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Airborne Thermal Investigation of Mining Activity in the Coleorton region, Leicestershire

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Outline

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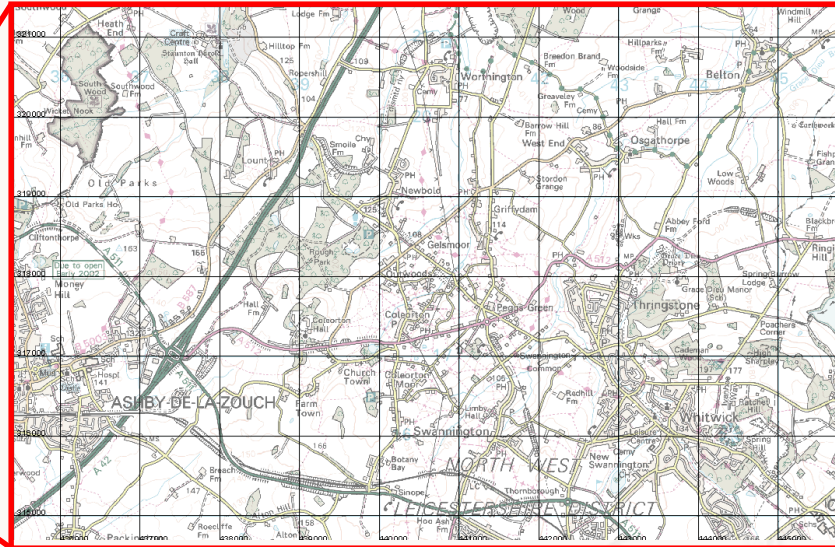


Introduction

- The Coleorton region of Leicestershire is known as an area of ancient coal mining activity
- Part of the North West Leicestershire coal field
- The location of many shafts is recorded but the exact position of the older shafts has not been well documented
- More recent mining activity (19th and 20th Century) has also occurred in the region and the position of these shafts is already recorded
- A new method to map the ancient mine workings in the region was proposed using thermal remote sensing data



Study Site



- The study site is an area of ancient coal mining near Loughborough, in Leicestershire
- Earliest documented mining 1105
- Bell Pits are spread around the region and have been mapped based on surface features

