

## Volcanism in Iceland

Iceland has a high concentration of active volcanoes due to its unique geological origin. There are about 130 mountains of volcanic origin, 18 of which have erupted since the colonization and the first settlements on the island at the end of the ninth century. Over the past 500 years, Iceland's volcanoes have ejected about one third of the total global lava output. Although the Laki volcano eruption in 1783 was classified as the largest eruption of lava since the island's colonization, the prior Eldgjá volcano eruption in AD 934 and other Holocene eruptions are now considered as much larger.

Among other active volcanoes in Iceland, Hekla volcano (63°59'N; 19°38'W), an active 1,491-m high stratovolcano located in the south of the country always played a dominant role in the island due to its extremely high volcanic activity. Being shaped as a boat turned upside down, it creates a prolonged 6 × 12 km large top plateau, covered by numerous craters; it is assessed that during the last millennium Hekla emitted some 8 km<sup>3</sup> of lava and another cubic kilometer of pyroclastic materials. Over 20 eruptions have occurred in and around the volcano since the year 874. During the Middle Ages, Icelanders called Hekla "A gateway to hell" (Fig. 59). Chemically, the lava released from Hekla is a basalt-type low-silica lava associated with effusive volcanism, like the volcanoes in the Hawaii islands. However, in Iceland, there are various kinds of volcanoes, many of which eject more evolved lavas such as rhyolite and andesite lavas.

The most common types of volcanoes are the composite volcanoes, which spread over vast areas of the country and are usually arranged in chains. In the south and southwest segments of the island, we can find Hekla, Mýrdalsjökull with Katla, Eldgjá, and the Laki craters, also Öræfajökull, Snæfellsjökull. In the north of the country and in the interior part, the glacier Vatnajökull with Bárðarbunga, Grímsvötn and Kverkfjöll, Krafla, Askja, and Herpubreip are located. And, off the southern Icelandic coast, there is the Vestmannaeyjar archipelago with the recently active Surtsey, and Eldfell on Heimaey.

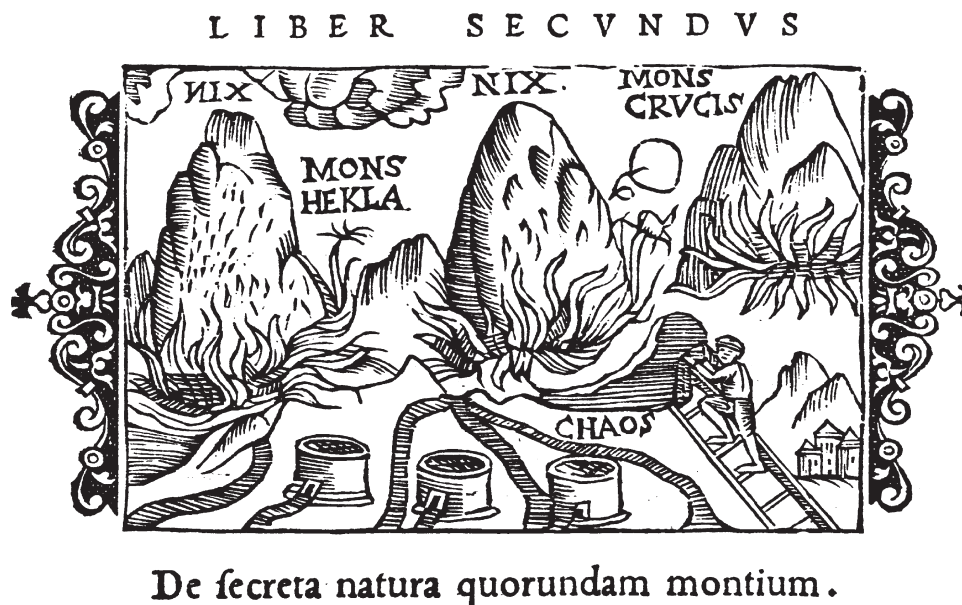
Icelandic volcanic eruptions are famous for their enormous volume of erupted ashes and for vast lava outflows. Together with the volcanic ashes, also large quantities of hydrofluoric acid have been released which, with other toxic gasses, contaminated the barren vegetation, the only scarce

pasturage for cattle. In this context, a huge eruption of the Laki volcano in southern Iceland in 1783 should be mentioned, when allegedly as much as 14 km<sup>3</sup> of lava poured out from the total of 135 newly opened craters. It is estimated that during this eruption, probably the most fatal Icelandic catastrophe ever, some half billion tones of toxic gasses got away into the atmosphere and killed one quarter of total Icelandic population (over 10,000 people) and slaughtered some 60% of cattle in the island (Krafft 1993).

