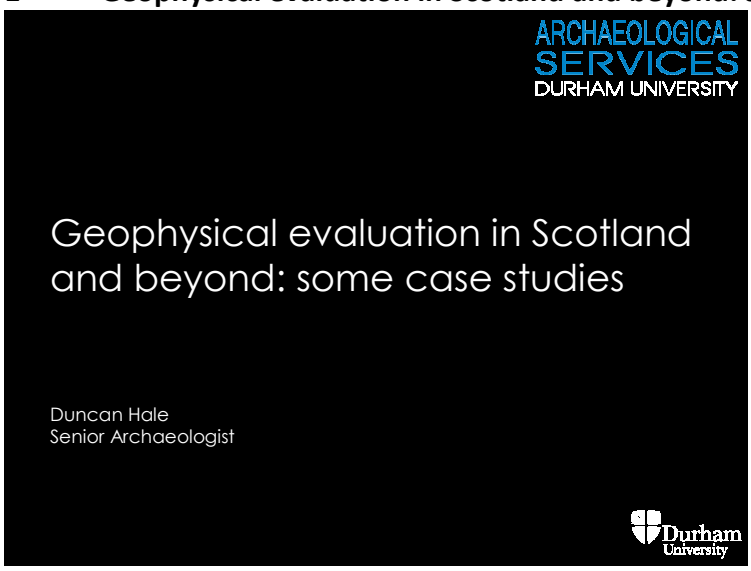
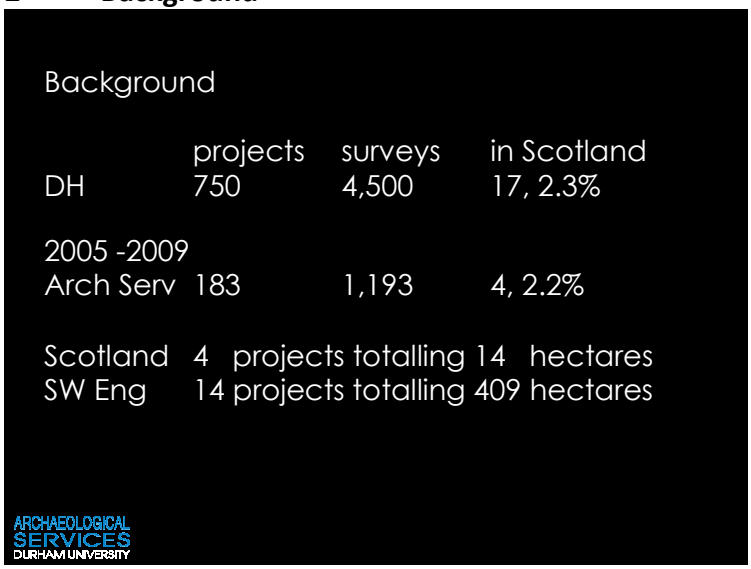
1 Geophysical evaluation in Scotland and beyond: some case studies



Abstract - This presentation will use case studies to demonstrate the application of geophysical techniques in different circumstances. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift. The latter has often been a determining factor in Scotland and has often resulted in no geophysical evaluation taking place. This need not be the case. Sampling strategies will also be discussed, in terms of how best to evaluate large areas.

Original title was to be 'Geophysical evaluation in Scotland' but not enough material…

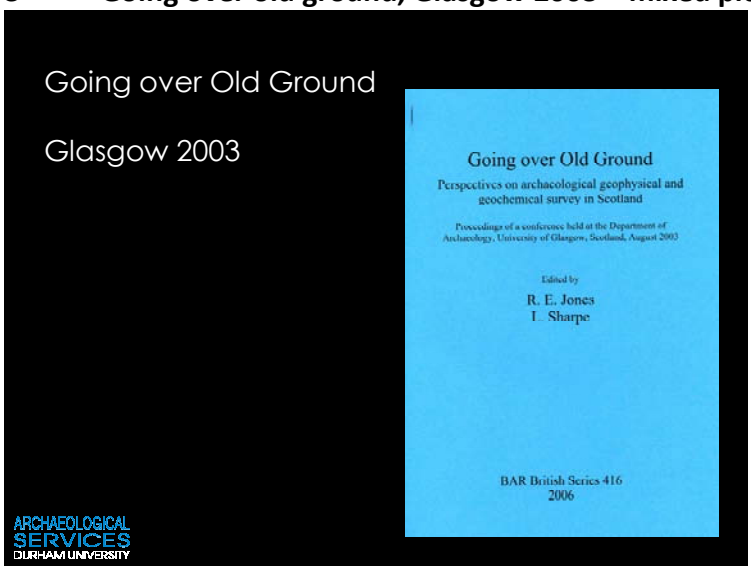
2 Background



…We haven't done many surveys in Scotland. The figures on the slide speak for themselves.

