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# Tools for building and delivering 3D models Perspectives by the BGS

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(on behalf of the 3D community of BGS)

**GGIPAC Workshop**

Geoscience Australia

Canberra

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[www.bgs.ac.uk/3dg](http://www.bgs.ac.uk/3dg)



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# Background

# Building the models

# Application and delivery of models

# A look to the future

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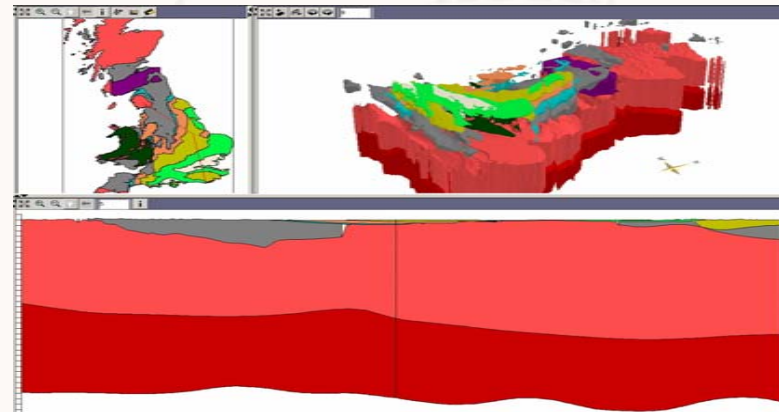
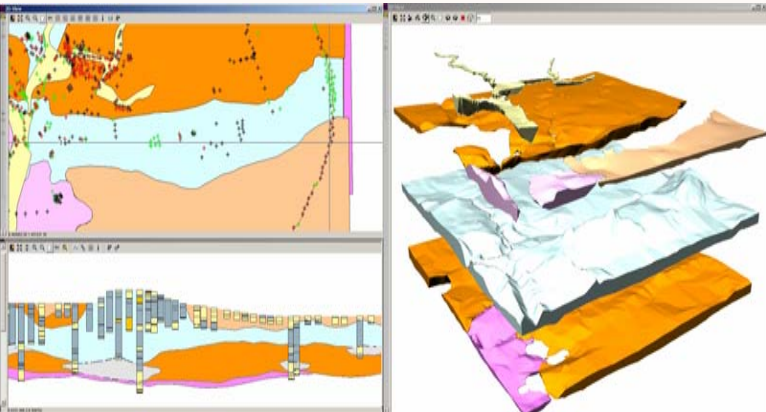


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## 3-D modelling – definition of terms

- “A model is an abstract representation of a system from the modeller's viewpoint” (source wikipedia.org)
- Mathematical models and spatial models are different things
- Geological modelling is as old as the science itself
- The difference now: **we can capture, manage and visualise geology like never before**
- We sometimes prefer to call it **3d geological mapping**







## How we got to where we are...

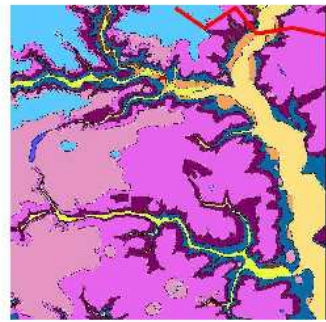
- 5 year research programme (DGSM) into 3D geological modelling completed in 2005 ([http://www.bgs.ac.uk/science/3Dmodelling/docs/DGSM\\_Final.pdf](http://www.bgs.ac.uk/science/3Dmodelling/docs/DGSM_Final.pdf))
- Standards, data formats and workflows have been established
- GSI3D and gOcad have been chosen as corporate software
- Systematic geological models of the UK are now core deliverable of the Survey – the LithoFrame concept was born
- Development of products and delivery methods is now one of the key priorities

30 projects and more than 50 staff have contributed to the work presented here – A BIG THANKS TO ALL...



# The GSI3D methodology

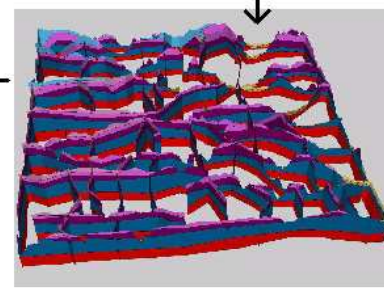
- developed by Hans-Georg Sobisch (INSIGHT, Cologne, Germany) since 1996 
- methodology published in his PhD in 2000
- since 2002 co-operation with the BGS and bespoke development of software tool
- the “Geologist’s vision” published in the Geoscientist (vol. 14) in 2004
- More on: [bgs.ac.uk/3dg](http://bgs.ac.uk/3dg)



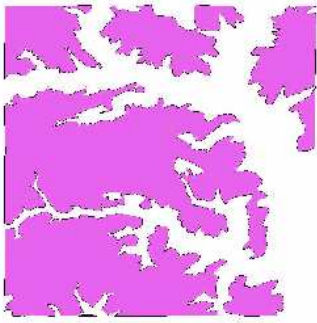
a) Map



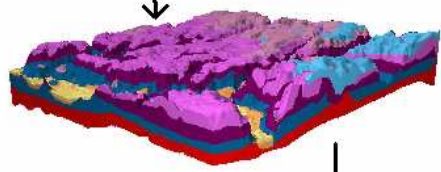
b) Section



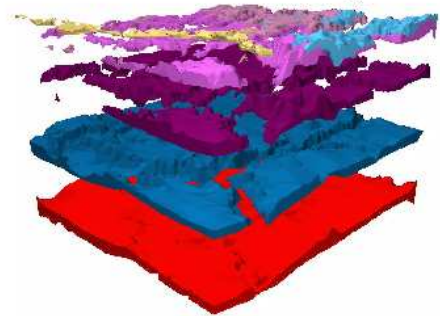
c) Fence diagram



d) Unit distribution



e) Block model



f) Exploded view

## Maps to models

*Major Update and Data Refresh* explains how our technology is at last fully capturing the geological vision.

Geologists have always used maps to describe the subsurface and the 3D vision of the subsurface is now being captured in a digital format. This is done through a process called '3D visualization' which allows us to see the subsurface in a 3D format. This is done through a process called '3D visualization' which allows us to see the subsurface in a 3D format. This is done through a process called '3D visualization' which allows us to see the subsurface in a 3D format.

