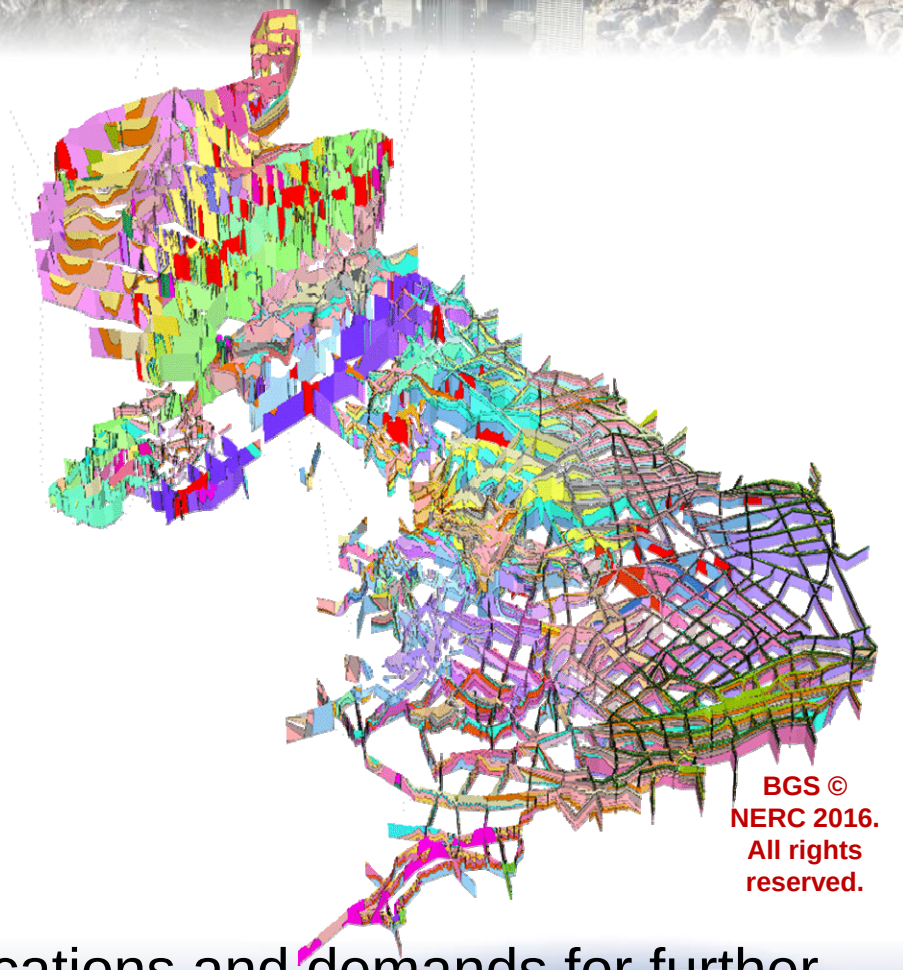
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Gateway to the Earth

The UK's 'National Geological Model'



Recent developments, current applications and demands for further enhancement

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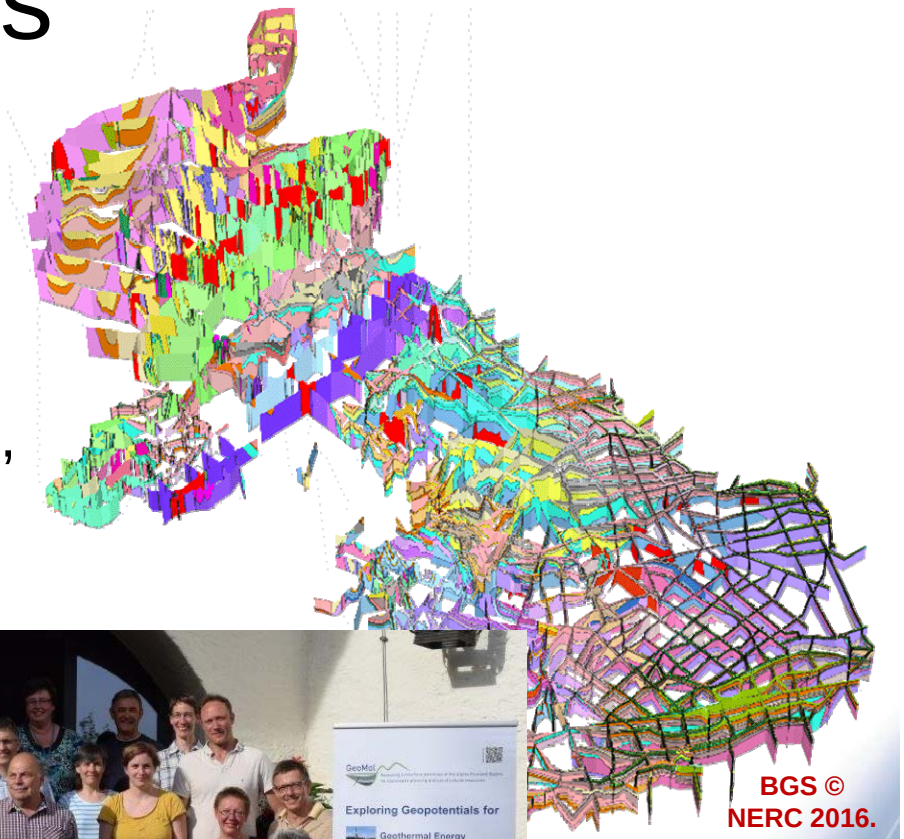
Acknowledgments

Holger Kessler, Jonathan Lee, Graham Leslie, Sian Loveless, Alison Monaghan, Tony Myers, Steve Thorpe, Ricky Terrington, Colin Waters, Ben Wood, Mark Woods

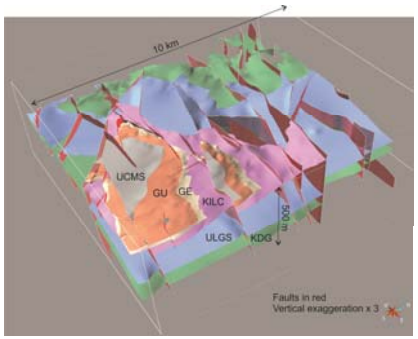
Steve Mathers

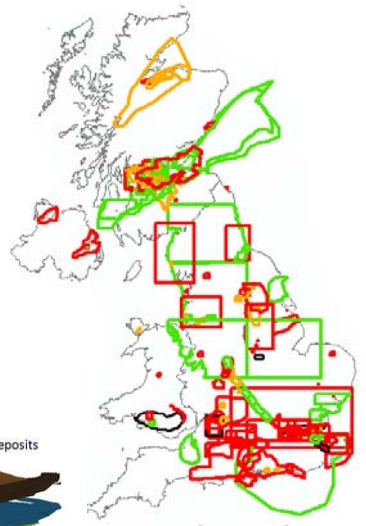


The National Geological Model

http://www.bgs.ac.uk/research/ukgeology/NationalGeologicalModel/home.html

- 3D modelling - major part of BGS portfolio:
  - range of scales, local-regional
  - variety of applications
  - diverse funding
  - sizeable 3D resource
- National Geological Model:
  - "promote a consistent approach to individual models" (recognising the need for these to be different)
  - "develop national-scale syntheses to meet an overarching strategic need for consistent UK-wide coverage"





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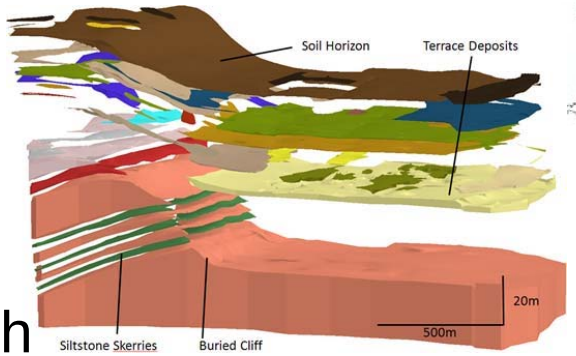

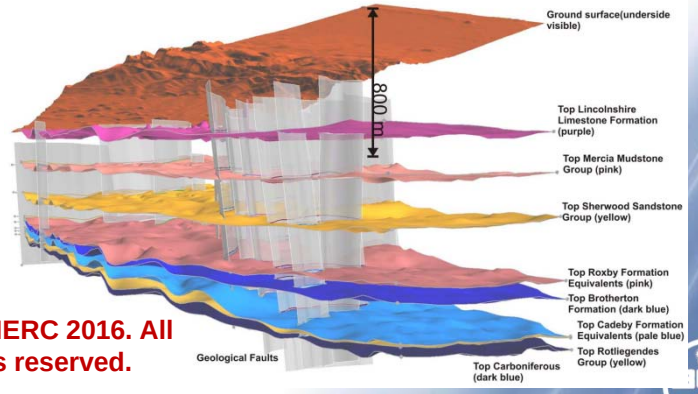

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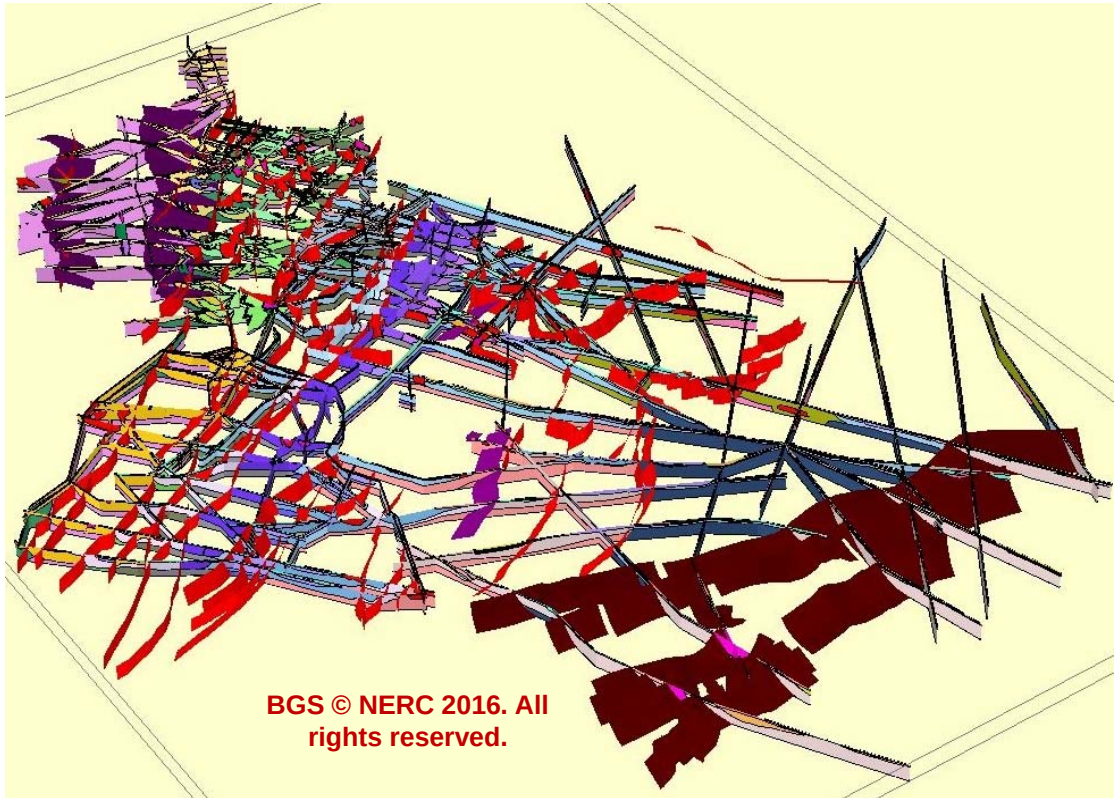
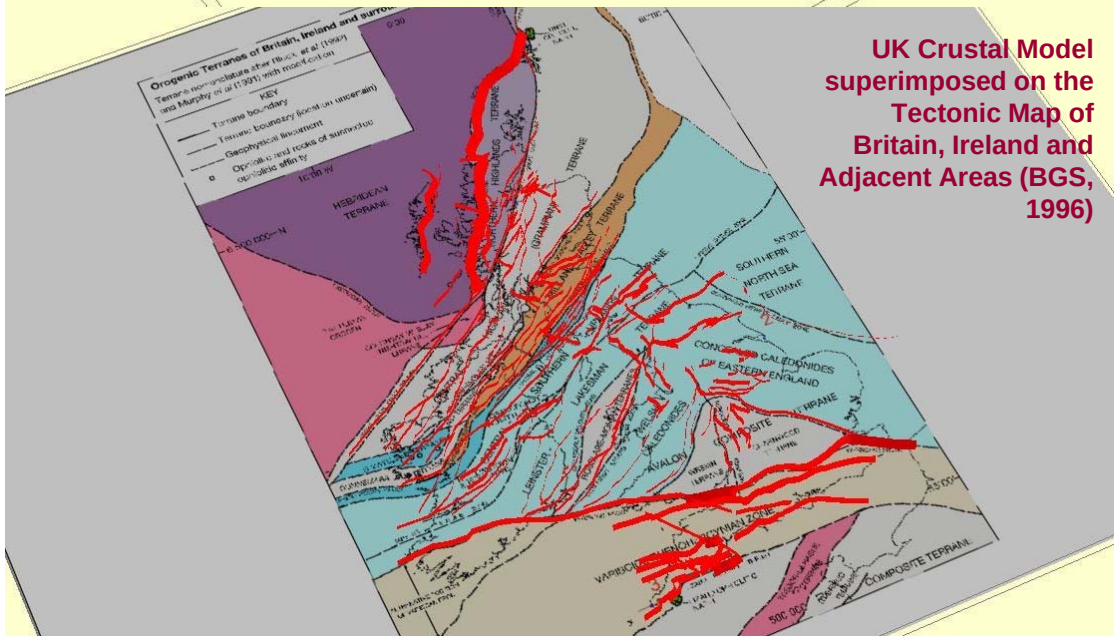
UK Crustal Model

