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

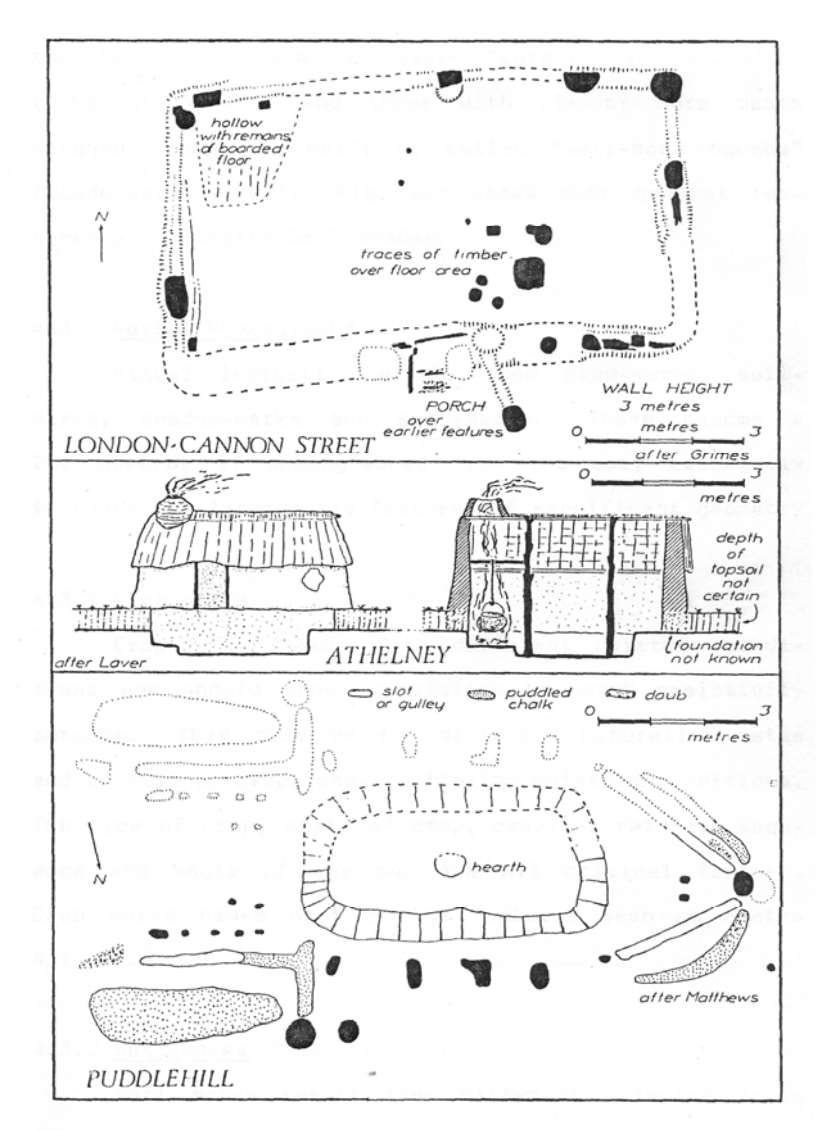
Paul Glover

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



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

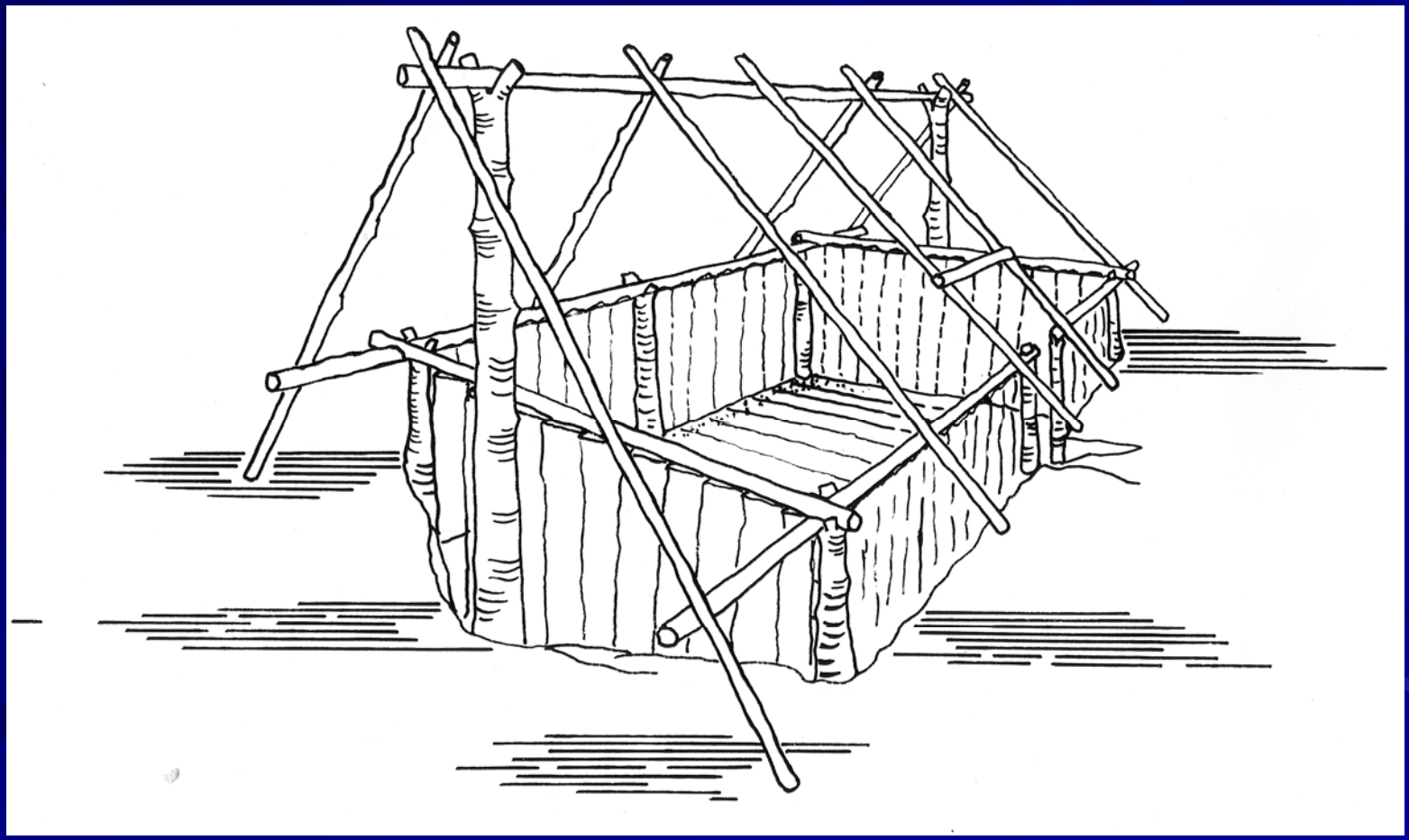
- Small sized
- Excavated floors lined with planks or packed clay
- Multiple use – workshops rather than dwellings
  - Pottery
  - Weaving
  - Metal-working
  - Animal husbandry…etc.
- Usually found in association with timber-framed halls

Grubenhäuser

UNIVERSITÉ LAVAL

Plan

- Introduction
- What is a Grubenhaus?
- Where is the search area?
- How? – Experimental Methodology
- How? – Data Analysis
- Results
- Conclusions
- Who? – Acknowledg-ments



Line drawing of the New Bewick Grubenhaus

Grubenhäuser

UNIVERSITÉ LAVAL

Plan

- Introduction
- What is a Grubenhaus?
- Where is the search area?
- How? – Experimental Methodology
- How? – Data Analysis
- Results
- Conclusions
- Who? – Acknowledg-ments