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In this paper we describe the 3D visualization of the subsurface. We describe the 3D visualization of the subsurface. We describe the 3D visualization of the subsurface. We describe the 3D visualization of the subsurface.



Fig. 1. British Geology's original vision from the 1970s.



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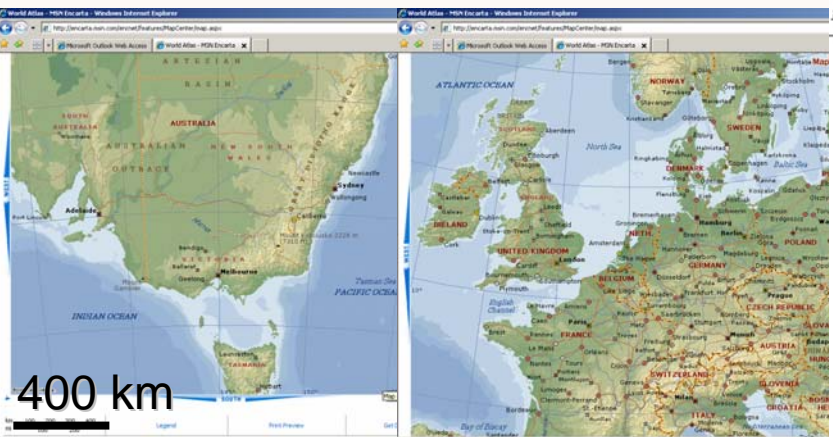
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# Areas of work

Current large scale (10k and 50k) modelling projects

Solid purple completed

Diagonal lines in progress







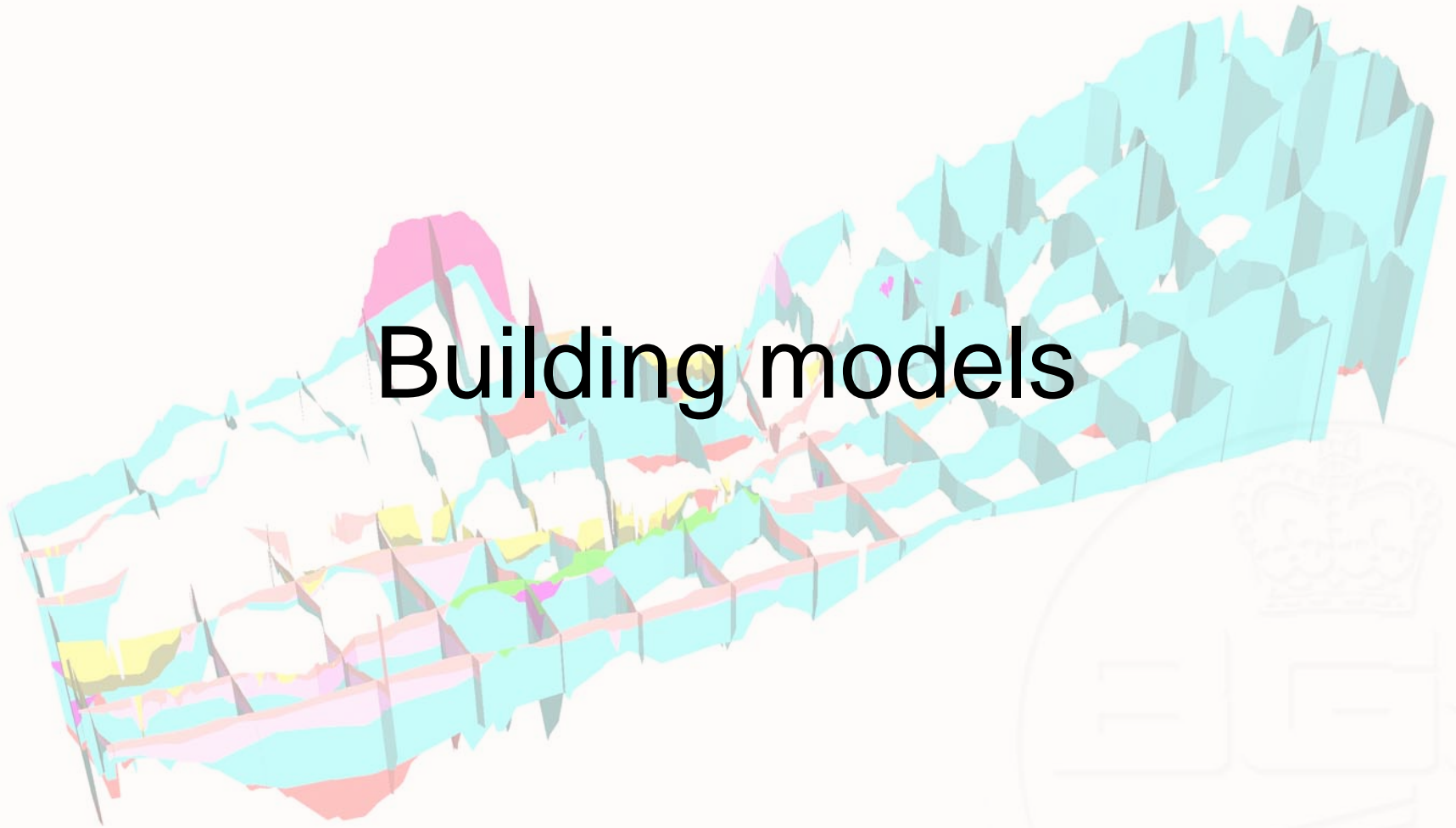
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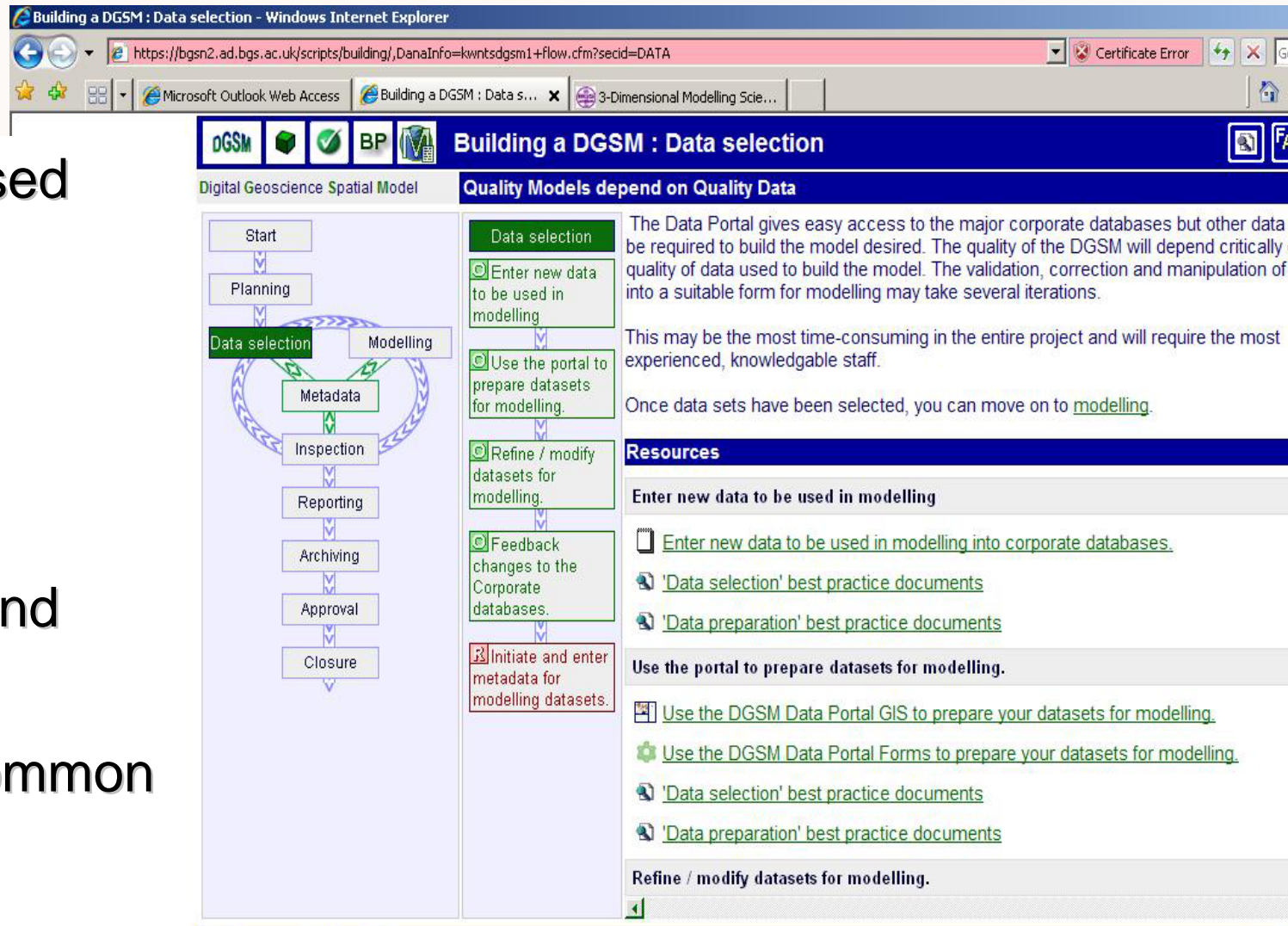
# Building models