Geologists explain the high concentration of volcanic activity in Iceland by a combination of the island's position on the Mid-Atlantic Ridge and volcanic hot spot underneath the island. Iceland is located astride the boundary between the Eurasian and North American Plates. A great deal of volcanism is concentrated along the plate boundary, which runs across the island from the southwest to the northeast. Some volcanic events occur offshore, too, especially off the southern coast. This kind of volcanism includes submarine volcanoes and newly formed volcanic islands such as the Jólnir Island.

The plate tectonic theory says that the Earth's surface is subdivided into a number of huge continental plates, which move each other. And along the deep faults, by which the individual plates are detached, molten lava can reach the surface. The volcanic activity of Iceland is predetermined by its location and also by history of its origin. The bottom of the Atlantic Ocean along its central ridge has been formed due to never-ceasing magma supply from sub-crustal sources; it is constantly elevated and spread out. The submarine volcanoes supply enormous quantity of new rock material, which finally appears above the sea level. Western part of Iceland belongs to the American plate, and the eastern part belongs to the Eurasian plate, both parts slowly move apart by the velocity of about 2 cm per year.

Since huge Hekla explosion in AD 1104 (lava ejection could have been estimated to approach 2.5 km<sup>3</sup>), when molten ejecta entirely devastated large territories in the southern part of Iceland, another 157 strong eruptions of this volcano have been recorded. No other European volcano could show off such a record. Being exhausted by such "work," Hekla took a certain long rest of 60 years prior to year 1845 when it suddenly exploded again on September 2: "*With a tremendous crash, two large openings were formed in the sides of*



**Fig. 59** A woodcut illustration of Icelandic symbols (mountains and fire), from the book by O. Magnus (1550). Private collection, Prague

the cone, whence there gushed torrents of lava, which flowed down two gorges on the flanks of the mountain. The whole summit was enveloped in clouds of vapor and volcanic dust. The neighboring rivers became so hot to kill fish, and the sheep fled in terror from the adjoining heaths, some being burnt before they could escape....” (An anonymous report of 1872, quoted from <<http://en.wikipedia.org/wiki/Hekla>>).

Eruptions of Hekla were always preceded by strong ground tremors; the following explosions together with mighty emissions of volcanic ashes took several hours. This scenario was a part of a repeated painful Hekla’s effort to get rid of “cork” from the bottle neck; once it did so, a massive outflow of lava followed for many days.

As concerns Hekla volcano itself, its eruptions have varied extremely in time and it was always very difficult to predict the next one. Some eruption spells were short, ranging from a couple of days to several weeks, whereas others could stretch into months and years. However, there was a general correlation: the longer Hekla goes dormant, the larger and more catastrophic was its next blast. For instance, during 1947–1948 lava poured out from Hekla for 13 months and more than 0.8 km<sup>3</sup> of lava and ashes were ejected; lava covered about 65 km<sup>2</sup> and volcanic ashes were blown out by wind up to Scandinavia. The 1991 eruption lasted for 53 days and lava covered 24 km<sup>2</sup>. The large recent eruption occurred on February 26, 2000.