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

General Location

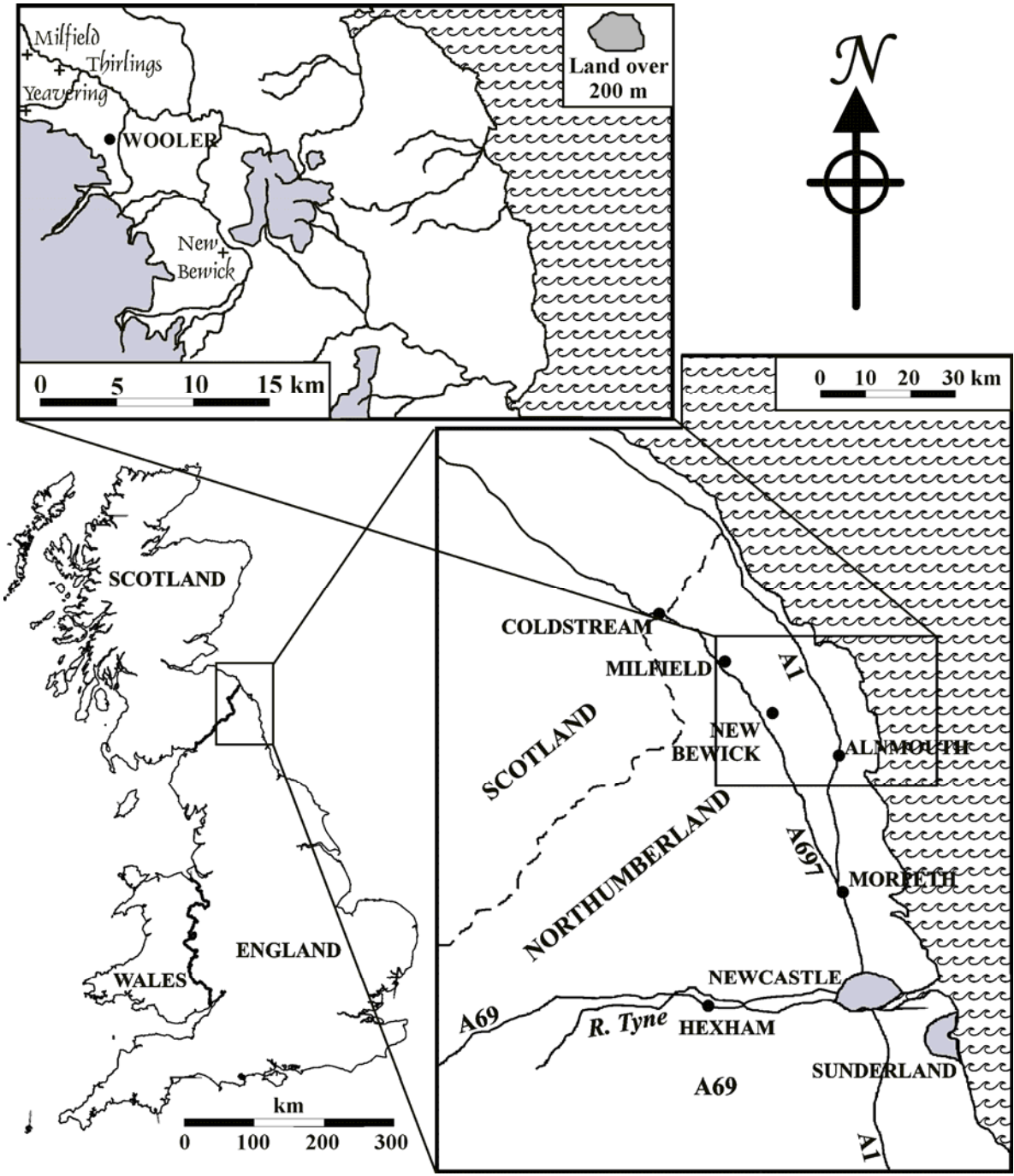
200 m from River Breamish

Elevation 94 m

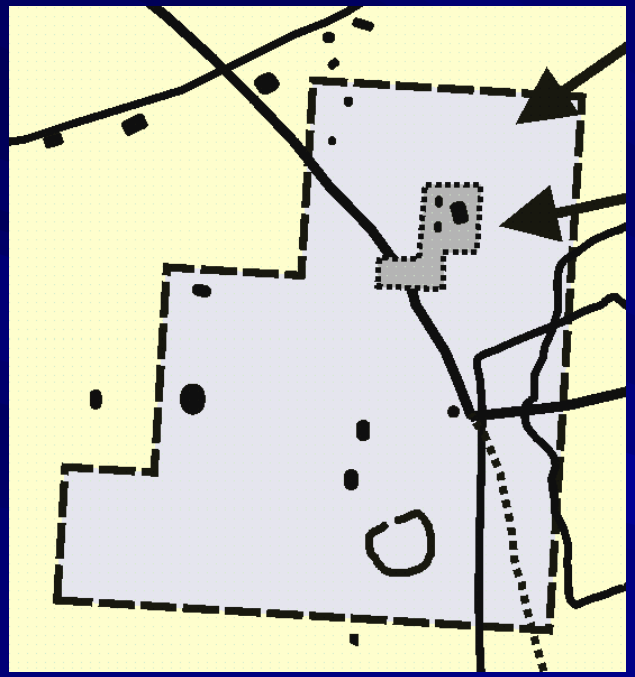
1.8 km from Old Bewick Iron Age Hillfort (rock art)

16 km from
- Milfield
- Yeavering
- Thirlings

Anglo-Saxon royal/ Palace settlements

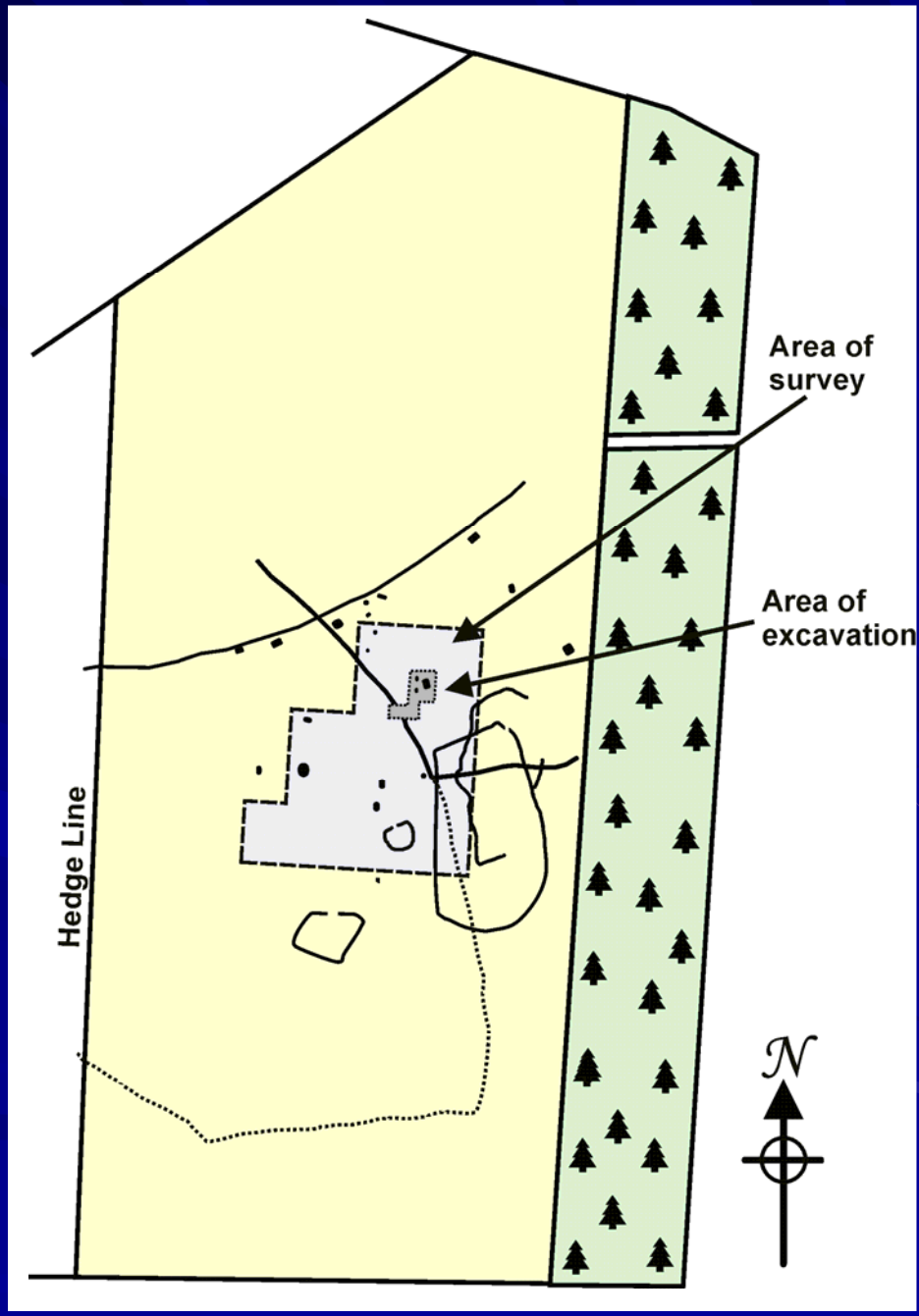


General Location



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

Dark grey area represents the subsequently excavated area



Aerial Photography

Plan

Introduction

What is a Grubenhaus?

Where is the search area?

