Volcanic system: Bárðarbunga system

Alternative name: Veiðivötn system

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Note to readers: The text on Bárðarbunga is a pre-publication extract from the Catalogue of Icelandic Volcanoes. The full Catalogue will be made publically available in the coming months. The Catalogue of Icelandic Volcanoes is a collaboration of Icelandic Meteorological Office, Institute of Earth Sciences University of Iceland, and Iceland Civil Protection. The Catalogue is funded by International Civil Aviation Authority and the European Community's Seventh Framework Programme under Grant Agreement No. 308377 (Project FUTUREVOLC).

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Summary: The Bárðarbunga volcanic system has been highly active in the Holocene with at least 26 eruptions in the last 11 centuries. The last eruption took place in 1910 CE. The Bárðarbunga system lies on the Eastern Volcanic Zone and is about 190 km long and up to 25 km wide, consisting of a central volcano rising to 2009 m a.s.l. and a fissure swarm partly covered by the Vatnajökull ice cap. The central volcano has an 80 km^2 ice-filled caldera. The characteristic activity is explosive basaltic eruptions occurring on central volcano flanks or the fissure swarm. Known eruptions have mostly been VEI 3-4 but occasionally VEI 5-6 (bulk volume of tephra up to 10 km^3). The largest eruptions occurred in the early Holocene, effusive basaltic eruptions on the fissure swarm with lava volumes ≥20 km^3. Eruption frequency during the last 1100 years is 1 eruption per 50 years on average. Eruptions on the ice covered part of the system have the potential to cause major floods in several rivers flowing southwards and northwards from the Vatnajökull ice cap.

Central volcano: Bárðarbunga

Lat, lon:	68°38´N, 17°31´W
Elevation:	2009
Type:	Subglacial volcano with caldera
Summit ice cover:	Yes
Dominant type of activity:	Basaltic explosive, phreatomagmatic
Magma type:	Basalt dominant
Known precursors:	No information
Expected precursors:	Significant increase in seismic activity
Monitoring level:	High
Current seismicity:	Seismic swarms from 16 August 2014. See http://vedur.is for live information
Eruption characteristics:	
Type of products:	Airborne tephra, water transported tephra
Volcanic Explosivity Index	Max: VEI 4; most freq: VEI 3-4; min: VEI 0
Column heights:	No information
Duration of eruptions:	Weeks to months
Bulk volume tephra (km^3):	Max: no information, aver: 0.1, min: no information
Fallout beyond 1000 km:	No information
Tephra <63µm at 30 km	No information
Bulk volume lava (km^3):	No information
Longest lava flow, km:	No information
Gas emissions, sulphur:	No information
Interval between eruptions, years:	(last 1000 years) Max: >100 years, min: <1 year
Last significant eruption:	1910 CE
Seismic characteristics	Persistent seismic activity. No information on previous eruptions. Seismic swarms expected
Deformation characteristics	No information on previous eruptions. Inflation expected

Current activity	Heightened unrest from 16 August 2014. See http://vedur.is for live information
Distance to international airports:	Keflavík 260 km, Reykjavík 220 km, Akureyri 115 km, Egilsstaðir 155 km
Principal hazards:	Tephra fallout, jökulhlaups

Fissure swarm:

Exists	Yes
Length:	115 km towards SW and 55 km towards NNE from Bárðarbunga
Trend:	Veidivötn fissure swarm NE-SW, Dyngjuháls fissure swarm NNE-SSW
Ice cover:	Partial
Type of activity:	Lava effusion, explosive phreatomagmatic
Magma type:	Basalt
Eruption characteristics:	
Type of products:	Airborne tephra, lava flows, water transported tephra
VEI	Max: VEI 5-6; most freq: VEI 1-2
Bulk volume tephra (km^3):	Max: ~10 km^3
Fallout beyond 1000 km:	At least one in last 1100 years
Tephra <63µm at 30 km	~5%
Bulk volume lava (km^3):	Max: >20 km^3
Longest lava flow:	>130 km
Gas emissions, sulphur:	Significant to large depending on magma volume, max known 150 Mt SO_2
Seismic characteristics	Quiet between eruptions except for the region 10-15 km north of the caldera. No information on previous eruptions. Seismic swarms expected
Deformation characteristics	No information on previous eruptions. Inflation expected
Current activity	Seismic swarms from 16 August 2014. See http://vedur.is for live information
Mean interval between eruptions:	300-400 years (30 fissure eruptions in 10,000 years)
Last significant eruption:	1862-1864 CE
Principal hazards:	Lava flows, tephra fallout, damming of rivers (hydropower disruption)

Detailed description

1. Geological setting, magmatic and tectonic context

The 190 km long and up to 25 km wide Bárðarbunga volcanic system (Figure 1) is located in the rift zone part of the Eastern Volcanic Zone. About one-third of the volcanic system lies below the NW part of Vatnajökull ice cap. A 2009 m high central volcano, Bárðarbunga, is located within the ice covered part. A potential second central volcano, Hamarinn, is located 20 km SW of Bárðarbunga. The fissure swarm is characterized by distinct tensional tectonics, including graben structures tens of km long and up to 70 km long volcanic fissures active in a single eruption. Rifting fades out at the SW end of the fissure swarm where it enters the older Torfajökull system. The dominant magma type is tholeiite basalt but genetically unrelated silicic magma may erupt where volcanic fissures cut into the Torfajökull system. Geothermal activity on the Bárðarbunga system is insignificant except at Hamarinn.

