# 2 A Volcano Comes to Life

Recently, Iceland has seen a rapid transformation from a country on the periphery of people's mental landscapes to a major tourist destination. This transformation is taking place in a country that is newborn, geologically speaking, having risen from the ocean floor a mere 24 million years ago.[1] Iceland plays host to an eruption every three to five years; in 2010, the volcano Eyjafjallajökull reminded the world of this country's volcanism.[2]

In this chapter, I explore the geology and history of volcanic eruptions on the island. In Iceland, historical time commenced at the beginning of the Norse settlement in the ninth century CE. Which significant volcanic eruptions occurred in Iceland before 1783? What hazards do the island's volcanic eruptions pose to Iceland and the world beyond? In addition to answering these questions, I also analyze descriptions of the Laki eruption and its direct aftermath within Iceland.

## The Geological Formation of Iceland

Studies of history rarely consider geological timescales, which cover deep history, the rise of mountain ranges, and the birth and death of oceans.[3] That said, we must consider them, as a volcanic eruption is at the center of this book. Eruptions can wreak havoc on flora and fauna, and thereby local food supplies and livelihoods. They can also influence the weather, atmosphere, and even the climate over a surprisingly broad area.

130 million years ago, in the early Cretaceous, the last age of the dinosaurs, the Iceland mantle plume came into existence at the base of the lithosphere, where the Earth's immobile uppermost mantle meets its convecting mantle (Figure 4). A mantle plume is a mass of relatively hot (and therefore less dense) material that rises from the Earth's lower mantle.[4] The lithosphere is composed of numerous tectonic plates that make up our planet's continents and ocean basins. Geologists assume that the mantle plume is fed from the lower mantle, just above the core-mantle boundary about 2,700 to 2,900 kilometers below the Earth's surface. The lifespan of a mantle plume is typically 100 to 150 million years.[5]

The Iceland mantle plume formed the basaltic Alpha Ridge in the Arctic Ocean, northwest of today's Greenland. The Alpha Ridge is considered the first expression of

1 Thordarson, Höskuldsson 2014: 1.

2 Thordarson 2010: 285; Schmidt et al. 2014a.

3 Fortey 2005: 28.

4 Condie 2001: 1–2, 67–68, 123; Condie 2016: 2–3; Science Direct, "Mantle Plume."

5 Saunders et al. 1997; Condie 2001: 123.


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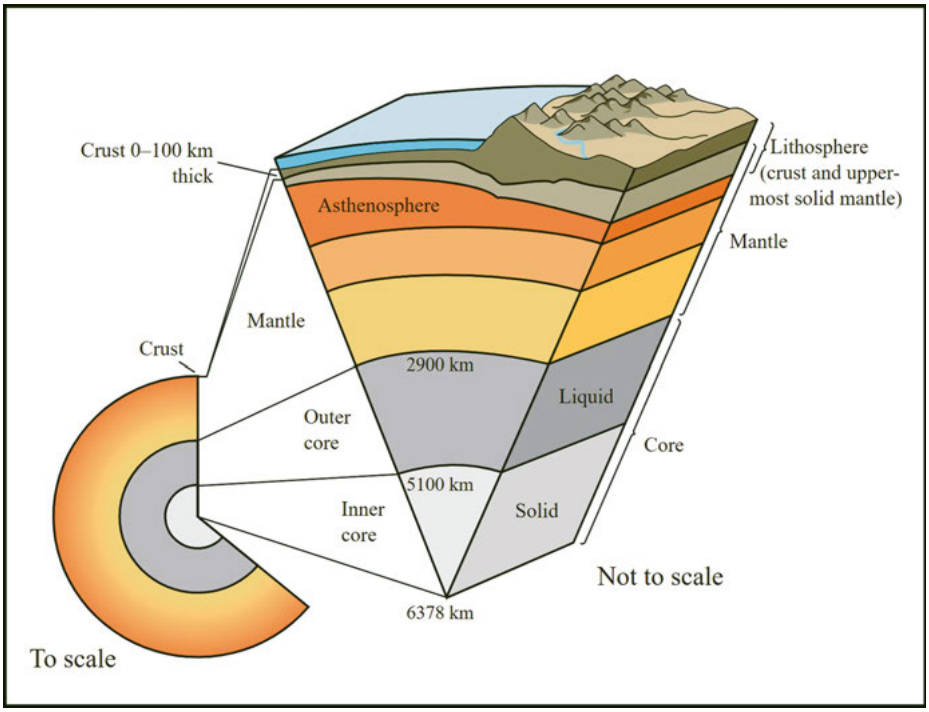


**Figure 4:** A model of Earth's internal density structure. The dynamic convection of the mantle takes place within the region illustrated by the three warm colors. The convecting mantle provides the energy for rising plumes and plate tectonics.

the Iceland mantle plume.[6] Mantle plumes require a continuous supply of hot materials from the lower mantle (Figure 5).[7] These buoyant materials move upward within a funnel-shaped zone toward the surface. The Iceland mantle plume is mushroom-shaped, with a narrow funnel and a head that is roughly 2,000 kilometers in diameter.[8] By definition, a hotspot is the surface manifestation of a mantle plume.[9]

Mantle plumes are planet-wide phenomena that occur in intraplate regions and at plate boundaries in both oceanic and continental crusts. If the magma within a

6 For a detailed study of the geological evolution of the North Atlantic region from the late Cretaceous to the early Eocene, see Jolley, Bell 2002. A recent study has discovered a geothermal heat flux anomaly running through Greenland from the northwest to the southeast, which Martos et al. (2018) interpret as the path that this plate took across the Iceland mantle plume between 80 and 50 million years ago.

7 Saunders et al. 1997; Condie 2001: 123.

8 White 1988: 8; White, McKenzie 1989. Other scholars describe the Iceland mantle plume as disk-shaped, with a plume head of 600 kilometers in diameter that is fed by a vertical conduit, which is 50 to 100 kilometers in diameter; Saunders et al. 1997: 52–53.

9 White 1988: 3; Condie 2001: 1–2.

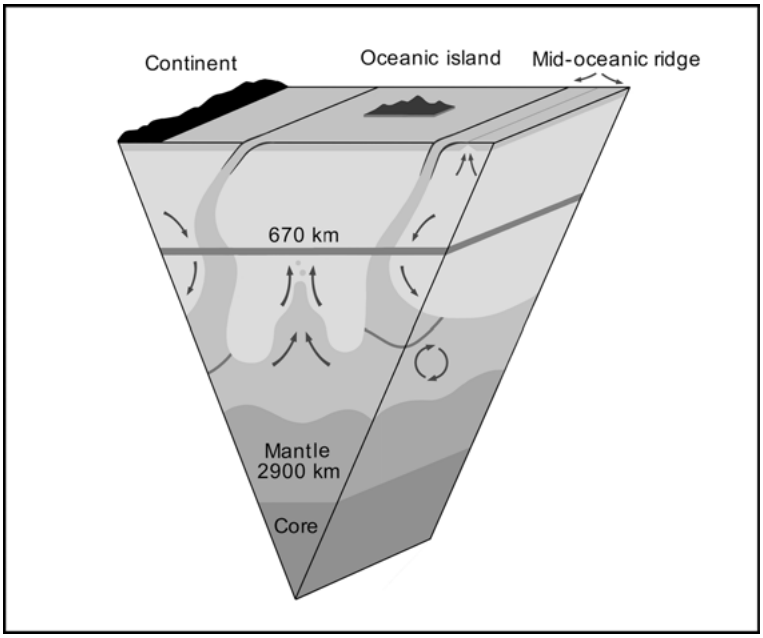


**Figure 5:** Dynamics of the possible effects of a dense layer in the lower mantle. Internal heating and heat flow along the core-mantle boundary drive the internal circulation of the lower mantle. Mantle plumes arise from local hotspots consisting of recycled slabs and other materials.

mantle plume breaches the surface, for a brief time, it is defined as lava before it cools and solidifies into volumes of igneous rock, the larger masses of which are called igneous provinces (Figure 6).[10] Igneous rock, also called magmatic rock, is one of three main rock types found on Earth, the other two types being sedimentary and metamorphic. The term "igneous" derives from the Latin word for fire, *ignis*.[11] In general, geologists assume that the large igneous provinces around the world formed as a result of mantle plume activity and not by the processes directly linked to plate tectonics.[12] The driver of both the mantle plumes and plate tectonics is convecting mantle.

The North Atlantic Igneous Province is one of the largest discovered so far, extending from Ellesmere Island in eastern Canada to the British Isles.[13] Between 62 million and 56 million years ago, igneous activity produced onshore magmatism in Canada's Baffin Island, Greenland, Scotland, and Northern Ireland, and offshore magmatism in eastern

**10** Condie 2016: 48.

**11** Park 2010: x.

**12** Saunders et al. 1997: 48; Condie 2001: 54.

**13** Saunders et al. 1997: 45; Lacy 1998: 13; Condie 2001: 56, 67; Rickers, Fichtner, Trampert 2013: 39; Barnett-Moore et al. 2017: 251. For more information on oceanic spreading rates in the North Atlantic, see Vibé et al. 2018.

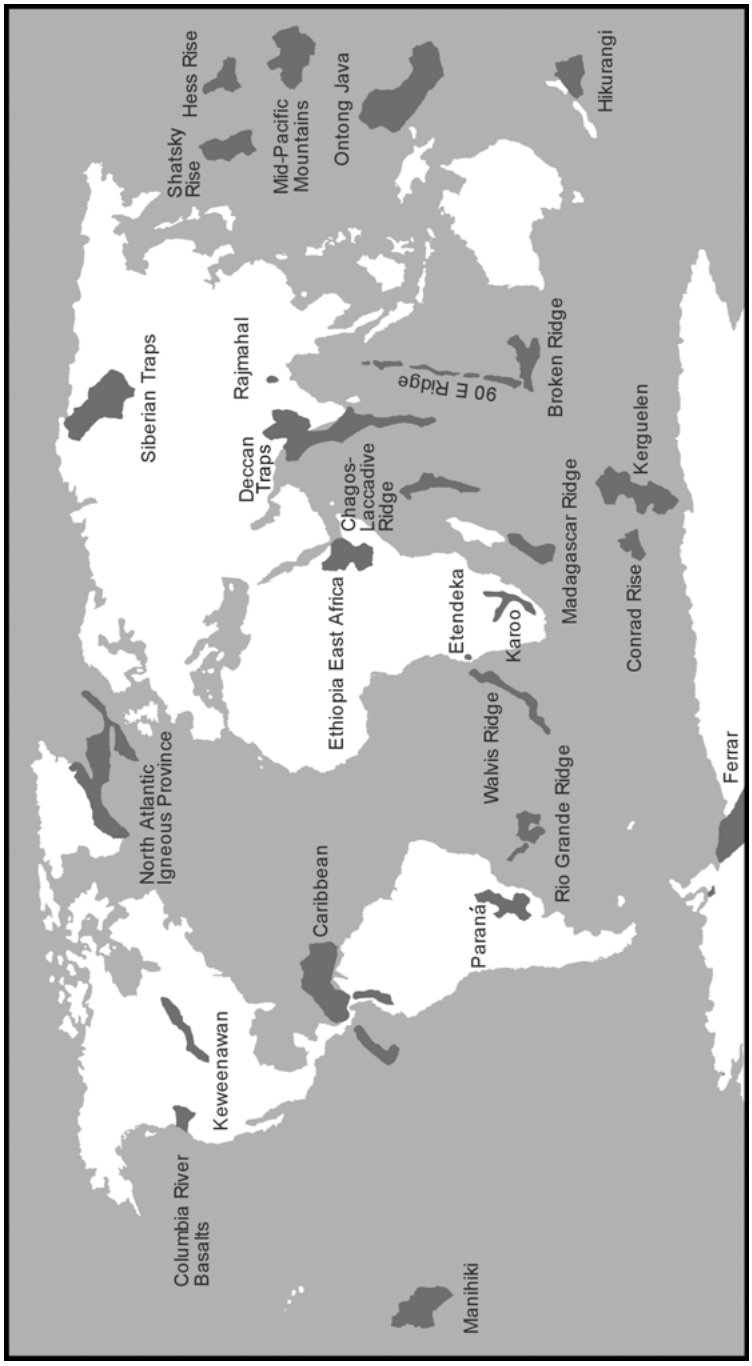


**Figure 6:** Large igneous provinces. The areas in black indicate the locations of large igneous provinces formed in the past 250 million years.

Greenland, the Greenland-Iceland-Faroe Ridge, and Iceland.[14] Even today, remains of large volumes of basaltic lava flows can be found in the depths of the North Atlantic.

The North American tectonic plate moved westward over time; therefore, the plume appears to have moved eastward, even though it remains stationary. These basaltic areas in Greenland and the North Atlantic trace the apparent trajectory of the mantle plume 30 to 40 million years ago.[15] Around 24 million years ago, the Iceland mantle plume and the Mid-Atlantic Ridge crossed paths and started interacting with one another, gradually forming the Iceland Basalt Plateau.[16] This plateau is more than 3,000 meters above the seafloor and has a crustal thickness ranging from 15 kilo-

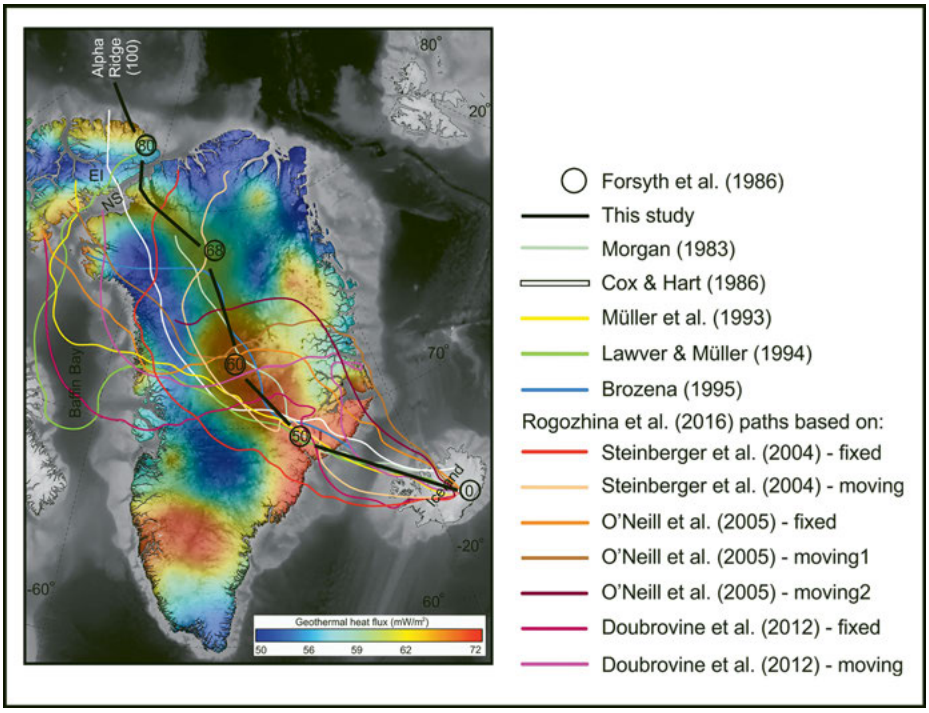


**Figure 7:** Proposed trajectories of the Iceland mantle plume over the past 100 million years. The numbers indicate the position of the Iceland mantle plume 80 million, 68 million, 60 million, and 50 million years ago to the present (0). The black line indicates the trajectory proposed by Martos et al. 2018, Figure 3.

**14** Saunders et al. 1997: 45, 59, 69, 71, 82. The age of these phases has been established through the reversal phases of the Earth's magnetic field; Lundin, Doré, 2005; Thordarson, Larsen 2007: 119.

**15** Katla Geopark Project: 3–4.

**16** Thordarson 2010: 286.

meters in coastal areas to 40 kilometers in central Iceland, underneath the northwestern part of the Vatnajökull ice sheet (Figure 7 and Figure 8).[17]

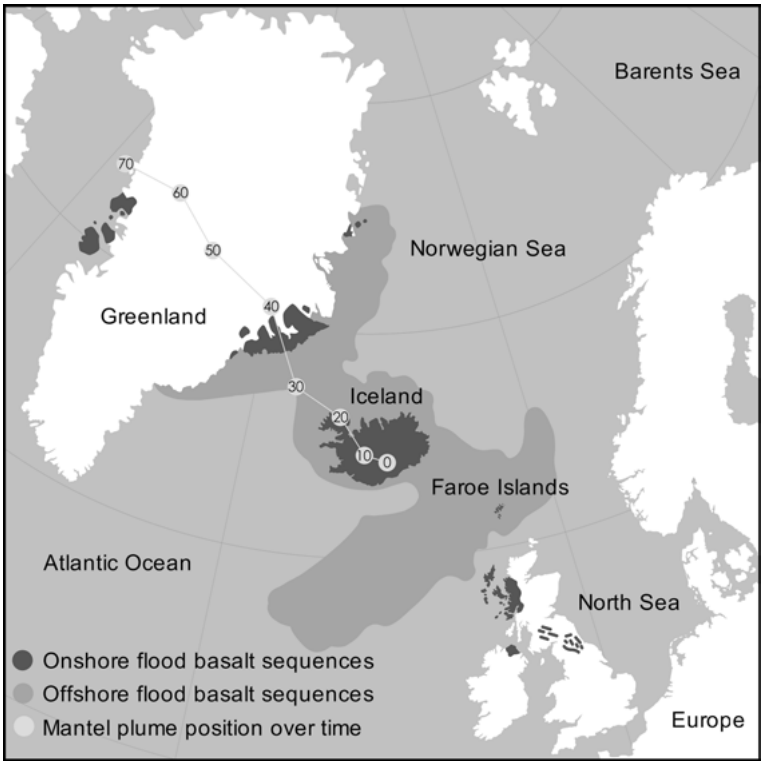


**Figure 8:** The North Atlantic's basalt structures. The dark colors show onshore (black) and offshore (gray) basalt formations created by the North Atlantic Igneous Province. The numbers within the gray circles show the present (0) and previous positions of the Iceland mantle plume (ten million to 70 million years ago).

This igneous activity is still ongoing. Today, the Iceland mantle plume sits beneath the Vatnajökull ice sheet. Although activity is more focused, magma production rates are two to three times lower than they were 56 million years ago when the large igneous province was formed.[18] Nevertheless, Iceland remains one of the most active volcanic regions on the planet above sea level.[19]

**17** Katla Geopark Project: 3–4; Fedorova, Jacoby, Wallner 2005: 123; Sigmundsson, Sæmundsson 2008. Vatnajökull literally translates as "Vatna glacier," but for the readers' convenience, at times, I use the full Icelandic name *Vatnajökull* followed by glacier or ice sheet.

**18** Saunders et al. 1997: 70–71.

**19** Thordarson, Höskuldsson 2008: 197.

Volcanoes can form near subduction zones, which are convergent (or destructive) plate boundaries. The subduction zone west of South America, for example, is described as destructive because the lithosphere gets subducted into the mantle and is slowly destroyed. Oceanic crust is thinner and lighter than continental crust; thus, it gives way and is subducted underneath the continental plate. As a result, the continental crust is uplifted, forming mountain belts. The subducted slab can go as deep as 670 kilometers to the so-called Wadati-Benioff-Zone, the boundary between the upper and lower mantle. Volcanoes can form on the surface near these subduction zones. They can also form at divergent (or constructive) plate boundaries. The mechanisms of constructive plate boundaries form new crust. One such example is the Mid-Atlantic Ridge.[20] Sometimes volcanism takes place far away from a plate boundary, the manifestations of which are called hotspot or intraplate volcanoes.

