

Joint Meeting 2009-GP10-829



Archaeometric prospection using electrical survey predictive deconvolution (ESPD)

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Plan

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Introduction

What is a
Grubenhau?

Where is the
search area?

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

Grubenhäuser

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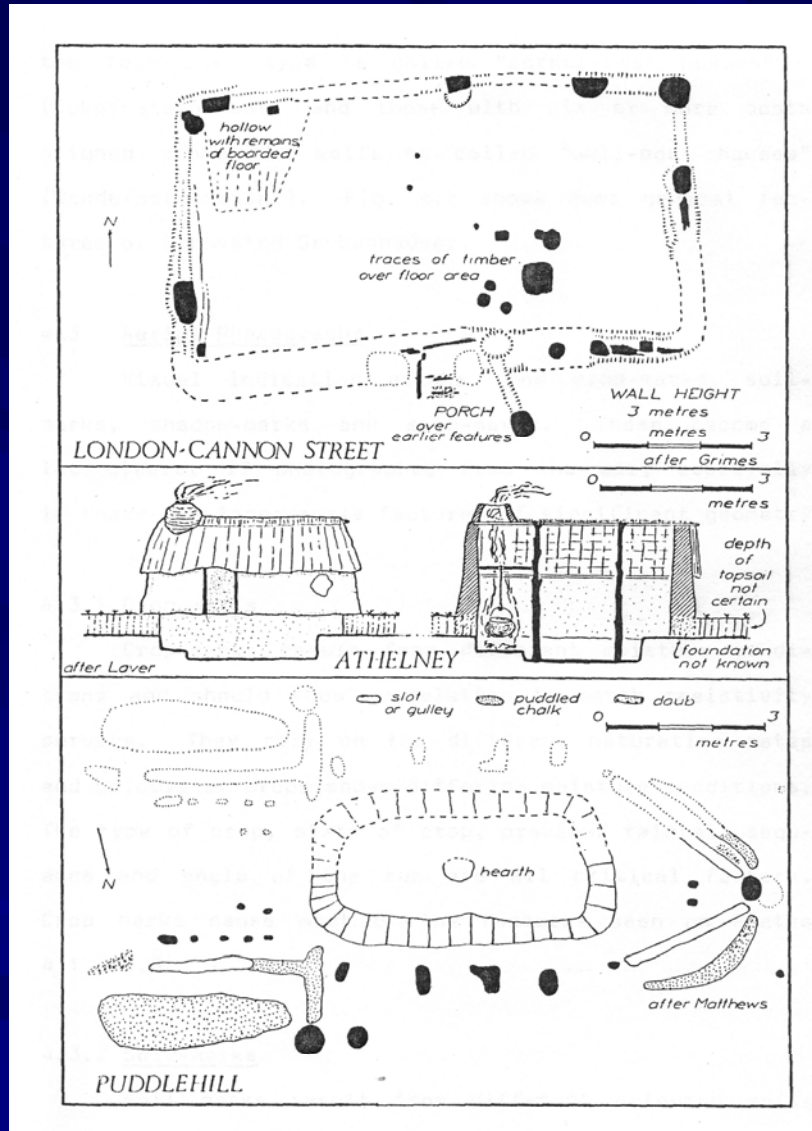
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Typical excavated Grubenhäuser
from 3 UK sites (Glover, 1985)

- ❖ 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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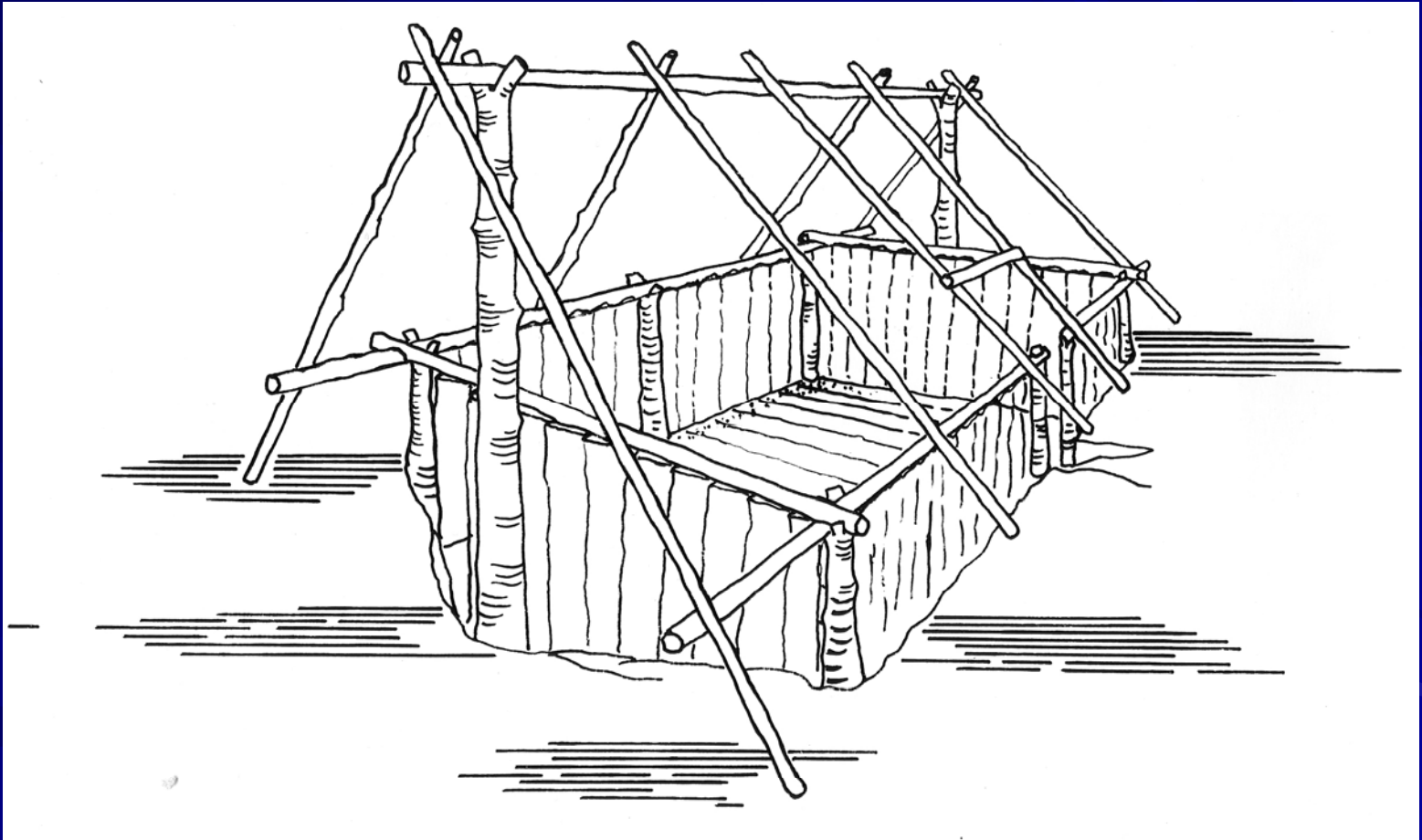
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Line drawing of the New Bewick Grubenhäuser

Grubenhäuser



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Reconstruction of the New Bewick Grubenhäuser

