# The present and future construction and delivery of 3D geological models

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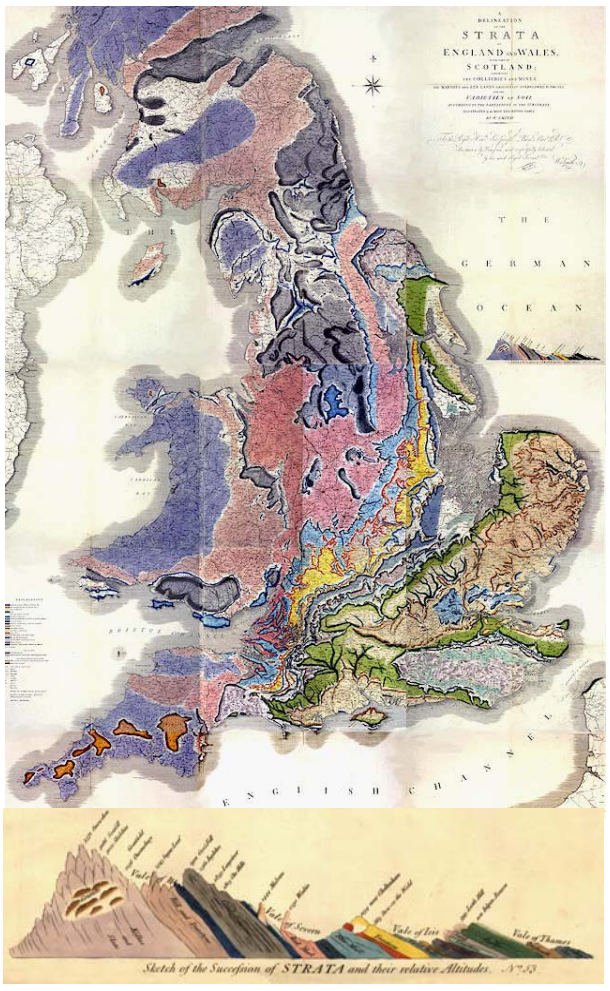
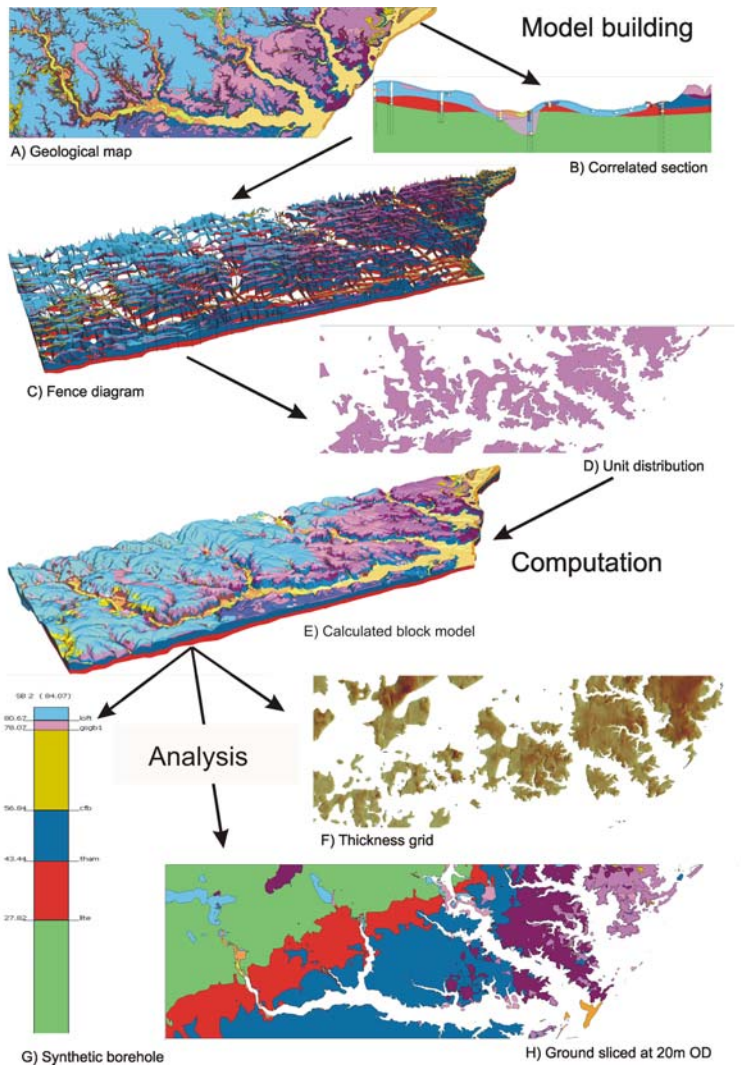
In its role as a national geological survey, the British Geological Survey (BGS) has produced geological maps of the UK at a series of scales for the past 170 years. These maps have served the nation well as the primary source of spatial information on the UK's geology. Geological maps can sometimes only be understood by another geologist; the surveyors' spatial ideas, models and concepts can never be properly represented using 2D media, and so, to date, much 3D knowledge has been lost to the science and to the users.