How? – Experimental Methodology

How? – Data Analysis

Results

Conclusions

Who? – Acknowledg-ments

Marks include

Tramlines

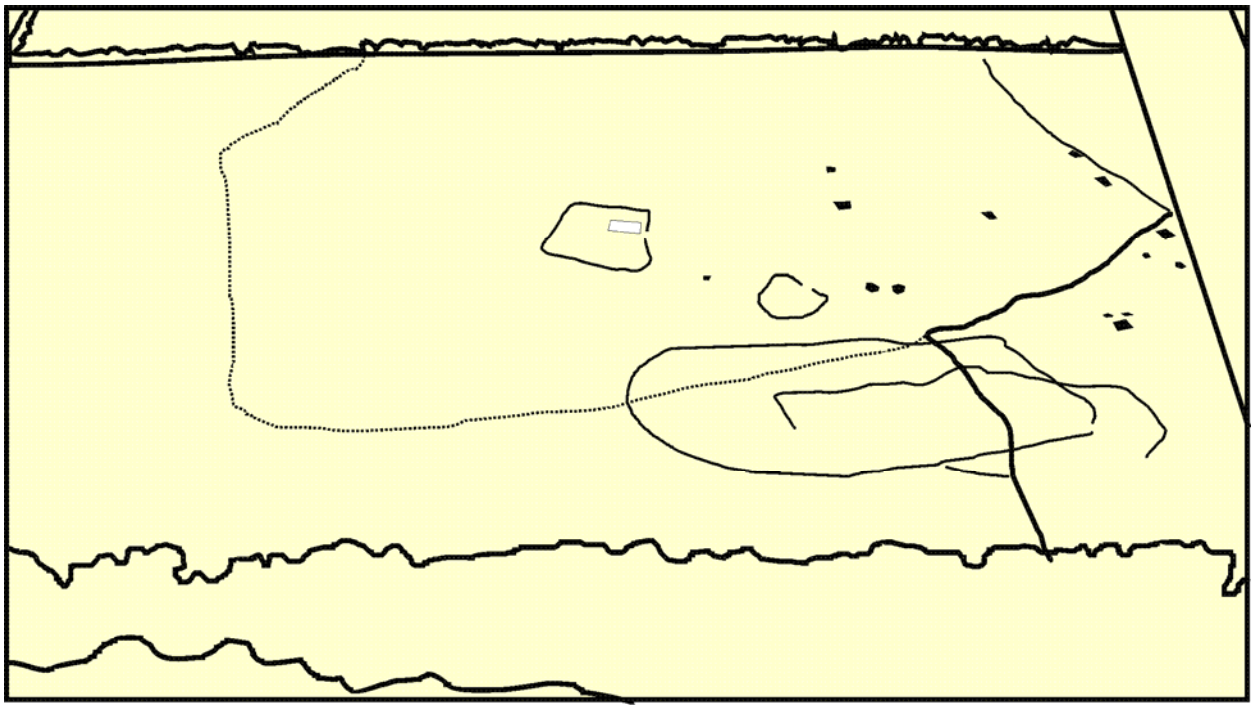
Drainage

Glacial Till

Frost Cracking

Old Hedge Boundaries

Archaeological Remains




Aerial Photography

Methodology

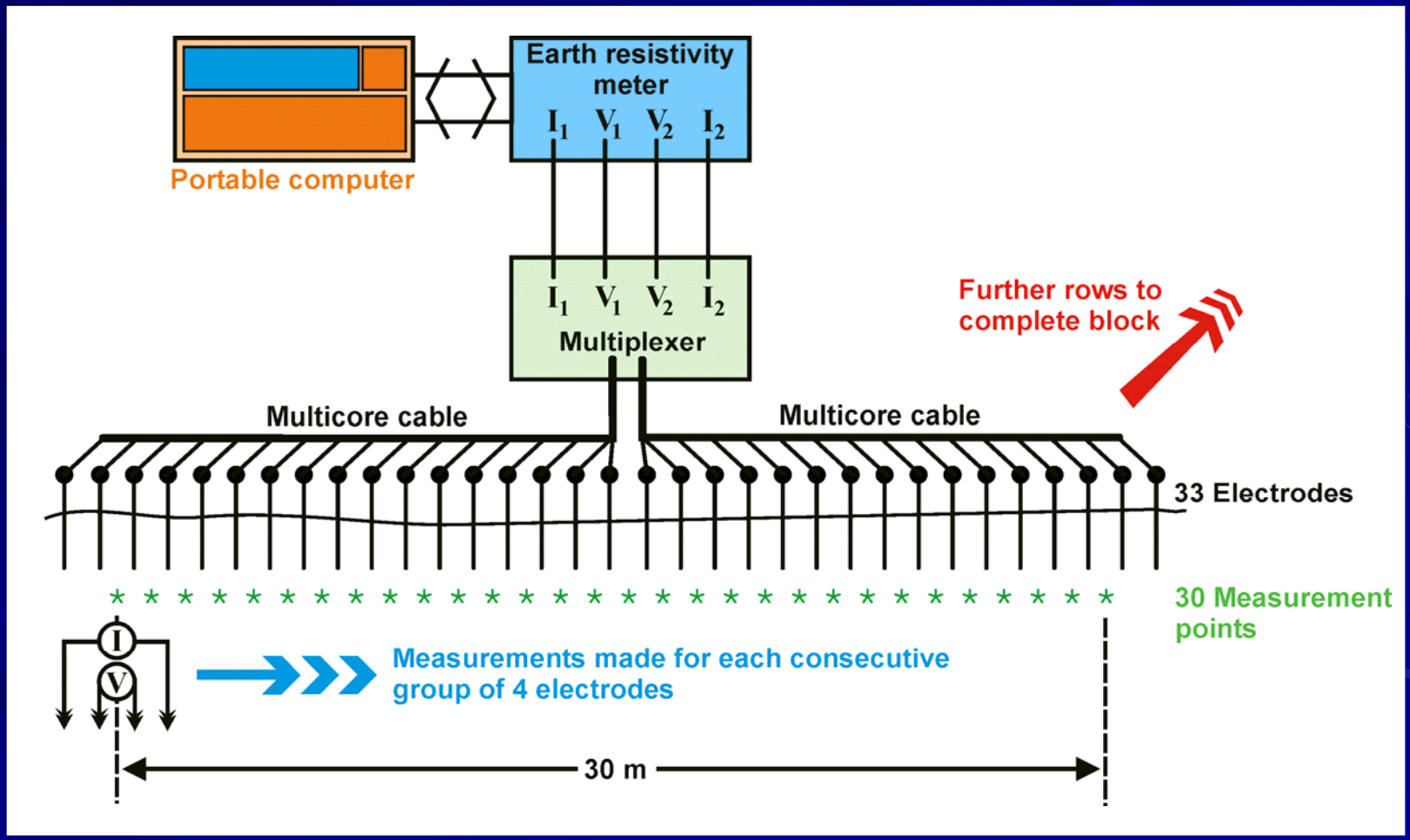
- Electrical survey
- ABEM Mk II Terrameter
- In-house designed meter
- 33 electrodes multiplexed into 4
- Survey area approximately 110 m x 110 m (10140 m^2)
- Surveyed during May and June, under short winter wheat
- Light, sandy topsoil after dry weather

Methodology

UNIVERSITÉ LAVAL

Plan

- Introduction
- What is a Grubenhaus?
- Where is the search area?
- **How? – Experimental Methodology**
- How? – Data Analysis
- Results
- Conclusions
- Who? – Acknowledg-ments



Raw data

Plan

Introduction

What is a Grubenhaus?

Where is the search area?

