The Discovery of an Anglo-Saxon Grubenhaus at New Bewick, Northern UK using Electrical Surveying and Predictive Deconvolution

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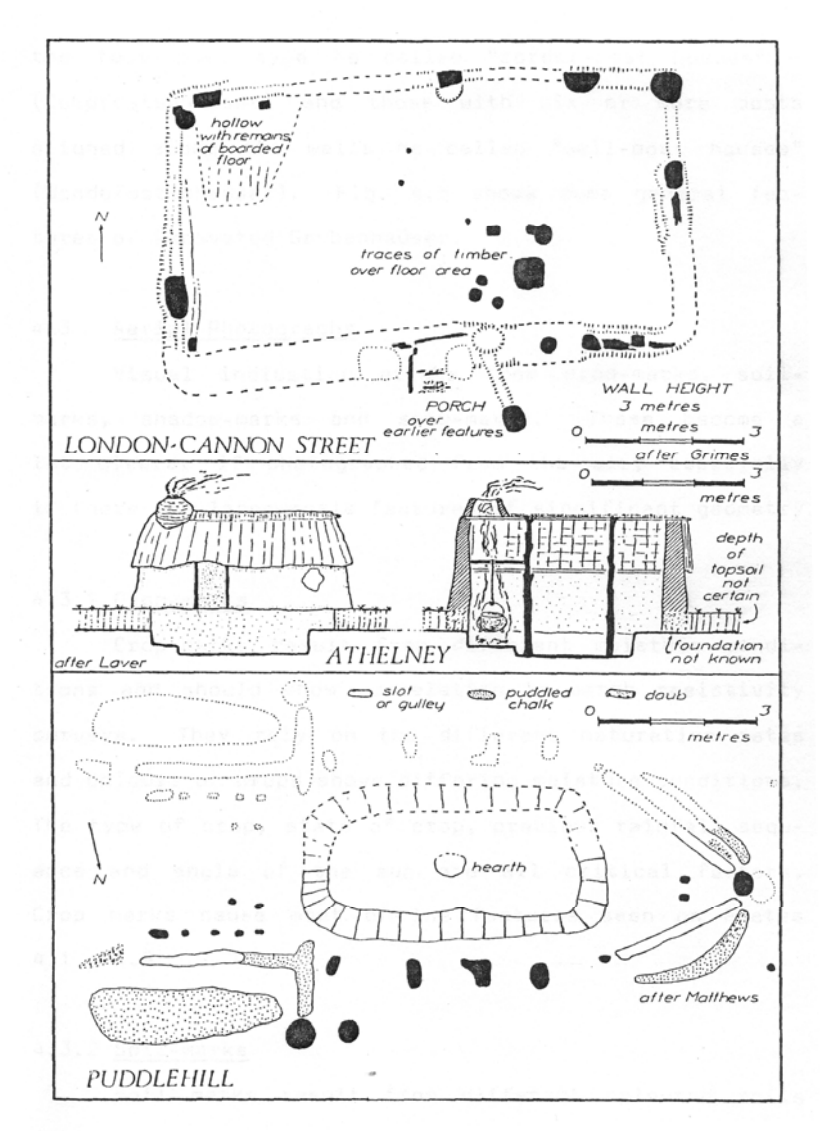
Plan

- Introduction – The past revisited!
- What is a Grubenhaus?
- Where is the search area?
- How? – Experimental Methodology
- How? – Data Analysis – Predictive deconvolution
- Results
- Conclusions
- Who? – Acknowledgments

Grubenhäuser



Typical excavated Grubenhäuser from 3 UK sites (Glover, 1985)

- Small sized
- Excavated floors lined with planks or packed clay
- Multiple use – workshops rather than dwellings
  - Pottery
  - Weaving
  - Metal-working
  - Animal husbandry…etc.
- Usually found in association with timber-framed halls

Grubenhäuser

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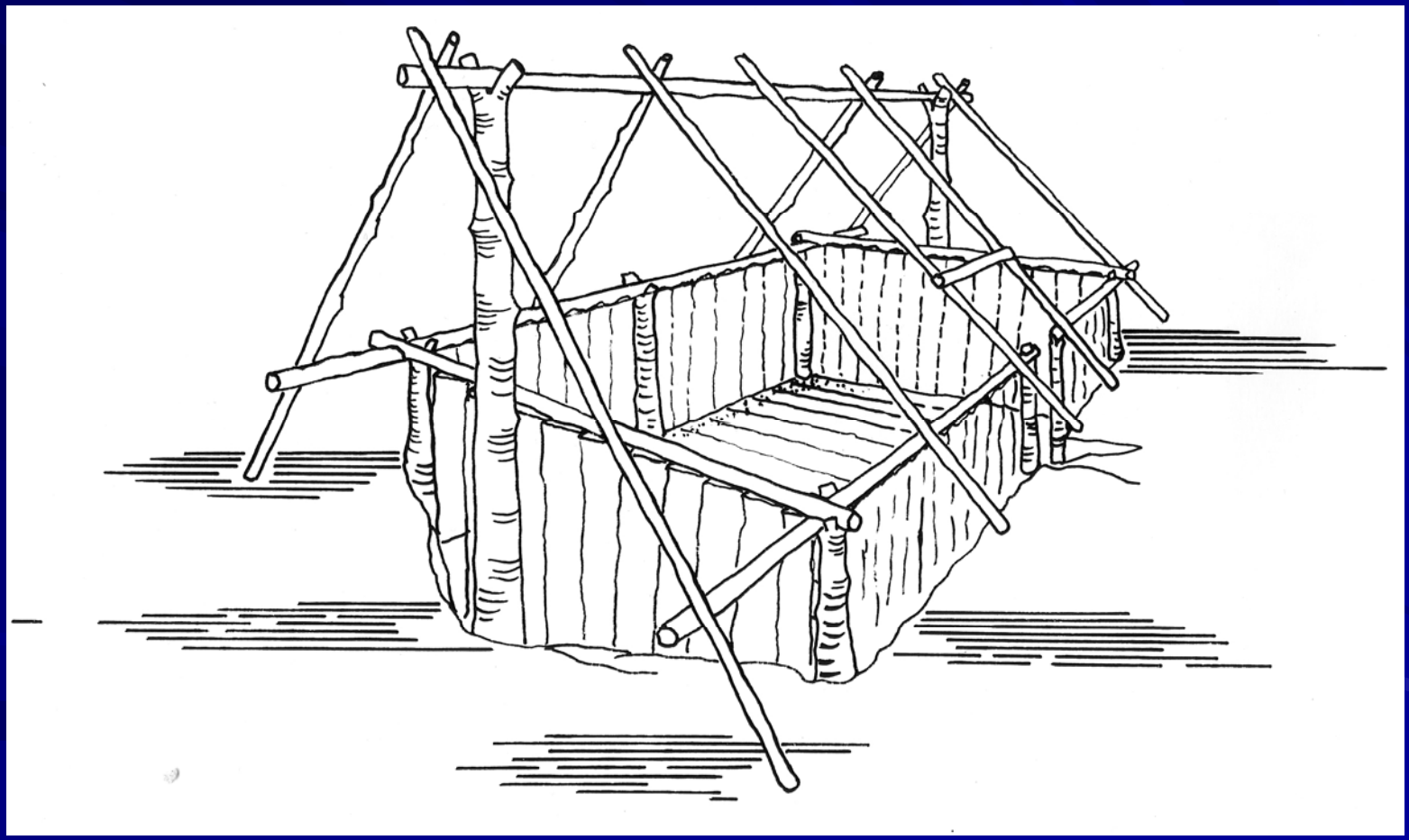

Line drawing of the New Bewick Grubenhaus

Grubenhäuser

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Reconstruction of the New Bewick Grubenhaus
http://www.bedesworld.co.uk/site_2003-05-10/building/nbkdescr.htm