## Icelandic Volcanism in the Holocene

Let us jump forward almost 24 million years, from the formation of Iceland to the Holocene: our current geological epoch. It is challenging to establish pre-Holocene volcanic events because erosion caused by glaciation destroyed a great deal of evidence. During glaciations, ice caps grew to thicknesses of about 500 to 1,500 meters.[21] At the end of the Pleistocene, around 10,600 BCE, an extraordinary eruption occurred at Katla: the so-called Sólheimer eruption is the only known Plinian (VEI 6) eruption to have occurred at this volcano. It produced ten cubic kilometers of tephra and pyroclastic surges. Tephra is the name given to the solid particles ejected by volcanoes during eruptions. It consists of ash particles, rocks, and pumice.[22] The tephra layer from the Sólheimer eruption settled in Iceland and other Scandinavian countries and is called Vedde ash. Pyroclastic surges are waves of tephra and hot gas that sweep away from a volcano at speeds of up to 700 km/h and can reach temperatures of 1,000 °C.[23]

Prevailing winds can carry tephra great distances. When it finally rests, its layers vary in thickness, from millimeters to meters, and in color, from yellow to red, brown, gray, or black.[24] A single volcano can produce tephra of a similar chemical signature from separate eruptions occurring years apart. The uppermost tephra layers are from more recent eruptions; the layers below derive from eruptions that occurred further back in time. In the 1940s, Icelandic geologist Sigurður Þórarinsson established this chronology of tephra layers and invented the science pertaining to

**20** Grotzinger, Jordan 2017: 22–34.

**21** Lacy 1998: 17.

**22** Lamb 1970: 427.

**23** Þórarinsson 1981; Larsen 2000; Óladóttir et al. 2005; Óladóttir 2008; Larsen 2010.

**24** Byock 2001: 89.

them; tephrochronology.[25] Today, tephrochronology is widely applied in the natural sciences to date volcanic eruptions, model climate reconstructions, and corroborate archaeological findings.[26]

Perched upon the Eurasian and North American Plates, Iceland grows by about two centimeters per year: one centimeter to the east and one to the west.[27] This equates to roughly 20 kilometers of growth in one million years. Volcanism in Iceland occurs within axial volcanic zones, which cover a third of the country and are primarily located along the Mid-Atlantic Ridge (Figure 9). The volcanic zone that is most relevant here is the Eastern Volcanic Zone (EVZ). The EVZ is Iceland's most active volcanic zone and is home to eight volcanic systems, including the four most active: Grímsvötn, Bárðarbunga, Hekla, and Katla.[28] It is also Iceland's most productive volcanic zone in

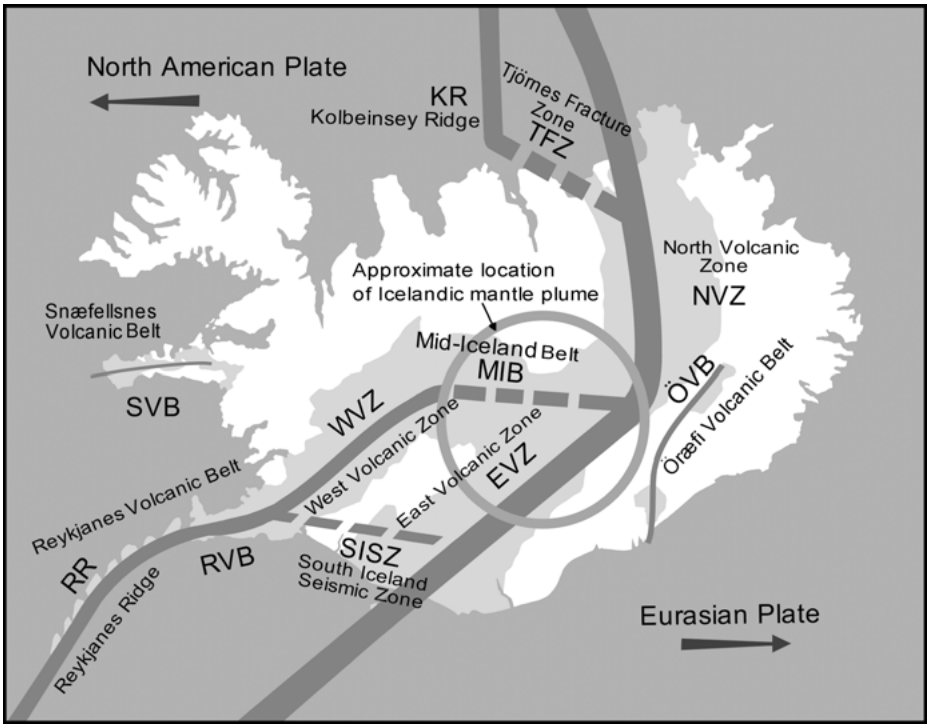


**Figure 9:** Iceland's deformation zones today.

25 Katla Geopark Project: 13; Þórarinsson 1944; Þórarinsson 1956b; Þórarinsson 1979.

26 Karlsson 2000a: 13–14; Dugmore, Vésteinsson 2012: 77, 81. For more information on tephrochronology in general, see Þórarinsson 1981; Dugmore et al. 2009a.

27 Pagli, Sigmundsson 2008: 4.

28 Thordarson, Larsen 2007: 118–121; Thordarson 2010: 286; Katla Geopark Project: 5.

terms of lava output. In historical times, 80 percent of Icelandic eruptions occurred in the EVZ. This zone has been active for two to three million years.[29]

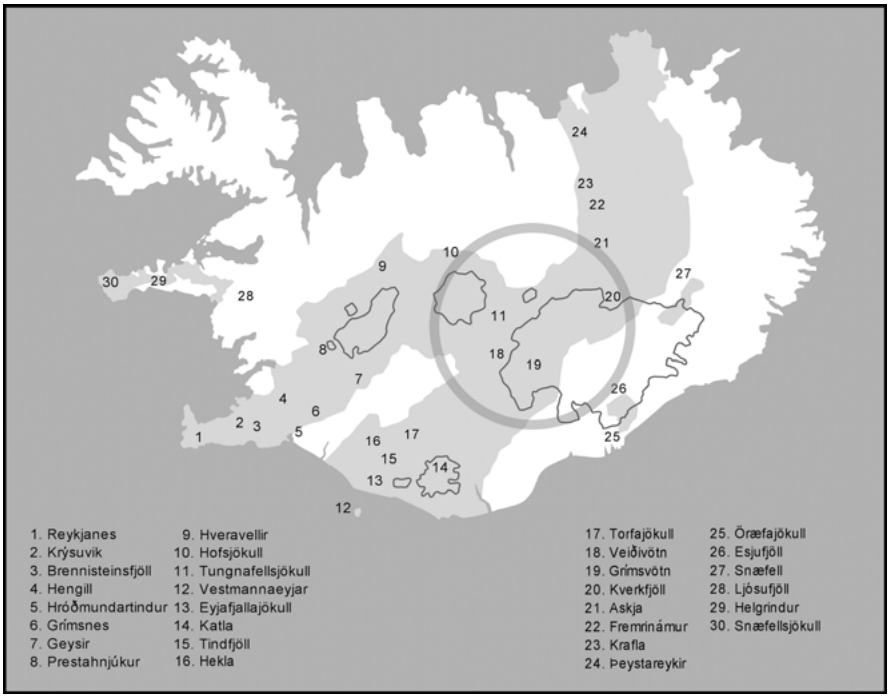


**Figure 10:** Iceland's 30 volcanic systems. The circle surrounds volcanic systems 11, 18, 19, and 20, representing the location of the Iceland mantle plume. The other lines indicate the locations of glaciers within Iceland. The dark gray area indicates the location of the spreading axis, the subaerial part of the Mid-Atlantic Ridge.

Iceland has 30 active volcanic systems (Figure 10). In this context, an active volcanic system is one that has had an eruption during the Holocene. A volcanic system consists of either a central volcano, a fissure swarm (a cluster of fissure volcanoes), or both. Activity close to the axial volcanic zones is connected to the phenomena of spreading and rifting and the creation of crust. It is not a continuous process; rather, it is episodic, with each phase traditionally referred to as a "fire," such as the Skaftá Fires. During such a rifting episode, the whole volcanic system is activated and expresses itself through one or more volcanic eruptions and recurring earthquakes.[30]

The Grímsvötn volcanic system (Figure 11) consists of two central volcanoes, Grímsvötn and Þórðarhyrna, and three calderas, 250 to 300 meters beneath the Vatnajökull ice sheet. A caldera is a large hollow that forms when a magma chamber collapses in

**29** Passmore et al. 2012: 2594.

**30** Thordarson, Larsen 2007: 121–123.

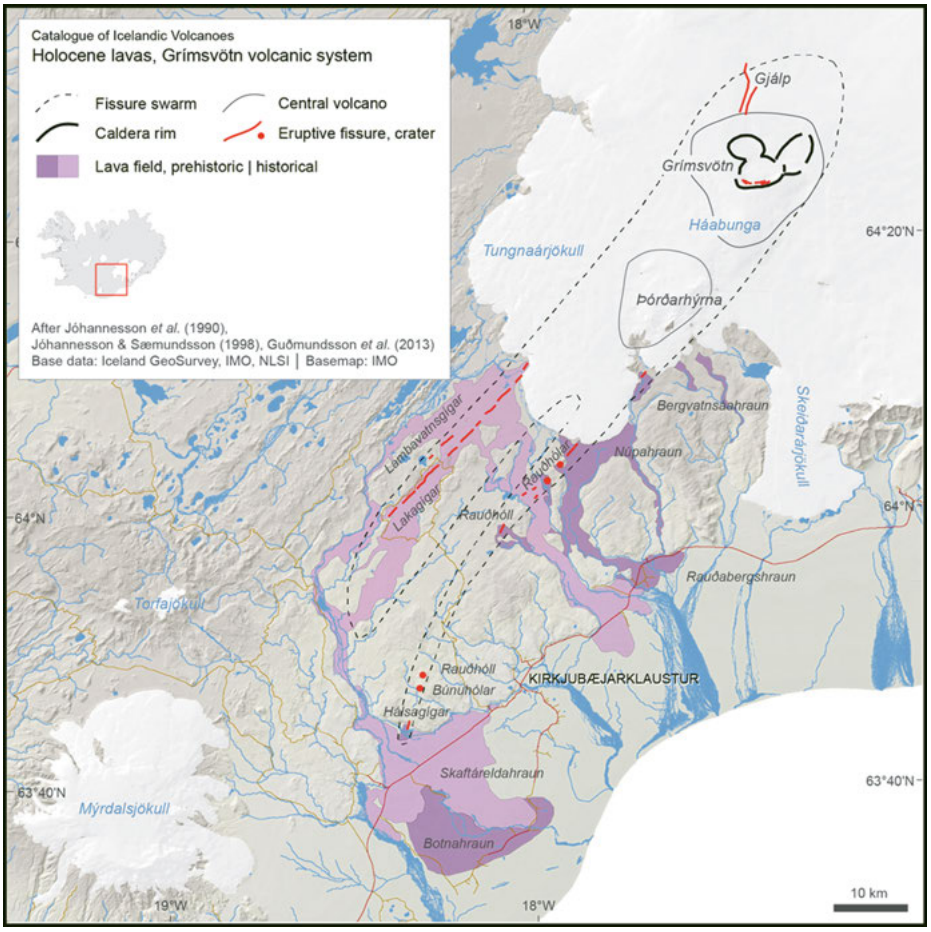


**Figure 11:** The Grímsvötn volcanic system. The caldera is underneath Vatnajökull (the glacier on the right), with subaerial parts of the Grímsvötn volcanic system represented by dotted lines. The pink color indicates the lava fields produced by Laki, while purple indicates older lava produced in pre-historical times.

on itself after an eruption.[31] Grímsvötn is a southeast-trending fissure swarm, some 80 kilometers long and ten to 15 kilometers wide, of which only the southernmost tip is ice-free. Four crater rows are visible here, all of which formed over the past 8,000 years: one of these rows is the Laki fissure.[32] Grímsvötn has seen more than 70 eruptions in

**31** For more information on subglacial lakes, see Björnsson 1974; Björnsson 1976; Björnsson 1992; Björnsson 2002; Russell et al. 2005: 163–164.

**32** Jakobsson 1979; Thordarson et al. 2003b: 13; Passmore 2012: 2594; Catalogue of Icelandic Volcanoes: Grímsvötn.

the last millennium.[33] It goes through a 60-to-80-year period of high activity consisting of 12 to 22 eruptions, followed by a 60-to-80-year period of low activity consisting of up to eight eruptions. Grímsvötn's geothermal activity frequently causes flooding on the plains around the Skaftá River.[34]

Iceland's 30 volcanic systems have produced roughly 2,400 eruptions and around 556 ± 100 cubic kilometers of lava since the last ice age. Scientists established this from tephra layers in Iceland and ice core records in Greenland, where many Icelandic eruptions deposit tephra.[35] Icelandic volcanoes range from majestic stratovolcanoes to earth-splitting fissures.[36] Subaerial, subglacial, and submarine eruptions occur here, which can erupt either effusively (most erupted materials are lava), explosively (most erupted materials are tephra), or with a mix of both.[37] Volcanologists classify eruptions, for the most part, as either wet or dry: most are wet (hydromagmatic or phreatic). Here, the magma interacts with water: a submarine eruption reacts with the ocean, a subglacial eruption reacts with the glacier and meltwater, and a subaerial eruption (which is not covered by water or ice) reacts with groundwater. The explosivity of wet eruptions depends on how much water is available. Wet eruptions constitute around 75 percent of all Icelandic eruptions. When magma does not react with water during an eruption, it is considered a dry eruption. When an eruption shows characteristics of being both wet and dry, it is called phreatomagmatic.[38]

An eruption that produces more than one cubic kilometer of lava is defined as a flood basalt event. Icelandic volcanologist Thorvaldur Thordarson estimates that large flood basalt events in Iceland occur once every 300 to 1,000 years.[39] Flood basalt events are relatively common in the EVZ. Throughout the Holocene, many such events have taken place in this part of Iceland, sometimes with hundreds of years between each.[40] The largest of these was an eruption caused by the Bárðarbunga volcanic system around 8,600 years ago, which produced the Great Þjórsá Lava; this vast lava field consists of more than 22 cubic kilometers of lava and covers an area of 970 square kilometers.[41] This volume of lava would fill 8.8 million Olympic-sized swimming pools. As with the Laki eruption millennia later, the sulfuric gases released made this a "climatically significant eruption."[42]

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**33** Thordarson, Höskuldsson 2014: 141.

**34** Catalogue of Icelandic Volcanoes: Grímsvötn.

**35** Thordarson, Höskuldsson 2008: 197; Ágústdóttir 2015: 1672.

**36** Thordarson 2010: 286.

**37** Þórarinsson, Sæmundsson 1979; Þórarinsson 1981; Thordarson, Larsen 2007: 118, 125–127; Thordarson, Höskuldsson 2008: 200; Dugmore, Vésteinsson 2012: 69.

**38** Thordarson, Höskuldsson 2008: 207–209, 215.

**39** Thordarson, Self 2003: 1; Thordarson, Höskuldsson 2008: 197.

**40** Thordarson et al. 2003b; Thordarson, Larsen 2007; Passmore et al. 2012: 2594.

**41** Thordarson et al. 2003a: 117; Thordarson 2005: 205–209; Global Volcanism Program: Bárðarbunga. The Global Volcanism program dates this event at Bárðarbunga to 6650 BCE ± 50 years.

**42** Thordarson 2005: 218.

There were several huge eruptions at Grímsvötn between 10,400 and 9,900 years ago.[43] These eruptions formed the thickest tephra layer of the Holocene, the Saksunarvatn layer; it is named after a lake on the Faroe Islands, its place of discovery. This layer is also present across almost all of Iceland. The amount of tephra released in total is estimated to be in the region of ten cubic kilometers.[44] One of the largest Holocene eruptions to date was Hekla 3, which occurred around 1000 BCE. Tree ring and stalagmite records indicate that this event significantly cooled the climate for the following decade.[45]

## Icelandic Volcanoes in Historical Times

Iceland was the last country in Europe, and one of the last large islands in the world, to be settled (after Madagascar and before New Zealand).[46] While its people escaped the bloody and brutal conflicts of Europe and North America by virtue of their homeland's geographical location, they could not evade the hardships visited upon them by its geology.[47] Every generation of Icelanders has experienced volcanism and its impact on society and the environment. Nevertheless, the local perception of volcanoes greatly depends on their frequency and magnitude, as well as their proximity to settled areas of the island.[48]

Europeans had paid Iceland sporadic visits before its settlement. Archaeological evidence suggests that Irish monks landed there in the eighth and early ninth centuries. It may be that the Greek explorer Pytheas of Massalia (today's Marseille, France) landed there in the fourth century. In around 860 CE, Norsemen sailing from Norway to the Faroe Islands happened upon the island of Iceland, with settlers following in the 870s.[49] Over the next 60 years, more Norsemen and people from the British Isles trickled in.[50] No verified numbers regarding population for this time exist, but the Icelandic historian Gunnar Karlsson estimates that it had around 10,000 inhabitants in 930 CE, given

**43** Johannsdóttir, Thordarson, Geirsdóttir 2006; Thordarson, Höskuldsson 2008: 219; Bramham-Law et al. 2013; Global Volcanism Program: Grímsvötn. The thickness of the Saksunarvatn layer indicates a very explosive volcanic eruption, perhaps even a super eruption (VEI 8). The tephra layer covered most of Iceland and can be found on both sides of the North Atlantic, even as far away as northern Germany. According to the Global Volcanism Program, the Saksunarvatn eruption was a VEI 6 event and the tephra can be dated to 8230 BCE ± 50 years.

**44** Catalogue of Icelandic Volcanoes: Grímsvötn.

**45** Global Volcanism Program: Hekla; Baillie 1989.

**46** Hjálmarsson 1988: 14; Vasey 1996.

**47** Stark 1994: 120–121; Oslund 2011: 30.

**48** Thordarson 2010: 285, 290.

**49** Hjálmarsson 1988: 13–15; Lacy 1998: 76–77; Karlsson 2000b: 9–15; Vesteinsson, Sverrisdóttir, Yates 2006. A study has been undertaken to carbon-date wood that was found in Reykjavík and is believed to have been from the early settlement; Sveinbjörnsdóttir, Heinemeier, Guðmundsson 2004.

**50** Lacy 1998: 81; Helgason et al. 2000; Karlsson 2000a: 11–20; Ogilvie 2005: 257–258.

the population of 50,000 by 1100 CE.[51] Iceland's *Althing* was founded in 930 at Þingvellir and is one of the oldest parliamentary assemblies in the world.[52]

*Reykjavík* loosely translates to "steamy bay," so called due to the geothermal activity in the area.[53] During the initial years of settlement, two separate volcanic eruptions produced by one volcanic system, Bárðarbunga, occurred around the same time. As a result, a double layer of tephra exists called the "settlement layer," an archaeological term, as it contains the oldest settlement-related finds. It lends its name to an archaeological museum in Reykjavík, "The Settlement Exhibition Reykjavík 871 ± 2."[54]

The volcanic activity in Iceland during historical times remained the same as in the post-glacial and pre-settlement periods. In recorded history, Iceland has seen at least 213 volcanic eruptions (some of these are listed in Figure 12).[55] On average, Iceland sees 20 to 30 eruptions in a given century: these eruptions produce around eight cubic kilometers of lava in total.[56] The frequency of eruptions has varied over the past 11 centuries. It seems to have increased recently, though this is perhaps due to better documentation in the modern period.[57]

The first huge volcanic eruption, and the largest flood basalt eruption, to take place in Iceland in the last 2,000 years occurred just after the settlement period. From spring 939 to autumn 940, Eldgjá, "the fire gorge," formed in 30 eruptive episodes and produced 19 cubic kilometers of lava along a 75-kilometer-long fissure in a northeast-southwest direction extending to Vatnajökull.[58] The lava covered 780 square kilometers, an area about the size of New York City.[59] Katla, a volcanic system underneath the

**51** Karlsson 2000b: 15. Jesse Byock (2001: 9) also argues that the population levels must have reached "at least ten thousand people [by 930], and perhaps as many as twenty thousand, [. . .]." Terry Lacy (1998: 77–79) believes Iceland might have had as many as 60,000 settlers by 930.