http://www.bedesworld.co.uk/site_2003-05-10/building/nbkdescr.htm

General Location

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200 m from
River Breamish

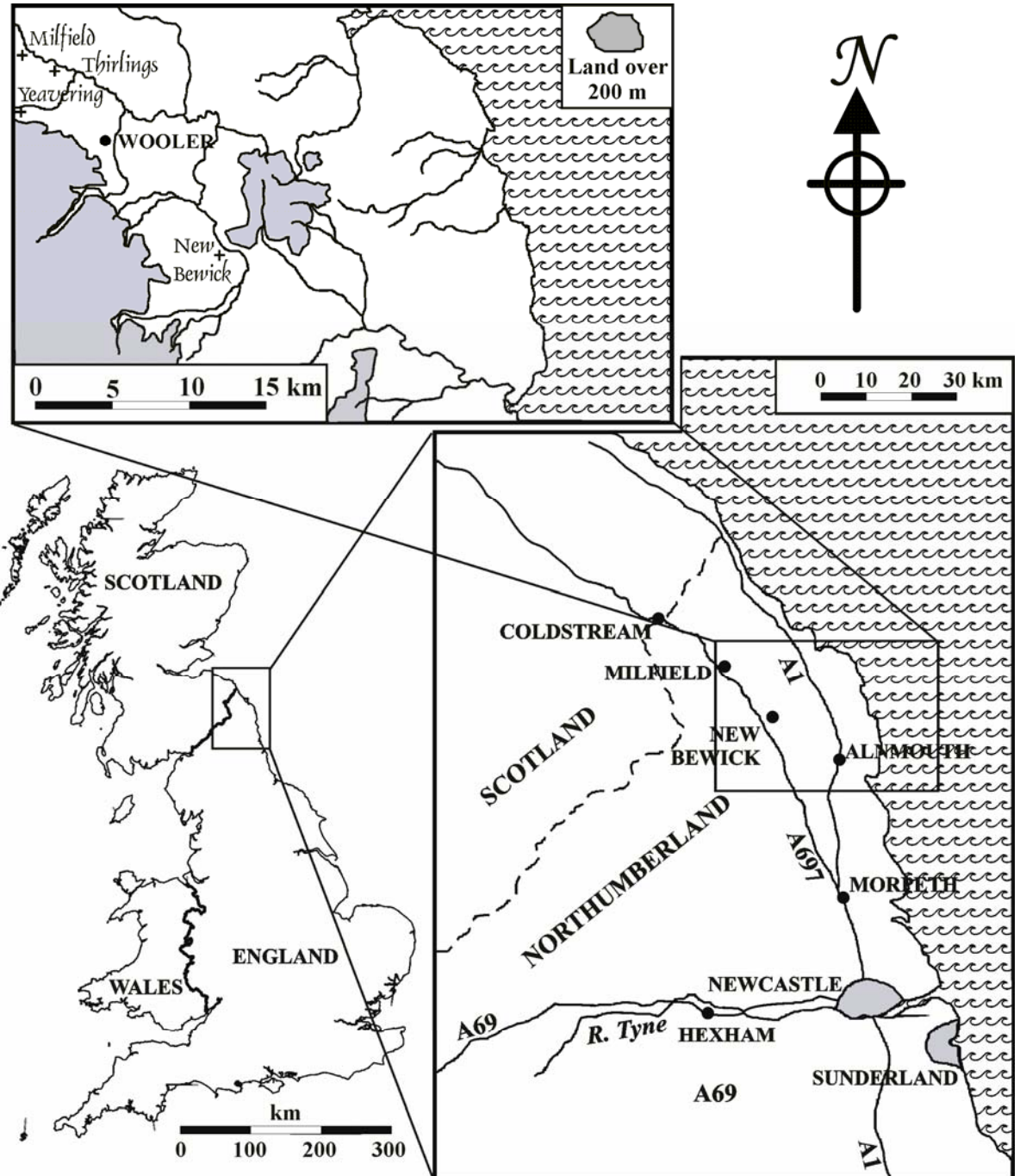
Elevation 94 m

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

16 km from

- Milfield
- Yeavinger
- Thirlings

Anglo-Saxon royal/
Palace settlements



General Location

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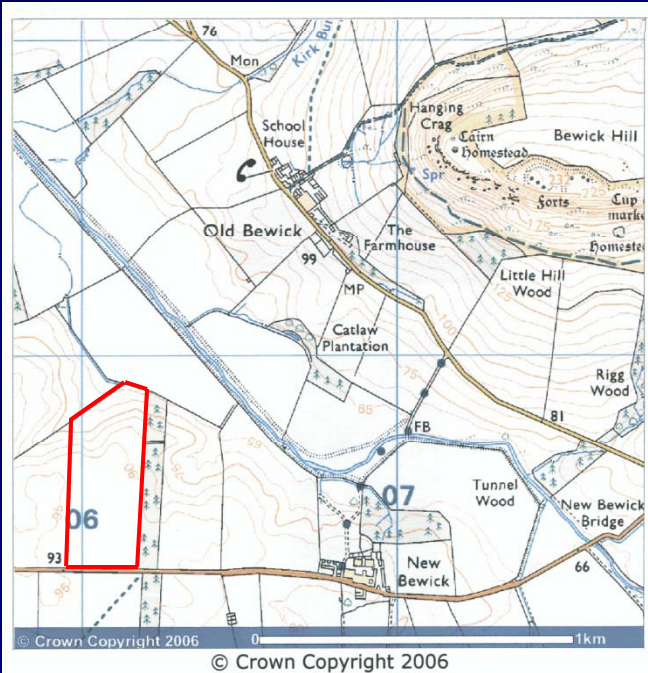
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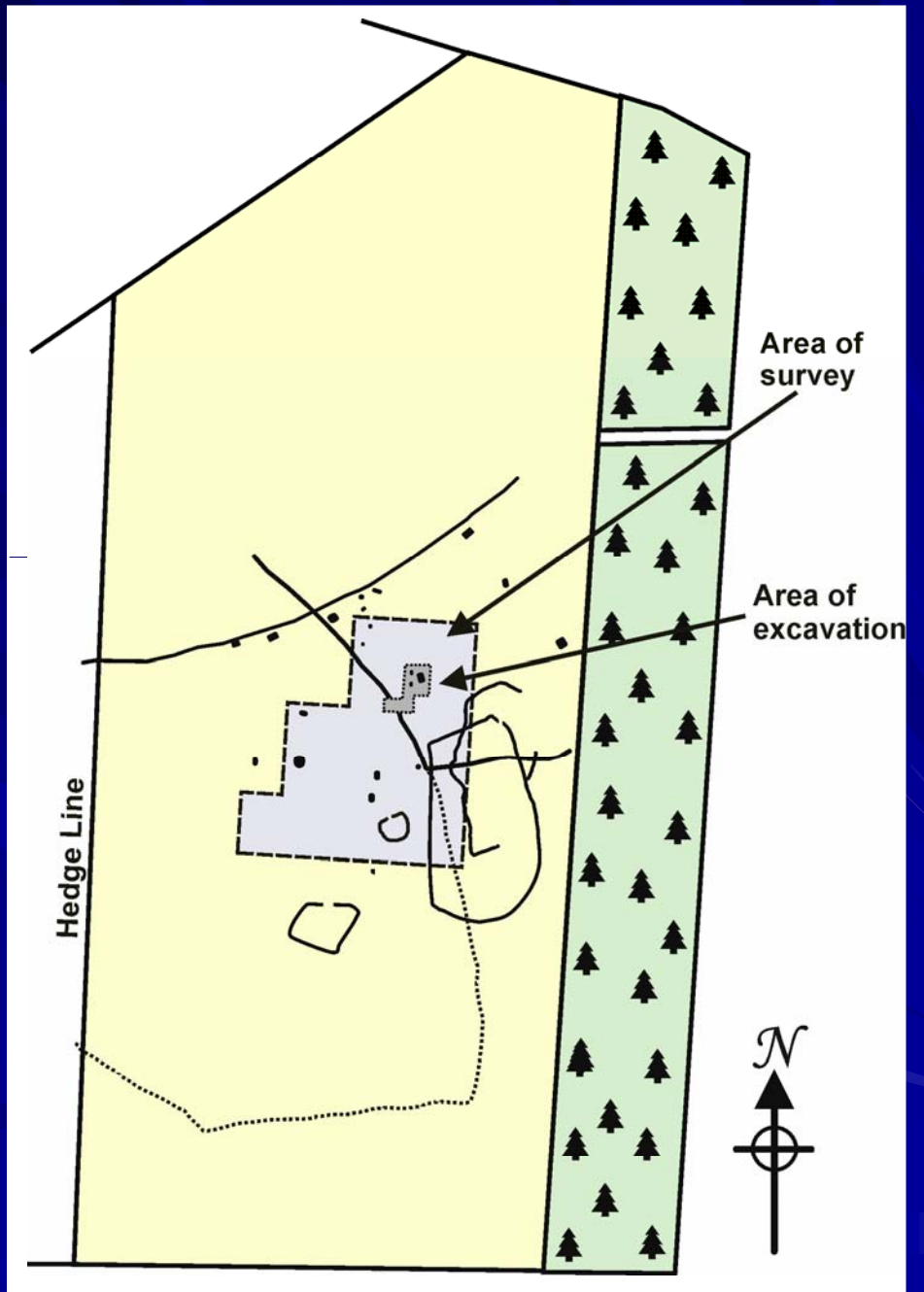
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Light grey area represents
The survey area (in two parts)

