Reviewed research article

The explosive basaltic Katla eruption in 1918, south Iceland I: Course of events, tephra fall and flood routes

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Abstract — *The 23-day long eruption of the ice-covered Katla volcano in 1918 began on October 12 and was over by November 4. Seismicity preceding and accompanying the onset had already started by 11:30 on October 12, while the eruption broke through the glacier around 3 PM. The plume rose to 14–15 km on the first day. The eruption caused widespread tephra fall, accompanied by lightning and thunder. Tephra fall from the intense first phase (October 12–14) was reported from Höfn, 200 km east of Katla, Reykjavík, 150 km to the west and Akureyri, 240 km to the north. The initial phase was followed by more sporadic activity for a week, and a second intense phase (October 22–24), with heavy tephra fall in populated areas east and south of the volcano. Skaftártunga (25–35 km east of Katla), was the worst hit farming district, with reported tephra thickness of 6.5–10 cm in total, collecting into drifts tens of cm thick. The Vík village suffered almost continuous tephra fall for 13 hours on October 24 and 25, leaving a 2 to 4 cm thick tephra layer on the ground. Tephra reached Reykjavík four times but minor tephra fallout («1 mm) occurred. Tephra also reached northern, western and eastern Iceland. In addition to producing the 0.9–1.0 km^3 tephra layer, which may as freshly fallen have been 1.1–1.2 km^3, the eruption was accompanied by a jökulhlaup that flooded the Mýrdalssandur plain and neighbouring areas. The jökulhlaup on October 12 had two separate phases. The first phase is considered to have flowed supraglacially down the lower parts of the Kötlujökull outlet glacier into the Leirá, Hólmsá and Skálm rivers (northern fork), and the Sandvatn and Múlakvísl rivers (southern fork). It was much more widespread than the second phase which emerged from below the glacier snout and was confined to the western part of Mýrdalssandur. That phase carried huge icebergs and massive sediment load onto the sandur plain.*

INTRODUCTION

Volcanism in Iceland is dominated by basaltic eruptions. Environmental factors such as large ice caps, lakes and high groundwater levels within the volcanic zones influence the style of the eruptions (Thordarson and Larsen, 2007). In Iceland explosive basaltic eruptions outnumber the effusive basaltic ones almost by 4 to 1 (Thordarson and Höskuldsson, 2008), and by far the largest number of the explosive basaltic eruptions occur in ice-capped or ice-covered volcanoes (Larsen, 2002). One consequence of eruptions below ice are the often hazardous jökulhlaups (glacial outburst floods) (Gudmundsson *et al.*, 2008).

The central part of the Katla volcano is covered by the 590 km^2 Mýrdalsjökull ice cap (Figure 1) with an ice thickness of 300–750 m within a 100 km^2 caldera (Björnsson *et al.*, 2000). It has erupted at least 300 times during the last 8400 years with an eruption frequency of 2–4 eruptions/century, on average (Óladóttir *et al.*, 2005, 2008). Over the last millennium Katla eruptions have averaged two per century (Thorarinsson, 1975; Larsen, 2000). These can be large events that severely affect the environment through extensive and often heavy tephra fall and catastrophic jökulhlaups (Thorarinsson, 1975; Tómasson, 1996; Larsen, 2000; Gudmundsson *et al.*, 2008).