2. Morphology and topography

Both Bárðarbunga and Hamarinn central volcanoes have extensive ice cover. The 2009 m high Bárðarbunga central volcano lies at the NW edge of the ice cap, with only its NW slopes ice free. It is dominated by a 80 km^2 and up to 700 m deep ice-filled caldera. Bedrock rises to 1850 m in the northwest caldera rim and is lowest in a narrow gap the east rim where minimum elevation is 1350 m. The ice free fissure swarm north of Vatnajökull strikes NNE-SSW at elevations between 1400 and 800 m. The part southwest of Vatnajökull strikes SW-NE at elevations between 560 and 1100 m. The lowest part lies in an area of high ground water and abundant surface water. Geothermal field below the ice near Hamarinn has caused small jökulhlaups (2000 m^3/s) in in river Kaldakvísl.

3. Plumbing system and subsurface structure

The Bárðarbunga volcano is underlain by a dense intrusive complex (probably gabbro), about 12 km in diameter. Below the centre of the caldera, material with lower density occurs, possibly a caldera fill, a subsided block or both. Existence of magma chamber is uncertain. If a shallow level magma chamber exists below the Bárðarbunga volcano a likely location is at the base of the lower density region. Earthquakes occur at larger

depth indicating magma movements below 5 km depth. Hamarinn volcano lacks caldera and pronounced high density rocks at depth. The 190 km long fissure swarm may be partially fed by lateral magma flow from a shallow level magma chamber below Bárðarbunga next to the central volcano. Volcanic fissures farther out on the fissure swarm may be fed by magma from a deep-seated reservoir.