Dark grey area represents the
subsequently excavated area



Aerial Photography

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Marks include

Tramlines

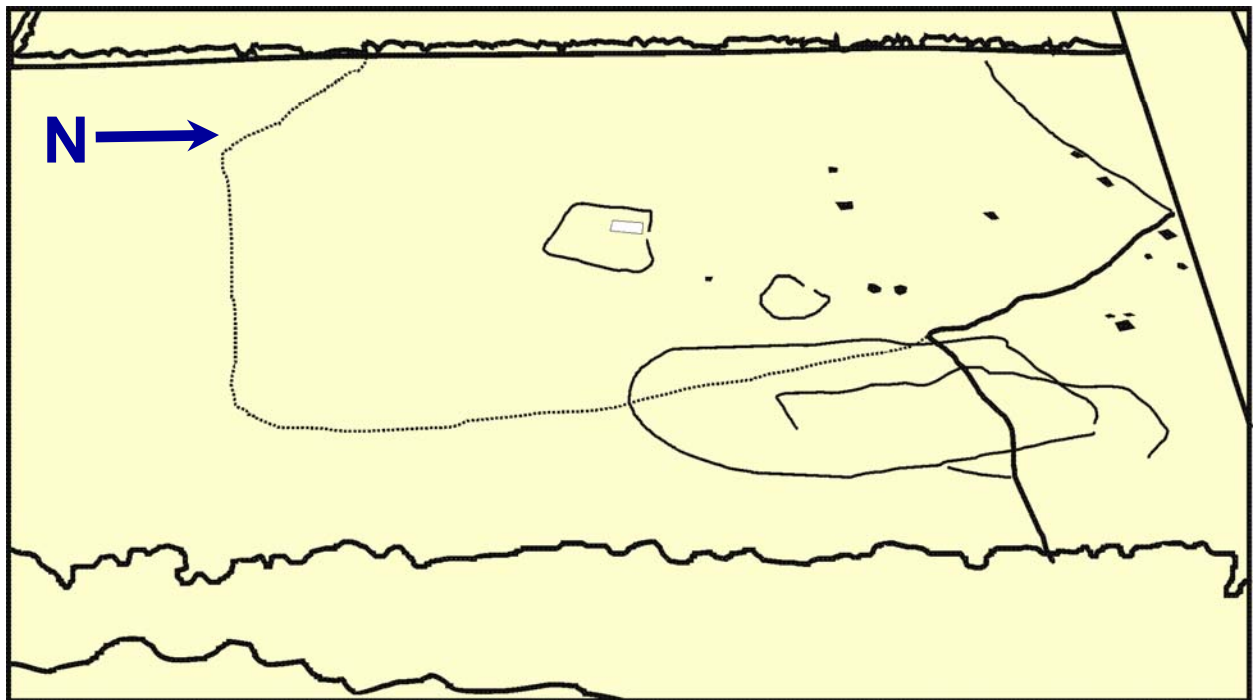
Drainage

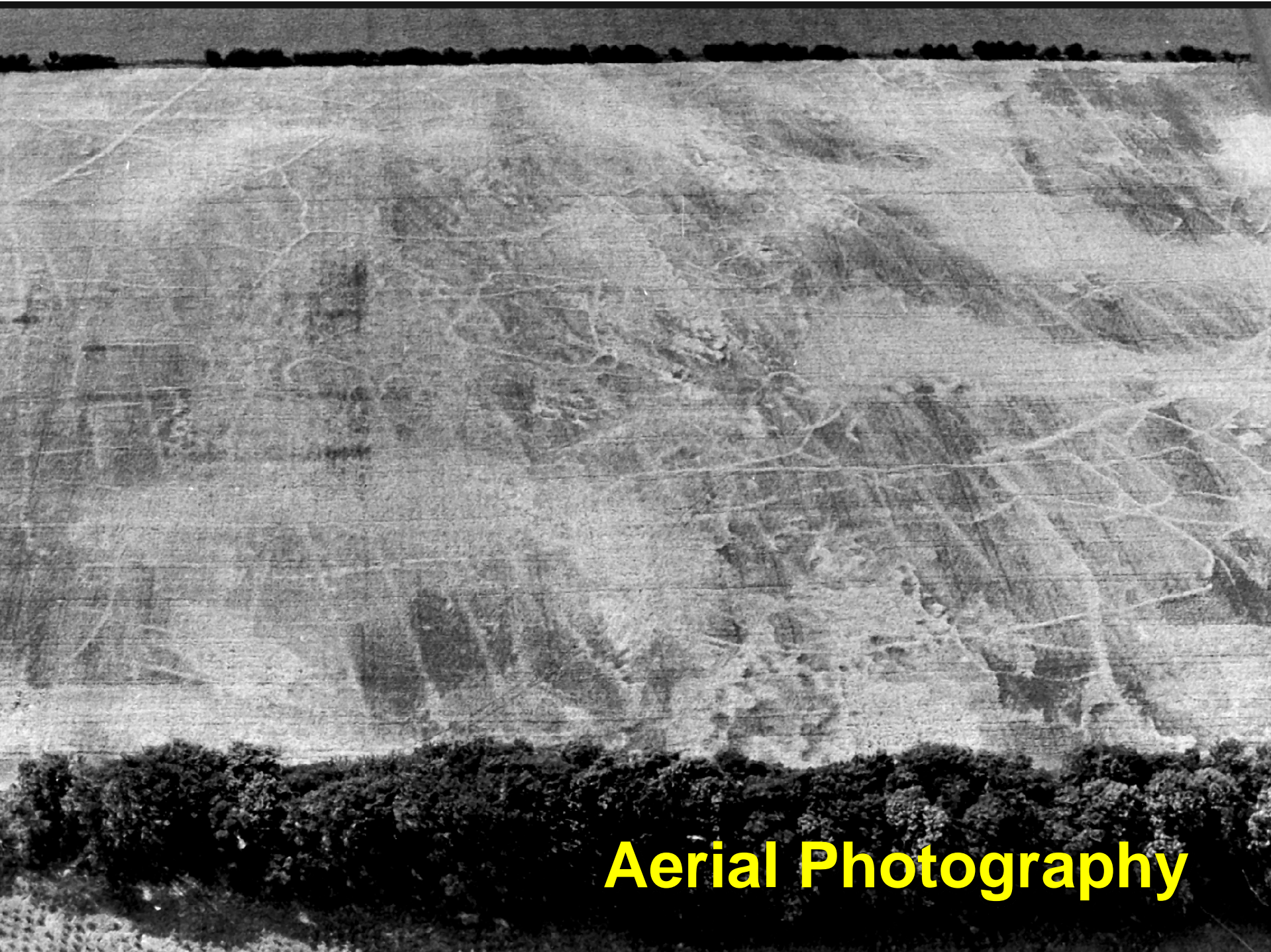
Glacial Till

Frost Cracking

Old Hedge
Boundaries

Archaeological
Remains





Aerial Photography

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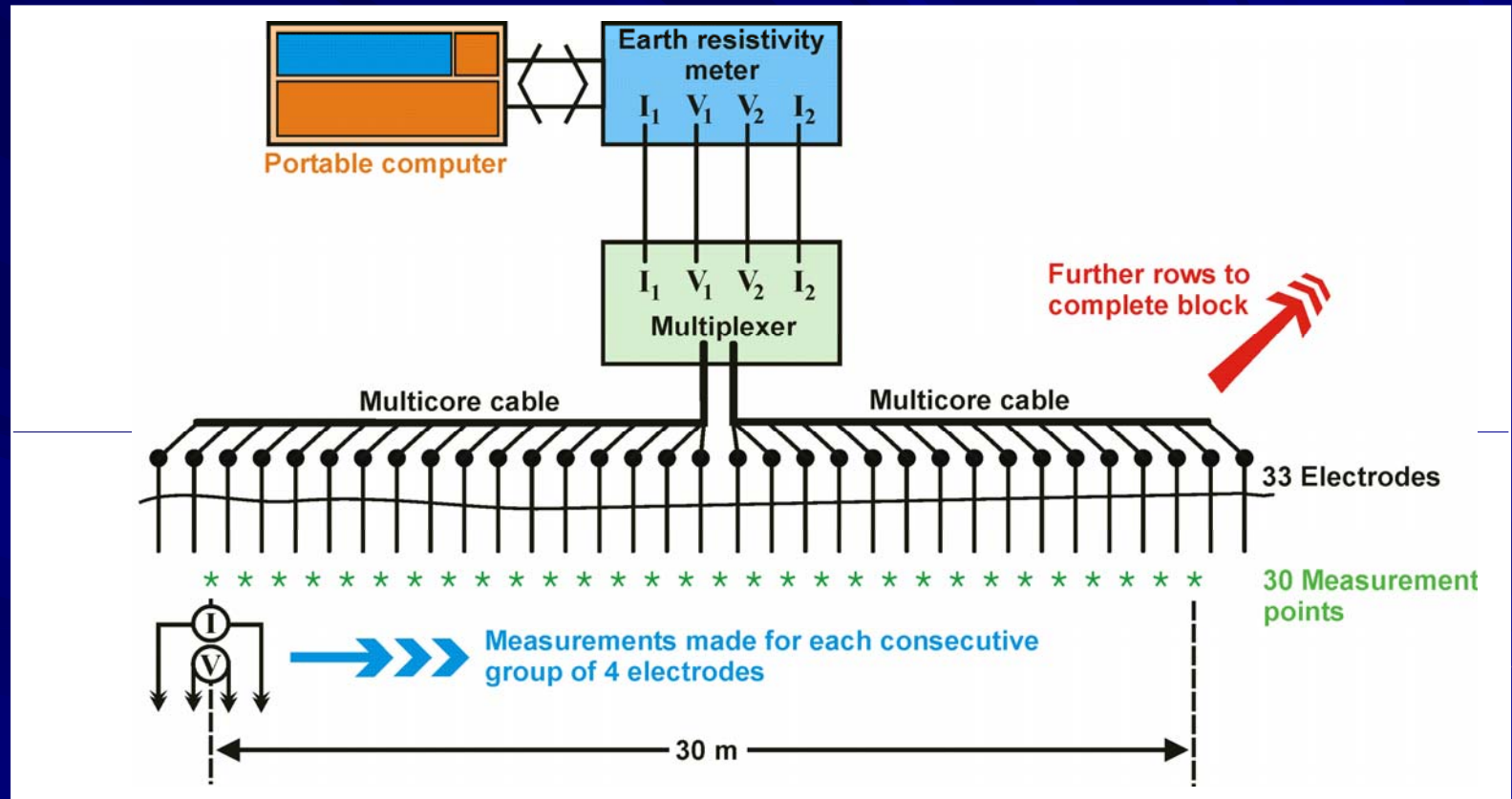
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❖ **ABEM Mk II Terrameter & in-house meter**

❖ **33 electrodes multiplexed into 4**

❖ **Survey area 10140 m²**

❖ **May and June, dry weather with short winter wheat**

❖ **Light, sandy topsoil**

Raw data

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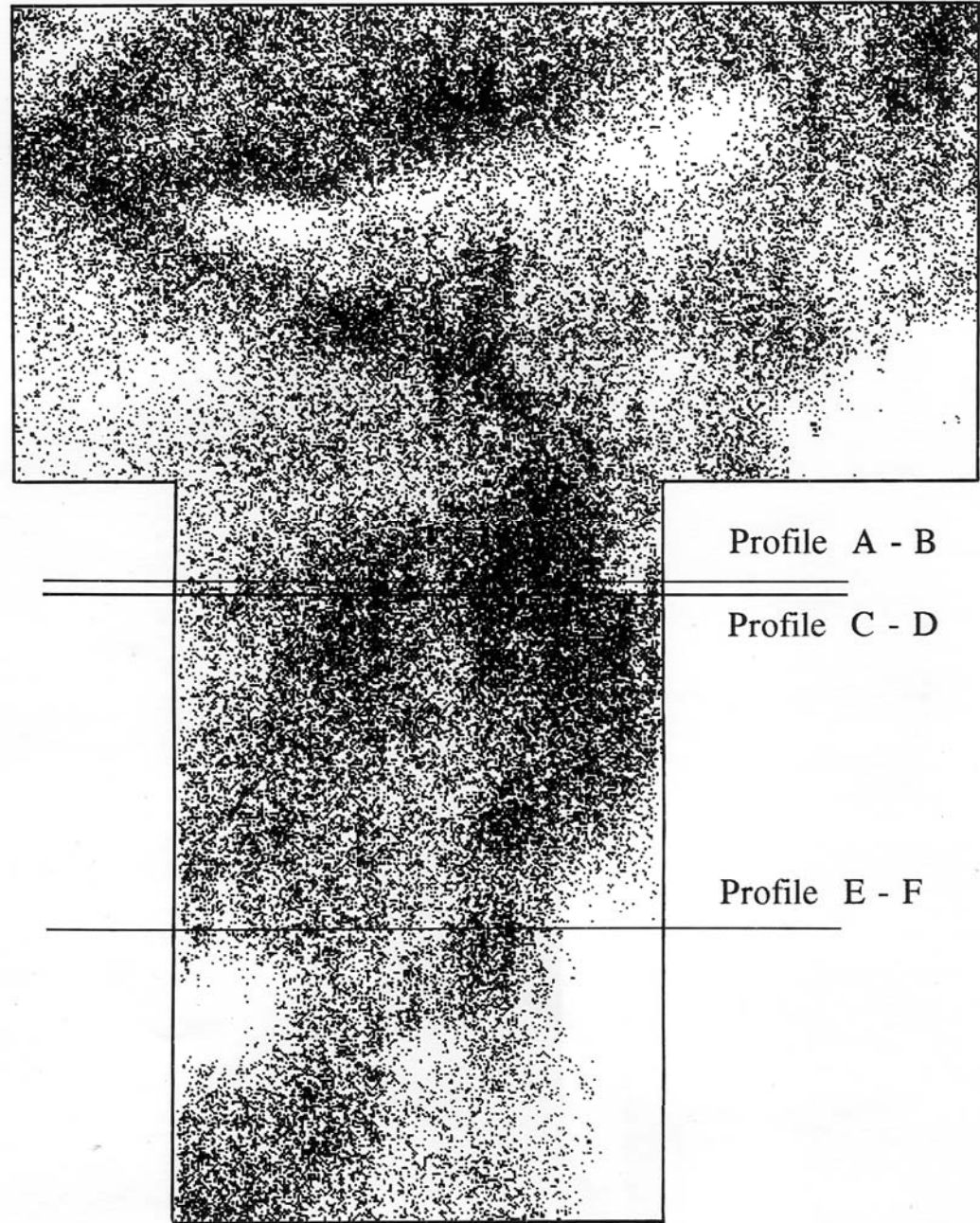
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Raw data from
the first part of
the survey area