In 1815, William Smith was already addressing the need to present the third dimension of the geology as well as the surface arrangement of units by providing a composite cross-section together with his surface geological map. With recent advances in computing power and the availability of national digital datasets, a new survey concept can be envisaged.



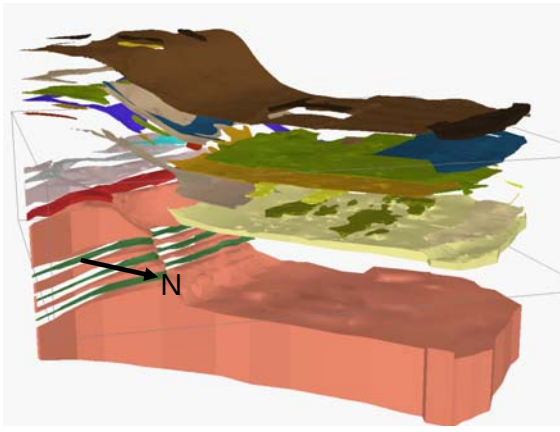

The first national geological map by William Smith (1815) with enlarged section showing 3D relationships and predicted thicknesses of units.

One of the main tools for 3D geological mapping at BGS is the Geological Surveying and Investigation in 3 Dimensions (GSI3D) software tool and methodology. GSI3D has been developed by INSIGHT GmbH over the last 15 years and since 2001 in cooperation with the BGS. The success of the GSI3D methodology and software is based on its intuitive design and the fact that it utilises exactly the same data and methods, albeit in digital forms, that geologists have been using for two centuries in order to make geological maps and cross-sections. The geologist constructs models based on a career of observation and experience. Together with the computational power of the software, this approach produces a 3D model consistent with available data points, but uses the geologists' understanding and tacit knowledge to guide the interpolation process.




The model building workflow (A-E) in GSI3D and example analytical outputs (F-H) that can be derived from the calculated model. The model shown comprises some 1200 sq km of the Sudbury–Ipswich–Felixstowe area of southern East Anglia, UK.

The image below shows a high detail soil/geology model with a succession of mudstones and sandstones, overlain by fluvial deposits and capped by a stack of soil horizons, most of which are less than half a metre thick. The main use of these detailed models will be to increase the understanding of near surface water pathways and the movement of nutrients and pollutants.