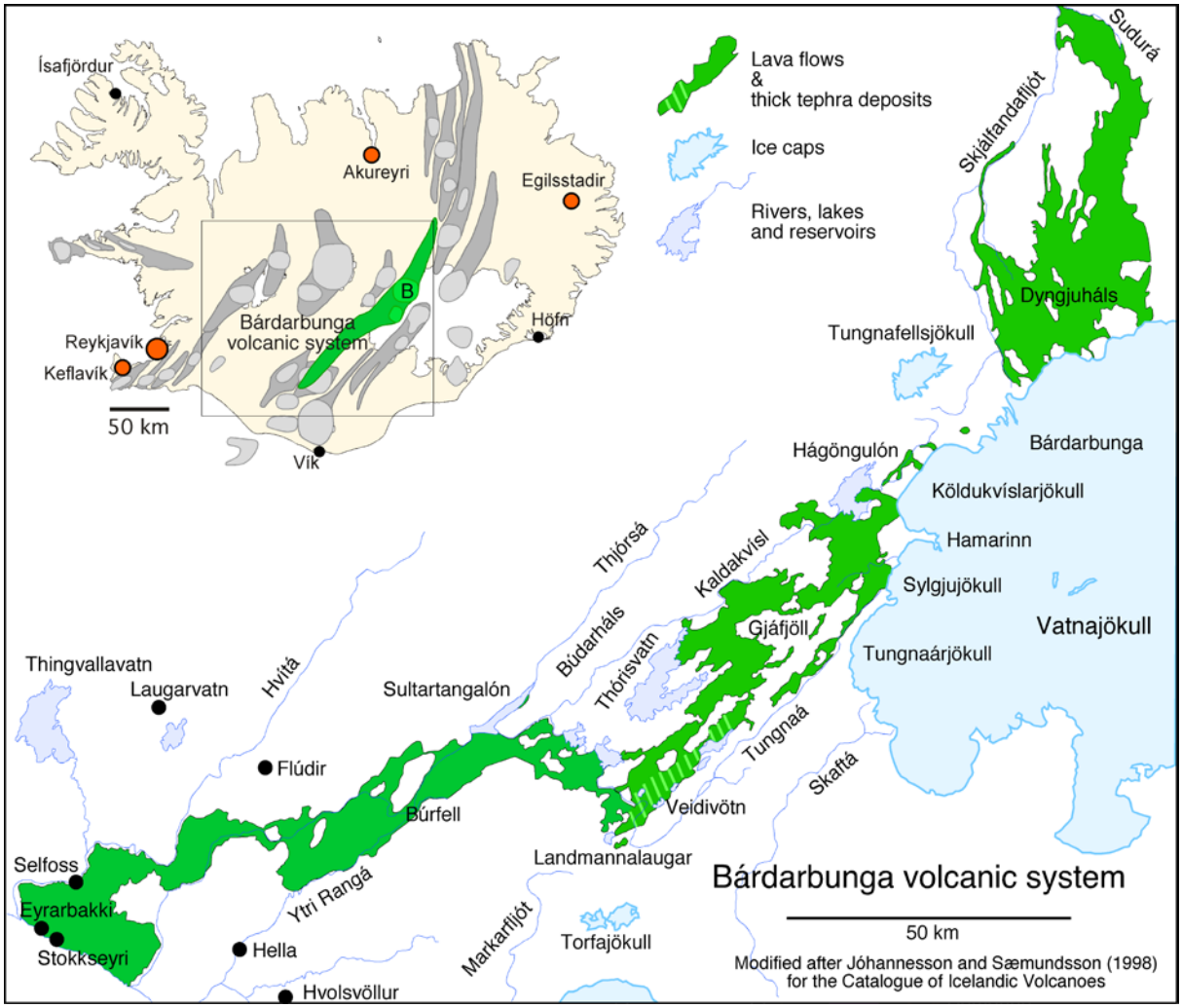

Figure 1. The partly ice-covered Bárðarbunga volcanic system (inset, green), central volcano is indicated by capital B. Holocene lava flows from the ice-free parts of the volcanic system are shown in green, areas of thick tephra deposits are ruled. Modified after Jóhannesson and Sæmundsson (1998). No discrimination is made between lava flows of different age. In southern Iceland the area covered by lava flows is indicated all the way to the south shore, and for those flowing towards north out to 60 km from the margin of Vatnajökull. Also shown are major rivers, lakes and reservoirs.

4. Eruption history and pattern

The Holocene eruption history is not fully known. Lava flows and tephra deposits from eruptions on the ice free parts of the fissure swarm have been mapped in some detail. Explosive eruptions within the ice covered part of the system, including both central volcanoes and the fissure swarm, are less well known. The eruption history is based on tephrochronological records from ice and soil together with written documentation for the last 1000 years and terrestrial soil tephrochronology for the preceding 7000 years. Because eruption sites below the ice have not been located it is not clear whether eruptions on the central part of the system belong to a central volcano or the ice covered fissure swarm. Both cases will generate jökulhlaups from rapidly melting ice. All explosive eruptions originating below ice are therefore described together.

4.1 Bárðarbunga central volcano and adjacent ice covered fissure swarm

1. Phreatomagmatic basaltic eruptions. Dominant type for the ice covered part of the volcanic system (Figure 2). The number of verified eruptions in the last 1000 years is 22. However, only one eruption out of every four left a tephra layer in the soils outside the Vatnajökull ice. During the preceding 6600 years at least 82 tephra layers were deposited in the soils outside Vatnajökull which could indicate that up to 330 eruptions had occurred in that period. The total number of eruptions on the ice covered part of the system in the last 7600 years could therefore be around 350. Tephra volumes are poorly known but may range (as freshly fallen) from <0.02 to >0.2 km^3 (Figure 3).

2. Explosive silicic eruptions. No confirmed eruptions in the last 1000 years. One small but highly silicic tephra layer is known from the Vatnajökull ice but its origin in Bárðarbunga is not verified.

