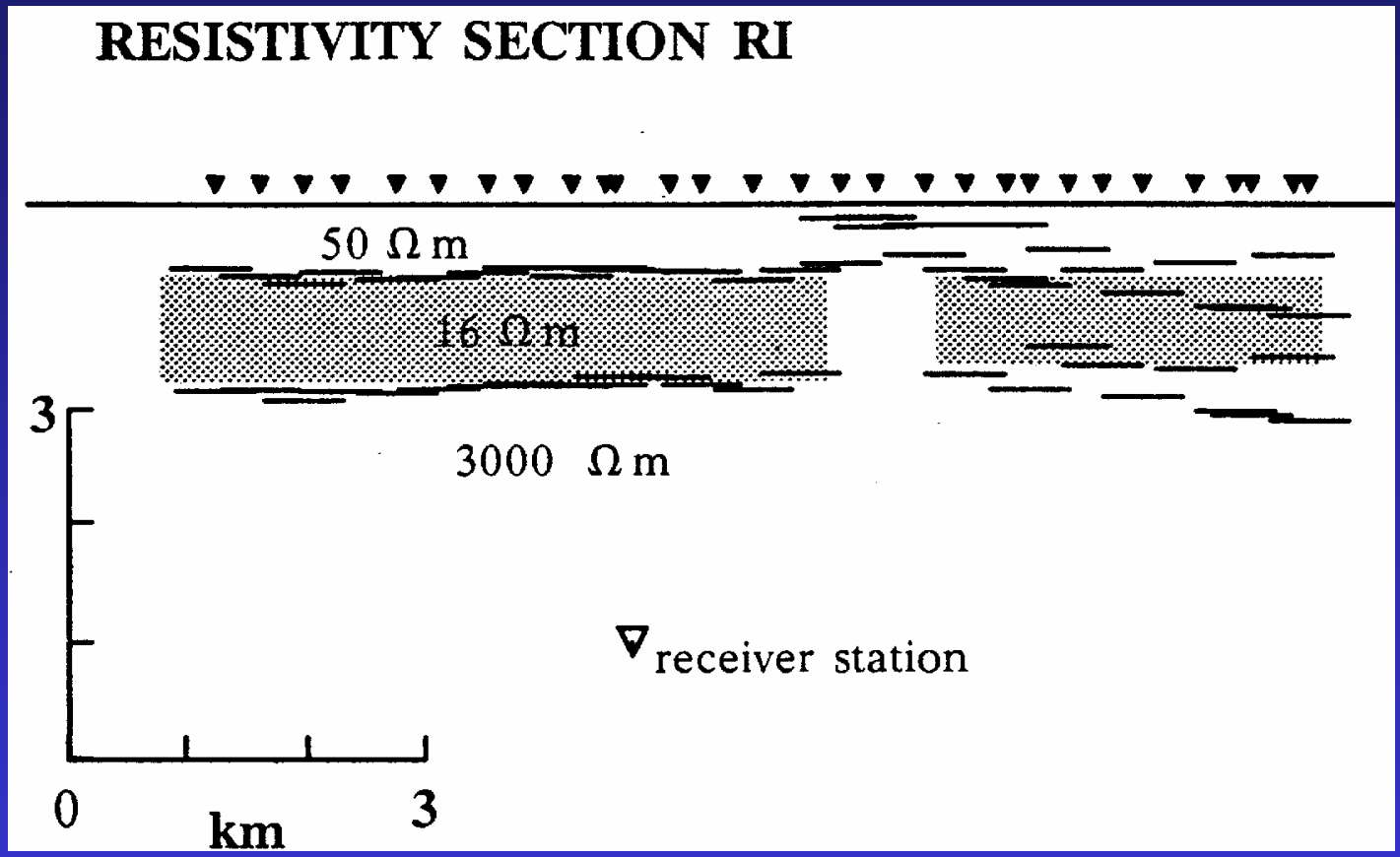
Receiver sites

India: The