

Building the geological knowledge base

Combining new technologies with 165 years of mapping experience

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The first geological surveys were established in Europe during the 19th century to underpin the industrial revolution.

Primary targets for these surveys were coal, ironstone, limestone and clays. The principles of the classic field surveying techniques developed at this time are still followed today. Careful field observation of the natural features of the landscape was used to infer the underlying geology. Key elements of the UK's stratigraphical framework were built up through the work of such famous geologists as E B Bailey, W J Arkell and A J Jukes-Browne and the foundations for

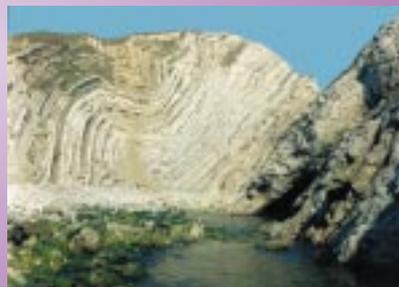
our science, and the nation's economic prosperity, were put in place.

In the first half of the 20th century, two World Wars created the need for an assured supply of raw materials. In response, geological surveys prepared more detailed maps and began to manage growing national inventories of resource information. At the same time, knowledge which had been gained about Europe's geology led to major scientific advances. The wider understanding of the Earth's evolution, properties and structure were built on a foundation of excellent geological mapping.

The Geology of the Country around Weymouth, Swanage, Corfe and Lulworth and the related geological maps (published up to 1947), represent the fruits of the late W J Arkell's long study of this classic area in the first half of the 20th century. It contains the type sections of some of the internationally accepted stages of the Jurassic System.

In addition to superb coastal sections, which have provided the subject matter of stratigraphical and palaeontological research for 180 years, the area has many structural features of exceptional interest, not least because of their importance in the search for hydrocarbons in the late 20th century. The area also attracts amateurs, students and professional geologists interested in historical and structural geology, and satisfies the needs of specialists for the advancement of their studies.

This long-term strategic field-based research still continues in the guise of the Core Programme. The information is held within the archives of the BGS. When combined with the organisation's extensive geoscience expertise, it provides a rich source of fundamental knowledge on the UK's geology.



Fold structures exposed in coastal section near Lulworth.

Photographic archives, BGS © NERC

Building from strength

In the second half of the 20th century, the challenges confronting society changed. In developed, post-industrial societies, basic raw materials gradually ceased to be of primary importance. Instead, new issues took prominence that revolved around managing the environment as a whole. They included certain key resources, such as construction materials and water, but also encompassed the legacy of mining and industrial activity. The geological knowledge base came to have new applications as an important input to decision-support tools for a wide variety of decision makers. Increasingly, these new users of geological information include planners, developers, legislators, regulators, lawyers and insurers.

In an increasingly crowded island, the central issue being addressed is how to use a particular piece of land; is it to be preserved in its natural state for future generations, mined, built on, used as a repository for waste or enjoyed as an amenity? Geological information is at the heart of this planning process, and there is an increasing demand for geological surveys to change their approach in two ways. Firstly, they must find new ways to present information to decision makers, who are rarely geologists. This means that the traditional map is being used as the basis for new maps showing only the desired themes, and as an input to models and algorithms that solve specific problems. Secondly, new problems need new types of geological information and this must be collected in the most rapid, efficient and economic fashion. So, traditional mapping is increasingly married to the very latest high-tech approaches to surveying.

Bringing the field into the office

Nothing can replace field observation as the basis for building up knowledge in depth about geology and its influence on the landscape. But fieldwork is a time-consuming and relatively expensive activity. Technology is being applied in the BGS to reduce the need for routine fieldwork, so that valuable field time can be dedicated to key problems, scientific challenges and areas that are difficult to map. In this way, it has been found that the time in the field can be both reduced and made more productive at the same



Computer-generated perspective view of a 3D model, derived from five metre Ordnance Survey contours, draped with an orthophotograph and the drift geology as a transparent layer.

time. The overall cost of mapping is being reduced, and yet better products result. How is this achieved?

Remote sensing, and in particular, digital photogrammetry, allow us to bring the geologists' field areas into their offices. Computers are used to create a detailed, 3D stereo model of the landscape from aerial photographs. Many of the features used to map the geology in the field can be located precisely within the digital model and mapped. These can then be checked during fieldwork, either by placing them on a paper fieldslip or by taking the digital model into the field. The power of modern portable computers makes this feasible for the first time. Linked to mobile communication and satellite positioning technologies, they may in time replace the hammer and field notebook as the icons of field geology.

The effectiveness of remote sensing as a geological mapping tool has been demonstrated over the past five years during the rapid revision of the Chalk outcrop of southern Britain, and advances in Chalk stratigraphical nomenclature have been derived in part from the new approach. Surveys now routinely incorporate, as a core activity, the interpretation of 3D stereo models to determine the basic geomorphological

framework and in some cases directly observe geological boundaries and features. Targeted field mapping to 'ground-truth' office-based interpretations speeds up surveying; eventually such digital interpretations may be carried into the field using laptop computers.



Solid geology draped over the 3D model as a transparent layer (arbitrarily coloured).

Meeting users' needs

The rapid response times that can now be achieved have been a key factor in winning support from users such as the Environment Agency and the water industry, who require the most modern geological interpretations to enhance their understanding of the Chalk aquifer.

One such study, completed in four months over the summer of 1999, revised the Chalk mapping of 400 square kilometres in the hinterland of Brighton and Worthing within the South Downs. The digital interpretation was backed up by rapid but comprehensive fieldwork and biostratigraphical studies. New material collected from the field has significantly improved the interpretation of the Chalk and its structure in the area. The new digital linework is the critical first step in the 3D visualisation of the Chalk aquifer in the area. Together with archival and newly derived hydrogeological data, it will enhance the understanding of the hydrogeology of this vital groundwater resource. Such understanding will eventually lead to a comprehensive science-based aquifer management plan. This is necessary both to increase the potential yield to meet ever-growing demands for fresh potable water in south east England and also to protect the environment from over-exploitation of the resource.

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