How? – Experimental Methodology

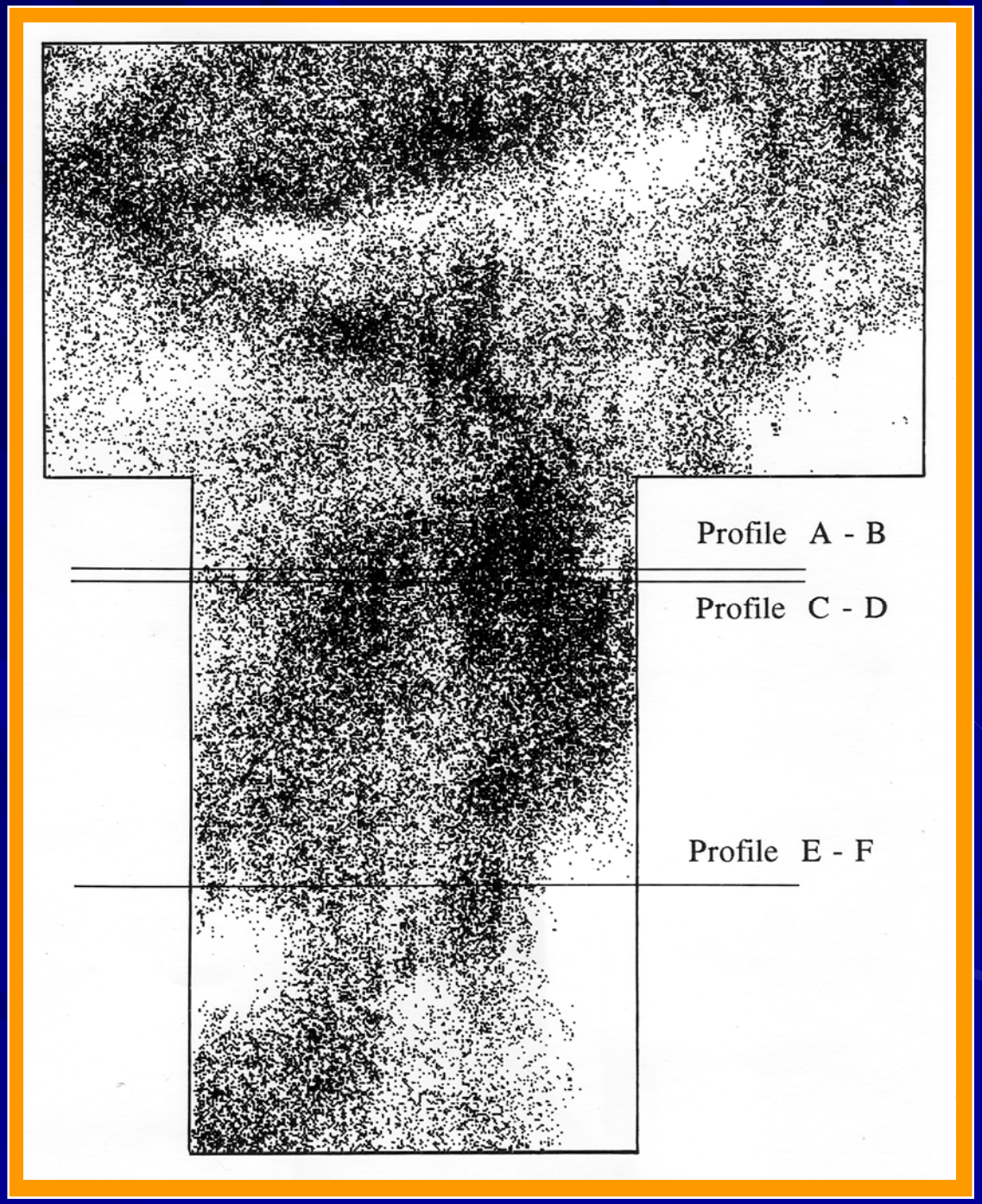
How? – Data Analysis

Results

Conclusions

Who? – Acknowledg-ments

Raw data from the first part of the survey area



Data Analysis

UNIVERSITÉ LAVAL

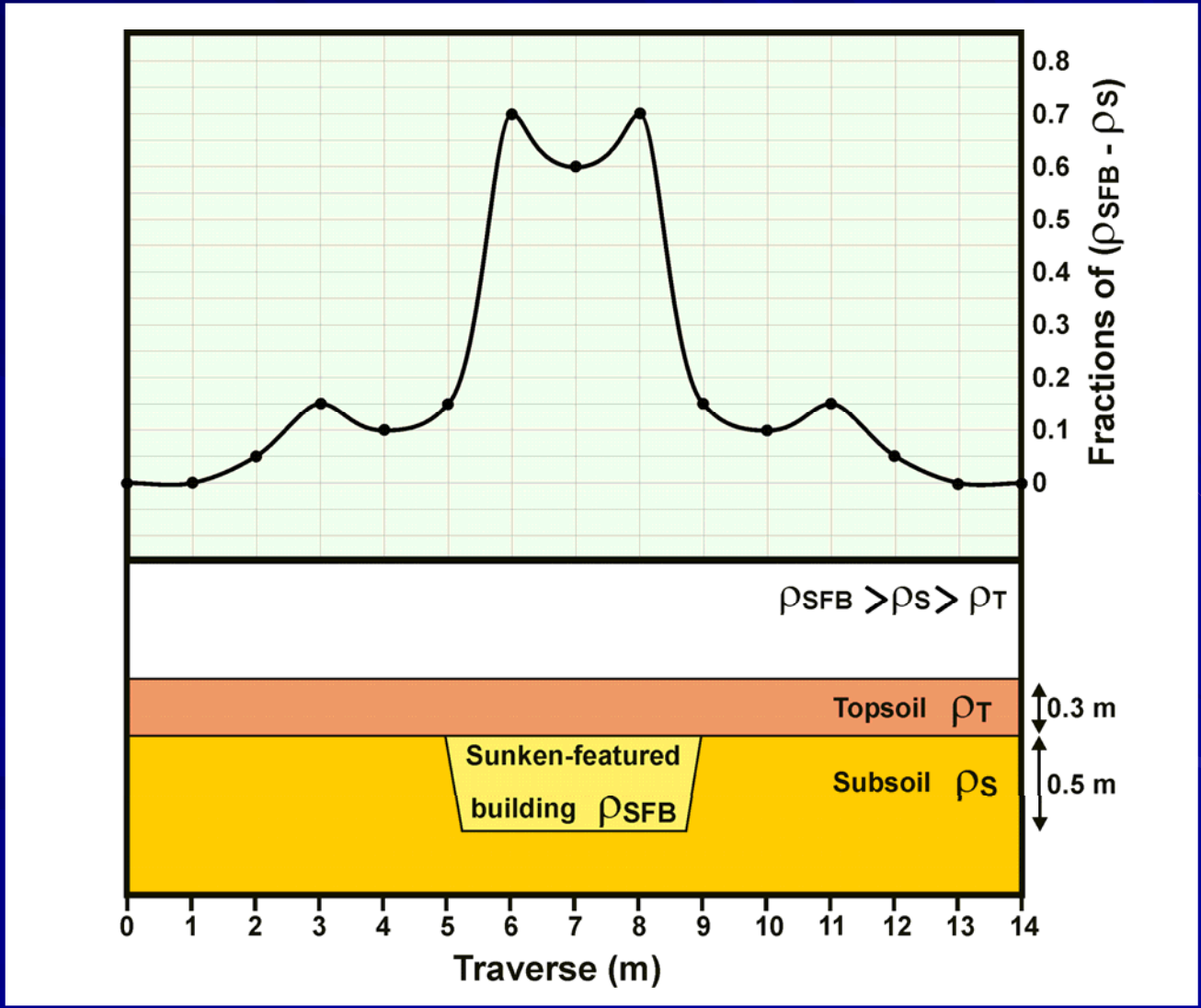
- Each structure has an electrical signature or source function
- Predictive deconvolution – need to predict the source function
- Source function can be calculated uniquely from a geometrical model of the subsurface feature
- The model, however, is not unique
- The method restores the target structure…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

Data Analysis: The Source Function

UNIVERSITÉ LAVAL

Plan

- Introduction
- What is a Grubenhaus?
- Where is the search area?
- How? – Experimental Methodology
- **How? – Data Analysis**
- Results
- Conclusions
- Who? – Acknowledg-ments



Convolution: Synthetic Data

Plan

Introduction

What is a Grubenhaus?

Where is the search area?

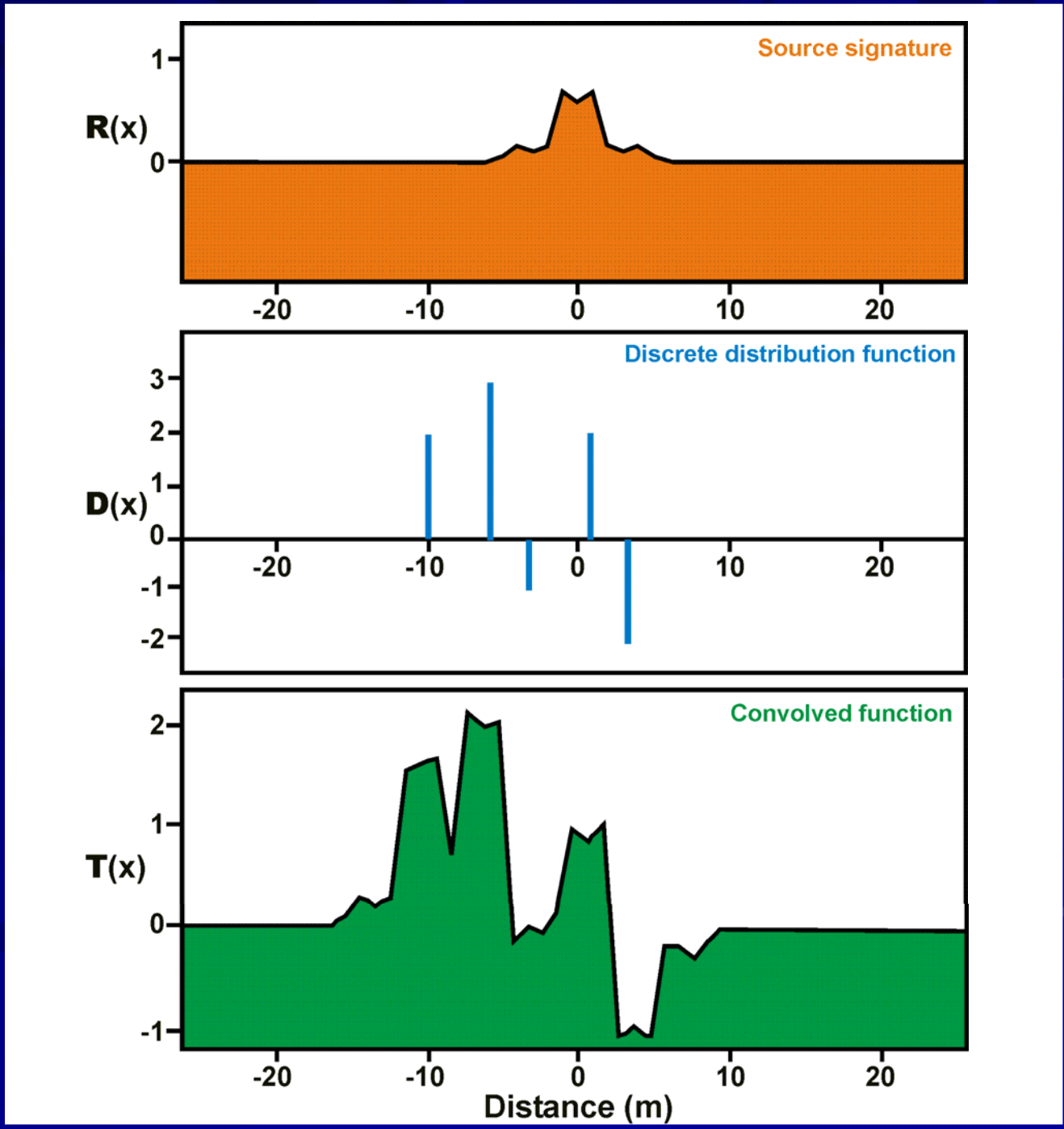
How? – Experimental Methodology

How? – Data Analysis

Results

Conclusions

Who? – Acknowledg-ments



Deconvolution: Restoration of location

Plan

Introduction

What is a Grubenhaus?

Where is the search area?

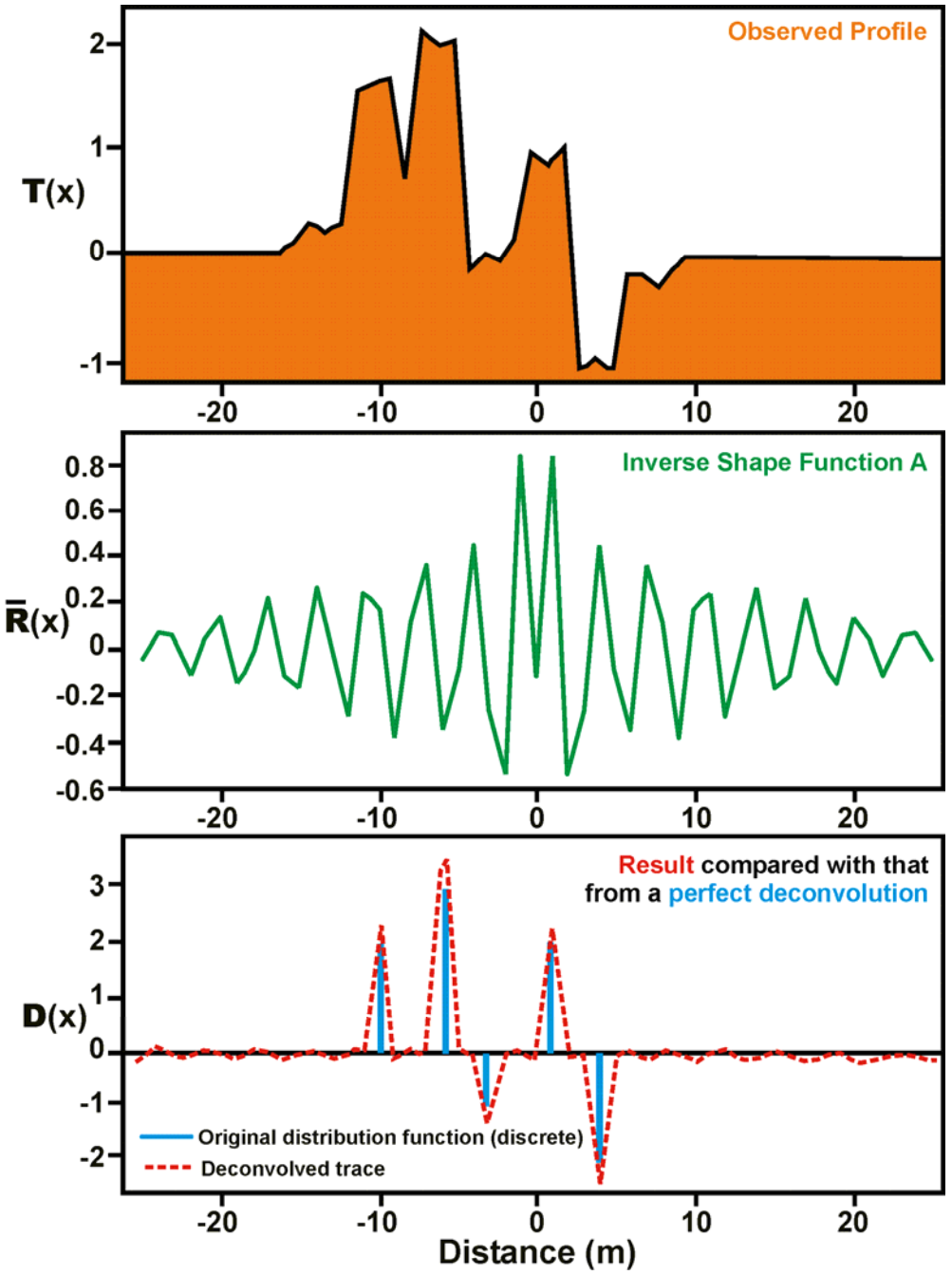
How? – Experimental Methodology

How? – Data Analysis

Results

Conclusions

Who? – Acknowledg-ments



Deconvolution: Restoration of location and extent

Plan

Introduction

What is a Grubenhaus?