Historic Event

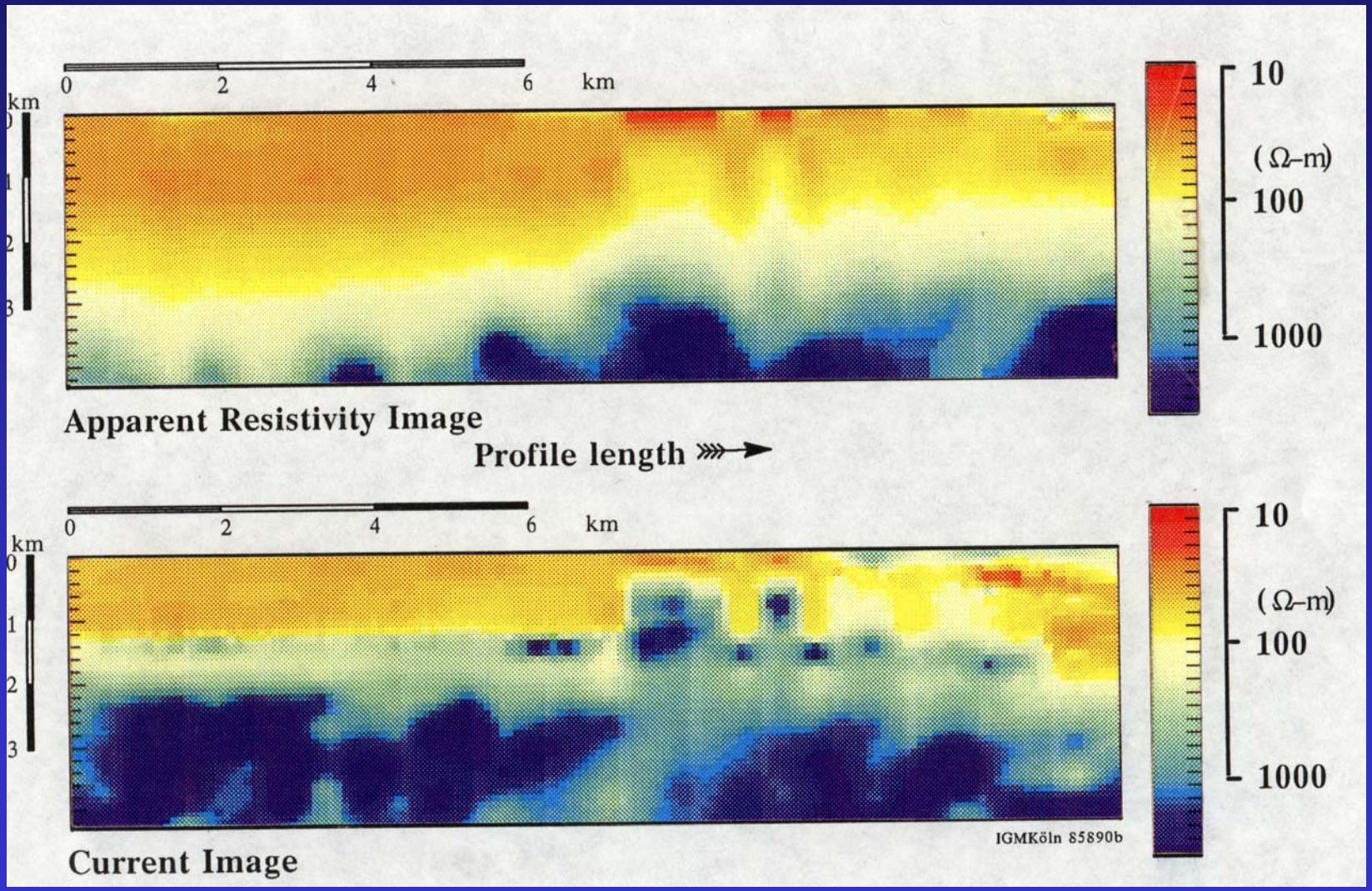
GM inspects

