legged lewis bolt itself is one of the freemason symbols, reflecting strength, and a tiny one is available on-line to be worn as a lapel pin.

Acknowledgements

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La Soufrière Volcano, St. Vincent. Eastern Caribbean.

By Graham Hickman

During April 2021 the usually dormant volcano called La Soufrière, on the Caribbean Island of St. Vincent, sprang to life. The explosive eruption made headlines in the world news (Fig. 1). Fortunately, there were no casualties as the 16,000 residence that live near the volcano had been evacuated in plenty of time. The early warnings were the result of good geological monitoring, which had been in-place. Since the 1700s La Soufrière has only erupted 4 times before, the frequency being slightly longer than the average lifespan which, together with the lack of historical record, has meant that the real threat from the volcano gets forgotten.

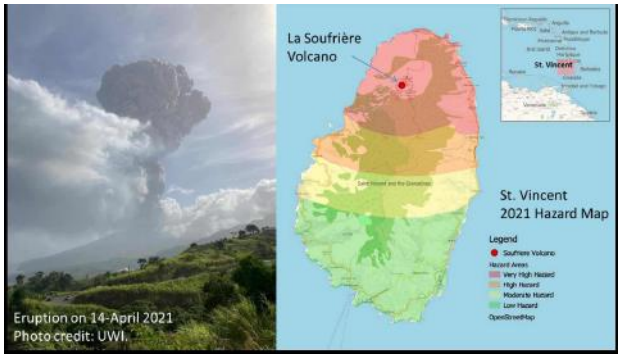

Fig. 1: St. Vincent and La Soufrière Volcano.

The Islands of St. Vincent is located towards the southern end of the Lesser Antilles, a chain of volcanic islands in the Eastern Caribbean. The volcanos are a result of the collision of Caribbean plate and the Atlantic plate. The Caribbean plate is overriding the colder and older Atlantic plate, a process called subduction. As the Atlantic plate sinks it melts and the resultant magma rises to form the volcanic chain of islands from Grenada in the south to Saba in the north.

My 2013 Visit to La Soufrière.

Back in 2013, during my time on assignment with BP Exploration in the nearby island of Trinidad, I had taken a short holiday on St. Vincent and Grenadines. Rather than staying at the popular beach resort to the south of the island, the geologist in me wanted to explore the volcano. I had researched my trip and discovered accommodation close to the volcano and a guide who could take my wife, Kerry, and I to the summit.

The accommodation was at the Richmond Vale Academy. It was more of a youth hostel than a hotel with very cheap rooms and communal meals. The Academy was run by a Danish organisation and pursues educational and environmental projects with the help of volunteers*. We stayed there three nights and they organised our guide, a local man named Franklin, to take us up the volcano.

Fig. 2: – La Soufrière, view from the beach.

On the morning of 24th Feb 2013, we set off from the Richmond Vale Academy to climb the volcano. There were four in our party; Franklin our guide, Kerry and I, plus a friendly Venezuelan called Ricardo. The first part of the hike involved walking along the black volcanic beach (Fig. 2), until we came to a deeply incised gully which a stream had cut through the layers of ash and lava (Fig. 3).

Fig. 3: Walking up the incised gully through layers of lava and ash.

I recorded the route on my GPS. We climbed from sea-level to the crater rim at 934m (3,065ft) then descended 180m (576ft) into the crater (Fig. 4). The first part of the trail had tree cover and good shade. However, the second part of the trail had no shade, exposing us to strong Caribbean sun, 27°C temperatures and high humidity. On approaching the crater edge, we encountered strong winds as we were no longer sheltered on the leeward side of the island but exposed to the full force of the Atlantic Easterlies (Trade Winds).

The view from the crater rim was stunning (Fig. 5). The sides were steep layers of ash and lava from previous eruptions could be clearly seen. A lava dome had grown inside the crater since the last eruption in 1979 but was now covered in vegetation. During the wet season a lake is often formed inside the crater but when we visited it was quite dry although there was still quite a bit of vegetation giving everything a green colour. A fumarole on the southern edge of the lava dome, which had no vegetation, was the only sign of activity. This was our target as we prepared to descend into the crater.