**52** Hjálmarsson 1988: 27; Karlsson 2000b: 9–13. *Thing* means assembly. For more information on the *Althing*, see also Lacy 1998: 90–93; Byock 2001: 174–176; Steingrímsson 2002: 341.

**53** The geothermal fields and steam might come from the Reykjanes or Hengill volcanic systems; Thordarson, Larsen 2007: 123–124.

**54** The tephra layer with the lighter color, called Hrafntinnahraun lava, was produced by an eruption at Torfajökull. Global Volcanism Program, Torfajökull; Catalogue of Icelandic Volcanoes: Torfajökull. The layer with the darker color was produced at Vatnaöldur, which is an approximately 60-kilometer-long fissure and part of the Bárðarbunga volcanic system. The Global Volcanism Program estimates the eruption to have taken place around 870 CE, reaching VEI 4. Global Volcanism Program: Bárðarbunga; Catalogue of Icelandic Volcanoes: Bárðarbunga; Thordarson, Larsen 2007: 133. For more information on the "settlement layer," see also Grönvold et al. 1995; Dugmore et al. 2009a.

**55** Thordarson, Larsen 2007: 135–136. When this paper was published in 2007, Icelanders had seen 208 eruptions since the settlement. With the addition of the 2010 Fimmvorduhals, the 2010 Eyjafjallajökull, the 2011 Grímsvötn, the 2014–2015 Holuhraun (Bárðarbunga), and the 2021 and 2022 Fagradalsfjall eruptions (Krýsuvík-Trölladyngja), the number has grown to 214 volcanic events [as of January 2023].

**56** Guðmundsson et al. 2008: 263; Thordarson, Höskuldsson 2008: 197.

**57** Thordarson 2010: 286.

**58** Oppenheimer et al. 2018.

**59** Thordarson, Larsen 2007: 142. New York City covers an area of 784 square kilometers.

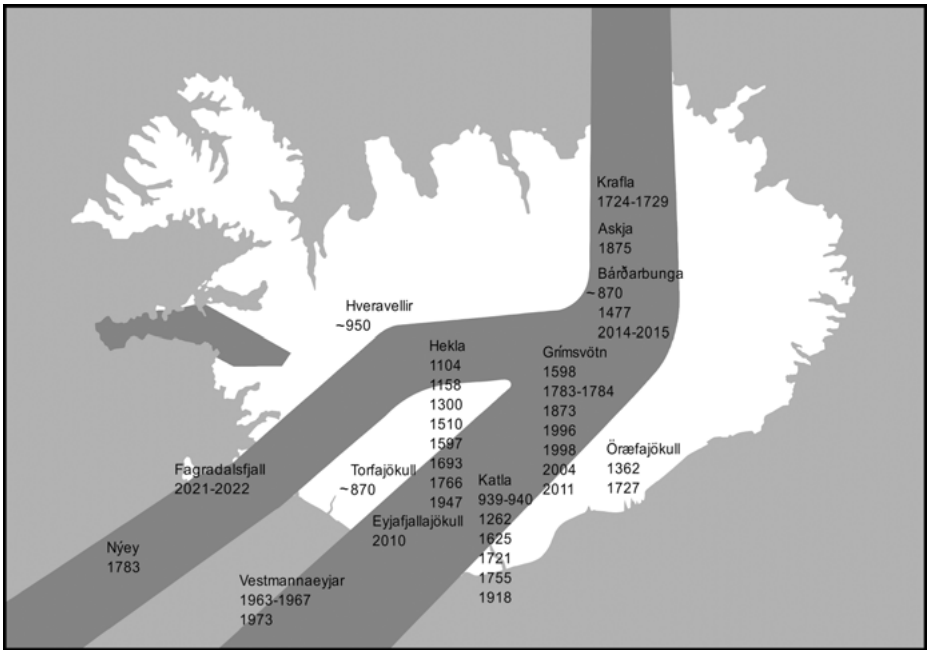


**Figure 12:** Map of eruptions in historical times featured in this book.

Mýrdalsjökull ice shield, was the source of this eruption.[60] The *Landnámabók*, the book of settlement composed in the twelfth and thirteenth centuries, briefly mentions this volcanic event.[61] The most obvious consequence of volcanic eruptions is lava flows that can continue for months or years, resulting in extensive property loss; this was the case during the Eldgjá eruption.[62] In addition, Eldgjá produced huge quantities of sulfur dioxide (about 220 megatons), making it the largest volcanic-pollution event in recorded history. A decade later, in 950, another flood basalt event, called Hallmundarhraun (*hraun* means lava field), produced around eight cubic kilometers of lava. This eruption was sourced by the Hveravellir volcanic system in the Western Volcanic Zone.[63]

In this heaving land they now called home, settlers dealt with the dramatic and the mundane. The foodstuffs they formerly benefitted from in their homelands were not necessarily available in Iceland; therefore, they had to change their diet according

**60** Larsen 2000; Guðmundsson 2005: 140.
**61** Thordarson 2010: 288.
**62** Guðmundsson et al. 2008: 259.
**63** Thordarson, Larsen 2007: 140–142; Dugmore, Vésteinsson 2012: 71–72.

to availability.[64] Icelanders used moss, a sort of lichen gathered in the mountains, to stretch flour. Seaweed was used for this purpose as well. At the beginning of the settlement, although plenty of fish and birds were available, there were no game animals or trees with fruit or nuts apart from a few kinds of bushes that bore wild berries.[65] While Iceland's climate is mild for its latitude, it was challenging to get by.[66] Agriculture was not easy because of the unstable weather patterns. These weather patterns are continually influenced by the Gulf Stream, which brings warm, damp air from the south, and the East Greenland Current, which brings cold, dry polar air.[67] The presence of sea ice lowered temperatures further.[68] Even at its warmest, during the Medieval Climate Anomaly between 870 and 1170, Iceland was never "self-sufficient as a grain producer."[69]

Many settlers brought livestock to Iceland, mainly sheep and cattle.[70] Grass became the main crop and was used primarily as winter fodder.[71] Early in the settlement process, Iceland's forests were cleared to create fields for grazing and to provide wood for fuel and charcoal production.[72] The lack of trees, the large-scale introduction of livestock, and frequent tephra deposits after volcanic eruptions made both erosion and desertification significant environmental challenges for the Icelanders.[73]

Fish, such as salmon, trout, and char, the occasional stranded whale, and birds' eggs supplemented the Icelandic diet. Until the late nineteenth century, fish were mainly caught in rivers and ponds or shallow waters close to the shore. The small row boats used by Icelanders at the time were inadequate for the open sea.[74] Iceland, cut off from Europe by a vast and boundless body of salt water, was, ironically, salt-deprived at all times. The resources vital for boiling saltwater were in short supply as well. Therefore, Icelanders smoked meat and air-dried fish to preserve them for the winter.[75] Seals, a staple for Icelanders, provided meat, oil, and leather.[76]

**64** Karlsson 2000b: 44–51.

**65** Rögnavaldurdóttir 2002: 1–3.

**66** Lacy 1998: 21–24; Jónsson, Valdimarsson 2005: 81.

**67** Bergþórsson 1969; Ogilvie 1984; Ogilvie 1986: 72; Ogilvie 2001; Steingrímsson 2002: 6.

**68** Gunnarsson 1980; Ogilvie et al. 2000; Byock 2001: 26; Jónsson, Valdimarsson 2005: 81–82; Andrews et al. 2009; Ogilvie et al. 2009; Ogilvie, Hill, Jónsson 2011.

**69** Rögnavaldardóttir 2002: 1 (quote). See also Byock 2001: 57; Steingrímsson 2002: 6: During the Medieval Climate Anomaly, temperatures were about 1 °C above the 1960–1990 average of 4 °C. As a comparison, the average annual temperature in Munich between 1993 and 2018 was 9.16 °C, based on weather data from Wetterkontor.de.

**70** Rögnavaldurdóttir 2002: 2.

**71** Ogilvie 2005: 257–258.

**72** Dugmore, Vésteinsson 2012: 80.

**73** Vasey 1991: 325; Lacy 1998: 43–48; Helldén, Brogaard 1999.

**74** Gunnarsson 1983: 21–23; Rögnavaldurdóttir 2002: 2–3; Robertsdóttir 2008: 36; Oslund 2011: 11.

**75** Rögnavaldurdóttir 2002: 1–4.

**76** Pelly 2001: 5–6: Some place names in Iceland still reflect on the use of seals, such Seley ("seal island"), Kópavogur ("bay of baby seals"), and Urtusteinn ("female seal rock").

Most of what scholars know from the settlement period and afterward is from two written sources, the aforementioned *Landnámabók*, the book of settlement, and the *Íslendingabók*, the book of Icelanders. The latter was probably written down for the first time in around 1130 CE by the Icelandic historian Ari Thorgilsson (1067–1148). The so-called Saga Age was the period between 871, the settlement, and 1262, the year Iceland became a dependency of Norway.[77] In the Saga Age, maritime travel played a vital role. During this time, Icelandic seafarers landed in Greenland and, in around the year 1000, traveled on to North America, where Leifur Eiríksson set up camp at today's L'Anse aux Meadows in Newfoundland.[78]

The Scandinavian settlers continued to observe their polytheistic faith until the introduction of Christianity at the turn of the millennium.[79] The *Althing*, located at the boundary between the North American and Eurasian Plates, played host to the debate over whether or not to adopt this new faith. Records of this discourse reveal that some settlers had a surprisingly good understanding of volcanism. For example, when news arrived from the Reykjanes Peninsula about a fissure eruption that had produced enough lava to overrun the farm of a pagan priest, those present asked whether the Gods, "enraged" at the possible adoption of Christianity, were exacting punishment for this meeting. A pagan priest named Snorri pointedly remarked: "At what were the gods enraged when the lava on which we are standing formed [. . .]?"[80] Given that the settlers came from lands unstirred by volcanism – Scandinavia, Britain, and Ireland – it is impressive how quickly they came to understand their new environment.[81]

In 1104, for the first time since settlement, Hekla erupted (VEI 5).[82] According to geologist Sigurður Þórarinsson, the *Liber Miraculorum*, the Book of Wonders, contains the oldest known reference to this eruption. Chaplain Herbert of Clairvaux authored this text in 1180. He was a man of questionable geographical skills: he mistook Iceland for Sicily and called it "Hell's chimney."[83] Indeed, historian Terry Lacy suggests that the English expression "go to heck," meaning "go to hell," derives from Hekla's name.[84] The 1104 eruption produced extreme tephra fallout called Hekla 1 (H1) tephra. This tephra layer covered an area of 55,000 square kilometers (half of Iceland). Within

77 Hjálmarsson 1988: 13, 29, 45–51; Lacy 1998: 34–42, 80–81; Karlsson 2000b: 66–71; Kristjánsson 2007. Iceland was interchangeably called a province, a dependency, and a colony; Hálfdanarson 2014: 42.

78 Wallace 1991; Karlsson 2000b: 28–32; Oslund 2011: 12. For more information on the discovery of Greenland and its development during the Medieval Climate Anomaly and the Little Ice Age, see also Barlow et al. 1997; Lacy 1998: 123–133; Fitzhugh, Ward 2000; Ogilvie et al. 2000; Barrett 2003; Dugmore et al. 2009b; Lasher, Axford 2019.

79 Lacy 1998: 89–90, 100–101; Karlsson 2000b: 16–19, 33–43; Steingrímsson 2002: 2.

80 Thordarson 2010, 289.

81 Karlsson 2000b: 38–43; Vésteinsson 2000; Steingrímsson 2002: 2, 357; Thordarson 2010: 293.

82 Hjálmarsson 1988: 35–40; Thordarson, Larsen 2007: 141. According to the Global Volcanism Program, the eruption took place on 15 October 1104 ± 45 days; Global Volcanism Program: Hekla.

83 Þórarinsson 1956a: 5–6; Krieger 2019.

84 Lacy 1998: 108.

70 kilometers of the volcano, the tephra fall was more than 25 centimeters thick and resulted in the total abandonment of the farms in the area.[85] Tephra can fertilize the land, stimulating growth; in this case, however, too much of a good thing led to damaged vegetation, soil erosion, and barren surfaces that required decades or even centuries to recover. Fluorine is a common component in tephra's chemical make-up; this element can poison bodies of water and grazing lands, destroy crops and livestock, and pose a significant hazard for a community depending on pastoralism.[86] In 1693, another Hekla eruption caused ashfall and, with it, the death of trout populations in lakes 110 kilometers away. Sheep, cattle, and horses were also affected, particularly by dental lesions called "ash teeth."[87]

Until the thirteenth century, mentions of volcanic eruptions in Icelandic sources were brief, mostly one-line descriptions, such as "1158: second fire in Hekla." The chroniclers only mentioned eruptions if they impacted their immediate environment or the economy.[88] Several sources from mainland Europe (most of which were written some time after the fact) reported natural phenomena that might have been related to Icelandic eruptions, such as hazes, red sunsets, and famines.[89]

In the thirteenth century, a few prominent families gained most of the political and economic power in Iceland, which disrupted the previous balance. In 1262, the Icelanders accepted the influential Norwegian king as their leader to restore peace on the island. In a personal union with the king of Norway, the Icelanders agreed to pay taxes but were allowed to maintain control of their laws. Iceland remained under the thumb of a foreign power until 1944.[90]

Between 1210 and 1240, the Reykjanes Peninsula saw a series of lava flows overrun farms close to fissure systems.[91] Sometime before the thirteenth century, another flood basalt event called Frambruni, part of the Bárðarbunga volcanic system in the Eastern Volcanic Zone, produced around four cubic kilometers of lava.[92] Then, in 1262, Katla saw a remarkably strong (VEI 5) eruption; in 1300, another VEI 4 eruption occurred at Hekla.[93]

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**85** Ágústdóttir 2015: 1674. Farmland is recoverable if it is under a tephra layer of 25 centimeters or less.

**86** Byock 2001: 58–59; Guðmundsson et al. 2008; Dugmore, Vésteinsson 2012: 73–75; Ágústdóttir 2015: 1673–1675.

**87** Pétursson, Pálsson, Georgsson 1984: 96.

**88** Dugmore, Vésteinsson 2012: 67–68 (quote). Falk (2007) discusses the notable absence of volcanoes and volcanic eruptions in the Icelandic sagas, which otherwise is a genre praised for its realism.

**89** Wozniak 2017: 736–738; Oppenheimer et al. 2018; Ebert 2019; Ebert 2021.

**90** Hjálmarsson 1988: 52–60; Lacy 1998: 139–148; Karlsson 2000b: 72–95; Steingrímsson 2002: 3; Oslund 2011: 12; Hálfdanarsson 2014: 40–44.

**91** Clifton, Kattenhorn 2006; Keiding et al. 2008; Dugmore, Vésteinsson 2012: 71–72; Catalogue of Icelandic Volcanoes: Reykjanes.

**92** Thordarson, Larsen 2007: 140; Dugmore, Vésteinsson 2012: 71–72; Global Volcanism Program: Bárðarbunga.

**93** Global Volcanism Program: Katla.

The mid-to-late thirteenth century also marked the beginning of the Little Ice Age in Iceland.[94] It was noticeable earlier in this part of the world than elsewhere: harsher weather, rougher seas, and sea ice around the coast of southern Iceland made shipping in the North Atlantic difficult and fishing even more dangerous.[95] This climatic change also impacted the Icelanders' diet.[96] They took to raising livestock instead of growing crops because, in emergencies, animals could sometimes be relied upon to fend for themselves. The flexibility of subsistence farming and the use of wild resources allowed the population to deal with setbacks brought on by cold winters or volcanic hazards; this was crucial, as they were almost always left alone to deal with the consequences.[97] In Iceland, the Little Ice Age lasted until the 1920s.[98]

In 1362, Öræfajökull, a 500-meter-deep caldera full of ice, sprang to life. It would be the most explosive eruption on the island since its settlement, reaching a VEI level of 6.[99] Lasting roughly from June to October 1362, it covered the surrounding meadows and fields with a thick layer of tephra and terrorized those nearby with glacial outburst floods. These torrential outbursts are a major threat during subglacial eruptions and are internationally referred to by their Icelandic name, *jökulhlaups*. In Iceland, they occur mainly at Mýrdalsjökull and Vatnajökull and can reach peak discharge rates of 300,000 cubic meters per second, flooding areas up to 400 square kilometers.[100] They contain debris such as ice blocks and other volcanic ejecta.[101] After the Öræfajökull eruption, at a distance of 15 kilometers from the volcano, the tephra was more than one meter thick.[102] The eruption also produced pyroclastic surges, which consumed 30 farms near the volcano.[103] In Iceland, this phenomenon is not a common occurrence; however, the 1362 eruption at Öræfajökull and the 1875 Askja eruption serve as reminders that Iceland could see pyroclastic surges again in the future.[104]

In 1380, Oluf II of Denmark inherited the Kingdom of Norway and all its territories, which included Iceland, when his father, Haakon VI of Norway, died; thus, Iceland became a Danish dependency.[105] From 1380 onward, Denmark ruled Iceland

**94** For a debate on the length of the Little Ice Age, see Degroot 2018a: 2.

**95** Hjálmarsson 1988: 12–13; Ogilvie, Jónsson 2000: 11–12.

**96** Rögnavaldardóttir 2002: 1–2.

**97** Guðmundsson et al. 2008: 263; Dugmore, Vésteinsson 2012: 71.

**98** Lacy 1998: 24.

**99** Global Volcanism Program: Öræfajökull; here, the eruption is said to have reached VEI 5.

**100** Thordarson, Höskuldsson 2008: 217; Dugmore, Vésteinsson 2012: 72.

**101** Thordarson, Larsen 2007: 134.

**102** Guðmundsson et al. 2008: 256.

**103** Þórarinsson 1958; Byock 2001: 61–62; Guðmundsson 2005: 140–141; Guðmundsson et al. 2008: 259; Dugmore, Vésteinsson 2012: 71.