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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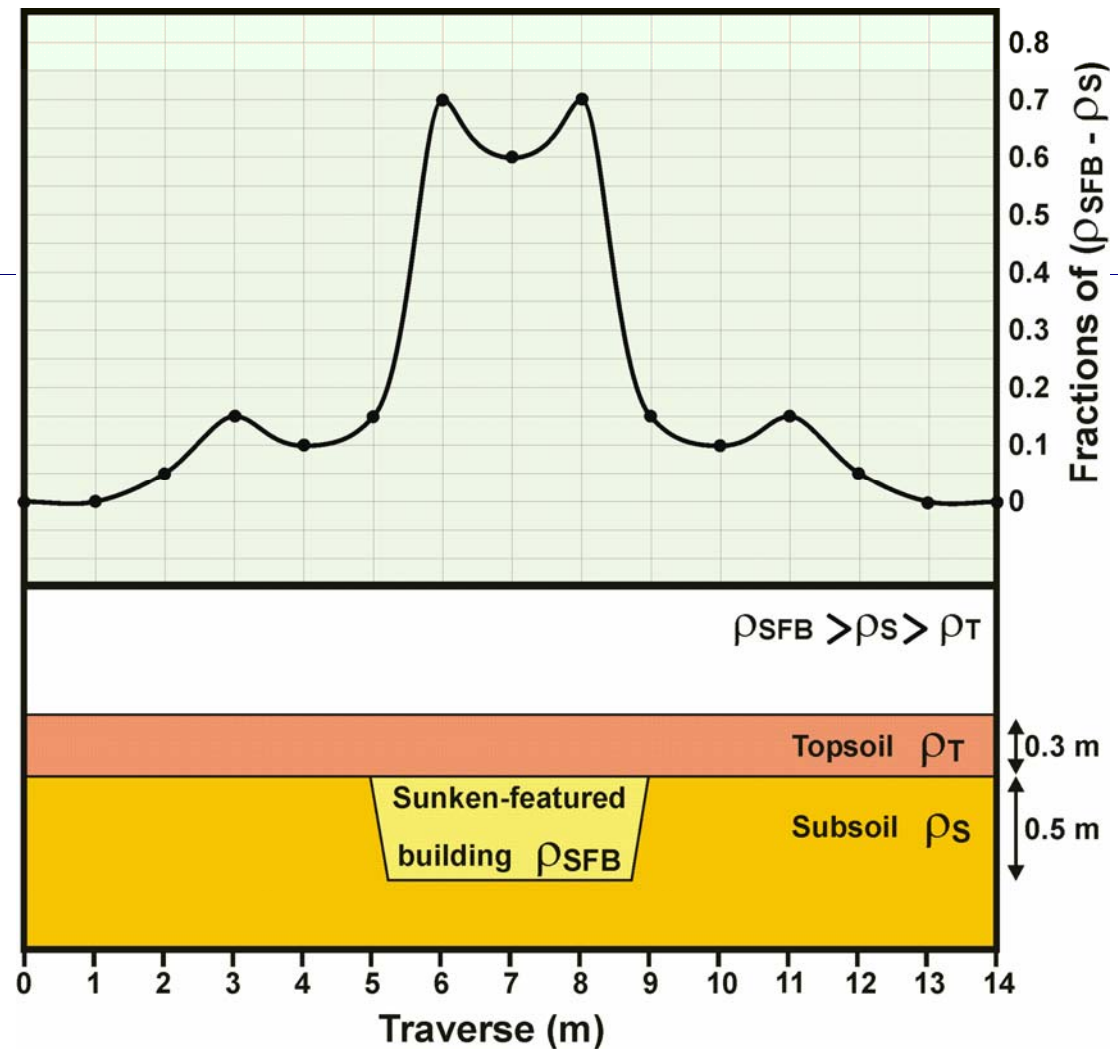
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Convolution: Synthetic Data

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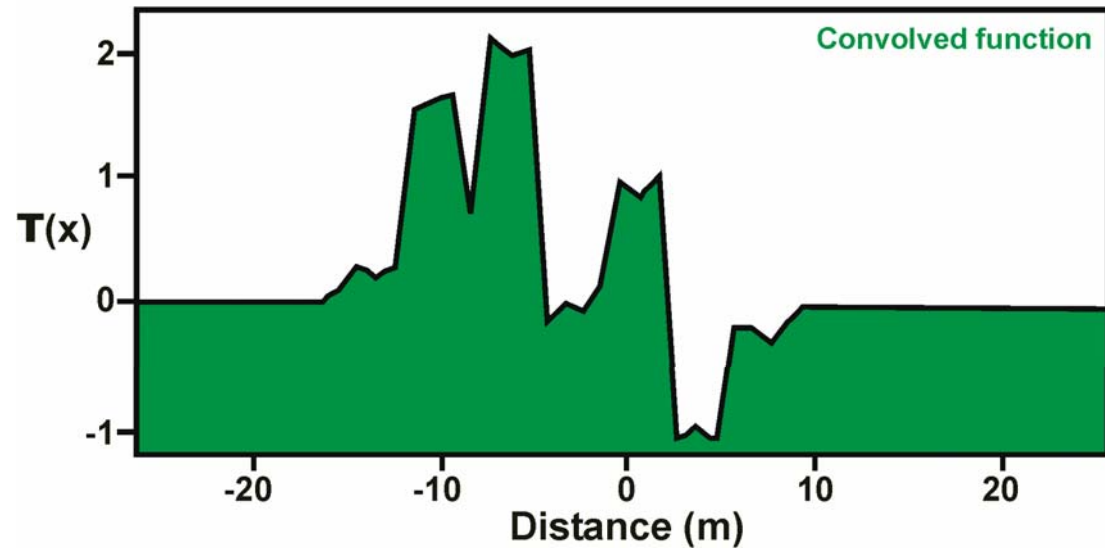
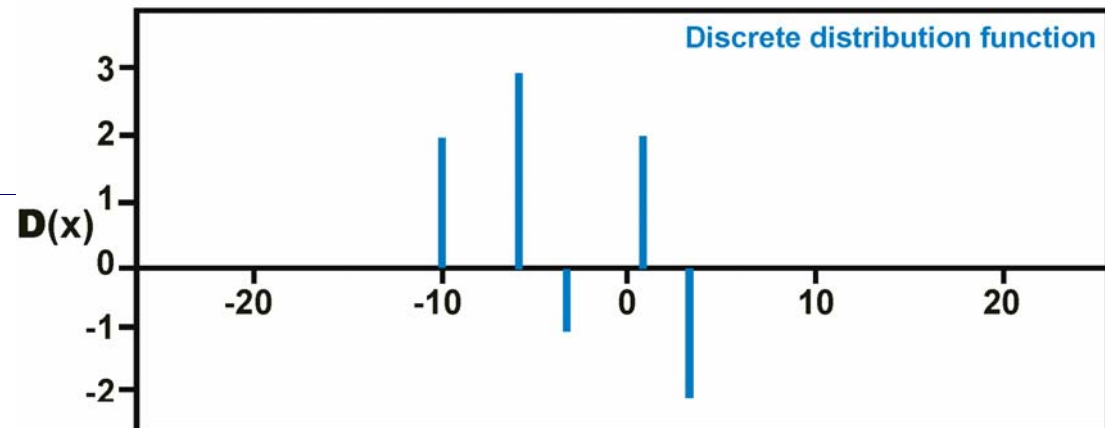
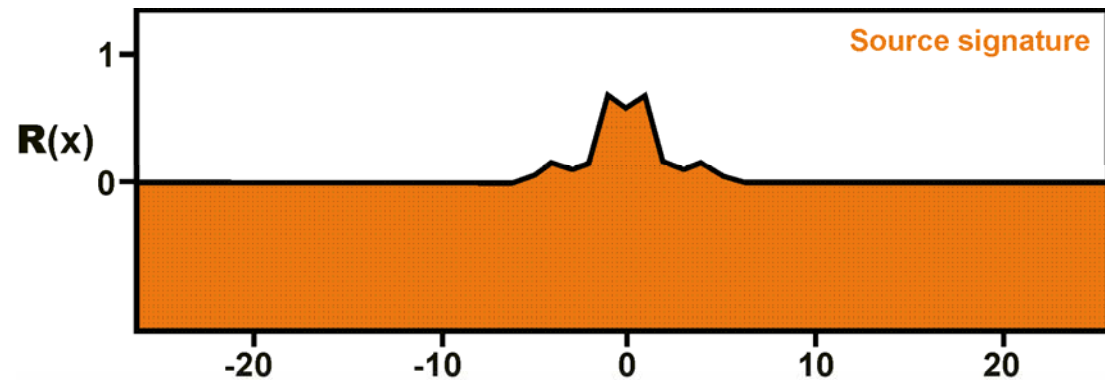
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Deconvolution: Restoration of location

