NEW GEOLOGICAL MODELS FROM THE BRITISH GEOLOGICAL SURVEY

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INTRODUCTION

Over the last decade many Geological Survey Organisations worldwide have begun to communicate their geological understanding of the subsurface through 3D geological models, and the traditional printed geological map has been increasingly phased out. This shift of emphasis has been made possible by modern computers, geological modelling software and delivery tools. The role of the geologist has however remained essentially the same, to gather all the relevant evidence (maps, boreholes, geophysics etc) and to come up with a 3D interpretation of the geology.

Today BGS uses a range of modelling techniques varying from interpretative, deterministic to stochastic, depending on the geological situation and how much data is available. The main modelling software includes GSI3D, GOCAD-SKUA used for structural geological modelling, Petrel which is mainly used for reservoir modelling and also 2DMove for section restoration and fault dynamics.

Clients for models are many and varied and have included the Environment Agency (EA), Nuclear Decommissioning Authority (NDA), the Department for Energy and Climate Change (DECC), together with the Water, Utility, Transport and Engineering sectors. Models have also been built for educational and research purposes.

Two recently released outputs are the GB3D onshore bedrock model and the London and Thames Valley model.

THE GB3D BEDROCK MODEL

Over the last five years as part of its National Geological Model programme combined with external funding, BGS has constructed a national resolution fence diagram model of the onshore bedrock geology of Great Britain (Figure 1).

The model covers England, Scotland (except the Shetland Isles) Wales and the Isle of Man and was built with contributions from 17 regional specialists supported by a team of data managers and developers. The model broadly adopts the colour schema and geological classification of the BGS 1: 625000 scale bedrock geology maps with some simplification, faults are indicated by offsets in the geology. Constructed using the GSI3D methodology (Kessler et al 2009), the sections are tied to over 300 important deep boreholes. The model also takes account of existing BGS onshore models of bedrock geology which are themselves underpinned by BGS's vast collections of boreholes, seismic lines and regional geophysical data. The cross-sections extend to depths up to 5 km, with a minimum depth of 1.5 km, together they comprise over 25,000 line kilometres of section. A similar model but at a deeper crustal scale covering parts of Ireland, Northern Ireland and Scotland was constructed in collabortation with the Geological Survey of Ireland (GSI) and the Northen Irish Geological Survey (GSNI) and is described by Leslie et al (2013).

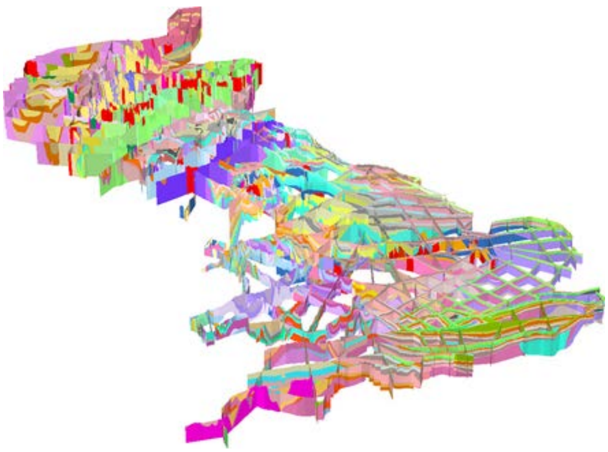

Figure 1 – The GB3D (v2012) fence diagram.

The latest version of the model is available for free download at http://tinyurl.com/mlsz6j4. The construction of the 2012 version of the model is described in detail by Mathers et al (2014).

In 2013 NDA decided that GB3D had the potential to act as a key source to inform the public about the geology of England and Wales, and subsequently to help facilitate screening for geological suitability for the location of a Geological Disposal Facility (GDF). Two phases of enhancement of the GB3D dataset were undertaken, the first involved the incorporation of 314 deep boreholes into the lines of cross-section and the second phase extended selected sections into the nearshore zone around England and Wales

GB3D has recently been used in the BGS iHydrogeology project to develop a risk screening tool for the UK's Department of Energy and Climate Change and the Environment Agency to consider the risks that could be posed to overlying aquifers by fracking of shale gas targets at depth. http://tinyurl.com/kfhmnqr.