Where is the search area?

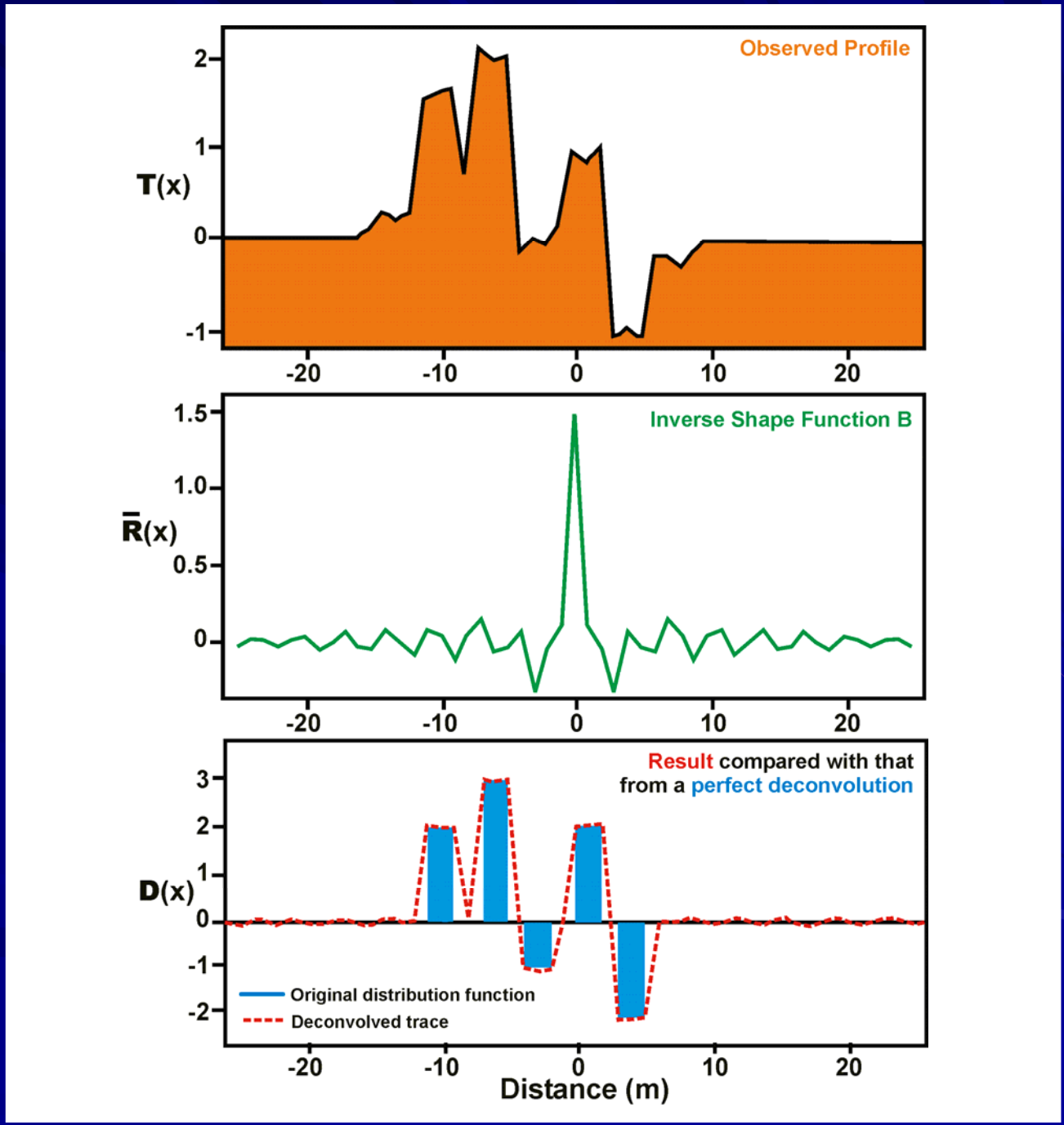
How? – Experimental Methodology

How? – Data Analysis

Results

Conclusions

Who? – Acknowledg-ments



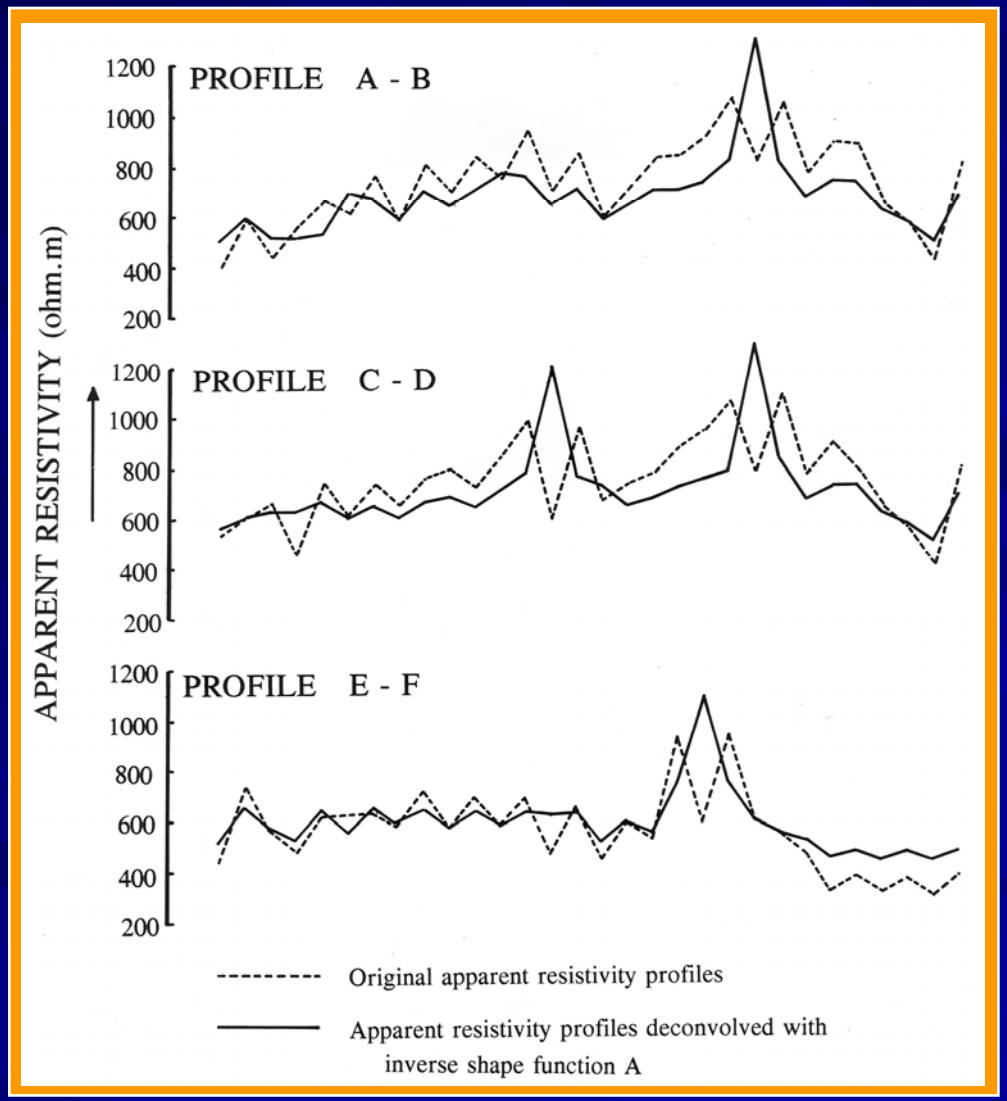
Data Analysis – Test 1

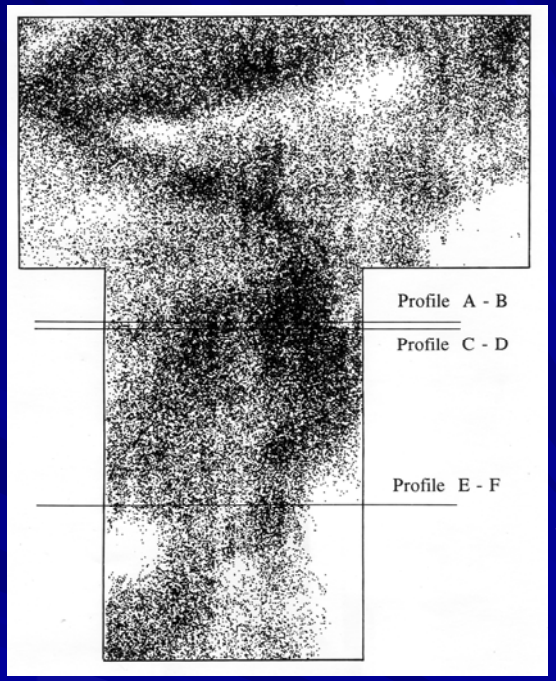
Restoration of location

UNIVERSITÉ LAVAL

Plan

- Introduction
- What is a Grubenhaus?
- Where is the search area?
- How? – Experimental Methodology
- **How? – Data Analysis**
- Results
- Conclusions
- Who? – Acknowledg-ments





