

# TWO MOST ACTIVE VOLCANOES



## IN BICOL REGION



# MAYON VOLCANO

## THE MOST ACTIVE VOLCANO

- ❖ Mount Mayon is the most active volcano in the Philippines. Since 1616 there were 47 eruptions.
- ❖ From 1616 until 2002 at least 1300 people died and thousands of people got homeless as a result of all the eruptions. The most recent eruptions were in 1947, 1984 and 1993. In 1993 the activity started with explosions. Half an hour later, flows of lava (molten rock) and pyroclastic flows (flows with mixtures of hot, dry rock fragments and hot gases).





# MAYON VOLCANO

## THE MOST ACTIVE VOLCANO

- ❖ They flows may result from the explosive eruption of molten or solid rock fragments, or both) came out of the crater in the top of the volcano. It killed 68 people and 60 000 people had to be evacuated.





# MAYON VOLCANO

## VOLCANO TYPE

- ❖ Mount Mayon is a splendid example of a strato volcano. Mount Mayon rises up 2462 meters above sea level.
- ❖ 8077FT ,131458.8677 N ,1234146.0947 E
- ❖ This type of volcano is typically steep-sided and composed of alternating layers of lava (the melted mass - magma - which came out of the crater) and other volcanic material, especially ash layers.





## THE LOST VILLAGE OF CAGSAWA

- ❖ In 1818 enormous flows of lava came over the village of Cagsawa. The whole village disappeared under the layers of 'lava' and 'pyroclastic flows'. Only the the top of the church reminds of the period that once there was a village.



# MAYON VOLCANO

**Eruption list:** 1616, 1766, 1800, 1811(?), 1814, 1827, 1834, 1839, 1845, 1846, 1851, 1853, 1855, 1857, 1858, 1859, 1860, 1861, 1862, 1863(?), 1868, 1871-72, 1872, 1873, 1876, 1876, 1881-82, 1885, 1886-87, 1888, 1890, 1891-92, 1893, 1895, 1896, 1897, 1900, 1902(?), 1928, 1928, 1939, 1941, 1943, 1947, 1968, 1978, 1984, 1993, 1999-2000, 2001, 2002, 2003, 2003(?), 2004, 2006, 2009, 2013



# MAYON VOLCANO

## 1814 ERUPTION



An old photograph of the Cagsawa Ruins with the façade still standing. The church was largely destroyed during the 1814 eruption of Mayon.



## 1984 and 1993 ERUPTIONS



Mount Mayon in eruption on July 21,  
1928



Mayon Volcano on September 23,  
1984



# MAYON VOLCANO

2009–2010 eruption



Mayon Volcano in eruption on December 29, 2009.






# Mayon Volcano in satellite image







Bulusan Volcano  
1565 M ASL

# MOUNT BULUSAN

- ❖ Stratovolcano 1565 m / 5,134 ft
- ❖ Luzon Island, Philippines,  $12.77^{\circ}$  N /  $124.05^{\circ}$  E
- ❖ Current status: minor activity or eruption warning (3 out of 5)
- ❖ Bulusan, one of the most active volcanoes in the Philippines, is Luzon's southernmost volcano. It lies at the SE end of the Bicol volcanic arc occupying the peninsula of the same name that forms the elongated SE tip of Luzon island.

# MOUNT BULUSAN

- ❖ Bulusan is a young andesitic volcano built upon the NE rim of an older dacitic-to-rhyolitic caldera, the 11-km wide Irosin caldera, which was formed about 35,000-40,000 years ago.





# MOUNT BULUSAN

- ❖ Bulusan is flanked by several other large intracaldera lava domes and cones, including the prominent Mount Jormajan lava dome on the SW flank and Sharp Peak to the NE. The summit of 1565-m-high Bulusan volcano is unvegetated and contains a 300-m-wide, 50-m-deep crater. Three small craters are located on the SE flank.