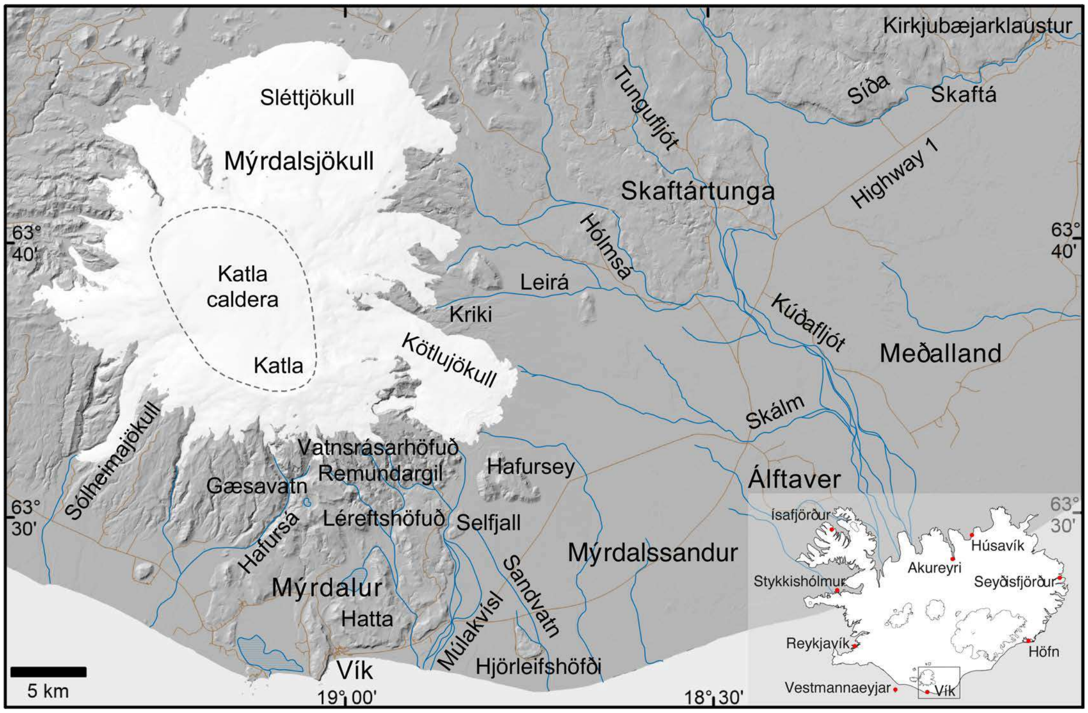


Figure 1. The Mýrdalsjökull ice cap and neighbouring areas. The Katla caldera rim (Björnsson *et al.*, 2000) is shown as a grey hatched line. Katla marks the 1918 eruption site. Base map topography ArcticDEM (Porter *et al.*, 2018), glacier topography Lidar (Jóhannesson *et al.*, 2013). – *Mýrdalsjökull og nágrenni. Brún Kötluöskjunnar er táknuð með grárri slitinni línu. Katla er sýnd þar sem gosstöðvarnar 1918 voru. Landslag samkvæmt ArcticDEM hæðarlíkani nema jökulyfirborð sem er samkvæmt Lidar mælingum.*

The last eruption to break through the ice in the Katla caldera (Figure 1) began around 3 PM on October 12 1918, accompanied by widespread tephra fall and a catastrophic jökulhlaup.[1] Detailed descriptions exist of the course of events during the 23 days of the eruption (Sveinsson 1919; Jóhannsson 1919) as well as photographs of the eruption plume and jökulhlaup deposits (National Museum of Iceland/Institute of Earth Sciences; Photographic archives of Westman Islands).

Considerable work has been carried out to map the 1918 tephra layer. Efforts were made in 2018, 100 years after the eruption of 1918, to constrain the magnitude of the eruption by collecting new data and combine with older data sets. New measurements of the tephra layer, obtained within and close to the Mýrdalsjökull ice cap were combined with the existing data set on the thickness of the tephra layer.

This paper presents a description of the Katla 1918 eruption: Precursors, eruption plume and tephra fall, based on contemporary sources, including a comprehensive isopach map of the Katla 1918 tephra, in the proximal and medial areas, and an overview of distal deposition. Flood routes for the two phases of the jökulhlaup of October 12 on Mýrdalssandur are described, based on eyewitness descriptions and analysis of aerial photographs from 1945 and 1946. Information on the preservation of the tephra is provided from contemporary thickness records in comparison with measured thicknesses at selected locations.

[1]Jökulhlaups that were 1–2 orders of magnitude smaller than those associated with known eruptions occurred in 1955, 1999 and 2011. The cause of these events has been debated, with both volcanic and geothermal origin suggested (e.g. Russell *et al.*, 2010; Galeczka *et al.*, 2014). These events will not be considered further here.

A complementary paper (Gudmundsson *et al.*, this issue) presents the details on this isopach map, the data used, analysis of tephra distribution and thickness variations on Mýrdalsjökull ice cap, and estimates of the volume of the tephra layer.

Lightning and thunder are an aspect of the 1918 eruption that is not attended to here although frequently mentioned in contemporary sources.

PRECURSORS, ERUPTION PLUME AND TEPHRA FALL: CONTEMPORARY RECORDS

The 1918 Katla eruption was among the largest 20th century eruptions in Iceland, despite being relatively short-lived, lasting 23 days. The following account of events from October 12 to November 4 is based on contemporary observations published in an official report to the authorities (Sveinsson, 1919), written descriptions from neighbouring areas (Jóhannsson, 1919; Loftsson, 1930), and newspaper reports from October and November 1918. Frequent mention is also made of the farming areas or districts that were greatly affected by the eruption and located to the northeast, east and south of Katla, notably Skaftártunga, Álftaver, Síða, Meðalland and Mýrdalur with the small village of Vík (Figure 1).

Precursors

The precursors observed were earthquakes felt at the village of Vík, about 20 km S of the eruption site (Sveinsson, 1919; see also Einarsson, 2019). At about 1 PM, local time, on October 12 a strong earthquake was felt in Vík, with frequent small quakes occurring in the next 1/2 hour (Jóhannsson, 1919). Signs of unrest, however, were noticed earlier. At about 11:30 AM, small ripples were noted in a water basin used for washing.[2] This suggests that small earthquakes and tremors had started at least 1.5 hours before the strong earthquake.

Eruption onset

The eruption plume was seen from Vík village rising from Mýrdalsjökull at about 3 PM (Jóhannsson, 1919). It was described as a steam cloud or as an ascending, winding smoke with a lower black part, brightening upwards and extending slowly towards east (Sveinsson, 1919). Figure 2 is most likely taken on this first day of the eruption. Another account described a fast ascending eruption column with uneven upwind edge with ripples and puffs, and strange formations within the plume, e.g. in the shape of an inverted funnel above a large horizontal ring, that remained unchanged for an hour (Jóhannsson, 1919). The plume extended eastwards towards Álftaver and darkened in the hours that followed.