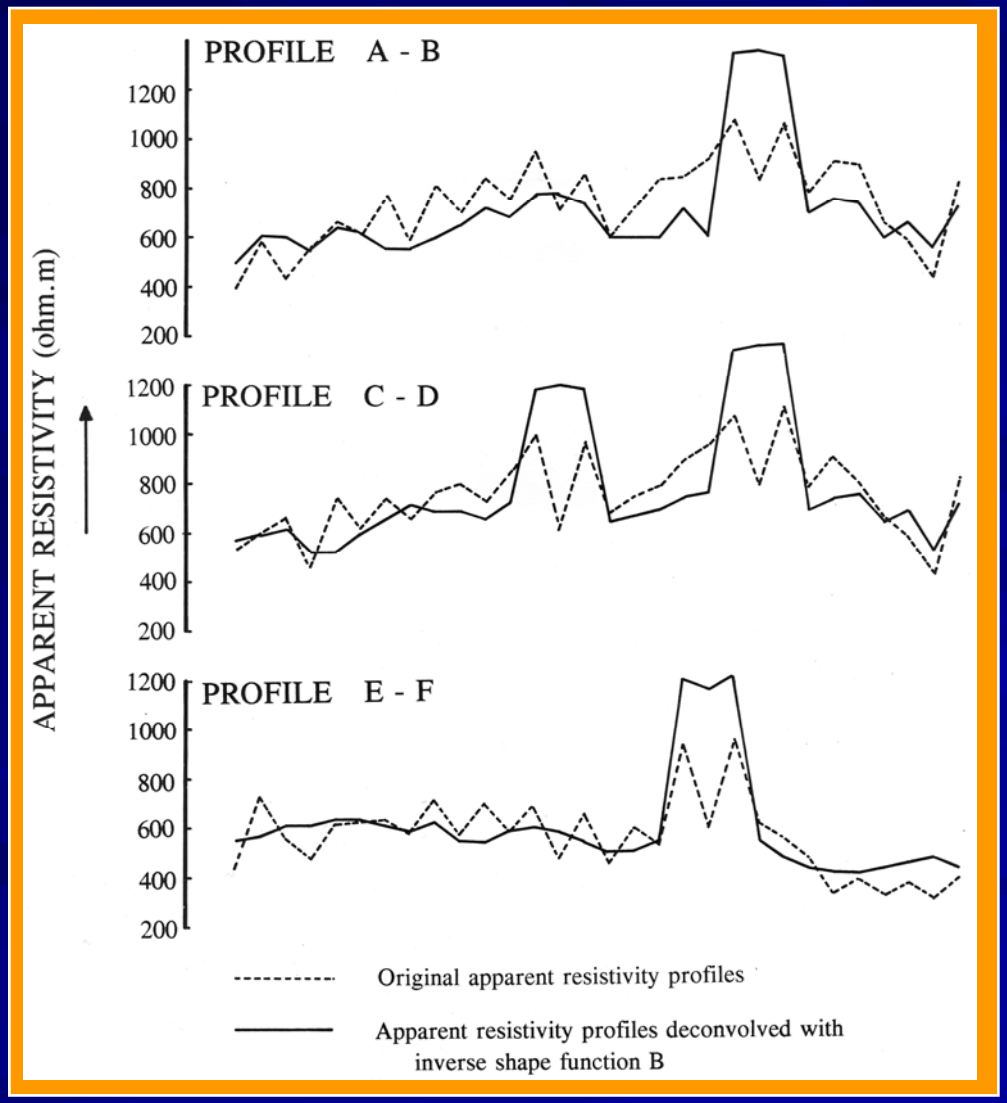
Data Analysis – Test 2

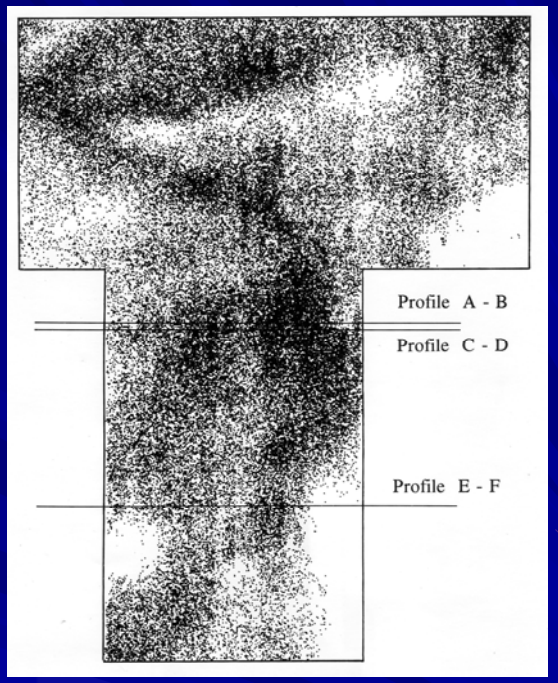
Restoration of location and extent

UNIVERSITÉ LAVAL

Plan

- Introduction
- What is a Grubenhaus?
- Where is the search area?
- How? – Experimental Methodology
- **How? – Data Analysis**
- Results
- Conclusions
- Who? – Acknowledg-ments