General Location

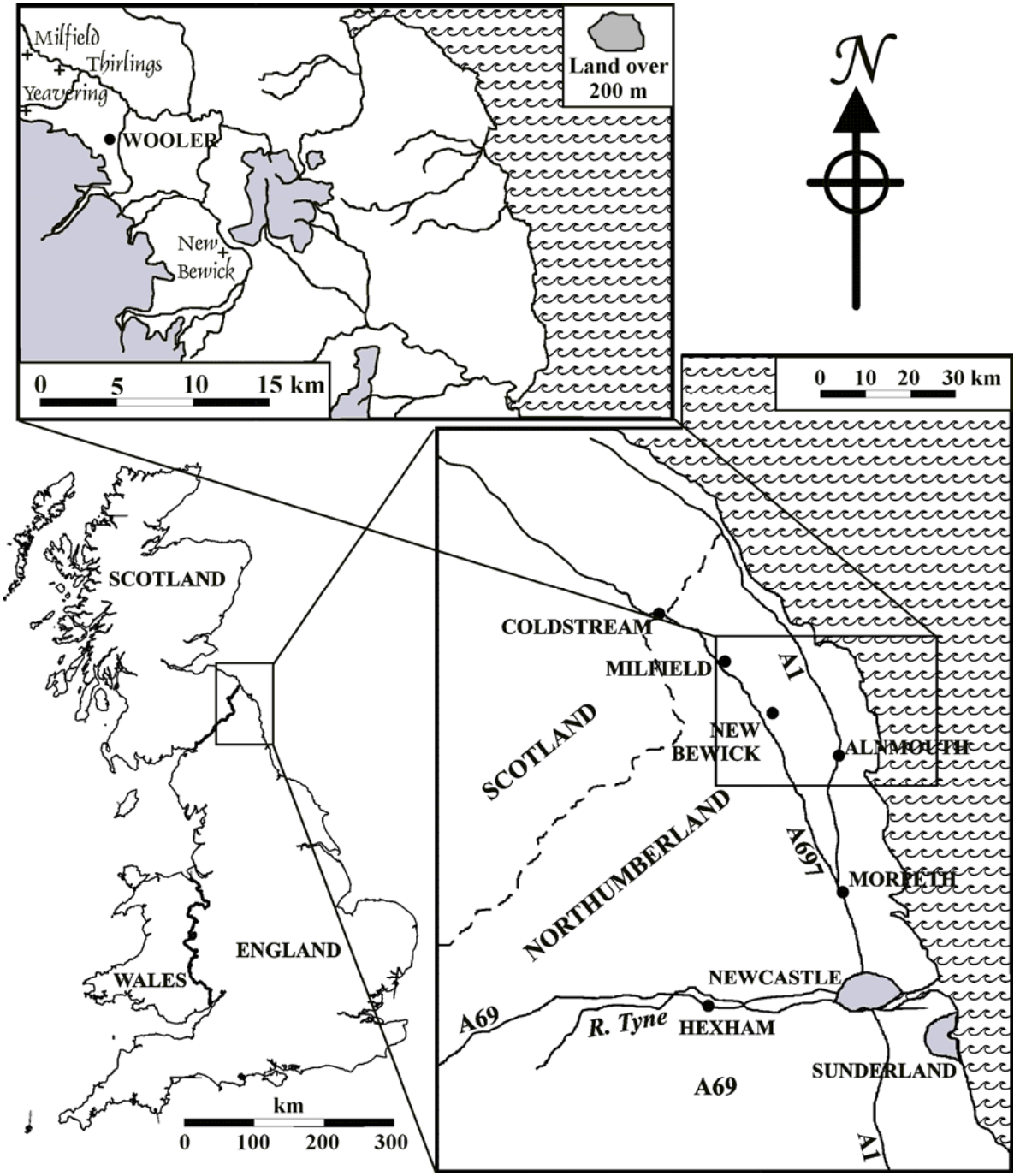
200 m from River Breamish

Elevation 94 m

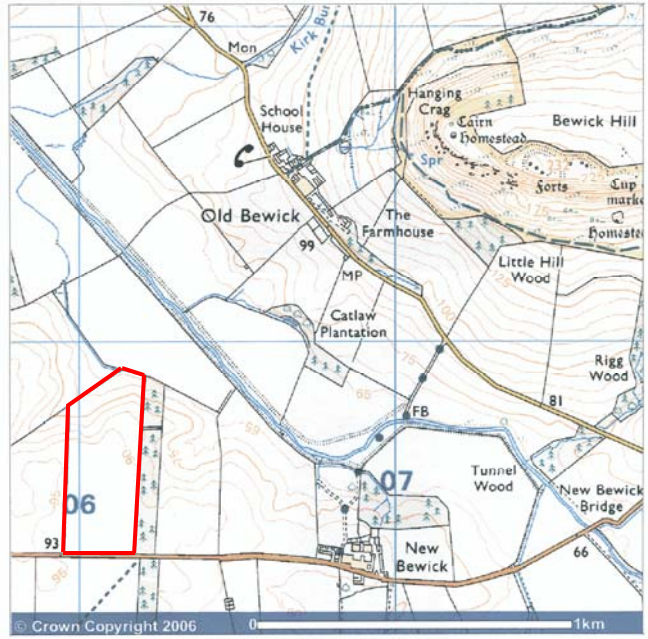
1.8 km from Old Bewick Iron Age Hillfort (rock art)

16 km from
- Milfield
- Yeavering
- Thirlings

Anglo-Saxon royal/ Palace settlements

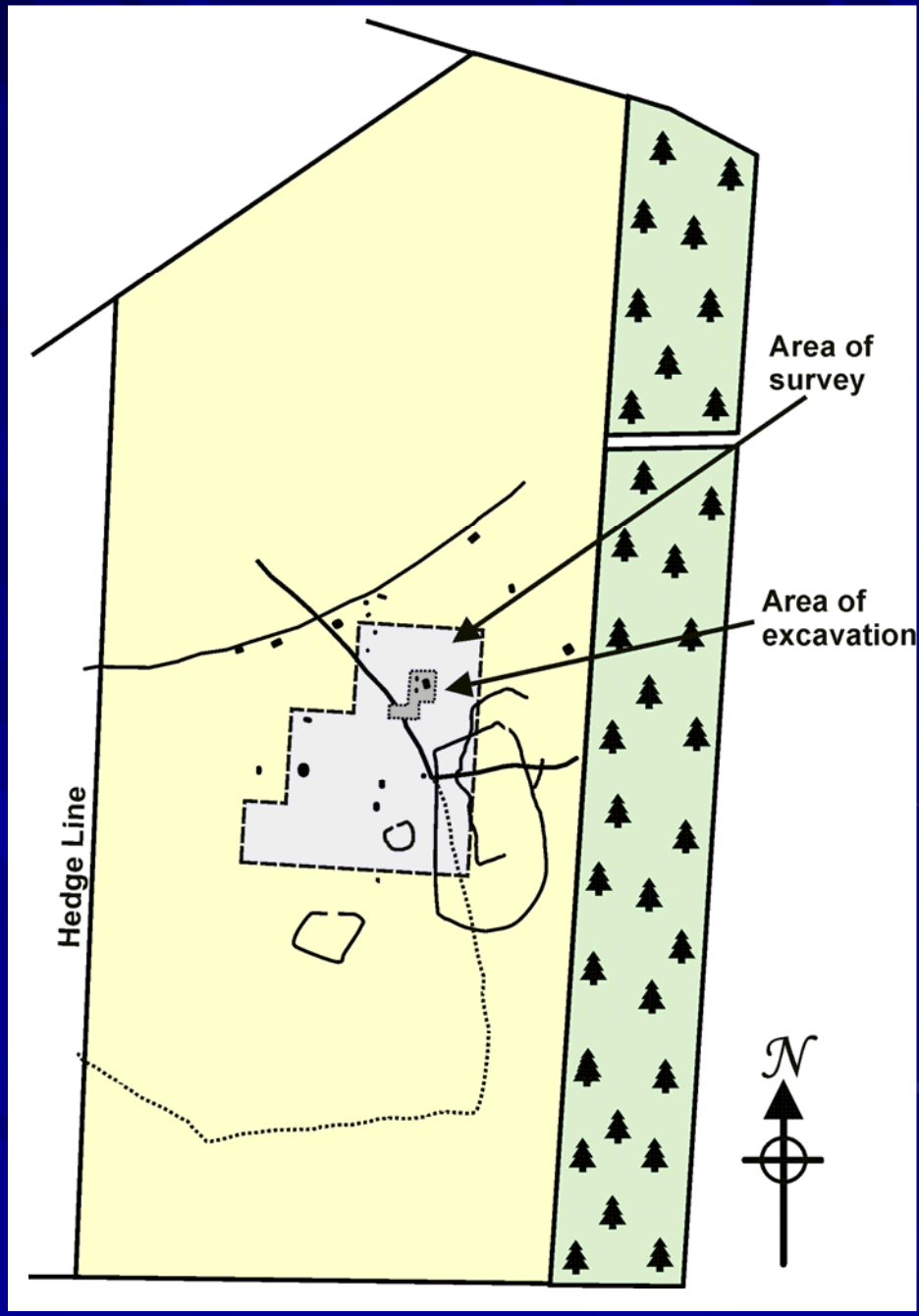


General Location



Light grey area represents The survey area (in two parts)