# The Modelling workflow

- Intranet based standardised workflow
- links to applications, reference documents and metadata
- enforces common approach



The screenshot shows a web browser window with the URL <https://bgsn2.ad.bgs.ac.uk/scripts/building/DanaInfo=kwnntsdgsm1+flow.cfm?secid=DATA>. The page title is "Building a DGSM : Data selection".

**Building a DGSM : Data selection**

Digital Geoscience Spatial Model

**Quality Models depend on Quality Data**

The Data Portal gives easy access to the major corporate databases but other data be required to build the model desired. The quality of the DGSM will depend critically quality of data used to build the model. The validation, correction and manipulation of into a suitable form for modelling may take several iterations.

This may be the most time-consuming in the entire project and will require the most experienced, knowledgeable staff.

Once data sets have been selected, you can move on to [modelling](#).

**Resources**

**Enter new data to be used in modelling**

- [Enter new data to be used in modelling into corporate databases.](#)
- ['Data selection' best practice documents](#)
- ['Data preparation' best practice documents](#)

**Use the portal to prepare datasets for modelling.**

- [Use the DGSM Data Portal GIS to prepare your datasets for modelling.](#)
- [Use the DGSM Data Portal Forms to prepare your datasets for modelling.](#)
- ['Data selection' best practice documents](#)
- ['Data preparation' best practice documents](#)

**Refine / modify datasets for modelling.**

The workflow diagram on the left shows the following steps: Start, Planning, Data selection, Modelling, Metadata, Inspection, Reporting, Archiving, Approval, Closure. There are feedback loops from Modelling back to Data selection and from Metadata back to Modelling.





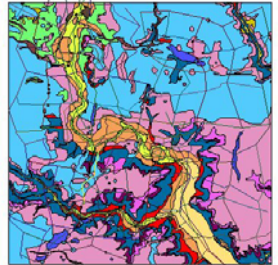
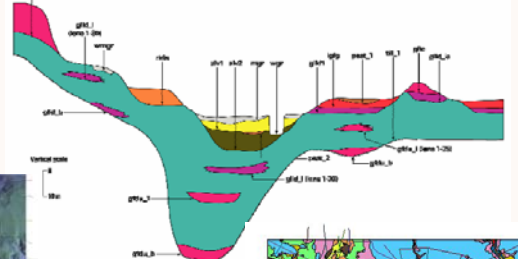
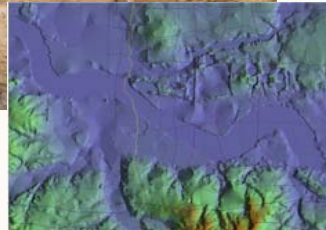
# The Data Portal

- Intranet based retrieval application
- runs ArcIMS and uses Java to retrieve data from ORACLE or SAN (Small Area Network)
- exports are formatted for GSI3D and gOcad
- is the VITAL link between corporate databases and modelling applications



# What do you need to build subsurface models?

- Stratigraphy (topology)
- DTM (Digital Terrain Model)
- Coded boreholes
- Geological linework
- Existing geological surfaces
- Geochemical and geophysical measurements
- Hydrogeological data
- Topographic data
- Historic land use data .....