- First crustal-depth (15 km) national-scale fence diagram for the UK and Ireland
- Generalised conceptual understanding of the tectonic framework
- Major faults and Caledonian and Variscan terranes depicted
- “A starting point”
- Intended to visualise the broad-scale architecture, for training and to promote scientific debate by the geoscience community

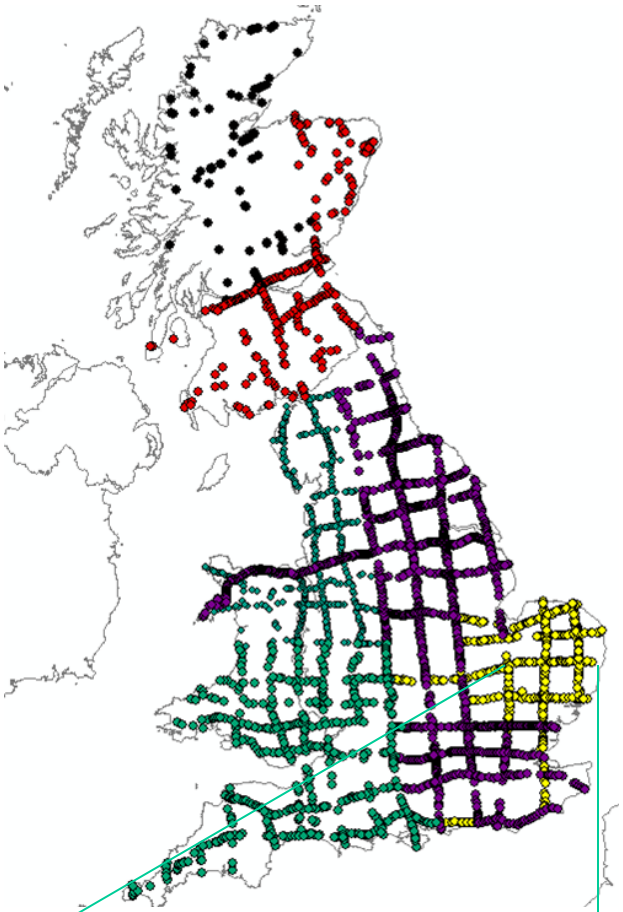


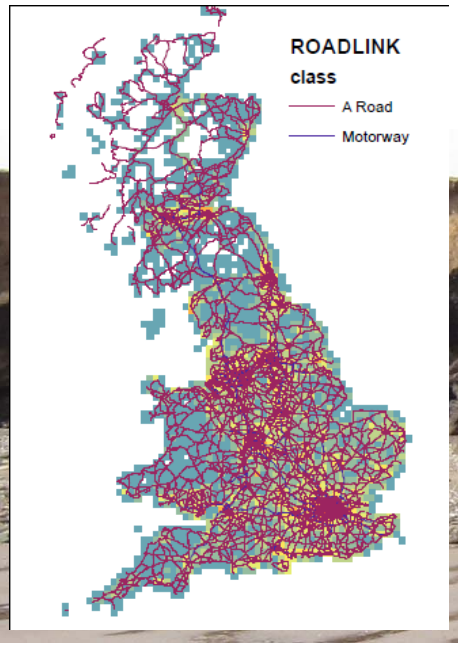


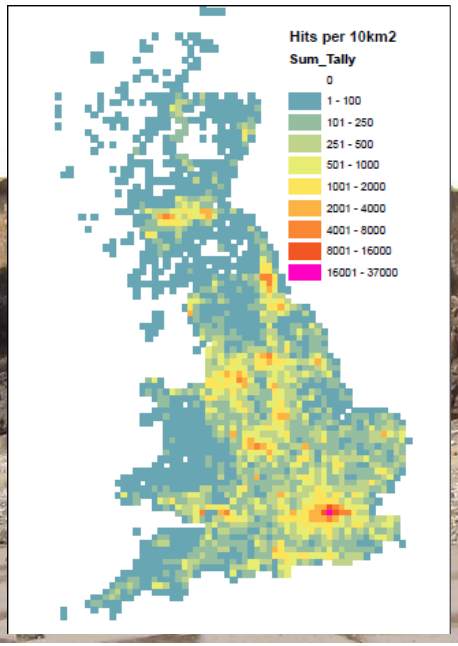
UK Crustal Model superimposed on the Tectonic Map of Britain, Ireland and Adjacent Areas (BGS, 1996)

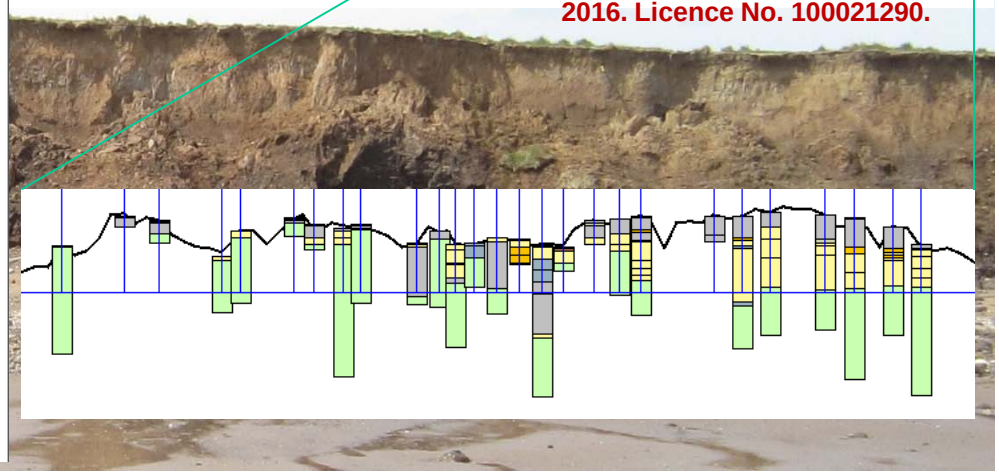
UK Quaternary Model

- Broad framework linking the major Quaternary basins and existing models
- Reference framework for new-start models
- 3D equivalent to 1:625 000 scale Quaternary map
- Constrained by 6000 boreholes, growing!



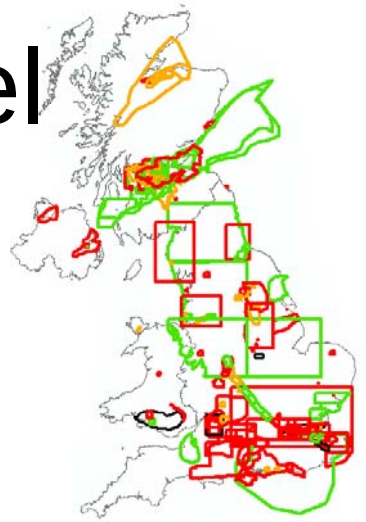


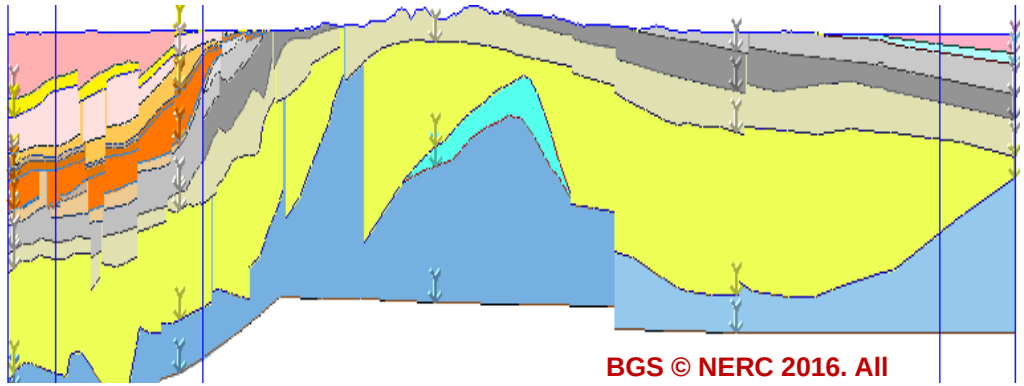




UK3D - National Bedrock Model

- An impartial reference-frame for the UK subsurface
- Successor to 1:625,000 scale map (lithostratigraphical Gp's)
- Synthesises a wealth of data and interpretation
- Captures geologists' knowledge in a consistent framework
- Peer-reviewed, open dataset

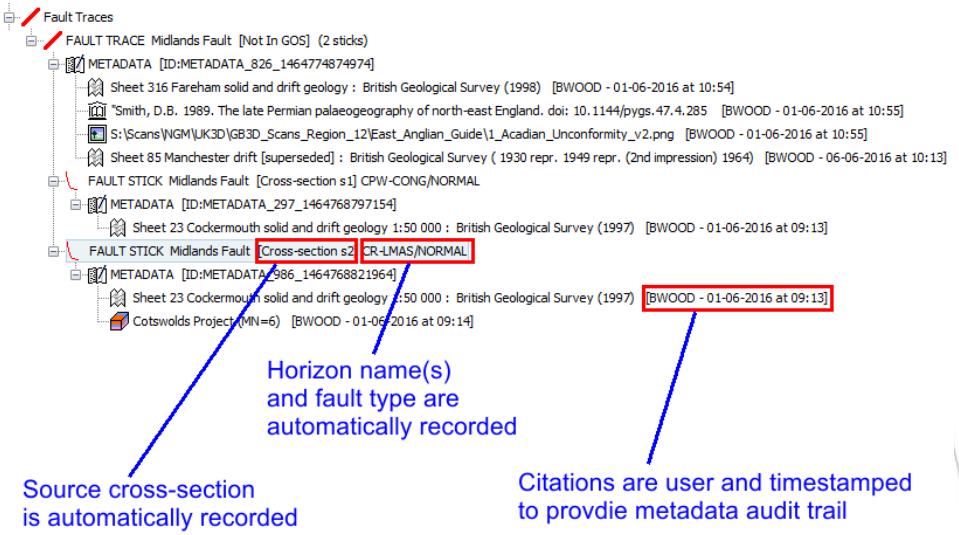




Waters, C.N., Terrington, R., Cooper, M.R., Raine, R.B. and Thorpe, S. 2015. The construction of a bedrock geology model for the UK: UK3D_v2015. British Geological Survey Report, OR/15/069 22pp.

UK3D - National Bedrock Model

- **2009-10** Initial sections for England & Wales
- **2010-12** Infill sections, coast and Scotland
- **2012** Deepening in sedimentary basins (GB3D)
- **2014** Infill, off-shore extension and key boreholes
- **2015** Northern Ireland extension
- **2016** software migration and structural enhancement



