

**March 1, 2021**

**Geohazards - Volcanoes**



**Figure 1 - Mount Etna Volcano Feb. 24, 2021.  
(Credit: AP Photo/Salvatore Allegra) <sup>1</sup>**

I noticed in the news this past week that Mount Etna in Italy is erupting again <sup>2</sup>, so I thought that the subject of geohazards, and volcanoes in particular, would make a good subject for this week's posting. I'll continue with the theme of geohazards for the rest of March 2021.

**What's a Geohazard?**

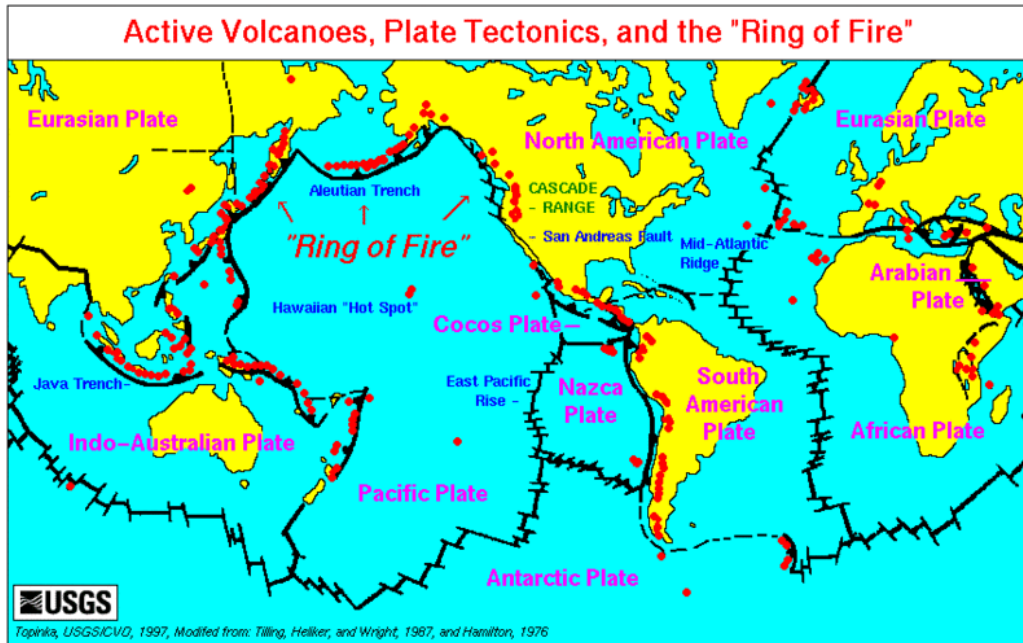
Geology is about the real world, and the world can be a dangerous place. Geohazards are any dangerous geological condition. These include: volcanoes, earthquakes, landslides, tsunami and floods. There are many ways that the Earth can kill us and we had better be aware of those threats for our own self protection.

For general information on geohazards, you might want to read the Natural Resources Canada document, *Evaluation of the Geohazards and Public Safety Program Sub-activity* <sup>3</sup>. The Canadian Geotechnical Society has periodic conferences on geohazards and has published the proceedings of those conferences <sup>4</sup>. There is also an international journal, *GeoHazards* on the subject <sup>5</sup>.

## Where are Volcanoes Found?

Volcanoes on the Earth are intimately connected to the movement of the crustal plates in the process called *Plate Tectonics*. (I'll have to discuss Plate Tectonics in a future blog posting.) Generally, volcanoes are found at plate boundaries. Volcanoes can also be found at so called "hot spots" in the middle of a plate.

Figure 2 shows the general location of the tectonic plates and the locations of volcanoes.



**Figure 2 - Volcanoes and Plate Boundaries** <sup>6</sup>

Active volcanic regions in Canada are found in five areas in the Western Cordillera. Figure 3 shows the locations of active volcanoes in Canada.