Dark grey area represents the subsequently excavated area



Aerial Photography

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Marks include

Tramlines

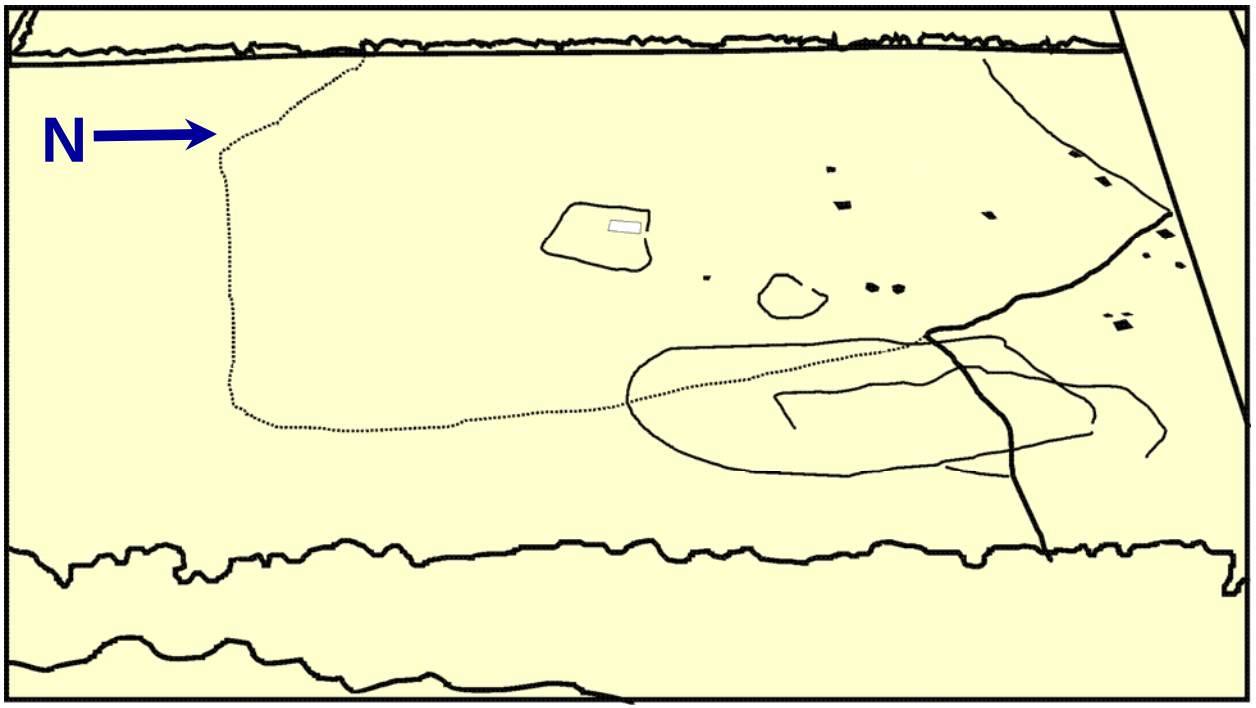
Drainage

Glacial Till

Frost Cracking

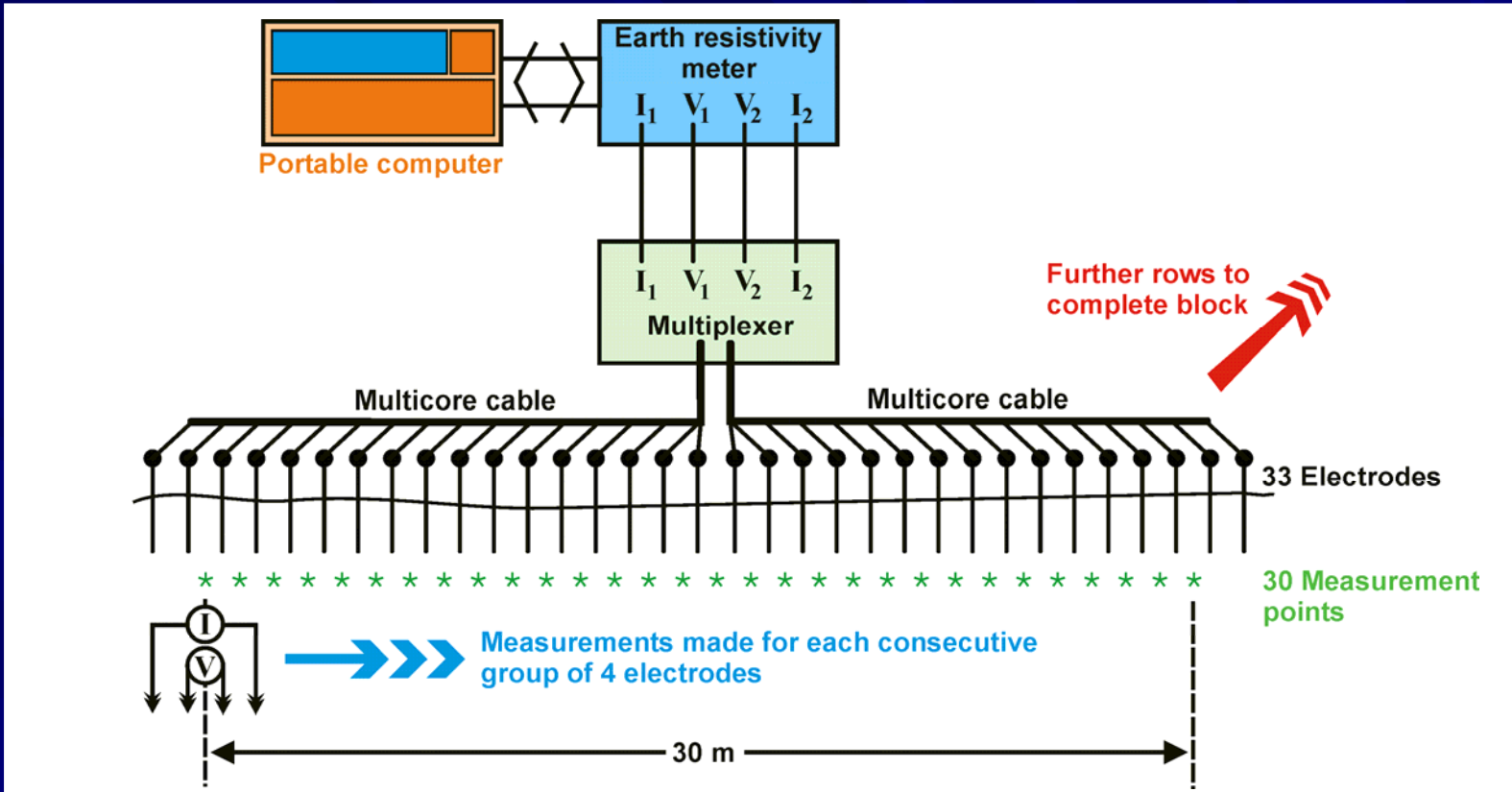
Old Hedge Boundaries

Archaeological Remains




Aerial Photography

Methodology



- ABEM Mk II Terrameter & in-house meter
- 33 electrodes multiplexed into 4
- Survey area 10140 m^2
- May and June, dry weather with short winter wheat
- Light, sandy topsoil

Raw data

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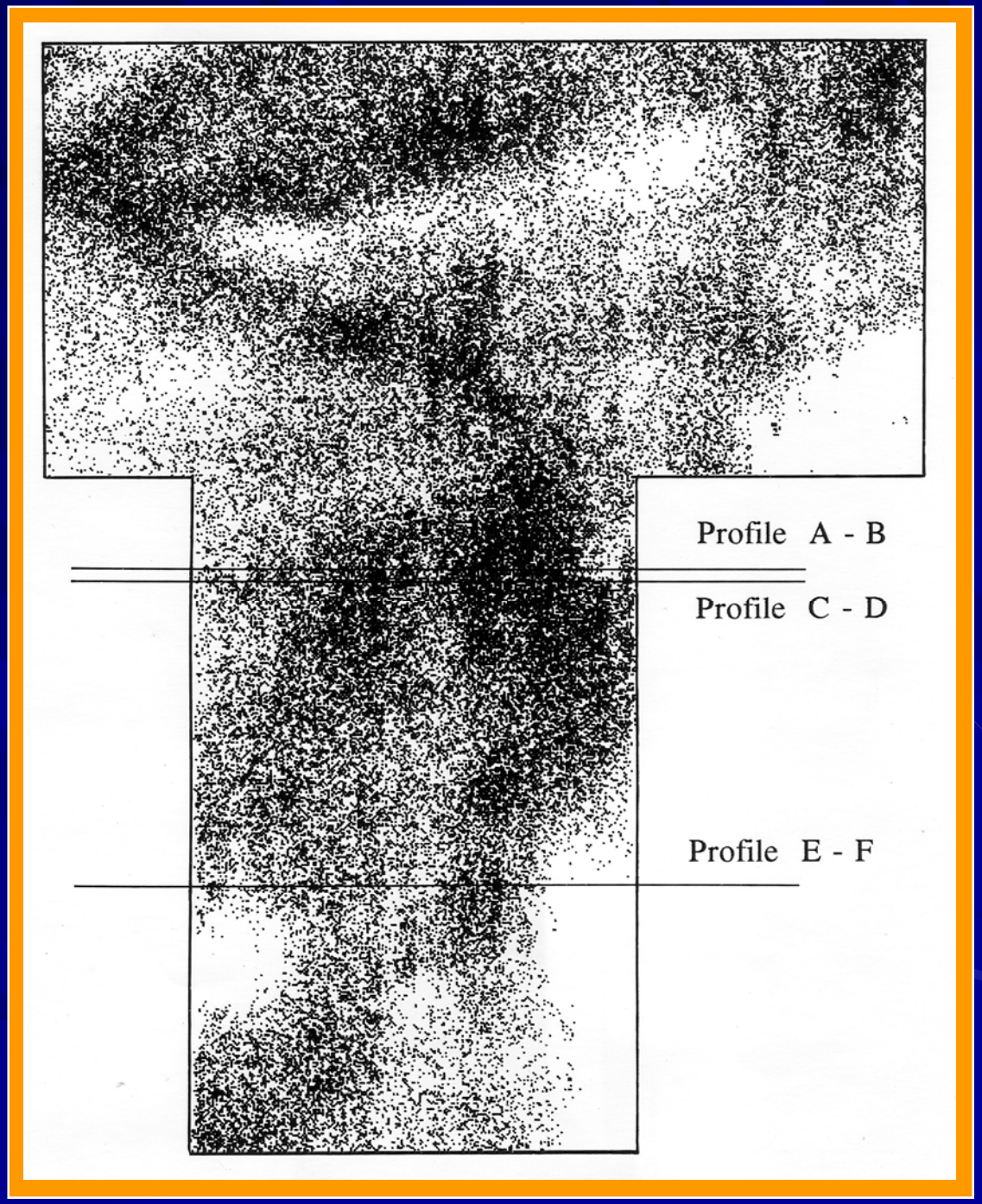
Raw data from the first part of the survey area



Data Analysis

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- Each structure has an electrical signature or source function
- Predictive deconvolution – need to predict the source function
- Source function can be calculated uniquely from a geometrical model of the subsurface feature
- The model, however, is not unique
- The method restores the target structure…
  …but destroys structures of other geometries
- Analysis carried out by matrix inversion