**Selected SOBI Bore(s)** (Rev R.1 KGL 02-04-2002) Primary Key for CURRENT BOREHOLE GEOLOGY ROW

QZ	TRC	RT	NUMB	BSUFF	BORE_NAME	
			1	A	001173	
CLIPNO SUPPDLR						
BNG	Nothing	Proc.	Star Height	Proc.	Typs.	
Eastng		Value	43.6			
50000	004920	5				
<input type="checkbox"/> Metric Original <input type="checkbox"/> Imperial Input Only						
Interpreter	Lithology Code	Lithostat Code	Unit Description	BEED	BM DEPTH TOP	DEPTH BASE
SJMA	DMTN	LOFT		W	0.000	14
SJMA	PESA	GSSG		W	14.300	16.3
SJMA	DMTN	LOFT		W	16.500	17
SJMA	PESA	GSSG		RH	17.100	18.3
SJMA	PESA	PLG	shaly from 22.6	W	18.300	24
SJMA	CLAY	TRAM		1D	24.700	28.8
HKE					0.000	

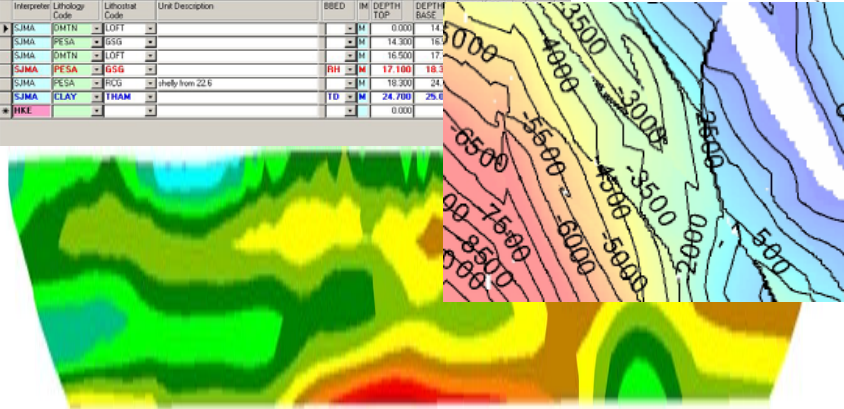
**Select Bore(s) Here** Enter Your Integer Code Here

Select Bore(s)    Select GS    TMC,REVW    Select RT

Select NUMB    Select BORE\_NAME    Select BS

Clear Criteria    Select BORE\_NAME

Optional - Highlight a Lithology    Start Height







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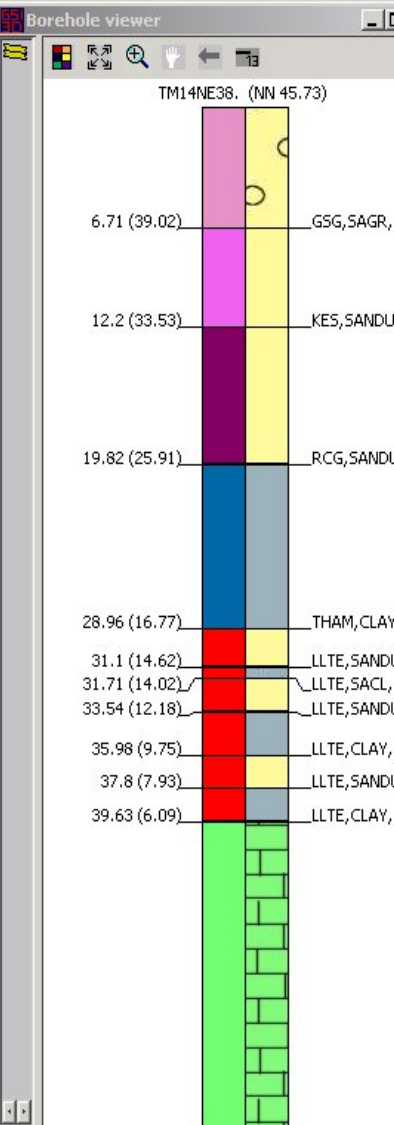
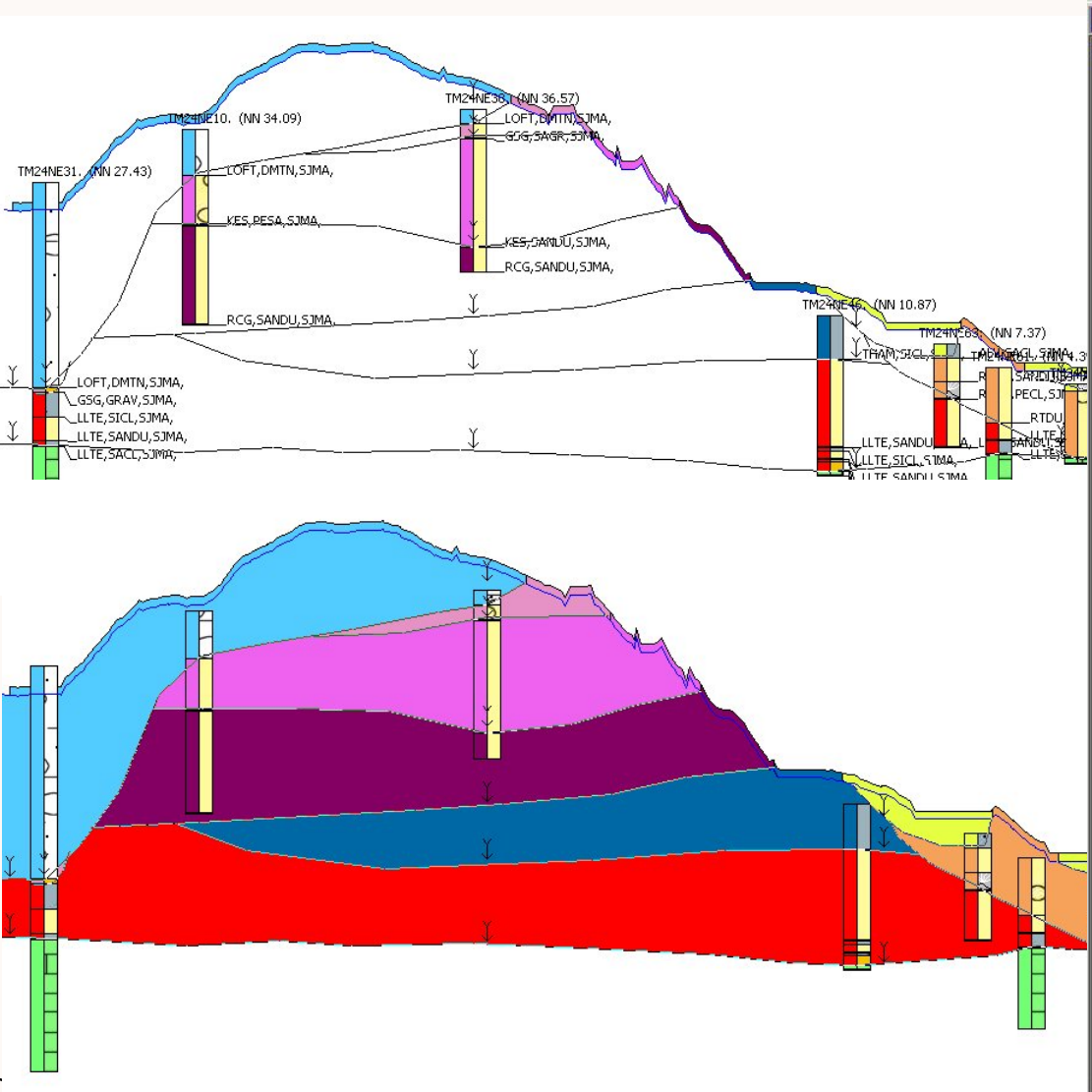
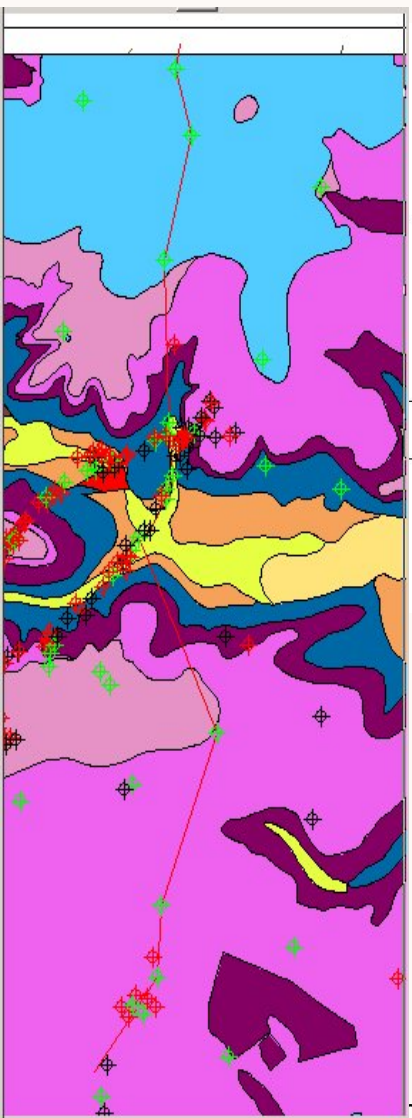
... but most importantly: we need geologists