DH 19 years survey - 750 projects (c. 4,500 surveys) but only 17 projects in Scotland and these were mostly at abbeys/castles for conservation/management, and research; only 7 have been development-led evaluation. Archaeological Services - last 5 years, considered fairly typical as we did virtually no surveys in Scotland then or at any other time: 2005-09, 183 projects (1,193 surveys) but only 4 were in Scotland though these were all developer-led. SW England is not even an area where we would expect to win many contracts, unlike Scotland which is relatively close for us. We have done more survey in eg Ukraine, Channel Islands, Egypt, Nepal than in Scotland.

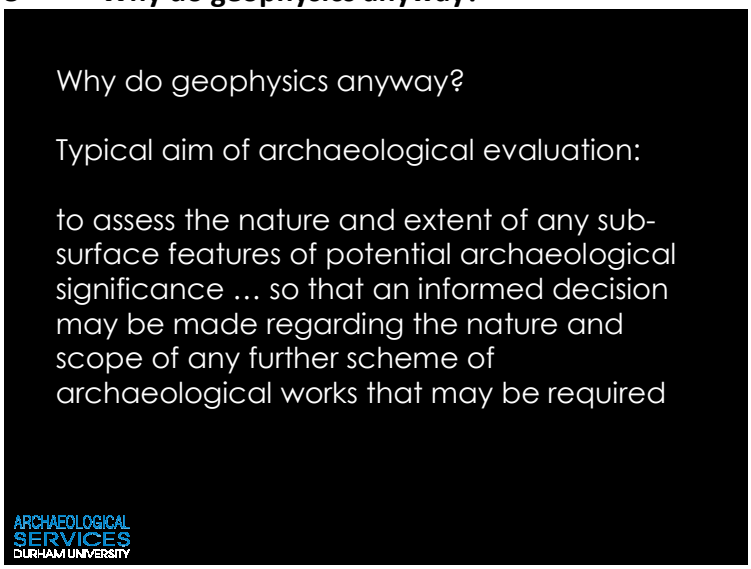
3 Going over old ground, Glasgow 2003 – mixed picture?



