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

Paul Glover
Université Laval, Québec, Canada
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

- 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

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

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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
- Yeavering
- Thirlings
- Anglo-Saxon royal/Palace settlements
General Location

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

Dark grey area represents the subsequently excavated area
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Marks include

Tramlines
Drainage
Glacial Till
Frost Cracking
Old Hedge Boundaries

Archaeological Remains
Aerial Photography
Methodology

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- Electrical survey
- ABEM Mk II Terrameter
- In-house designed meter
- 33 electrodes multiplexed into 4
- Survey area approximately 110 m x 110 m (10140 m²)
- Surveyed during May and June, under short winter wheat
- Light, sandy topsoil after dry weather
Methodology

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**Earth resistivity meter**

- $I_1$
- $V_1$
- $V_2$
- $I_2$

**Portable computer**

**Multiplexer**

- $I_1$
- $V_1$
- $V_2$
- $I_2$

**33 Electrodes**

**30 Measurement points**

**Multicore cable**

- Measurements made for each consecutive group of 4 electrodes

**Further rows to complete block**

- 30 m
Raw data from the first part of the survey area
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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![Graphs showing apparent resistivity profiles and deconvolved profiles](image_url)
Data Analysis – Test 2

Restoration of location and extent

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**Profile A - B**

**Profile C - D**

**Profile E - F**

- Original apparent resistivity profiles
- Apparent resistivity profiles deconvolved with inverse shape function B
Results

- Five displays of data are shown:
  - **Un-deconvolved** (raw) – best for fine detail such as small ditches and postholes (if at all)
  - **Deconvolved** with 3 different widths
    - 3 m
    - 4 m
    - 5 m
  - **Combined** data display
Results - Undeconvolved

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Results – Deconvolved
Source function 3 m wide

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Results – Deconvolved
Source function 4 m wide

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Results – Deconvolved
Source function 4 m wide

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Results – Deconvolved

Source function 5 m wide

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Results - Combined View

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**Proof by Excavation**

*(Gates and O’Bien, 1988)*

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**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

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