# MOUNT BULUSAN

- ❖ Many moderate explosive eruptions have been recorded at Bulusan since the mid-19th century.





# MOUNT BULUSAN

Typical eruption style:

- ❖ Explosive. In historic time, frequent small to moderate phreatic and phreatomagmatic ash eruptions. Mudflows from loose deposits on flank are often generated when heavy rains fall (e.g. during taifuns).
- ❖ **Last update:** 7 May 2015 (intermittent phreatic explosions)

# MOUNT BULUSAN

## BULUSAN VOLCANO ERUPTIONS

2011, Oct 2006-07, Mar-Jun 2006, 1994, 1988,  
1983, 1981, 1979, 1978, 1933, 1928, 1918-22,  
1916, 1894, 1892, 1889, 1886, 1852(?)



# MOUNT BULUSAN

## March - June, 2006

- ❖ The Philippine Institute of Volcanology and Seismology (PHIVOLCS) declared Alert Level 1 on March 19, 2006 after it recorded increased seismic unrest.
- ❖ On June 8, 2006, volcanologists raised the Alert Level to 2 (moderate level of seismic unrest) after it spewed ash. On June 9, the resulting ash cloud damaged a number of houses in the nearby town of Casiguran, 5 kilometers (3.1 mi) north of the volcano, and reached Sorsogon City, about 20 kilometers (12 mi) north of Bulusan.

# MOUNT BULUSAN

March - June, 2006

- ❖ On June 13, 2006, volcanologists said new craters were created by the mild explosions of Mount Bulusan. Aside from the new craters, two of the volcano's four craters appeared to have merged and cracks were observed on the crater on the western side of the summit. Another eruption took place on April 8, 2007



# MOUNT BULUSAN

July – October, 2007



Mount Bulusan in active mode on  
February 2007

# MOUNT BULUSAN

May, 2015

- ❖ Mount Bulusan ejected a 250 m (820 ft) ash plume in May 1, 2015 at around 9:46 PM, lasting for 3.5 minutes. The incident is classified as a "minor explosion event" by PHIVOLCS leading to the raising of Alert Level 1 (abnormal activity) for the surrounding area. A second ash explosion lasting for five minutes also occurred on the same day. PHIVOLCS determined the cause of the eruptions to be hydrothermal activity beneath the volcano.



# MOUNT BULUSAN

May, 2015

- ❖ People were advised not to enter the 4 km (2.5 mi) Permanent Danger Zone. Further advisories were given to low-flying aircraft against the dangers of sudden phreatic eruptions, and to local residents near rivers and streams in case of lahar flows.

# CONTINGENCY PROCEDURE DURING VOLCANO ERUPTION

Legazpi Aerodome Tower/Approach Control Facility



# 1. General Description

## 1.1 Standard Legazpi Control

Tower/Approach procedures in the event of a volcanic eruption.

## 2. Objective

2.1 To provide Legazpi Tower/Approach personnel a set of standardized procedures and guidelines for the provision of information to all stakeholders before and during a volcanic eruption.

#### 4. PHASES OF AN EVENT. The table below shall serve as guide in the course of actions in the event of a volcanic eruption

PHASES OF EVENT	DEFINITION	ACTIONS TO BE TAKEN BY LP ATC
<p>1. PRE-ERUPTION PHASE (When Application)</p>	<p>When flight operations are planned in areas that are susceptible to volcanic eruptions. The focus of this phase is to gain early recognition of volcanic events. Initial awareness may be by means of a special AIREP/VAR and/or from information provided by meteorological or volcanological agencies. Emphasis is place on rising awareness of the hazard and to protect aircraft in flight.</p>	<p>“raising the alert”</p> <ol style="list-style-type: none"> <li>1. Monitor the volcanic activity.</li> <li>2. Inform aircraft about the potential hazard and continue to provide normal services.</li> </ol>