Reviewed survey in Scotland, successes and failures

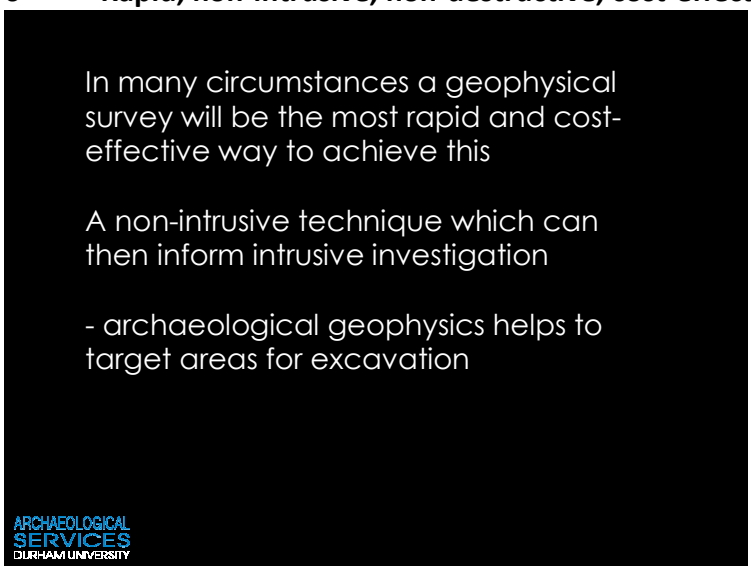
4 ALGAO Perth 2009

5 Why do geophysics anyway?



Typical aim

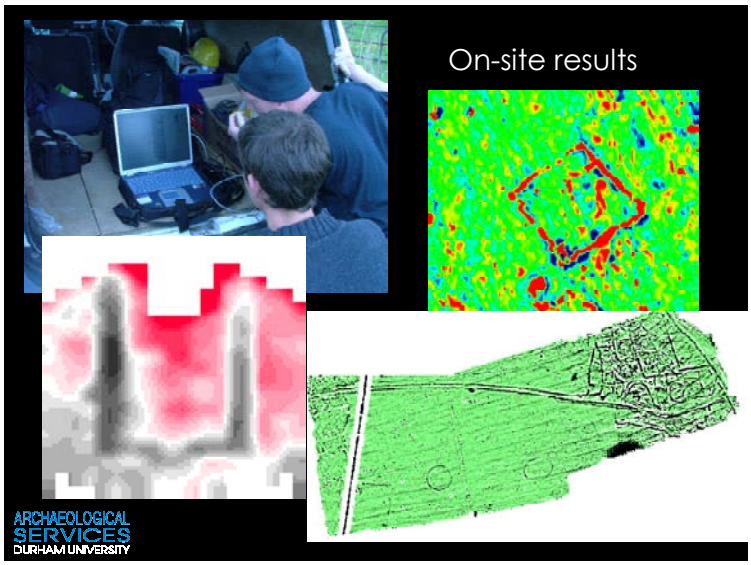
6 Rapid, non-intrusive, non-destructive, cost-effective



Up to 4ha per day per instrument

7 slides

8 On site results



9 Is there an appropriate technique?

Technique selection – is there an appropriate technique?

Different techniques are available for different site circumstances

Different techniques measure different physical properties of the soil; objects within graves or pits can also be detected

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10 slides – techniques

fluxgate gradiometry

electrical resistance survey

ground penetrating radar (GPR)

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11 determining factors

Determining factors:

Nature of likely targets
Depth of likely targets
Ground conditions (crops, landuse, surfaces)
Proximity of buildings, services etc
Local solid geology and drift

A suite of complementary techniques should be used whenever possible

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in an ideal world, at least an option for a second technique, targeted

12 Geological factors

Geology

The most commonly used technique (magnetic) has traditionally not been used because of geological concerns

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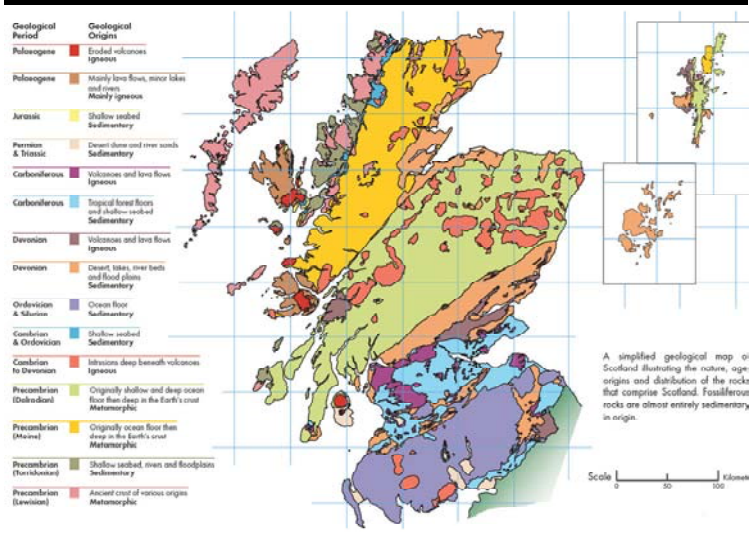
13 Map

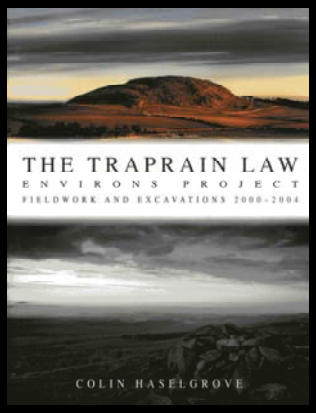


North: thermoremanence of metamorphic rock not necessarily a significant problem – magnetic survey can be effective eg Balivanich, Western Isles. Also large areas of sedimentary rock; areas of igneous rock more problematic, eg Skye & other islands; Glasgow-Edinburgh belt mostly sedimentary but with lot of volcanoes and lava flows, however…some examples…