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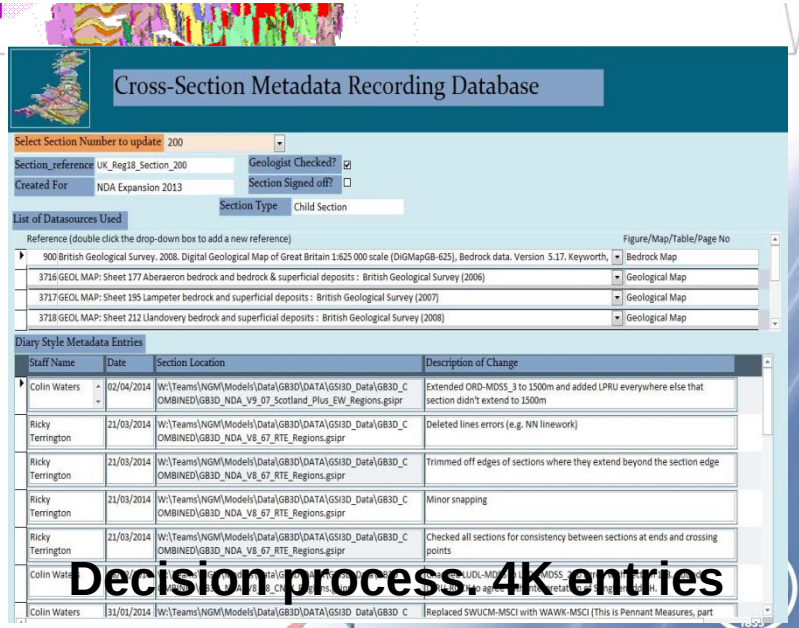
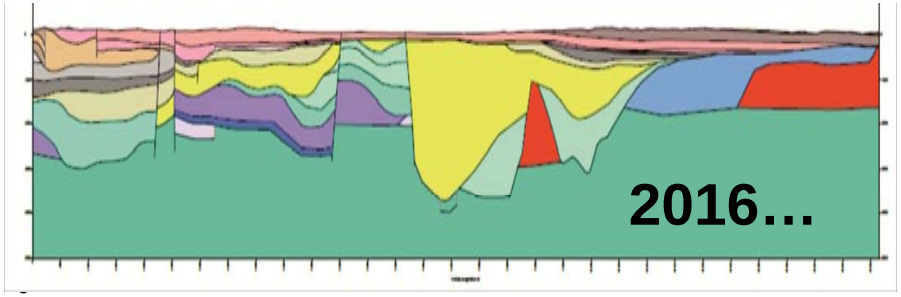
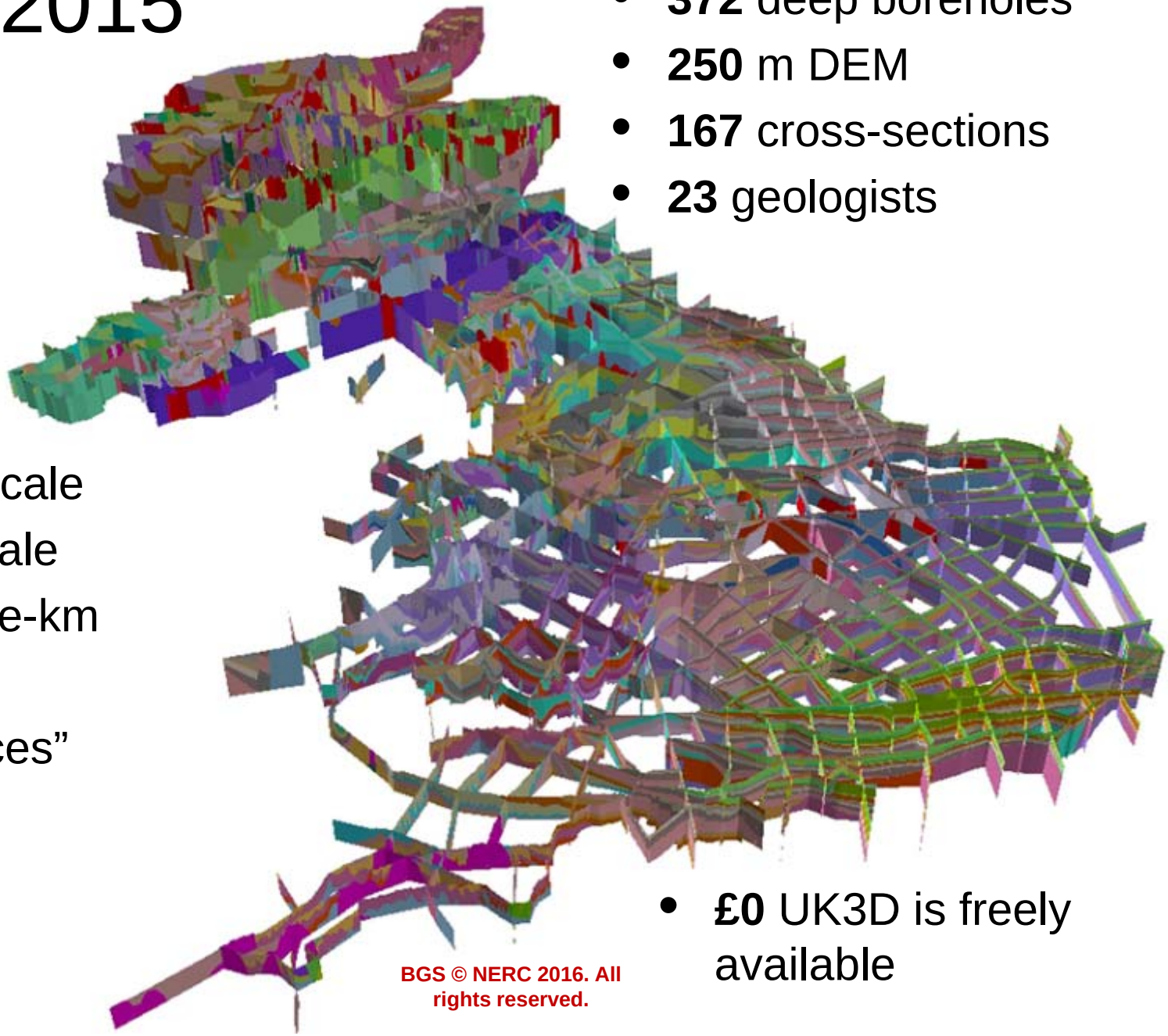


Decision process: 4K entries



UK3D v2015

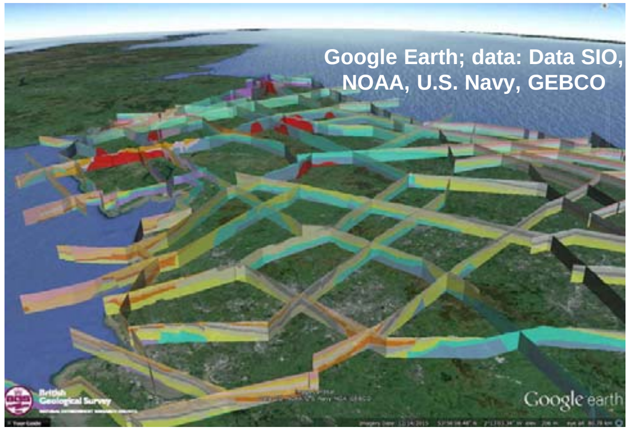
- **372** deep boreholes
- **250** m DEM
- **167** cross-sections
- **23** geologists

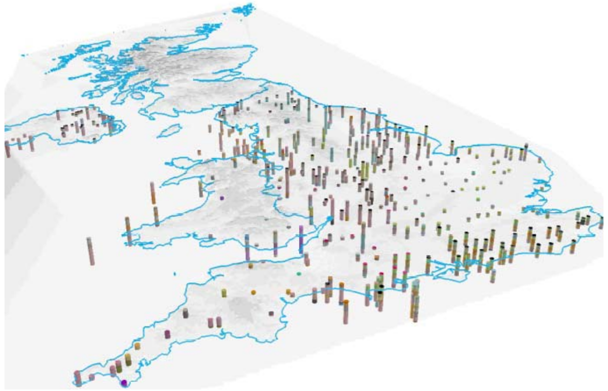


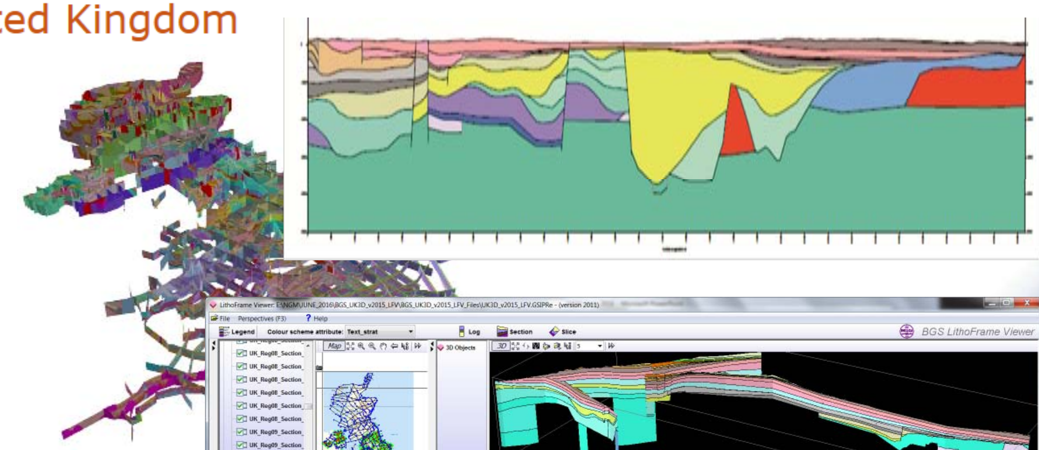
- **625 000** scale
- **50 000** scale
- **20,000** line-km
- **6000** m
- **5427** “traces”
- **445** units

- **£0** UK3D is freely available

UK3D Access and Delivery







UK3D — 3D geological model for the United Kingdom

Downloads

The model is available for free download in a number of formats, including 3D PDF, 3D Shapefiles, KMZ (for Google Earth), in the bespoke BGS Viewer and as files for use in specialist geological modelling packages.

Terms of use

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- UK3D Boreholes 2015 (3D Shapefile with layer file) 880 kb, zip
- UK3D Cross sections 2015 (3D Shapefile with layer file) 6.9 MB, zip
- UK3D England North 3D pdf 19.9 MB, zip. Double Sided rendering must be enabled for visualisation – please see ReadMe.txt file with 3D PDF download.
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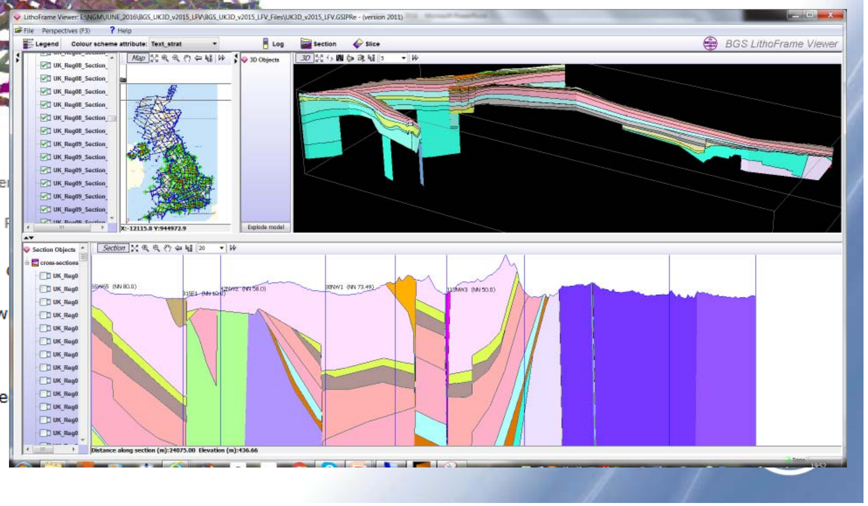
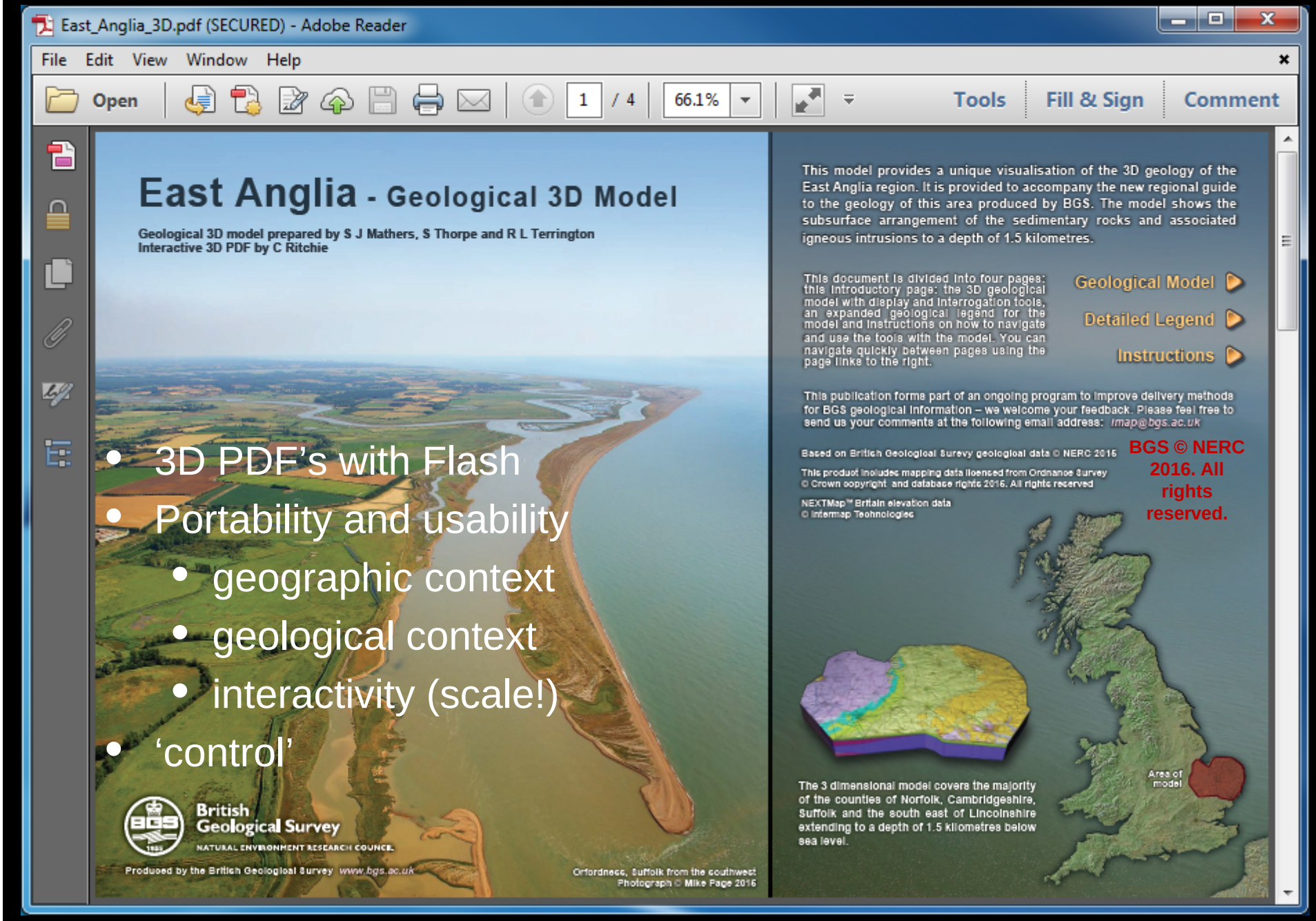
- UK3D Wales 3D pdf 9.94 MB, zip. Double Sided rendering must be enabled for visualisation – please see ReadMe.txt file with 3D
- UK3D individual sections (KMZ format) 9.84 MB — best viewed using Google Earth 7
- UK3D GOCAD Plines (polylines) 2.57 MB (extracted from UK3D cross sections for the base of stratigraphical units Silurian))
- UK3D Petrel correlation lines 1.7 MB (extracted from UK3D cross sections for the base of stratigraphical units dow Silurian))