3. Effusive and explosive eruptions at margins of the central volcano. No known eruptions in the last 1000 years.

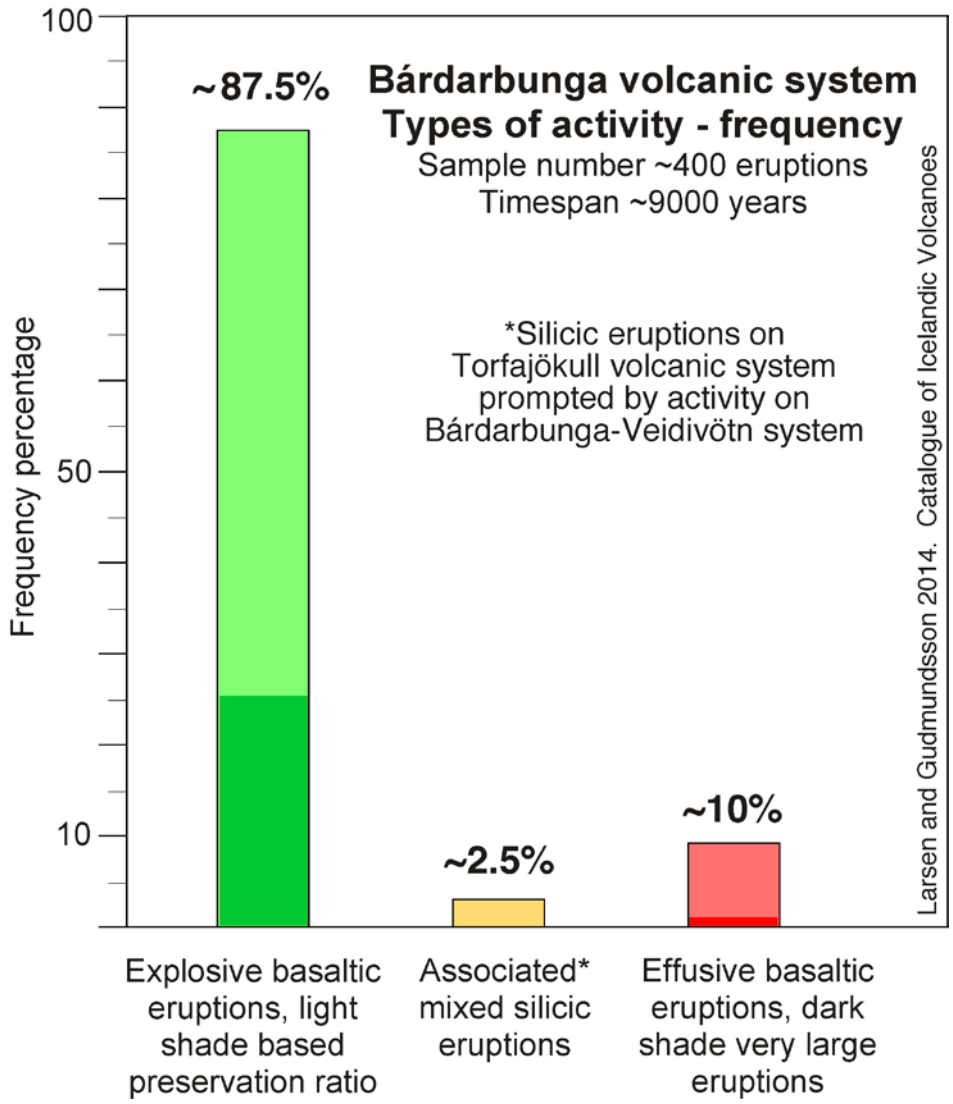

Figure 2. Frequency of the three types of volcanic activity on the Bárðarbunga volcanic system. Explosive basaltic eruptions (green), occurring mostly within the ice-covered part of the volcanic system, are most frequent. Dark green shade shows verified eruptions, based on trustworthy descriptions and/or tephra layers known in soil, ice or sediment, light shade indicates eruptions inferred by preservation ratio of tephra layers (e.g. Thorarinsson 1974; Larsen 1984, Larsen et al. 1998; Óladóttir et al. 2011). Mixed silicic eruptions with in the adjacent Torfajökull volcanic system but triggered by and occurring simultaneously with eruptions on the Bárðarbunga system (yellow) are least frequent (e.g. McGarvie et al. 1990). Effusive basaltic eruptions (red) on the ice-free part of the volcanic system include the largest eruptions on the system (e.g. Jakobsson 1979; Vilmundardóttir et al. 1988, 1990, 1999, 2000; Sigvaldason 1992; Hjartarson 2011).

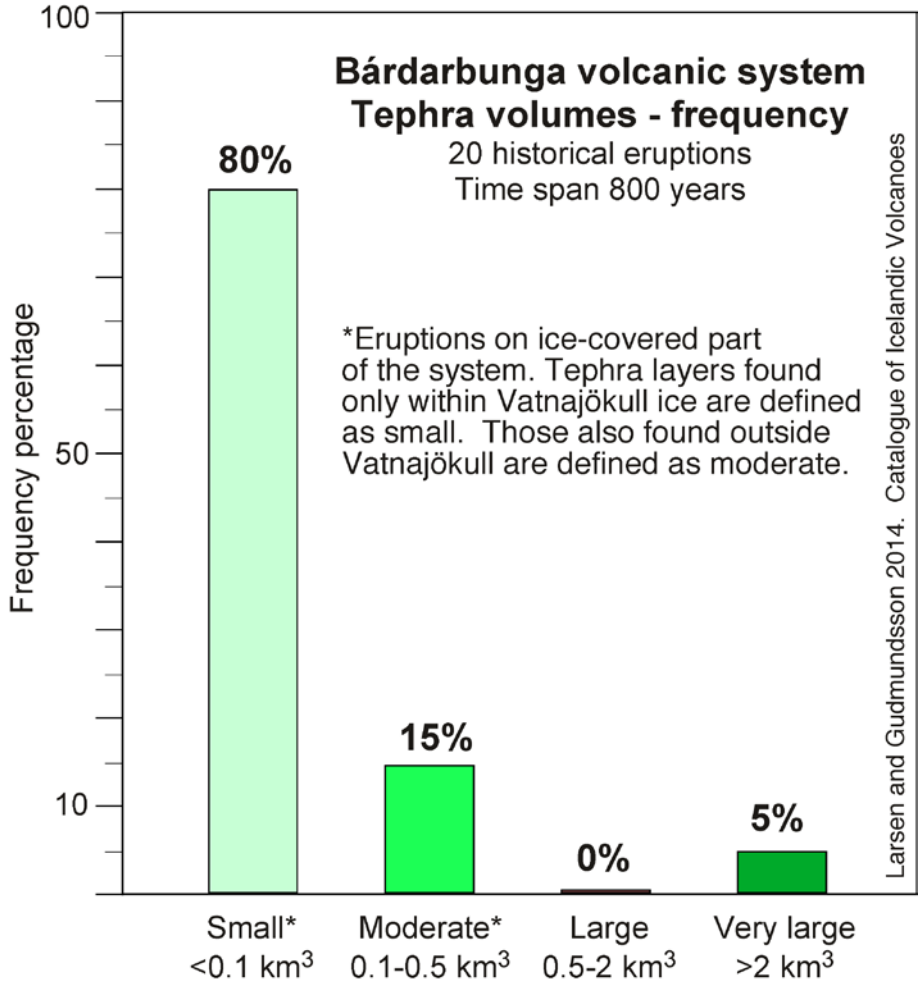

Figure 3. Proportion of small-, moderate-, large- and very-large-volume basaltic tephra layers erupted on the Bárðarbunga volcanic system in the last 800 years (Thorarinsson 1974; Steinthórsson 1977; Larsen 1984, Larsen et al. 1998). Silicic tephra is treated under Torfajökull volcanic system.