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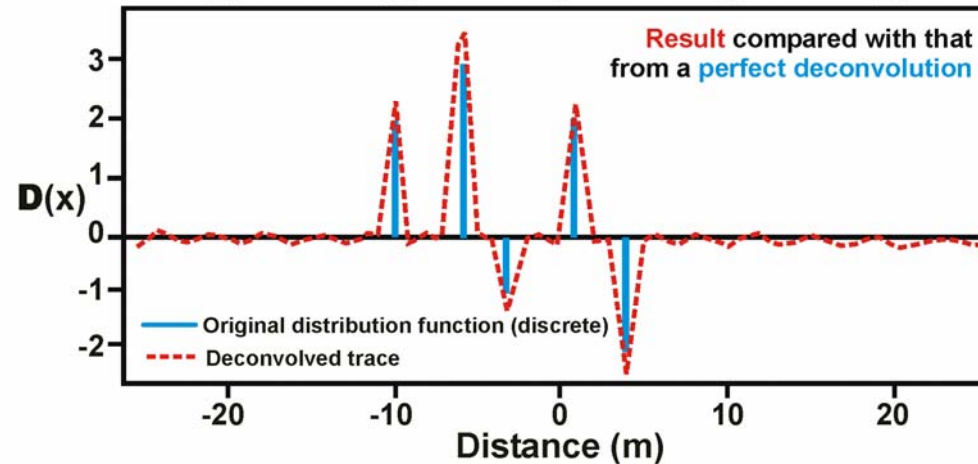
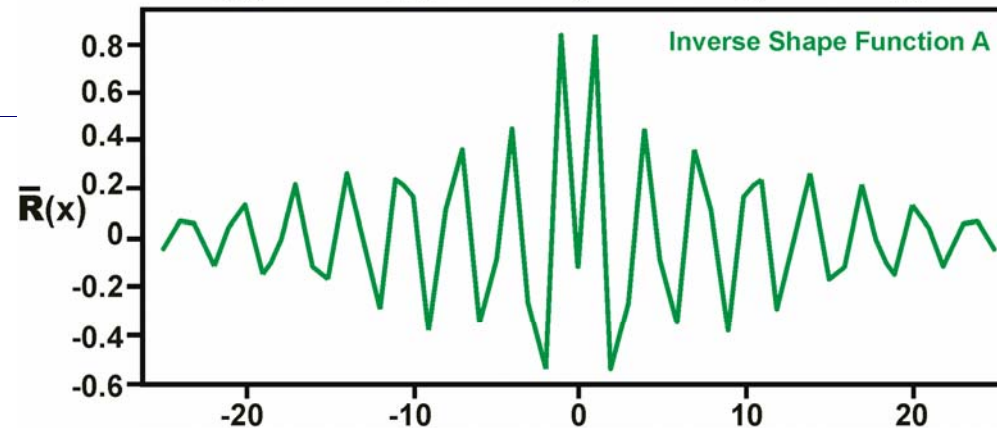
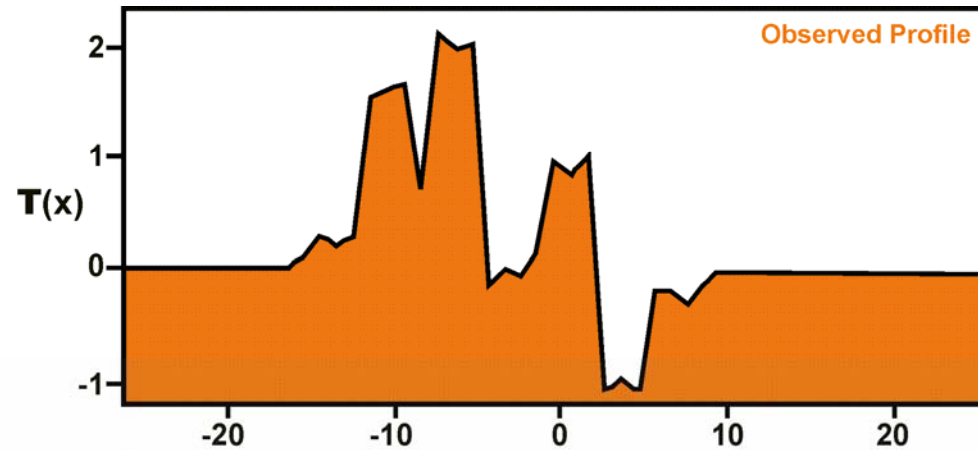
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Deconvolution: Restoration of location and extent

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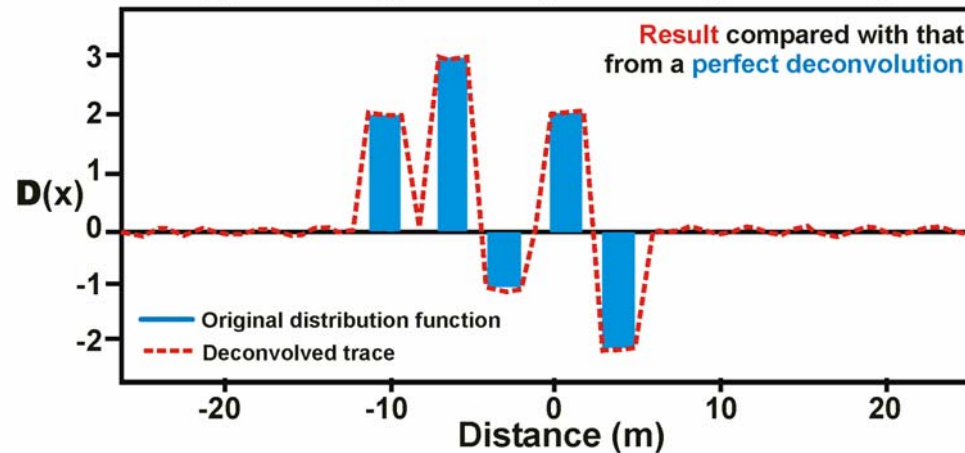
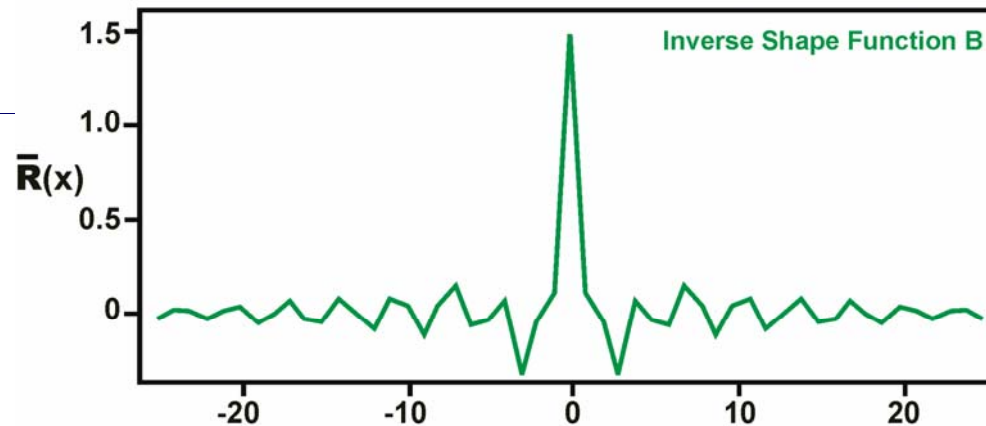
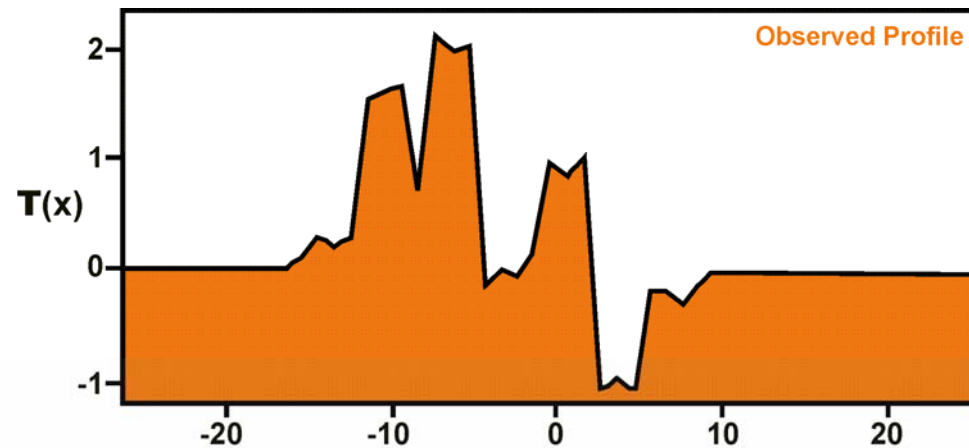
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Data Analysis – Test 1

Restoration of location



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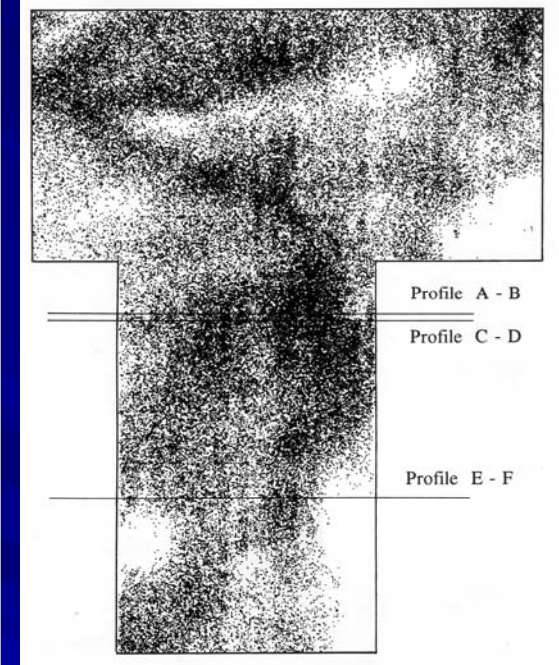
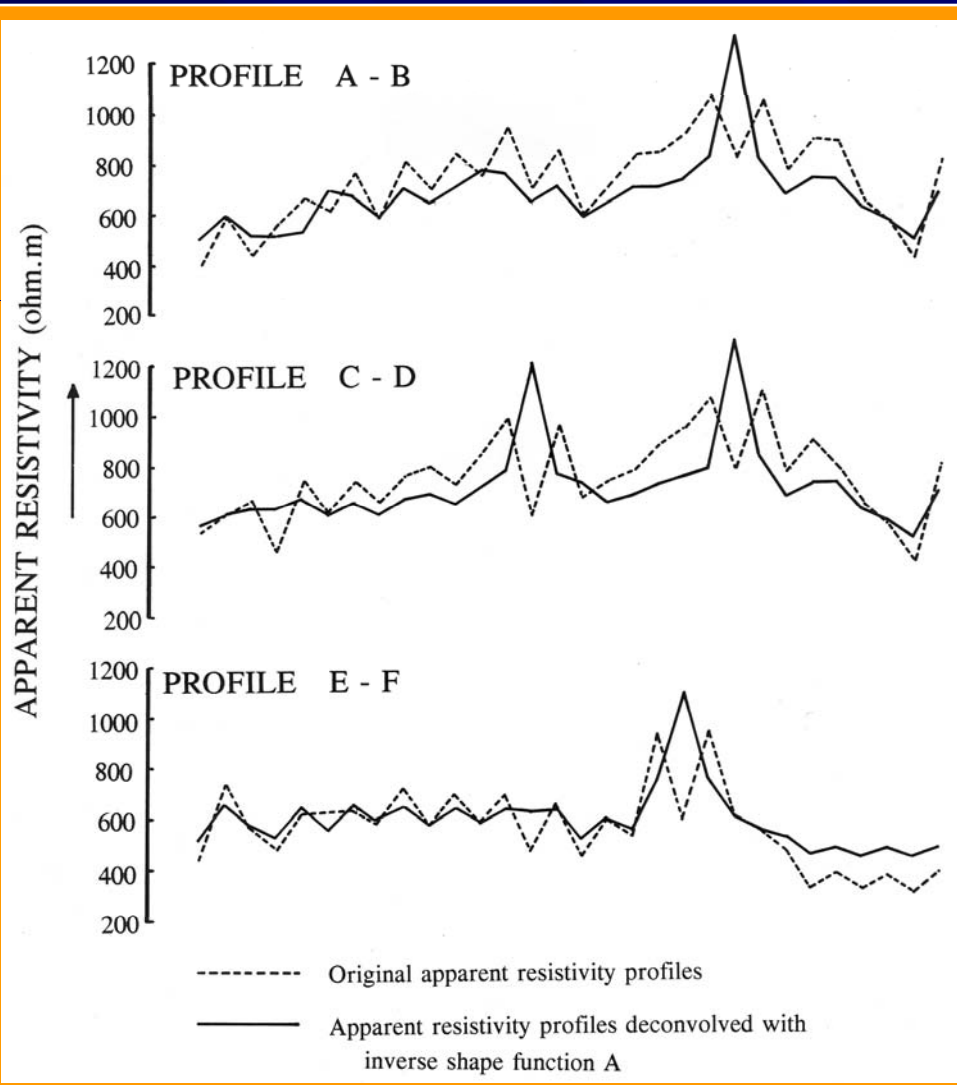
How? –
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Data Analysis – Test 2

Restoration of location and extent



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search area?