UK3D national bedrock fe



http://www.bgs.ac.uk/research/ukgeology/NationalGeologicalModel/GB3D.html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East Anglia - Geological 3D Model
Geological 3D model prepared by S J Mathers, S Thorpe and R L Terrington
Interactive 3D PDF by C Ritchie
This model provides a unique visualisation of the 3D geology of the East Anglia region. It is provided to accompany the new regional guide to the geology of this area produced by BGS. The model shows the subsurface arrangement of the sedimentary rocks and associated igneous intrusions to a depth of 1.5 kilometres.
This document is divided into four pages: this introductory page; the 3D geological model with display and interrogation tools, an expanded geological legend for the model and instructions on how to navigate and use the tools with the model. You can navigate quickly between pages using the page links to the right.
Geological Model
Detailed Legend
Instructions
This publication forms part of an ongoing program to improve delivery methods for BGS geological information – we welcome your feedback. Please feel free to send us your comments at the following email address: imap@bgs.ac.uk
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NEXTMap™ Britain elevation data © Intermap Technologies
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Area of model
The 3 dimensional model covers the majority of the counties of Norfolk, Cambridgeshire, Suffolk and the south east of Lincolnshire extending to a depth of 1.5 kilometres below sea level.
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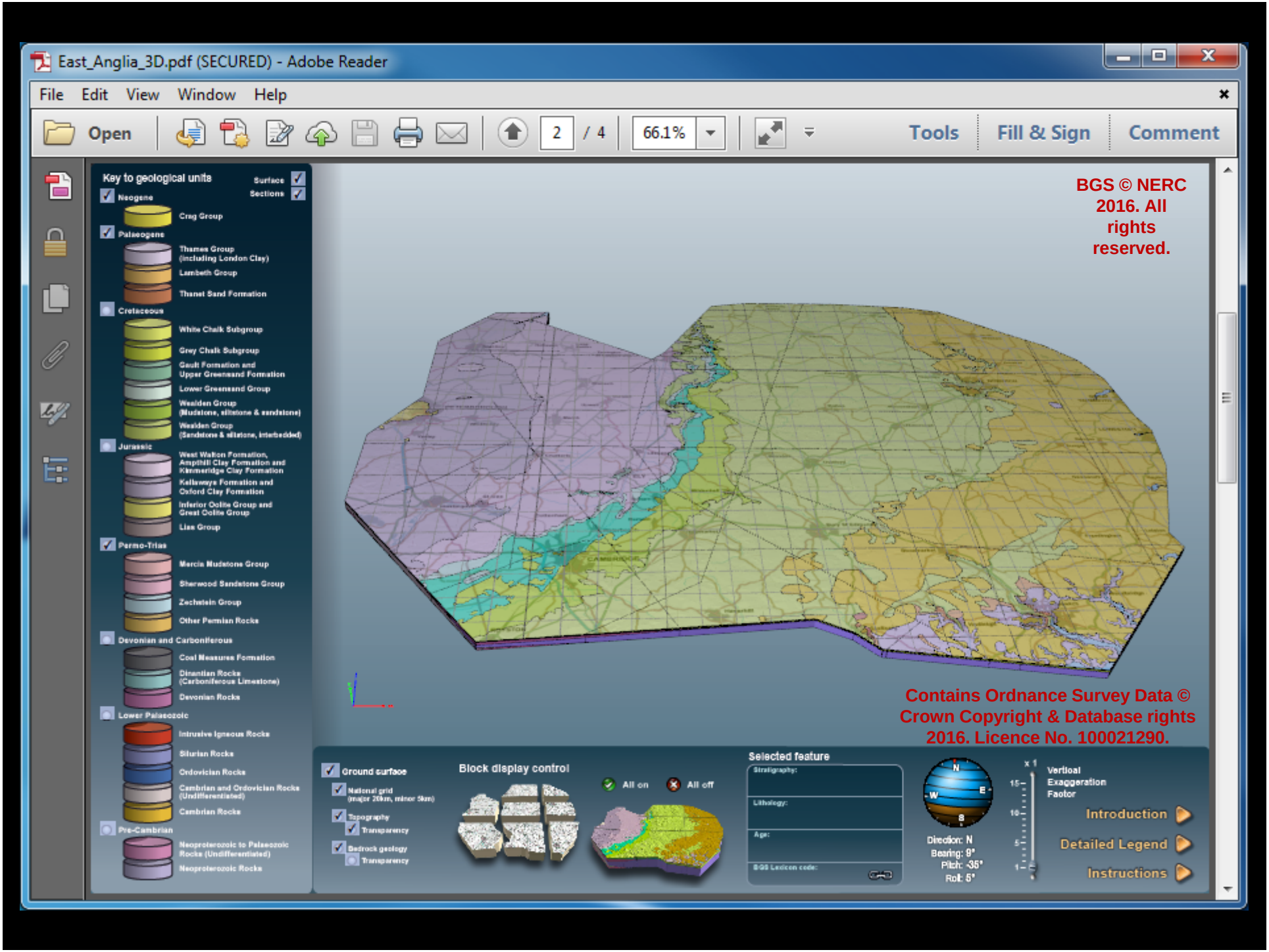
Produced by the British Geological Survey www.bgs.ac.uk
Orfordness, Suffolk from the southwest
Photograph © Mike Page 2016
3D PDF's with Flash
Portability and usability
geographic context
geological context
interactivity (scale!)
'control'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Crag Group
Palaeogene
Thames Group (including London Clay)
Lambeth Group
Thanet Sand Formation
Cretaceous
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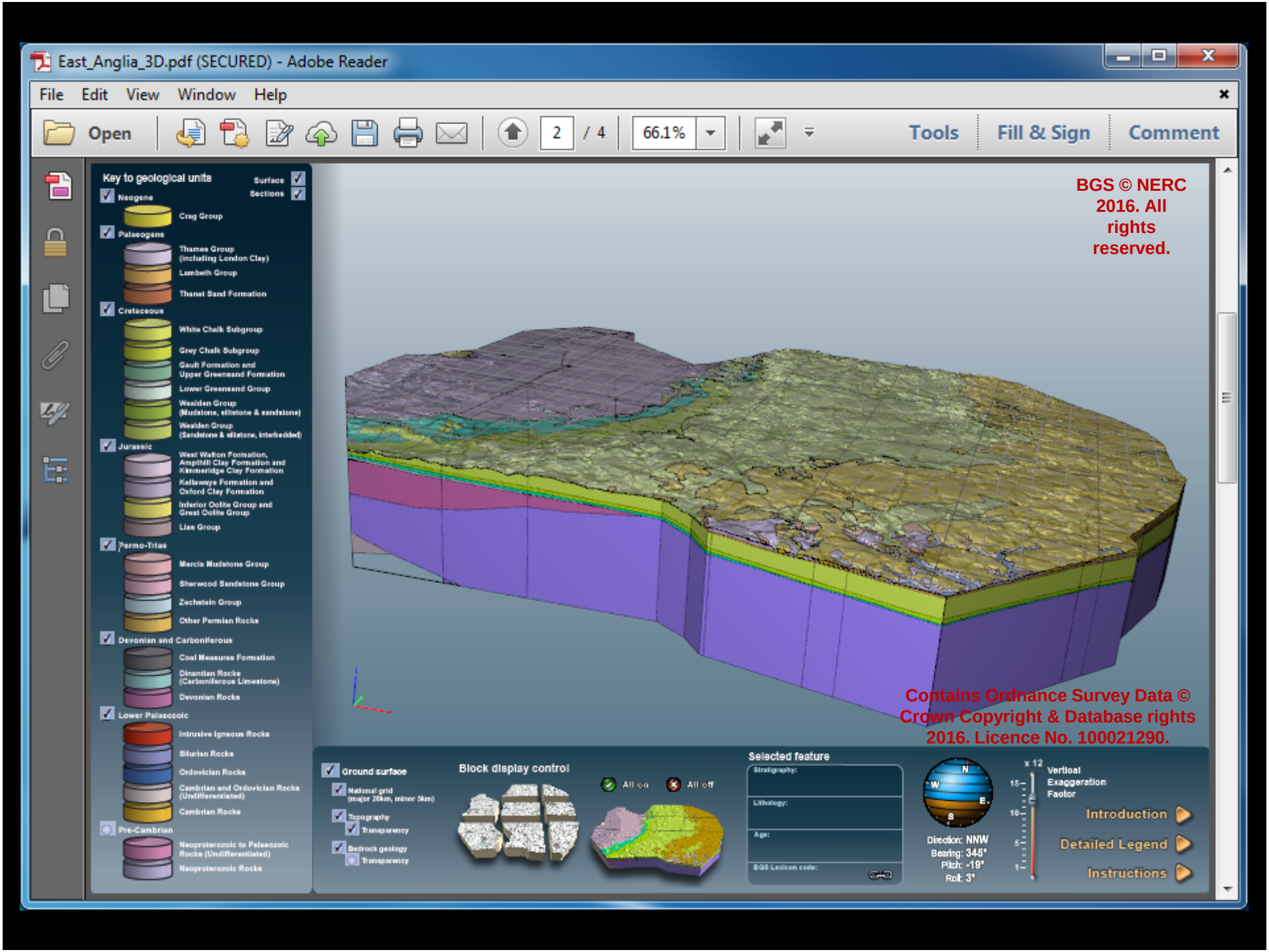
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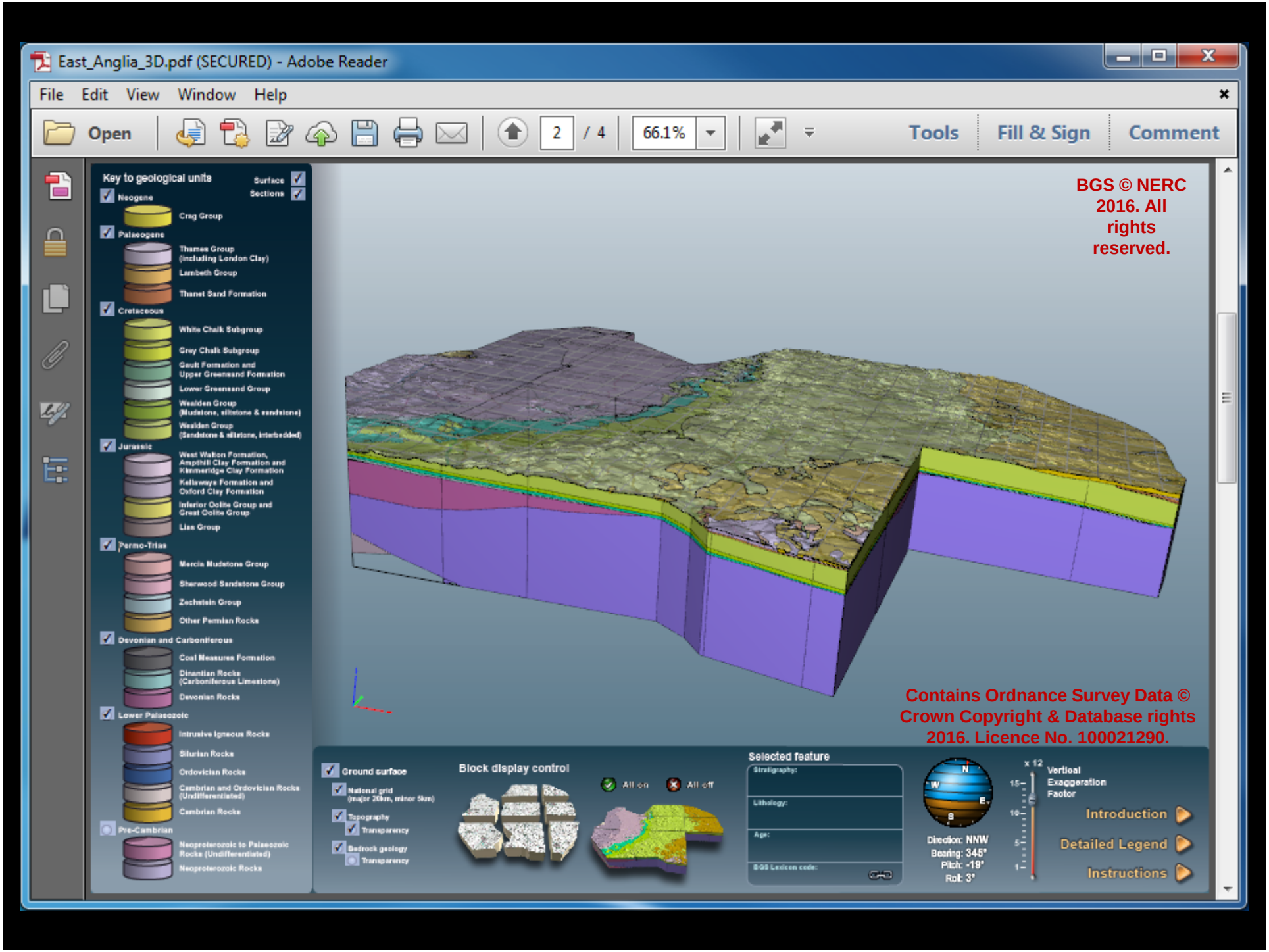
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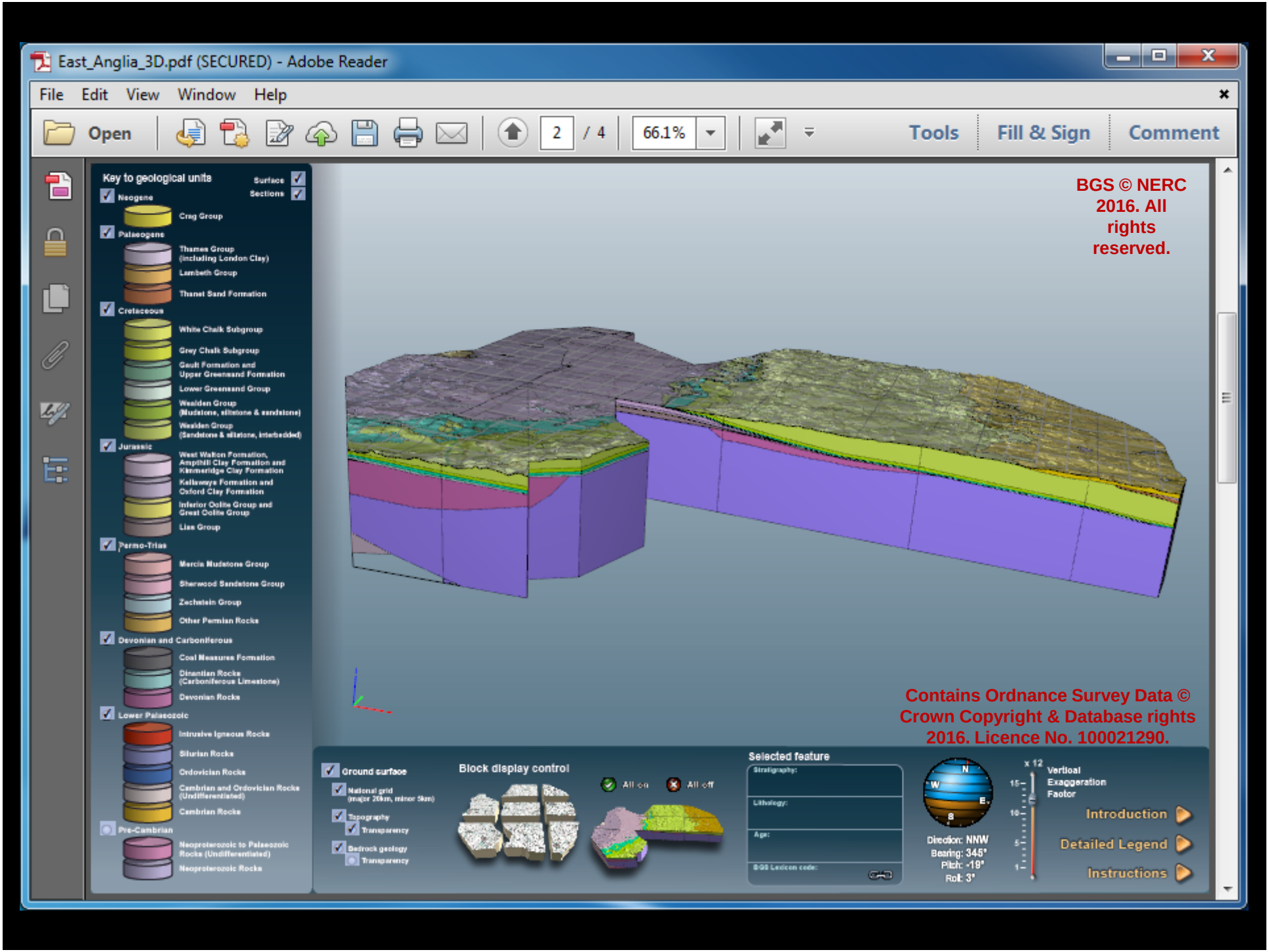
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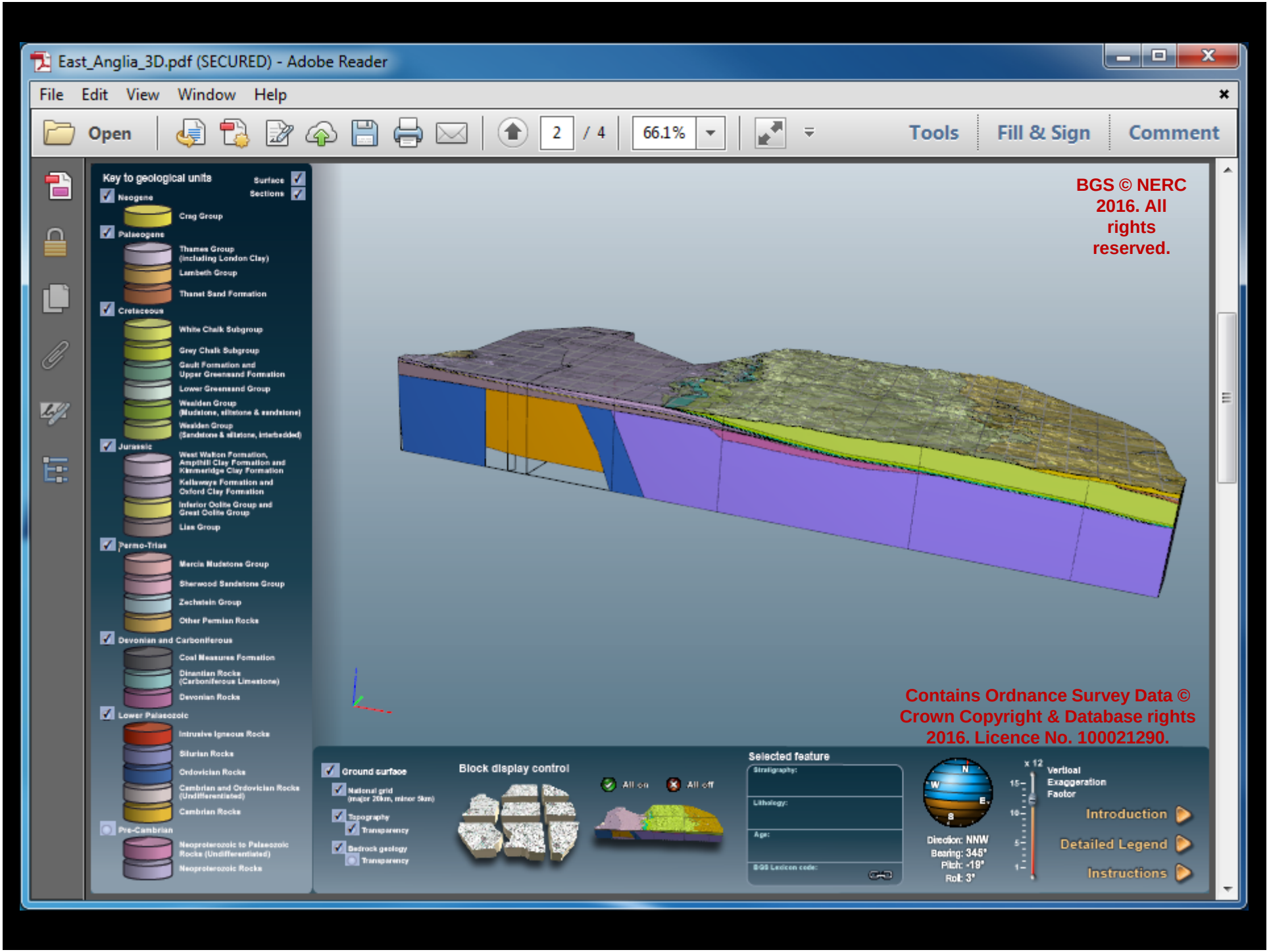
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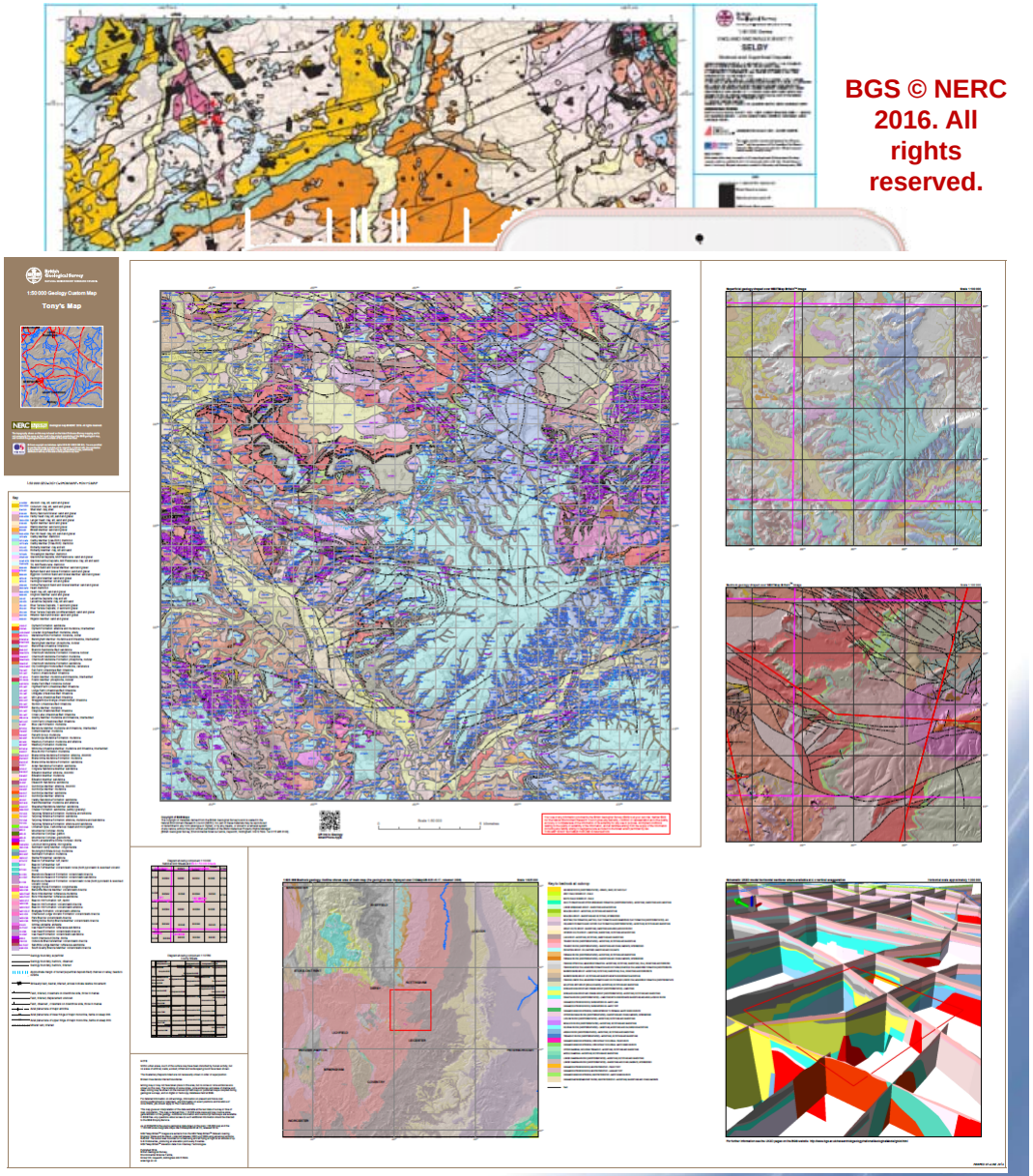
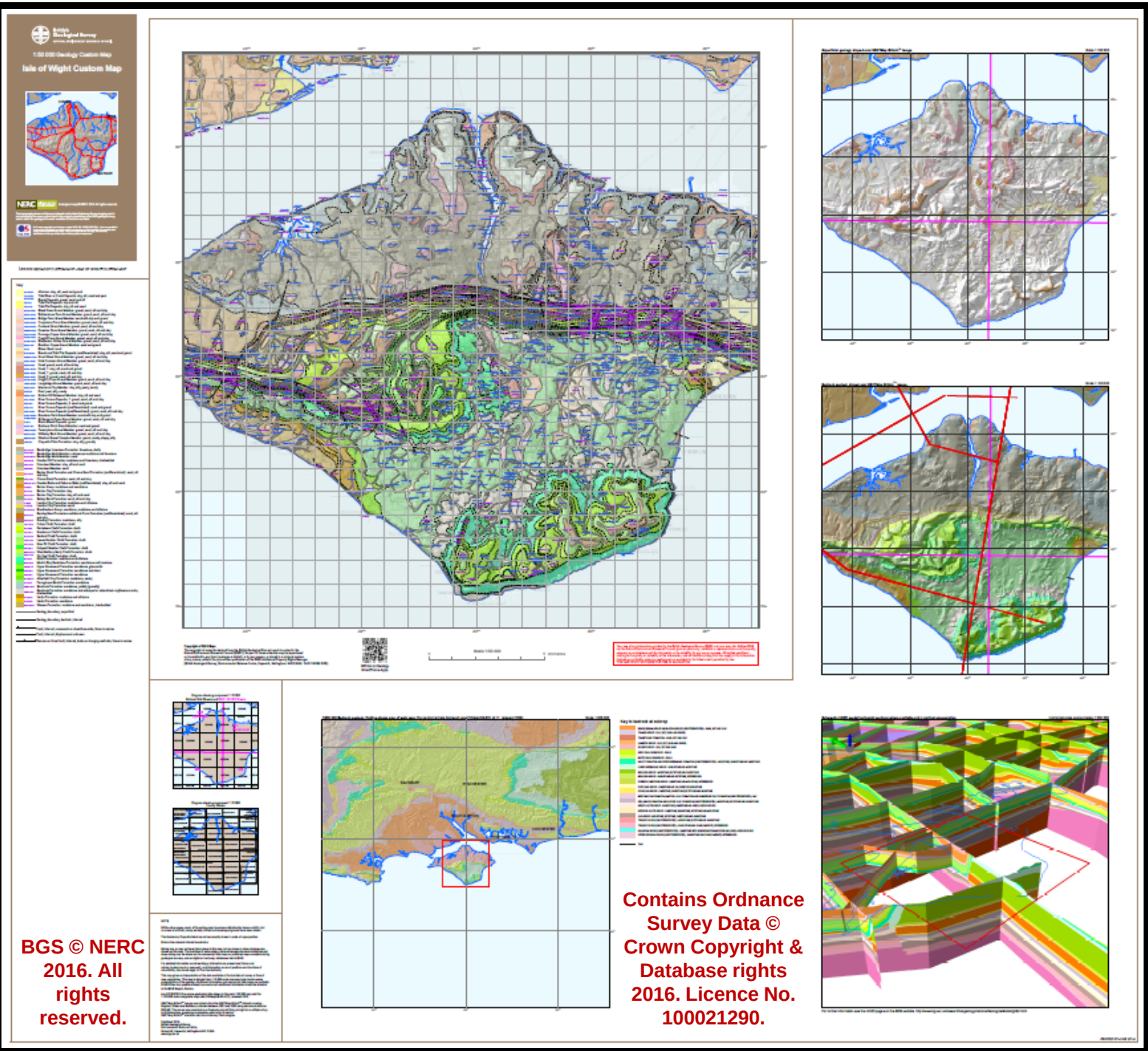
1
Vertical Exaggeration Factor
Introduction
Detailed Legend
Instructions