# Interactive section drawing – expert interpretation







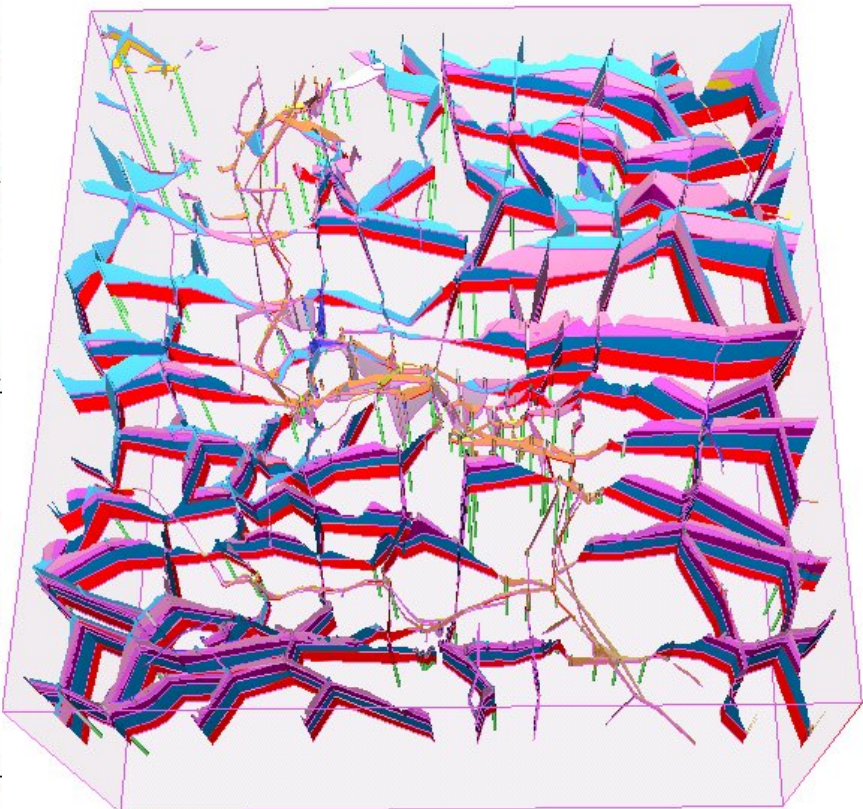
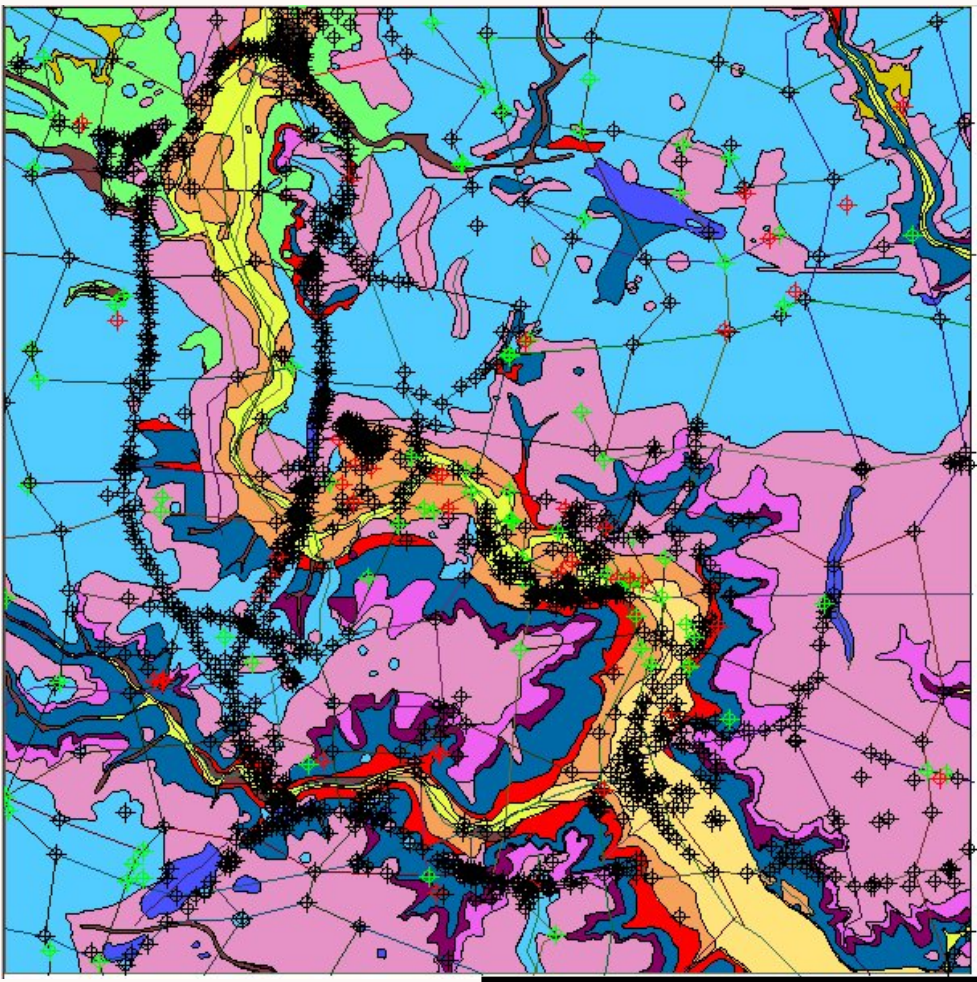
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# Completed fence diagram