**104** Thordarson, Larsen 2007: 133; Guðmundsson et al. 2008: 257–259.

**105** Lauring 1960: 105–109; Hjálmarsson 1988: 64–68; Lacy 1998: 166–177; Karlsson 2000b: 2–3, 100–105; Steingrímsson 2002: 3; Oslund 2011: 12.

from its central administration in Copenhagen.[106] Iceland was twice the size (103,000 square kilometers) of Denmark proper (42,933 square kilometers) and far away, which initially allowed for a certain amount of autonomy.[107]

In the first few years of the fifteenth century, the Black Death reached Iceland: one-third of the population perished from the disease. Surrendering to the plague and a worsening climate, some Icelanders gave up their farms and sold them to other landowners or the Church.[108] Iceland was not spared strong volcanic eruptions in the fifteenth century: in 1477, an unusually explosive eruption (VEI 5 to 6) occurred in the Icelandic highlands at Veiðivötn, producing ten cubic kilometers of tephra and small lava flows. Intermittent epidemics followed this, which thinned out the population yet more, killing around one-quarter of the hardened inhabitants.[109] Hekla erupted again in 1510 and caused yet more devastation.[110]

In 1523, the Kalmar Union, which had joined the kingdoms of Denmark, Sweden, and Norway under a single monarch, came to an end. Consequently, Iceland came under the direct rule of the Danish Crown.[111] In the same year, Denmark became Protestant, as did Iceland in 1550. The Protestant Reformation increased the Danish king's authority and landholdings as it allowed him to seize all the land formerly owned by Catholic monasteries.[112] From the sixteenth century onward, Lutheran Mass was conducted in Icelandic rather than Latin, and preaching and teaching became more important; however, much religious terminology was left unchanged.[113]

In 1602, the Danish king, Christian IV, gave privileges regarding all Icelandic trade to approximately 25 Danish merchants. This marked the beginning of the Danish trade monopoly, which lasted until 1787 and prevented the Hanseatic Trading League from getting a foothold in the Icelandic market. Each privileged merchant was allowed to send one or two ships to a certain trading post.[114] Usually, the ships left Denmark in the spring, arrived in Iceland in June or July, traded throughout summer, and returned to

**106** Ogilvie 2005: 272–274.

**107** Robertsdóttir 2008: 40–41.

**108** Karlsson 1996; Karlsson 2000b: 111–117; Byock 2001: 353; Hufthammer, Walløe 2013; Callow, Evans 2016.

**109** Larsen 1984; Zielinski et al. 1997; Thordarson, Larsen 2007: 133; Thordarson, Höskuldsson 2008: 219–220; Streeter, Dugmore, Vésteinsson 2012: 3664–3665. The Global Volcanism Program estimates that this eruption reached a VEI 6; Global Volcanism Program: Bárðarbunga.

**110** Global Volcanism Program: Hekla. For a discussion of the climate in Iceland from 1500 onward, see Ogilvie 1991; Ogilvie 1992. Another eruption occurred at Hekla in 1597.

**111** Lacy 1998: 106–107; Oslund 2011: 12.

**112** Hjálmarsson 1988: 70–77; Hastrup 1990: 37; Karlsson 2000b: 128–137. In Denmark itself, the Reformation was relatively uneventful compared to what took place in other European countries; Lauring 1960: 141–144.

**113** Today, "an ordained minister of the Icelandic Lutheran Church is called a *prestur* (priest in English), and the regular liturgical church service is called a *messa* (mass in English)." Steingrímsson 2002: 4, 357.

**114** Karlsson 2000b: 123–127; Steingrímsson 2002: 7; Oslund 2011: 36–38.

Denmark in autumn. This seasonal rhythm was necessary because the journey to Iceland was all but impossible in the winter.[115] To maintain social stability, the merchants were prohibited from staying in Iceland during the winter or employing Icelanders.[116] These arrangements were disadvantageous to the Icelanders, to say the least: the Danes were now the only way Icelanders could get supplies and goods from outside the island. The privileged merchants could name their price and sell the Icelanders rotten goods, ensuring a profit.[117] Their trade was mainly made by barter, as very little money was in circulation on the island.[118]

In 1625, another eruption at Katla took its place in the litany of Icelandic disasters.[119] A day-to-day account of this eruption and its consequences survives until the present: the author of this was Þorsteinn Magnússon. His notes inspired others to document large eruptions in greater detail; publications of this genre became what is known as *eldrit* ("books of fire"). Those who authored the texts were usually government or Church representatives.[120] Sources became more plentiful from 1600 onward, allowing for more detailed climate reconstructions.[121]

## Before the Laki Eruption

Iceland would suffer yet more hardships throughout the eighteenth century. In periods of plummeting temperatures, the Icelandic people could count on volcanic activity to worsen their already precarious situation. With two decades of reasonably mild weather in the 1760s and 1770s, the worst weather of the century came in the 1780s.[122] A colder climate and wildly unpredictable weather patterns made surviving difficult. The population fell victim to malnutrition and disease: life became a case of adapt or perish.

Denmark kept Iceland as a dependency for reasons of prestige rather than profit. The revenue from Iceland for the Danish king was small, and he was frequently called upon to assist Icelanders in times of crisis. In 1702, the Danish king, Frederick IV, began exploring ways to improve the Icelanders' situation. This endeavor was not as philanthropic as it may have seemed, for the king was motivated by the notion that

**115** Byock 2001: 266.

**116** Andrésson 1984: 232; Gustafsson 1994; Karlsson 2000b: 138–142; Robertsdóttir 2008: 41–42.

**117** Hjálmarsson 1988: 77–78; Gunnarsson 1983: 11–12.

**118** Steingrímsson 2002: 7; Agnarsdóttir 2013: 13.

**119** Guðmundsson 2005: 140.

**120** Thordarson 2010: 289, 293.

**121** The data available shows that the Medieval Climate Anomaly was not uniformly mild, and the Little Ice Age was not uniformly cold. Reality, as it often is, was more complex. Ogilvie 1986; Luterbacher 2001: 30; Ogilvie 2005: 283–286; Degroot 2018a: 2, 32–37.

**122** Ogilvie 1986: 67, 72; Ogilvie 2005: 283–284.

each part of the Danish realm should do its part to contribute to the well-being of the entire kingdom.[123]

A general census in 1703 revealed that Iceland had a population of 50,358.[124] In the eighteenth century, almost all Icelanders lived on farms in rural areas. It is anachronistic to describe these Icelandic settlements as villages or towns, the lack of which was the most notable difference between Iceland and western Europe at the time. There were no chartered towns in Iceland until 1786. The most significant settlements were the two bishoprics: Skálholt (85 people) in the south and Hólar (93 people) in the north. Reykjavík was a mere farmstead, just like a thousand others across the country.[125] Industry, such as tanning, wool spinning, knitting, and rope making, slowly emerged to complement farming and fishing during the eighteenth century. These crafts were usually carried out on farms when animal husbandry was not the sole focus, particularly during winter.[126]

As most of the farmers (roughly 96 percent) did not own the land they worked on, they frequently fell into poverty. Tenant farmers cared for the livestock they rented with the land. There was no insurance: if an epizootic disease or a volcanic eruption with poisoning ashfall struck, the farmer was liable for the cost of replacing the animals.[127] The Danish Crown and the Church owned almost half the land (48 percent), and private landowners, who made up around four percent of the population, held the remaining 52 percent.[128] In Iceland, there were around 180 parishes; most had one priest and a congregation of fewer than 500 people.[129]

Apart from a small elite on the island, Icelanders were relatively equal. Even members of this small elite – officials and clergy, such as district governors, sheriffs, bishops, and priests – farmed to provide for themselves and their families.[130] Thus, they also depended on good weather during the growing season to produce a good harvest. Volcanoes did not discriminate; they could affect all parts of Iceland and all

**123** Robertsdóttir 2008: 37–38, 368; Oslund 2011: 13.

**124** The National Archives of Iceland, Census Database: The Icelandic Census of 1703. The number of people in Iceland in 1703, as given on the manntal.is website, is 50,958, which is slightly higher than the above-mentioned figure. However, at least 400 inhabitants were counted twice, as people were moving around in the six-month period during which the census was taken. On the matter of population development, see also: Karlsson 2000b: 161–168; Steingrímsson 2002: 358; Oslund 2011: 22.

**125** Karlsson 2000b: 182–185; Steingrímsson 2002: 335–336; Oslund 2011: 64; Agnarsdóttir 2013: 13–16, 31. In the aftermath of the 1784 earthquake, Skálholt's population was relocated to Reykjavík; Lucas 2009: 76–77; Wieners 2020: 10. Icelandic towns only started to grow by the end of the nineteenth century; Karlsson 2000b: 248–249. By 1920, 31 percent of the population lived in towns; Gunnlaugsson 1988; Byock 2001; Agnarsdóttir 2012.

**126** Oslund 2011: 77.

**127** Vasey 1991: 325; Steingrímsson 2002: 8.

**128** Robertsdóttir 2008: 35; Agnarsdóttir 2013: 12.

**129** Magnússon 2010: 33–34.

**130** Agnarsdóttir 2013: 12.

levels of society.[131] The threat that volcanic eruptions or adverse weather conditions posed to the harvest and livestock was the Icelanders' constant company. Unfavorable terms of trade imposed by the Danish Crown, coupled with the geographic distance from Denmark, a significant source of aid, created political and social vulnerability on the island.

In the 1680s, the office of the governor of Iceland (*stiftamtmaður*) was established. This office was the highest representative of the Danish king in Iceland for almost two centuries. Until 1752, the governors were only Danish; after that date, Icelanders, too, could serve in this role.[132] Beneath the governor, there were four district governors, called *amtmenn*, one for each of the four districts of Iceland (north, east, south, and west) (Figure 13).[133] Iceland was further divided into 23 counties called *sýslur* (singular, *sýsla*) (Figure 14), which, from the seventeenth to the nineteenth century, were


**Figure 13:** A map of Iceland, ca. 1700. This map by Peter Schenk and Gerard Valk is titled "*Novissima Islandiæ Tabula*," and it shows the four districts of Iceland in different colors. Hekla is depicted as erupting.

**131** Thordarson 2010: 293.
**132** Steingrímsson 2002: 340; Ogilvie 2005: 272–274.
**133** Magnússon 2010: 33–34.

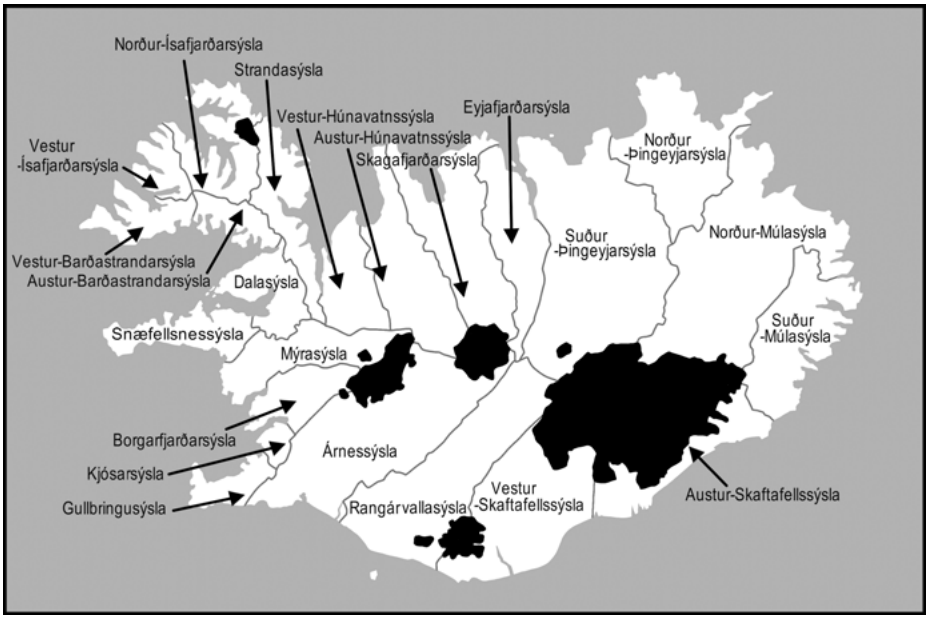


**Figure 14:** A map of Iceland's counties. Vestur-Skaftafellssýsla is in the south, near Vatnajökull, Iceland's largest glacier.

administered by sheriffs, local officials called *sýslumenn*.[134] Each *sýsla* was subdivided into approximately eight to ten regions, called *hreppar* (singular, *hreppur*). A *hreppur* was run by an unsalaried official, often an influential local farmer, aided by a regional committee consisting of other farmers and the parish priest; together, they were responsible for offering relief to people in poverty, which included relocating paupers to farms within the *hreppur* to prevent vagrancy.[135]

Death and disease spread throughout Iceland in the country's pre-modern period. The living conditions of most Icelanders, although not entirely to blame, did not help. Their houses, built from turf and stone for lack of timber, were ramshackle buildings that leaked and were poorly ventilated. These factors, together with the inevitable dampness and cold, left people susceptible to disease.[136] An epidemic of smallpox occurred between 1707 and 1709, which coincided with a famine; these events wiped out over a quarter of the population, leaving only 37,000 souls on the island.[137] A strong

**134** Ogilvie, Jónsdóttir 2000; Ogilvie, Jónsson 2000; Ogilvie 2005: 272–274; Agnarsdóttir 2013: 12.
**135** Steingrímsson 2002: 7; Magnússon 2010: 33–34.
**136** Steingrímsson 2002: 8; Magnússon 2010: 48–58.
**137** Hjálmarsson 1988: 87–88; Vasey 1991: 346; Karlsson 2000b: 177.

eruption (VEI 5) occurred at Katla from May to October 1721.[138] From 1724 to 1729, the Mývatn Fires in northern Iceland produced a lava flow that buried two farms and several farmhouses.[139] Öræfajökull also erupted from 1727 to 1728 and caused a *jökulhlaup*, killing three people.[140]

In the eighteenth century, the level of education in Iceland was relatively high compared to elsewhere in Europe. There were no elementary schools. Instead, the parents and the clergy were responsible for a child's education.[141] In the 1740s, around 50 percent of children were "at least minimally literate," and by the 1790s, this number increased to approximately 90 percent.[142] Industrious Icelanders traveled to Europe and beyond during the eighteenth century; some went to Copenhagen to study at the university, while others moved further afield to learn trades like spinning or weaving.[143] New ideas were brought back to Iceland by letter and return voyage. Icelanders were not as culturally isolated as they are often portrayed.[144]

The 1750s saw sea ice travel as far south as Vestmannaeyjar, a group of islands south of the Icelandic mainland. It made fishing all but impossible and was the first in a series of misfortunes that transpired during this decade. Bouts of scabies and lung disease were commonplace.[145] From 17 October 1755 until 13 February 1756, Katla saw another strong (VEI 5) eruption, which caused one direct and two indirect fatalities due to lightning at a farm 30 kilometers away. In addition, it caused severe damage from tephra fall and a *jökulhlaup* in the south.[146]

Farmers imported sheep to compensate for the loss of livestock; however, these sheep were highly susceptible to disease and infected the native animals, further depleting the Icelandic reserve.[147] A famine inevitably followed, peaking in the spring of 1757.[148] After this calamity, Iceland's population stood at 43,000.[149]

The Danish central administration introduced reindeer from Finnmark in an effort to combat the almost constant threat of famine. In 1771, the first shipment of 13 animals arrived; only about half survived the first year.[150] Thus, further shipments of reindeer followed in 1777, 1784, and 1787. In Iceland, they were allowed to live in the wilderness. Soon this invasion was met with resistance, as the reindeer fed on the

**138** Global Volcanism Program: Katla.
**139** Guðmundsson et al. 2008: 259; Dugmore, Vésteinsson 2012: 71–72.
**140** Global Volcanism Program: Öræfajökull; Guðmundsson et al. 2008: 261.
**141** Magnússon 2010: 88–89.
**142** Steingrímsson 2002: 5, 326.
**143** Agnarsdóttir 2013: 25.
**144** Magnússon 2010: 69–70.
**145** Ogilvie 1986: 65, 72; Karlsson 2000b: 177; Oslund 2011: 71; Dugmore, Vésteinsson 2012: 71.
**146** Global Volcanism Program: Katla; Guðmundsson et al. 2008: 257.
**147** Oslund 2011: 69.
**148** Vasey 1991: 346.
**149** Karlsson 2000b: 177; Dugmore, Vésteinsson 2012: 71.
**150** Oslund 2011: 69–71.

lichen the Icelanders used and competed for pastureland with the surviving sheep. Farmers complained about the reindeer and requested permission to hunt them, which Copenhagen granted in 1798. Today, about 7,000 reindeer live in the wild in Iceland, descendants of that initial population.[151] In a nutshell, the plan to use reindeer to supplement animal husbandry and reduce farmers' dependency on sheep had failed.

In 1766, Christian VII became the king of Denmark. He would reign until his death in 1808. He was, however, only the nominal king, as he suffered from mental illness. Thus, from 1772 to 1784, his half-brother, Ove HØEGH-GULDBERG, served as regent and de facto prime minister. From 1784 onward, Christian VII's son (who would later be king), Frederick VI, served as the unofficial regent.[152] After the epizootics and famine of the 1750s and 1760s, Christian VII sent the first royal land commission (*landsnefndin fyrri*), consisting of three men, to Iceland in 1770 to gather information and (among other things) research ways to bolster the Icelandic economy.[153] The first royal land commission concluded that the office of the governor should be in Iceland rather than in Copenhagen and that the official ranks should consist of more Icelanders. Skúli MAGNÚSSON (1711–1794) became the first Icelandic treasurer. His task was to make the Danish merchants treat the Icelandic people better by insisting on fair prices and sufficiently fresh products.[154] Despite the criticisms leveled against it by the island's people, the Danish trade monopoly remained in place.[155]

By June 1783, Icelanders had had a wealth of experience with volcanic eruptions acquired over several generations. Thus, the economy could deal with sudden disasters such as bad weather and, importantly, could adapt to the effects of volcanic eruptions.[156] Historian Gunnar KARLSSON believes that prior to the Laki eruption, Iceland had recovered from the famines of the 1750s and 1760s and had a population of around 50,000.[157]

Geoscientist Andrew DUGMORE and archaeologist Orri VÉSTEINSSON argue that every Icelandic volcanic eruption's impact must be judged on a case-by-case basis within its own historical and geographical context as the eruptions display great diversity in type and magnitude. Important factors to consider include the remoteness and strength of an eruption, the landscape around it, its temporal proximity to another large eruption, and the health of the human and animal populations. Usually,

**151** OSLUND 2011: 71–73; "Reindeer Warning in East Iceland." Iceland Review, 6 January 2018.
**152** LAURING 1960: 178–188.
**153** LACY 1998: 188; AGNARSDÓTTIR 2013: 14–15.
**154** HJÁLMARSSON 1988: 89–91; AGNARSDÓTTIR 2013: 25.
**155** OSLUND 2011: 36–38, note on 181.
**156** AGNARSDÓTTIR 2013: 13–14.
**157** KARLSSON 2000b: 178.

major eruptions only cause devastation if other unlucky circumstances exacerbate their negative impacts. Throughout their history, the Icelandic population and economy repeatedly recovered, showing tremendous fortitude.[158]

Given their history, one could argue that the Icelandic population could have been better prepared for the events of 1783 and their consequences; perhaps the Icelanders could have stored more non-perishable food and seeds for the seemingly inevitable unlucky times that they frequently suffered. However, Iceland was a poor country with extremely limited resources whose population lived from season to season.[159] The agricultural output had always been stifled by the country's high latitude, cold weather, and eroded soils, and by 1783 livestock numbers had been greatly thinned out by various epizootics.[160] Furthermore, the recurrence period of strong volcanic eruptions is quite long: approximately 30 to 50 years. Large flood basalt events are rarer still, which makes planning for them difficult.[161] To substantiate these claims, the following subchapter will analyze descriptions of the eruption, the complex factors that came together in 1783, and the eruption's aftermath.