14 Traprain Law Environs Project

Traprain Law Environs Project
East Lothian
surveys 2000-02

30 surveys over cropmarked enclosures in an area of complex, often igneous, geology



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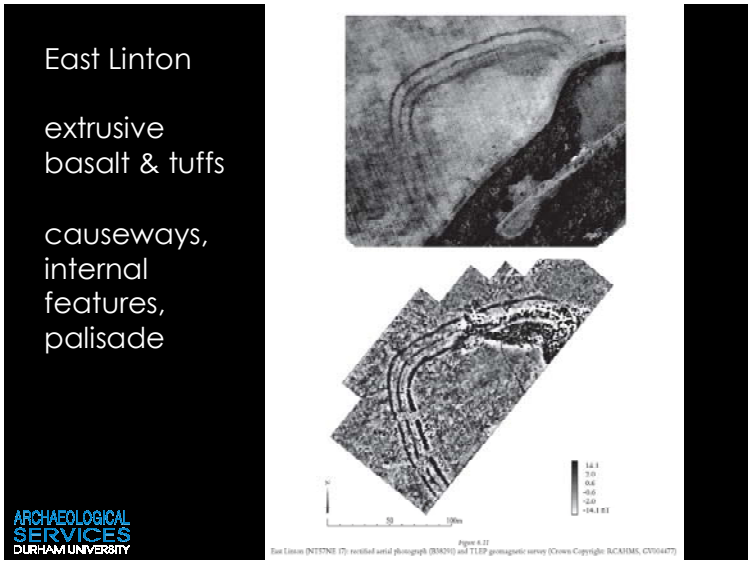
Area of varied geology, often igneous, and much AP coverage; some great sites on APs but not the whole picture. Some ask why do geophysics? – eg: adjacent A1 scheme – no geophysics was required, the assumed resource was based on APs- however lots of additional sites revealed at late stage in works eg Phantassie Farm.

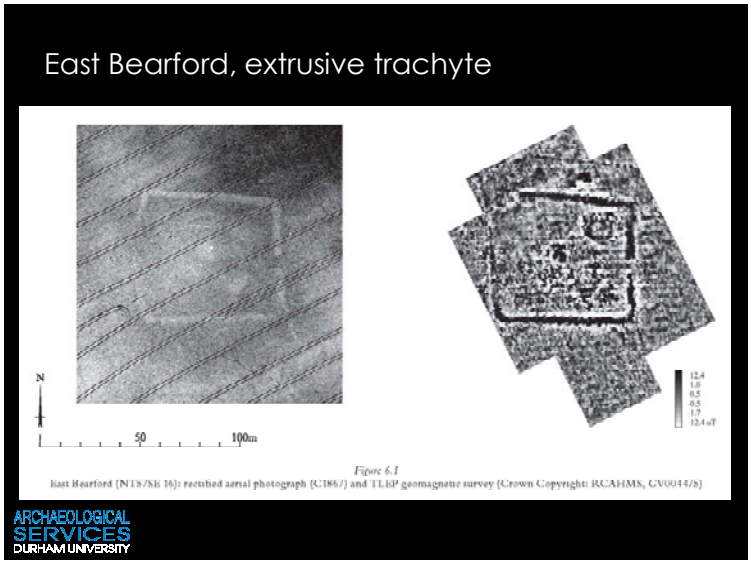
A subsidiary aim of TLEP was to evaluate the effectiveness of geomagnetic technique over these different rock types – only one site where igneous geology appears to be cause of non-detection of AP site.

