Keith Westhead, Patrick Bell, Colm Jordan and **Andy Kingdon** describe how the geological map has evolved from William Smith's pioneering work, reflecting contemporary technologies and society's needs.

From watercolour to web

The British Geological Survey has been making maps across three centuries but the way these are surveyed, drawn and used has changed radically in the past 20 years with the advent of the internet era. The modern BGS field geologist and cartographer have digital technologies at their disposal which would amaze the nineteenth century surveyor. The map user can now reach beyond the traditional paper product to their computer or even their mobile phone to see instant displays of the geology and gain access to the framework of digital information that supports the geological interpretation.

The geological map is the cement which binds all our geoscientific data and research together. BGS field surveyors and their contemporaries over 175 years have worked on foot, on horseback, in cars and even in planes, to sweep across Great Britain and produce the striking and detailed national geological map we have today. They have ventured into ditches and quarries, drilled holes by hand and machine, and traced the shape of the landscape, exploring beneath the soil to reveal the geology for everyone. They have used paper, then computers, to record their observations in the field and take them back into the office to make the geological maps we find so familiar.

The newly launched BGS Geological Mapping App on the iPad.

New technologies such as BGS•SIGMAmobile and GeoVisionary are powerful tools to help the modern surveyor.

In the nineteenth century, pioneers like William Smith and John MacCulloch were amongst the first to represent the geology of Britain on maps, and BGS geologists have followed their tradition, reusing and expanding the colour palette as the geological mapping has become ever more detailed. Right up to middle of the twentieth century, teams of artists worked with the geologists,

William Smith's Geological Map of England & Wales*, and the modern digital map of Great Britain, delivered through BGS Web Map Services and displayed in Google Earth.*

applying ink and watercolour to paper to produce published maps. Into this century, modern cartographers have used increasingly sophisticated computer graphics and geographical information systems (GIS) software to build our national digital geological map of Great Britain (DiGMapGB). This digital map is the link between the traditional geological field techniques of the past and an exciting digital future for the geosciences.

The tools and techniques used by geologists to get beneath the skin of the landscape and understand the geology remained largely the same through the nineteenth and most of the twentieth centuries but have changed radically in recent years. For example, a BGS surveyor no longer carries a map case and paper field slip. Instead they use the BGS•SIGMAmobile computer system, not only to record their latest results digitally, but also to access and combine a wealth of digitised information from earlier surveys to speed up their work and make it more accurate.

Back in the office, the field surveyor is increasingly aided by digital observations and data from above and below the ground. Earth observation information, such as aerial and satellite imagery, can be combined with underground (subsurface) information from boreholes or geophysical imaging and displayed in new, interactive 3D models. For example, the BGS's GeoVisionary system allows the geologist to make digital observations in a 'virtual fieldwork' environment.

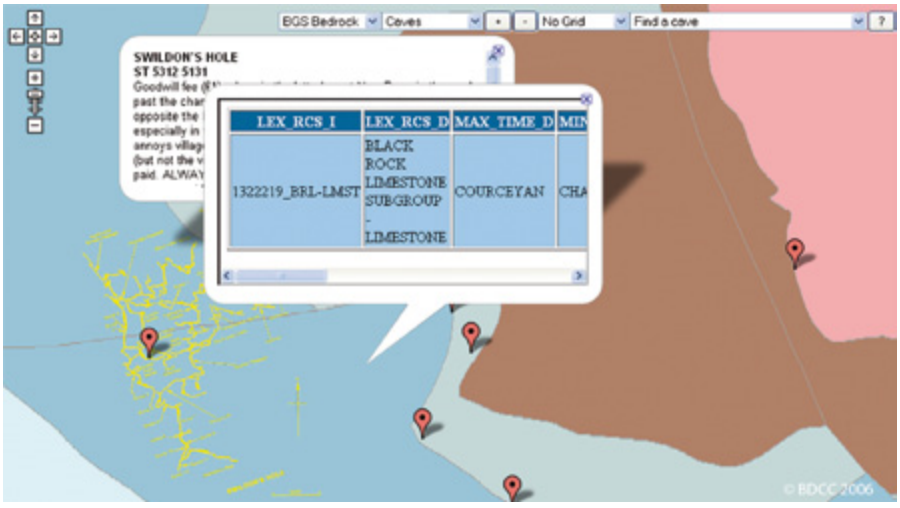
The map user has followed a similar journey from the paper map to the digital world. Computer interfaces such as Google Earth have been responsible for introducing a new generation of users to the digital map and to ever greater levels of detailed information on the 'spatial' world around them. The advent of the GPS-enabled 3G mobile phone has taken this a step further, allowing the user to receive this information 'live', as they travel. For example, the new BGS Application (App) for the iPhone delivers the latest digital geological map along with a description of the various layers of the geology straight to the user, wherever they are.

Exciting new web mapping services also allow users to take these digital maps and data and combine them (or 'mash up') easily with other environmental information. For example, the new BGS OpenGeoscience portal lets anyone have instant access to our national geological map at the 1:50 000 'street-level' scale (called DiGMapGB-50) and also to tens of thousands of high-resolution photographic images and accompanying digital databases, reports and software. People are already making imaginative use of this, such as combining the digital geological map with known caving locations to look for perhaps undiscovered cave entrances. The possibilities are endless.

So, as the geological map has moved into the digital age it has expanded into many dimensions and become more than 'just' a map. It is now the framework to bind together a new generation of digital geoscientific information on the environment. It is more accessible and usable than ever before and, thanks to new mobile technologies, is right back in the hands of the user.

For more information, contact:

Keith Westhead, BGS Edinburgh
Tel: +44(0)131 667 1000
e-mail: rkw@bgs.ac.uk



An example 'mash-up' where BGS geological mapping (delivered through the OpenGeoscience Web Map Service) is combined with cave locations by Bracknell District Caving Club (BDCC). Image with permission from BDCC.