

Explosive research

Monitoring Montserrat's volcano – past, present and future

Since 1995, British Geological Survey researchers have been monitoring an explosive volcano on the Caribbean island of Montserrat. **Sue Loughlin, Brian Baptie and Bill McCourt** discuss the handover to Caribbean volcanologists and their plans for the huge volumes of data in their hands.



Lee Jones (BGS) prepares to survey the lava dome using ground-based LiDAR, August 2005.

Montserrat, sometimes known as the Emerald Isle, is a small island, only 16 kilometres long and yet it contains four separate massifs, one of which is the impressive and active Soufrière Hills Volcano.

Major volcanic activity probably took place about 330 years ago, but there were increases in seismicity and hot spring activity in 1897-98, 1933-37 and 1966-67. These 'seismic crises' are believed to have been failed eruptions caused by magma rising beneath the volcano but not reaching the surface.

The British Geological Survey (BGS) began its links with Montserrat in 1936 when Dr Archibald MacGregor was asked

by the Royal Society to investigate the second seismic crisis. The relationship was renewed in 1995, when, after three years of rumbling, the volcano finally erupted. The southern part of the island was evacuated and a thick layer of ash engulfed the Georgian capital, Plymouth, the only town on the island.

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BGS, along with the Seismic Research Centre (SRC) at the University of the West Indies, took joint responsibility for managing and staffing the Montserrat

Volcano Observatory (MVO) until 1999. BGS then took sole responsibility with continued support from SRC. We monitored the volcano intensively 24 hours a day, kept the authorities and public informed and provided warnings of impending activity wherever possible.

Natural laboratory

The Soufrière Hills Volcano has been a natural laboratory for the science of volcanology. We have detailed many diverse volcanic phenomena throughout the ongoing eruption, including lava-dome growth and collapse (within the crater, thick lava piles up to build a dome), pyroclastic flows (the red-hot avalanches of volcanic

debris and gas that move at frightening speed), explosions and lateral blasts.

Continuous volcano monitoring provides clues about complex volcanic processes, for example, we recognise the signs of magma pressurisation and can therefore forecast periods of unrest. Torrential rain can trigger lava dome collapse so weather systems are also tracked. Nevertheless, some volcanic activity takes place with no apparent precursory activity making forecasting difficult.

Well over a hundred scientists from around the world have studied the eruption. The wealth of data collected has led to major advances in our understanding of the generation and ascent of magma and the dynamics of eruptive processes at the volcano. We can now model cycles of activity in terms of magma ascent, degassing, crystallisation and subsequent pressurisation as it rises up beneath the lava dome.

Despite our best efforts, the driving forces of the eruption at depth remain, to a large extent, unknown. A recent international project, SeaCALIPSO, co-funded by NERC, BGS and others, is one of the most ambitious seismic experiments yet conducted at an active volcano and is addressing this problem. The team is constructing three-dimensional models of the Earth's crust under Montserrat. These

Torrential rain can trigger lava dome collapse.

will include new geophysical, geological and geochemical observations and should significantly improve our understanding of magma movement and storage at depth.

The data we have gathered whilst monitoring Soufrière Hills Volcano is a valuable resource. As a National Geoscience Data Centre, BGS is well placed to manage these vast, valuable datasets and make them available to others. Data exist in varying formats from field notebooks, photographs to continuous GPS and broadband seismic data. Collaborative studies on these data continue to generate fascinating insights into the volcano's behaviour.

The data are also being put to use in education. A role play activity has been tested in secondary schools in the East Midlands based on the fatal 25 June 1997 partial lava-dome collapse.

This activity was used as the science case study in the launch of the new 2008-09 *STEM Directory* – a science resource for



Graham Ryan (BGS) and Raquel 'Tappy' Syers (MVO) carry out photogrammetric and Electronic Distance Measurement (EDM) surveys of the volcano.

teachers – at the British Association Festival of Science in September last year.

Indeed, we have made data available for educational resources and websites worldwide. We intend to develop this work further and provide data in formats useful to different sectors of the educational community.

Part of the contract between the government of Montserrat and BGS was for BGS to recruit an entirely regional scientific staff to monitor the volcano and to hand over to that team in 2008. Two Montserratian students carried out postgraduate research in volcanology in the UK and joined the observatory staff in 2004.

The observatory is now managed by the regional agencies: SRC who monitor all volcanoes in the Lesser Antilles, with support from the Institut de Physique du Globe de Paris who also monitor volcanoes on the French islands of Guadeloupe and Martinique.

BGS has established a new Earth Hazards and Systems programme committed to continued collaboration with the UK and international volcano research community as well as managing and using existing data stored at BGS. It's hoped that this unusually large and diverse resource will continue to generate exciting and productive collaborative research long into the future. Our research into this and other volcanoes worldwide will continue as we seek to better understand volcanoes and mitigate their hazards. ❖

Understanding volcanoes and forecasting hazardous volcanic activity is an ongoing challenge to the scientific community. Quite apart from direct hazards to people living nearby, volcanic ash can damage aircraft and destroy agricultural land over vast areas for long periods and volcano-generated tsunamis can affect distant shorelines.

See www.planeteearth.nerc.ac.uk for more information on NERC's volcano, earthquake and tsunami research.



Thomas Christopher (BGS) and Mick Strutt (BGS) sample fresh pyroclastic flow deposits in Tar River valley, November 2005.

MORE INFORMATION

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Links

www.mvo.ms
www.bgs.ac.uk/education/volcanoes.html
www.bgs.ac.uk/photoarchive/home.cfm
www.stemdirectories.org.uk
www.stemdirectories.org.uk/catastrophe.asp