Farmers were herding sheep in Mýrdalur on October 12. This included the Hafursá canyon (Hafursárgil), which cuts into the lower slopes of the Katla volcano. The plume was seen rising from the glacier where none had been earlier. This description is not timed, but indicates the rapid ascent of the plume.[3]

An account from Vestmannaeyjar islands, about 65 km to the of WSW of Katla, described the beginning of the eruption on October 12 as the appearance of a dense, light-grey cloud among the clouds above Mýrdalsjökull, rising slowly at first, soon accelerating and forming a tall, straight smoke column that widened at the top and extended towards east. The light-grey plume was noticed around 3 PM, but there were also claims that some smoke had been spotted at least an hour earlier. The column had a well-defined point of origin as seen from Vestmannaeyjar. Flashes of light were seen in the cloud soon after it appeared and onwards. The "smoke" was extruded continuously, the plume becoming more impressive in the

[2] Lilja Tómasdóttir (1906–1973), was 12 years old in 1918 and lived with her parents in Vík. On the morning of October 12 she had been washing clothes with her mother (Margrét Eiríksdóttir, 1867–1950) by the small river that runs through the village. At about 11:30 AM she noticed that there were small ripples on the surface of the water in the tub they were using. Her mother then said: "Guð hjálpi okkur, ætli Katla sé að koma?" (God help us, could this be Katla coming?) At 3 PM they had lunch. As the family sits by the table, a man comes and shouts: "Katla er að koma" (Katla is coming). Lilja then ran up the slope above the house and looking east saw the jökulhlaup burst forth carrying large blocks of ice, west of Hjörleifshöfði, 8–10 km away (Source: Erlingur Ísleifsson, son of Lilja, 30th of January 2001).

[3] This observation was made by Magnús Ingibergur Þórðarson (1895–1983) (Source: Þórður Eydal Magnússon, son of Magnús, 11th of October 2018).

evening hours. Later in the evening a red glow was seen at its base, lasting for some time (Skeggi, Oct. 12 and 18, 1918).

Figure 2. Eruption plume above Katla seen from north of Vík village. The mountain to the right is Hatta, 504 m a.s.l. The eruption plume rises at least 15 km a.s.l. See descriptions in main text. Photo: Þorlákur Sverrisson, undated, but most likely from October 12. – *Gosmökkur yfir Kötlu. Myndin er tekin fyrir norðan Vík í Mýrdal. Fjallið til hægri er Hatta, 504 m y.s. Mökkurinn rís a.m.k. 15 km y.s. Ljósmynd: Þorlákur Sverrisson, ódagsett en líklega tekin 12. október.*

Lightning and accompanying thunder was observed within the eruption plume from the beginning. In the evening the arrow-like flashes were said to occur almost constantly, although "sometimes with a few seconds in between" (Jóhannsson, 1919). Larger flashes "that lit up the whole cloud" were also observed, sometimes lasting for a while, and "booms" were heard every now and then from the beginning of the eruption. Around 9 PM a glow at its base was noticed, lasting for a while (Jóhannsson, 1919).

The eruption plume was measured from Reykjavík on October 12 (Eggertsson, 1919), about 150 km WNW from Katla at a time when the plume was heading towards E or ESE in the direction of Álftaver. The maximum plume height reported by Eggertsson (1919) is 14.3 km a.s.l., but he does not give the timing of this observation. The descriptions from Reykjavík state that upwards-directed lightning strikes rose from the plume reaching 20–25 km height (Figure 3). The width of the eruption plume at its top was measured to be about 8 km across (Eggertsson, 1919).

Eruption plume 13 October – 4 November

The photographs of the eruption plume shown in Figures 4a-d are examples of the several images that exist; some of which are not dated. However, they show a plume as high as 15 km (a, most likely taken on October 12), as low as 4 km (b), and then there are two showing height of 7–8 km (c and d).

No detailed descriptions exist from October 13 and 14. The weather was cloudy on the 13th and haze caused poor visibility on the 14th. On October 15, the visible activity fluctuated, with periods of ascending and receding plume. On October 16, the plume was definitely lower than before, and it was at its lowest the following day (Jóhannsson, 1919). On October 18 no plume was observed. On October 20, two separate eruption columns were spotted for the first time (see Larsen and Högnadóttir, this issue), the western column was much lower and weaker than the eastern one, each "apparently coming from several vents" (Jóhannsson, 1919). The plume was now lower and darker than during the first days and described as an ash cloud.

On October 22 the eruption intensified and the plume became more magnificent than ever before, and the black, lower part of the plume had never been as high as seen on this day (Sveinsson, 1919). The following day the plume was referred to as "black smoke", but on October 24 the plume was described as a "horrible black ash column" akin to that of October 22 but emanating from two sources (vent areas), this time with the western one "blacker" (Sveinsson,

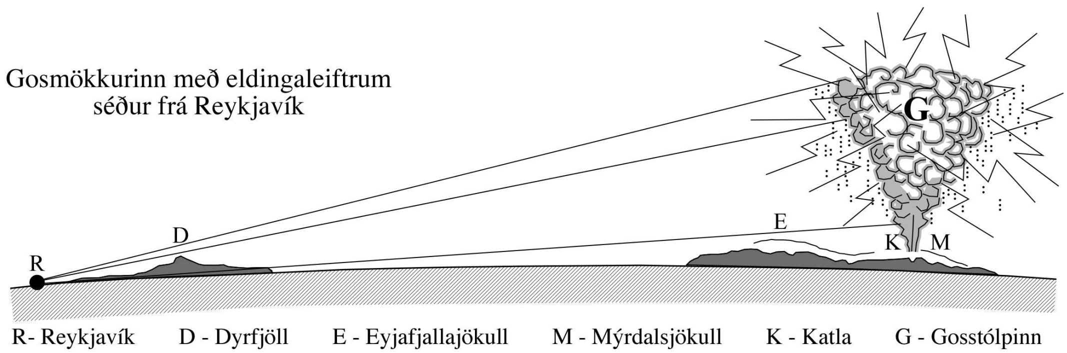


Figure 3. Drawing by Samúel Eggertsson (1919, redrawn here) showing the eruption plume with lightning flashes as seen from Reykjavík on October 12, also explaining how the height of the plume was determined from Reykjavík. – *Teikning Samúels Eggertssonar (1919, endurteiknuð) sýnir gosmökkinn með eldingaleiftrum eins og hann sást frá Reykjavík 12. október. Myndin sýnir einnig hvernig hæð gosmakkarins var ákvörðuð.*

1919). From then onwards no large eruption column was described but black smoke was noted on October 27 and November 2. On November 3 and 4 some steam was seen coming from the "crater".