India: Section R1



Dyke photos

Data appa & current image



Occam's inversion of dyke data

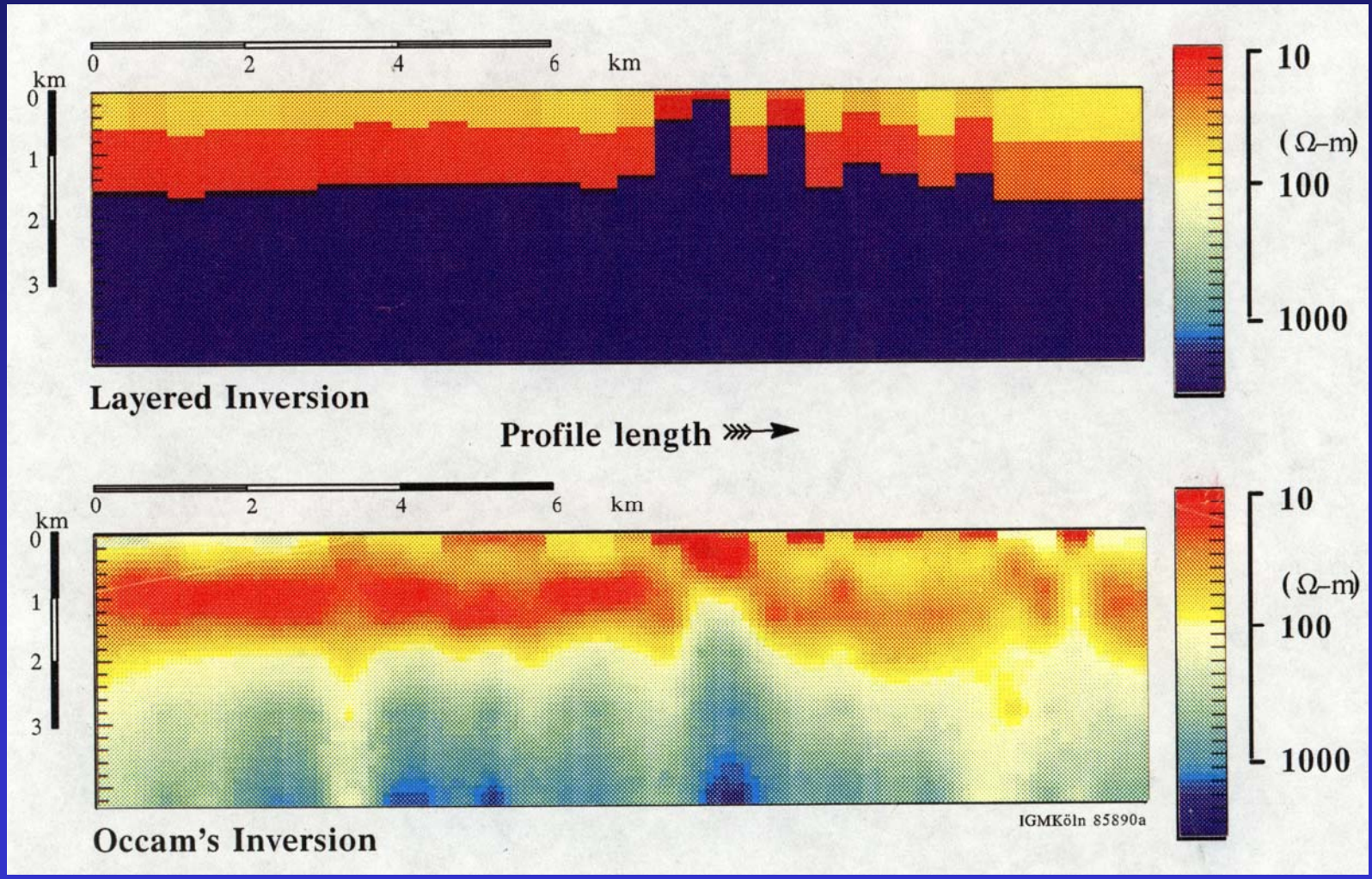