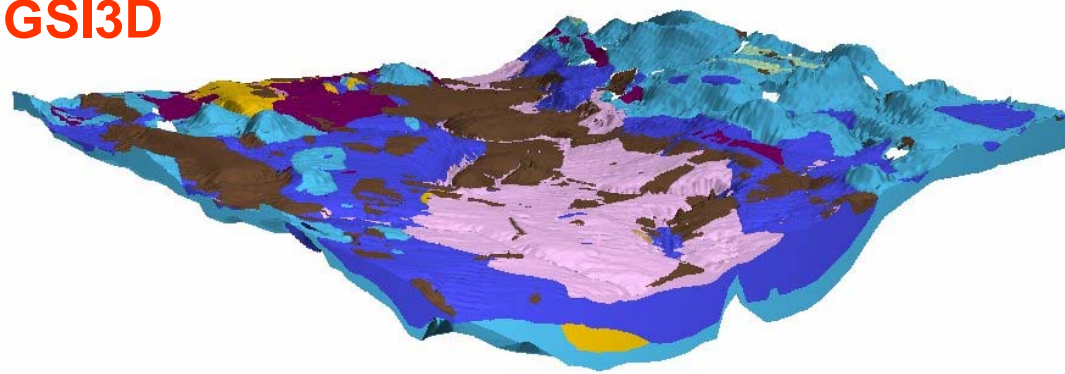
5 km





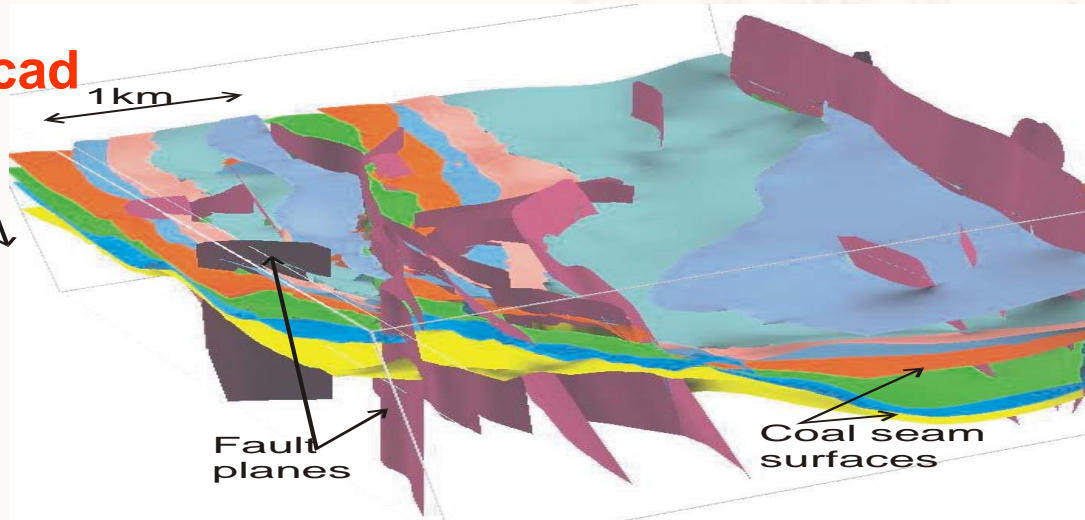
# The main differences in approach

Superficials and simple bedrock - **GSI3D**  
**‘Geological interpolation’**  
through expert knowledge from heterogeneous datasets.



*“Full stack” modelling approach*

Complex and deep bedrock – **gOcad**  
**‘Mathematical interpolation’**  
through algorithms from quality well and geophysical data.