## The Laki Eruption

### Kirkjubæjarklaustur and the Fire Districts

The Laki eruption took place in the remote highlands of south-central Iceland, above a rift zone between Mýrdalsjökull and Vatnajökull, also known as the Fire Districts.[162] Several large fissure swarms cut through this area.[163] These unique ridges were formed by subglacial eruptions during the last glaciation. Although the individual ridges are of different ages, they run in the same southwestern-northeastern direction, parallel to one another, as they formed on the spreading axis, the subaerial part of the Mid-Atlantic Ridge (Figure 15).[164]

Kirkjubæjarklaustur is a village on the southern coast of Iceland, nestled at the foot of a steep, 200-meter-tall cliff in the Síða region, not far from the *sandur* plains and just west of Vatnajökull.[165] Glacial rivers, such as the Skaftá and Hverfisfljót,

**158** Dugmore, Vésteinsson 2012: 68–69.
**159** McCallam 2019: 217–218.
**160** Andrésson 1984: 232; Hálfdanarsson 1984: 162.
**161** Hjálmarsson 1988: 93; Dugmore, Vésteinsson 2012: 76.
**162** Thordarson, Höskuldsson 2014: 128–131; Witze, Kanipe 2014: 59–60.
**163** Guðmundsson et al. 2008: 265.
**164** Katla Geopark Project: 12.
**165** Thordarson et al. 2003b: 13.

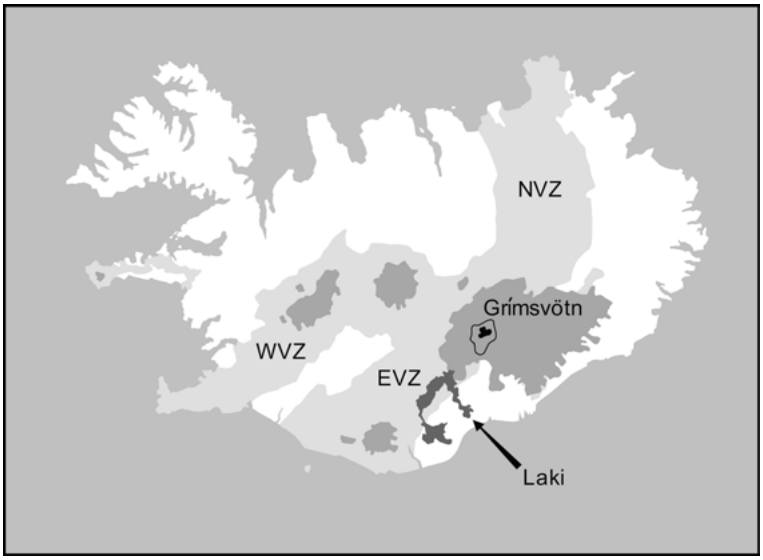


**Figure 15:** The location of the glaciers (light gray), the spreading axis (gray), and the location of the Laki lava (dark gray).

formed the *sandur* plains, which are covered by lava fields from other Holocene eruptions.[166] The Skaftá River is named after Skaftárjökull, part of Vatnajökull, its source. From there, it flows down from the highlands and into the Atlantic Ocean, not too far from Kirkjubæjarklaustur.[167]

The cliff face north of Kirkjubæjarklaustur marks the beginning of the highlands. Kirkjubæjarklaustur, is often abbreviated as "Klaustur," which means "church farm cloister," and refers to a Benedictine convent that existed there from 1186 until the Reformation.[168] In 1783, Klaustur consisted of a church and a farmstead. The Síða region is in Vestur-Skaftafellssýsla ("the county to the west of [the mountain] Skaftafell"). Vestur-Skaftafellssýsla also encompasses Mýrdalsjökull and the western parts of Vatnajökull. The Síða region is one of the six parts of the Fire Districts.[169] It was comparable to most Icelandic regions at the time: its inhabitants lived on farmsteads scattered throughout the surrounding area. Grímsvötn, situated around 70 kilometers from Klaustur and covered in a thick sheet of ice, is Iceland's most active volcanic system: it erupts every two to seven years.

**166** Thordarson, Self 1993: 234.

**167** Þórarinsson 1984: 35.

**168** Herrmann 1907: 105–106; Byock 2001: 340.

**169** The other Fire Districts are Álftaver, Meðalland, Skaftártunga, Landbrot, and Fljótshverfi; Thordarson et al. 2003b.

The danger posed by a flood basalt event was probably the last thing on anyone's mind in the spring of 1783 because it had been eight centuries since the last one had occurred in that area. Vestur-Skaftafellssýsla had around 2,200 inhabitants in early 1783.[170] Klaustur and its surrounding farmsteads, with their 613 inhabitants living only 32 kilometers from the Laki fissure, would take center stage in the unfolding drama. The region's best-known resident at the time was Jón STEINGRÍMSSON (1728–1791), the local priest. Like everyone else, STEINGRÍMSSON farmed to provide for his family.[171] He was married to Þórunn HANNESDÓTTIR (1718–1784), and together they had five daughters. The family lived in nearby Prestbakki, five kilometers north of Klaustur.

STEINGRÍMSSON was born in 1728 and was originally from northern Iceland. He studied at the diocesan school in Hólar. After his schooling, he took a position as a church deacon in Reynistaður. There, he fell in love with Þórunn, whose abusive husband died under dubious circumstances shortly after STEINGRÍMSSON's arrival. In 1753, they married and had a child soon after. In Reynistaður, in addition to his priestly duties, STEINGRÍMSSON served as a self-educated physician to his parishioners.[172] When the rectory for the parish of Kirkjubærjarklaustur fell vacant in 1778, STEINGRÍMSSON successfully applied for the position. The family moved to Prestbakki; their first few years in their new home were happy and prosperous.[173]

By the late eighteenth century, Icelanders had a general understanding of volcanic eruptions and their nature. STEINGRÍMSSON himself was aware of at least two other eruptions prior to Laki: the Mývatn Fires of 1724 to 1729 – documented by another priest by the name of Jón SÆMUNDSSON in a text STEINGRÍMSSON was familiar with – and the Katla eruption of 1755, an event that he himself had witnessed.[174] Jón STEINGRÍMSSON authored both an autobiography and a fire treatise (*eldrit*). His was one of the first Icelandic autobiographies. He wrote the first part of it during his first few years in Prestbakki before 1783 and the rest after the Laki eruption. Most of it was written in 1788, only a few years before his death in 1791. STEINGRÍMSSON never intended to publish this text, having written it exclusively for his daughters and their children. The fact that the autobiography was supposed to remain private allows for the assumption that STEINGRÍMSSON wrote honestly and openly about his feelings, fears, and struggles.[175] His *eldrit*, on the other hand, was intended for publication so that all Icelanders "born and yet unborn" could remember the Laki eruption.[176]

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**170** GUÐBERGSSON, THEODÓRSSON 1984: 112–115.

**171** STEINGRÍMSSON 1998: 80; STEINGRÍMSSON 2002: 10.

**172** STEINGRÍMSSON 1998: 7; STEINGRÍMSSON 2002: xvi, 10–15.

**173** STEINGRÍMSSON 1998: 19; STEINGRÍMSSON 2002: 11–15, 178.

**174** THORDARSON 2003: 2.

**175** STEINGRÍMSSON 2002: 1–2, 18–22, 359. His sister's son, Steingrímur JÓNSSON, the bishop of Iceland between 1824 and 1845, received the manuscript and liked it so much that he decided it had to be published. For this reason he kept it safe and, in 1916, the full autobiography was published posthumously for the first time.

**176** STEINGRÍMSSON 1998: 15. This text was originally published in 1788.

The two texts that Steingrímsson penned are the reason we know the exact start and end dates of the eruption and of the many incidents in between. Steingrímsson wrote daily for the first three months of the eruption; after this, he wrote less frequently and gave fewer details.[177] His writings provide descriptions of the events and illustrate how he and others interpreted them.[178] He distinguishes between his direct observations and his theological interpretations of the events. Steingrímsson confronted several phenomena that he had never encountered and, in all likelihood, never heard of before. Yet, he still found the language to describe them, allowing the modern reader to visualize what happened.[179] Examples include his descriptions of Pèle's hair, which he calls "volcanic hair," and passages that detail tephrochronology.[180] He was aware that several ash layers make up the soil, some thicker than others.[181] Steingrímsson showed great interest in observing nature and his surroundings. The values of the Enlightenment lived in Steingrímsson and throughout Iceland, just as in the rest of Europe.[182]

There are ten known *eldrit* that describe the fire columns of the Laki eruption.[183] Steingrímsson's is by far the most thorough. Icelandic volcanologist Thordarson has studied all ten and, in 2003, used them to analyze the seismic activity, explosivity, lava surges, and eruptive episodes of the eruption. Thordarson argues that Steingrímsson decided to write such a detailed account because he knew a description of the course of events and a list of damages would help when Icelanders negotiated disaster assistance relief with the Danish central administration.[184]

### The Fire Priest

1783 had started promisingly in the south of Iceland, in contrast to the rest of the country, with the winter and spring being reasonably mild.[185] The previous year had been quite cold across the island.[186] After a few arduous seasons, a good harvest and

**177** Thordarson 2003: 2.

**178** Steingrímsson 2002; Thordarson, Höskuldsson 2014: 134.

**179** Steingrímsson 1998: 7.

**180** For Péle's hair, see Steingrímsson 1998: 27.

**181** Thordarson 2003: 1–2.

**182** Steingrímsson 2002; see also Demarée, Ogilvie 2001: 223; Witze, Kanipe 2014: 25, 106.

**183** For a detailed list of all the *eldrit* written about the Laki eruption, see table 1 in Thordarson 2003: 3.

**184** Thordarson 2003: 1, 4, 10; Thordarson et al. 2003b. This almost daily record of the eruption has greatly helped the modern understanding of flood basalt events and large igneous provinces.

**185** Ogilvie 1986: 63: The winter of 1782/1783 was severe in the north and east, reasonable in the south, and cold in the west. The spring of 1783 was variable in the north, mild in the south, cold in the east, and reasonable in the west. Astrid Ogilvie (1992; 2005) has done much work on weather and climate history in Iceland. For this period, she used several Icelandic weather diaries.

**186** Ogilvie 1986: 67–69.

enough fodder for the animals in the coming winter were essential. In mid-May 1783, the ominous occurrences began: the residents in the Síða region noticed many weak earthquakes.[187] By 1 June 1783, the earthquakes increased in number and size. Their intensity became so strong that at some farmsteads in Vestur-Skaftafellssýsla, people slept outside in tents because they feared their houses might collapse. The stronger earthquakes in that sequence were perceptible in other parts of southern Iceland, from Mýrdalur in the west to Öræfi in the east; the latter is some 75 kilometers away from the Laki fissure.[188] This phenomenon is called an earthquake swarm, a precursor to some volcanic eruptions in Iceland.

Residents of the Fire Districts could feel these tremors – which probably reached a magnitude greater than 4.0 on the Richter scale – up to 80 kilometers away from the fissure's eventual location.[189] The earthquakes between May and early June 1783 were the strongest to occur between 1783 and 1785; this was due to pressure in the magma chamber reaching critical stress levels. The subsequent inflation of the magma chamber led to the bending, fracturing, and weakening of the crust above.[190]

On roughly 20 May 1783, a Danish ship called the *Torsken* was skirting the southern Icelandic coast when the sailors noticed fires in the mountains or glaciers north of the Síða region.[191] These fires may have been activity at Grímsvötn, which would indicate volcanic activity prior to June 1783. This was the beginning of the volcano-tectonic episode at the Grímsvötn volcanic system.[192]

We can imagine the likely scene: on that fateful Sunday morning, Steingrímsson and his parishioners walked to church or rode on horseback. The sun was long up.[193] It was a clear day with blue skies and calm weather. Attending Mass and meeting other parishioners was a welcome break from the toil of farm work.[194] Whitsunday, which in 1783 fell on 8 June, celebrates the descent of the Holy Spirit upon Jesus' disciples. That said, in this case, it will always be remembered as the beginning of Iceland's descent into the worst disaster in its almost 1,150-year history, as this was the day the Laki fissure violently roared to life. At around 9:00 a.m., something unusual caught the parishioners' eyes: dark clouds appeared above the mountains just behind Klaustur and

**187** The earthquakes were first noticed by a farmer by the name of Jón Eiríksson at Ljótarstadir in the Skaftártunga district; Thordarson et al. 2003b: 19.

**188** Þórarinsson 1984: 35; Thordarsen et al. 2003b: 19.

**189** Thordarson et al. 2003b: 27.

**190** Guðmundsson 1989; Thordarson, Self 1993: 259.

**191** Scarth 1999: 107. The *Torsken* sailed from Denmark toward Hafnarfjörður, a harbor town around ten kilometers south of Reykjavík.

**192** Thordarson et al. 2003b: 19, 26, and their translations of the earthquake sources titled B1 on 40. The eruption mentioned might refer to Nýey, but it is not clear.

**193** Klaustur is located close to the Arctic Circle; on 8 June, the sun rose at 1:30 a.m. and set at 9:56 p.m.; Time and Date website.

**194** Steingrímsson 2002: 10.

steadily filled the sky.[195] The faint sun became a menacing red behind thick clouds of ash, tephra, and gas from an atmospheric eruption plume that reached as high as 15 kilometers and was visible across the length and breadth of Iceland.[196] The tephra fallout from the plume resulted in complete darkness up to 100 kilometers from Grímsvötn.[197] Although sunset was 11 hours away, the ash fall, or "black haze of sand" as Steingrímsson describes it, "caused darkness indoors."[198] Later the same day, rain fell the color of "black ink."[199] It irritated the eyes and skin.[200] Inhabitants heard thunderous noises from the highlands.[201] When the wind blew the ash clouds away, fires were distinct against the darkness in the distance behind the mountains.[202] Strong earthquakes occurred throughout the night.[203] The Skaftá Fires, *skaftáreldur*, had begun.

> Now comes the beginning of the Lord's chastisements and of the fresh calamities that befell me and others, as I shall now relate. And yet they came upon us with greater forbearance and leniency that we had deserved. On Pentecost, [8 June 1783], an eruption of molten rock took place coming out of the mountains of the highland pasturage, whose effects were to destroy farmland, men, and beasts far and wide.[204]

So writes Jón Steingrímsson of the onset of the Laki eruption in his autobiography. When he talks of divine forbearance, he is likely referring to the ominous dreams that had plagued him before the eruption; they had warned him of something awful that was about to happen. Steingrímsson also feared that his parishioners had lived carelessly and wastefully and that this, therefore, might be their just punishment.[205]

From 8 to 11 June 1783, the strong earthquakes continued. Steingrímsson states that "however much the earth and houses trembled and shook, thunderclaps crashed, and fireballs flew," he felt no fear.[206] On 10 June, the waters of the mighty Skaftá River evaporated, leaving an empty riverbed in their wake.[207] The next day the river flowed with lava instead. On 11 June, amazingly, Klaustur experienced "a snowstorm,

**195** Þórarinsson 1984: 35.

**196** Thordarson, Self 1993: 233. For more information on how to calculate the height of the fire fountains and the eruption columns, see Thordarson, Self 1993: 257–258.

**197** Pétursson, Pálsson, Georgsson 1984: 97; Lacy 1998: 16; Steingrímsson 1998: 26–27; Thordarson, Höskuldsson 2014: 131.

**198** Steingrímsson 1998: 25.

**199** Þórarinsson 1984: 35.

**200** Pétursson, Pálsson, Georgsson 1984: 97; Thordarson, Höskuldsson 2014: 134.

**201** Þórarinsson 1984: 35. According to the Catalogue of Icelandic Volcanoes: Grímsvötn, the "groundwater levels are high in many parts of the ice-free area [of the Grímsvötn system], making the likelihood of an initial phreatomagmatic eruption likely."

**202** Þórarinsson 1984: 35.

**203** Steingrímsson 1998: 25.

**204** Steingrímsson 2002: 180.

**205** Steingrímsson 1998: 21–22; Steingrímsson 2002: 178–179.

**206** Steingrímsson 2002: 181.

**207** Þórarinsson 1984: 35; Steingrímsson 1998: 25.

which came from the black cloud," with the snow cover lasting for five days.[208] Thereafter, the summer of 1783 was cold throughout Iceland, except in the north, where the weather was more variable.[209]

The first fissure segment opened on 8 June. Initially, the eruption was very explosive; this was unusual as fissure eruptions tend to be rather effusive. In total, there were ten eruptive episodes, and with each one, a new fissure segment opened (Figure 16). These fissure segments are *en echelon*, meaning they are arranged diagonally, and consist of 140 craters, vents, and cones.[210]

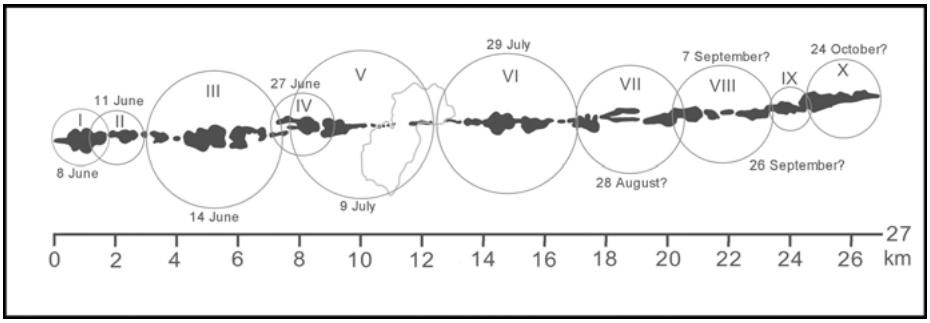


**Figure 16:** The different segments of the Laki fissure. Each segment was formed during a different eruptive phase, the start date of which is indicated. The southwestern part is on the left, Vatnajökull is on the right, and Mount Laki is almost in the center of the fissure (between segments V and VI).

The eruption began in the Úlfarsdalur valley, near the Hnúta Mountain, and continued in a northeast direction in an almost straight line toward the pre-existing Mount Laki. The mountain divides the fissure into two nearly equal parts. Eventually, the fissure continued past Mount Laki, reaching all the way to the tip of Vatnajökull.[211] The fissure, which may extend further underneath the glacier, measures 27 kilometers over its entire subaerial length. It sits at an altitude of roughly 600 meters above sea level, and its highest craters reach 100 to 120 meters above the surrounding landscape; by contrast, Klaustur is only 35 to 40 meters above sea level.[212]

**208** Steingrímsson 1998: 26.

**209** Ogilvie 1986: 63. In the spring of 1784, Sveinn Pálsson wrote a short treatise on the effects of the Laki eruption on northern Iceland. It contained some information on southern Iceland based on a letter from a friend, who lived there; for more information on the letter, see Thordarson et al. 2003b: 20, source C7 therein; Gunnarsdóttir 2022: 80.

**210** Thordarson, Self 1993; Thordarson et al. 2003a; Passmore et al. 2012: 2594; Thordarson, Höskuldsson 2014: 131, 136–137.

**211** Katla Geopark Project: 10–11.

**212** Einarsson, Sveinsdóttir 1984: 47.

The fissure segments to the southwest of Mount Laki had five eruptive episodes. Each episode began with seismic activity and a short-lived but explosive phase of Strombolian to sub-Plinian type (VEI 1 to 4), each lasting from half a day to four days.[213] The water table was very high at the site, as this area was quite boggy; the interaction of magma with the high groundwater resulted in this initial phreatomagmatic phase of the eruption.[214] These mild explosions created rootless vents and pseudocraters that are still visible today.[215] Once the availability of water dwindled, the next eruption phase began, with lava production becoming more effusive. The lava fountains reached 800 to 1,400 meters above the fissure and were visible from the lowlands around Klaustur. Within a few days, the first lava surge reached the lowlands, having traveled there at a pace of three to four kilometers per day.[216] Luckily, lava fields from previous flood basalt events had hindered its progress.