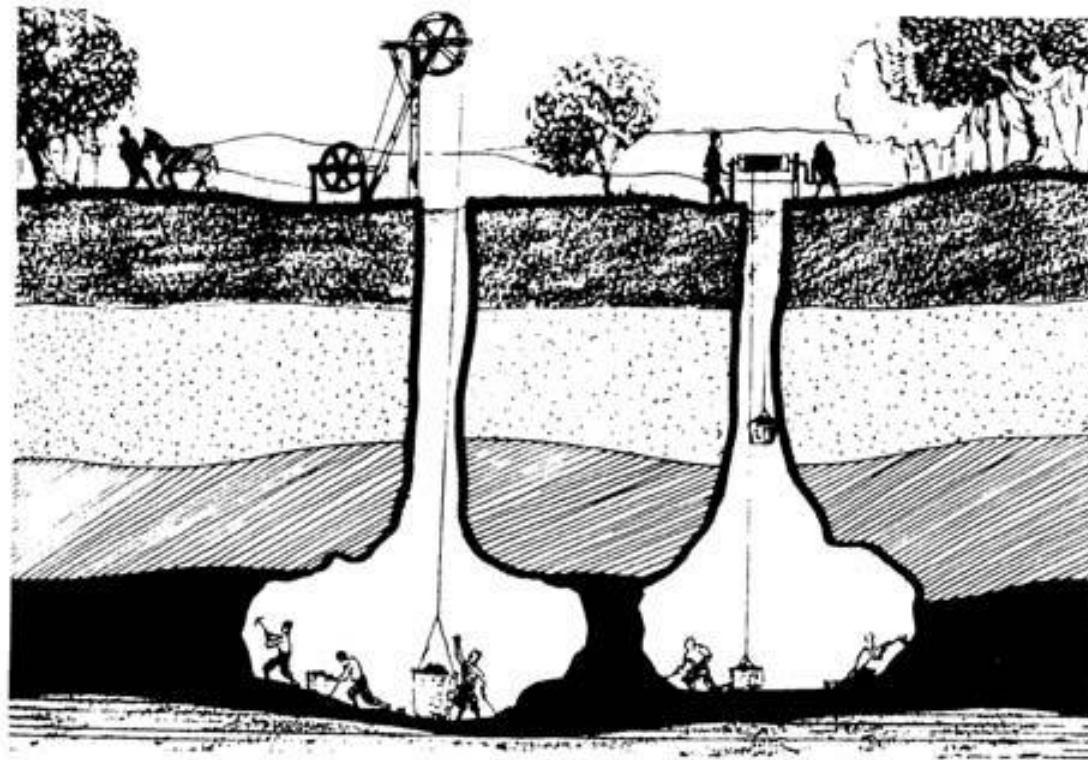


Bell Pit

- The name bell pit comes from the shape of the excavation
- A narrow vertical shaft sunk into the coal which was then opened out into a small chamber
- Little timber was used, so once the roof became unsafe, the pit was abandoned and another shaft sunk nearby
- Coal was cut by using picks and shovels
- This is the earliest method of underground mining



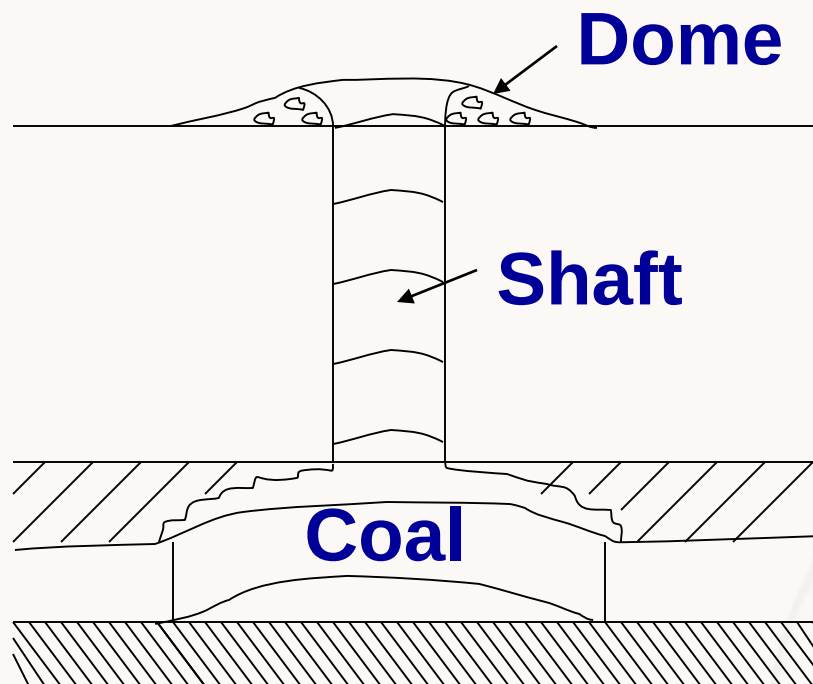
Bell Pit



A cross-section of a bell-pit mine, the first system of underground mining



Bell Pit Cross Section





Methodology

- The thermal band of the Airborne Thematic Mapper (ATM) was proposed to be used to map bell pits and other areas of made ground associated with mining activity
- Data acquired at dawn on 12th October 1999
- ATM Data was received and pre-processed
- Geocorrected – Azgcorr Software
- Further geocorrection – Rubber Sheeting
- Mosaic strips



Methodology

- Both Thermal and natural colour bands in various combinations were viewed
- Discovered that Thermal bands were best for mapping bell pits as predicted
- Thermal data was contrast stretched to enhance temperature differences
- Edge enhancement was undertaken to sharpen image and highlight features of interest