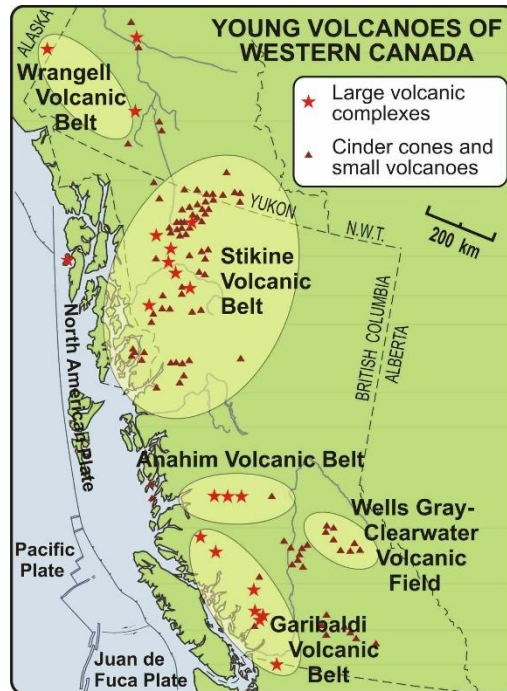
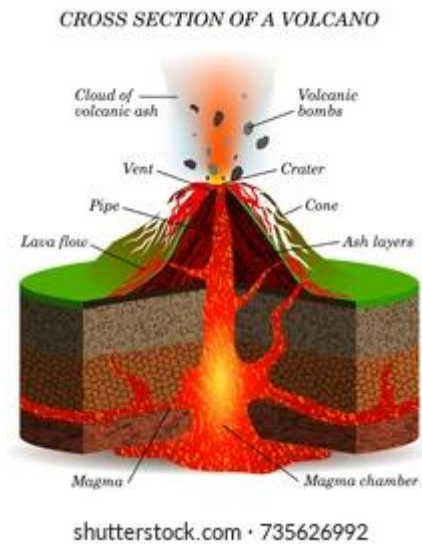


Figure 3 - Active Volcanoes in Canada <sup>7</sup>

### Anatomy of a Volcano

The main features of a volcano are, from the bottom up:

- The *magma chamber*, this is where the molten *magma* accumulates;
- The *pipe* through which the magma flows to emerge through the *vent* in the *chamber* as either *lava*, *volcanic ash* and/or *volcanic bombs*;
- The *cone* that is made up of accumulated layers of *lava*, *volcanic ash* and/or *volcanic bombs*.



**Figure 4 - Anatomy of a Volcano**

### **Types of Volcanoes**

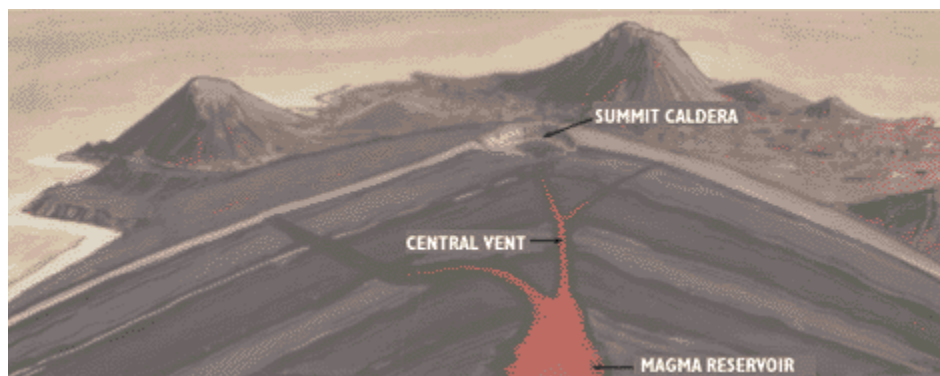
Generally, there are four kinds of volcanoes, the kind of lava produced by a volcano will largely determine the form that a volcano takes:

1. **Cinder cone volcanoes** are made up of a collection of volcanic dust, pebbles, cobbles and boulders (volcanic bombs). Volcanoes that erupt viscous lavas will form cinder cones. Paricutin, in Mexico, is a typical cinder cone volcano. <sup>8</sup>



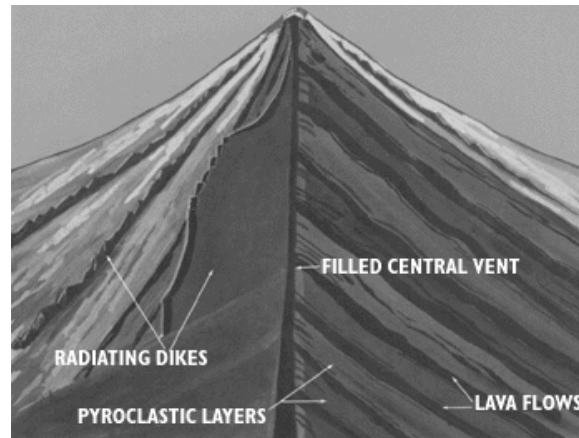
**Figure 5 - Parícutin Volcano** <sup>9</sup>