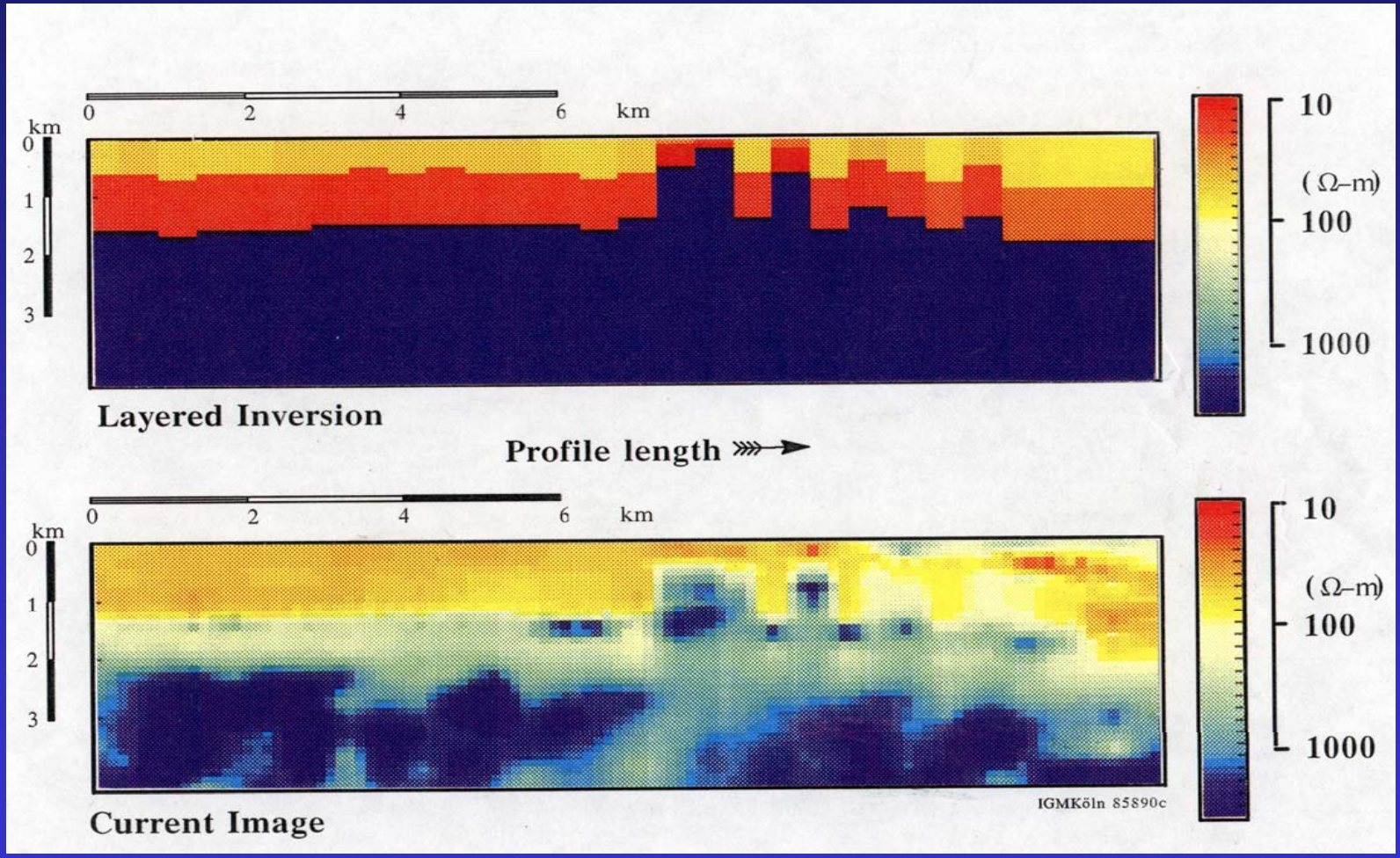
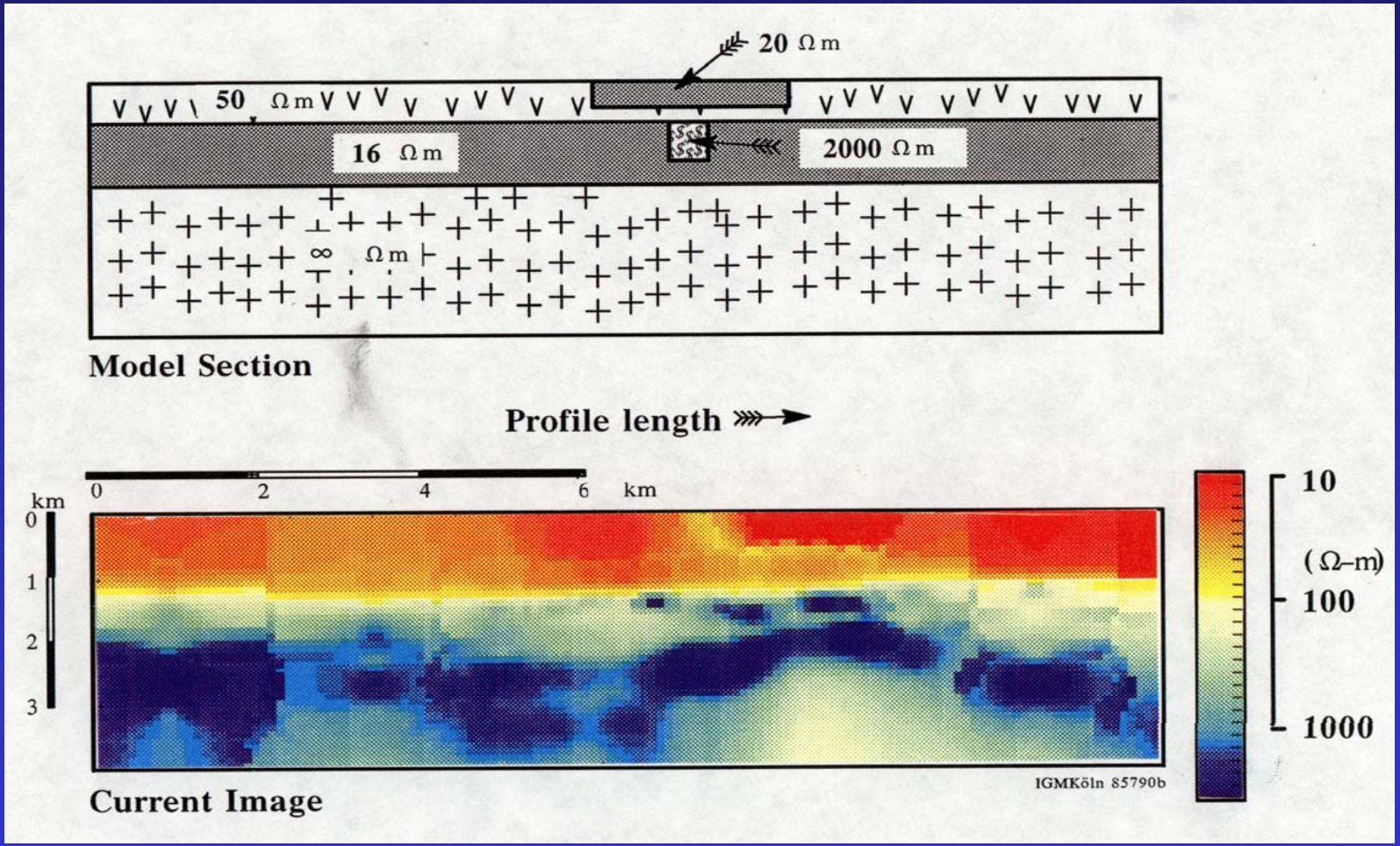