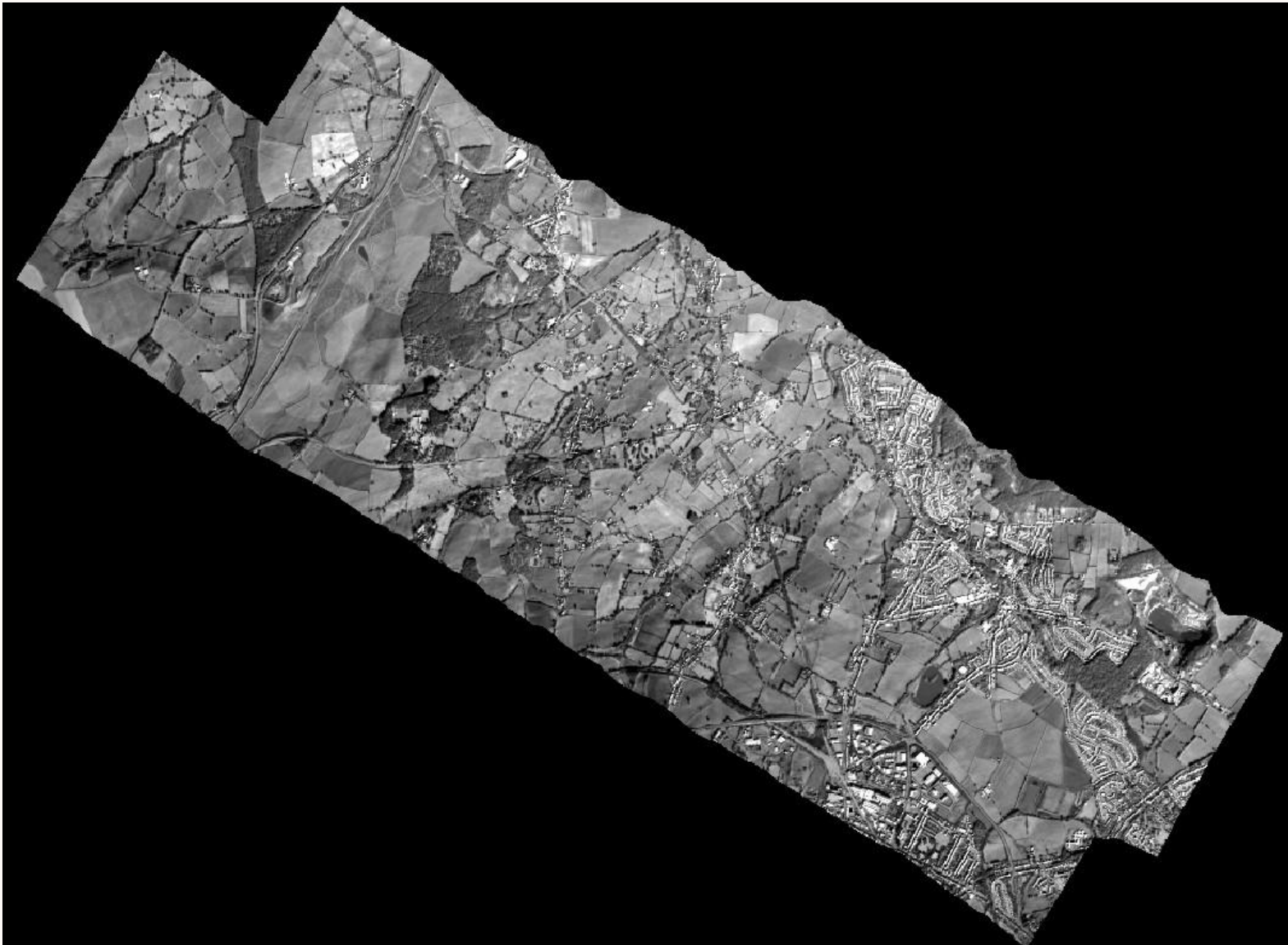


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Methodology

- Began interpretation by highlighting all areas where anomalous features could be seen
- Field mapping interpretation of the area already existed
- This was used for validation purposes
- Some areas identified in the imagery had not been mapped as mined areas
- Follow-up field work was undertaken to verify the existence of the features seen in the imagery on the ground