Data Analysis: The Source Function

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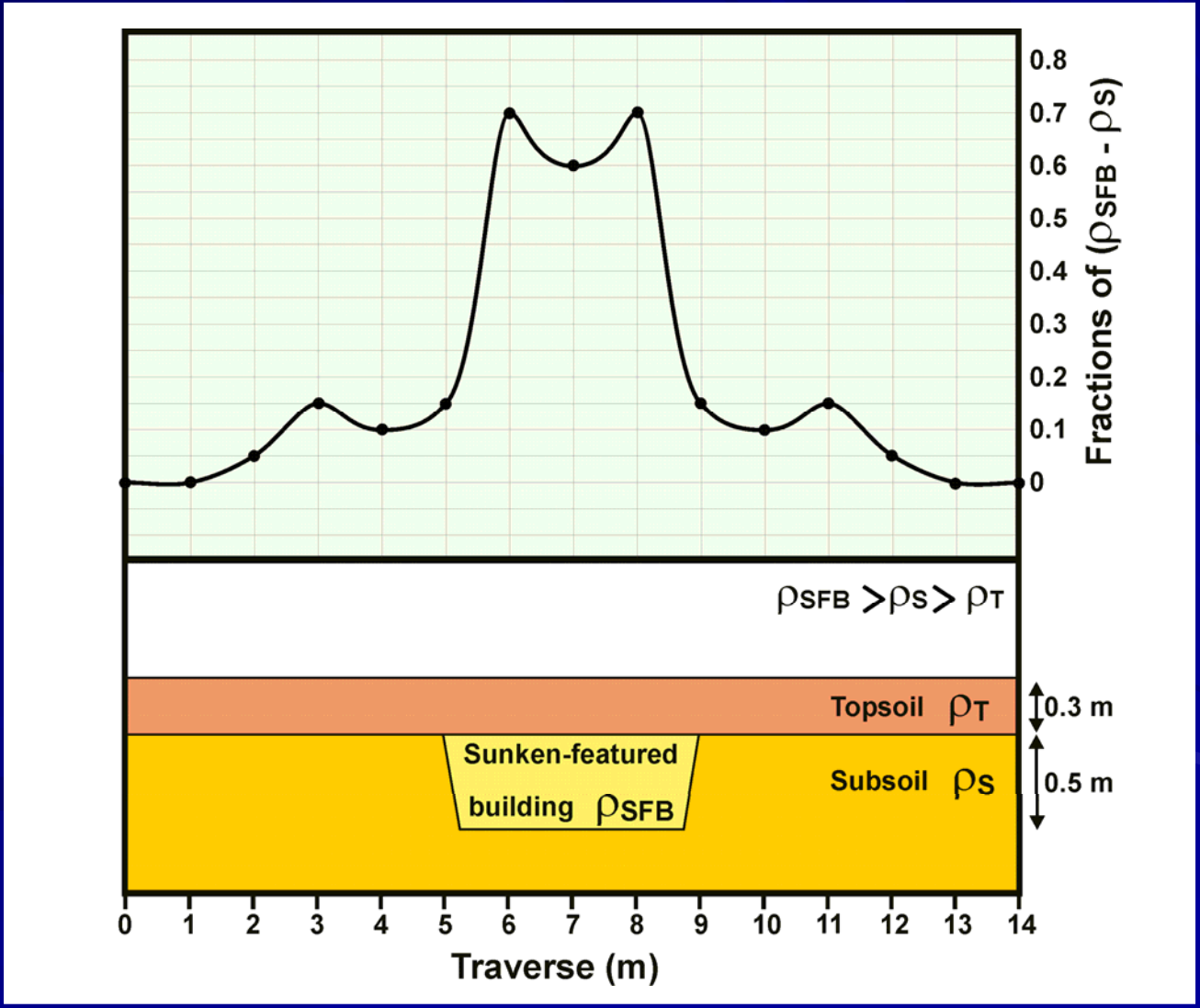

Convolution: Synthetic Data

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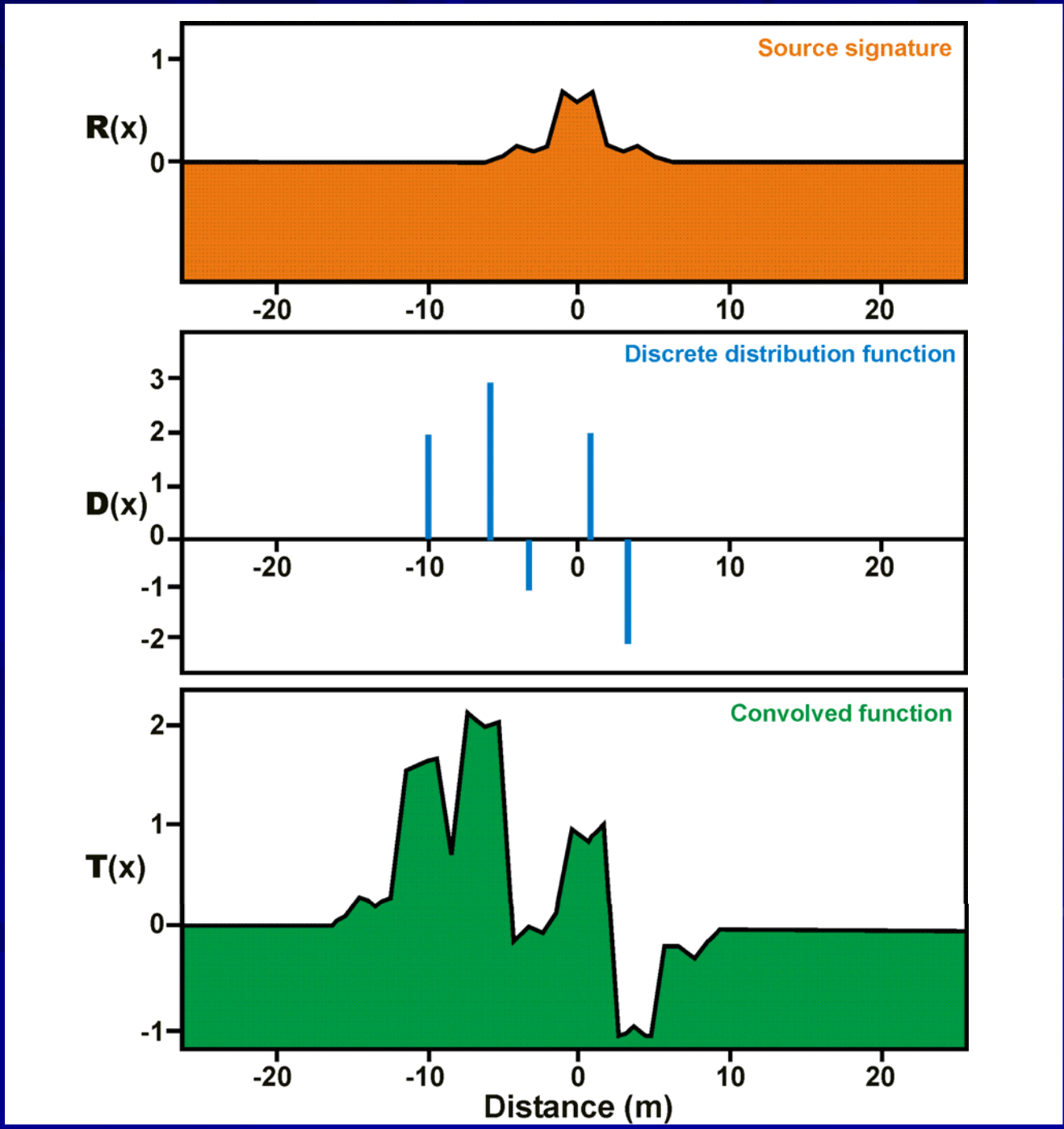

Deconvolution: Restoration of location

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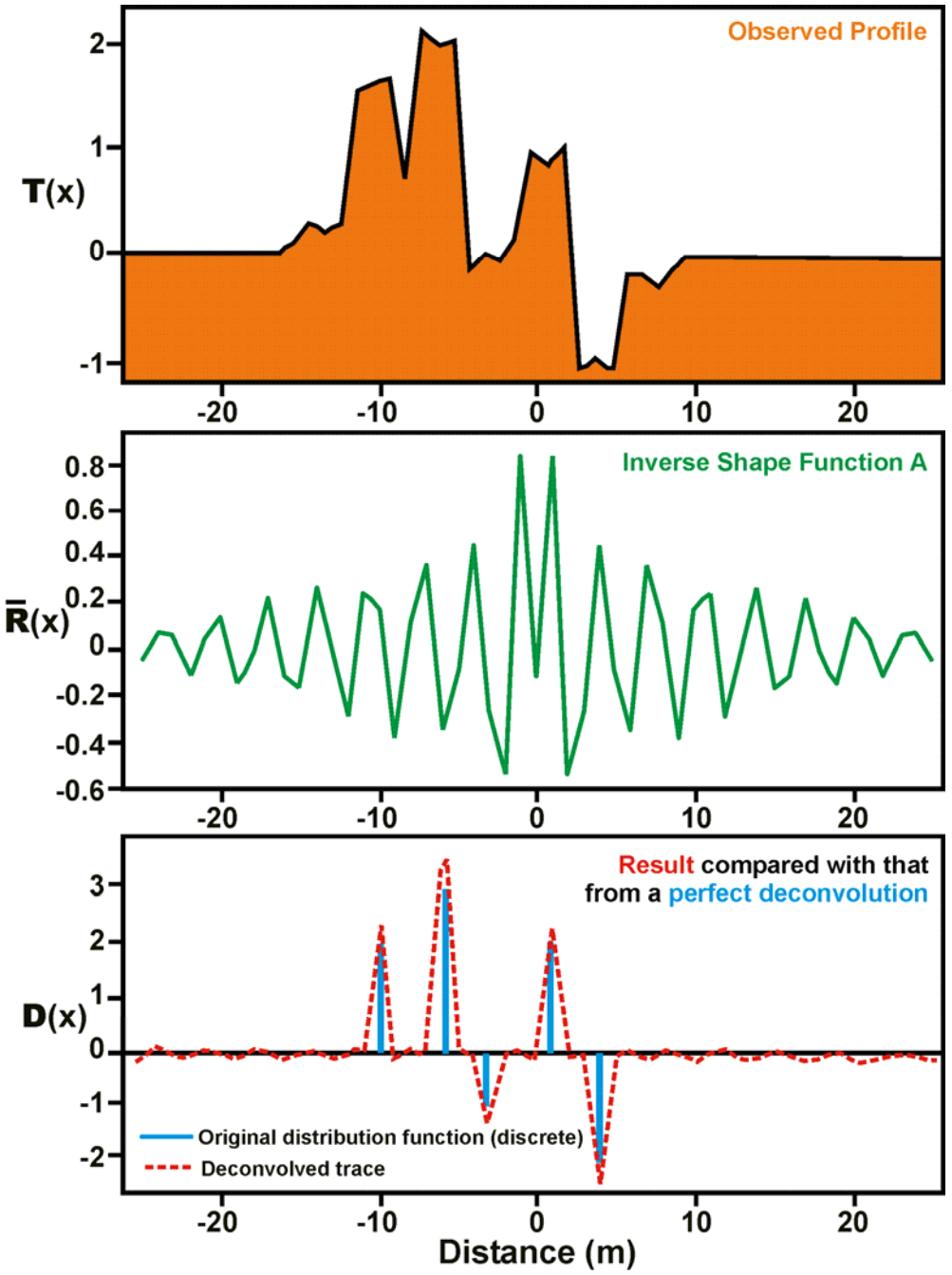

