Not yet dead but resting in pieces: Soufrière Hills Volcano revisited

The Caribbean is a beautiful place but threatened by tectonic violence. The many West Indian islands that form the outermost ('windward') part of the horseshoe-shaped Lesser Antilles arc mark a dangerous subduction zone where the east-moving Caribbean plate is being pushed over the west moving North American plate. The West Indian islands all have a similar and fairly predictable geology with old cores of volcanic rocks marking the first appearance of the island when volcanoes grew up from the sea floor some several tens of millions of years ago. These are surrounded by fossil-rich limestones deposited on fringing coral reefs. Several islands have young intermittently active volcanoes such as La Soufrière Volcano on the island of St. Vincent and there lies the threat. Soufrière is French for sulphur and it is a recurring name along the Caribbean arc. The Soufrière Hills Volcano on the island of Monserrat some 40 km southwest of Antigua is the most recent to erupt, beginning in 1995 after 350 years of inactivity and destroying the old port city of Plymouth in August 1997. The walls of roofless buildings now protrude through thick covers of ash and pyroclastic debris containing enormous boulders. Soufrière is an unstable cone about 2000 m high (it reaches 1000 m above sea level, having grown up from the ocean floor some 1000 m below where its circular base is 25 km in diameter). A monitoring observatory is operated by the British Geological Survey and Soufrière Hills Volcano is one of the best studied anywhere in the world with its own webcam (http://webcams.volcanodiscovery.com/montserrat).

In early December 2013 I had the opportunity to revisit the island for the first time since 2007 to assess what is happening. Today, Soufrière is officially regarded as 'restless' (it has a grade of 2 on a scale of 5 where 5 denotes an active eruption). The central peak of the volcano is actively growing in height as magma is slowly pushed up through the throat of the volcano.

Soufrèire Hills Volcano in late 2013

Emissions of sulphur dioxide gas spewing from the summit are routinely monitored and is a widely used indicator of the rate at which the volcano is producing magma and thus the likelihood of an eruption; currently emissions are said to be 'moderate' i.e., about 200 tonnes per day. Most of the gas coming out of the volcano is actually water vapour; as much as 1 million tonnes a day during major eruptions, with hydrochloric acid thrown in for good measure. An expanding magma dome is not good news as it acts as a stopper in the volcano's neck with predictable consequences when the volcano eventually clears its throat. The magma is very stiff ('viscous') and is of an andesitic composition relatively rich in silica and water. The latter boils off as it reaches the top of the volcano stiffening the magma still further. The slow upward creep of cooling magma is expressed as small earthquakes and their frequency is a harbinger of massive eruptions when the volcano finally clears its throat to send large columns of ash many kilometres up into the atmosphere. At these times sulphur dioxide emissions can peak at more than 2000 tonnes per day.

A growing magma plug creates a volcanic cone that is frighteningly unstable ('oversteepened') when viewed at close quarters by the trained eye of a geologist. A virtual pack of cards just waiting to collapse when shaken by small earthquakes. Collapse releases red-hot incandescent gases which rapidly expand as they heat up the surrounding air and are able to lift and carry

house-sized rocks downslope at speeds of 100 km/hr. These devastating, fast moving pyroclastic flows are also known as nuée ardentes (French for 'glowing cloud') such as buried Pompeii and Herculaneum in Italy. The name was coined by the French geologist Alfred Lacroix who studied the effects of a deadly flow from Mont Pelée that destroyed the heavily populated (28,000) port city of St.Pierre on the nearby island of Martinique in 1902; the only survivor was a prisoner Louis-Auguste Cyparis protected deep within the poorly ventilated confines of the city's gaol. He left to join Barnum & Bailey Circus in Chicago as 'the man who lived through Doomsday' ironically to die of a common cold in 1929.

The eruption of 2007; the ash- covered city of Plymouth is in the foreground

Part of the steep side slopes of Soufrière Hills Volcano collapsed in 2010 creating a deep opening in the side of the volcano through which gas and enormous boulders were shot sideways as a 'lateral blast' much like that from a shot gun and most famously seen at Mount St. Helens in 1980. Like all the Caribbean islands Montserrat experiences very heavy rainfalls and frequent hurricanes that help to churn loose volcanic ash and rocky debris left by pyroclastic flows into wet concrete-like slurries that are remobilised downslope as volcanic mud flows ('lahar' so named after the famous flows of Indonesia). Lahars buried the island's main airport after the 2010 eruption making life even more difficult for the few inhabitants that chose not to be relocated and who remain perched at the far northern end of the island at the volcano's mercy.

The former city of Pymouth in late 2013 hidden under ash and debris left by lahars

Part of the abandoned city of Plymouth as it appears in late 2013 buried under ash and boulders

Today there is an exclusion zone around this dangerous volcano that will shortly grab the world's attention when restless turns to hyperactive. It will come very soon.

Nick Eyles