4.2 Fissure swarm

1. Effusive basaltic eruptions on the fissure swarm. The dominant type for the ice-free part of the fissure swarm (Figure 2). At least 22 eruptions have been verified on the fissure swarm SW of Vatnajökull in the last 9000 years. The last eruption was the 0.3 km^3 Tröllahraun eruption in 1862-84 CE. Volumes of lava flows in individual eruptions ranges from ≤0.3 to ≥20 km^3. Length of fissures ranges from 8 to 50 km. Longest lava flows followed river channels and the largest, the 8600 year old Thjórsá lava, flowed 130 km to the south coast of Iceland. The eruptions on the fissure swarm north of Vatnajökull are less well known but more than 10 eruptions are expected to have occurred, including that of the 15 km^3 shield volcano Trölladyngja. The largest lava flows followed river channels over 100 km towards north, to within 15 km of the north coast.

2. *Explosive phreatomagmatic basaltic eruptions on the fissure swarm.* Dominant type for areas of high ground water and surface water on the SW-most part of the fissure swarm. Such conditions prevailed in early Holocene during the melting of the inland ice, when e.g. the Fontur row of tephra rings erupted. These conditions have been revoked by repeated lava flows that raised river channels and the ground-water table in the area. As a result two major recent eruptions, the Vatnaöldur ~870 CE (Figure 4) and the Veiðivötn ~1477 CE eruptions, were predominantly explosive, producing large amounts (~5 and ~10 km^3) of highly fragmented basaltic tephra and some small lava flows. Tephra from the ~1477 CE eruption has been found on the North Iceland shelf and overseas in Ireland and Sweden. Both fissures are 60-65 km long and both intersect the Torfajökull central volcano, prompting extrusion of silicic tephra and lava (Figure 2).

3. *Mixed explosive and effusive eruptions, SW tip of fissure swarm.* Where the SW tip of the fissure swarm cuts into the adjacent Torfajökull system genetically unrelated silicic, basaltic and hybrid lava and tephra is extruded. Volume of largest silicic tephra layer is about 0.4 km^3 and that of the largest lava flow 0.36 km^3. (See Torfajökull volcanic system for details).

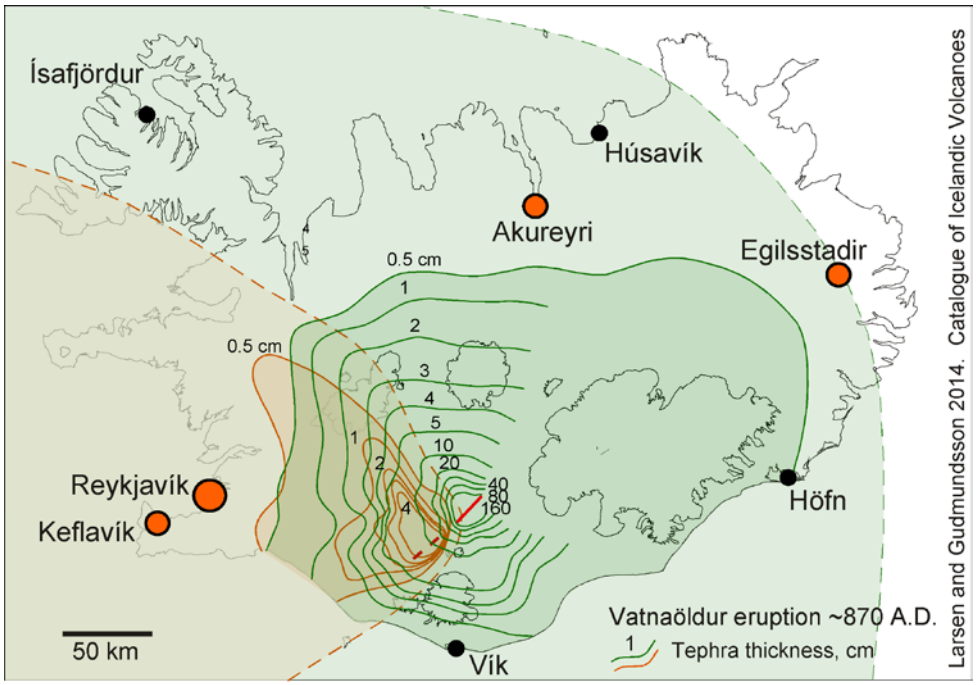

Figure 4. Isopach map of a very large basaltic tephra layer (green) from the Bárðarbunga volcanic system, with freshly fallen volume of ~5 km^3 (Larsen 1984). Also shown is the associated average-sized silicic tephra layer from the Torfajökull volcanic system (orange) triggered by the activity on the Bárðarbunga system. Changing wind directions dispersed the basaltic tephra in all directions. Limited dispersal of the silicic tephra is the result of a short-lived explosive phase.

4.3 Frequency and duration of eruptions.

Ice-covered central part of system, including Bárðarbunga: On average 2 eruptions per century during the last 1000 years, but most of the eruptions occurred in the interval 1200-1500 CE and in the 18th century. The duration of these explosive eruption ranges from days to months.