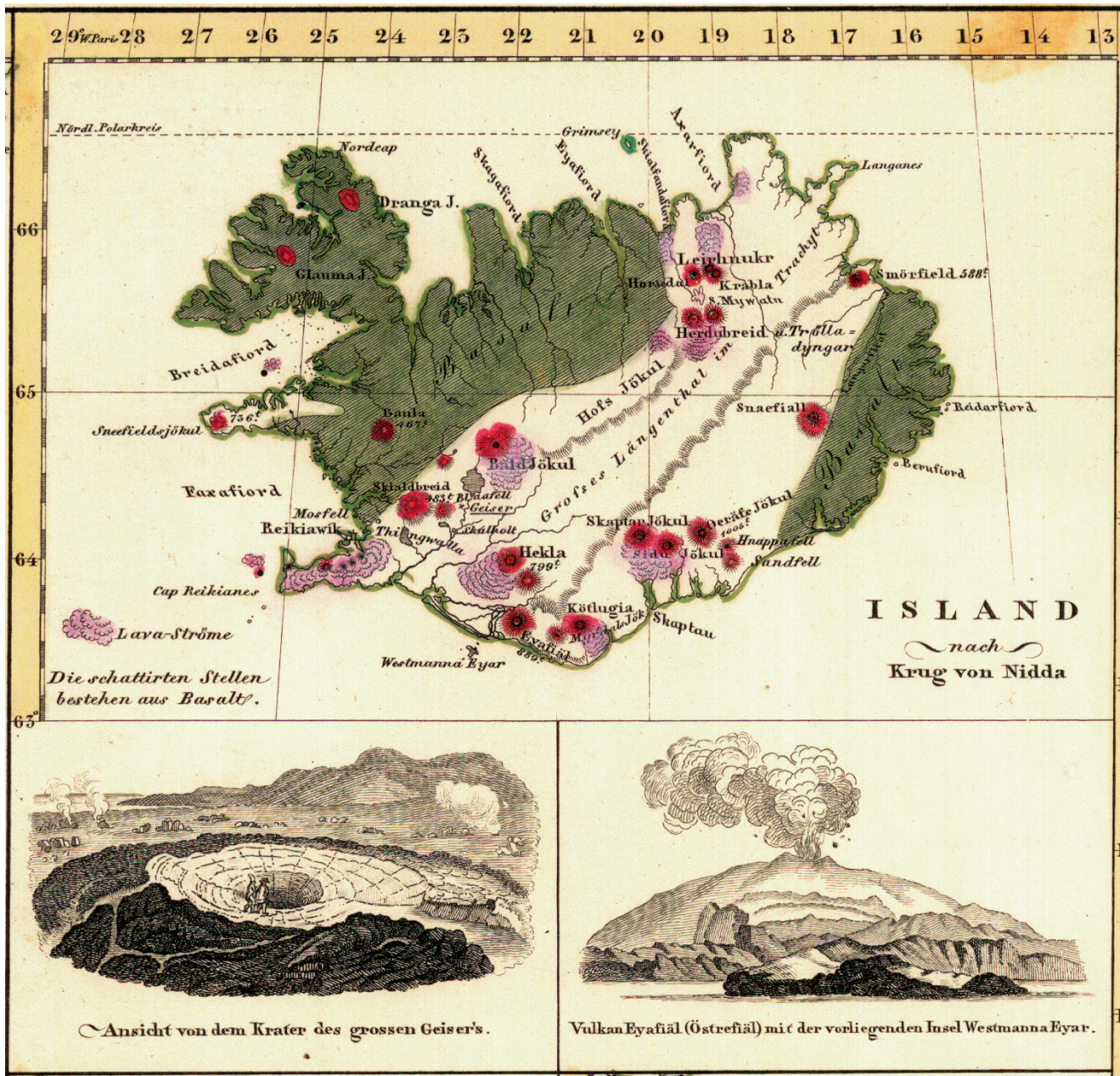
The map (**Fig. 60**) is actually a part of a large graphic sheet illustrating volcanic and seismic events in the Atlantic Ocean summarizing the concepts of the mid-nineteenth century. The part dealing with volcanism in Iceland (Krug,

c. 1840) showed that the island is subdivided into three parts: the left and right sectors are marked by green and present large basalt massifs. The *Grosses Längenthal in Trachyt* (Big Trachyte valley) stretches from the southwestern coast across the central part of the island to the northeast. The author marked the position of volcanoes by purple and the areas covered by lava by orange. The reality roughly corresponds to the situation of the year 1840. Two pictures at the bottom present the Big Geyser and volcano Eyafjäl on the southern coast together with a small island in front of the volcano. The exceptional volcanic activity of the region was documented by three tens of active volcanoes shown in the map.

Krug’s (c. 1840) map was composed a long time before the principles of plate tectonics were formulated; by locating the “big trachyte valley” correctly into the central part of Iceland, the author outran the time by more than 80 years (see also Anonym 1841). Today, we can only admire his right understanding of the relation between his “big trachyte valley” (actually a deep-fault surface projection) and the Iceland’s volcanic activity.