*Surface modelling approach*





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# Application of Models





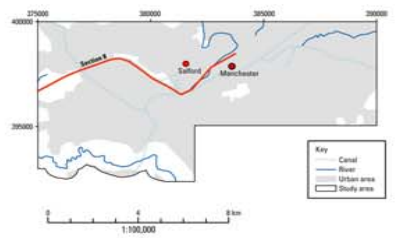
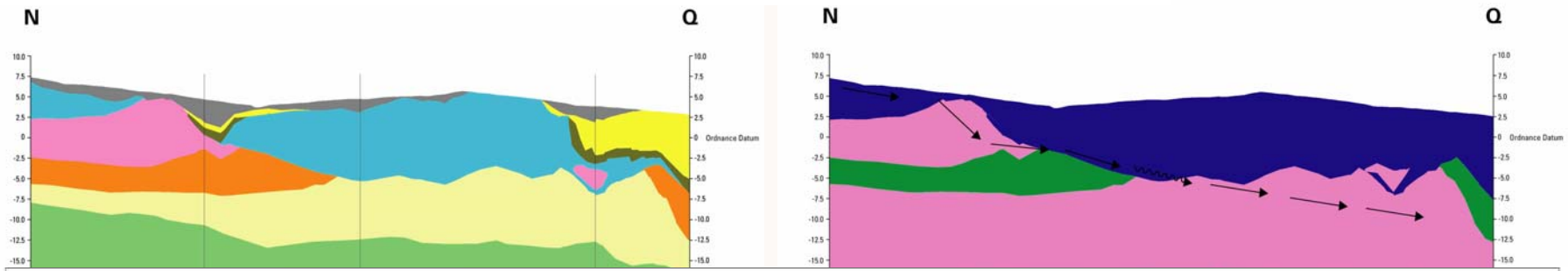
# Hydrogeological visualisation

## Conceptual hydrogeological pathways at a pumping station in Grimsby (top) and along the Manchester ship canal (bottom)

**Little Coates - Grimsby Hydrogeological Pathways Study**  
 For explanation of colours and symbols in this section, see Figure 2

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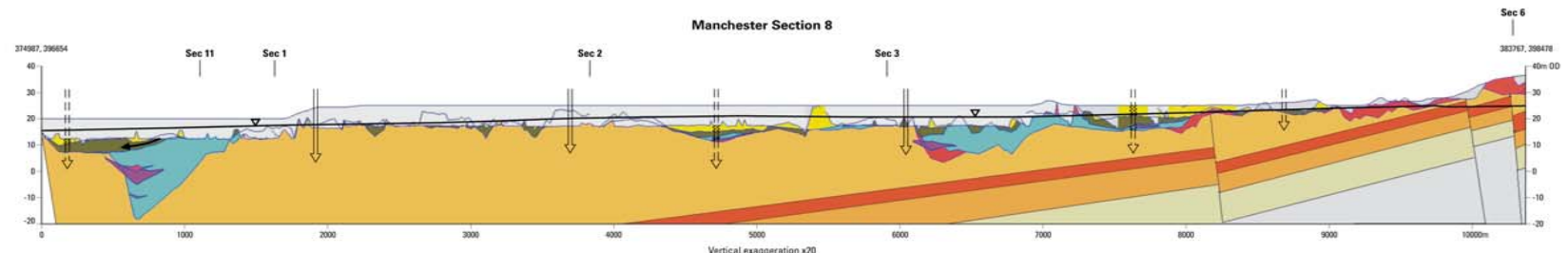
anglianwater



**Conceptual pathways in Superficial deposits in Manchester Section 8**  
 For explanation of colours, symbols and the positions of this section, see page ...

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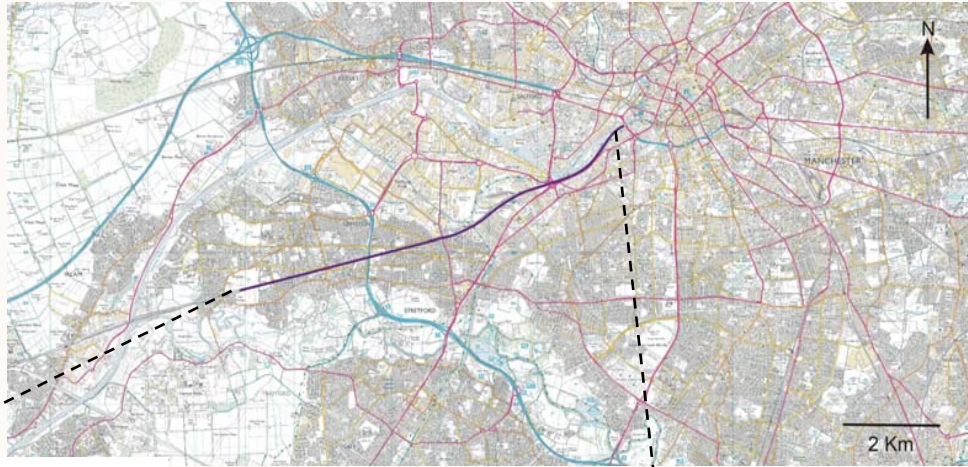
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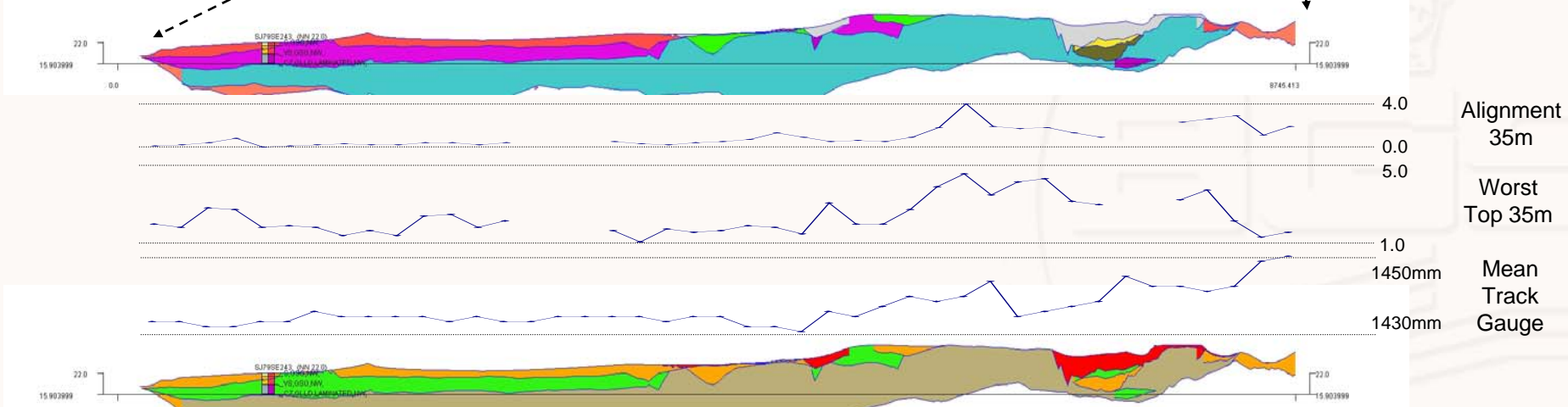
# Railway track bed geometry