15 East Linton

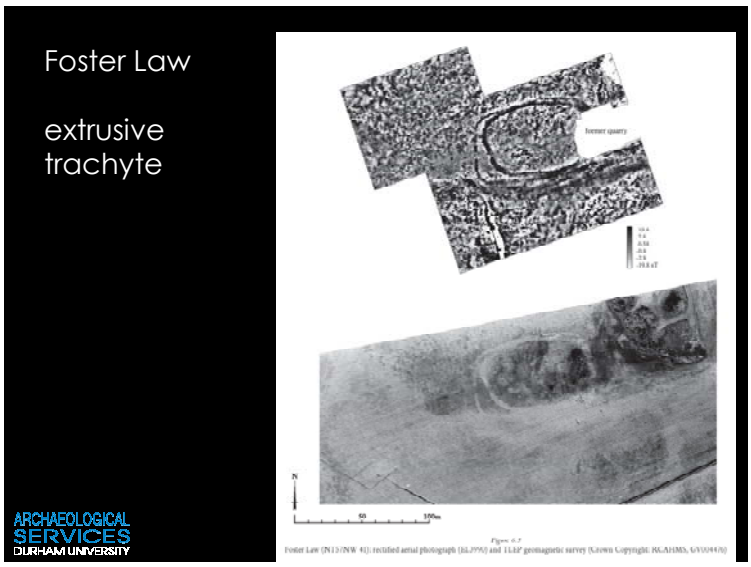


Various previously unrecorded features

16 East Bearford

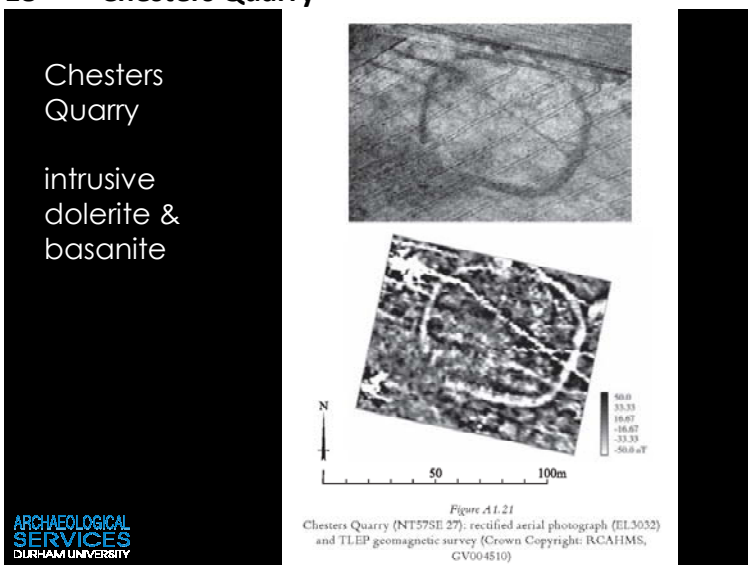


17 Foster Law



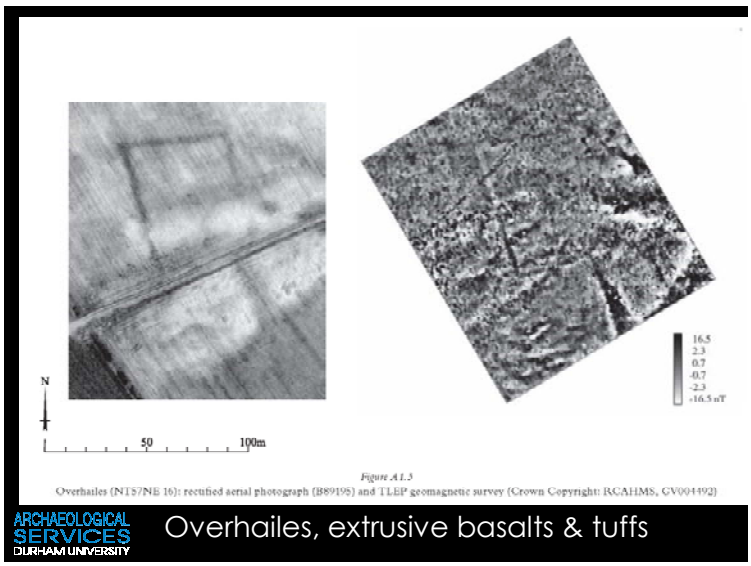
Lot of background noise due to fragmented rockhead in former ploughsoil, but still good