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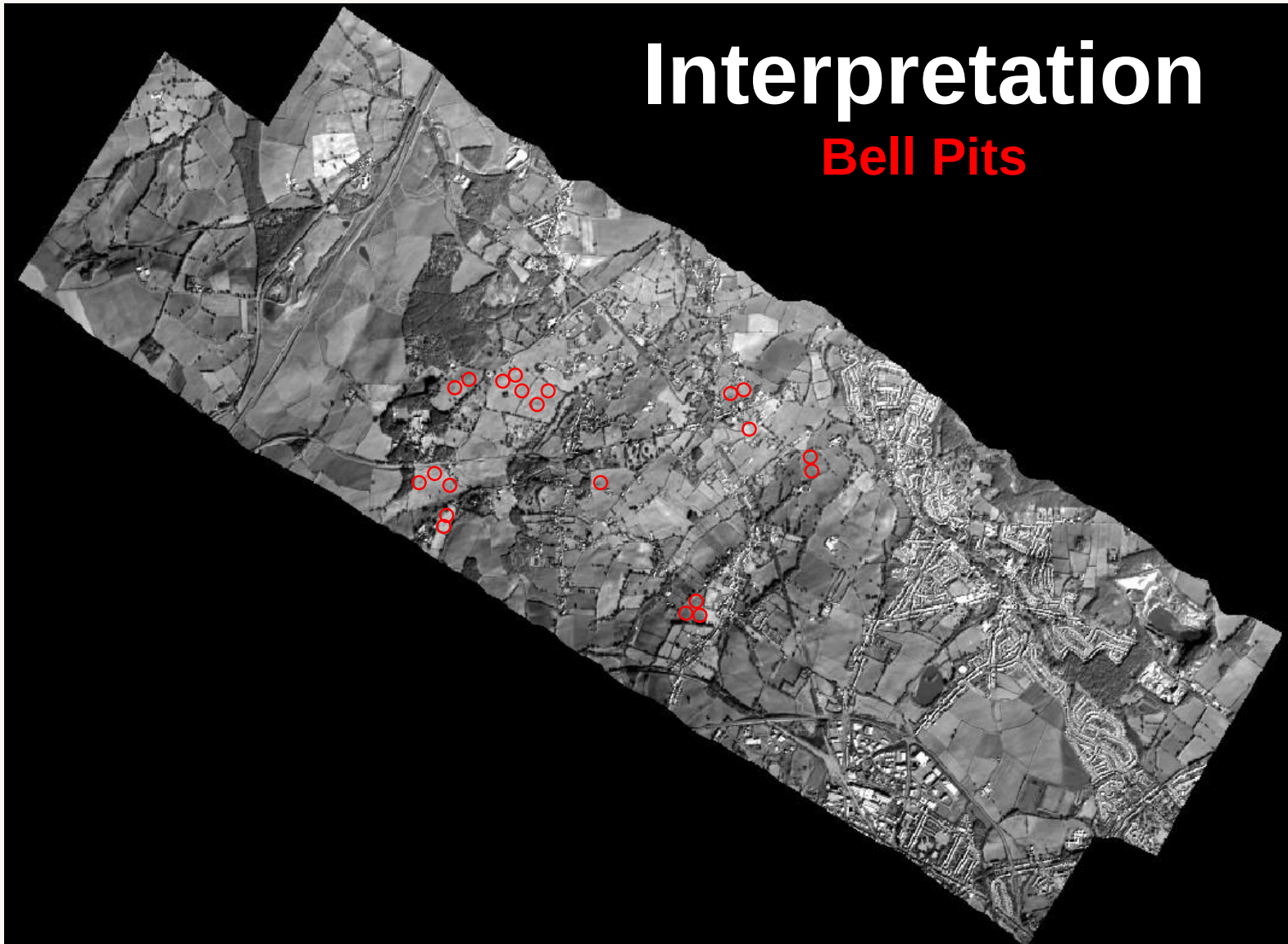
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Interpretation

Bell Pits





Bell Pit Interpretation

- Circular thermal anomalies were found to be associated with the bell pits and mine shafts
- Typically a circular mound with circular depression at the centre
- Tear dropped mounds were also observed where mounds were built up on a hill side