Each initial eruptive episode precipitated a lava surge that appeared in the gorge of the Skaftá River.[217] "[E]pisodic increase[s] in lava production at the fissures and hence in the magma discharge" were the source of these lava surges.[218] The second fissure segment opened on 11 June, and the third on 14 June 1783.[219] In the lowlands of Vestur-Skaftafellssýsla, the second lava surge came on 16 June; this lava did not stay in the riverbed but overran pastures and farms. Steingrímsson notes in his autobiography on 15 June 1783: "The uproar to the north of the mountains of the Síða region now grew violently, with such sounds of breaking and crashing, fire and smoke, and earthquakes, that no one knew whether the settlements here were in danger or not."[220] Many were frightened about the prospect of the fires spreading further and causing complete devastation. That same day, an exploratory party of three farmers walked north into the highlands and to Kaldbakur, the highest scalable mountain in the vicinity. When they returned, they told of as many as 27 fires that extended in a southwest direction from Mount Laki. These "fires" were likely lava fountaining from the 27 different vents and cones on the first fissure segments.[221]

The third lava surge came on 18 June 1783, the severity and speed of which forced people to flee; it carried some large rocks "tumbling about like large whales swimming,

**213** Thordarson, Self 2003: 3. Passmore et al. (2012: 2595) estimate it lasted half a day to one full day.

**214** Larsen, Thordarson 1984: 65; Thordarson, Self 1993: 233; Thordarson et al. 2003b: 13. For more information on explosive lava-water interactions at Laki, see also Hamilton, Fagents, Thordarson 2010.

**215** Katla Geopark Project: 12. These pseudocraters usually measure 50 to 60 meters across and are less than ten meters in height. For more research on rootless cones and vents, see also Boreham, Cashman, Rust 2018.

**216** Thordarson, Self 1993: 233; Thordarson 2003: 6; Thordarson, Self 2003: 3; Passmore et al. 2012: 2596; Thordarson, Höskuldsson 2014: 131.

**217** Passmore et al. 2012: 2595.

**218** Thordarson et al. 2003b: 30.

**219** Passmore et al. 2012: 2615, Figure 14a.

**220** Steingrímsson 1998: 30.

**221** Þórarinsson 1984: 35; Steingrímsson 1998: 35–36.

red-hot and glowing."[222] Molten lava dammed up former tributaries to the Skaftá River, causing flooding (of water this time).[223] The contact between the lava and these tributaries caused terrifyingly loud noises.[224] STEINGRÍMSSON asserts, "All that day and night, the thunderous crashing was so great that everything shuddered and shook, and the earthquakes made every timber crack and crack again."[225]

The first three fissure segments produced 6.1 cubic kilometers of lava between 8 and 21 June; this was 41.5 percent of the total volume of lava produced during the entire eruption. At its peak, the fissure ejected magma at a rate of 5,000 to 6,600 cubic meters per second. An Olympic-sized swimming pool contains 2,500 cubic meters of water; thus, at this rate, the discharge of the Laki eruption could have filled two to two and a half Olympic-sized swimming pools per second.[226] Throughout the eruption, lava was produced on average at a rate of around 580 cubic meters per second, meaning it would have taken (on average) about 4.3 seconds to fill an Olympic pool.[227]

The fourth fissure segment opened on 25 June 1783; the fourth lava surge in the Síða region followed soon after, on 29 June. The lava flow had already formed three branches, with which it terrorized the lowlands. It continued to burn down farmsteads and churches.[228] The fifth fissure opened on 9 July 1783; shortly after, on 14 July 1783, the fifth lava surge cascaded down the Skaftá Gorge. The lava mainly flowed within the Skaftá riverbed en route to Klaustur. By the time the fissure reached Mount Laki, 61 percent of the total magma volume had been ejected.[229] Utterly terrifying noises had accompanied each surge:

> [. . .] with boiling sounds, cracking and smashing and such quaking underground, as if everything were likely to break apart. [. . .] Flashes of fire were everywhere around us both indoors and out, but no one was killed outright by them. All week long, neither sun nor sky could be seen for the thick clouds of fumes and smoke which blanketed the area.[230]

After the initial surges, the lava continued to creep menacingly forward, seemingly unstoppable. To STEINGRÍMSSON and his parishioners, it now seemed inevitable that it would move through Klaustur and destroy everything in its path, including the church. On 18 July 1783, a Friday, STEINGRÍMSSON "imagined nothing but collapse and destruction." He expected none of his parishioners to sleep soundly in these tumultuous times.

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**222** STEINGRÍMSSON 1998: 33.
**223** ÞÓRARINSSON 1984: 36.
**224** STEINGRÍMSSON 2002: 15.
**225** STEINGRÍMSSON 1998: 33.
**226** THORDARSON, SELF 2003: 5.
**227** EINARSSON, SVEINSDÓTTIR 1984: 48.
**228** ÞÓRARINSSON 1984: 36; THORDARSON, SELF 2003: 5.
**229** THORDARSON, SELF (2003: 5) and PASSMORE (2012: 2615) give slightly different dates for the openings of the fissure segments; here, I use the ones that THORDARSON and SELF (2003) gave.
**230** STEINGRÍMSSON 1998: 47.

Locals could not drive their animals out of harm's way, so they released them to roam freely instead.[231]

When it was time for worship on Sunday, 20 July 1783, five weeks after Trinity Sunday, the lava was already alarmingly close to the church.[232] As well as the immediate danger posed by the lava, STEINGRÍMSSON and his parishioners were threatened from above by a sky overcast with "hot vapors and fog" accompanied by thunder and lightning, and from below, where they could feel "rumbling and thudding."[233] It must have been a truly terrifying day; even so, the faithful attended church. When they arrived, the air was so full of fumes and smoke that the outline of the church "could only be hazily seen."[234] In his *eldrit*, STEINGRÍMSSON mentions his despair at the thought that this might be the last service held in this church.[235] He notes that the church was "shaking and quaking from the cataclysm that threatened it from upstream" during his sermon.[236] "Claps of thunder were followed by such great flashes of lightning, in series after series, that they lit up the inside of the church and the bells echoed the sound, while the earth tremors continued unabated."[237] The parishioners had shown genuine commitment by attending, and he believed that they, like himself, felt no fear. Thus, he claims that they "were contented and prepared to accept whatever God would send."[238]

With lava approaching, the sermon commenced. When it ended, the congregation stepped outside and realized the lava flow had stopped; to their surprise, it had not moved since the sermon began. They believed that STEINGRÍMSSON's service had stopped the flow of lava.[239] "Instead [of advancing further] it piled itself up in a heap, layer upon layer. In addition, all the lakes and rivers came flooding down upon the heaped-up lava and violently quenched it. To God alone be the glory!"[240]

Because of these events, the church service of 20 July 1783 is known as *eldmessan*, the fire sermon, and STEINGRÍMSSON as *eldprestur* or *eldklerkur*, the fire priest: the man who stopped Klaustur's church from being consumed.[241] The lava surges in the Skaftá riverbed ended with the fire sermon. As the lava had piled up, tributaries of the former Skaftá River had started pouring over it, smothering the fire.[242]

**231** STEINGRÍMSSON 1998: 48.

**232** STEINGRÍMSSON 2002: 182, 380. Jón STEINGRÍMSSON mentions that the fire sermon was held on the fourth Sunday after Trinity. However, he also gave the date of 20 July, which is the fifth Sunday after Trinity. The date 20 July is believed to be the correct date of the fire sermon; GROTEFEND 2007: 203.

**233** STEINGRÍMSSON 1998: 48.

**234** STEINGRÍMSSON 1998: 49.

**235** STEINGRÍMSSON 1998: 48.

**236** STEINGRÍMSSON 2002: 182.

**237** STEINGRÍMSSON 1998: 49.

**238** STEINGRÍMSSON 2002: 182.

**239** HENDERSON 1818: 279–286; KARLSSON 2000b: 178; WITZE, KANIPE 2014: 87–88, 153.

**240** STEINGRÍMSSON 2002: 16.

**241** STEINGRÍMSSON 2002: 1.

**242** STEINGRÍMSSON 1998: 50.

Thereafter, the southwestern part of the Laki fissure continued to produce lava and gases until September 1783, although not quite with the same explosivity as it had in early June.[243] Steingrímsson was certain that the lava would remain visible "until the end of the world. [. . .] It will be for all eternity a source of the greatest wonder, that any living thing should have survived at all here in Síða."[244] Indeed, to this day, the Eldhraun lava field is still visible near Klaustur.

On 29 July 1783, the people in southern Iceland heard more frightening noises, this time from further northeast. These rumblings announced the opening of a new fissure segment, the sixth, located on the northeastern side of Mount Laki. Another dark cloud descended upon Klaustur and, once again, day turned into night.[245] Over the following three months (29 July to 30 October 1783), the sixth to tenth fissure segments opened.[246] The last two fissure segments on the east, the ninth and tenth segments, look slightly different due to erosion caused by the movement of the glacier and the flow of the Skaftá River since the eruption.[247]

On 31 July 1783, a familiar pattern repeated itself. While the Skaftá River runs by the west of Klaustur, another river runs to the east: this river is called Hverfisfljót. Two days after the parishioners had heard the noises from the northeast, the Hverfisfljót River started to heat up until it eventually evaporated. On 6 August 1783, the sixth surge, the first at Hverfisfljót River, cascaded down the empty river trunk and breached its banks, burning or engulfing the farmsteads that lay in its way. On 1 and 10 September 1783, the seventh and the eighth surges followed.[248] From Prestbakki, the fire made the sky glow behind the mountains. "Whenever the sun or the moon could be seen on the part of the sky where the fire vapours swirled about, each appeared red as blood."[249] The ninth surge commenced in late September. The tenth and largest surge in the Hverfisfljót River came on 25 October and continued until November 1783.[250]

Frightening sounds once again announced the lava surges and were accompanied by an "intolerable reek and odor [. . .] as if burning coal had been doused with urine or other acrid substance."[251] Over the summer of 1783, Steingrímsson harvested as much hay as he could. He used some as fodder for his one remaining cow; the unfortunate

**243** Þórarinsson 1984: 36.

**244** Steingrímsson 1998: 56.

**245** Steingrímsson 1998: 54.

**246** Thordarson, Self 2003: 3. The dates for the respective fissure segment openings are as follows: Fissure segment VI: 29 July to 9 August; fissure segment VII: 31 August to 4 September; fissure segment VIII: 7 to 14 September; fissure segment IX: 24 to 29 September; fissure segment X: 25 to 30 October.

**247** Thordarson, Self 1993: 236–237. Detailed descriptions of the events during the individual eruptive episodes can be found here: Thordarson, Self 2003: 238–244.

**248** For a discussion on the slightly differing dates of the drying of the Hverfisfljót River and the surge of the lava in the riverbed, see Thordarson 2003: 6.

**249** Steingrímsson 1998: 60.

**250** Þórarinsson 1984: 36; Steingrímsson 1998: 63; Thordarson, Self 2003: 3.

**251** Steingrímsson 1998: 56.

beast soon after perished. Steingrímsson later used this hay for warmth. In his *eldrit*, he claims that "it smoked and flamed like sulphur" when thrown into the fire.[252] One of Steingrímsson's strategies to mask this presumably sulfuric smell was to burn pieces of bark and juniper wood in his home.[253]

As the lava slowly crept closer from the east, the people in the Síða region were concerned that they might soon become trapped.[254] To the north lay the highlands, the very place the lava had originated; to the west, the smoldering remains of the first surges; to the east, the molten lava of the latest surges; and to the south, the coast; those who were still able to do so fled the area.[255]

The magma output decreased substantially after November 1783.[256] In December of that year, Steingrímsson wrote that "all the flames and glare in the sky began to decrease."[257] The new year of 1784 began with milder and calmer weather, with spells of sharp frost and northerly winds. Nevertheless, a strange odor still lingered in the air.[258] Those in the vicinity observed the fires of the Laki fissure for the last time on 7 February 1784; this is the official end date of the eruption. By February 1784, the lava measured 14.7 cubic kilometers and covered an area of 599 square kilometers, which is approximately the size of the Isle of Man.[259] Although the lava flows did not kill anyone directly, they did lay waste to eight farms and damaged 29 severely; two parishes remained almost entirely uninhabitable for two years.[260]

Volcanic and seismic activity in the Grímsvötn system, in the subglacial parts underneath Vatnajökull, did not cease on 7 February 1784.[261] The residents of the Síða region continued to hear "rumbling noises [. . .] from under the glacier."[262] Two large and foul-smelling *jökulhlaups* occurred in the spring of 1784.[263] At least four eruptive episodes occurred at the Grímsvötn volcano; two before the end of the Laki eruption and two after. Although they did not precipitate further lava surges in the lowlands, they did curse the surrounding area with yet more tephra fall.[264] The *jökulhlaups* and noises from Vatnajökull indicate that volcanic activity continued at the Grímsvötn volcano underneath the ice until 1785.[265] The eleventh eruptive episode occurred on

**252** Steingrímsson 2002: 182.
**253** Steingrímsson 1998: 83.
**254** Herrmann 1907: 96; Steingrímsson 1998: 51–52; Thordarson, Höskuldsson 2014: 135–137.
**255** Steingrímssons 2002: 182–183.
**256** Þórarinsson 1984: 36.
**257** Steingrímsson 1998: 63.
**258** Steingrímsson 1998: 65.
**259** More information on calculating the lava volume, see also Thordarson, Self 1993: 251–256.
**260** Herrmann 1907: 94–97.
**261** Steingrímsson 1998: 65.
**262** Þórarinsson 1984: 36.
**263** Þórarinsson 1984: 36.
**264** Thordarson et al. 2003b.
**265** Thordarson, Self 1993; Thordarson et al. 2003a; Passmore et al. 2012: 2594.

24 November 1783, the twelfth episode from January to February 1784, the thirteenth episode from April to August 1784, and the last one, the fourteenth episode, from 4 to 26 May 1785.[266] The end date of this volcano-tectonic episode at Grímsvötn was 26 May 1785.[267] Two more *jökulhlaups* occurred in May 1785 and November 1785: the origin of the second *jökulhlaup* remains obscure.[268]

The seismic activity of the Grímsvötn system began in May 1783 and ended in May 1785. The Laki eruption took place within this timeframe.[269] The most prominent volcanologist working on the Laki eruption, Thorvaldur THORDARSON, has concluded that the simultaneity and the synchronization of the activity of the Laki fissure and Grímsvötn is a sign that both eruptions were part of the same volcano-tectonic event, caused by the same regional stress at the Grímsvötn volcanic system.[270]

In the past, volcanologists have wondered about the origin of the huge volumes of lava that engulfed the Síða region. Possible sources include a magma chamber located underneath the fissure or one within the caldera of Grímsvötn, probably located at a depth of two to five kilometers. The latter is unlikely, as the caldera would have collapsed from the outpouring of such a large volume.[271] Another possibility is a magma chamber underneath a *nunatak*, which is a mountain summit that protrudes out of a glacier.[272] Thorvaldur THORDARSON believes it is likely that a deep-seated magma chamber located at the crust-mantle boundary fed the eruption.[273] The crust-mantle boundary, in the northwest of Vatnajökull, is 40 kilometers deep.[274] This theory would explain the continuous magma flow for the entire eight-month period of the eruption.[275]

After May 1785, there was a protracted cessation of activity at Grímsvötn; the next eruption was in 1823, 38 years later.[276] In general, a period of rest is not unusual for volcanic systems after eruptions that produce extremely large volumes of lava. The same phenomenon occurred at the Katla volcanic system after Eldgjá erupted in 939: this eruption was followed by a quiescence of 240 years.[277]

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**266** The episodes' numbering and dates come from THORDARSON et al. 2003b: 25, table 2.

**267** THORDARSON et al. 2003b: 26. The dates of the eruption come from THORDARSON, SELF 1993: 239–240.

**268** STEINGRÍMSSON 1998: 87. *Jökulhlaups* at Grímsvötn can happen without volcanic activity; on average, they occur every two to three years; ÞÓRARINSSON 1984: 36.

**269** THORDARSON, SELF 1993: 258; THORDARSON 2003: 1.

**270** THORDARSON et al. 2003b: 33.

**271** BJÖRNSSON, BJÖRNSSON, SIGURGEIRSSON 1982; GUÐMUNDSSON 1987; THORDARSON, SELF 1993: 258–259.

**272** For the magma chamber underneath the fissure, see GRÖNVOLD 1984: 57. The lateral movement of magma from a crustal magma chamber similar to the Krafla Fires was suggested by SIGURÐSSON and SPARKS (1978); THORDARSON 2010: 288. For information on the magma originating from the Grímsvötn caldera, see Catalogue of Icelandic Volcanoes: Grímsvötn.

**273** SIGMARSSON et al. 1991; THORDARSON et al. 1996: 215–216.

**274** FEDOROVA, JACOBY, WALLNER 2005: 123, 132; ALFARO et al. 2007.

**275** THORDARSON, SELF 1993: 259.

**276** THORDARSON, SELF 1993: 259 THORDARSON et al. 2003b: 13.

**277** THORDARSON, LARSEN 2007: 142; RUSSEL, DULLER, MOUNTNEY 2009; ÁGÚSTDÓTTIR 2015: 1674.

### Pollution and Environmental Impact of the Laki Eruption in Iceland

The cessation of the outpouring of lava did not bring an end to the suffering of those in the Síða region or Iceland in general. Help was slow to arrive: Icelanders were left to deal with the situation with limited means. During the first few days of the eruption, it became apparent that the volcanic gases had "thickly contaminated" the air; Steingrímsson states that he was unable "to breathe in fully, and hardly went outside [. . .], all that year [1783] and the next."[278] As early as 10 June 1783, he noticed that the "bitter rain [. . .] caused almost unbearable soreness to the eyes or bare skin, as well as a sense of dizziness."[279] Over the next two weeks, the eruption would show its deadly force:

> more poison fell from the sky than words can describe: ash, volcanic hairs, rain full of sulphur and saltpeter, all of it mixed with sand. [. . .] All the earth's plants burned, withered, and turned grey, one after another. [. . .] the first to wither were those plants which bore leaves, [. . .] and the horsetails were the last to go.[280]

The smell of the air was foul: according to Steingrímsson, it smelled as "bitter as seaweed and [was] reeking of rot for days on end."[281] He laments the fact that those already plagued by pre-existing respiratory problems could no longer take a deep breath and remarks that "Indeed, it was most astonishing that anyone should live another week."[282] A combination of volcanic gases, together with lung lesions caused by PM 2.5 – particulate matter with a size smaller than 2.5 micrometers – was probably to blame for the breathing difficulties these people endured.[283] Between June and September 1783, there were at least 15 incidents of tephra fall up to 40 kilometers from the fissure.[284]

Steingrímsson also noticed how rapidly the eruption impacted his livestock. On Saturday, 7 June 1783, his cows and ewes had given eight buckets of milk. One week later, on Saturday, 14 June, they offered only six and a half. The animals' "[f]lesh and body were ravaged at the same time."[285] On 10 June, he detailed how newly shorn sheep received scorch marks on their skin when rain fell.[286] The Laki eruption ejected large amounts of fluorine, in addition to other gases. While fluorine is beneficial to humans (particularly their teeth) in small doses, in high concentrations it leads to dental and skeletal fluorosis. Dental fluorosis is a condition that causes deformation and loosening of the teeth, while skeletal fluorosis is a bone disease resulting in pain and

**278** Steingrímsson 2002: 180.
**279** Steingrímsson 1998: 25.
**280** Steingrímsson 1998: 41.
**281** Steingrímsson 1998: 41.
**282** Steingrímsson 1998: 41.
**283** Pétursson, Pálsson, Georgsson 1984: 97.
**284** Larsen, Thordarson 1984: 65.
**285** Steingrímsson 2002: 180.
**286** Steingrímsson 1998: 26.

damage to the bones and joints.[287] Icelanders had known that volcanic ash could lead to "ash teeth" and death in animals for at least a century.[288] In hindsight, STEINGRÍMSSON wrote, they should have slaughtered the livestock there and then while they still had some meat on them.[289]

Although people were afraid that the foul-smelling sheep meat was poisonous, they "nevertheless tried to dress it, clean it and salt it as best they knew how or could afford to."[290] STEINGRÍMSSON outlines how his parishioners tried to save their livestock but that most efforts were in vain.[291] His dairy animals, and those of his neighbors, all perished over the next few weeks: they had either been poisoned by pollution or starved for lack of fodder.[292] Between 12 August 1783 and 24 June 1784, his family had no dairy food at all.[293]

As early as 14 June 1783, STEINGRÍMSSON writes of birds fleeing and leaving their eggs behind, which could be collected but "were scarcely edible because of their ill odor and sulphurous taste."[294] With fish he fared no better as the ponds and the rivers nearby were all poisoned by the eruption's ejecta.[295] The trout, pipits, wrens, and white wagtails became disoriented at first and then died.[296] Field mice were similarly affected.[297] In his writing, STEINGRÍMSSON notes that "[a]ll the mice in this county and the next one to the west, which had often caused great damage to our lyme grass, grain and other stores, were killed and there has been no sign of them since."[298]

The meat the parishioners ate and the water they drank were contaminated.[299] Since the beginning of the eruption, every drop of water had been characterized by "its bad flavor and bitter taste in the mouth," which made it unpotable.[300] Nevertheless, STEINGRÍMSSON remarks that his family continued to drink the water for lack of an alternative. He writes: "We became so used to drinking [the] water that it tasted to us like sweet whey. But it was polluted and brought in its train more disorders than I care to mention."[301] This brief mention of "disorders" most likely refers to waterborne diseases such as dysentery.