18 Chesters Quarry



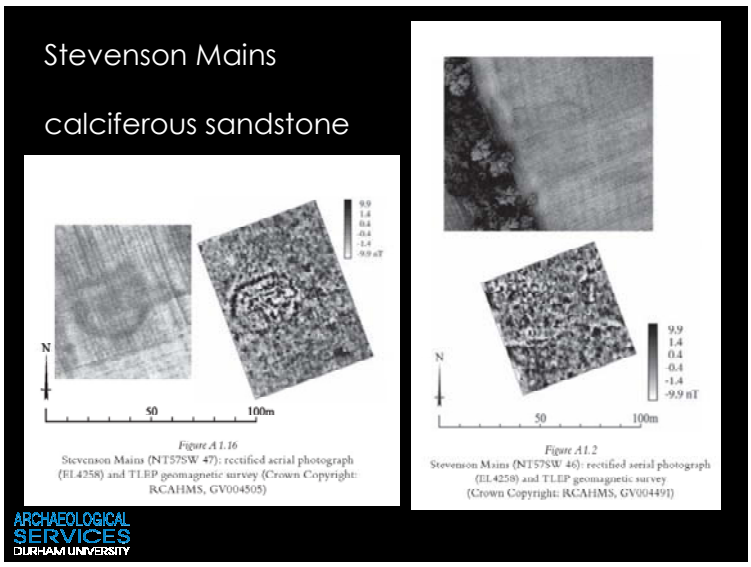
?rockcut ditch and soil-cut internal features. There are several other good examples too.

19 Overhailes



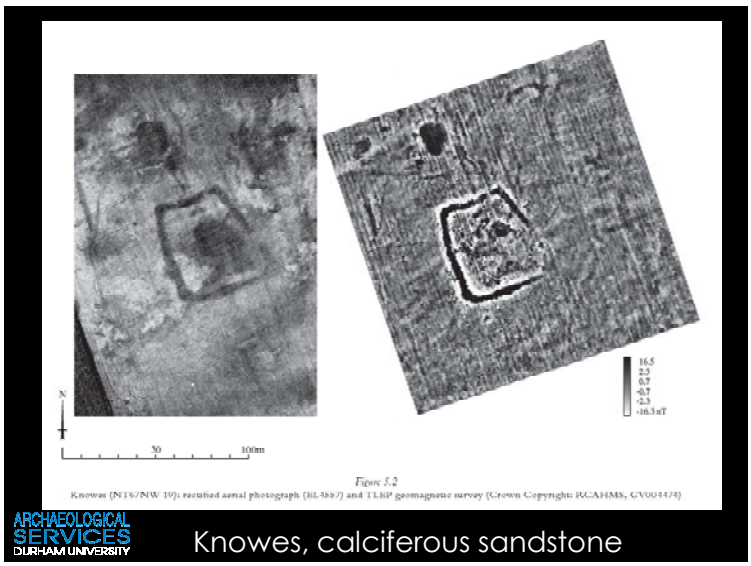
Not so good, on lava flow

20 Stevenson Mains



Two AP sites on sedimentary strata, within 150m of each other – might expect these to be better, but varying data

21 Knowes



Great – same strata as before – can't look at geological maps and assume sedimentary rock is good and igneous is bad.

And if magnetometry is problematic, try another technique.

Other examples: Cheviot/Ingram surveys in Northumberland, on andesite and basalt, and in West Lothian over dyke, Channel Islands, Ukraine and elsewhere.

22 Sampling – large areas

Evaluating/sampling large areas

Preference for survey of whole evaluation area; pilot surveys first

Exceptional circumstances, magnetic susceptibility survey then smaller detailed surveys, at least 50% detailed survey

Use existing desk-based or other information to identify priority areas, or at least areas of impact, and sample the rest

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100% survey can lead to reduction of trenching percentage

23 Magnetic susceptibility and targeted detailed magnetometry

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65ha mag sus, 8ha detailed mag

24 40% in alternate 50m N-S strips

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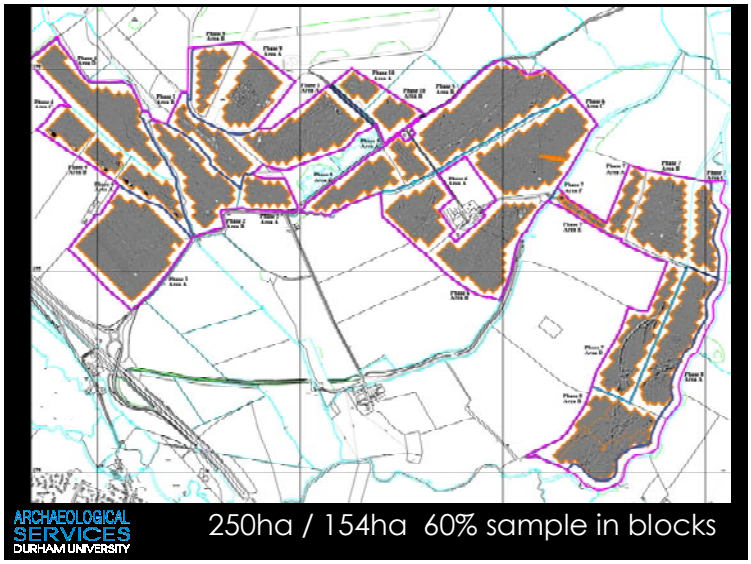
195ha / 78ha 40% sample in strips