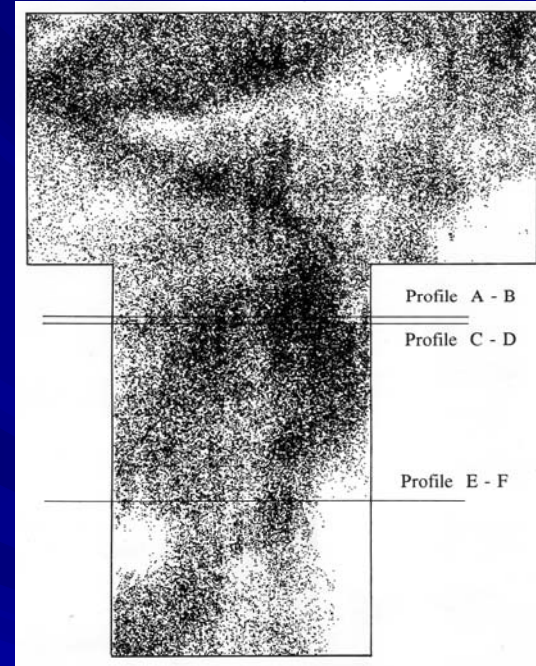
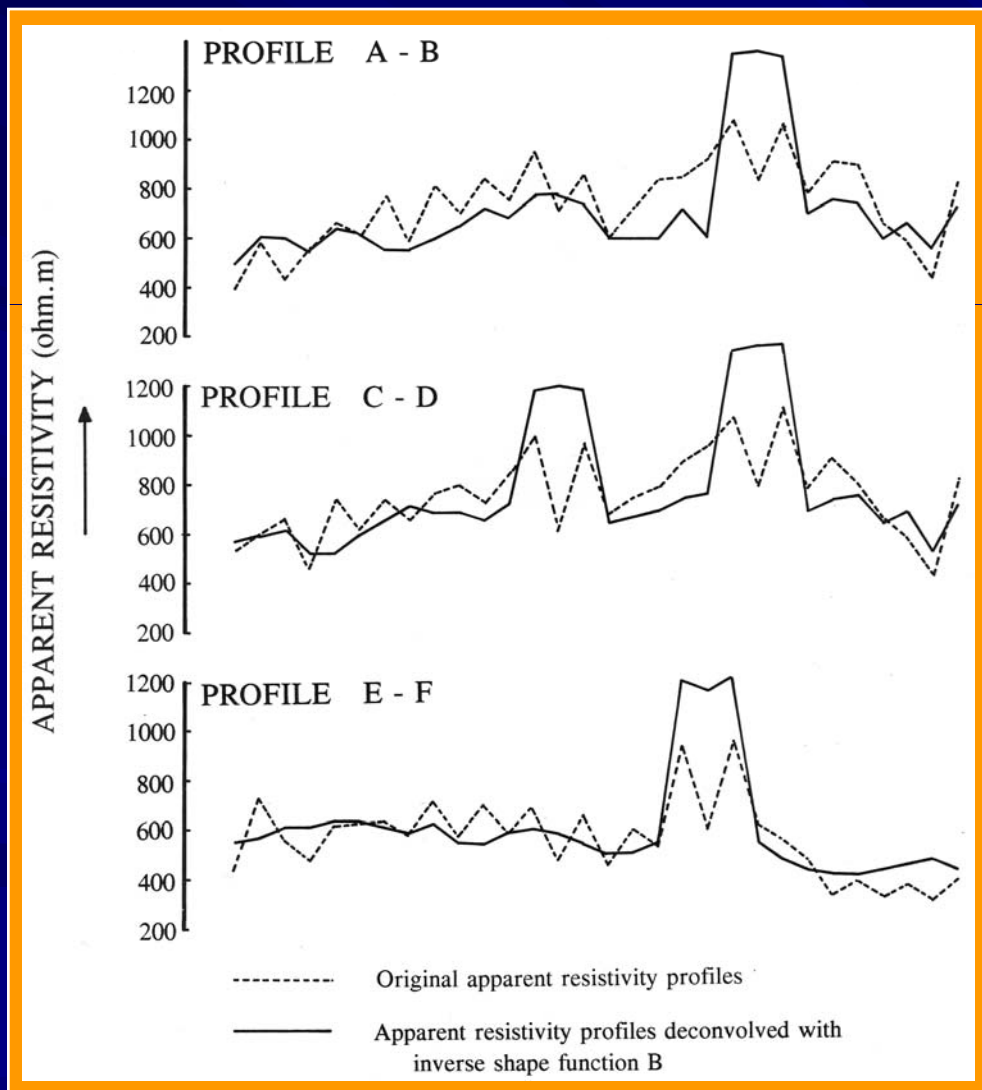
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Results - Undeconvolved

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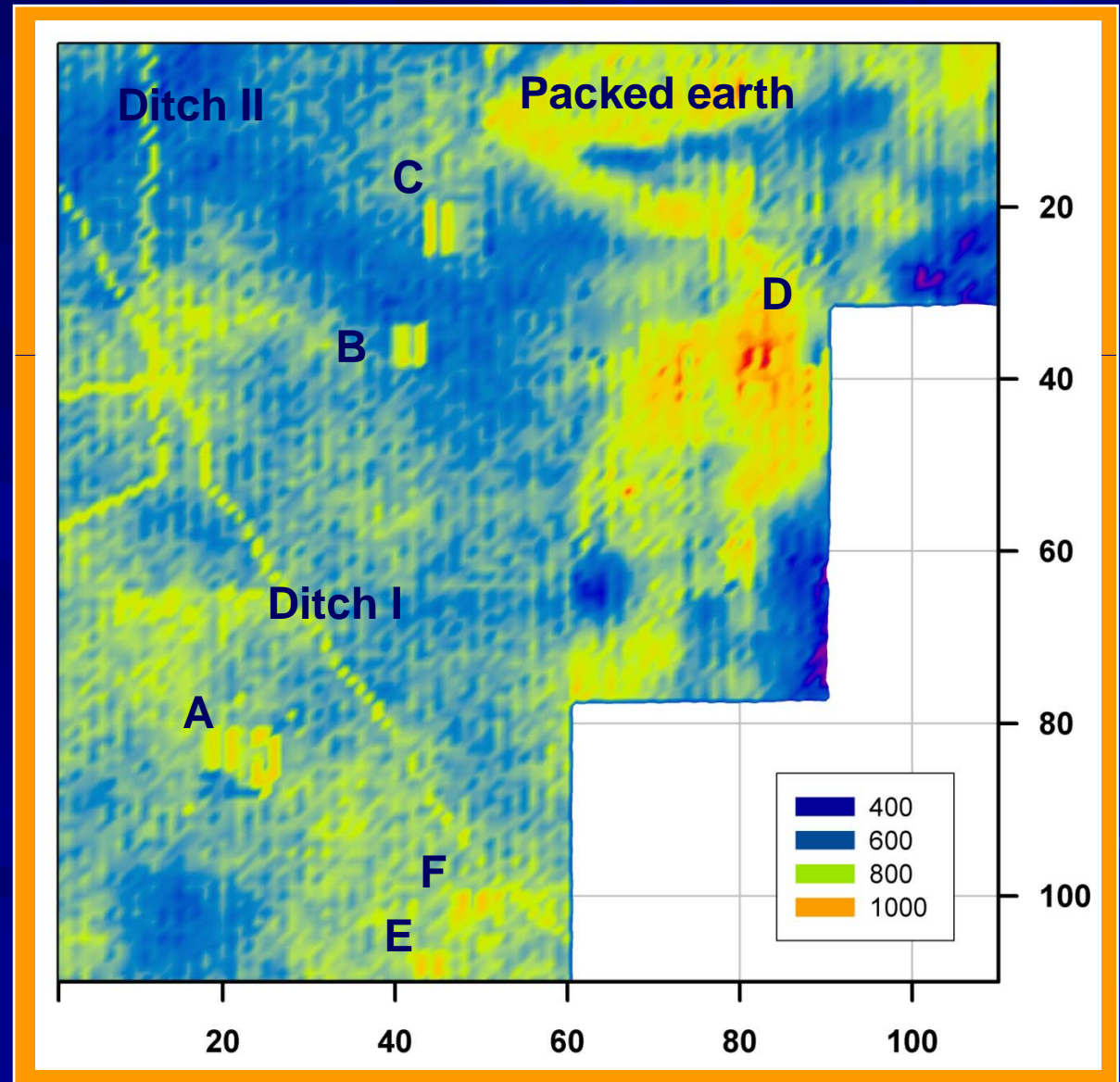
Undeconvolved