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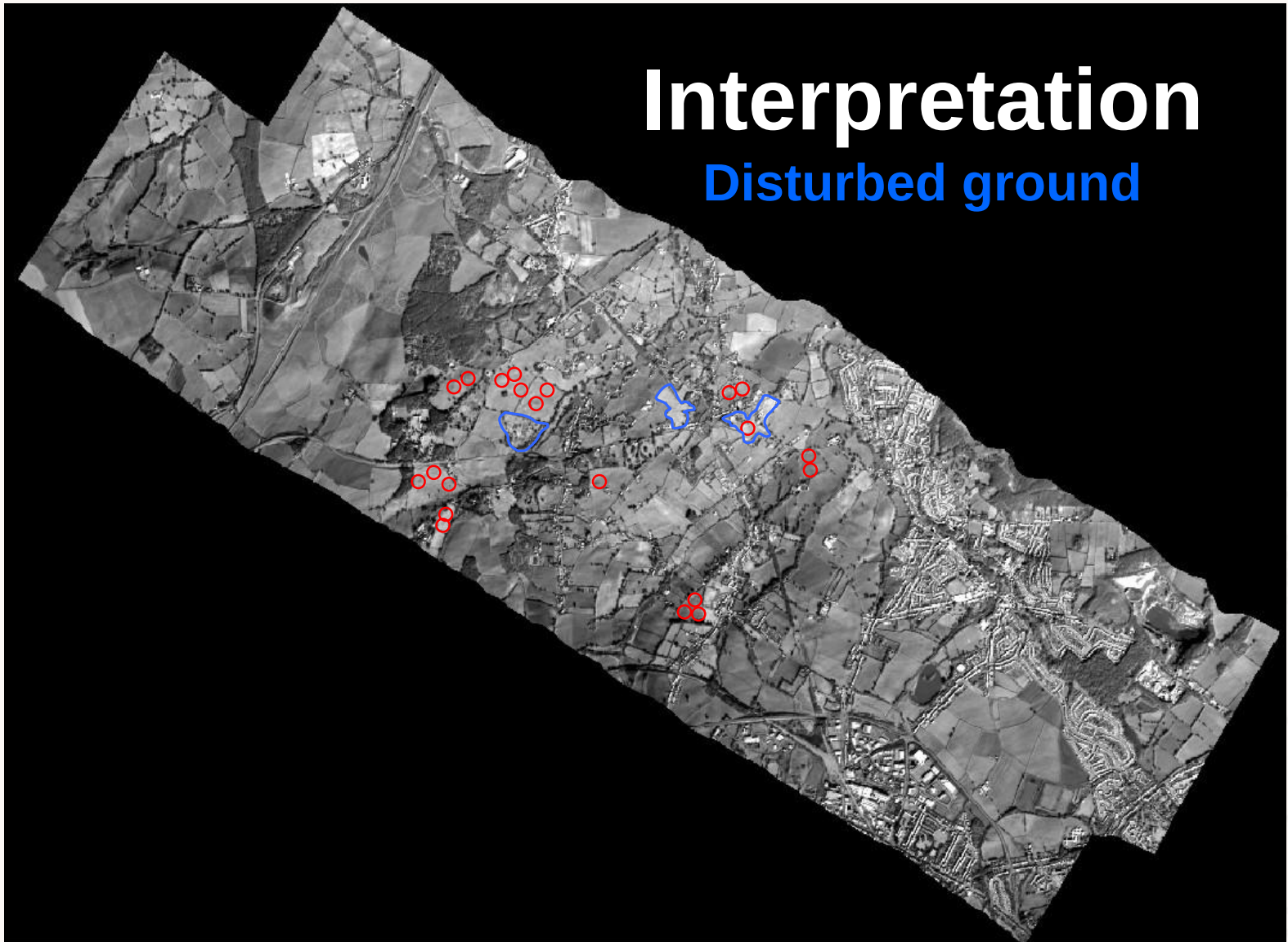
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Interpretation