What is intended on paper as 50% can become 40% in practice. Not preferred, leaves big gaps, here 50m – other issues include subsequent filling of gaps

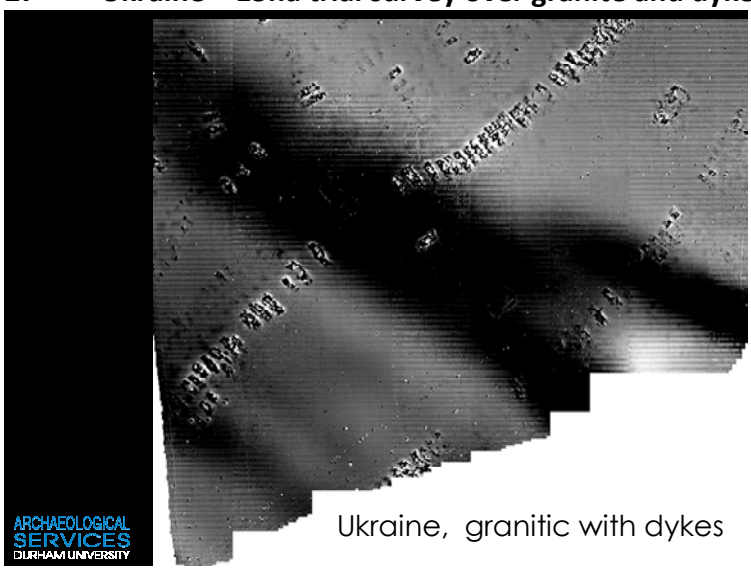
25 50% in blocks

26 60% in blocks

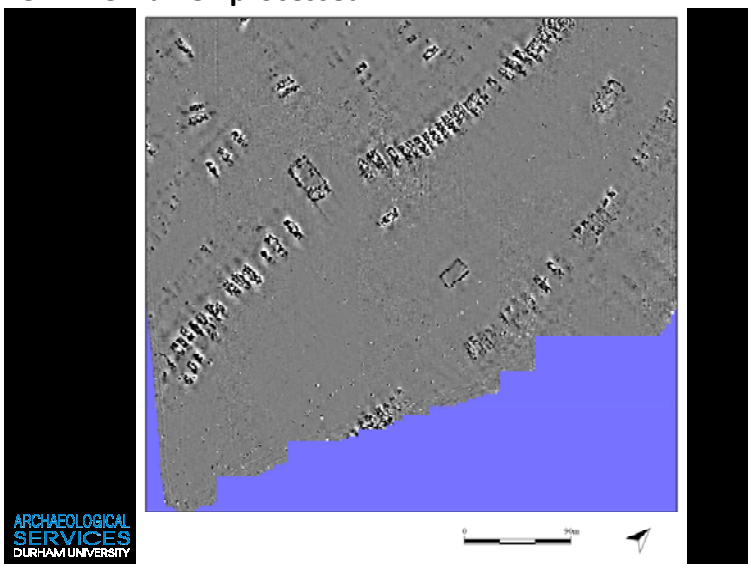


These examples allow surveyor to maximize use of sampling percentage by avoiding areas such as alongside field boundaries where the land is often disturbed/noisy, contain wire fences and often pipes along edges. Also allows for consideration of existing knowledge about a site, known services or other modern features, and the known archaeological resource.

27 Ukraine – 15ha trial survey over granite and dykes



28 Ukraine - processed



The survey reveals rows of Neolithic houses. It would have been a great shame not to have done this geomagnetic survey based on assumptions about magnetometry and the local geology.

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