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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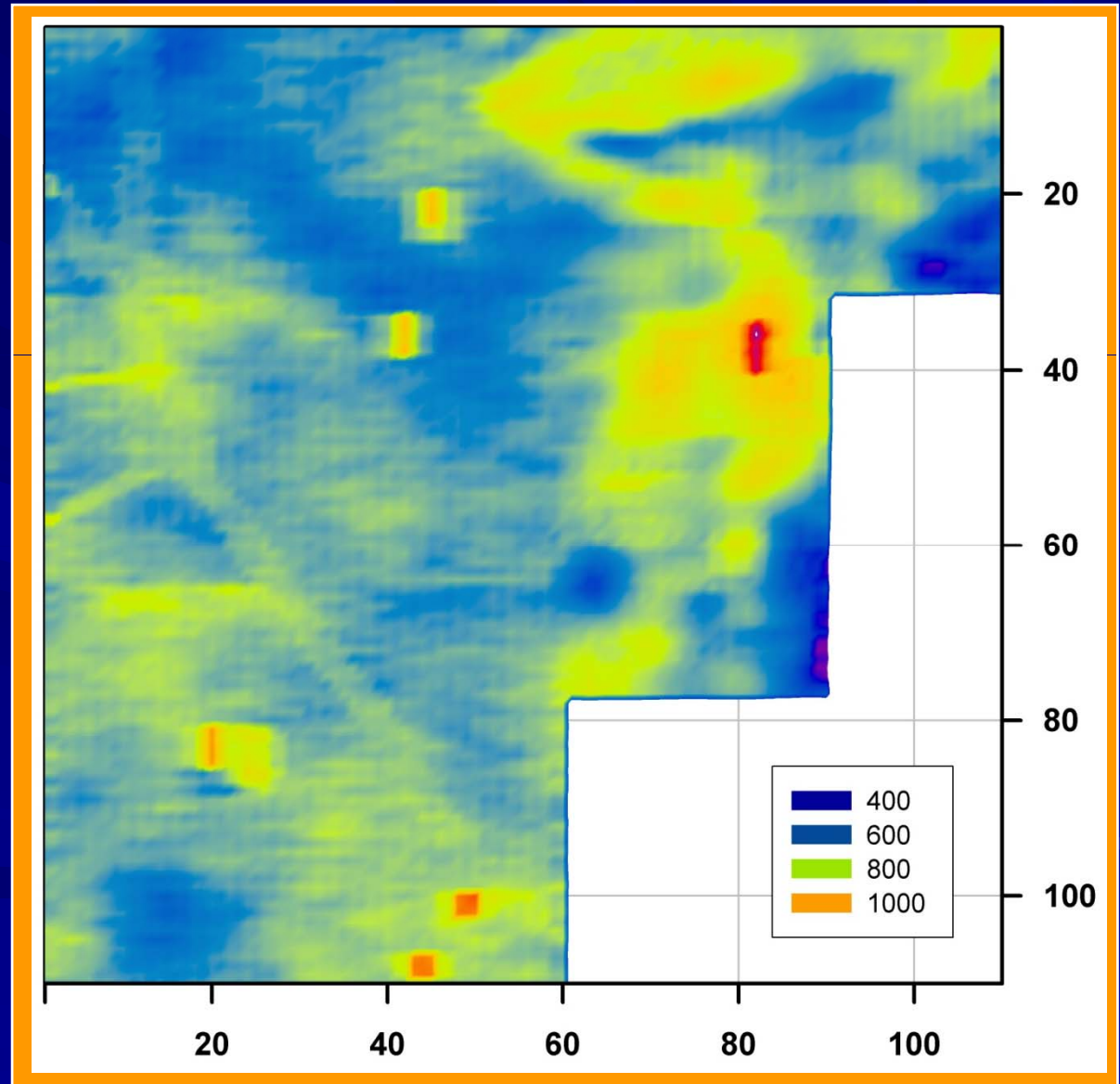
Undeconvolved

Deconvolved
3 m width

Deconvolved
4 m width

Deconvolved
5 m width

Combined
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Results – Deconvolved

Source function 4 m wide



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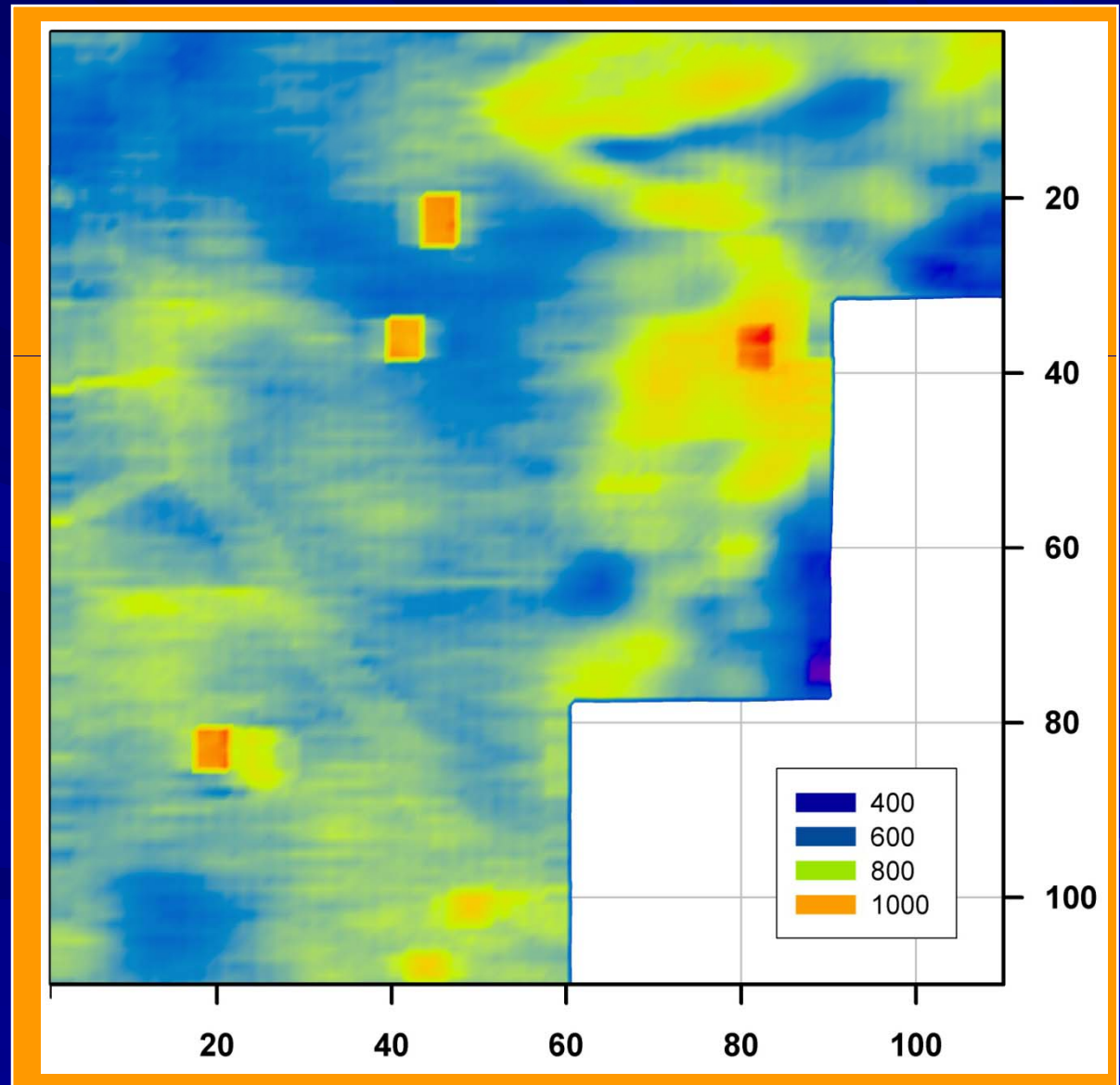
Undeconvolved

Deconvolved
3 m width

Deconvolved
4 m width

Deconvolved
5 m width

Combined
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Results – Deconvolved

Source function 5 m wide



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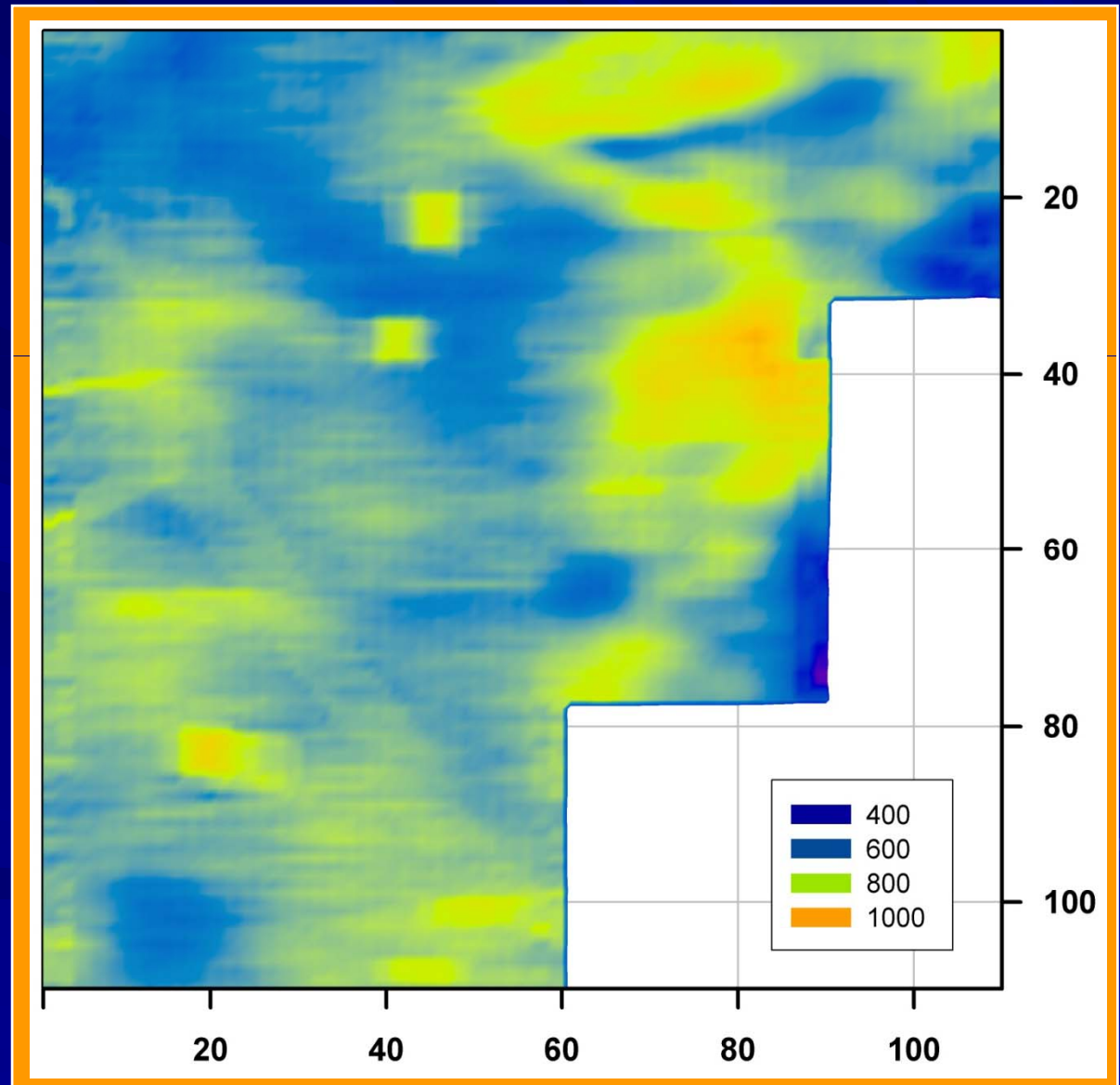
Undeconvolved