Ice-free southwestern fissure swarm: Eruption frequency has varied from 1 to 10 eruptions per millennium, being highest >7000 years ago. The last three eruptions took place in 1862-64 CE, ~1477 CE and ~870 CE. Duration is months to years. Eruption frequency on the ice free northern fissure swarm is not known.

5. Characteristics during non-eruptive periods

Bárðarbunga is seismically active with of the order of 100 earthquakes (1.5<M<5) detected every year. Activity is associated with the Bárðarbunga central volcano and the area near Kistufell, at the glacier edge to the north. Bárðarbunga has minor geothermal activity manifested in small ice cauldrons. Earthquakes are also relatively frequent at Hamarinn, and geothermal activity with a possible minor magmatic component on its east side lead to an unexpected flood in 2011.

6. Precursory signals

Observed signals: No confirmed subaerial eruption since instrumental monitoring began. Inflation of volcano and elevated seismic activity expected to precede eruptions by days to months. See 9. for further details on current activity.

7. Erupted material

Basaltic tephra, 0.02 to ~10 km^3 per eruption, ~350 eruptions estimated in 7600 years.

Silicic tephra, erupted within Torfajökull volcanic system. Largest mapped tephra layer 0.4 km^3.

Basaltic lava flows, volume range ≤0.3 - ≥20 km^3 in a single eruption, ≥30 eruptions in 10,000 years. Areal range 30 - 970 km^2. Maximum flow range 130 km from source.

Silicic lava flows, remobilized magma erupted within Torfajökull volcanic system. Volume range 0.005 - 0.36 km^3, ~10 eruptions in 10,000 years, areal range 0.3 - 9 km^2.

Volcanic debris transported by jökulhlaups (ash, pumice, lithic material), volumes unknown.

8. Volcanic hazards

8.1 Proximal areas (<30 km distance from volcano – no permanent dwellings). *Heavy tephra fall* of 20 - >1000 cm. Ground transportation expected to stop during heavy eruption. Possible loss of radio communication during heavy fallout. *Disruption of power production, power line damage* possible. *Total darkness* under eruption cloud can last hours. *Jökulhlaups* (outburst meltwater floods) of order 5,000-10,000 m^3/s peak discharge have occurred in the last 1000 years. Much larger jökulhlaups (max. discharge >100,000 m^3/s occurred before 2500 BCE. *Health hazards including respiratory problems. Damage to vegetation.*

8.2 Medial areas. *Tephra fall* causing *total darkness* for hours. Transport (and communication) disruptions. *Health hazards including respiratory problems.* Jökulhlaups in large glacial rivers. Damage to vegetation.

8.3 Distal areas. A*sh clouds* on airline routes and airports causing *disruption of air traffic*. *Aerosol clouds* (sulphur).

9. Activity status and monitoring (Kristin S. Vogfjord, Evgenia Ilyinskaya and Magnus Tumi Gudmundsson, Icelandic Meteorological Office, British Geological Survey and Institute of Earth Sciences)

Bárðarbunga is monitored by Icelandic Met Office (IMO) seismic and GPS networks. The present threshold for earthquake detection is about M 1 on Richter.

Over the last seven years seismic activity has been gradually increasing in Bárðarbunga and the northern part of the fissure swarm. This activity dropped again after the Grímsvötn eruption in May 2011, but it soon began to increase gradually again. In May 2014, there was a relatively small swarm of over 200 events.

An intense seismic swarm started under the eastern part of Bárðarbunga system on August 16 2014. The aviation colour code was raised to YELLOW on August 16, ORANGE on August 18 and RED on August 23. The colour code was lowered again to ORANGE on August 24. For more recent updates see IMO's web, under the link http://en.vedur.is/earthquakes-and-volcanism/articles/nr/2947.

IMO, Institute of Earth Sciences at the University of Iceland, and Civil Protection in Iceland are monitoring the situation. Live data from seismic network and updates (in English) are available at http://en.vedur.is/.

A direct link to the Vatnajökull seismic map (live data):

http://en.vedur.is/earthquakes-and-volcanism/earthquakes/vatnajokull/#view=map

A direct link to Bárðarbunga seismic map (live data):

http://en.vedur.is/earthquakes-and-volcanism/articles/nr/2949

10. Possible eruption scenarios – based on last 1100 years

The possible eruption scenarios are based on known events in historical times (last 1100 years). For information on the current activity follow updates on http://en.vedur.is

Sizes of eruptions (small, moderate, large):

Small eruptions (<0.1 km^3)

A small explosive eruption below NW Vatnajökull may last for days or weeks, e.g. the 1797 CE eruption. Length of warning period is unknown. Likely magma composition is basaltic. Peak activity will not necessarily occur at the beginning of the eruption. Activity is expected to be intermittent. Intense tephra fall outside Vatnajökull is possible. Total maximum fallout thickness 25-30 km from volcano unlikely to exceed 5 cm. Likelihood of tephra being transported to Europe very small. Eruption plume height expected to be <10 km.

A jökulhlaup is likely to emerge from underneath NW Vatnajökull during the eruption, possibly preceding the onset of subaerial explosive eruption. A jökulhlaup will cause increased discharge or floods in Jökulsá á Fjöllum as in 1684 CE, Thjórsá as in 1766 CE or Skjálfandafljót as in 1902 CE, depending on location of eruption site. Likely maximum discharge could be of the order 5,000-10,000 m^3/s. The floods may carry ice blocks and increased amounts of sediment. Damage of roads and bridges possible.