Disturbed ground





Mine Waste Interpretation

- Irregular “mottled” patterns are also observed where tipping of mine waste had occurred
- These mottled features were also thought to occur where bell pit features have been subdued following farming activities, ploughing etc.
- Field investigations have verified the presence of bell pits and mine waste associated with these thermal anomalies



Thermal Expression



- Some areas do not display circular patterns but mine waste can still be recognised as a mottled pattern



Results

- Large circular depressions associated with the bell pits





Results



**Sloping bricks
indicate slight
subsidence**

- Mining related subsidence is a common problem in the region
- Settlement of bell pits may cause very localised subsidence
- This out building has been affected by subsidence



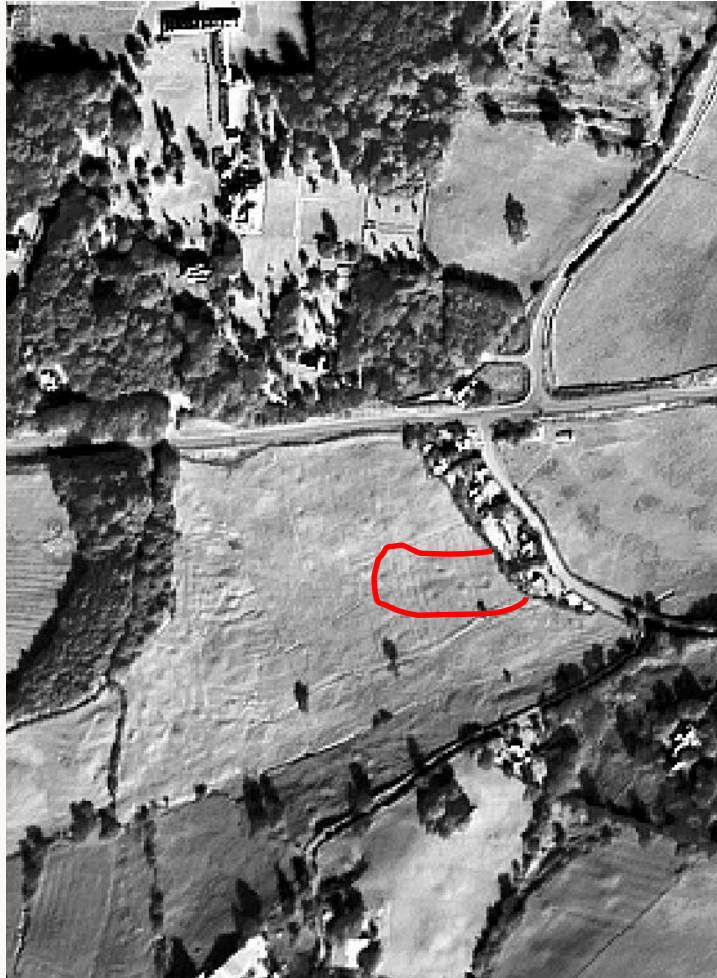
Results



- Larger bell pits have been mapped already during field campaign
- Circular pattern created as spoil was emptied around the mouth of the pit
- Smaller pits are not as easily mapped on the ground



Following Coal Seams





Following Coal Seams



- Coal seams can be mapped at depth by following bell pits
- Coal seams outcrop in the valley bottom
- Coal fragments found at the surface of the bell pit



Disturbed Ground



- Hummocky ground
- Seen as distinctive pattern in imagery
- Thermal anomaly exists
- Mine waste gives rise to darker soils than natural background
- Can also be seen in ploughed fields where surface expression has been destroyed



Disturbed Ground



- Individual pits are not routinely mapped in the field
- Lines are drawn around areas of made ground
- These are then included on the 1:10 000 scale BGS geological maps
- If developers need the exact location of shafts and pits this technique would be invaluable



Summary

- Certain areas have been picked up within the thermal imagery where no mine related activity has been mapped previously
- The surface expression of some bell pits has been subdued over the years due to farming activities etc but this can still be seen using thermal data
- Thermal data can be used for the accurate mapping of bell pits and other mine related features in the region



Acknowledgements



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BGS Team –

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