In the following days unfavourable weather did not allow observations of the eruption site until November 10, when a "smoke veil" was observed. The eruption was, however, considered to have ended on November 4 (Sveinsson, 1919; Jóhannsson, 1919).

Tephra fall and course of events

The eruption and the tephra fall, as experienced in the populated areas in the vicinity of Mýrdalsjökull, can be divided into two intense phases with less intense activity in between. The first intense phase lasted through day 1 to 3 (October 12–14) and the second phase occurred on days 11–13 (October 22–24). From day 16 (October 26), the tephra fall was mostly towards northerly directions over unpopulated areas with scant information on intensity (Figure 5).

During the first hours, after breaking through the ice on October 12, the eruption plume was carried ESE. No contemporary records of tephra fall exist from the unpopulated region of glaciers and sandur plains east of the volcano. Tephra fall began 30–40 km to the ESE of the volcano around 3:30 PM (Loftur Guðmundsson, in Ásbjörnsson, 1994) on October 12. Around 8 PM in the evening the ground in Álftaver (Figure 1) had become "black by sand", a description commonly used of black Katla ash on the ground. The tephra fall gradually decreased, but continued until 6 AM in the morning of October 13 (Sveinsson, 1919).

A slight change in wind direction late on October 12 carried the eruption plume towards E and ENE over Skaftártunga, where tephra fall began in the evening and continued until morning on October 13, forming a $\leq {}^1/_2$ inch layer of ash ($\sim$1 cm; 1 Danish inch = 2.61 cm). At Síða and in Fljótshverfi farther to the east the tephra fall began in the early hours of October 13. By morning, the ground was covered by black ash that prevented livestock from grazing. It was noted by the farmers in Skaftártunga (Sveinsson, 1919) that this first ash was much finer than the tephra that fell later during the eruption.

In the late morning of October 13 the wind shifted and carried tephra towards W, reaching Reykjavík (Figure 5). The tephra falling in Reykjavík that day was collected from flat surfaces at three different locations and was measured to be 35, 38 and 44 g/m^2, respectively, or 39 g/m^2 on average. Using a density of 1000 kg/m^3 this translates to a thickness of 0.04 mm (Eggertsson, 1919).

On October 14–15 the weather was calm and visibility poor in the areas south and east of Katla. Tephra fall was reported from Akureyri and several locations in North Iceland on October 14 (Morgunblaðið, 15 Oct.). Minor tephra fall on the village of Vík and the districts to the east occurred on October 14 and 15. On