Moderate eruptions (0.1-0.5 km^3).

A moderate explosive eruption below NW Vatnajökull can last for weeks to months, as the 1717 CE eruption that lasted from early August to mid-September 1717, spreading tephra across North and Northeast Iceland. Length of warning period is unknown. Eruption column height unknown but could exceed 14 km. Intermittent but substantial tephra fall and darkness in proximal areas (<40km) can be expected (Figure 5a). Tephra fall could

reach mainland Europe. A predominantly effusive eruption on the fissure swarm can last intermittently for 1-2 years, such as the 1862-1864 CE Tröllahraun fires, that produced 0.3 km^3 of lava on a 16 km long fissure.

Jökulhlaups are likely to emerge from underneath NW Vatnajökull during an eruption there and cause floods in Jökulsá á Fjöllum as in 1717, or in rivers Thjórsá, Kaldakvísl, Skjálfandafljót, depending on location of eruption site. Maximum discharge could range from 10,000 to 100,000 m^3/s. The floods may carry ice blocks and increased amounts of sediment. Damage to roads and bridges.

Large eruptions (>0.5 km^3) including largest likely eruption.

In the last 1100 years the large eruptions have been confined to the fissure swarm southwest and north of Vatnajökull. No large eruptions are known to have occurred in the central volcano. A large fissure eruption is likely to continue for several months to years. Warning period is unknown. Instrumental precursors are expected to be seen before eruption outbreak. A discontinuous volcanic fissure over 60 km long between the extreme ends can be expected. Depending on the location of the fissure, it could be either predominantly explosive, or predominantly effusive.

A predominantly explosive eruption on the SW part of fissure swarm, similar to the eruption on the 65 km long Veiðivötn fissure in 1477 CE, could emit >5 km^3 of basaltic tephra, covering >50,000 km^2 on land. Heavy tephra fall and darkness in proximal and medial areas (<100 km) can be expected (Figure 5b). Tephra fall could reach mainland Europe.

Eruptions elsewhere on the fissure swarm will be predominantly effusive and could release 1 - 4 km^3 of lava and significant amounts of tephra. Lava can extend tens of km from source, e.g. the 35 km long Frambruni lava flow in 13th century CE. Depending on location of the erupting fissure, lava flows can reach power stations on the Tungnaá river. Considerable amount of magmatic gases will be released from the erupting fissure and the cooling lava.

Large fissure eruptions are likely to begin on a single fissure segment and progress gradually to full length. The time scale is unknown. Ash may reach mainland Europe. Sulphur emissions may have atmospheric effects on a regional to hemispheric scale.

An eruption on a 60 km fissure on the SW part of the fissure swarm is likely to lie across Tungnaá river, obstruct water flow and cause temporary dams and unstable lakes. Floods through breached dams could be of the order 10,000 m^3/sec.

Eruption scenarios:

1. Eruptions in central volcano and/or vicinity (~2 events/100 years):
    a. Small to moderate eruptions in central volcano and/or vicinity below ice:
    Small to moderate tephra fall, jökulhlaups north or south (examples: 1766, 1797, 1902 CE).
    b. Eruption episode in central volcano and/or vicinity below ice as in 1711-1729 CE. Small to moderate eruptions in central volcano and/or vicinity below ice. Small to moderate tephra fall, jökulhlaups north or south.

2. Eruptions on the fissure swarm, either on the northern or south-western swarm within 50 km from central volcano (~1 events/500 years):
    a. Eruption on Dyngjuháls ridge, effusive unless partly below ice, moderate to large. No distal tephra dispersal or jökulhlaups from fissure north of glacier. For glaciated part of fissure see 1a.
    b. Eruption on the fissure swarm north of Gjáfjöll mountain range. Effusive for ice free part – see 1a and 1b for glaciated part. Moderate to large (example: 1862-1864 CE Tröllahraun).

3. Eruption on the fissure swarm beyond 50 km from central volcano (~1 event/1000 years):
    a. Southwesternmost part (Veiðivötn part) of the fissure swarm: Large or very large eruptions. Fissures 10-70 km long, cutting into (e.g. 1477 CE) or across (e.g. 870 CE) the Torfajökull volcanic system. Mostly explosive basaltic if fissure lies on eastern side, mostly effusive basaltic if on western side. Silicic explosive and effusive within Torfajökull. DRE volume 1-6 km^3, bulk tephra volume up to 10 km^3. Damming of Tungnaá river regardless of type.
    b. Northern end of fissure swarm: Large or very large eruptions. Predominantly effusive, forming large lava fields (example: Frambruni, 13th century CE).

