

# **ASSESSMENT OF THE HAZARDS AND RISKS ASSOCIATED WITH THE SOUFRIERE HILLS VOLCANO, MONTSERRAT**

## **20<sup>th</sup> Report of the Scientific Advisory Committee on Montserrat Volcanic Activity<sup>1</sup>**

Based on a meeting held between November 2<sup>nd</sup> and 5<sup>th</sup>, 2015 at the Montserrat  
Volcano Observatory, Montserrat

### **Part I: Summary Report**

Issued on December 10<sup>th</sup>, 2015

- There has been no significant surface activity at the volcano during the last year and the current pause has extended to five and a half years. The absence of any pyroclastic flow or major rock fall activity implies an ongoing stabilisation of the lava dome. However, temperatures of volcanic gases that escape through fractures and fumaroles have remained high.
- Seismicity overall has further declined except for occasional short bursts of volcano tectonic earthquakes, sometimes accompanied by an elevated output of sulphur dioxide. Observations of continuous outgassing and ground deformation indicate that the volcano remains in a state of internal unrest and that lava extrusion is still possible.
- Comparable to last year, our estimates remain at the similar level of risk to the people of Montserrat due to potential hazards from the volcano. For people living in Zone A we estimate the odds of an individual's death due to the volcano in the next year at about 1-in-4,000,000. For Zone B we estimate those odds at about 1-in-17,000, and for Zone C at about 1-in-8,000.

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<sup>1</sup> The information provided in both parts of this Report is advisory. It is offered, without prejudice, for the purpose of informing the party commissioning the study of the risks that might arise in the near future from volcanic activity in Montserrat, and has been prepared subject to constraints imposed on the performance of the work. While Committee members believe that they have acted honestly and in good faith, they accept no responsibility or liability, jointly or severally, for any decisions or actions taken by HMG or GoM or others, directly or indirectly resulting from, arising out of, or influenced by the information provided in this report, nor can they accept any liability to any third party in any way whatsoever.

## **Volcanic activity**

During the last year, volcanic surface activity has remained at a very low level; no pyroclastic or significant mud flows occurred. However, temperatures of volcanic gases that escape through fractures and fumaroles in the lava dome have remained high, with the hottest fumaroles maintaining 600<sup>0</sup>C over the five and a half years since the last major activity. Flow of hot gas mainly derived from the deep magma reservoir is maintaining the fumaroles at high temperature. The MVO measured sulphur dioxide emissions ranging between 300 and 400 tonnes/day. These conditions might continue for a long time, even without any new magma influx.

Whenever gases are trapped somewhere beneath the volcano and a certain overpressure is reached, short bursts of volcano tectonic earthquakes (so-called VT strings) herald the opening of cracks and escape routes for the stored gas. On some occasions, this type of seismicity will be accompanied by ash venting from vents located in or near the collapse scar of February 2010. Six VT strings have been detected by MVO over the last year.

The monitoring of ground deformation indicates a slow but steady lengthening trend over the island as well as a significant amount of uplift of several centimetres. This apparent inflation which follows a continuous trend over the last 5 years must be interpreted in the context of previous periods of strong deflation during magma extrusion. Several processes such as rebound, pressurisation through magma cooling and crystallisation, or new magma influx could explain these observations. Given the long time scale of these processes it is too early to resolve which process, if any, could be dominant.

Based on the current observations and monitoring results we conclude that the volcano remains in a state in which lava extrusion is still possible at short notice; however, there is no indication that this is imminent. We think there is less than 22% probability that magmatic surface activity, such as lava extrusion or explosions, will resume at some time during the next 12 months.

## **Volcanic Hazards**

Hazards from rock falls, pyroclastic flows of limited reach, minor explosions and mudflows remain a possibility over the next year. Even without lava extrusion a collapse of the dome that is larger than any so far in the present pause, with more extensive pyroclastic flows also remains possible but less likely.

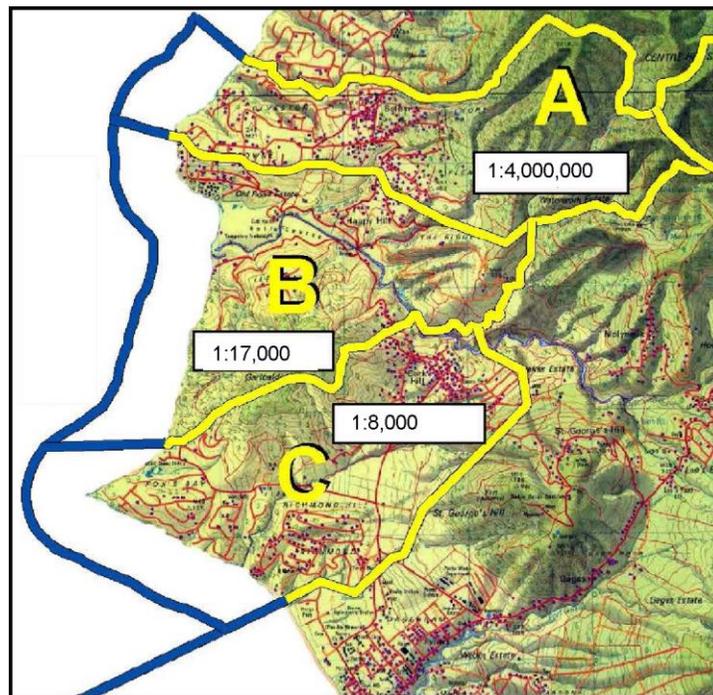
A resumption of lava extrusion would require magma to rise within the dome likely producing an initial period of increasing surface activity, such as ash venting and small explosions. This initial activity is unlikely to be hazardous to Zones A, B and C but ash fall and, in more energetic explosions, small rocks might reach these areas. Such hazards are more likely to affect areas within the Zone V, such as Plymouth and St George's Hill.