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**287** The *Lakagígar* eruption was particularly rich in fluorine; THORDARSON et al. 1996: 205–225.
**288** PÉTURSSON, PÁLSSON, GEORGSSON 1984: 96.
**289** STEINGRÍMSSON 1998: 28.
**290** STEINGRÍMSSON 1998: 76.
**291** STEINGRÍMSSON 2002: 180.
**292** PÉTURSSON, PÁLSSON, GEORGSSON 1984: 97.
**293** STEINGRÍMSSON 2002: 180.
**294** STEINGRÍMSSON 1998: 27.
**295** HERRMANN 1907: 96–97; STEINGRÍMSSON 1998: 73.
**296** STEINGRÍMSSON 1998: 27.
**297** PÉTURSSON, PÁLSSON, GEORGSSON 1984: 97.
**298** STEINGRÍMSSON 1998: 93.
**299** STEINGRÍMSSON 2002: 180.
**300** STEINGRÍMSSON 1998: 67.
**301** STEINGRÍMSSON 2002: 182.

Shortly after the beginning of the eruption, the grass on the south-central coast withered and the harvest subsequently failed. This was unlucky, as sometimes haymaking is possible as early as July in the warmer regions of Iceland.[302] Hay was used as feed for the livestock during the winter months when the animals could not remain in the fields due to heavy snowfall.[303] Without this additional hay, Icelanders knew most of their animals would perish over the winter.[304]

The fine layer of tephra that blanketed most of the country led to the harvest failing almost everywhere (Figure 17).[305] In his *eldrit*, Steingrímsson concludes that "the other effects of this fire spread over the entire country, [are] the withering of the grass and the ensuing famine among men and animals alike, [. . .]."[306] The people in the Síða region quickly ran out of food: illness followed their hunger. People suffered from pain in

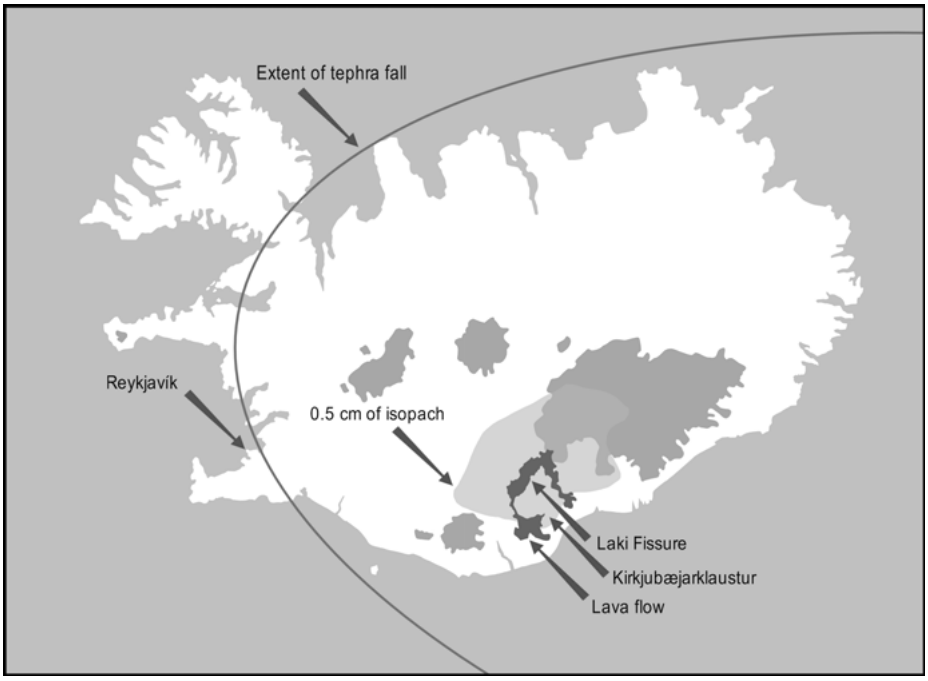


**Figure 17:** Tephra fall during the Laki eruption. The dark gray color indicates the area affected by at least 0.5 centimeters of tephra (7,200 square kilometers); the light gray color indicates the area covered in fine dust (200,000 square kilometers). Within this area, 60 percent of the livestock perished.

**302** Vasey 1991: 333–335.
**303** Hálfdanarsson 1984: 161.
**304** Vasey 1991: 324, 333–336.
**305** Pétursson, Pálsson, Georgsson 1984: 96–97; Ogilvie 1986: 70; Ágústdóttir 2015: 1674.
**306** Steingrímsson 1998: 71.

their mouths, swelling of their gums, and toothaches.[307] These symptoms are typical signs of fluorosis; however, new research on the skeletal remains of animals in the region has called into question the extent of the problem in this area.[308] In addition, many suffered from scurvy, and otherwise relatively harmless infections became deadly.[309] As their health deteriorated, many people lost their hair, died of dysentery, or starved to death.[310]

Fish was a staple food for Icelanders. Yet, for most of 1783, even fishing in the shallow coastal waters was impossible due to the thick, blinding haze. To add to the Icelanders' bad luck, the East Greenland Current brought much sea ice to Iceland between 1781 and 1784, which lowered temperatures further and prevented many merchant vessels from reaching the Icelandic coast.[311] In early August 1783, making use of every possible opportunity to find additional sources of nourishment, STEINGRÍMSSON gathered a group of people to hunt seals at the river mouth of Hverfisfljót; they managed to club 26 of them.[312]

The eruption and bad weather also hindered Icelanders' access to trading posts. Iceland's southeastern and southern coasts had no harbors; the nearest trading posts were in Djúpivogur in the east and Eyrarbakki in the west (Figure 18). There were no roads from these posts and few bridges over the rivers; even under normal circumstances, journeys across the land by horse were difficult.[313]

In autumn 1783, STEINGRÍMSSON traveled to Skálholt to ask the bishop, Hannes FINNSSON (1739–1796), for his help. The trip disappointed STEINGRÍMSSON greatly: the bishop only gave him 20 *ríkisdalir*, a currency of silver coins, to buy food for his parishioners. Under normal economic circumstances, one *ríkisdalur* bought a sheep, seven *ríkisdalir* bought a cow, and eight *ríkisdalir* bought a horse.[314] STEINGRÍMSSON found little charity during this frigid autumn journey.[315]

**307** STEINGRÍMSSON 1998: 78.

**308** GESTSDÓTTIR, BAXTER, GÍSLADÓTTIR 2006: 32–33.

**309** PÉTURSSON, PÁLSSON, GEORGSSON 1984: 97; THORDARSON et al. 1996: 205–225.

**310** HERRMANN 1907: 94–97; STEINGRÍMSSON 1998: 78.

**311** DAMODARAN et al. 2018: 520.

**312** STEINGRÍMSSON 1998: 55.

**313** VASEY 1991: 324. It was only in the late nineteenth century that roads were built to transport carriages. During this time, two bridges were built over the two largest rivers in southern Iceland; KARLSSON 2000b: 248–249.

**314** GUNNLAUGSSON 1984: 213–214. This result was found by a special commission that had been initiated in February 1785 to investigate the conditions in Iceland; GUNNARSSON 1983: 144–147; OSLUND 2011: 36–38. Price series of Icelandic currency only go back to 1849 and, therefore, an accurate estimate of the value of *ríkisdalur* from 1783 is impossible. Table 12.25 in JÓNSSON, MAGNÚSSON 1997: 637; personal correspondence with Prof. Guðmundur JÓNSSON, University of Iceland, 16 February 2020.

**315** STEINGRÍMSSON 2002: 180–181; see also OGILVIE 1986: 63.

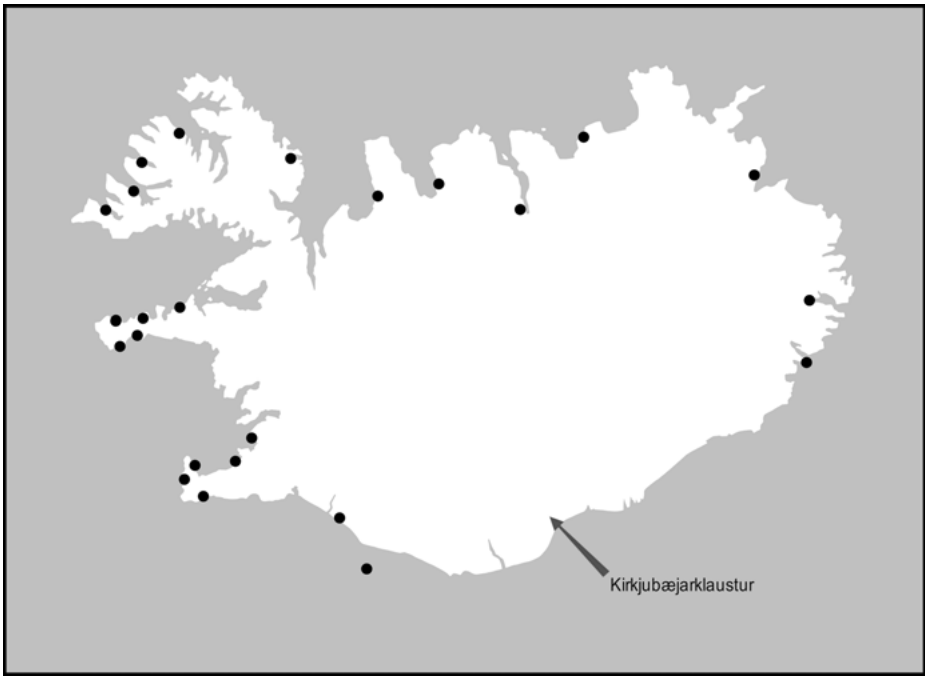


**Figure 18:** Danish trading posts in Iceland during the time of the Danish trade monopoly, 1602 to 1787. A lack of trading posts in the south and southeast around Kirkjubæjarklaustur becomes apparent.

### *Móðuharðindin*, the Famine of the Mist

The situation in and around Klaustur was dire from the beginning of the Laki eruption, only growing worse with time. Winter was fast approaching, and there was no sign of help from Denmark. Yet more people left for the relative safety of the less affected parts of Iceland. Those who could not flee witnessed a seemingly interminable period of death and decay.

Usually, the trading posts in Iceland held only a meager surplus of cereals. By autumn 1783, however, these stations housed large amounts of fish, the main export product from the southwest and the west, as well as mutton from the north and east. All this was gathered for ships to take back to Denmark as part of the trade monopoly. The governor, district governors, and sheriffs of Iceland could prohibit the export of any Icelandic foodstuff if famine threatened. The officials felt uncomfortable making this decision without consent from Copenhagen: so it was that considerable amounts of food were exported from Iceland to Denmark on the eve of the most disastrous winter in Icelandic history.[316]

**316** Andrésson 1984: 233.

While the mortality rate for Iceland in 1783 was actually below average, it seemed inevitable that all this would soon come to a head.[317] Early in the new year of 1784, people began to die in droves.[318] With no feed for animals or available winter pastures, famine struck.[319] In Iceland, the aftermath of the Laki eruption has a name: (*reykur*-) *móðuharðindin*, which loosely translates as "the famine of the mist." *Reykur* means "smoke," *móða*, "haze or mist in the air caused by the eruption," and *harðindi*, "hardship induced by a bad harvest."[320] The eruption's effects on mortality were not uniform in all parts of Iceland. Some regions, such as south-central Iceland and those north of the fissure, such as Skagafjarðarsýsla, Eyjafjarðarsýsla, and Suður-Þingeyjarsýsla, were hit harder than others.[321]

In his autobiography, STEINGRÍMSSON describes the state of affairs in early 1784. "I now had to travel on foot all the time, and to lean on my only horse for bringing dead bodies to the Church, since there were no other means of transportation."[322] Miraculously, one horse was able to survive on the contaminated hay; thus, perhaps it should rightly be called the Fire Horse. In the winter months, it was difficult for STEINGRÍMSSON to find able-bodied men to dig holes in the cemetery's frozen soil, which meant some people were buried in mass graves of up to ten people. However, all 76 people who died in STEINGRÍMSSON's parish in 1784 were given individual coffins.[323] The lack of fuel made people resort to burning furniture and even parts of their homes.[324] From STEINGRÍMSSON's description of what his parishioners ate during this time, it becomes apparent how hungry and desperate people were becoming. They "put their mouths on many things they never before thought to taste," even their robes and shoes.[325]

> All those who knew how, lived as sparely as they could, stretching what food they had, cooked what [. . .] ropes they owned, and restricted themselves to the equivalent of one shoe piece per meal, which was sufficient if soaked in soured milk and spread with fat.[326]

**317** VASEY 1991: 328–329.

**318** STEINGRÍMSSON 1998: 79.

**319** VASEY 1991: 335–336.

**320** HERRMANN 1907: 94–97; KRISTINSDÓTTIR 1984: 186.

**321** VASEY 1991: 328–329.

**322** STEINGRÍMSSON 2002: 183–184.

**323** STEINGRÍMSSON 1998: 79; STEINGRÍMSSON 2002: 182–184.

**324** STEINGRÍMSSON 1998: 80.

**325** PÁLSSON 1945, vol. II: 597–598. "Hallæri það, sem á féll, neyddi vesalings fólkið, sem þraukaði heima í eldsveitunum, til að leggja sét til munns marga þá hluti, er það hafði aldrei áður látið sér til hugar koma að bragða á."

**326** STEINGRÍMSSON 1998: 81–82.

His desperate parishioners mixed hay with their porridge and collected fishbones from the seashore to crush and eat. As a last resort, some people ate horsemeat; still, even in this wretched situation, not everybody could bring themselves to eat their horses.[327]

With the spring of 1784 came some hope: plants began to grow, the roots and leaves of which locals could use for food. The pastures, however, were still polluted and the grass produced little hay.[328] A study by Icelandic scholar Páll BERGÞÓRSSON demonstrated that a decrease of 1 °C in mean annual temperatures leads to a 30-percent reduction in hay production. Several cold spells throughout the eighteenth century amounted to just that. This led to severe shortfalls, time and time again, in fodder for livestock over the winter.[329]

In 1784, STEINGRÍMSSON mourned a loss of his own: on 4 October 1784, his wife of 31 years, Þórunn HANNESDÓTTIR, passed away. After her death, he suffered from depression. The famine and general hardship he and his parishioners endured worsened his condition:

> The period from the autumn of 1784 until the spring of 1785 was the most dismal that I have ever lived through. When I lost my wonderful wife, everything, so to speak, collapsed around me. [. . .] I had no fuel for the lamps and so had to languish in constant darkness. My people had to be in the cowshed because of our milking stock, the thieves were on the prowl; so I had to lie or sit there in a state of anxiety. [. . .] The house was now empty and horribly cold. And yet I found pleasure in sitting often by the familiar bed and reading God's word. But then my hands and my feet became swollen by the frost so that I could not take up my pen for diversity. At Christmas, I injured my arm so that for five weeks, I could hardly get dressed. But the church services were not canceled, for it was – and still is the greatest delight to worship God in His house.[330]

STEINGRIMSSON's parish, once 613 members strong, was reduced to just 93 souls by the end of 1784. Many had left in the early summer, settling in the fishing stations to the west. These refugees left most of their possessions, which were soon stolen if not left with a trustee.[331]

Weather-wise, the autumn of 1784 was reasonable everywhere in Iceland.[332] By contrast, the winter that followed was horribly cold again, resulting in another surge in mortality that lasted until the spring of 1785.[333] Bishop Hannes FINNSSON estimated infant mortality of 30 percent for the year 1784, which he partly blamed on a lack of breastfeeding.[334]

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**327** VASEY 1991: 323–324; STEINGRÍMSSON 1998: 82.
**328** STEINGRÍMSSON 1998: 68, 83.
**329** BERGÞÓRSSON 1985: 117; BERGÞÓRSSON 1987: 396; VASEY 1991: 347.
**330** STEINGRÍMSSON 2002: 187–188.
**331** STEINGRÍMSSON 1998: 80.
**332** OGILVIE 1986: 63.
**333** VASEY 1991: 332–333, 346.
**334** LACY 1998: 187, 226; MAGNÚSSON 2010: 99.

The year 1785 began with inclement weather, including a very sharp frost. Steingrímsson observed how, on 23 January 1785, "a whole pint bottle of communion wine which stood on the altar during the service that day turned to slush."[335] Given that wine freezes at temperatures between 0 and −6 °C, it is hard not to admire the steadfastness of all those at church that day. In the autumn of 1785, Iceland experienced a smallpox epidemic that started in Reykjavík and quickly spread in all directions.[336] This epidemic was relatively mild; nevertheless, given the population's weakened state, it killed around 1,500 people.[337]

Scholars estimate that the moss in Iceland took three years to recover; the inland trout fisheries and the offshore fishing grounds took about the same length of time. Only in 1786 did the food supplies slowly begin to recover.[338] Between 1783 and 1785, about 76 percent of Iceland's horses, 79 percent of the sheep, and half of the cattle perished.[339] Cattle were kept alive as a priority, rather than sheep or horses.[340] Farmers generally culled sheep and expected their horses to fend for themselves.[341]

Roughly 15 percent of all farms inhabited before the eruption were abandoned. Overall, the eruption initiated a movement from the inland areas to the coast and so diversified the economy, making it less dependent on livestock and introducing fishing and foreign trade.[342] Guðmundur Pétursson and his colleagues estimate that Iceland had a population of 48,884 before the eruption. This is based on extrapolated data from parish registers for births, deaths, and pastoral visitations, which date back to as early as 1668.[343] The hardships in Iceland were severe. The famine lasted until the spring of 1785, by which time 20 to 25 percent of the population had perished; around 10,000 people lost their lives.[344] In 1786, Iceland had a population of 38,363.[345] Vestur-Skaftafellssýsla lost about 44 percent of its population (from 1,964 to 1,072 people) between 1783 and 1785. 472 people from this region died and, during the same time period, 80 children were born; the remaining 500 or so fled (temporarily) to

**335** Steingrímsson 1998: 86.

**336** Hálfdanarsson 1984: 162.

**337** Pétursson, Pálsson, Georgsson 1984: 97; Vasey 1991: 333.

**338** Bjarnar 1965: 416; Þórarinsson 1979: 152; Vasey 1991: 323–324, 333–336; Oslund 2011: 36.

**339** Henderson 1818: 275; Fisher, Heiken, Hulen 1997: 170; Oppenheimer 2011: 286.

**340** Pétursson, Pálsson, Georgsson 1984: 96–97; Rafnsson 1984a: 178.

**341** Vasey 1991: 324.

**342** Rafnsson 1984a: 178. Although many eruptions tested the Icelanders, no district in Iceland was ever permanently or entirely deserted; Þórarinsson 1979; Thordarson 2010: 293.