“Print on demand” maps

- Ongoing demand for 2D data and products
- Map marginalia and cross-section enables 3D understanding
- Digital data greatly increases uptake
- Lacks of marginalia limits 3D comprehension
- ‘POD’ under development
- Offers best of both!
- UK3D provides cross-section information




1:50 000 Geology Custom Map
Isle of Wight Custom Map
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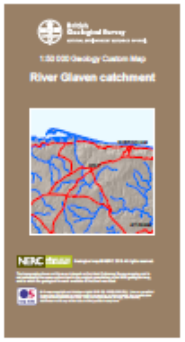
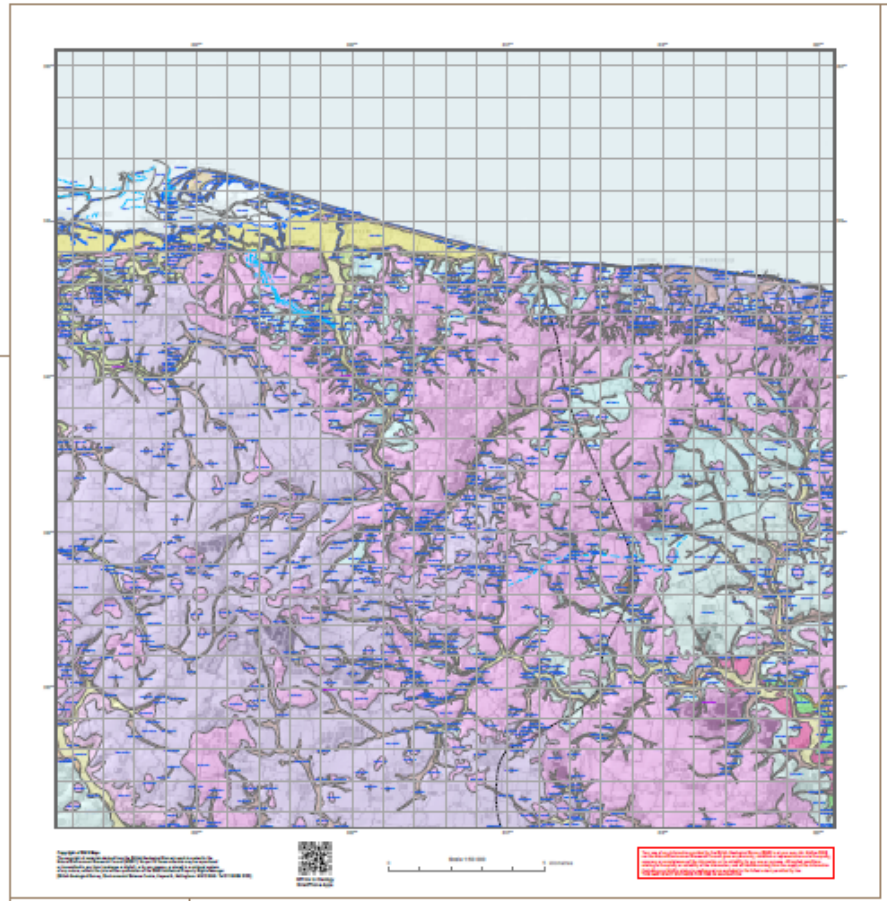
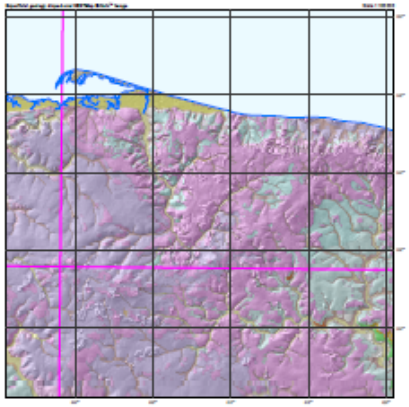
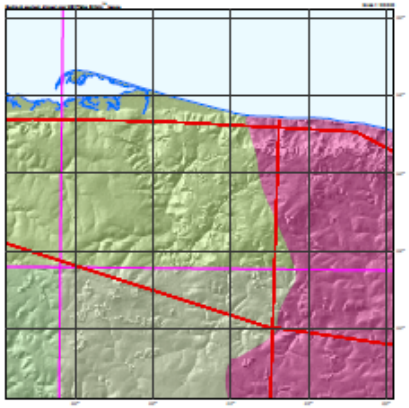
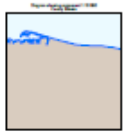
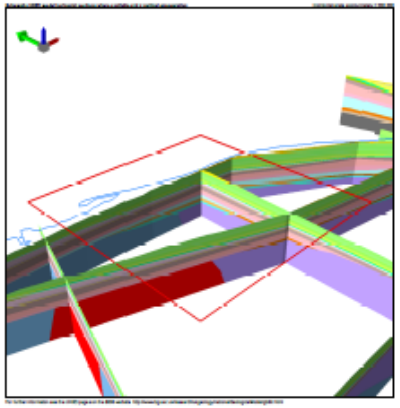