Deconvolution: Restoration of location and extent

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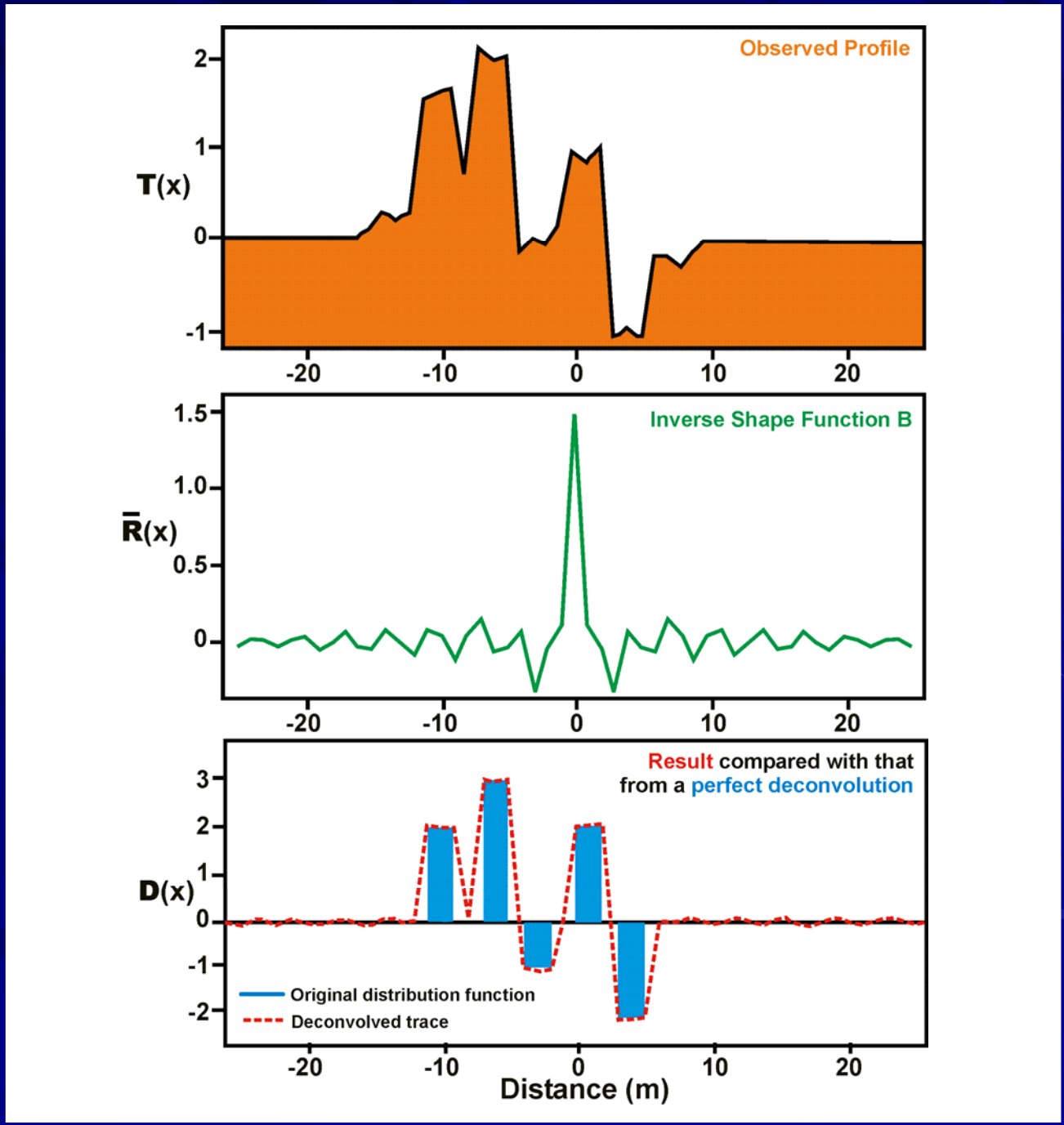

Data Analysis – Test 1

Restoration of location

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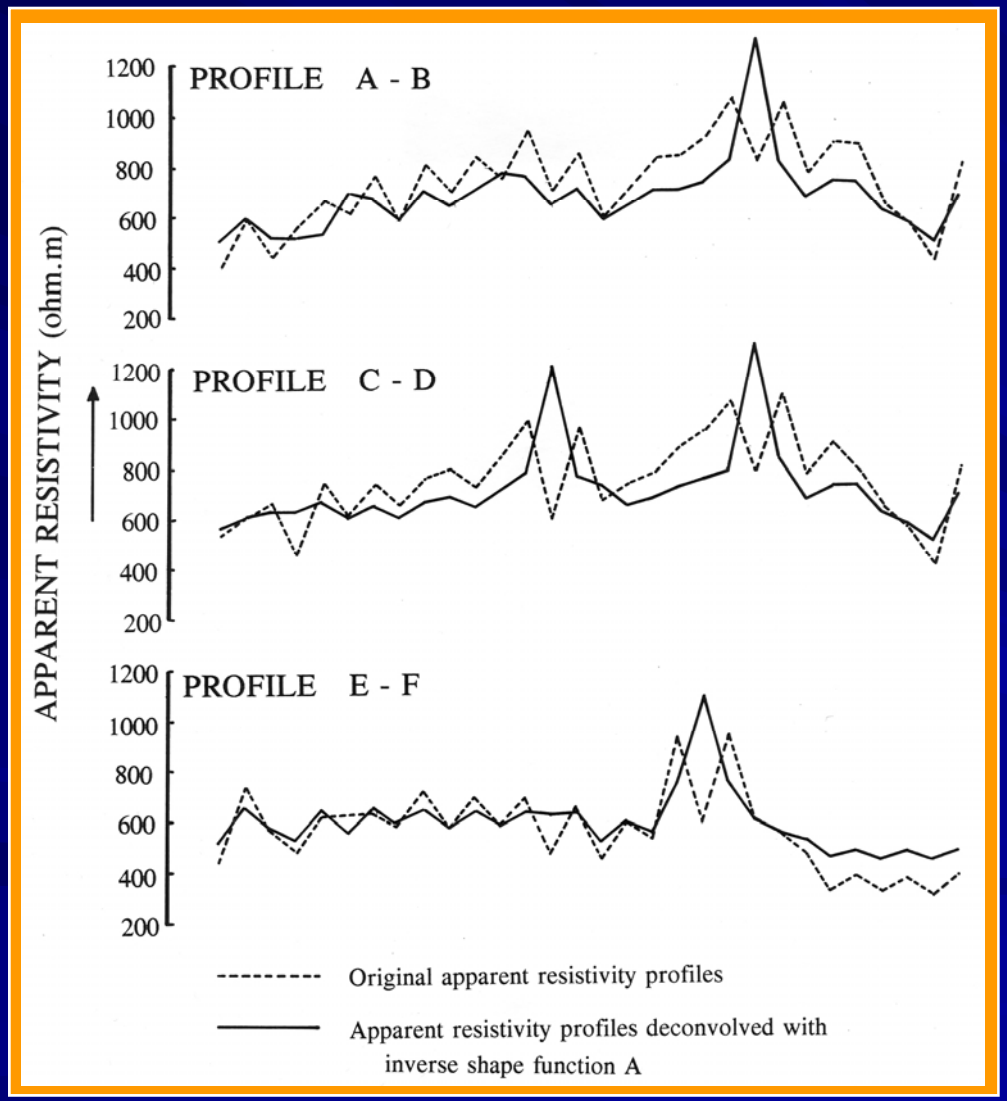