**343** More information on parish registers here: Hálfdanarsson 1984: 161; Vasey 1991: 326–327. The Genealogical Society of Utah microfilmed these for their Genealogical Data Communications. Daniel Vasey (1991) analyzed them to ascertain the fate of most Icelanders prior to and after the famine.

**344** This equates to 19 to 22 percent of the population at the time; Bjarnar 1965; Demarée, Ogilvie 2001: 224. Other estimates put the figure at around 22 percent, such as Thordarson, Self 1993: 261. Vasey estimates it to be around 22.4 percent, Vasey 1991: 343; Vasey 2001.

**345** Pétursson, Pálsson, Georgsson 1984: 96–97.

other regions.[346] Historian Ólöf GARÐARSDÓTTIR has found a distorted sex ratio in the live births in Iceland in the aftermath of the Laki eruption, with a higher-than-average number of girls being born.[347]

### The Danish Response to the Crisis

Copenhagen is around 2,000 kilometers from Iceland; the only way to send a message between these two places in the eighteenth century was via Danish merchant ship. Over the summer of 1783, the Danish merchants who were in Iceland witnessed the volcanic eruption and its dire consequences. When they returned to Copenhagen in late August 1783, they brought this news with them. Their accounts were subsequently printed in Danish newspapers and elsewhere in Europe. Most of the first newspaper reports were in large part based on a detailed letter written by Danish merchant C. J. SÜNCKENBERG in Stykkishólmur[348] on 24 July 1783; all the early reports contain the same inaccuracies and misspellings that were present in the letter.[349]

In 1783, the Icelandic governor was Lauritz Andreas THODAL (1718–1808), a Norwegian whom historians regard as a competent official. At the time of the Laki eruption, THODAL was ill.[350] He lived in the vicinity of Reykjavík, far from the Síða region and the people who suffered the most. THODAL had heard about the eruption but wanted to confirm these reports before he passed them on to the Danish central administration. On 16 September, he duly sent his report, which took over two months to arrive.[351]

In response to the dire accounts that trickled in, the Danish central administration sent two representatives to investigate the disaster and the woes it had inflicted upon the Icelandic economy and society. The representatives were Hans VON LEVETZOW

**346** GUNNLAUGSSON 1984: 128.

**347** Ólöf GARÐARSDÓTTIR gave a paper about this topic at the ESEH conference in Tallinn, 2019. In Sweden, this eruption seemingly had effects on perinatal health. In 1784, fewer males were born than before, which resulted in a distorted sex ratio. In 1785, both male and female infant mortality rates were unusually high; CASEY et al. 2019.

**348** In the letter, the settlement is referred to as Holmershafen, which is located on Iceland's west coast and is one of the trading posts of the Danish trade monopoly. The letter was addressed to the directors of the Royal Monopoly Company in Iceland; THORDARSON et al. 2003b: 37. The letter can be found in GUNNLAUGSSON et al. 1984: 269–270.

**349** Kjøbenhavns Adresse-Contoirs Efterretninger, no. 170, 5 September 1783; I thank Karl-Erik FRANDSEN for his assistance in obtaining this newspaper report. GUNNLAUGSSON 1984: 213.

**350** WIENERS 2020: 2.

**351** WIENERS 2020: 6–9. Claudia WIENERS makes a good argument here: In the summer of 1783, it was difficult for governor THODAL to predict that a severe, deadly famine would result from this eruption based on his information. In fact, it is difficult even in the present to foresee the magnitude of famines in certain parts of the world.

(1754–1829), a German-Danish nobleman, an official of the Danish central administration and later governor of Iceland (1785–1789), and Magnús STEPHENSEN (1762–1833), an Icelander conducting his law studies in Copenhagen at the time. The latter would later become chief justice of the high court of Iceland.[352]

The ship set off in autumn; unfortunately, adverse weather made it impossible to dock anywhere in Iceland and forced them to winter in Norway. In spring 1784, they set sail again, landing in Iceland in April.[353] STEPHENSEN and VON LEVETZOW began their survey in the summer of 1784, coming eventually to Vestur-Skaftafellssýsla. Unfortunately, they were unable to obtain the precise information needed for their survey, as there was no way to prove whether somebody had died or simply moved elsewhere.[354]

The delayed arrival of this reconnaissance mission was not the only thing that went wrong in the Danish response to the crisis. In addition, another ship carrying supplies for the expedition was wrecked off the coast of Meðalland, just to the west of the Síða region. Immediately after that, whoever had the means could buy flour, hemp, and iron from the survivors of the wrecked ship.[355]

In the spring of 1784, STEPHENSEN and VON LEVETZOW were able to give some relief to the people in southern Iceland as direct financial aid was made available for those who fled Vestur-Skaftafellssýsla to resettle elsewhere. People were also allowed to receive supplies and new livestock from the Crown's stores in Iceland. The privileged merchants and Icelandic officials administered this aid until 1785.[356] Each farmer was given roughly eight *ríkisdalir* to buy livestock, a task made difficult due to higher prices and a dwindling supply.[357] At this time, around 20 to 30 percent of farms were in dire need of animals.[358] The problems faced by the farmers in the Síða region were compounded by the demands of their landlords to pay rent and settle any other debts that had gone into arrears.[359]

During the first half of 1784, the central administration in Denmark published several royal decrees regarding measures to tackle famine and loss of livestock in Iceland. They knew, from what little information they had, that the Icelanders required urgent aid. However, as the gravity of the situation was unclear, the suggested measures were far from sufficient.[360] In early 1784, fundraising activities for the Icelanders began in Copenhagen. Despite this, merchants traveled to Iceland in the spring of 1784

**352** STEINGRÍMSSON 1998: 85. Magnús STEPHENSEN's father, Ólafur STEPHENSEN, was the governor of Iceland from 1790 to 1806.

**353** GUNNLAUGSSON 1984: 213; WIENERS 2020: 6.

**354** STEINGRÍMSSON 1998: 85–86.

**355** ANDRÉSSEN 1984: 233; STEINGRÍMSSON 1998: 85.

**356** GUNNLAUGSSON 1984: 213.

**357** STEINGRÍMSSON 1998: 84.

**358** GUNNARSSON 1983: 144–147; GUNNLAUGSSON 1984: 213–214; OSLUND 2011: 36–38.

**359** STEINGRÍMSSON 1998: 89.

**360** GUNNLAUGSSON 1984: 213.

without additional food supplies and still exported their regular fish quota: for this thoughtless action, they were heavily criticized.[361]

Throughout 1784, ships returning from Iceland arrived in Copenhagen with updates on the grim situation. On 21 July 1784, a royal decree ordered the shipment of 3,000 to 4,000 barrels of rye to Iceland to be distributed amongst those in need. In the end, 5,300 barrels were shipped. The decree also ordered that fish from western and eastern Iceland be shipped to the north and south; in addition, extra cargoes of timber were sent to aid the effort to rebuild.[362]

Few of the proposed initiatives to help the situation in Iceland were quite as ambitious as the plan to relocate the poor, elderly, ill, and orphaned to the moors of Jutland in mainland Denmark.[363] Many Danes had left Jutland due to the area's problems with soil erosion.[364] This plan of resettlement, however, was never realized.[365] Moreover, new research and close examination of written protocols call into question whether the planned evacuation was ever taken seriously in Copenhagen, instead suggesting that it had only been briefly and informally discussed.[366]

The collection of funds in churches in other parts of the Danish kingdom, such as Norway, only began in 1785. In total, the amount raised for Icelandic relief was 46,000 *ríkisdalir*. In addition, the royal trading company donated another 32,000 *ríkisdalir* to the campaign.[367] 78,000 *ríkisdalir* was an immense sum; unfortunately, according to German medievalist Paul Herrmann (1866–1930), only a quarter of the donations reached the intended recipients. The rest was used for other purposes, such as measuring and mapping the coastline.[368]

A second royal land commission was initiated in February 1785 and ran until 1794. Its mission was to analyze the consequences of the *móðuharðindin* and to follow up on issues that the first royal land commission from 1770/1771 had not concluded satisfactorily. Some unresolved matters included police ordinance, commerce, free trade, fishing, grinding grain, and manufacturing, to name a few.[369]

Around 95 percent of the population's livelihoods depended on farming, animal husbandry, and fishing, all of which were severely disrupted by the volcanic eruption.

**361** Oslund 2011: 36–38.

**362** Andréssen 1984: 233; Gunnlaugsson 1984: 213; Thordarson 2003: 1, 10.

**363** For a history of Jutland, see Olwig 1984.

**364** Kjaergaard 1994; Oslund 2011: 70, 181.

**365** A short overview of the matter can be found here: Bjarnar 1965: 421; Gunnlaugsson 1984: 213; Oslund 2011: 70.

**366** Wieners 2020: 8.

**367** Gunnarsson 1983: 145–146; Gunnlaugsson 1984: 213–214; Oslund 2011: 36–38.

**368** Herrmann 1907: 94–97. According to Gunnarsson (1983: 145–146), a special fund was created from the donations that were collected in Denmark and Norway. Most of this money remained in Copenhagen to be used for the Icelanders in the future, should the need arise; in the 1840s, a high school was built in Iceland with the money.

**369** Robertsdóttir 2008: 418.

The short-term response of the distant central administration in Copenhagen was too slow, and the aid provided too meager to ensure the survival of many Icelanders and their livestock.[370]

## The Road to Recovery

The *móðuharðindin*, the famine of the mist, cut down one in five Icelanders. That on which they depended, land and livestock, was swept from beneath their feet. In many ways, it is surprising that Icelandic society did not totally collapse. The societal structure remained intact: most Icelanders lived in multi-person households, within which the burden of risk was shared. Some abandoned farms had been pillaged, but one can understand people's desperation in the face of starvation and almost certain death. Icelandic households showed solidarity with one another and cared for their own as best they could. They rationed food and ate whatever they could find.[371]

Daniel Vasey found that the mortality rate during the *móðuharðindin* was almost twice that of the Irish potato famine of 1845 to 1849.[372] Whereas the Irish response was emigration, the Icelandic response was domestic relocation. Perhaps they did not have the means to travel abroad or simply did not want to leave their country.[373]

Over time, the Icelandic population crept upward. The birth rate rose sharply in the late 1780s and early 1790s, a common occurrence after a famine. In 1801, when the second national census took place, the population hovered around 47,200. However, it took until the 1810s for Iceland to reach pre-eruption population levels again.[374] The region of Vestur-Skaftafellssýsla needed longer still, only reaching pre-eruption population levels half a century later, in the 1830s.[375] Throughout the nineteenth century, the average age of marriage fell, as did infant mortality.[376]

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**370** Vasey 1991; Karlsson 2000b: 180–181; Dugmore, Vésteinsson 2012: 76. For a detailed study of the Danish central administration's response to the Laki eruption, see Wieners 2020.

**371** Vasey 1991: 344, 348–349.

**372** Ireland, just before the potato famine, however, had a population of eight million. One million people died from hunger and diseases; another million left the country. So, in numbers, the Irish potato famine was much worse, but in terms of percentage, the mortality rate was higher in Iceland during the *móðuharðindin*; Vasey 1991: 344.

**373** Emigration from Iceland to Canada took place in the second half of the nineteenth century. In total, around 17,000 Icelanders (20 percent of the population) left for North America between 1870 and 1914. To this day, they are referred to as "West Icelanders" by native Icelanders; Karlsson 2000b: 234–238; Magnússon 2010: 64–84; Oslund 2011: 50, 185.

**374** The National Archives of Iceland, Census Database: The 1835 Census. Historical Demographical Data of the Whole Country of Iceland between 1703 and 2050. The data from populstat.info reveals that Iceland had 49,000 inhabitants in 1810 and 50,000 inhabitants in 1815. See also Vasey 1991: 344; Karlsson 2000b: 186–192; Magnússon 2010: 21.

**375** Gunnlaugsson 1984: 128.

**376** Magnússon 2010: 22, 198.

The Laki eruption transformed Iceland's landscape. The course of both the Skaftá and Hverfisfljót Rivers changed due to the enormous outpourings of lava. In addition, the eruption also raised the land by an average of 25 meters; in some parts, it was well over 100 meters.[377] The lava fields of the eruption remain to this day in the form of undulating expanses of igneous rock flecked with moss.

The *móðuharðindin* was a "major hunger catastrophe."[378] As we have seen from the history of Iceland up to 1783, it was by no means the first of its kind. The Icelandic economy, as well as its population numbers, stagnated throughout the eighteenth century. The trade monopoly did not allow for any competition, and – as a result – Icelanders remained, for the most part, cash-poor subsistence farmers.[379] In the eighteenth century, Iceland was prone to famines and epidemics; when they struck in tandem, they usually wiped out around 20 percent of the population. This was the case between 1707 and 1709, between 1754 and 1759, and again between 1783 and 1786. Resources were distributed unevenly within Iceland, and the poor were more likely to perish than the wealthy.[380]

Why was the *móðuharðindin* the last major hunger catastrophe in the history of Iceland?[381] What did the Icelanders and the Danes learn from this experience? The effects of the disaster were devastating. With the loss of the hay harvest in 1783, only a meager harvest in 1784, no access to supplemental food sources due to fluorine poisoning, and high livestock losses, should one not ask why *only* one in five Icelanders died?[382] Perhaps they had learned from the many hunger-induced mortality crises that came before the *móðuharðindin*. Or was it a mere coincidence that Iceland was not struck again by a large famine?

Throughout Iceland's history, the Laki eruption and the *móðuharðindin* have been interpreted differently, depending on the zeitgeist. In the late eighteenth century, the debate focused on the reaction to the eruption so that such a calamity could be mitigated in the future. Inspired by the Enlightenment, many Icelanders came to regard the hardships of 1783 as anthropogenic rather than heaven-sent.[383] Even religious men like Jón Steingrímsson eventually came to this conclusion. He was a keen observer of nature and sometimes felt conflicted between science and the dictates of his faith. Steingrímsson conducted some experiments, such as throwing small boulders into the lava. When they did not melt, he concluded that there was no way that the lava could destroy the mountains surrounding Klaustur as some had feared.

**377** Thordarson 2010: 290–291.
**378** Gunnarsson 1984: 242.
**379** Vasey 1991: 344.
**380** Gunnlaugsson 1984: 212–213.
**381** Gunnarsson 1984: 242.
**382** Vasey 1991: 344–346. The severe weather between 1782 and 1784 certainly played a role in the loss of life, both human and animal; Ogilvie 1986.
**383** Gunnarsson 1984: 242.

Steingrímsson was both a man of the Enlightenment and a priest of his time. In another passage of his autobiography, he talks of two men living together on a farm near Klaustur. He believed the men to be homosexual and considered that God may have produced the volcanic eruption to drive them apart.[384]

The bishop of Skálholt, Hannes Finnsson, wrote a treatise titled *Mannfaekkun af Hallærum* ("Loss of Life as a Result of Dearth Years") in 1786 and published it ten years later. The inspiration for this work was most likely the hardships that the bishop witnessed during the *móðuharðindin*. Finnsson defines a "dearth year" as one in which famine and hunger-related deaths affect the whole country of Iceland. For climate historian Astrid Ogilvie, Finnsson's treatise is the first Icelandic work in the then-unnamed genre concerning the "human dimension of climate change."[385] Finnsson concludes that several factors can contribute to a dearth year, the most important of which are climatic in nature. He points the finger specifically at an accumulation of consecutive cold seasons, which can lead to poor harvests and famine. Finnsson did not think that the climate varied throughout the time of his study; he complained about a lack of data from earlier times in Icelandic history but nevertheless found that there had been fewer years of hardship before 1280.[386] Today, given what we know about the early onset of the Little Ice Age in the North Atlantic Rim, we can appreciate the accuracy of these findings.

Another treatise focusing on the hardship caused by the so-called dearth years was written and published in 1790 by Stefán Þórarinsson, district governor of northern and eastern Iceland from 1783 to 1823. This treatise focuses on the years between 976 and 1783. According to Þórarinsson, four events could cause hardship and adversity in Iceland: the grass harvest failing, restricted access to fishing waters, severe and extremely long winters, or the delayed arrival of Danish merchant ships. He regards volcanic eruptions as another cause of hardship but concedes that nothing can be done to prevent them. Therefore, he suggests another course of action. The details of this plan are revealed by the title of his treatise: *Thoughts for Greater Consideration Regarding Dearth Years and their Effects, in addition to the setting up of Food or Grain Reserves for Severe Years.* Food reserves, in the opinion of Þórarinsson, would allow Icelanders the opportunity to rise above the status of helpless victims and mitigate future disasters.[387]

By 1783, Icelanders had lived in and struggled with their natural environment for almost 900 years. When the Laki fissure erupted, they made do with what they had. Throughout their history, they had fended for themselves in the face of volcanic eruptions and hazardous weather conditions and so learned how to attenuate their effects. Isolated from Europe by hundreds of kilometers of ocean, they developed a communal

**384** Steingrímsson 1998: 7–8, 32.
**385** Ogilvie 2005: 280.
**386** Ogilvie 2005: 280.
**387** Ogilvie, Jónsson 2001; Ogilvie 2005: 280–281.

resilience rather than a dependence on Copenhagen: help, in the shape of resources or refuge, often came from areas within Iceland that were less affected.[388] Creatively, they looked for internal solutions, such as clearing the tephra from fields so that the grass could grow and animals could graze again. Similarly, they relocated farms that were destroyed and created new paths for those cut off by lava.[389]

The Laki eruption precipitated the termination of the Danish trade monopoly in 1787. Now, within the realm of the Danish kingdom, Danes and citizens of other dependencies were allowed to trade with one another. In 1855, yet more restrictions were lifted: Denmark granted free trade to all its subjects. Now, Icelanders were allowed to contact foreign merchants directly without Denmark acting as a middleman.[390] In the nineteenth century, the interpretation of the eruption's aftermath changed when a distinct anti-Danish sentiment arose, with some blaming the Danes for their lackluster aid effort. In the twentieth century, blame shifted to the "fire and ice" of Iceland. Interestingly, in both explanations, Icelanders are painted as helpless victims.[391]

What if the trade terms for Iceland had been fairer or agricultural methods had been different? Would they have fared better had they not suffered from endemic poverty? How would they have coped had they worked their own farms rather than rented lands? The fact remains that the Laki eruption was of a size that only occurs on average once every 500 years. Icelanders could not have known an eruption like this was an inevitability. Even today, nothing can protect fields from being poisoned by fluorine. Daniel Vasey is confident that the Laki eruption would "probably have caused excess mortality under any pre-industrial circumstances."[392] It seems many of the deaths during this period were unavoidable.

Having analyzed the eruption and its aftermath, we now leave Iceland behind and follow the Laki haze toward Europe. The haze mesmerized and frightened many, inspiring a few to find explanations for what they were witnessing.

**388** Dugmore, Vésteinsson 2012: 76.
**389** Thordarson 2010: 293–294.
**390** Karlsson 2000b: 243–244; Agnarsdóttir 2013: 14–15.
**391** Gunnarsson 1984: 242.
**392** Vasey 1991: 348.