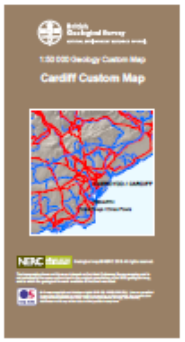


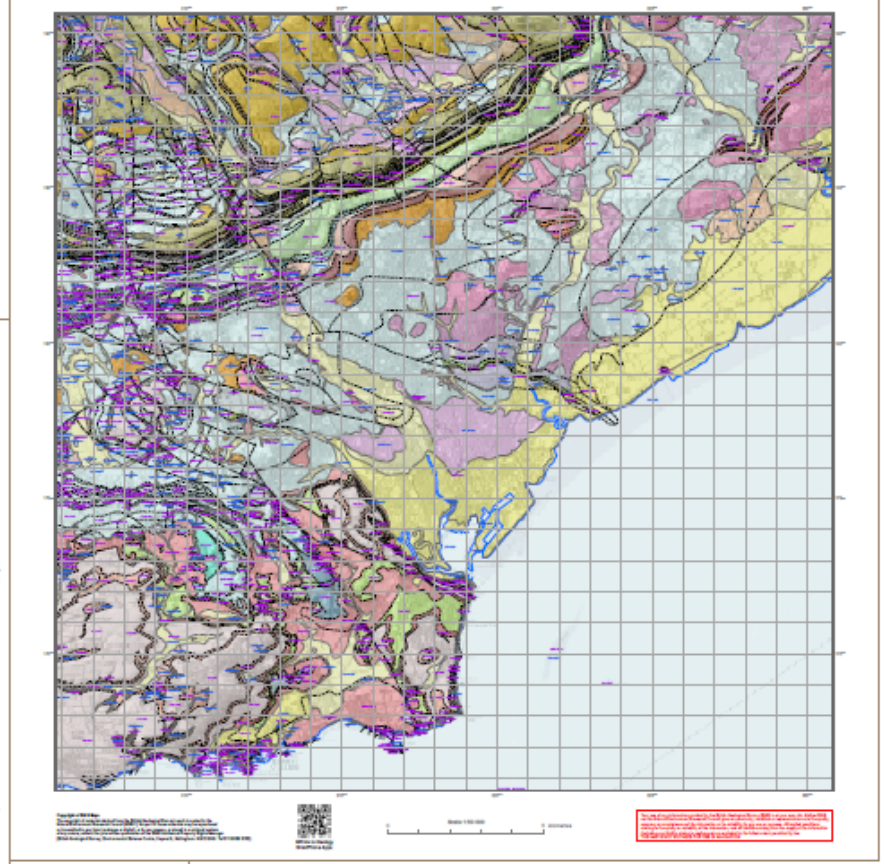


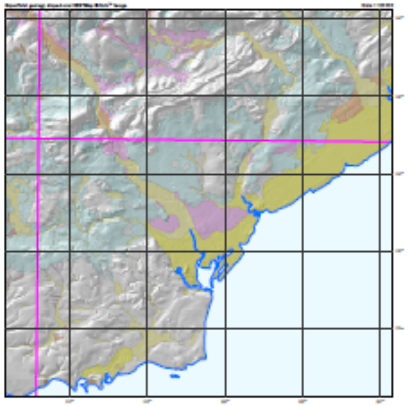


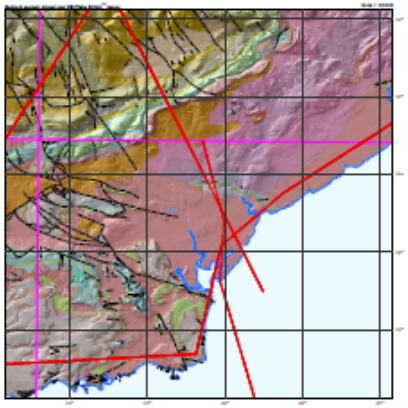


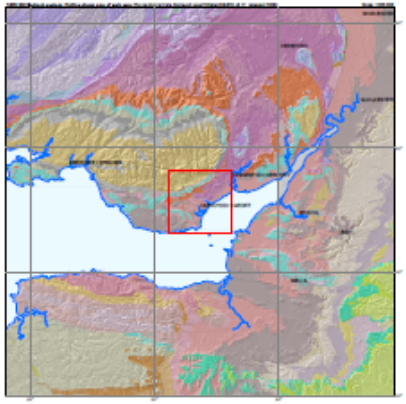


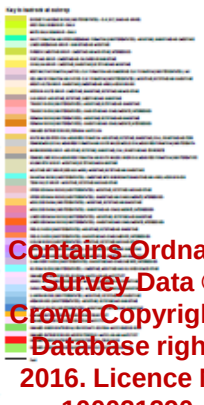


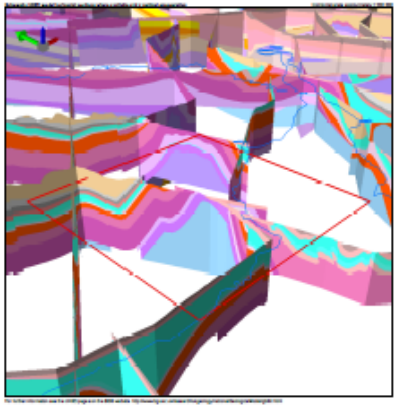










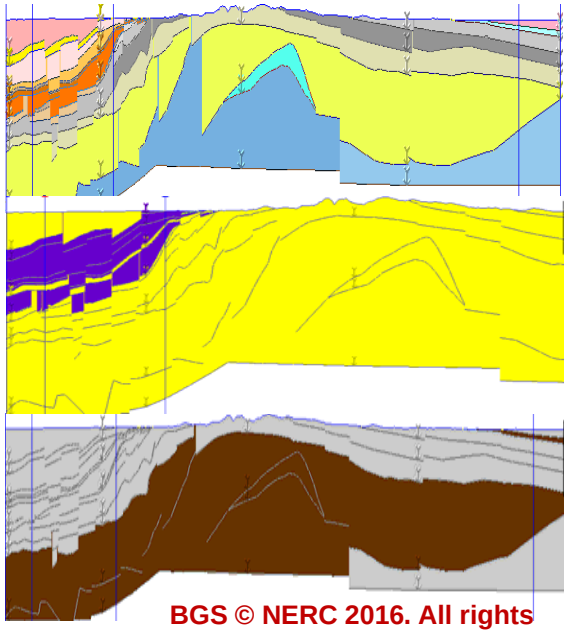


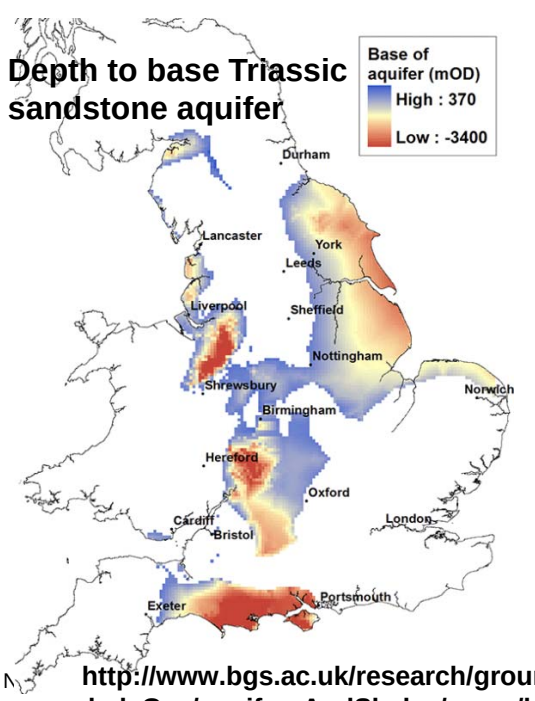
National Geological Screening

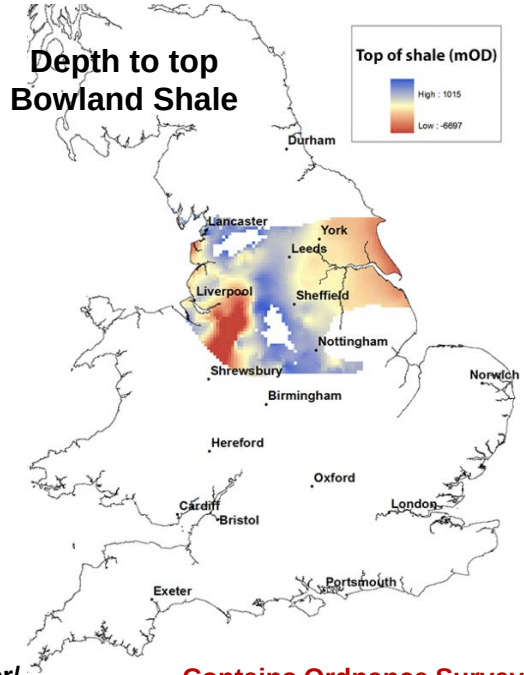
- National screening exercise for geological disposal of radioactive waste (E, W & NI)
- UK Gov't favours a voluntarist approach from communities
- BGS Contributing to the prospectus of information available to inform interested communities
- UK3D used in the process that will identify:
  - rock types of interest
  - major faults
- Ongoing RWM Ltd funded-work

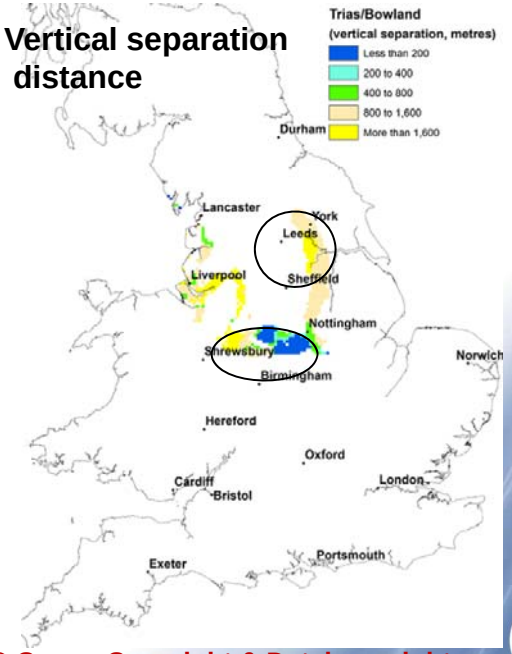
Aquifer/shale separation

- Unconventional hydrocarbons driving significant interest in the subsurface
- **Assumption: risk of contamination (by any pathway) is greater if aquifers and shales closer together**
- Location of Principal Aquifers and continuation at depth and shale units with the potential for exploitation
- National scale (England and Wales), online resource









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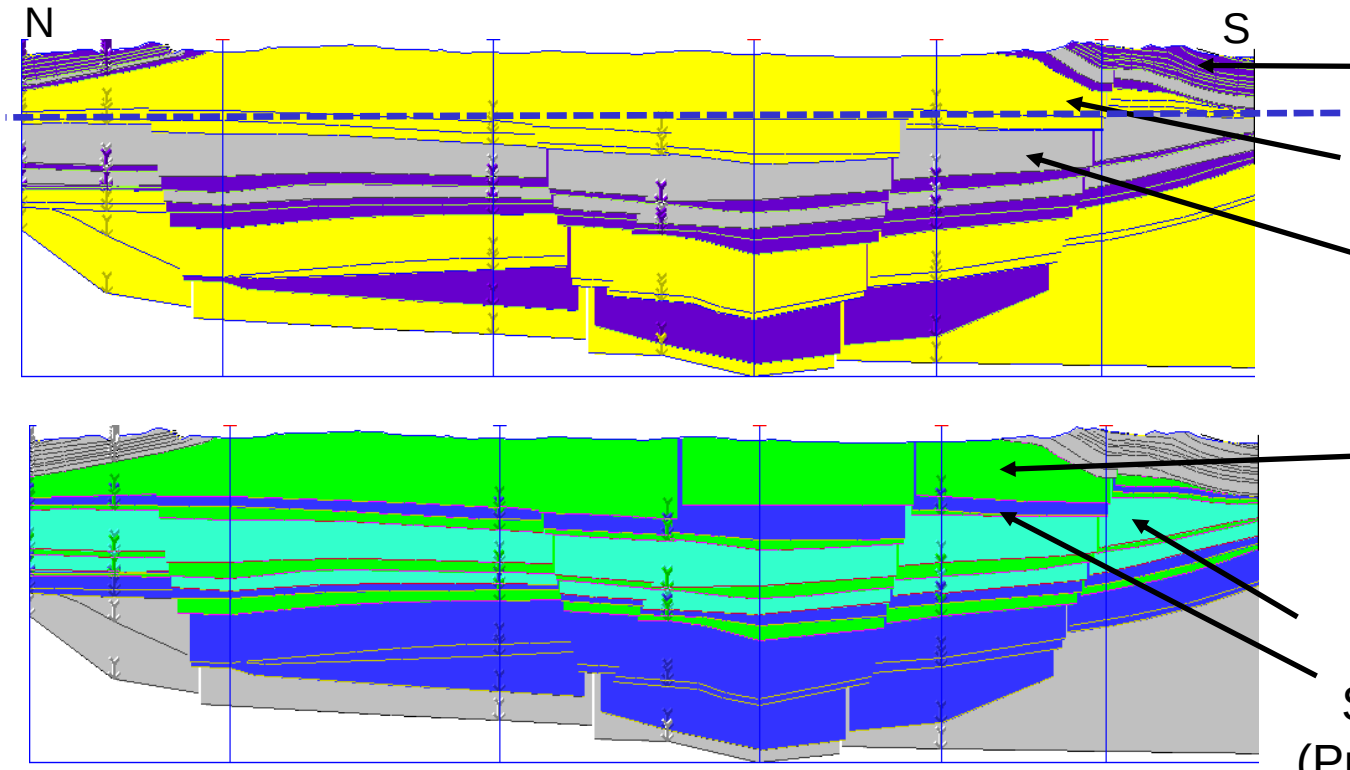
http://www.bgs.ac.uk/research/groundwater/shaleGas/aquifersAndShales/maps/home.htm

3D Groundwater Vulnerability

- Further identification of aquifers and sources
- Geometric understanding of sources/receptor relationships
- Identification of specific possible preferential flow pathways

Loveless S., Bloomfield, J., Ward, R., Davey, I., Hart, A. and Lewis, M. Groundwater vulnerability to onshore hydrocarbon activities in England. Geophysical Research Abstracts. Vol. 18, EGU2016-14540, 2016. EGU General Assembly 2016

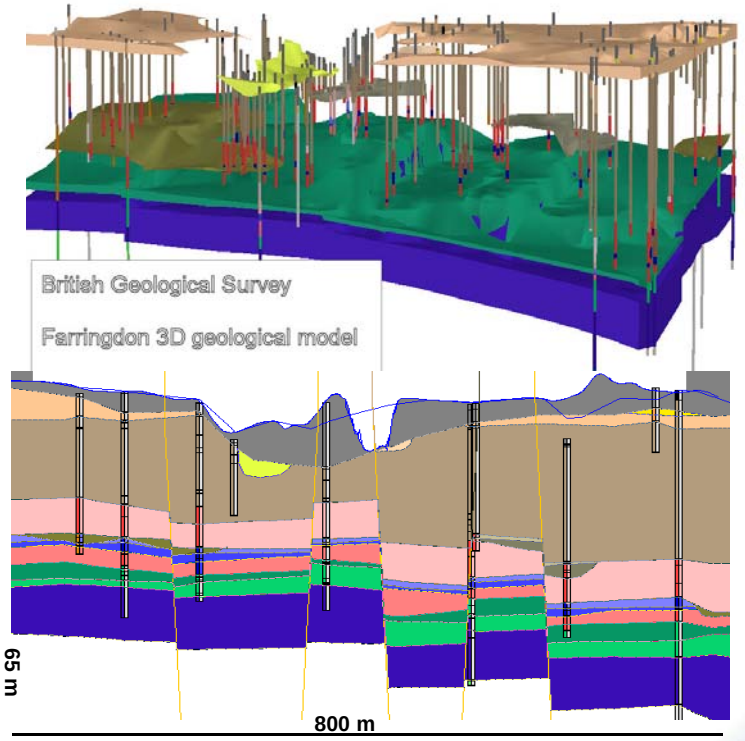


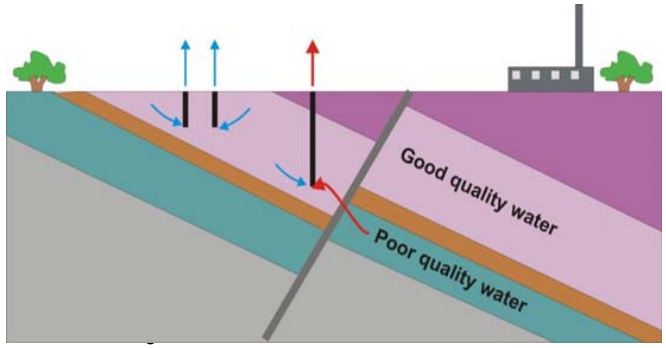
UK 3D Fault Network

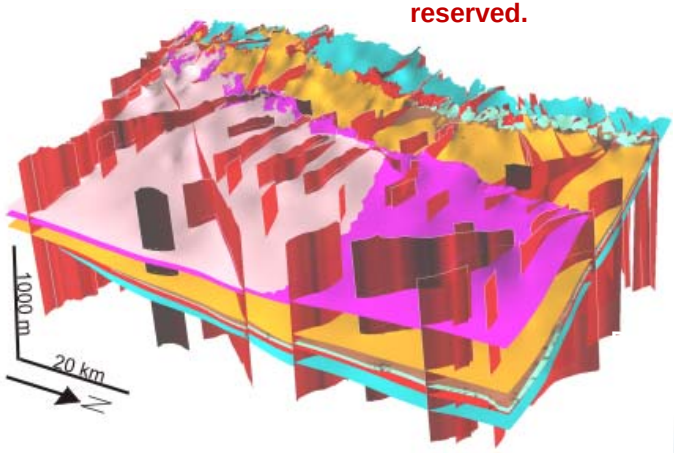
- “Pathways” increasingly significant
- #1 driver for bedrock modelling: fault detection & analysis **across scales**
- Need to go beyond current 2D national datasets:

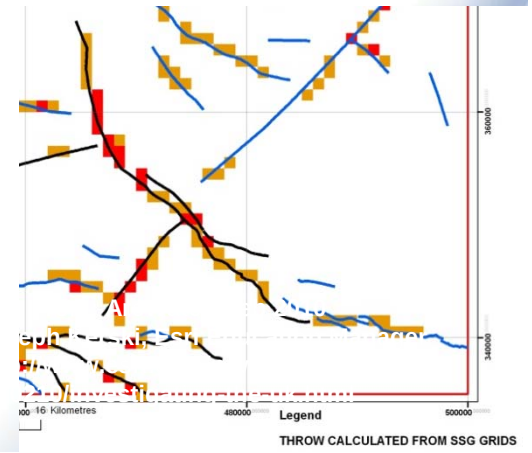
UK3DFN

- 3D geometry & extent
- rock properties
- 4D history
- Confidence



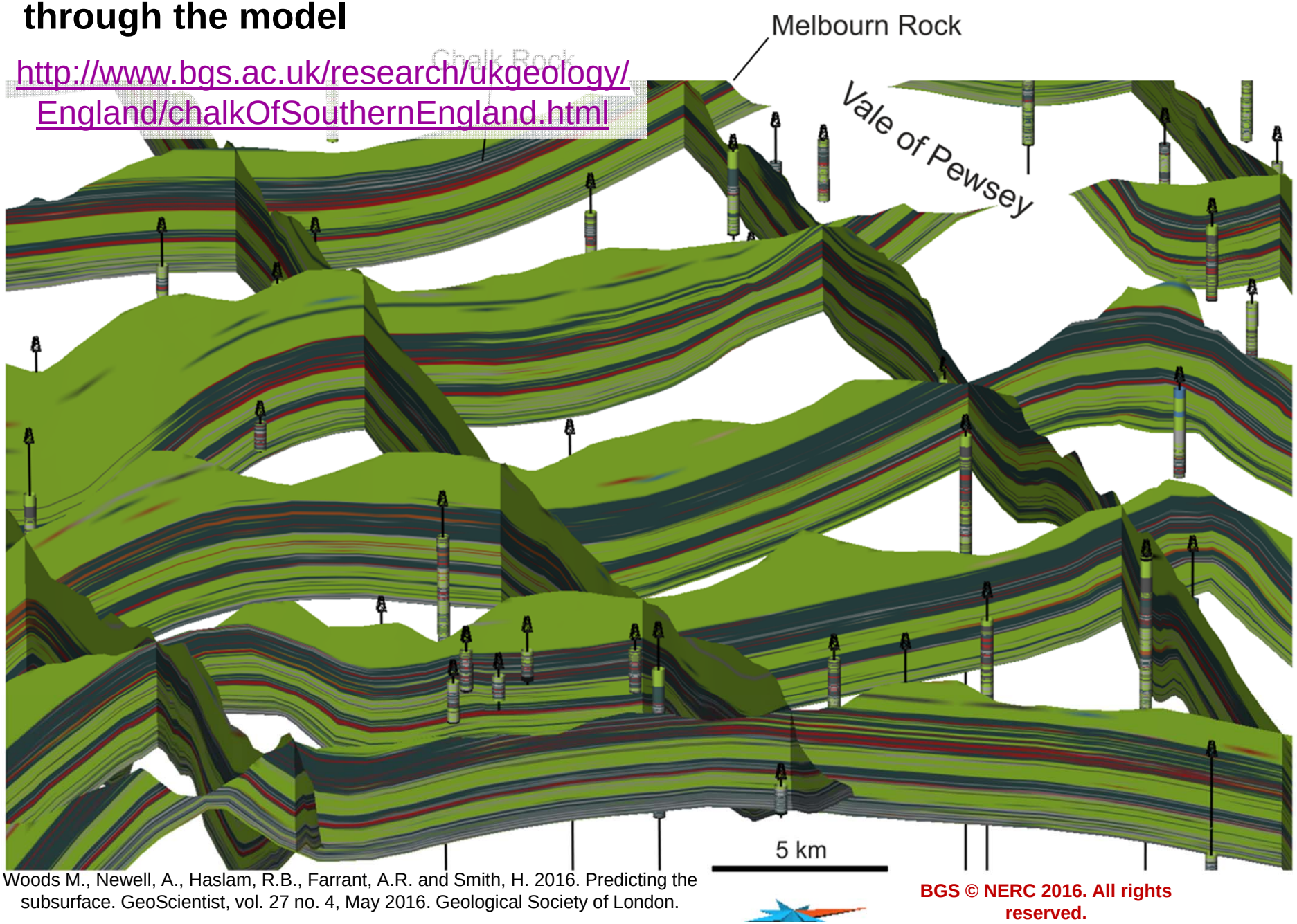






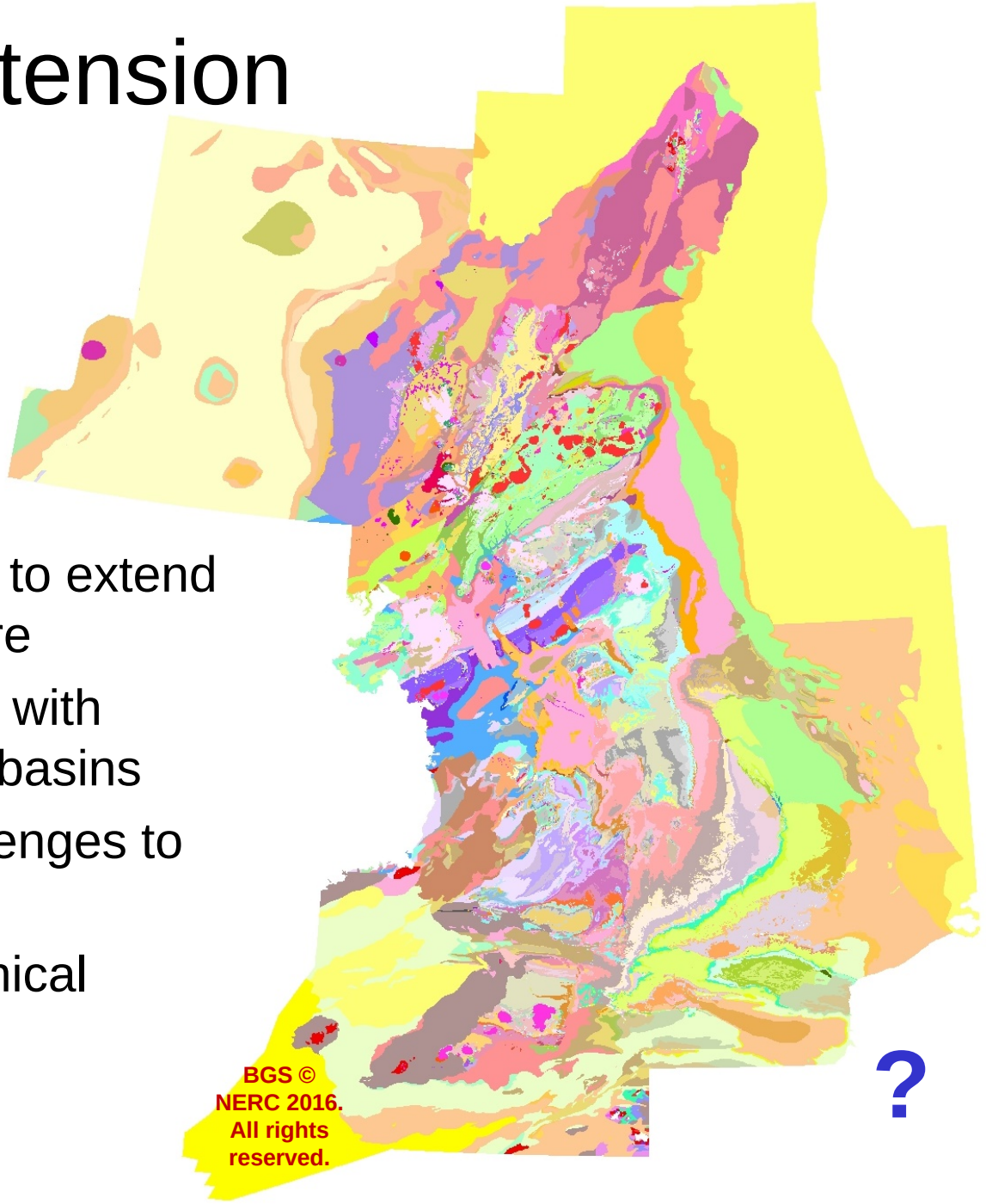
Use geostatistical techniques to extrapolate physical properties through the model

http://www.bgs.ac.uk/research/ukgeology/England/chalkOfSouthernEngland.html



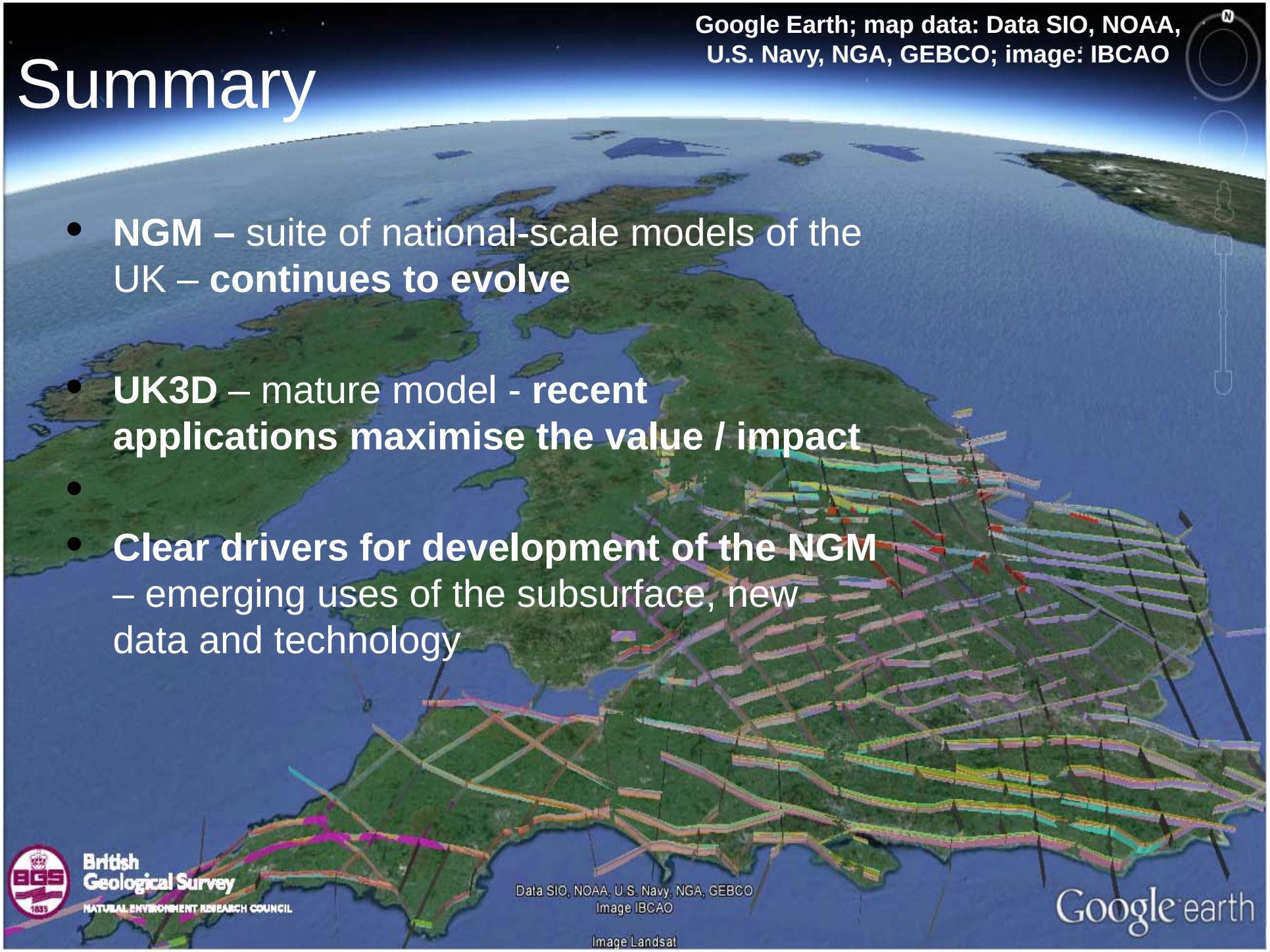
Woods M., Newell, A., Haslam, R.B., Farrant, A.R. and Smith, H. 2016. Predicting the subsurface. GeoScientist, vol. 27 no. 4, May 2016. Geological Society of London.

Offshore extension



- Strategic aim to extend UK3D offshore
- Commencing with hydrocarbon basins
- Various challenges to overcome:
  - stratigraphical
  - technical
  - cultural

Summary



- **NGM –** suite of national-scale models of the UK – **continues to evolve**
- **UK3D** – mature model - **recent applications maximise the value / impact**
- **Clear drivers for development of the NGM** – emerging uses of the subsurface, new data and technology