Fig. 4 – GPS track of our route and profile. (11 miles round trip.)

Fig. 5: Panoramic view La Soufrière crater in February 2013.

We descended into the crater using rather old and worn ropes to prevent us from slipping. (Fig. 6). The decent was difficult with loose and unconsolidated ash and lava underfoot. On reaching the crater floor I was exhausted and short of water, but I was also quite exhilarated about being inside the crater of a volcano!

Fig. 6: (left) myself and Ricardo resting on the crater rim. (Right) Our guide Franklin leading the way into the crater, note the fumarole in the distance.

Fig. 7: Inside the crater of La Soufriere heading for the fumerole. Feb 2013.

Once on the crater floor we headed to the area of the fumarole on the southside of the lava dome. (Fig. 7.) Wafts of steam could be seen and there was a stong smell of sulphur. The ground was very hot. I collected a few rock samples and we investigated the fumerole before starting on the return journey. The ascent out of the crater required a lot of crawling on all fours due to the loose material and proved to be easier than I had anticipated. From the crater rim it was then all down hill to the sea.

The 2021 Eruption

As La Soufrière came back to life during December 2020 scientists from the UWI Seismic Research team began monitoring the volcano closely. The photo below (Fig. 8) shows the new lava dome had begun to form to the west of the fumarole, which I had visited in 2013, indicating a new vent had opened up to the west. This new lava dome continued to grow in the early months of 2021.

Fig. 8: La Soufrière crater in January 2021 showing new lava dome. (Photo credit: UWI)

The scientists from the UWI Seismic Research team use a variety of techniques to monitor the volcano; direct observations, gas analysis, seismic detectors, tilt meters and satellite GPS measurements. In December 2020, earthquake swarms referred to as ''Volcano tectonic earthquakes'' were recorded at a depth of 3km and suggested that magma was moving deep inside the volcano stressing the rock and causing it to fracture. This was followed by more earthquakes on April 5th 2021 at a depth of 6km, suggesting even more magma was rising and building pressure within the volcano. Seismic activity is known to occur as a precursor to most large eruptions, so the Island was put on alert. By April 8th alert levels had been raised to ''Red'' and 16,000 people were evacuated from their homes in the northern part of the island. Then on April 9th 2021 an explosive eruption sent clouds of ash 6km into the air, falling like snow on St. Vincent and the neighbouring Caribbean Islands.

Explosive History

I described earlier that La Soufrière was a usually dormant volcano. Prior to colonial times the only clues we have are in the rocks as the indigenous people kept no records. Since the 1700s there have been four recorded eruptive phases; 1718, 1812, 1902, 1979 and now in April 2021 the fifth recorded event in the last 300 years.

An account of the 1718 eruption is recorded by Daniel Defoe, the author of Robinson Crusoe, in the Mist's Journal. Defoe (1718) gave a detailed account of the volcanic explosion of the island of St. Vincent, relying on letters he had received describing the event. He described tephra falling on ships in the region and on several other Caribbean islands. At this time St. Vincent was only populated by the indigenous Caribs and there is no information regarding casualties.

Discovered by the Spanish, St Vincent changed hands several times between the French and the British. It was under British control when the next major eruption occurred on April 30th 1812. The observations were made by Hugh Perry Keane, a barrister and plantation owner. The sketch he made of the eruption was the basis for the dramatic painting made by William Turner (Fig. 9) now in Liverpool Museum and Art Gallery. Few casualties were reported from the 1812 eruption.

Fig. 9: William Turner's painting of the April 30th 1812 eruption.

1902 was the next major eruption occurring on May 7th 1902, accompanying the eruption of Mont Pelée on the neighbouring island of Martinique. This eruption is well documented, Anderson (1902). There were multiple earthquake precursors to the main eruption for about three weeks from mid-April 1902. On the north side of the island numerous earthquakes were felt, causing small landslides and rocks to dislodge and roll down the slopes. On May 6th clouds of steam were observed being emitted from the centre of the old crater along with noises, sounding like canon fire. The climax occurred on May 7th 1902 when a great black cloud swept from the crater to the sea, burning and suffocating those in its path. This event is now recognised and referred to as a nuée ardente, or pyroclastic density flow. It is estimated that 1,500 people died, the death toll being higher on the windward side of the island because their view of the summit had been obscured by clouds. The volcano had eruptions later in May, September and October 1902, with a final explosion in March 1903.