## Liverpool to Manchester Railway Flixton – Central Manchester



### Key

- Artificial Deposits
- Alluvium(overbank) Deposits
- Alluvium(channel) Deposits
- River Terrace Deposits
- Glaciofluvial Ice-contact Deposits
- Glaciofluvial Sheet Deposits
- Glaciolacustrine Deposits
- Till







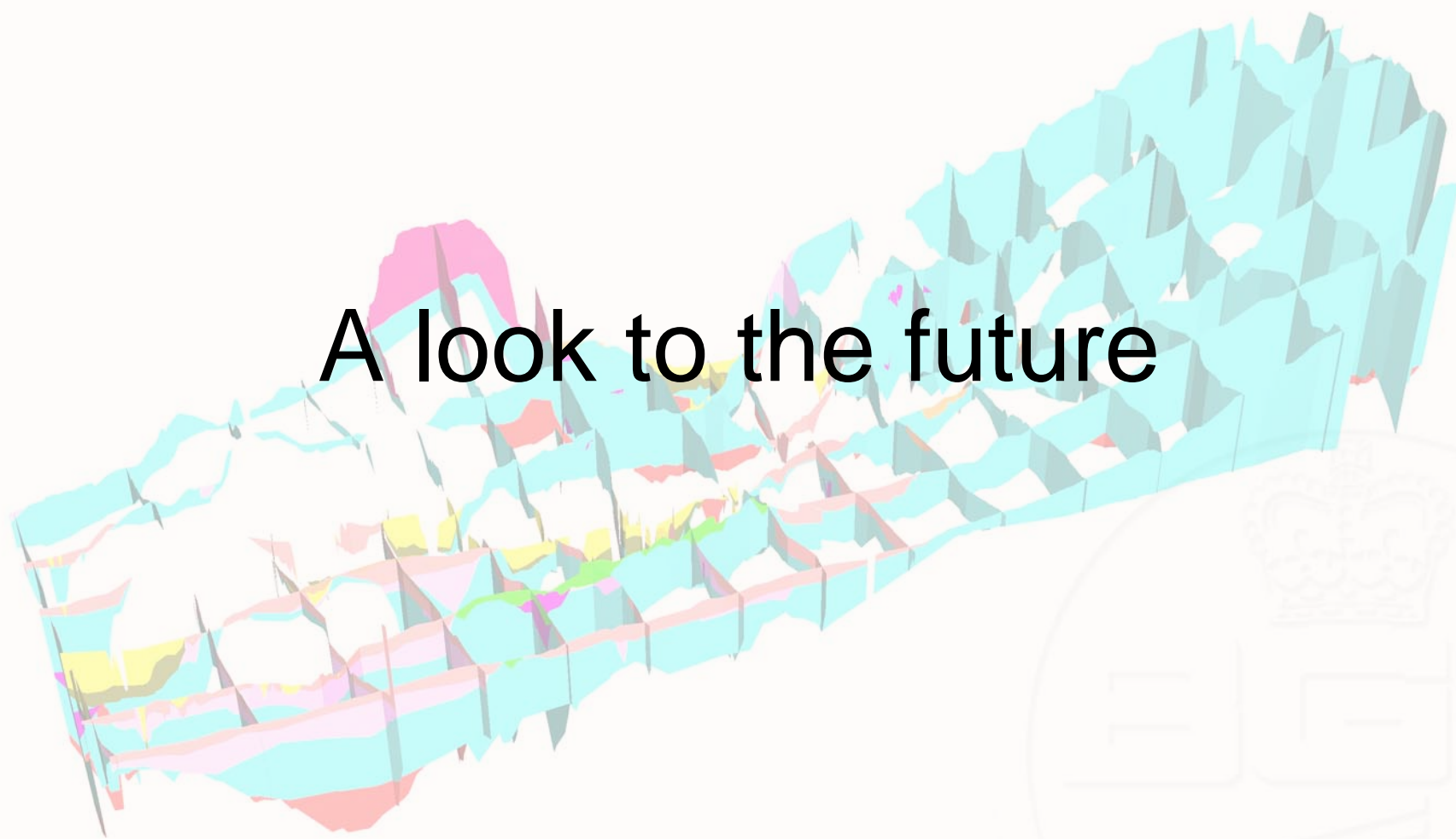
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# A look to the future





## Further development of bedrock modelling functionality in a 3 year project 2007-2010

The aim is one single integrated, easy to use workflow and software solution to carry out 3D mapping of both superficial deposits and bedrock.

The tool will be tied to working practices of bedrock surveyors and will have a strong link to field survey teams on the ground.

Tender process for external consultancy is still in progress.

INSIGHT is the current preferred bidder.





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# Virtual field reconnaissance & 3D surveying in the field







# Delivering models to clients

BGS has identified 5 User Requirements for “3D model Viewers”

Free

Thumbnails/Screenshots

Frozen movies of models - \*.avi, \*.mov and flash

Preview of model with interactive function – 3D pdf

Sold

The 3D geological map – Subsurface Viewer

Licensed

The full model in 3D software – LithoFrame model

Increasing  
interactivity



Not one technology will suit all purposes and we still have to work closely with customers, from schools to industry to find out what really works for them!



# Live demonstration of the Subsurface Viewer Viewer – The 3D geological map

## Key features of the Subsurface Viewer:

- JAVA based – platform independent
- software is free for the client
- delivers full richness of geological model including property information
- user can export sections, maps and 3D view as raster maps
- potential for web-enabling
- most importantly, it communicates our science ...