2. **Shield volcanoes** are made up of consecutive lava flows formed from relatively fluid lava as in Figure 6, below. The islands of Hawaii and Iceland are giant shield volcanoes. <sup>8</sup>



**Figure 6 - Internal Structure of a Shield Volcano** <sup>8</sup>

3. **Composite volcanoes** are made up of different layers of lava flows and volcanic ash. These are formed where the underlying magma chamber produces alternating fluid lava and viscous lavas as in Figure 7, below. <sup>8</sup>



**Figure 7 - Internal Structure of a Composite Volcano** <sup>8</sup>

4. **Lava domes** form from relatively small, bulbous masses of lava, too viscous to flow any great distance. As a result, when extruded through the pipe, the lava piles over and around the volcano's vent. The Novarupta Dome, formed during the 1912 eruption of Katmai Volcano in Alaska, is an example of a lava dome. <sup>8</sup>



**Figure 8- Novarupta Dome, Mt. Katmai, Alaska** <sup>10</sup>

### **Some Examples of Famous Volcanic Eruptions**

Volcanoes can be deadly. Here are a four examples from history:

### ***Thera, Greece, 1628 B.C***

The volcano on the island of Thera (also called Santorini) blew up with a huge explosion around 1628 B.C. Approximately 40,000 people were killed by the explosion and the subsequent 40 foot tsunamis. The blast was heard 3,000 miles away <sup>11</sup>.

The destruction of the island severely weakened the Minoan Civilization and, according to authors such as Dr. Charles Pellegrino, may be the source of Plato's myth about Atlantis <sup>12</sup>.

### ***Mt. Vesuvius, 79 AD***

The eruption of Mt. Vesuvius in 79 AD was famously recorded by Gaius Plinius Caecilius Secundus (Pliny the Younger) in his correspondence with the historian Publius Cornelius Tacitus (Tacitus). In Letters LXV and LXVI, Pliny describes the eruption of Vesuvius and the death of his uncle, Gaius Plinius Secundus (Pliny the Elder) <sup>13</sup>.

In those days, the Romans believed that leading citizens should risk their lives for the common good. Pliny the Elder, a Roman Senator, died trying to rescue people from the eruption. He was among the approximately 1,500 people that perished as a result of the eruption of Mt. Vesuvius <sup>14</sup>.

The eruption of Mt. Vesuvius in 79 AD buried the cities of Pompeii and Herculaneum and archaeological studies of the two buried cities have given us a unique glimpse into life during Roman times.

### ***Tambora 1815***

Tambora is found in Indonesia and on April 10, 1815 it erupted with what has been described as the greatest explosion in recorded history. The eruption spewed an estimated 36 cubic miles of volcanic ash into the atmosphere. Approximately 88,000 people were killed in the explosion. <sup>15</sup>

The following year was called the "Year Without Summer" and was marked by crop failures, famine and general gloominess. Mary Shelley wrote her famous novel *Frankenstein*, that summer. <sup>16</sup>

### ***Krakatoa, August 1883***

Krakatoa lies in the Sunda Strait between Java and Sumatra. In May 1883, it began to erupt. On August 27, 1883, it exploded with an equivalent force of 200 megatons of TNT. The explosion and subsequent tsunami killed approximately 36,000 people. <sup>17</sup>

## Mitigating the Hazard

Volcanoes are notoriously dangerous. If a volcano goes off in your neighbourhood, the best course of action is to **GET THE HELL OUT OF THERE** and observe the volcano from a safe distance.

Volcanologists, geologists who study volcanoes, are brave people as in Figure 9, below. I think that it would be fun to do this, don't you?



**Figure 9 - USGS Geologist Sampling at Mauna Loa Volcano, Hawaii** <sup>18</sup>

Besides physical distancing when an eruption occurs, the best long term mitigation strategy for the danger from volcanoes is to study them. As a society, supporting the work of volcanologists is a good investment. We still have a lot to learn about volcanoes, especially about predicting the timing and scale of eruptions. Failure to prepare ourselves for the dangers in this world could be fatal for millions of people.

If you have a taste for disaster movies involving volcanoes, [this is a good film](#).

As always, this is a big subject, and if volcanoes interest you, follow up on the references listed below.

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