Deconvolved
3 m width

Deconvolved
4 m width

Deconvolved
5 m width

Combined
Data



Results - Combined View

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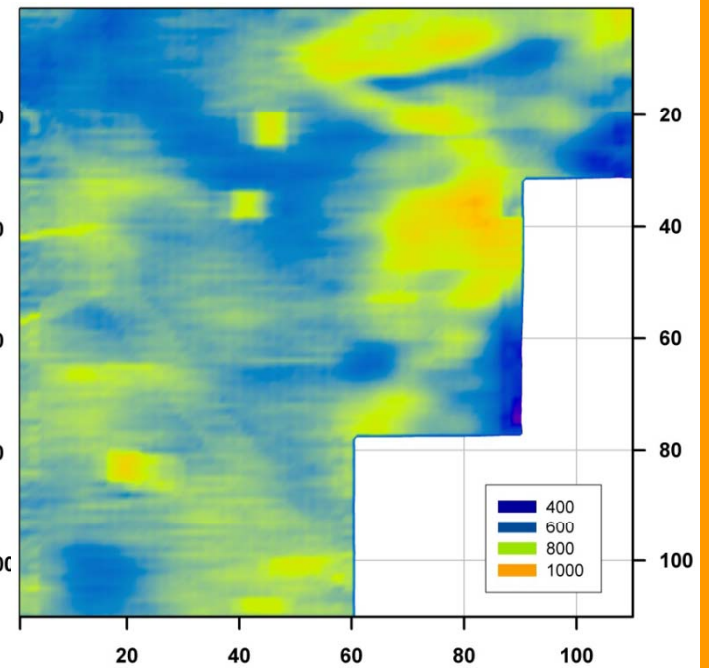
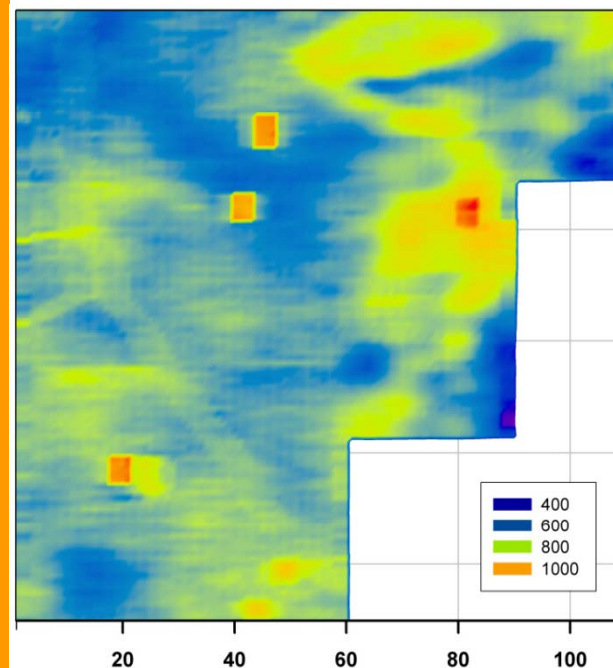
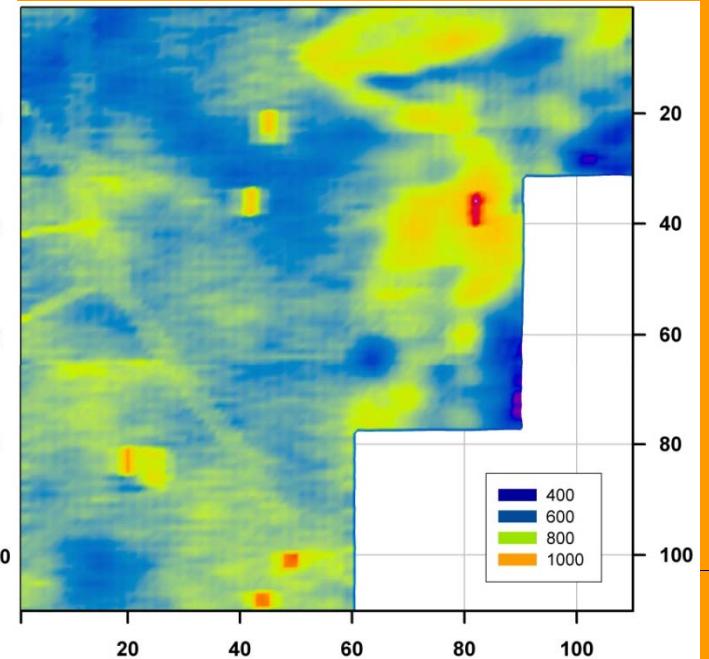
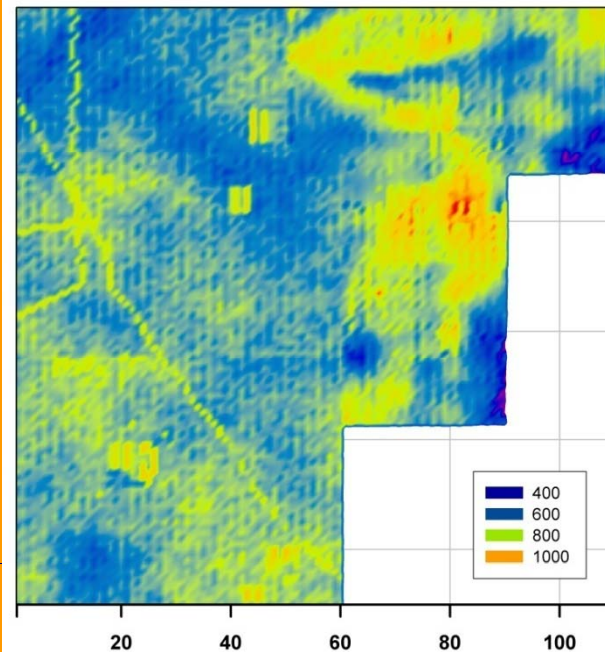
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Proof by Excavation

(Gates and O'Brien, 1988)



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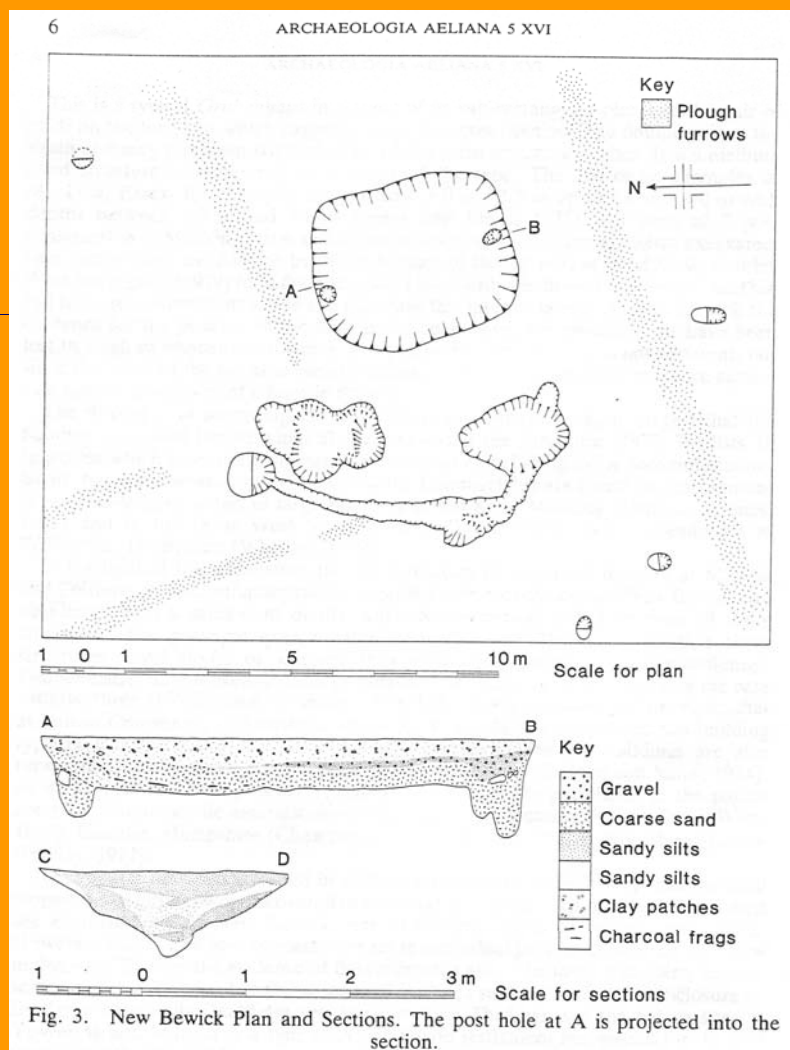
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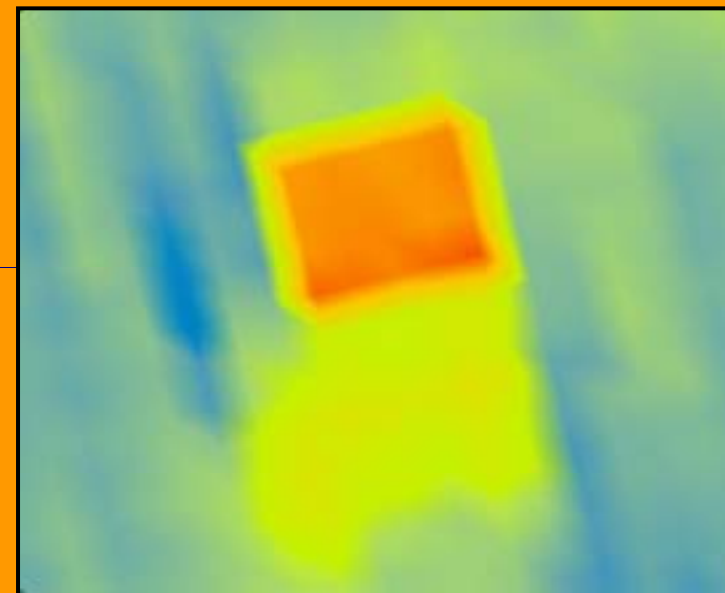
Conclusions

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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



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- ❖ **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?)**

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