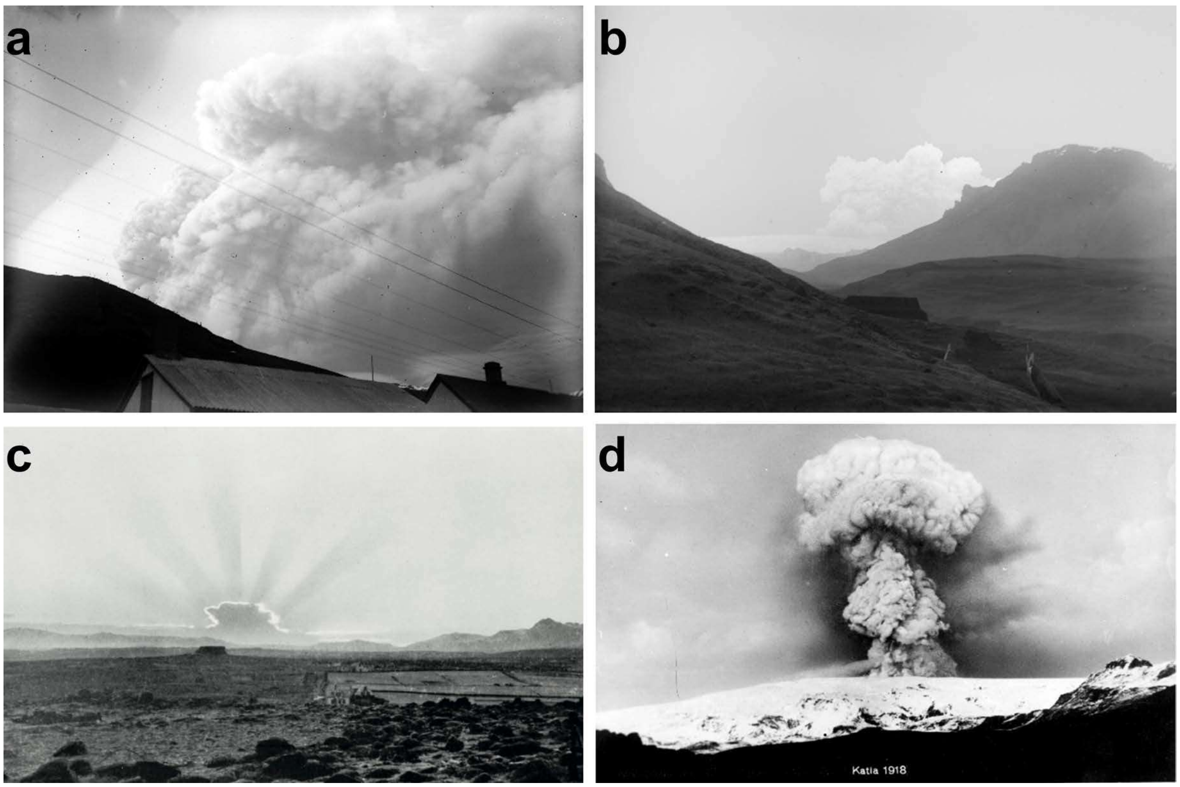
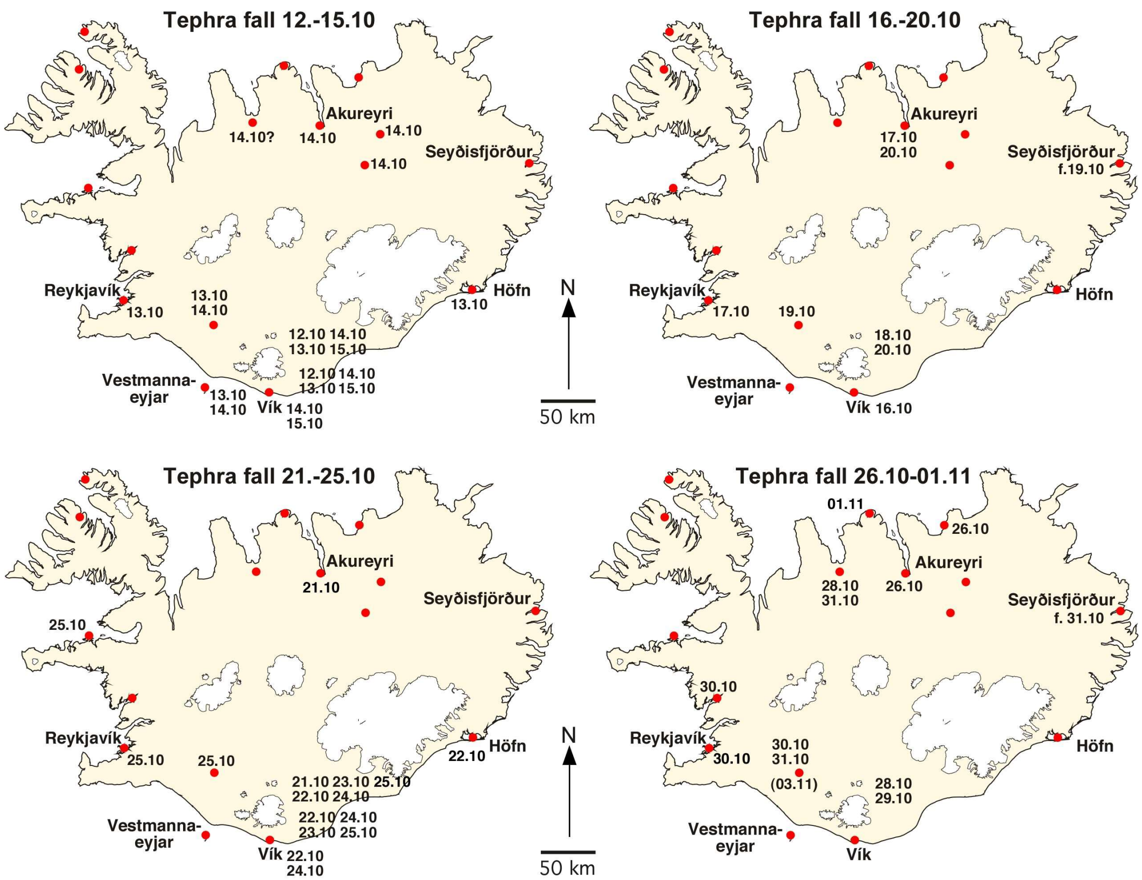


Figure 4. Photos of the Katla 1918 eruption plume. a) This photo is taken from the Vík village, 20 km from the eruption site, with a view towards north. The rim with snow seen between the houses is Hatta, the mountain to the right in (b). The plume apparently rises to about 15 km above sea level (Larsen and Högnadóttir, this issue). The photo is undated, but probably taken on October 12 (Photo: Þorlákur Sverrisson). b) The photo is taken about 1 km north of Vík, most likely on October 20. The plume rises 3–3.5 km above the vents (4–4.5 km a.s.l). (Photo: Þorlákur Sverrisson). c) The 1918 eruption plume seen from Reykjavík. The photo is undated, but cannot be from October 12, as it is taken in the early morning (Photo: Magnús Ólafsson). The plume was seen from Reykjavík on October 15 and 16 (Morgunblaðið, Oct. 16 and 17, 1918) and this photo could be taken on either of these dates. The plume is 7–8 km high (a.s.l.). d) The Katla eruption near its end. The photo was taken about 2.5 km to the north of Vík, on November 2. The plume rises to 7–8 km a.s.l. (Photo: Kjartan Guðmundsson). – *Ljósmyndir af gosmekki í Kötlugosinu 1918. a) Ljósmynd Þorláks Sverrissonar, tekin í Vík í Mýrdal, 20 km frá gosstöðvunum, ódagsett en líklega tekin 12. október. Milli húsanna grillir í efstu fjallsbrúnir Höttu. Gosmökkurinn rís um 15 km y.s. (sjá einnig grein Guðrúnar Larsen og Þórdísar Högnadóttur í þessu hefti). b) Ljósmynd Þorláks Sverrissonar tekin um 1 km norðan við Vík, ódagsett en líklega tekin 20. október. Mökkurinn rís 3–3,5 km yfir gosstöðvarnar (4–4,5 km y.s). c) Gosmökkurinn séður úr Reykjavík, ljósmynd Magnúsar Ólafssonar, ódagsett en tekin að morgni til og er því ekki frá 12. október. Gosmökkurinn er 7–8 km hár (y.s). Hann sást frá Reykjavík 15. og 16. október (Morgunblaðið, 16. og 17. október 1918). d) Kötlugosið undir lokin. Ljósmynd Kjartans Guðmundssonar tekin 2. nóvember 1918. Gosmökkurinn rís 7–8 km y.s.*



