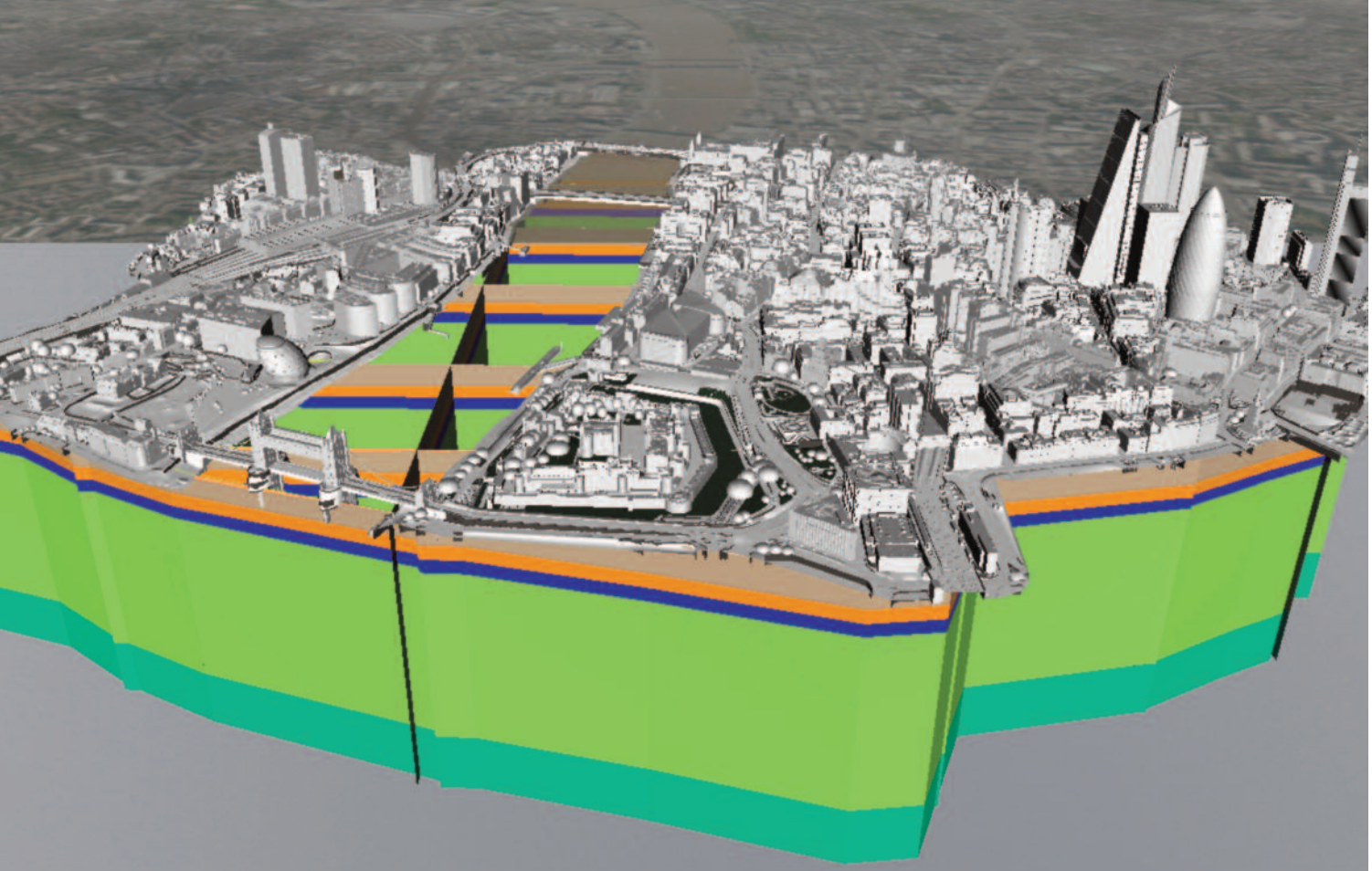

Collecting geological data in a 3D digital world

Leanne Hughes, Survey Geologist at the British Geological Survey (BGS), outlines how digital technology can help to better quantify and understand geological data...