LONDON AND THE THAMES VALLEY MODEL

The London and Thames Valley model (Figure 2) is a full 3D volume model of the anthropogenic, superficial and bedrock geology down to a depth of a few hundred metres. The model is a subsurface extension of the 1: 50 000 scale digital geological map. It was built using a combination of GSI3D and GOCAD and covers 4800 km^2 along the London Basin encompassing an area 40 km in breadth stretching from Thatcham and Didcot in the west to Basildon and Tilbury in the east, the model is described in detail by Burke et al (2014). Similar models also exist for parts of southern East Anglia covering Ipswich, Sudbury, Colchester and Chelmsford, Manchester and Merseyside, Humberside and the Clyde Basin in Scotland. The model takes into account several thousand boreholes including most of those that exceed 100m in depth. It is suitable for use at a regional-district scale and can also act as a framework within which more detailed site or linear route models can be constructed. Examples include models built for the new Crossrail Farringdon tube station in central London and along the proposed HS2 route from Euston northwestwards towards Birmingham.

No anthropogenic deposits are modelled and shallow superficial such as Head and Clay with Flint are depicted in the model as 2D coverages draping the surface because modelling the 3D extent of these discontinuous deposits is very labour intensive.

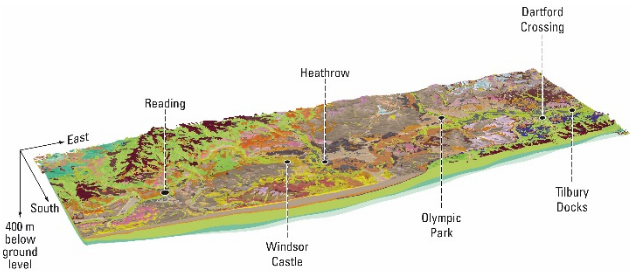

Figure 2 – The London and Thames Valley model viewed from the southwest, the pale green is the Chalk Group, mid-brown is London Clay, this view extends to the base of the Cretaceous strata.

THE DELIVERY AND USE OF GEOLOGICAL MODELS

Geological models only make impact if they are delivered to users in an understandable form and through an easy-to-use system, a point made well by Turner (2006).

The BGS and other organisations have been on a long journey to find suitable routes for publishing and delivering the results of modelling (see Kessler 2005) and recent years have seen real progress towards the efficient delivery of models to clients. A summary of solutions across the EU has been published in a report by Kessler and Dearden (2014). A clear emerging trend is the increasing use of the Internet to disseminate models, for example the BGS' Groundhog web viewer (http://www.bgs.ac.uk/services/3Dgeology/virtualBoreholeViewer.html) is now deployed for the London and Thames Valley geological model as well as a series of free sample models. Figure 3 shows an output from the viewer.

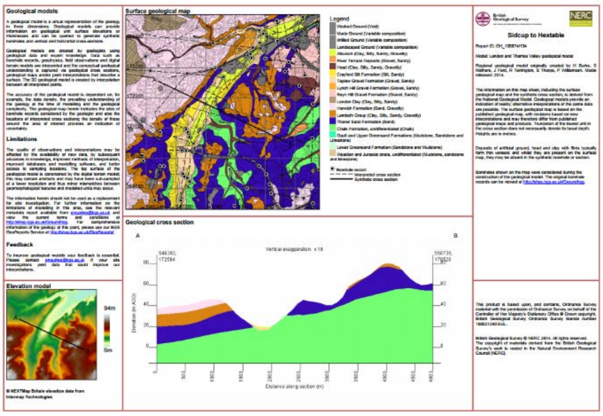

Figure 3 – synthetic cross-section report generated from the BGS Groundhog web-based model viewer

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