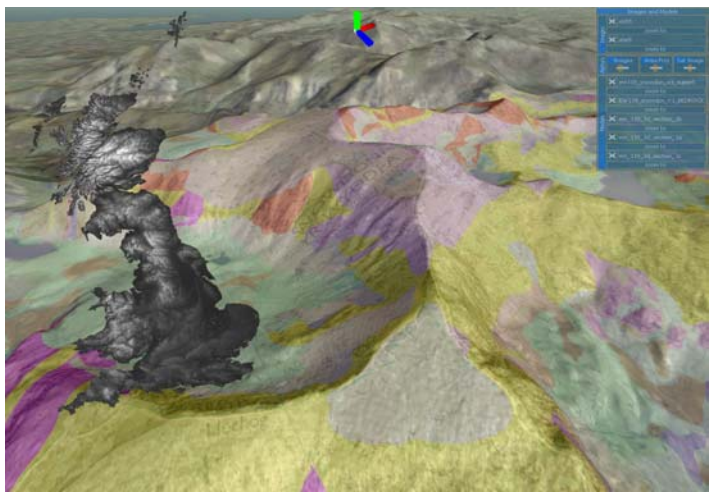


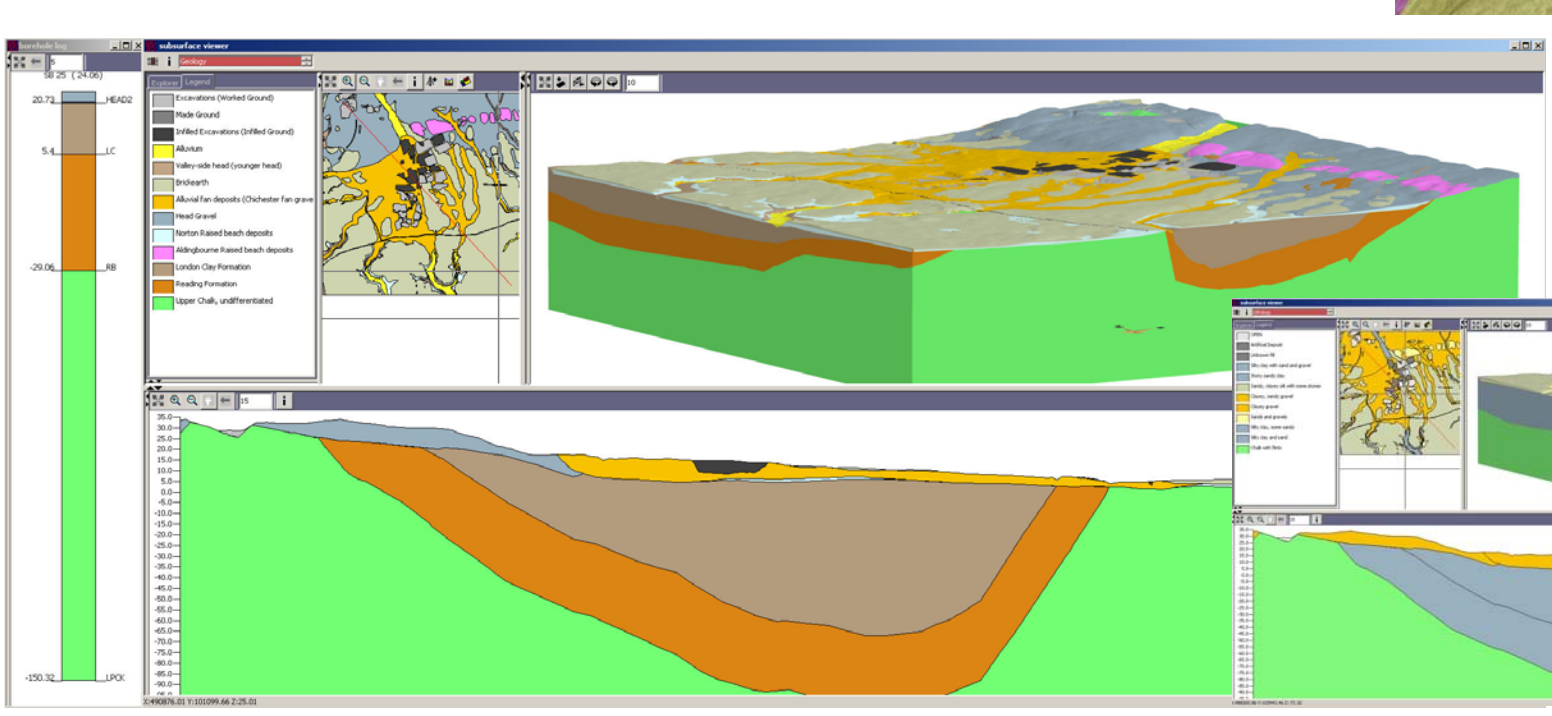

3D soil geology model to 50 m depth of a 2 x 1 km area at Shelford, near Nottingham, UK (x10 vertical exaggeration).

The BGS has produced a 3D geological model of Britain's most significant subsurface layers, from the base of superficial deposits down to the Moho, along with major faults and intrusions (pictured above). A wide variety of sources have been used to construct the model, pulling together 2D maps, previously modelled surfaces and new modelling to create the final product. Its main use will be in geoscience education and the communication of geoscience to the public.

The GSI3D modelling technology is available on all desktop PCs at the BGS and when working in larger teams staff also use the 3D visualisation facility pictured above right.

GeoVisionary is the stunning result of a collaborative software development between BGS and Virtalis (see software screenshot to the right). It enables the visualisation of highly detailed landscape data, along with subsurface information. Geoscientists can fully prepare and evaluate many interpretive ideas before they begin fieldwork. The link between already powerful GIS systems and the immersive visualisations allows teams to map in a virtual collaborative environment and, for the first time, record information back to BGS corporate databases.






The Subsurface Viewer pictured above is an exciting new package developed by BGS and INSIGHT for the visualisation and analysis of 3D geological models. In this stand-alone software the constructed model can be examined and analysed to produce geological maps (at surface and uncovered), user defined synthetic borehole logs plus horizontal and vertical sections. Geological units can carry several attributes such as stratigraphy, lithology or permeability, just to mention a few.
The model above (10 x 10 km) was constructed on behalf of the UK Environment Agency and was used in the assessment of groundwater recharge through Quaternary and Tertiary cover to the Chalk aquifer in green. The main image shows the model coloured by stratigraphic unit, and the small inset model distinguishes the lithologies of the deposits, with clay shown in grey and sand and gravel in yellow and orange.

The UK regional model and some sample data embedded within the Subsurface Viewer are available for download on www.bgs.ac.uk/free. General information on the BGS's modelling activities is located at www.bgs.ac.uk/Science/3dmodelling/home.html

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