#### 4. PHASES OF AN EVENT. The table below shall serve as guide in the course of actions in the event of a volcanic eruption

PHASES OF EVENT	DEFINITION	ACTIONS TO BE TAKEN BY LP ATC
<p>2. START OF ERUPTION PHASE</p>	<p>This phase commences at the outbreak of a volcanic eruption, with volcanic ash being ejected into the atmosphere.</p> <p>The focus of the processes in this phase is to protect aircraft in flight and at aerodrome from the hazards of the eruption through the collection and use of relevant information.</p>	<ol style="list-style-type: none"> <li>1. Receive PIREPs and forward them to the appropriate authorities to ensure its dissemination to all concerned;</li> <li>2. Inform flights about the existence, extent and forecast movement of volcanic ash and provide information useful for the safe and efficient conduct of flights.</li> <li>3. Avoid initiating a clearance through a danger area;</li> </ol>

#### 4. PHASES OF AN EVENT. The table below shall serve as guide in the course of actions in the event of a volcanic eruption

PHASES OF EVENT	DEFINITION	ACTIONS TO BE TAKEN BY LP ATC
		<ol style="list-style-type: none"> <li>4. Inform aircraft about the hazard and continue to provide normal services;</li> <li>5. Devise and update ATFM measures when necessary to ensure safety of flight operations, based on forecasts and available information;</li> <li>6. Maintain close liaison with PAGASA and PHIVOLCS;</li> <li>7. Begin planning for the on-going eruptions, phase in conjunction with the aircraft operators. AFTM units and other stakeholders.</li> </ol>

#### 4. PHASES OF AN EVENT. The table below shall serve as guide in the course of actions in the event of a volcanic eruption

PHASES OF EVENT	DEFINITION	1. ACTIONS TO BE TAKEN BY LP ATC
3. ON-GOING ERUPTION PHASE	The on-going phase commences with the issuance of the first volcanic ash advisory (VAA) which contains information on the extent and movement of the volcanic ash cloud.	<ol style="list-style-type: none"> <li>1. Plan and apply appropriate ATFM measures based on the VAA;</li> <li>2. Report differences between published information and observations (pilot reports, airborne measurements, etc) to appropriate authorities.</li> </ol>
4. RECOVERY PHASE	The Recovery phase commences with the issuance of the first VSS/VAG containing a statement that “NO VA EXP” (i.e.”no volcanic ash expected”) which normally occurs when it is determined that the volcanic activity has reverted to its pre-eruption state and the airspace is no longer affected by volcanic ash contamination.	<ol style="list-style-type: none"> <li>1. Revert to normal operations as soon as practicable.</li> </ol>



**5. Procedures.** The following procedures shall be adhered to by Legazpi Tower/Approach personnel:

**5.1 If a volcano ash cloud is report or forecasted in the Legazpi TMA the following actions should be taken:**

1. Replay all pertinent information immediately to flight crews whose aircraft could be affected to ensure that they are aware of the ash cloud's position and levels affected;

2. Request the intention of the flight crew an endeavour to accommodate requests for re-routing or level changes;

3. Suggest appropriate re-routing to the flight crew to avoid an area of report or forecast ash clouds; and

4. Request a special air-report when the route of flight takes the aircraft into or near the forecast ash cloud and provide such special air-report to the appropriate agencies

## 5.2 When advised by the flight crew that the aircraft has inadvertently entered a volcanic ash cloud, Legazpi Tower/Approach shall:

1. Take such action applicable to an aircraft in an emergency situation; and
2. Not initiate modification of route or level assigned unless requested by the flight crew or necessitated by airspace requirements or traffic conditions.



5.3 When advised by CFR that the runway has been substantially contaminated by volcanic ash, Legazpi Tower/Approach, shall:

1. Suspended landing at the aerodrome;
2. Expedite the departure of aircraft in the aerodrome; and
3. Coordinate with the Airport Manager for the possible closure of the aerodrome.