Technological advances in GPS, mobile computing and remote sensing have changed the face of geological mapping at the British Geological Survey (BGS). In the space of 15 years the process has developed from a largely paper-based 'fieldslip' system, to one which is entirely digital. Geological mapping has been a core role of the survey for 180 years, with early geologists colouring sections of their maps to represent the different rock types and mineral resources that lay beneath their feet. Today geologists at the BGS continue to collect observations to develop the next 3D and 4D generations of geological data, which will tell us everything we need to know from earthquakes to energy and from aggregates to agriculture. Traditional paper maps have been supplanted by digital data delivered via the web, and an entire map library of information on Britain's rocks and soils can now be accessed using smart-phone apps and carried in a small pocket. How has this changed the traditional image of field geologists with their maps, geological hammers and notebooks?

Pre survey remote sensing

Before any fieldwork takes place it is common to conduct a desktop survey of existing remote data such as digital aerial photographs or geophysics, gathering specific information relevant to the questions such as; "Are the ground conditions suitable for a wind turbine?", "What is the best location for this tunnel?" and "Which aquifers are at risk of pollution?" This survey identifies landscape features and changes in vegetation that indicate changes in geology, using stereo aerial photographs and a Geographic Information System (GIS). Geophysics enables the geologist to look below the Earth's surface and map the properties and processes that occur beneath.

Field data

Preliminary interpretations from the pre-survey are imported into the BGS digital mapping system 'SIGMA'. This uses a typical tablet PC with integral GPS, camera and long-life battery, running purpose-built software applications designed by BGS. SIGMA holds data such as aerial photographs, historic maps and 3D terrain models that provide data on the landscape, and boreholes, reports and geological cross sections that provide data on the ground beneath. Field geologists are no longer isolated from such data while in the field and can make new interpretations in the context of all the information available. By integrating all this data, a geologist can build up an interpretation of the subsurface, and use a range of data input tools in SIGMA to capture a map and 3D model of the geology while still working efficiently in the field. But SIGMA has evolved way beyond its original brief as a geological mapping tool, and now has versions that enable scientists and international disaster relief teams to record vital information on the aftermath of natural hazards such as landslides, earthquakes and tsunamis.

Visualisation and modelling

Once field data has been collected it can be modified, developed and checked in the GeoVisionary™ (Virtalis/BGS) software, which enables the subsurface environment to be visualised in the same way that apps like Google Earth™ help us to visualise our landscape. We use software originally developed for oil and gas exploration to build 3d models of the geology of the subsurface. Each rock formation in those models carries a unique, digital code, which enables other attributes of the rocks such as engineering properties, permeability and resource potential to be displayed and queried. Such models have proved particularly useful for our end users, who may not be skilled or experienced in interpreting a traditional geological map. Overlaying 3D terrain data such as buildings and infrastructure helps to put the geological information into a context. The geological data from these models is provided digitally for users such as engineers and planners to integrate with their own data and systems.

Products

Access to geological data has been made much easier since online web mapping systems have been widely available. The BGS 'Geology Viewer' uses a web-GIS to display bedrock and superficial polygons overlaid on a map of the UK. For a general audience the iGeology app has been developed by the BGS for use on mobile devices and tablets and has been downloaded by over ¼ million individual users. It presents geology overlaid on topographic maps and uses the device's GPS to locate the user. The data can be queried and is hyperlinked to detailed descriptions on the BGS website. The more advanced iGeology3D app employs 'augmented reality' to overlay geological polygons on the terrain as viewed by the devices camera in real time giving the user a geologist's eye-view. The map data, amongst many other datasets such as ground stability and geohazards, are also available as a digital product for government regulators and industry to licence. Far from being out of sight and out of mind, our geological foundations are now an essential and integral part of our 3D digital world. ■

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