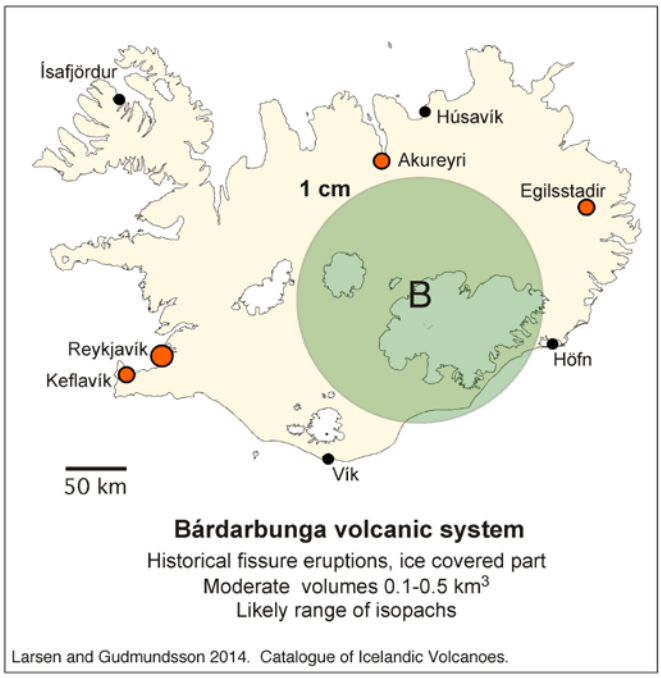

Figure 5a. Likely maximum range of the 1 cm isopach of tephra in a moderate explosive basaltic eruption (based on Sigurgeirsson et al. 2002).

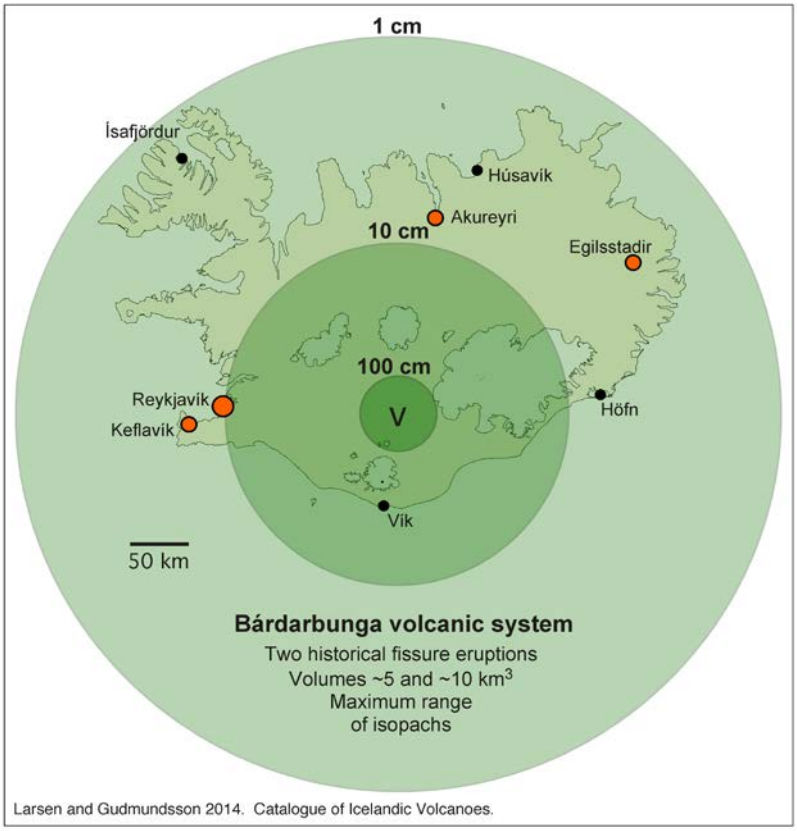

Figure 5b. Maximum range of the 1 cm, 10 cm and 100 cm isopachs of the largest basaltic tephra layer erupted in historical time, the ~10 km^3 (freshly fallen volume) Veiðivötn tephra (based on Larsen et al. 2013). Wind direction remained between west and southwest throughout the tephra fall which partly explains how far from source the isopachs extended.

11. Largest known eruption

Effusive eruption: The eruption of the Great Thjórsá Lava (>20 km^3) about 8600 years ago is the largest known eruption on the fissure swarm SW of Vatnajökull. The lava covers over 900 km^2 and was channelled via riverbeds of Tungnaá and Thjórsá more than 130 km from source to the south coast. Source area is not known in detail. The largest known eruption on the fissure swarm north of Vatnajökull is the Tröllladyngja lava shield (~15 km^3), its age is not known in detail but is probably mid-Holocene. The lava field covers over 400 km^3.

Explosive eruption: The large explosive basaltic eruption in 1477 CE took place on a ~65 km long volcanic fissure on the southwestern part of the Veiðivötn fissure swarm where ground water level is high, and deposited about 10 km^3 of tephra on land affecting 50% of the country (Figures 4 and 5b). Heavy proximal tephra fall clogged water ways and volcanic craters dammed river Tungnaá resulting in formation of unstable lakes behind tephra dams.

12. Extent of knowledge and bibliography

Volcanic history and eruption frequency of the last 11 centuries is fairly well documented. Information on prehistoric eruptions is adequate on eruption frequency and type of activity. Holocene lava flows on the southwestern half of the volcanic system have been mapped, dated and some volumes estimated. Holocene lava flows on the northeastern part, Dyngjuháls, have not been mapped in detail. Dispersal maps and volume estimates exist for the two largest explosive basaltic tephra deposits but only a few other deposits have been mapped.

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