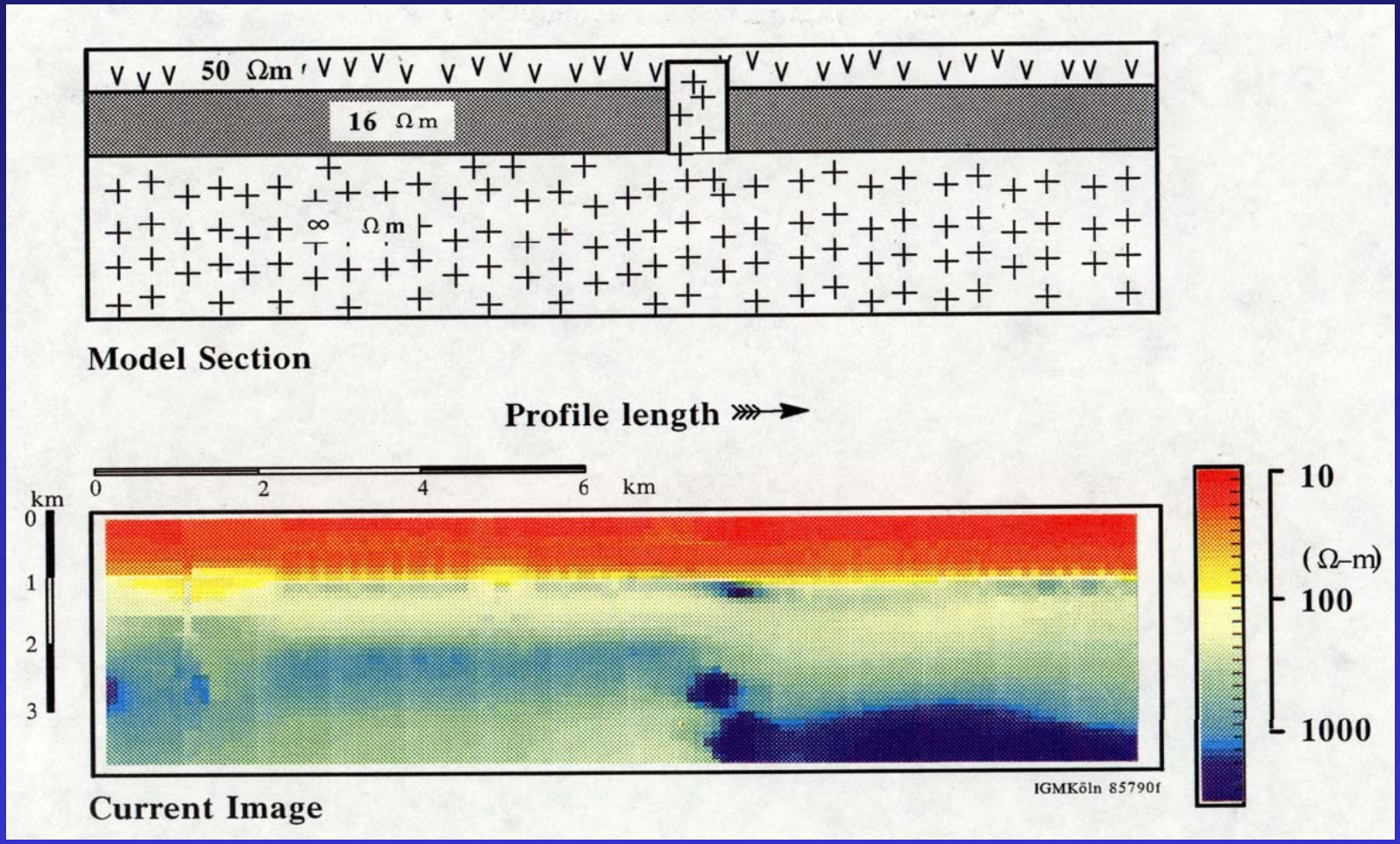
Image of dyke data



3D image of dyke data: model 1



3D image of dyke data: model 1



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Summary

- Lotem - a well understood method
- Hardware systems commercially available
- Seismic style data acquisition
- Seismic style data processing
- Interpretation tools exist (1D, 3D)
- More experience needed
- Last Press:

  ... Lotem in Guarat was confirmed by well

Acknowledgements

The work in Germany was funded by: German Ministry for Science and Technology. ONGC funded a major part of the work in India.

Further funding from: HarbourDom GmbH Cologne, Geometra GmbH, Braunschweig, Electromagnetic Instruments Inc, Curtin University Perth, University of Cologne.

Special thanks to: ONGC: S. Ray, S.K.Jha, M. Pal
German team: P. Wolfgram, J.L.Seara, P.J.Buerger, A.Stephan

LOTEM case histories locations

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