If fresh lava pressurises the dome or reaches the surface, hazard levels could rise rapidly. Subsequent pyroclastic flows and explosions are likely to be much more energetic and more widely hazardous than those produced during the previous active phase.

Given the vigilance of MVO, and assuming the continued maintenance and upgrade of the monitoring networks we consider it very likely that signs of resuming lava extrusion would be picked up by MVO; however renewed volcanic activity without precursors cannot be completely ruled out.

### Risks during the next year

We have applied our usual method of quantitative risk assessment using expert judgment on the probability of future events, together with risk modelling. Note that the risk values will need to be re-assessed following any major change in behaviour, e.g. resumption of lava extrusion or significant increase in seismicity, ground deformation or gas emission.



*Fig. 1 Map of Hazard Level boundaries for Zones A-C together with estimated, rounded annual risks from volcanic hazards of death for full-time residents, averaged over zones A, B and C , respectively.*

We assess the current overall risk of death from volcanic hazards for the population of Montserrat to be similar to last year. For a full explanation of how these values are derived, see the Full Report.

## Risks in Zones A, B & C

The average annual risks of a full-time resident individual being killed by volcanic activity have remained at broadly similar levels in all Zones (Figs 1 & 2). These values are expressed as ‘odds’ rounded to the nearest 1000, and compared with the estimates from the previous year:

Zone A	1-in-4,000,000 (1-in-950,000 at SAC19)
Zone B	1-in-17,000 (1-in-95,000 at SAC19)
Zone C	1-in-8,000 (1-in-29,000 at SAC19)

For residents of Zone A, this exposure to volcanic risk is now less than that for hurricanes. For residents of Zone B it is less than the domestic risk of accidental death.

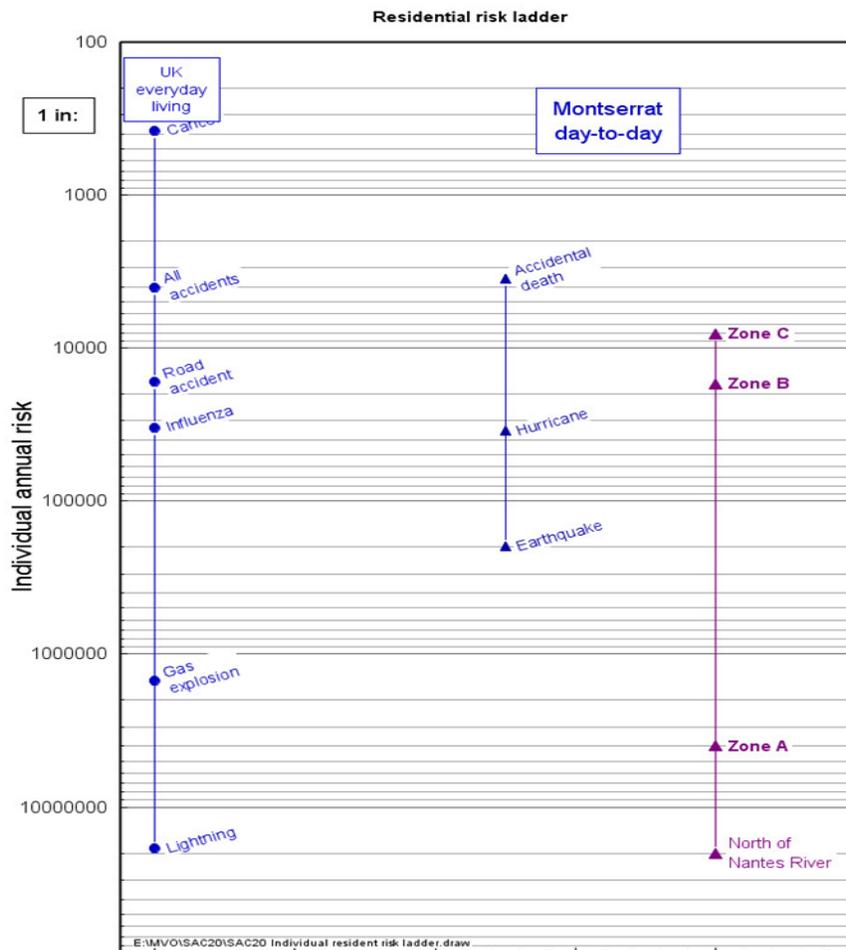


Fig.2 Relative individual annual risk from the volcano for full-time Montserrat residents compared with other non-volcanic risks in Montserrat (centre) and everyday risks in the UK (left). The scale of risk is logarithmic, increasing upwards and expressed numerically as odds (left-hand scale).

**Risks in Zone V**

As in previous years we have analysed the risks to workers who might be involved in shipment of sand and gravel on barges from Plymouth jetty in Zone V. We assess this to be a risk of death over a year of 1-in-12,500 assuming restricted working hours and full safety measures are being followed. We have also assessed the risk to guided tourist groups visiting for short intervals Plymouth and St George's Hill. See Part II, the Full Report, for the details of this assessment and our other findings.