An even more devastating loss of life occurred on the neighbouring island of Martinique where more than 30,000 people were killed by the eruption of Mont Pelée. This was the start of the serious study of volcanos and the modern science of volcanology.

La Soufrière erupted again in 1979. The eruptions were preceded by a strong local earthquake on Apr 12th 1979. 20,000 people were evacuated and major loss of life was avoided. The seismic activity increased throughout the day, leading to continuous harmonic tremors, indicative of magma rising in the vent. Then powerful explosions produced ash clouds and pyroclastic avalanches as the

blockage in the vent was opened up.

La Soufrière volcano is a Peléan type volcano, named after the nearby Mont Pelée volcano. It is characterised by having viscous magma that rises but blocks the vent. As gases and magma continue to rise the subsequent eruption is explosive often with nuée ardentes - pyroclastic density flows of super-heated material that kill and destroy anything in their path.

Following such eruptions poor weather conditions also create further hazards, especially in valleys close to the La Soufrière Volcano. Ash can be mobilised as Lahars or mudflows in rainy conditions. Flooding, landslides and heavy accumulation of volcanic ash can result in collapsed roofs of buildings. Vegetation and livestock can be severely impacted. History suggests that the volcanic activity may persist for six months to a year before recovery of the human population can get underway. Meanwhile those affected must rely on friends or the government for help and shelter. The only upside is that the volcanic ash is very fertile and with a warm wet climate vegetation soon gets growing again once the volcanic activity stops.

My visit to La Soufrière in 2013 has certainly left me with a memorable impression and appreciation for the hardships faced by those who live on the volcanic island of St. Vincent.

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Foot Note

*In researching this article I discovered that back in the 1980's the Richmond Vale Academy, where we had stayed, had been accused of embezzlement, financial mismanagement, cult-like behaviour and questionable associations. In addition, Social Services in London had sent a number of young offenders here for rehabilitation in a tropical setting, a world away from their experience. I might have met some of them? Everyone was very pleasant, including the Russian who spoke no English and the Venezuelan who was continually high on marijuana.

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Girls into Geoscience, 28th-29th June 2021, virtual event summary

by Harriet Carlill

Girls into Geoscience (GiG) is an award-winning STEM outreach initiative based around an annual event. Co-founded by Dr Jodie Fisher and Dr Sarah Boulton from the University of Plymouth, the event aims to bring together women working in geoscience and girls interested in the subject in what is a predominantly male-dominated field.

Fig. 1: Girls into Geoscience logo

This year's Girls into Geoscience event, as in 2020, was an online affair. Spanning two days in June, there was a huge range of subjects on offer, both in the virtual field trips on the first day, and the Q&As and subject lectures on the second. There were contributors from all over Britain, as well as from overseas, who had come to talk in the area of expertise to the around 100 girls who attended.

After a short welcome on the first day, I spent the afternoon on two very different virtual field trips. The first - 'Ancient Landscapes and Life! How did the Yorkshire coast change 170 Ma?' with Dr Amanda Owen - explored a sequence of rock on the Yorkshire coast, and how analysing the rock and fossils could determine how they formed. With interactive polls and questions, we were able to work out that over around 26 million years, the area went from a deep marine environment, to a fluvial environment, to a shallow marine/beach environment, and then back to deep marine. Dr Owen then went on to explain why doing this sort of analysis is important. Not only can it show how past environments, animals and plants responded to changing conditions, helping us understand possible changes in the future, but it also helps to find resources based on the environment of deposition (e.g. hydrogen and carbon dioxide storage in geological formations

The second field trip was 'Hidden Glaciers on Earth and Mars' with Dr Katie Miles and Adam Hepburn. Using Google Earth, we were able to fly around the globe and see glaciers from our own screens. After briefly looking at the Perito Moreno glacier in Argentina as an example