MOUNT BROMO, INDONESIA PHOTO: OLIVIER BACHMANN

VOLCANOES

Lecture by Olivier Bachmann

When looking at a cross section of the earth, one notices its core to be split into two entities: an inner core that is solid and mostly made out of iron, and an outer core that is liquid. There are charged particles in this part, and its fluid movement generates the magnetic field of our planet. It also generates a hot surface called the mantle with a lot of pockets or hot spots where material rises to the earth?s crust. Once these convection currents reach the crust, they are deflected horizontally and carry the tectonic plates. Connected to the plate?s movement, there exist different places where volcanoes can appear: most of the magma erupted at the surface of the earth is produced at an average of 2,000 to 3,000 metres below the sea level at ocean spreading ridges. There are only a few locations on earth where these rather quiet mid-ocean ridges are sticking out of the ocean, for instance in Iceland. They are also called diversion plates, because here the plates, speak the currents beneath the crust, are moving away from each other.

The other place with a lot of volcanoes is where two plates collide. These trenches or subduction zones rest at the top of down moving currents and are very explosive. In their case, either two ocean plates collide - an island arc or island subduction zone like the Mariana trench - or a continental plate meets an oceanic one - a continental arc or continental subduction zone like the Andes. In the second case, the volcanoes are due to the fact that water trickles beneath the continental plate: without the water the mantle is solid, however, with the addition of it pockets of magma appear. At high pressure the water is dissolved and stuck inside the magma. Around 100 kilometers beneath the surface, the pressure decreases and the water in the rock starts to leave again. As a consequence, the magma expands and produces air pockets. In reciprocal interaction, the bubbles accelerate the magma?s speed of moving upwards, while their own size increases. The result are explosive eruptions once the slugs burst apart at the surface. There are a few volcanoes with a relatively small volume called hot spots or plumes that are right in the middle of a plate like Hawaii. They usually produce shield volcanoes like Mauna Loa that have incredibly shallow slopes due to their gradual building up process of fluid lava. The other well-known volcanoes including Strombili are called strato volcanoes. They are more conical in shape due to an internally consistent layer of rock and through their formation by a sequence of ejecta producing lava and tephra.

As indicated, volcanoes can produce a wide range of eruption styles that depend largely on what types of magma erupts. If it is very fluid, it will produce fire fountains, lava lakes, and quiet flows. However, at the conversion plate margins with water rich volcanoes, they are more active. There, the least explosive ones are called Strombolian eruptions, since they have less viscous magma. They usually produce small burstings with incandescent material, fountains of ash, small lava bombs and cinders. These are commonly very long lasting eruptions, and Stromboli - called the ?Lighthouse of the Mediterranean? by the Romans - has been active for several millennia now. Since the conduits reaching down to the magma reservoir originate at very deep level, it is difficult to predict what kind of bubble bursting phenomena will occur atop. Not possible at present, one of the ways to avoid volcanic eruptions would be to drill into the gaseous reservoirs beneath a volcano and decompress them in a controlled manner.

Within the once solidified lava stones one can practically find all the elements of the periodic table. The most abundant are Silicon Oxide, Sodium and Potassium Oxide, which are also used to classify the different rocks. Generally, the more Silicon Oxide content there is, the stickier the magma. Basalt that is typical on Stromboli, has about 50% of Silicon Oxide and less than 5% of the other chemicals. Around the world, the composition is incredibly variable, whereas on the different Aeolian Islands one finds a good cross-section of all the options. Alicudi and Filicudi consist mainly of Andesite that is the most abundant volcanic rock on earth. The kind of rocks produced also depend on the temperature at which the magma erupts (usually between 1,000 and 1,500°C); at the coldest one on earth, the Oldony'o Lengai in Tanzania (about 500°C), molten limestone is

erupted.

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