## DEFINITIONS

*Affected area.* a volume of airspace, an aerodrome or another area on the ground, identified by VAA/VAG and/or SIGMET as being affected by known or forecast volcanic cloud contamination.

*Danger area.* In the context of volcanic ash cloud contamination, a volume of airspace identified by NOTAM as being affected by levels of known or forecast volcanic cloud contamination which states judgement merit publication to operators.

## DEFINITIONS

*Volcanic ash.* Comprised of minerals unique to the volcanic eruption. Minerals common to most volcanic ash are silica together with small amounts of the oxides of aluminum, iron, calcium and sodium. The glassy silicate material is very hard and extremely abrasive. Its melting point is below jet engine burner temperature which introduces additional hazards. (Refer to Section 2.1 of ICAO's Manual on Volcanic Ash, Radioactive Material and toxic Chemical Clouds (Doc 9691)).



# DEFINITIONS

*Volcanic cloud.* The sum of the material ejected from a volcano into the atmosphere and transported by winds aloft. It comprises volcanic ash, gases and chemicals (Refer to Section 2.1 of ICAO's Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (Doc 9691))

## APPENDIX A

### PARTICULAR ASPECTS OF VOLCANIC ASH CLOUD THAT ATS PERSONNEL SHOULD BE MADE AWARE

1. Volcanic ash contamination may extend for hundreds, or even thousands of miles horizontally and reach the stratosphere vertically;
2. Volcanic ash may block the pilot-static system of an aircraft, resulting in unreliable airspeed indications;
3. Braking conditions at aerodromes where volcanic ash has recently been deposited on the runway will affect the braking ability of the aircraft. This is more pronounced on runways contaminated with wet ash. Flight crews and ATS personnel should be made aware of the consequences of volcanic ash being ingested into the engine during landing and taxiing.

## APPENDIX A

### PARTICULAR ASPECTS OF VOLCANIC ASH CLOUD THAT ATS PERSONNEL SHOULD BE MADE AWARE

For departure, it is recommended that pilots avoid operating in visible airborne ash; instead they should allow sufficient time for the particles to settle before initiating a take-off roll, in order to avoid ingestion of ash particles into the engine. In addition, the movement area to be used should be carefully swept before any engine is started;

4. Volcanic ash may result in the failure or power loss of one or all engines of an aircraft; and

## APPENDIX A

### PARTICULAR ASPECTS OF VOLCANIC ASH CLOUD THAT ATS PERSONNEL SHOULD BE MADE AWARE

4. Volcanic ash may result in the failure or power loss of one or all engines of an aircraft; and
  
5. Aerodrome with volcanic ash deposition may be declared unsafe for flight operations. This may have consequences for the ATM system.



# APPENDIX B

## ICAO COLOR CODE OF VOLCANIC ACTIVITY

Aviation color codes are based on four colors and are intended for quick reference only in the international civil aviation community; they are part of the ICAO International Airways Volcano Watch system (IAWW). The Aviation Color Code reflects conditions at or near a volcano and are not intended to pertain to hazards posed at a distance or downwind by drifting ash. The code range from **GREEN** to **RED**

# APPENDIX B

## ICAO COLOR CODE OF VOLCANIC ACTIVITY

ICAO Color Code	State of Volcano's Activity
GREEN	Volcano is in normal, non-eruptive state. <b><i>Or, after a change from a higher level:</i></b> Volcanic activity considered to have ceased, and volcano reverted to its normal, non-eruptive state.
YELLOW	Volcano is experiencing signs of elevated unrest above known background levels. <b><i>Or, after a change from a higher level:</i></b> Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
ORANGE	Volcano is exhibiting heightened unrest with increased likelihood of eruption. <b><i>Or:</i></b> Volcanic Eruption is underway with no or minor ash emission.
RED	Eruption is forecast to be imminent with significant emission of ash into the atmosphere likely. <b><i>Or:</i></b> Eruption is underway with significant emission of ash into the atmosphere.

