

# Recording and delivering seismic and geomagnetic data

## Achieving high standards of reliability

by David Kerridge & Simon Flower, *Edinburgh*

**F**ollowing earthquakes and magnetic storms there is a high level of demand for prompt access to information from a range of BGS customers. The BGS produces the data needed to respond to customers by operating the UK's seismic network and magnetic observatories, which are equipped with sensors continuously monitoring seismic and geomagnetic activity. Because the

systems are recording geophysical time-series data, a high level of instrument reliability and continuity of recording is vital — if a piece of equipment is out of action when an interesting event occurs, the opportunity to record that event is lost forever. Reliable collection of data from the sensors, and efficient methods for transmission of the data to the BGS offices in Edinburgh for analysis and subsequent dissemination of data

products, are essential in providing the level of service expected by customers. This article describes the recording and communication systems that have been developed to ensure that high standards of service are achieved.

### Earthquake Monitoring

The BGS seismic network consists of 141 seismometer stations spread throughout the UK, from the Channel Islands in the south to the Shetland Islands in the north, with a further five stations in the Faeroes. At each of the stations a seismometer is located in a pit and data is transmitted over the 458 MHz UHF radio band to one of 24 collection nodes. At the data collection node the data is digitised to produce 100 Hz samples, time-stamped using either Global Positioning System (GPS) or a radio-transmitted time standard, and recorded on a computer. During the recording process the data are analysed to detect seismic events and event files are generated and saved. The event data are transferred to Edinburgh four times a day (or on demand during periods of particular interest) using either dial-up telephone lines or the public Internet. The data are analysed to determine the location, magnitude and nature of an event (e.g. earthquake, explosion, or mining-induced seismicity) before customers are informed and the results are posted on the BGS web pages.



When earthquakes occur, either in the UK or abroad, interest from the BGS's wide spectrum of customers in government and industry, and from the media and the public, is intense. BGS scientists need to be able to make rapid, accurate interpretations in order to satisfy the demand for information. A 24-hour on-call service is operated, with computer connections between staff members' homes and the BGS Edinburgh office allowing rapid analysis of data.

The BGS has installed similar seismic networks overseas — Montserrat, Hong Kong and Portugal for example — and is involved in international efforts for seismic data exchange. As part of an EU-funded project aimed at improving the response to large earthquakes in Europe, the BGS has developed methods to automatically provide rapid alerts and data to the European Mediterranean Seismological Centre in France following detection of significant earthquakes by the UK network.

### Recording the Earth's magnetic field

The BGS runs three geomagnetic observatories in the UK and three overseas. At each site a highly sensitive magnetometer is kept in a non-magnetic and, where possible, temperature-controlled environment. A high-precision digitiser converts the analogue output of the magnetometer into digital form to be

read by computer. A clock, synchronised to GPS time, is used to time-stamp the data samples. Data, with sampling rates up to 1 Hz, are recorded and stored for a number of days, allowing for short-term failures in data communications. Computers at the BGS office in Edinburgh call the observatory data loggers every few minutes to retrieve the data, using either dial-up lines over the public telephone network (both analogue and ISDN), satellite telephone systems (such as INMARSAT) or the public Internet. Some observatories have METEOSAT satellite transmitters and here data are transmitted once an hour. Once the data have passed automated quality control checks they are processed, and data products are generated. Customers expect data transmissions to be both timely and reliable and both the public Internet and dedicated telephone links are used.

Because magnetic observatories are sited in remote locations to minimise man-made disturbances, electricity supplies and telephone communications tend to be unreliable. The UK observatories are equipped with stand-by generators to cover loss of the electrical supply and they have more than one method for data communication. Back-up magnetometers and data recording systems are installed, as far as possible from the primary systems, to provide redundancy.

Some of the most widely used geomagnetic data products are global indices of magnetic activity formed by combining records from magnetic observatories around the world. The BGS plays a leading role in the INTERMAGNET programme, encouraging all observatories to adopt modern standards for data collection, analysis and transmission. More than half the world's observatories are now operating to INTERMAGNET standards and this is enabling faster production of global indices.

*Power at remote seismometer sites is provided by batteries backed up by solar panels.*



Ted Harris, BGS © NERC

*Data from the BGS magnetic observatory in the Falkland Islands are transmitted to Edinburgh every hour by satellite.*

### Future Developments

The infrastructure provided by the UK seismic network offers the potential to monitor environmental conditions in rural areas, recording meteorological parameters, levels of ultraviolet radiation, radioactivity and the concentrations of atmospheric pollutants, for example. These measurements can be transmitted together with seismic data using existing communications equipment. A demonstration project is under way to show feasibility, and to acquire multi-parameter data-sets over several months.

To maintain the operations of the BGS seismic network and magnetic observatories requires continual hardware and software development, applying state-of-the-art technology to ensure the provision of high-quality data and data products by means of reliable recording, communication and analysis systems. With the support of its customers the BGS will invest to continue to provide relevant and timely seismic and geomagnetic data and services.

*For further details contact  
Simon Flower on:*

**Tel: 0131 667 1000**  
**E-mail: [smf@bgs.ac.uk](mailto:smf@bgs.ac.uk)**