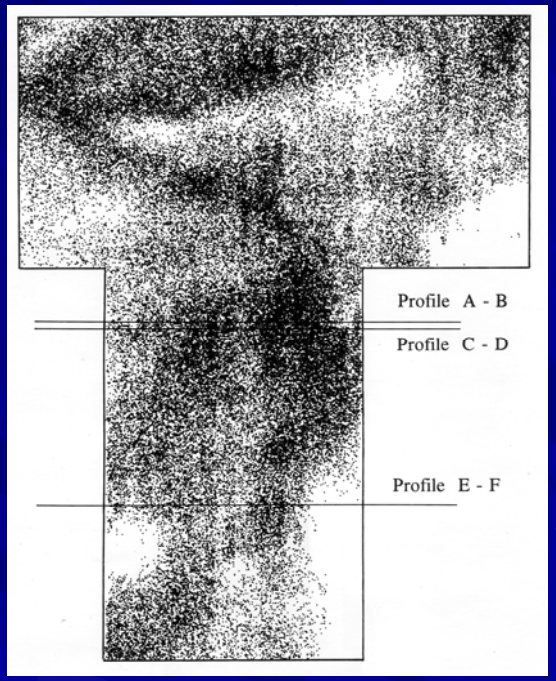

Data Analysis – Test 2

Restoration of location and extent

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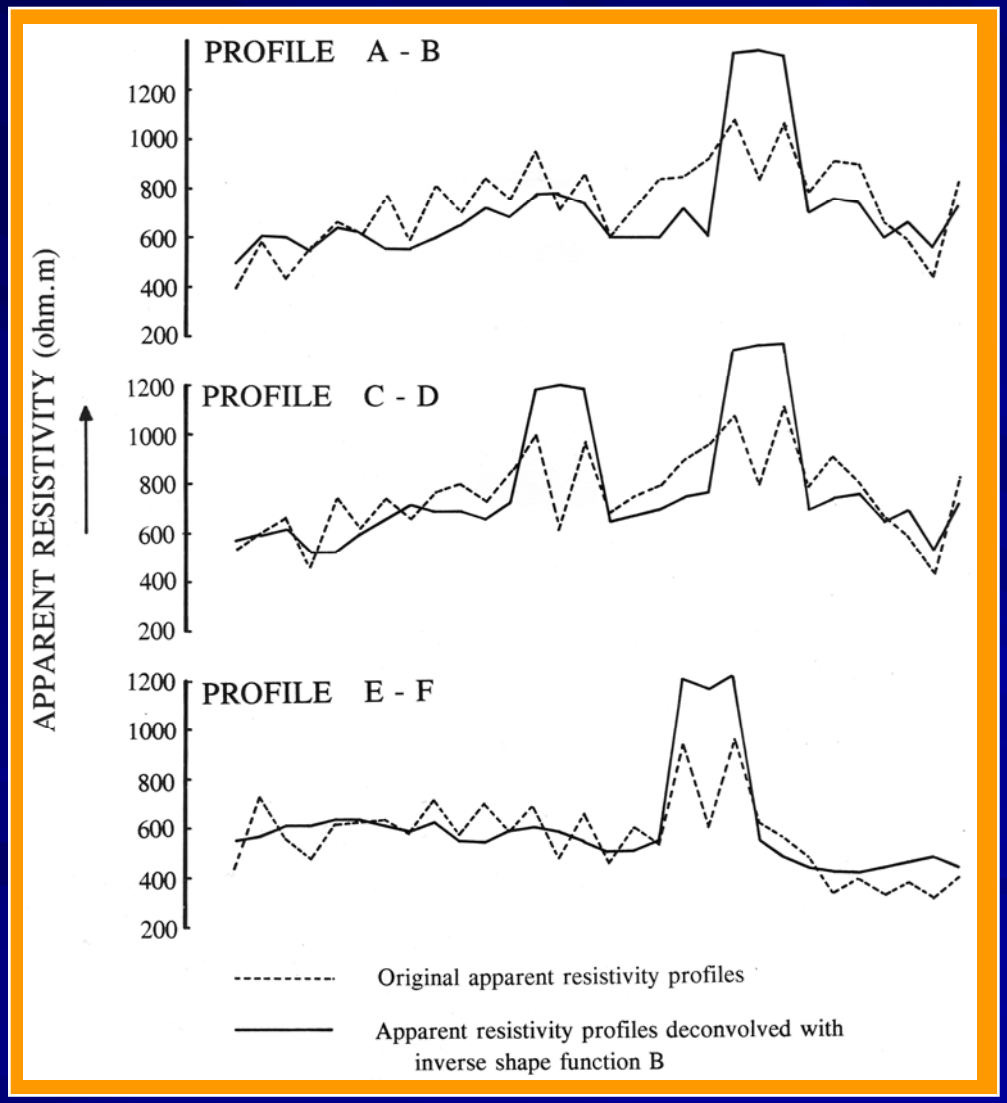