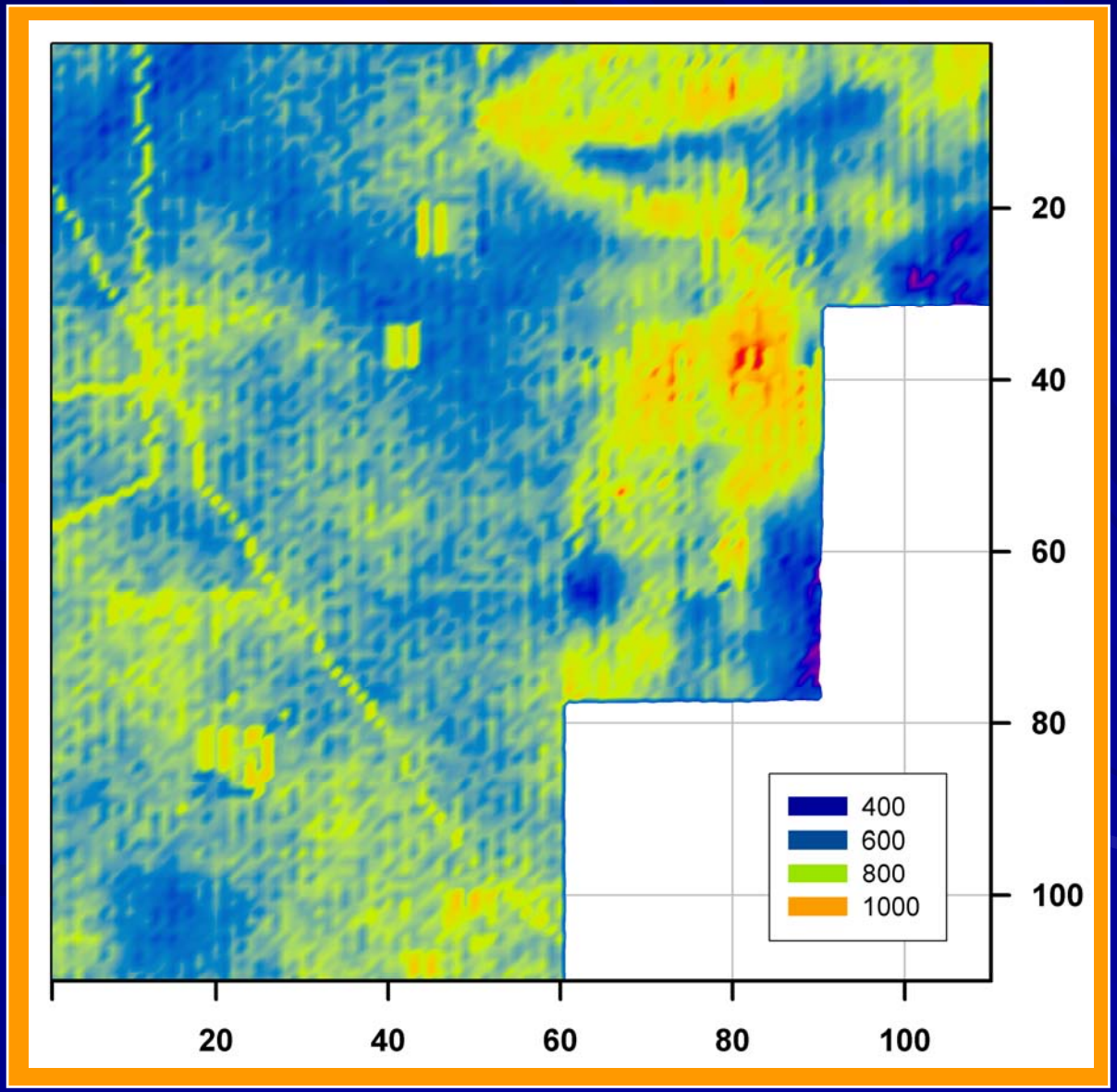


Results

- 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

UNIVERSITÉ LAVAL



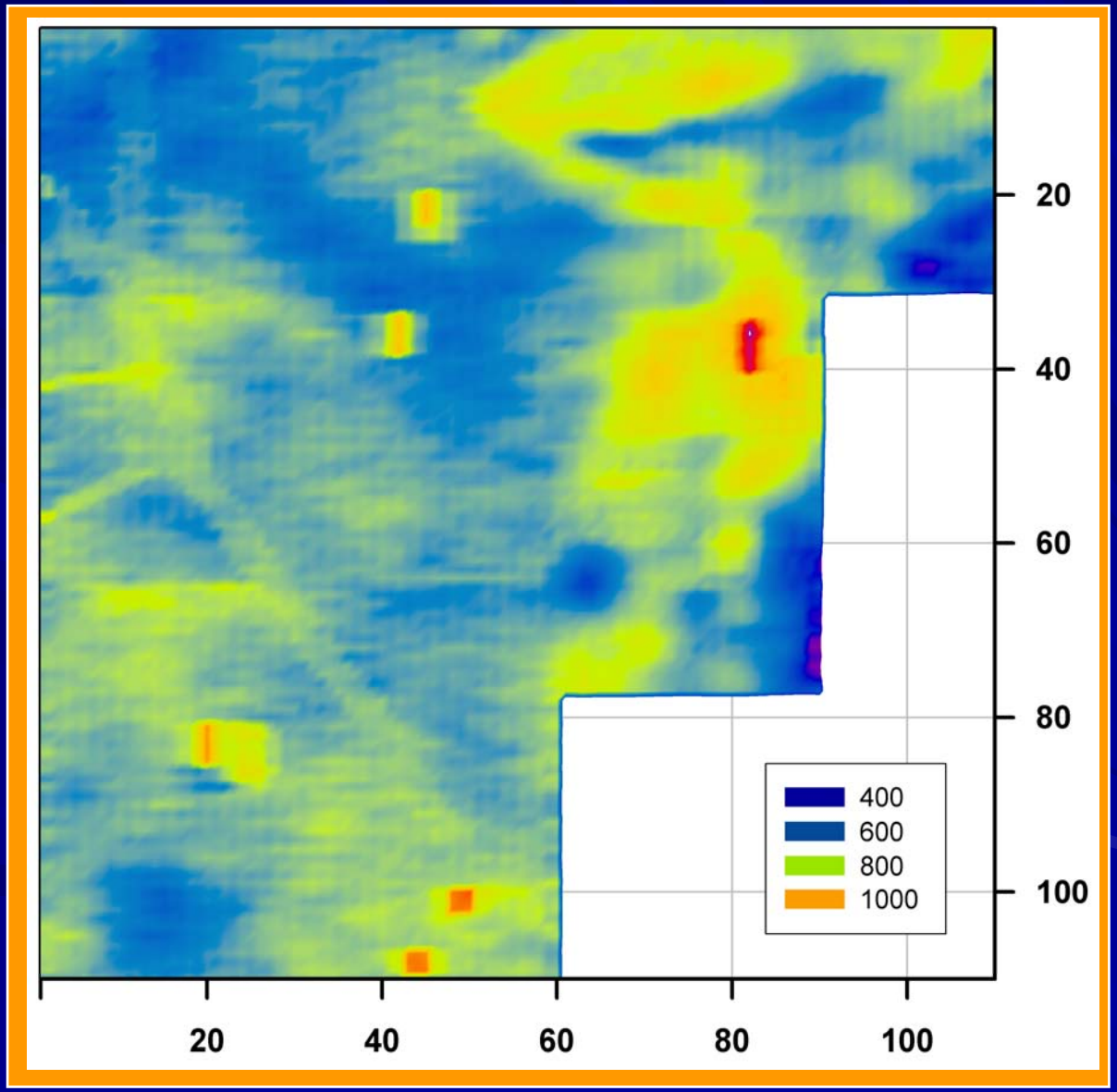
Results – Deconvolved

Source function 3 m wide

UNIVERSITÉ LAVAL

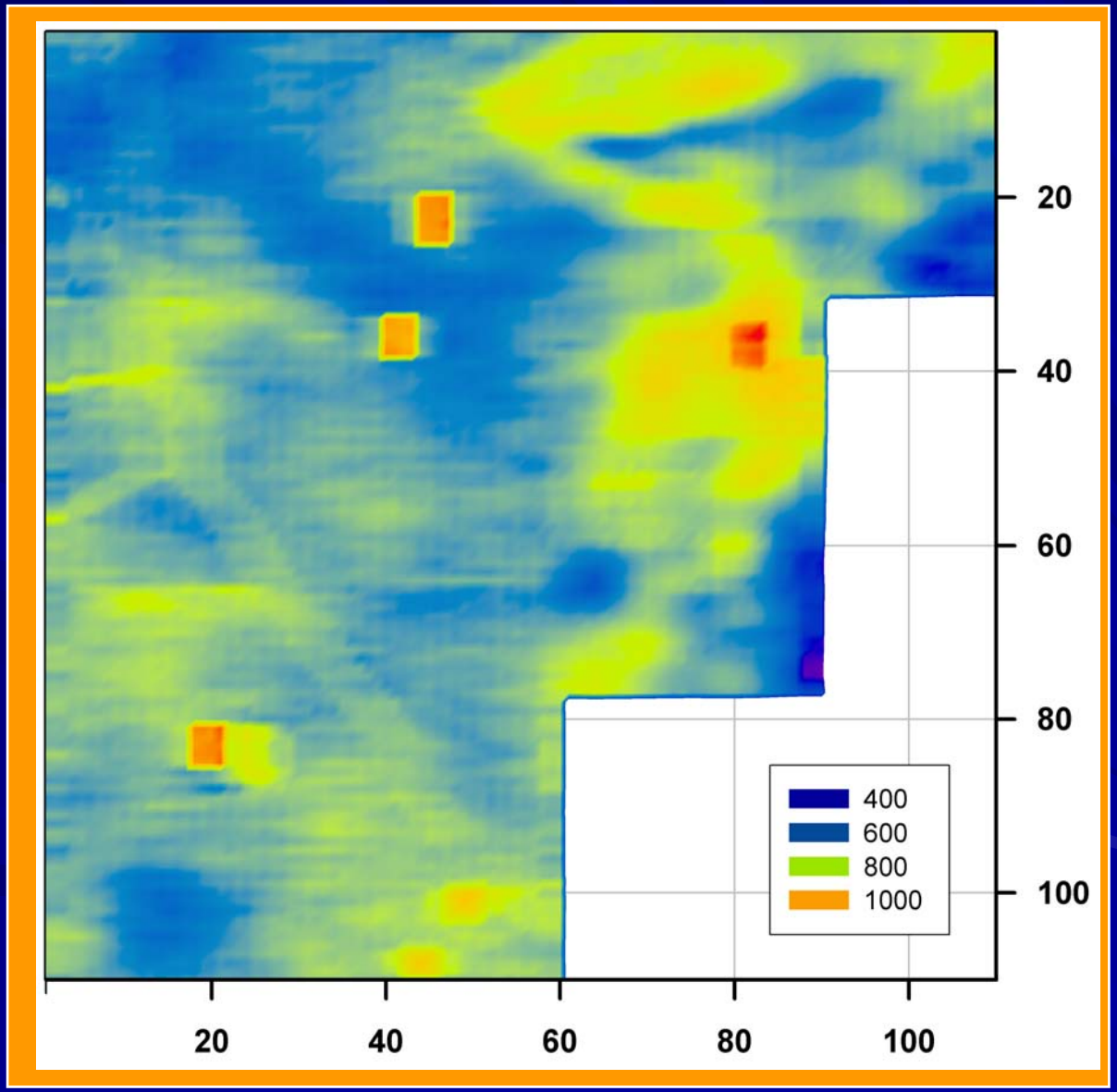
Plan

- Introduction
- What is a Grubenhaus?
- Where is the search area?
- How? – Experimental Methodology
- How? – Data Analysis
- Results
- Conclusions
- Who? – Acknowledg-ments



Results – Deconvolved

Source function 4 m wide



Plan

Introduction

What is a Grubenhaus?

Where is the search area?

How? – Experimental Methodology

How? – Data Analysis

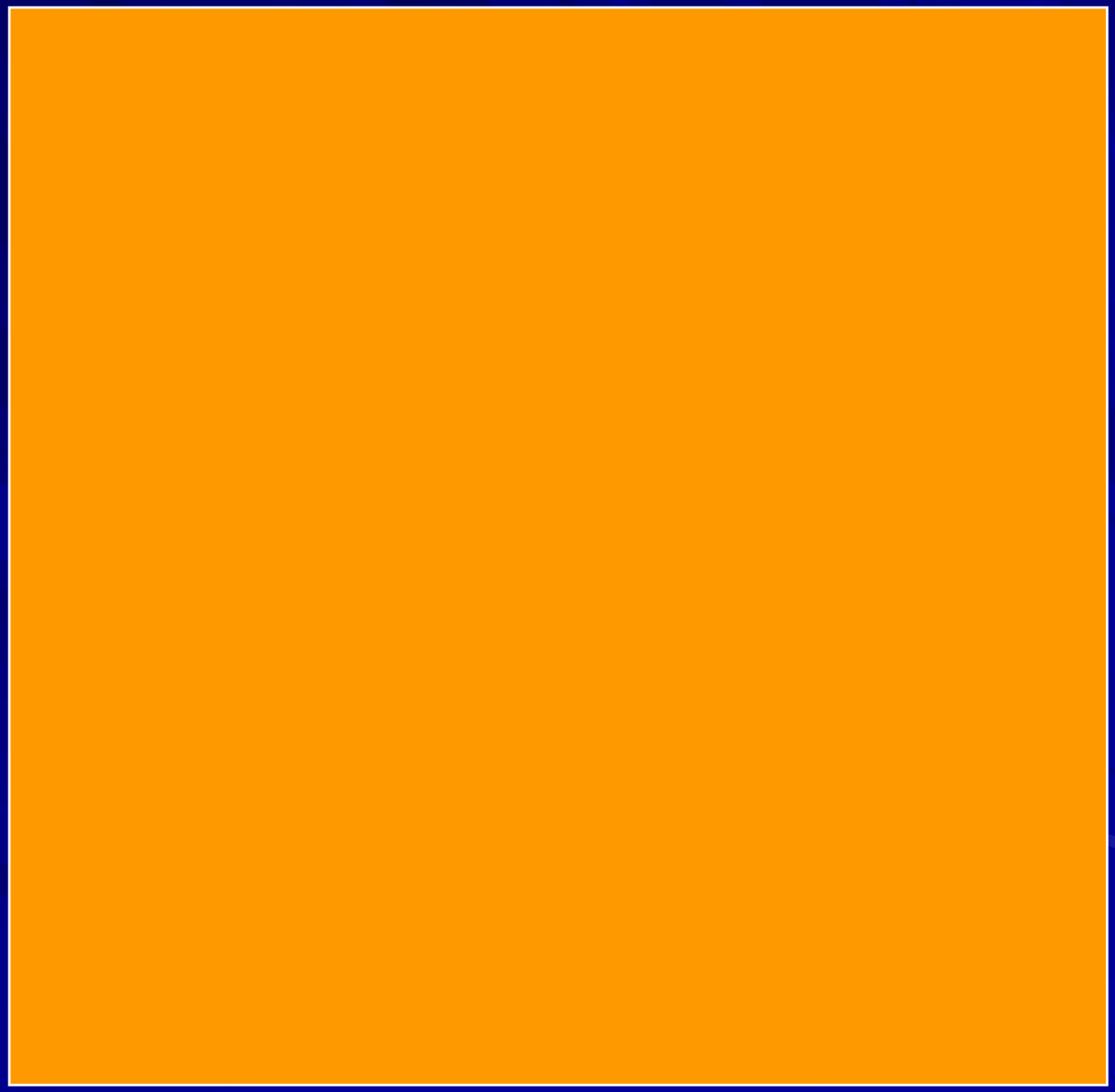
Results

Conclusions

Who? – Acknowledg-ments

Results – Deconvolved

Source function 5 m wide



Plan

Introduction

What is a Grubenhaus?

