

## **Aviation services**

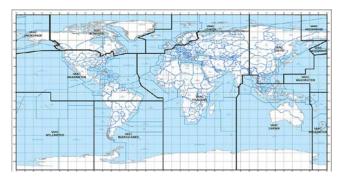
# Volcanic ash

#### Hazardous phenomena

Volcanic ash in the air is composed of fine pulverised rock, minerals and glass and is accompanied by a number of gases which are then converted into droplets of sulphuric acid and other substances. It is extremely hazardous to aircraft and their passengers.

### Introduction

There are 9 Volcanic Ash Advisory Centres (VAAC) that detect, track and forecast the movement of volcanic ash clouds and provide advice to meteorological watch offices (MWO) in their area of responsibility. These VAACs are Anchorage (US), Buenos Aires (Argentina), Darwin (Australia), London (UK), Montreal (Canada), Tokyo (Japan), Toulouse (France), Washington (US) and Wellington (NZ).



Volcanic Ash Advisory Centres - areas of responsibility

The highest concentration of active volcanoes lies along the rim of the Pacific Ocean, the so-called 'Pacific Ring of Fire' which stretches northwards along the western edge of South and North America, across the Aleutian and Kuril Island chains, down through the Kamchatka Peninsula (Russia), Japan and the Philippines and across Indonesia, Papua New Guinea and New Zealand to the islands of the South Pacific. In a 40,000 km horseshoe shape, it is associated with a nearly continuous series of oceanic trenches, volcanic arcs, and volcanic belts and/or plate movements. Other active volcanic regions are in Iceland, along the Great Rift Valley in Central and East Africa, and in countries around the Mediterranean.



The Pacific Ring of Fire

#### Effects on aviation

The most critical effect of volcanic ash on aviation is caused by ash melting in the engine, and then fusing into a glass-like coating on components, causing loss of thrust and possible engine failure. In addition, there may be an abrasion of engine parts, the airframe and those parts protruding from the aircraft, and possible clogging of the fuel and cooling systems.

## Volcanic activity

The behaviour of erupting volcanoes ranges from a quiet, steady effusion of lava to highly explosive eruptions which may blast several cubic kilometres of volcanic ash and corrosive gases high into the atmosphere. An ash cloud from a large volcanic eruption can remain in the atmosphere in dangerous concentrations for many days. Over this time, it can travel many thousands of kilometres with the prevailing winds.

Some volcanoes eject modest ash clouds on a regular basis, whereas others are generally quiet until a big eruption event. Bagana (Papua New Guinea) and Dukono (Indonesia) are examples of volcanoes that are known to be regular



Tavurvur volcano, Rabaul, PNG. Credit: iStock

emitters of modest amounts of volcanic ash. Some switch between modes very easily, for example Semeru (Indonesia) and Manam (Papua New Guinea).



Mount Lewotobi Laki-Laki, Indonesia. Credit: NASA

The movement, spread and dispersion of volcanic ash clouds depend upon:

- the altitude reached by the ash cloud
- the nature and strength of the eruption
- the meteorological condition of the atmosphere, e.g. atmospheric stability, wind shear and precipitation (as ash particles can be 'rained out')
- the ash concentration and the size distribution of particles.

## Detection and monitoring

The VAAC Darwin is responsible for the monitoring of various sources of information (e.g. ground reports, satellite imagery, pilot reports, social media) for volcanic activity within its area of responsibility (which includes Indonesia, the southern Philippines, Papua New Guinea and the western Solomon Islands).

A pilot in command of an aircraft must make a special AIREP as soon as practicable after encountering or observing any volcanic ash cloud, pre-eruption volcanic activity or volcanic eruption.

Indicators that an aircraft is encountering volcanic ash may include:

- **Odour**. A smoky or acrid odour that can smell like electrical smoke, burnt dust or sulphur.
- Haze. Haze within the aircraft cockpit and/or cabin, with dust settling on surfaces.
- Changing engine conditions. Surging, torching from the tailpipe, and flameouts. Changes in engine temperatures. A white or orange glow at the engine inlet.
- Airspeed. If volcanic ash fouls the pitot tube, the indicated airspeed can decrease or fluctuate erratically.
- Pressurisation. Change in cabin pressure and possible loss of cabin pressure.

- Static discharges. St Elmo's Fire (blue sparks or glow)
  can appear to flow up the outside of the windscreen,
  or a white glow can appear at the leading edges of
  the wings or at the front of the engine inlets.
- Windscreen. The windscreen can become eroded and opaque very quickly.



St Elmo's Fire seen from a cockpit. Credit: iStock

## Forecasts and warnings

It is important that pilots flying over areas known for volcanic activity review all relevant forecasts, advisories and warnings prior to departure and monitor updates enroute.

While long-term forecasting of volcanic eruptions is not possible, volcanologists are able to give short-term forecasts based on their own monitoring techniques (e.g. seismic activity, ground deformations). Although primarily used for providing warnings to local communities, this information can be used by VAACs in providing advice to the aviation industry on imminent eruptions and their expected nature (e.g. whether an eruption is likely to reach cruising levels).

The following aviation products can include volcanic ash information:

- Volcanic ash advisory (VAA) and graphic (VAG)
- SIGMET and AIRMET
- Significant weather chart (SIGWX)
- Meteorological report (METAR/SPECI)
- Aerodrome forecast (TAF)
- · Graphical area forecast (GAF)
- Aerodrome warning
- · Volcanic activity report (VAR)
- Special air report (AIREP).

Further aviation educational resources produced by the Bureau of Meteorology can be found at www.bom.gov.au/aviation/knowledge-centre.

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