Tephra fall days during the 1918 Katla eruption

Figure 5. Some of the localities where tephra fall was reported are shown by red dots. East of Mýrdalsjökull the dates refer to tephra fall in Skaftártunga and Síða districts (upper) and in Álftaver and Meðalland districts (lower). Based on Sveinsson (1919), Jóhannsson (1919), and reports in various newspapers (Ásbjörnsson, 1994). – *Helstu staðir og dagsetningar þar sem gjóskufall var skráð frá 12. október til 1. nóvember (rauðir deplar). Austan Mýrdalsjökuls eru dagsetningar gjóskufalls skráðar saman fyrir Skaftártungu og Síðu (ofar) og fyrir Álftaver og Meðalland (neðar). Heimildir Gísli Sveinsson (1919), Guðgeir Jóhannsson (1919) og frásagnir í fréttablöðum og tímaritum (Samantekt Sigurður Ásbjörnsson, 1994).*

the 16th and 17th the eruption column was reported as a "smoke stack" not rising as fast as earlier, dark/black at the base, light at the top with ash dispersing from midways up the column. A period of weaker activity, with scattered minor tephra fall, followed until October 21 (Sveinsson, 1919; Jóhannsson, 1919).

In the late afternoon on October 21, the eruption gained strength with the lightning and thunder accompanying the eruption plume, similar to what was observed on October 12 (day 1). Tephra fall was reported in Skaftártunga, Síða and the district Fljótshverfi further to the east late that evening and continuing until the morning of the 22nd (Sveinsson, 1919). Around noon on October 22 the plume had become black of ash higher up than ever before. Its source appeared to be somewhat farther east than earlier in the eruption. The wind was blowing from the northwest resulting in some tephra fall in Álftaver (Jóhannsson, 1919) and about 1/2 inch (1.3 cm) in eastern Mýrdalur (Sveinsson, 1919). In Álftaver, tephra fall resumed around midnight and lasted with a short pause until noon on October 23 when the total tephra fall amounted to 5 cm (Jóhannsson, 1919). The wind then shifted and carried the plume across Skaftártunga and Síða. During 5 hours of tephra fall about an inch (2.6 cm) of pumiceous ash was deposited in Skaftártunga (25–35 km from source). Later in the evening and the following night another inch of ash fell on Skaftártunga, bringing the total, from the beginning of the eruption, to 2.5 inches (6.5 cm). The Síða district (40–60 km from source) received less tephra fall, but the ground was covered by ash to such an extent that it prohibited grazing (Sveinsson, 1919; Jóhannsson, 1919).

In the early hours on October 24, the wind was from the northwest and tephra was carried across Álftaver and Meðalland between 4 and 6 AM. In Álftaver the accumulated tephra thickness was now 6–8 cm (Jóhannsson, 1919). This was the last significant tephra fall in these districts. From Vík village the eruption column looked as black as ever and was apparently ascending from two separated "vents". Around 1 PM the wind had become more northerly and carried ash and pumice over Mýrdalur and Vík village (Figure 6a), causing total darkness around 2 PM. Electricity had to be turned off in the village and use of telephones was forbidden due to the threat of lightning (Sveinsson, 1919). Intense tephra fall lasted until 5 PM, when there was a short break. Less intense tephra fall continued until 2 AM on October 25, and had by then lasted for 13 hours (including a one hour break). After three hours of intense tephra fall the tephra thickness was 1–2 cm on level ground and after 13 hours 2–4 cm. Most of this time the darkness in Vík was so complete that windows could not be discerned from solid walls (Jóhannsson, 1919).

On October 25 the wind was southerly. Minor tephra fall was reported in Skaftártunga and Síða in the morning and later that day tephra fell in Reykjavík (Figure 5) for the third time (Morgunblaðið, 26 Oct.). The next day the eruption column was described as mostly composed of steam. During the following 7 days the wind was southerly and the tephra was carried towards the north (Sveinsson, 1919). Tephra fall in the early hours and morning of October 26 was reported from Akureyri and Húsavík in North Iceland (Figure 5), in both areas footprints were traceable on the ground (Morgunblaðið, 27 and 28 Oct.; Dagur, 5 Nov.), which indicates deposition of the order of 300 g/m^2 ($\sim$0.3 mm) of tephra (Thorarinsson, 1955). Tephra fall was reported from the Skagafjörður district on October 28, (Tíminn, 14 Dec.).