Where is the search area?

How? – Experimental Methodology

How? – Data Analysis

Results

Conclusions

Who? – Acknowledg-ments

Results - Combined View

Plan

Introduction

What is a Grubenhaus?

Where is the search area?

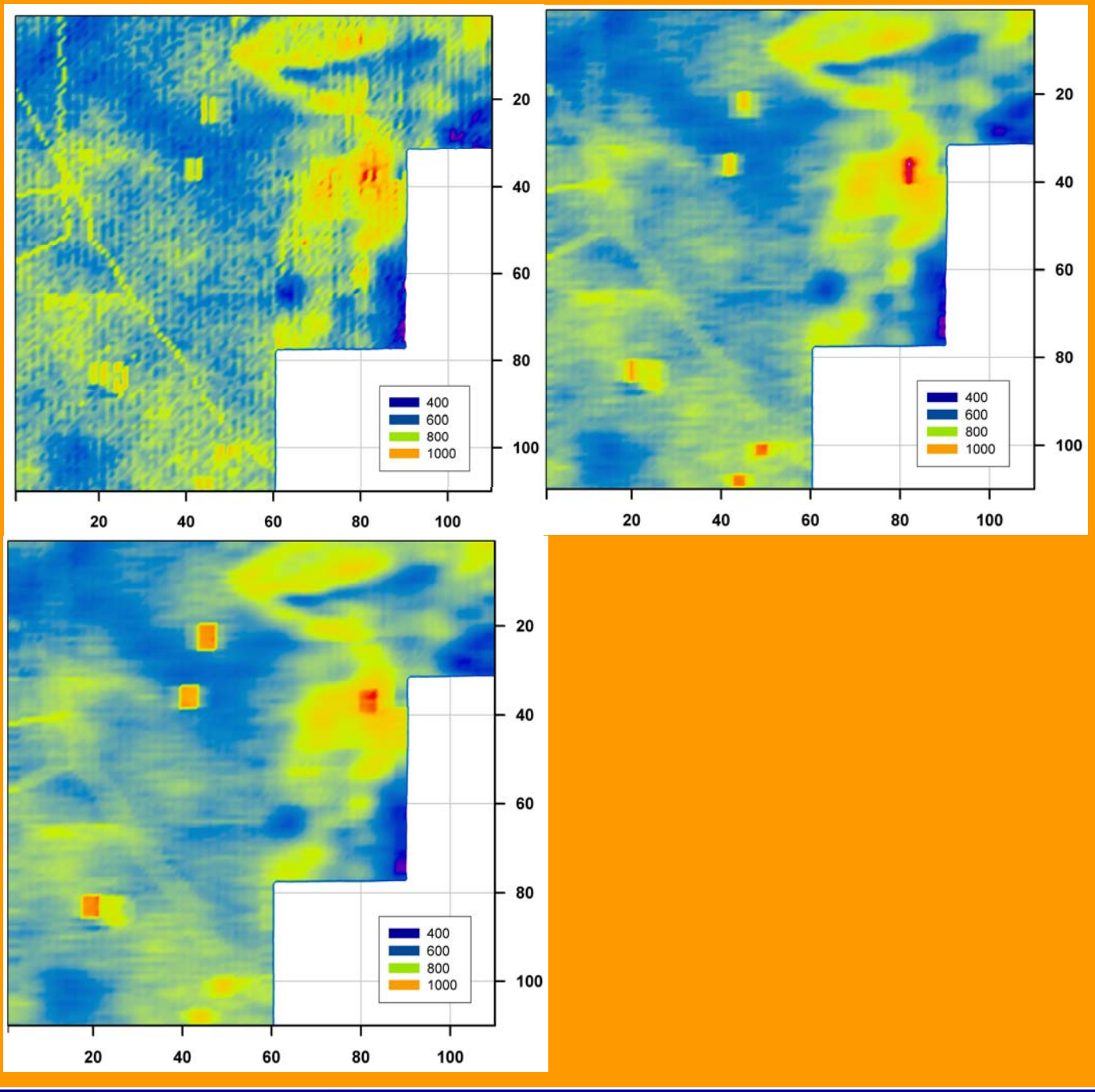
How? – Experimental Methodology

How? – Data Analysis

Results

Conclusions

Who? – Acknowledg-ments



Proof by Excavation

(Gates and O'Brien, 1988)

UNIVERSITÉ LAVAL

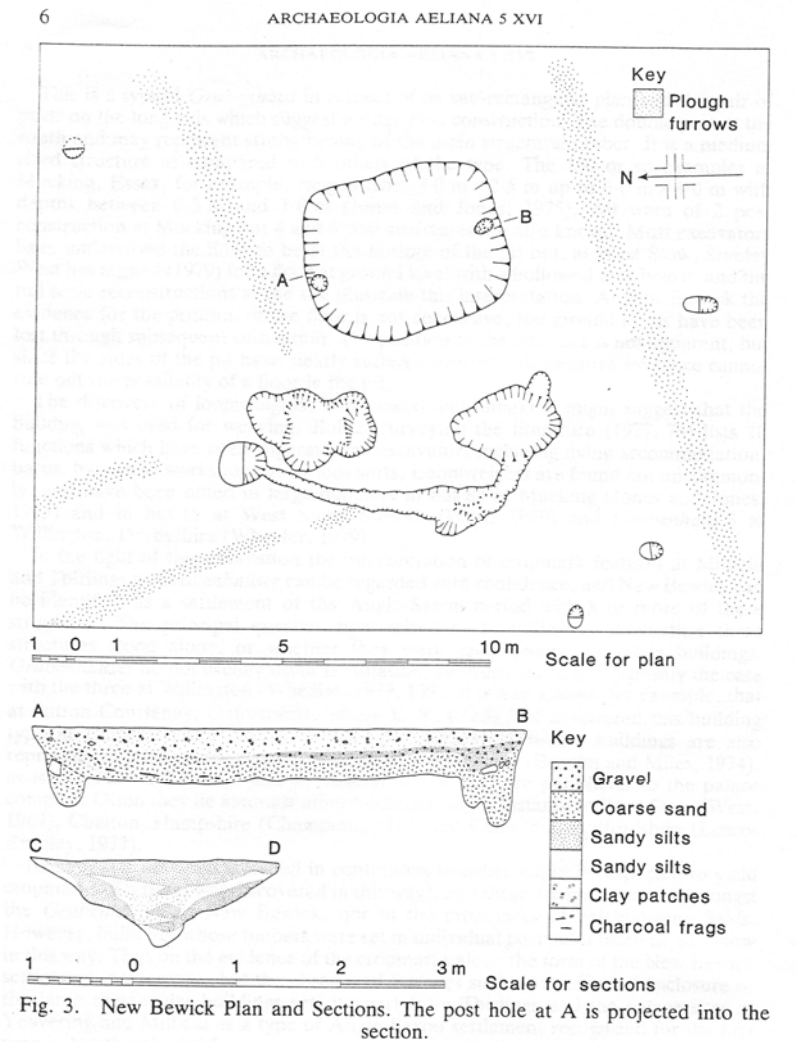
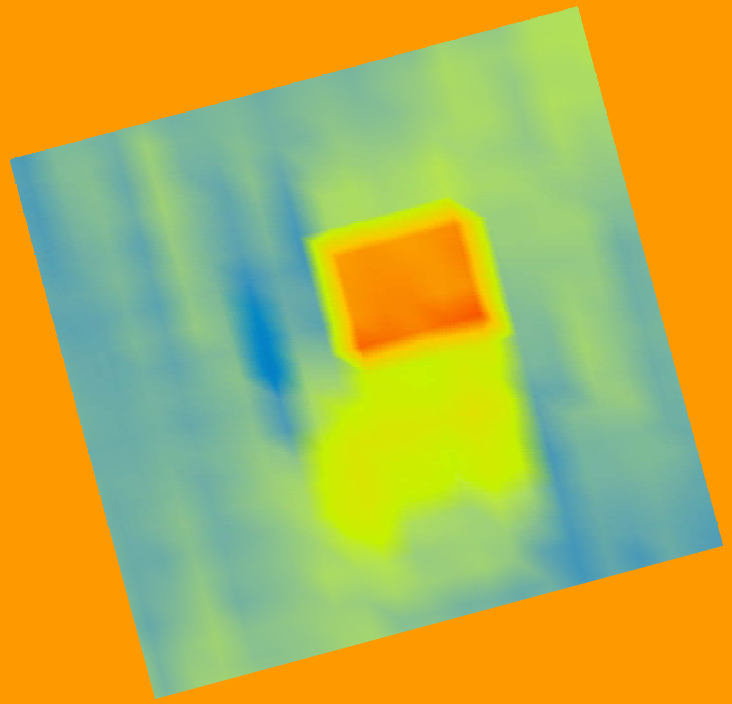


Fig. 3. New Bewick Plan and Sections. The post hole at A is projected into the section.



(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