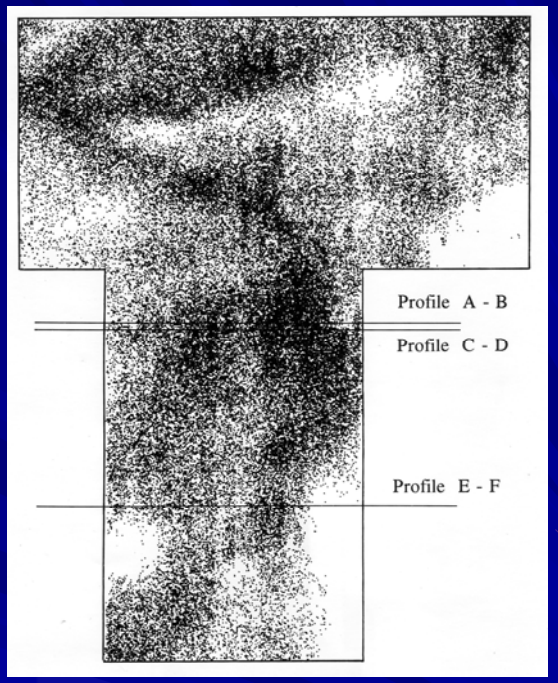

Results - Undeconvolved

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Results

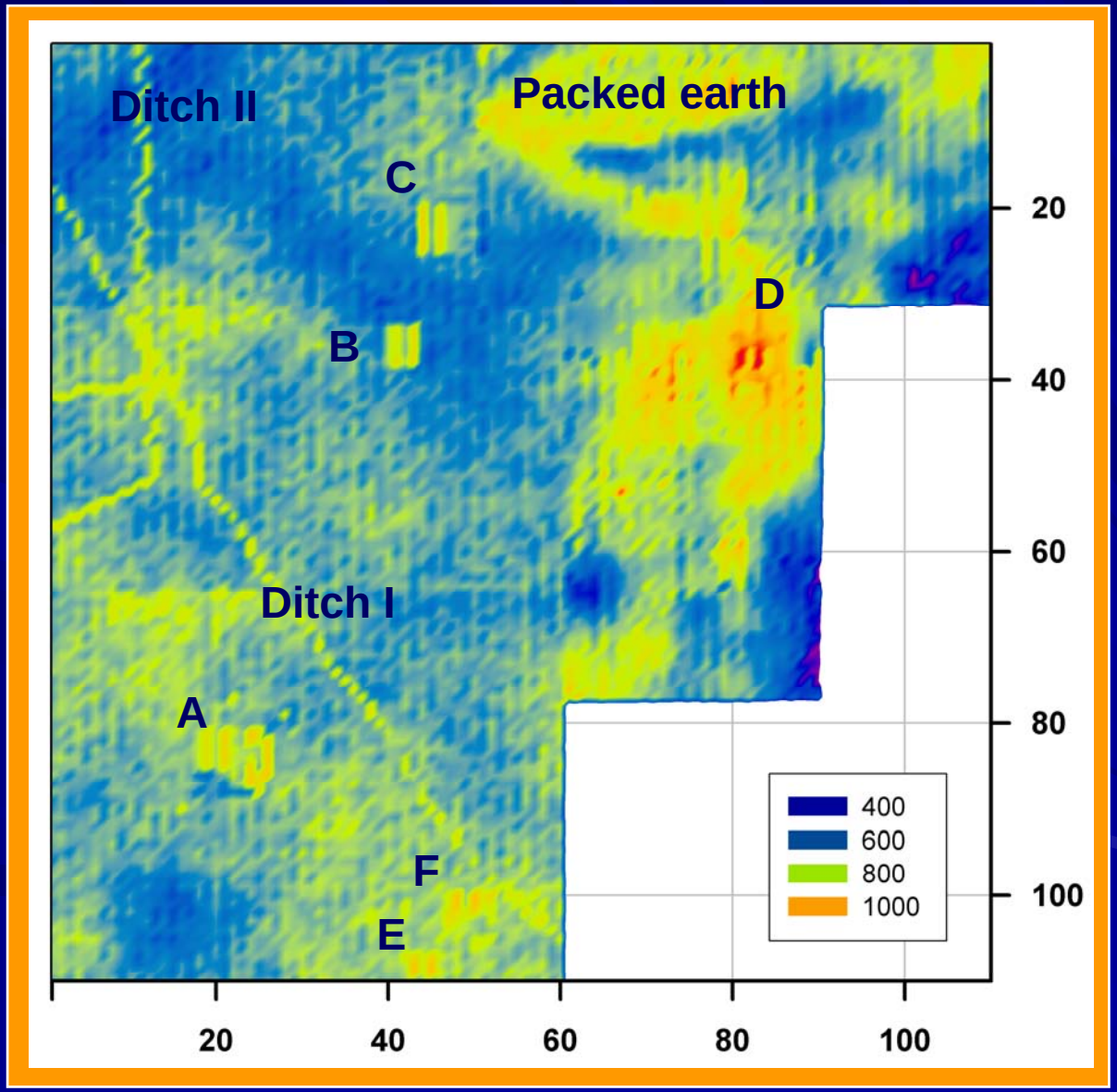
Undeconvolved

Deconvolved 3 m width

Deconvolved 4 m width

Deconvolved 5 m width

Combined Data



Results – Deconvolved

Source function 3 m wide

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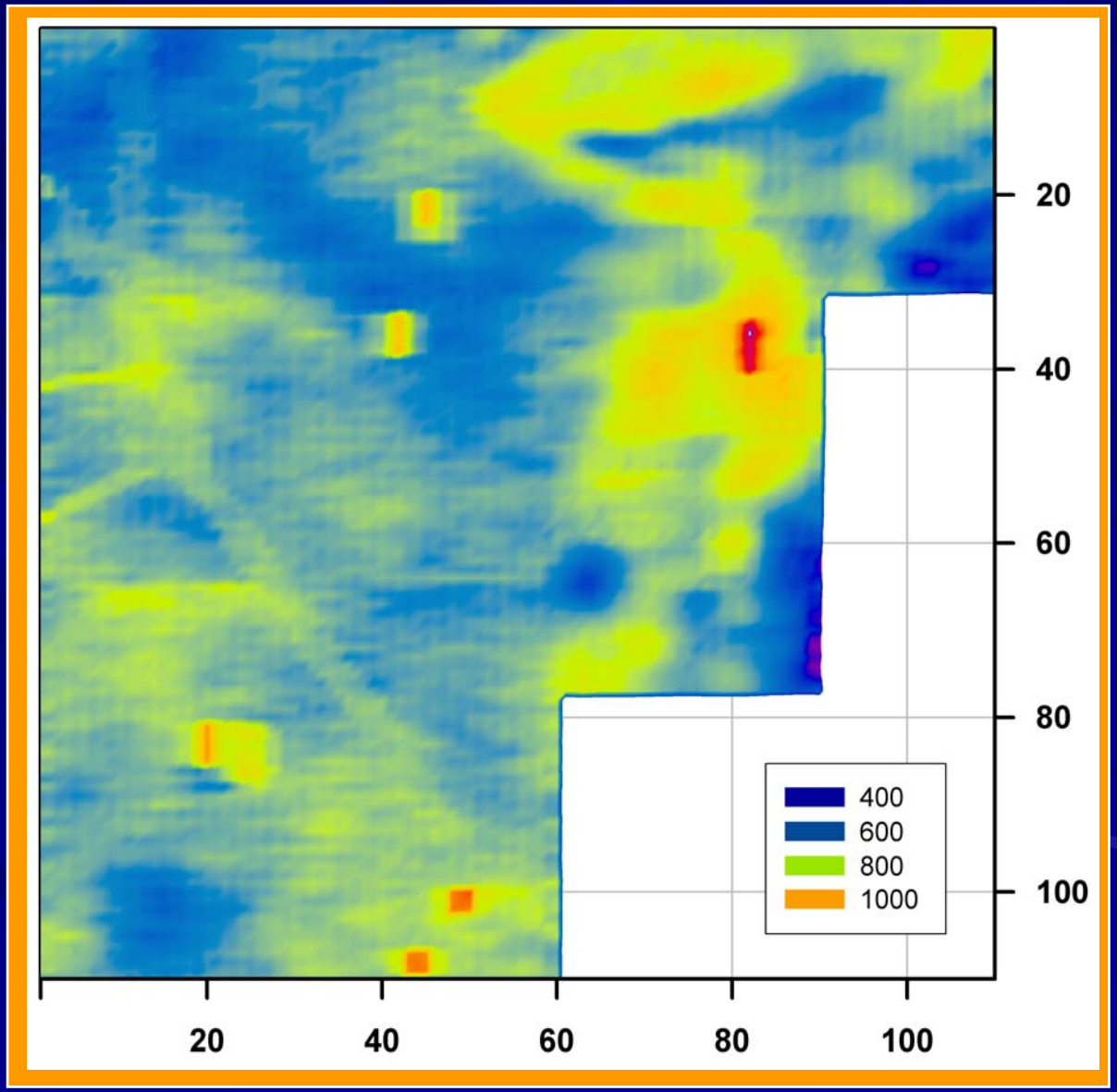
Deconvolved 3 m width

Deconvolved 4 m width

Deconvolved 5 m width

Combined Data



Results – Deconvolved

Source function 4 m wide

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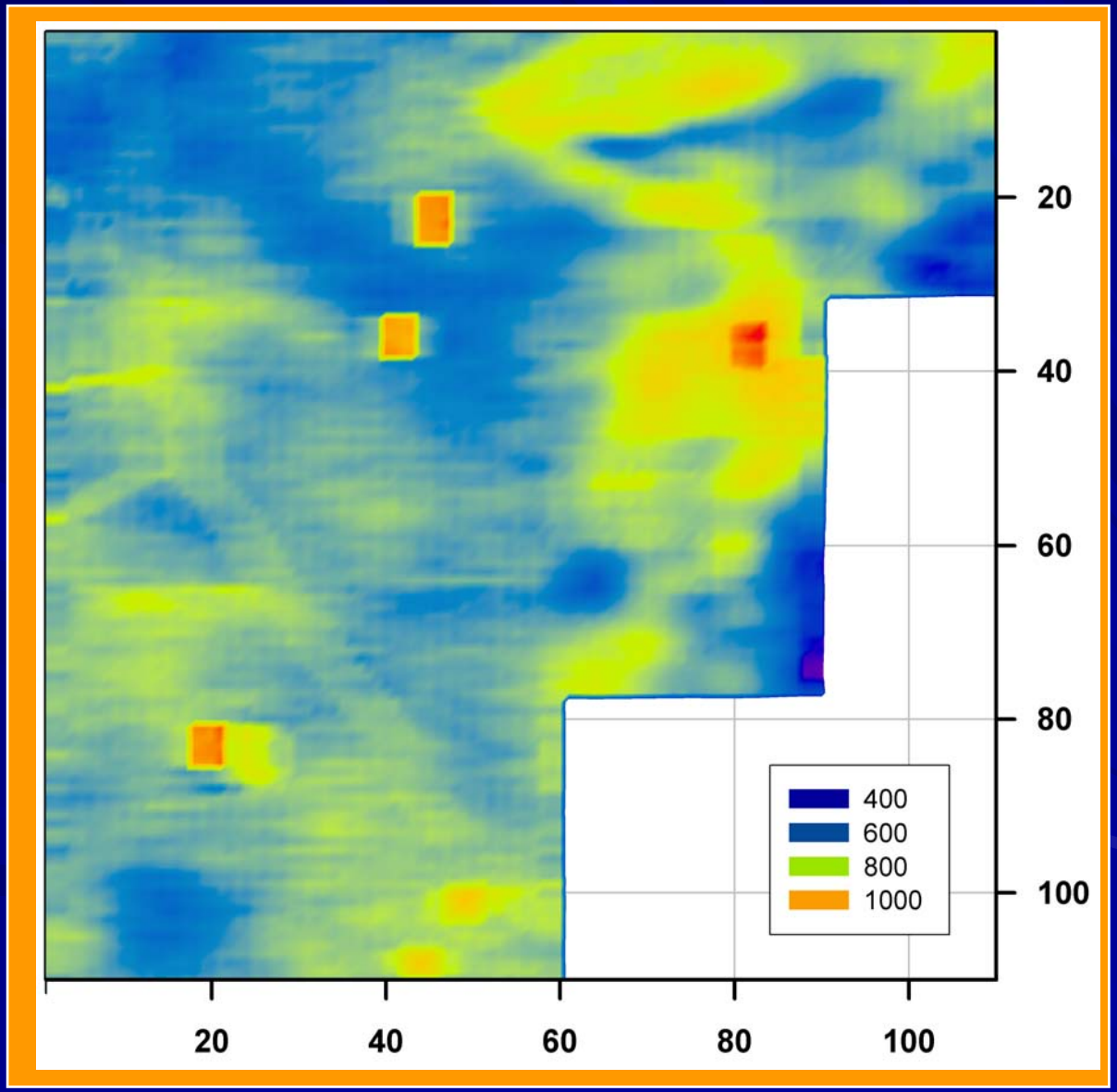
Results

- Undeconvolved
- Deconvolved 3 m width
- **Deconvolved 4 m width**
- Deconvolved 5 m width
- Combined Data



Results – Deconvolved

Source function 5 m wide

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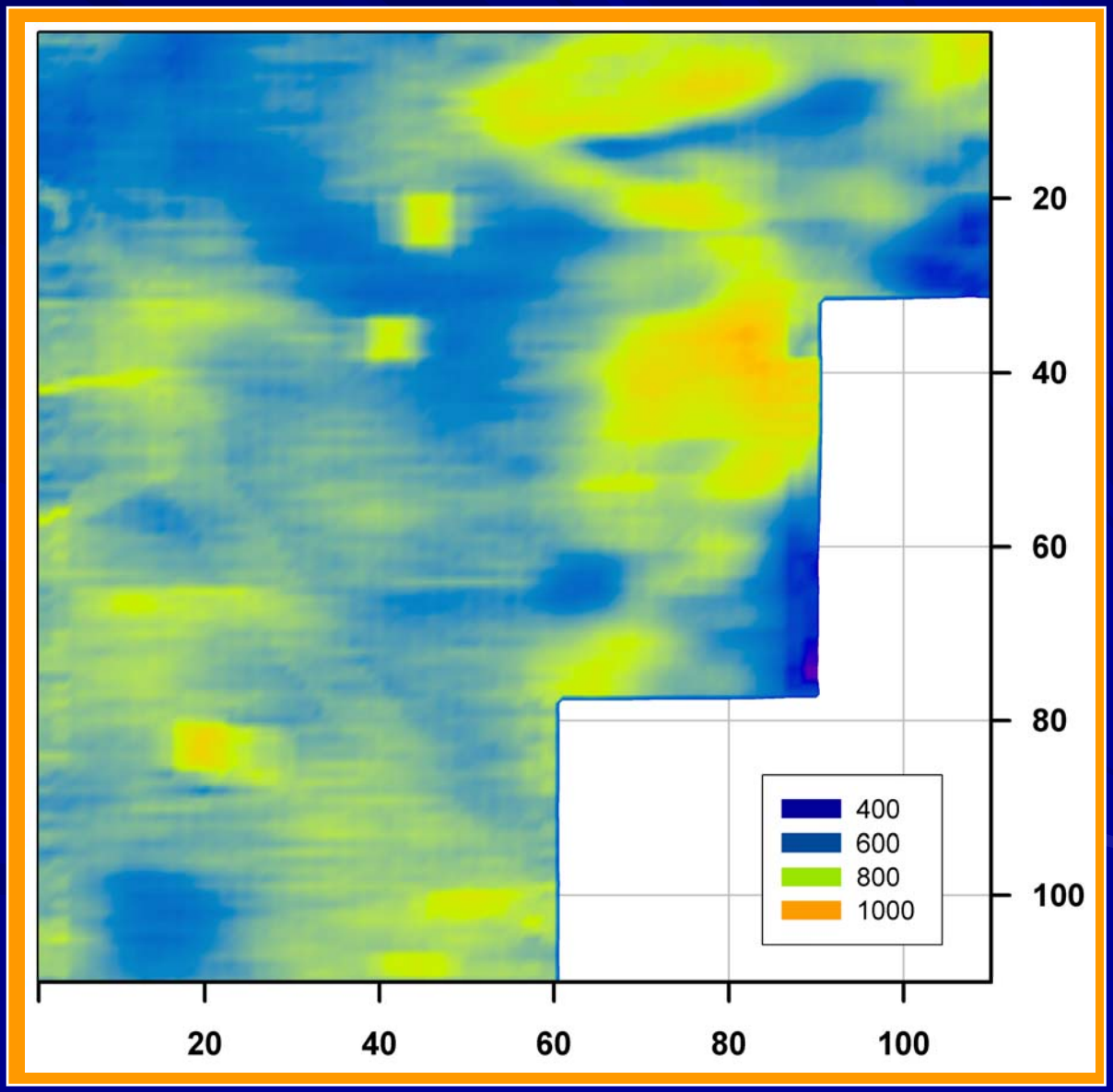
Deconvolved 3 m width