On October 30, with the wind blowing from the southeast, tephra fall was reported in areas to the west, in Rangárvallasýsla and Reykjavík (Morgunblaðið, 31 Oct.; Lögrjetta 27 Nov.). During the next two days fallout was reported in northern Iceland; in Skagafjörður and Siglufjörður "the greatest" tephra fall occurred on October 31 and November 1, respectively (Fram, 2 Nov.; Tíminn, 14 Dec.). This was the last verified tephra fall from the Katla 1918 eruption (Figure 5). Re-deposition of wind-blown ash was, however, reported on several occasions during and after the eruption (e.g. Sveinsson, 1919; Jóhannsson, 1919; Lögrjetta 27 Nov.).

The 1918 tephra layer, preservation

The 1918 Katla eruption occurred in late autumn. The tephra fall areas were grasslands and sandur plains in the lowland areas, unvegetated highland areas and ice caps. The preservation potential in the 1918 tephra fall area is therefore generally low.

The Katla 1918 tephra is relatively fine grained and was mostly in the ash size range (<2 mm) outside of the Mýrdalsjökull ice cap (Jónsdóttir, 2015). The contemporary records mention that the tephra deposited during the first days was much finer than the tephra deposited later in the eruption. The records describe syn-and post-depositional erosion after each tephra fall event. They also describe how the tephra was eroded and redeposited by wind and water during the following winter, in some places almost completely obliterated, and later on in springtime, when the ground had become snow-free, how the dry tephra was blown about "On a windy day an ash-storm blew all over the neighbourhood" (Sveinsson, 1919, 38).

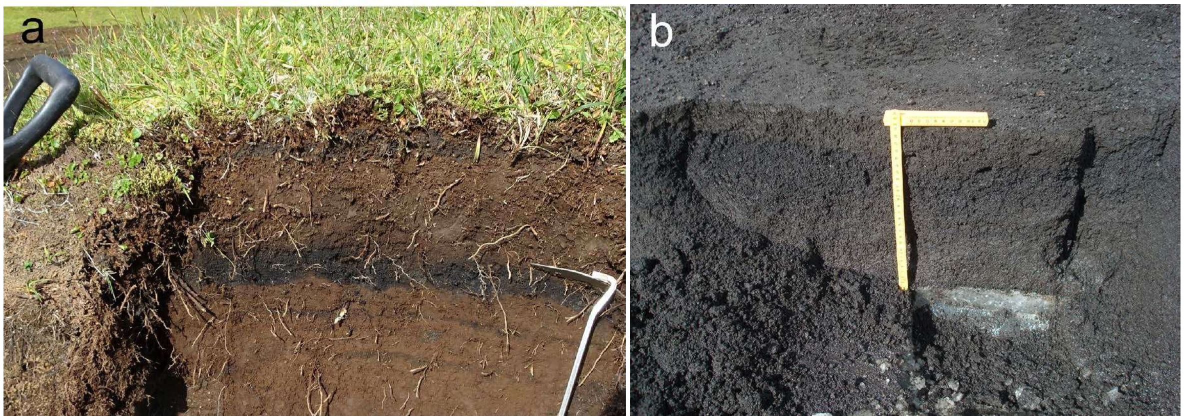


Figure 6. a) The 1918 Katla tephra layer in soil near Gæsavatn, about 10 km north of Vík and 10 km south of the eruption site. It is now 6–8 cm thick, at most. Just below the grass lies the 2010 Eyjafjallajökull tephra layer. Photo:/*Ljósm.* Maria H. Janebo. b) The 1918 Katla tephra recently melted out of the ice at Sléttjökull, northern outlet of Mýrdalsjökull, ice below. The tephra thickness is about 30 cm. Photo:/*Ljósm.* Guðrún Larsen, August 2018. – *Kötlugjóskulagið frá 1918. a) Svört, 6–8 cm þykk Kötlugjóska í jarðvegi við Gæsavatn, um 10 km sunnan gosstöðvanna og 10 km norðan Víkur. Uppundir grasrótinni er grá gjóska frá Eyjafjallajökli 2010. b) Um 30 cm þykk, lagskipt Kötlugjóska á Sléttjökli í norðanverðum Mýrdalsjökli, nýkomin/nýbráðin út úr ís (sést undir gjóskulaginu) í ágúst 2018, tæplega 100 árum eftir að hún féll.*

The thickness of tephra at the present time is 1.5–4 cm in Álftaver where the total or accumulated thickness as freshly fallen was over 2.5 inches or 6–8 cm (Jóhannsson 1919). In Skaftártunga the thickness is now 0.5–6 cm where the total thickness was over 2.5 inches and 3–4 inches (6.5–10 cm) in lows (Sveinsson, 1919). In Vík and vicinity the thickness now measures 0–2 cm but was 2–4 cm after 13 hours of tephra fall. There the thickness was measured during and after the tephra fall, before rain compacted the tephra (Jóhannsson, 1919).

On grassland the thickness of tephra may have been overestimated because accurate measurements on a rough surface can be problematic. However, reports from farmers show that they distinguished between dry, new ash and wet, compacted ash. Although a substantial part of the tephra outside the icecap may have been redeposited and/or lost, the thicknesses measured in the field now do not seem far off in areas where conditions for preservation (vegetated areas except hayfields) were appropriate in 1918, given the compaction by overlying soil.