# APPENDIX C

## MAYON VOLCANO ALERT SIGNALS

Alert Level	Main Criteria	Interpretation/Recommendations
<p style="text-align: center;">0</p> <p style="text-align: center;">No Alert</p>	<p><b>Quiet.</b></p> <p>All monitored parameters within background levels</p>	<p><b>No eruption in foreseeable future.</b></p> <p>Entry in the 6-km radius permanent danger zone (PDZ) is not advised because phreatic explosions and ash puffs may occur without precursors.</p>
<p style="text-align: center;">1</p> <p style="text-align: center;">Abnormal</p>	<p><b>Low level unrest</b></p> <p>Slight increase in seismicity. Slight increase in SO<sub>2</sub> gas Output above the background level.</p> <p>Very faint glow of the crater may occur but no conclusive evidence of magma ascent. Phreatic explosion or ash puffs may occur.</p>	<p><b>No eruption imminent</b></p> <p>Activity may be hydrothermal, magmatic or tectonic in origin.</p> <p>No entry in the 6-km radius PDZ</p>

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## MAYON VOLCANO ALERT SIGNALS

Alert Level	Main Criteria	Interpretation/Recommendations
<p style="text-align: center;">2</p> <p>Increasing Unrest</p>	<p><b>Moderate unrest.</b> Low to moderate level of seismic activity. Episodes of harmonic tremor.</p> <p>Increasing SO<sub>2</sub> flux. Faint intermittent crater glow. Swelling of edifice may be detected.</p> <p>Confirmed reports of decrease in flow of wells and springs during rainy season.</p>	<p><b>Unrest probably of magmatic origin; could eventually lead to eruption.</b></p> <p>6-km radius Danger Zone may be extended to 7 km in the sector where the crater rim is low</p>



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## MAYON VOLCANO ALERT SIGNALS

Alert Level	Main Criteria	Interpretation/Recommendations
<p style="text-align: center;">3</p> <p>Increased tendency toward eruption</p>	<p><b>Relatively high unrest.</b></p> <p>Volcanic quakes and tremor may become more frequent.</p> <p>Further increase in SO<sub>2</sub> flux.</p> <p>Occurrence of rock falls in summit area.</p> <p>Vigorous steaming/ sustained crater glow. Persistent swelling of edifice.</p>	<p><b>Magma is close to the crater.</b></p> <p>If trend is one of increasing unrest, <b>eruption is possible within weeks.</b></p> <p>Extension of Danger Zone in the sector where the crater rim is low will be considered.</p>

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## MAYON VOLCANO ALERT SIGNALS

Alert Level	Main Criteria	Interpretation/Recommendations
<p style="text-align: center;">4</p> <p>Hazardous eruption imminent</p>	<p><b>Intense unrest.</b></p> <p>Persistent tremor, many “low frequency”-type earthquakes.</p> <p>SO<sub>2</sub> emission level may show sustained increase or abrupt decrease.</p> <p>Intense crater glow. Incandescent lava fragments in the summit area.</p>	<p><b>Hazardous eruption is possible within days.</b></p> <p>Extension of Danger zone to 8 km or more in the sector where the crater rim is low will be recommended.</p>

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## MAYON VOLCANO ALERT SIGNALS

Alert Level	Main Criteria	Interpretation/Recommendations
<p>5 Hazardous Eruption</p>	<p><b>Hazardous eruption ongoing</b></p> <p>Occurrence of pyroclastic flows, tall eruption columns and extensive ash fall.</p>	<p>Pyroclastic flows may sweep down along gullies and channels, especially along those fronting the low part(s) of the crater rim.</p> <p>Additional danger areas may be identified as eruption progresses. Danger to aircraft, by way of ash cloud encounter, depending on height of eruption column and/or wind drift.</p>

*Thank You*