Deconvolved 4 m width

Deconvolved 5 m width

Combined Data



Results - Combined View

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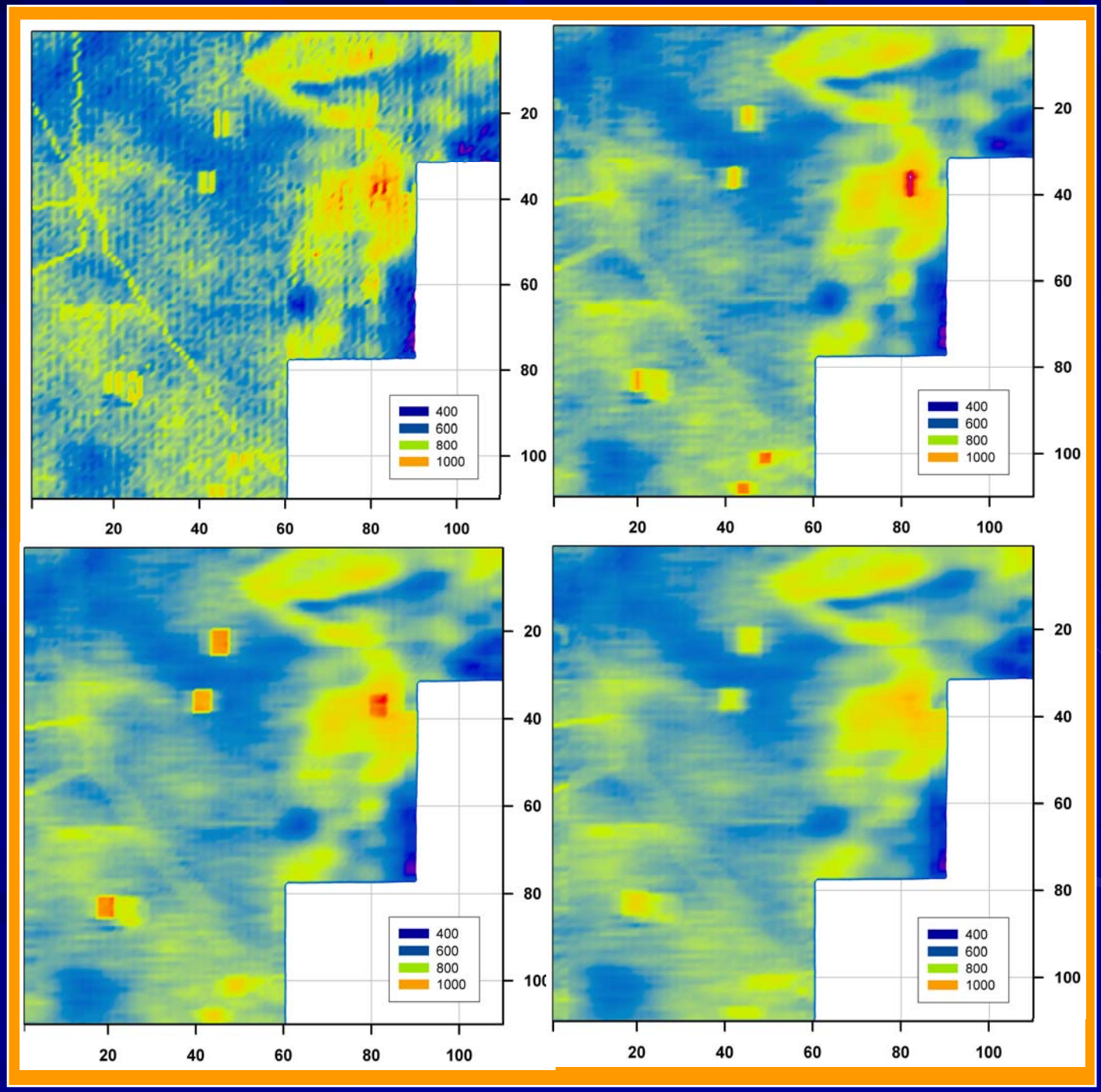

Proof by Excavation

(Gates and O'Brien, 1988)

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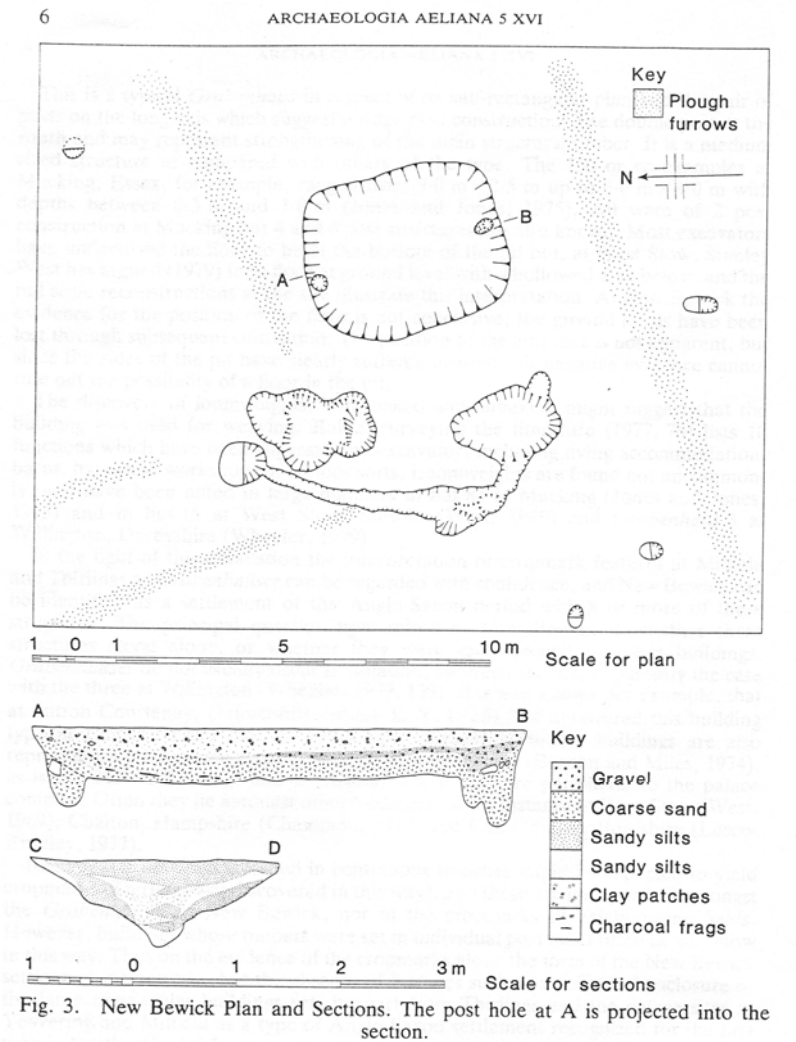
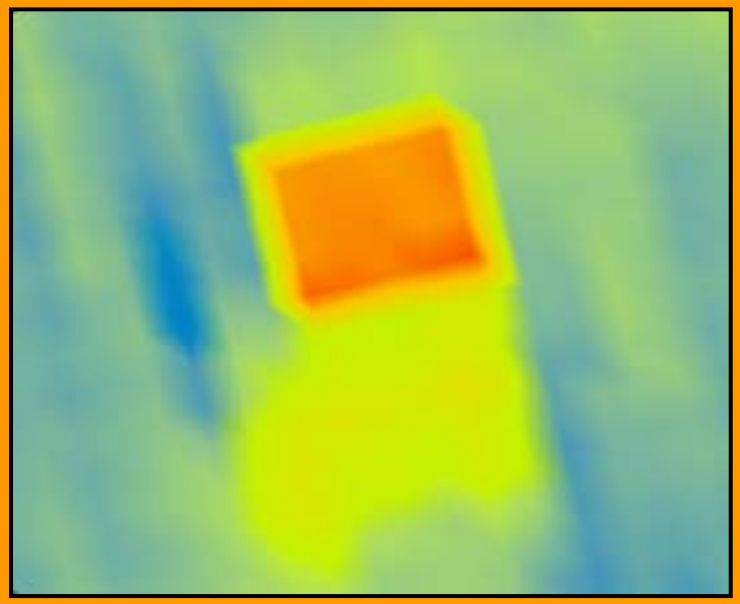


Fig. 3. New Bewick Plan and Sections. The post hole at A is projected into the section.

Gates and O'Brien, 1988

Deconvolved survey



(in metres)	Survey	Excavated
Width	4	3.9
Length	5	4.7
Depth	0.6	0.5
Topsoil	(0.3)	0.3

Conclusions

- Complex electrical survey data can be deconvolved to provide the location and extent of buried features IF their source signature can be predicted
- Electrical survey at New Bewick predicts the presence of at least 6 grubenhäuser
- One of the predicted grubenhäuser has been excavated and confirmed with the same dimensions as the survey predicted
- The site shows other features, and may be the site of a significant settlement (timber-framed halls?)

Acknowledgments

- Mr. J Clark – New Bewick Farm
- P. Clark & T. Gates - Newcastle Archaeological Unit
- Prof. Norman McCord – Aerial photography