**Figure 61** is taken from the *Viennese Illustrated Weekly* and introduces the Hekla volcano in one of its frequent eruption periods. The picture, no doubt, looks authentically, but it is a fantasy composition: Hekla volcano is not shaped as a slim, sharp cone and is not located at the sea coast. Evidently, the author of the image did not bother himself with Iceland geography and simply used as a model some portrayal of Etna (?) for his depiction. By other words, Iceland was a too distant and too exotic corner of the world for central-Europeans of Austria in the mid-nineteenth





**Fig. 60** Iceland with a segment of the physical map of the Atlantic Ocean, prepared by Heinrich Berghaus (1838-48). Hand colored copper engraving. Private collection, Prague

century so that a topographically correct representation – even in a standard periodical – was not a necessity.

Similarly, as in other regions of the world, where hot lithosphere material communicated with the Earth's surface, also in Iceland, hot springs and geysers occur in a large amount. A geyser is a hot spring characterized by intermittent discharge of water ejected turbulently and accomplished by a vapor phase (Fig. 62). The word “geyser” comes from

*Geysir*, the name of an erupting spring at Haukadalur, Iceland; that in turn comes from the Icelandic verb equal to English “to gush.” The “Great Geyser,” which first erupted in the fourteenth century, used to erupt in every 60 min until the early 1900s when it became dormant. Earthquakes in the year 2000 subsequently reawakened the giant geyser, and it now erupts approximately in every 8–10h and may reach the height up to 61 m.

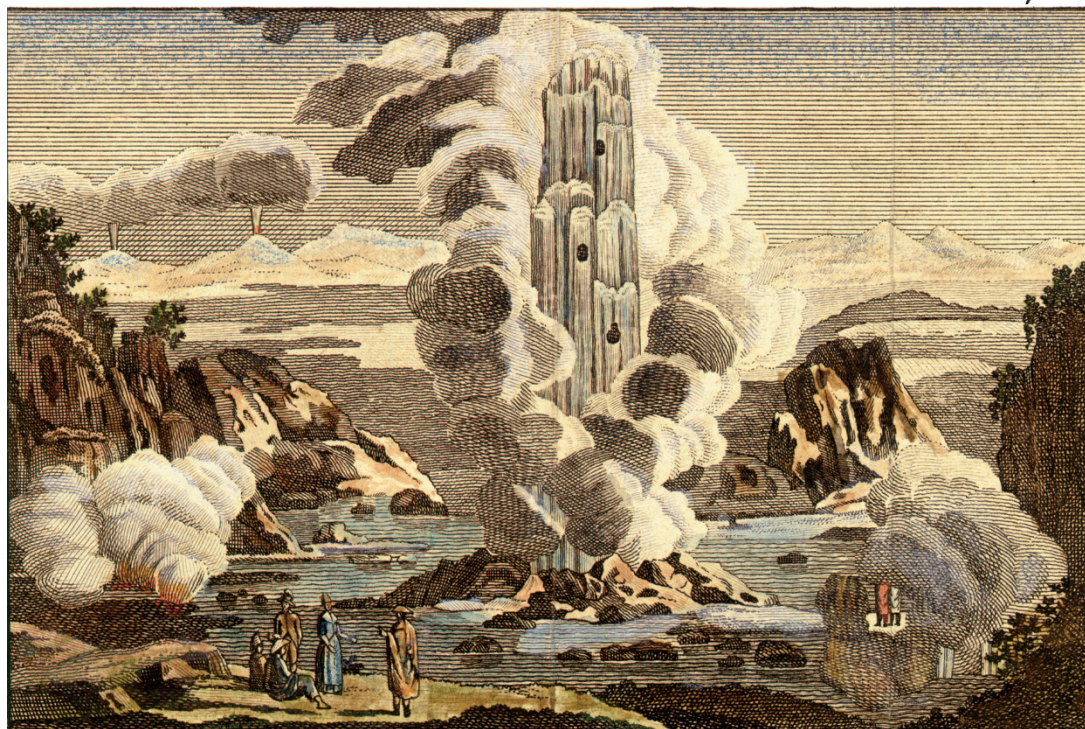


**Fig. 61** Hekla in eruption. Hand colored xylographic illustration from Wiener Illustrierte Zeitung of 1850s. Fantasy composition. Private collection, Prague



Der Ausbruch des Hekla.

Taf. 10.



*Der grosse Geiser, auf Island.*

**Fig. 62** “Der grosse Geiser auf Island”. Imaginary composition showing the Great Geyser in Iceland. German hand colored copper engraving of the mid-19th century; unidentified bibliographic source. Private collection, Prague

The Illustrated History of Natural Disasters

Kozák, J.; Cermák, V.

2010, XVIII, 203 p., Hardcover

ISBN: 978-90-481-3324-6