

To say that Planet Earth sustains our very existence is stating the obvious but we often overlook the importance of the ground beneath our feet. **Mick Lee**, Director of Geology and Resources, outlines the BGS's role in maintaining our modern way of life.

The essentials of life

When asked why geology is essential to our everyday lives, geologists often like to point out that 'what isn't grown is dug out of the ground'. While this is basically still true, in the modern world organisations such as the BGS are concerned equally with promoting the responsible use of the Earth's resources and protecting the natural environment for future generations.

Most people would identify shelter, water and food as the top three 'essentials of life' — none of us would survive more than a few hours in winter without shelter, a few days without water or a few weeks without food. In the poorest parts of the developing world the provision of these basic essentials still dominates the lives of many people. However, as prosperity increases these tend to be taken for granted (until a major natural disaster strikes) and the right to a good job, a house full of modern appliances, personal transport, holidays and a range of leisure facilities are increasingly regarded as 'essentials' to modern life. At the same time people demand a clean and safe environment and expect the principles of sustainable development to be applied to the use of natural resources. When the effects of an increasing global population and climate change are added to the mix the challenges become even more daunting.

Tewkesbury Abbey, Gloucestershire, caught at the confluence of the Avon and Severn rivers experienced some of the worst flooding in living memory during July 2007. The Mill Avon runs from left to right at the bottom of the photograph. Its route can be traced along the line of boats up to the Abbey Mill (far right). The River Swilgate is also in flood (top of photograph).

Water and food

Providing clean drinking water is a huge challenge and in many parts of the world groundwater (water stored in underground aquifers) is the only available source. We have been helping developing countries to utilise and protect their groundwater resources for over fifty years, with a focus on helping people in rural communities to manage and maintain good quality supplies using appropriate local technology. Work in the UK is focused on sustainable groundwater management, aquifer vulnerability and groundwater quality in the face of growing demands for clean water and the effects of climate change. An important part of this is improved characterisation of key aquifers such as the Chalk and Sherwood Sandstone Group using innovative new methodologies for modelling the detailed subsurface geology in three dimensions. Another new development is the use of low-level airborne geophysical surveys, flying at just 55 metres above the ground, to measure changes of electrical conductivity in the subsurface related to pollution and to define structural controls on the movement of groundwater.

The connection between geology and food might not seem obvious at first sight, but soil type and quality are intimately related to the underlying

geology (the soil parent material). As well as being the medium for growing crops, soils also perform important functions such as acting as a filter for rainwater entering subsurface aquifers. We have recently established a suite of collaborative projects to determine soil characteristics and provide improved soil maps using our extensive archives of geological, geophysical and geochemical data together with new analysis and geostatistical techniques. The health of crops and grazing animals is also influenced by the chemical balance of the soil and the distribution of trace elements — information provided by our national geochemical survey (G-BASE) of soils, stream sediments and stream waters.



Clean water — a basic right and a major challenge.



Tourism and leisure: our landscape is fashioned by the geology. Ben Mor Coigach mountain in the North West Highlands Geopark is composed of Torridonian rocks around 900 million years old. The geopark also includes some of the oldest rocks in Europe such as the Lewisian Gneisses which are almost 3000 million years old.

Life, health and property

No one can guarantee perfect safety from natural events but we are working in many areas at home and abroad to help reduce the risks to life and property. International examples range from monitoring of the Soufrière Hills Volcano on the Caribbean island of Montserrat (to support emergency planning and future development), to research into the causes and impacts of tsunamis in different geological settings. Closer to home, our activities cover a wide spectrum including monitoring leakage from landfill sites, mapping landslides, identifying areas at risk from extreme weather events, mapping concealed mineshafts, and defining areas at risk to subsidence, flooding, coastal erosion and the release of natural radon gas from the rocks. All of these are aimed at characterising the risks, understanding the underlying processes and helping people mitigate and manage the risks in the context of a rapidly changing world.

Flooding in Britain in the summer of 2007 caused widespread damage to crops and untold misery to people whose homes were flooded. There is nothing the BGS can do about the weather but our geological maps can provide important insights into where flooding has occurred in the past (from mapped fluvial deposits and floodplain terraces), especially major events that occurred before records began.

We have compiled this information into a new Geological Indicators of Flooding map that complements other methods for predicting where flooding might occur and provides important information on 'extreme events' of the sort we might expect as the climate warms.

Energy and minerals

The ready availability of energy underpins every aspect of our daily lives and the citizens of developing countries quite rightly aspire to the same standard of living as those of us in more developed nations. The vast majority of our energy still comes from fossil fuels (oil, coal and gas) but the risk of global warming from ever-increasing carbon dioxide (CO₂) emissions is becoming widely accepted. Renewable energy will become more and more important but development of methods to reduce CO₂ emissions will be a vital part of the medium term energy strategy. The BGS is engaged in some major research projects with others around the world

on 'carbon capture and storage' to enable CO₂ from power plants to be buried deep underground. We also work closely with government and industry to support efficient extraction of the remaining oil and gas reserves and promote the introduction of 'clean coal' power generation.

In the nuclear sector Britain has a legacy of waste that must be dealt



A BGS team monitoring the Montserrat volcano.

This image is a product of the programme of work carried out in Montserrat by the BGS under contract to the GoM.



with, irrespective of whether a new generation of nuclear power stations is built. Underground storage is generally accepted as the safest option but clearly requires a detailed understanding of the subsurface conditions — an area of research we have been involved in for many years. A recent example of our role in the renewables sector is the new GeoReport service to provide information on ground conditions for the installation of ground source heat pumps.

The challenges in the minerals sector are just as great. Our houses and almost every modern appliance we use are made from materials extracted from the Earth. Recycling will play an important part but metals and construction materials will continue to be needed. Some can be sourced from the world market (although we should be mindful not to export our environmental problems to poorer parts of the world), while bulk minerals such as sand, gravel and aggregates are best supplied locally. One of the most important challenges will be to manage the extraction of mineral resources with the minimum impact on local communities and the environment. We are working closely with government and industry, and increasingly with economists and social scientists, to support mineral planning and apply the principles of ‘sustainable development’ to the minerals sector. We have also started to look at the important issue of ‘carbon footprint’ in order to compare the combined impact of extraction and transport on the environment.

Sport, leisure and heritage

Leisure activities might be considered a luxury rather than an ‘essential’ but there is no doubt that they are an important part of modern life. So what is the link with geology? One example is the London 2012 Olympic and Paralympic Games where we are developing a 3D geological model of the site to support construction work and also analysing the carbon footprint of the huge quantities of construction minerals required to develop the facilities.

We should also remember that our landscapes are fashioned by the underlying geology and that some of the most scenically beautiful areas of the UK are also the most geologically interesting. We have been actively involved in recent years with national park authorities, heritage organisations, environmental groups, industry and government bodies to establish a series of UN-designated Geoparks and to write ‘popular publications’ to help people enjoy the countryside and their geological heritage. We are also helping to conserve our built heritage by undertaking research into the weathering of building stones and finding new sources of supply for repairing our historic buildings.

Underpinning all of this is our commitment to providing a consistent ‘framework’ of information on the surface and subsurface geology and geo-environmental characteristics of the UK to support sound decisions on managing the environment. Geology does, quite literally, underpin everything.

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We must attempt to manage the extraction of mineral resources with the minimum impact on local communities and the environment.