The Katla 1918 tephra is best preserved within the Mýrdalsjökull ice cap (Gudmundsson *et al.*, this issue). The original thickness ranged from about 10 cm to some 25 m. The tephra was often covered by snow after deposition, at least from October 20 onwards. The tephra is exposed in the lower parts of the ablation areas of all outlet glaciers of Mýrdalsjökull (Figure 6b) and can be accessed as it melts out of the ice (Gudmundsson *et al.*, this issue).

The new isopach map (Gudmundsson *et al.*, this issue), here presented in Figures 7 and 8, was compiled from thickness measurements in over 300 locations from various sources, including new data points on the ice cap. As expected from the contemporary descriptions of changing wind directions and repeated tephra fall, the map shows several thickness axes. The three most distinct axes trend N, NE and SE with minor axes towards the SSE, W and WNW. Very little tephra was carried towards the SSW; the Vestmannaeyjar islands only reported tephra fall on two days throughout the eruption (Figure 5).

Tephra deposited to the NE of Katla caused the most severe damage to the farmlands and summer pastures. The four farms within the present 5 cm isopach line were temporarily or permanently abandoned (Figure 8). The north-axis is the largest, but

Table 1. Comparison of the Katla tephra thickness as reported in 1918 and as measured in the soil 50–100 years later. – *Samanburður á þykkt Kötlugjóskunnar samkvæmt heimildum 1918 og eins og hún mældist í jarðvegi 50–100 árum síðar.*

The 1918 Katla tephra

Districts south and east Mýrdalsjökull	Tephra thickness on surface as reported in 1918	Tephra thickness measured in soil 1970 and later	Comments
Mýrdalur	3.5-4.5 cm	0-2 cm	Calculated from reports (GS, GJ)
Álftaver	6-8 cm	1.5-4 cm	Accumulated tephra as reported (GJ)
Skaftártunga	6.5-10 cm	0.5-6 cm	Accumulated tephra as reported* (GS)
Síða	3.5-4.5 cm	0.5-3 cm	Estimated from reports* (GS, GJ)

*Thickness reported in inches

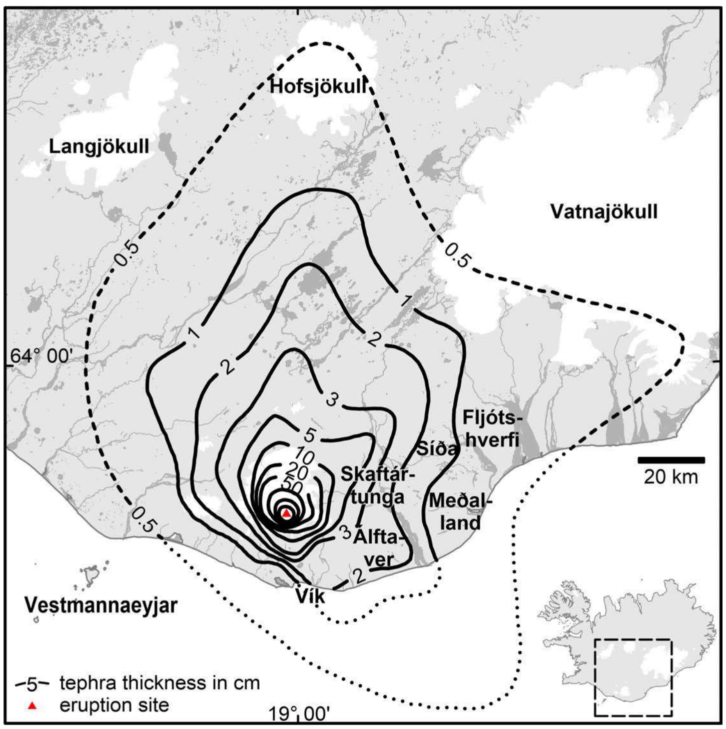


Figure 7. Map of the 1918 Katla tephra layer within the 0.5 cm isopach, as it is currently found in soil and ice (compacted). It has three main sectors, to the SE, NE and N, which correspond reasonably well to contemporary records of the tephra fall. Compiled by M. H. Janebo, G. Larsen, S. Thorarinsson, J. Gudnason, T. Thordarson, M. T. Gudmundsson, T. Jónsdóttir and others. – *Þykktarkort af Kötlugjóskunni frá 1918 eins og hún er í jarðvegi nú. Helstu þykktarásarnir stefna SA, NA og N sem er í samræmi við lýsingar í samtímaheimildum. Byggt á gögnum frá Mariu H. Janebo, Guðrúnu Larsen, Sigurði Þórarinssyni, Jónasi Guðnasyni; Þorvaldi Þórðarsyni, Magnúsi T. Guðmundssyni, Tinnu Jónsdóttur og fleirum.*

tephra carried in that direction was mostly deposited over unpopulated areas. The tephra badly affected trout fishing in the Veiðivötn lakes up to 70 km to the north of Katla (Guðmundsson, 2017), but caused only minor tephra fall in populated areas.

The volume of the tephra is estimated in Gudmundsson *et al.* (this issue) as 0.95±0.25 km^3. Assuming ∼20% compaction since deposition this corresponds to 1.1–1.2 km^3 as freshly fallen tephra.

THE 1918 JÖKULHLAUP ON 12 OCTOBER

All Katla eruptions described in contemporary records have been accompanied by jökulhlaups, floods of meltwater originating at the subglacial eruption sites within the caldera. These jökulhlaups escape subglacially through the deep subglacial pass in the caldera rim on the eastern side (Björnsson *et al.*,

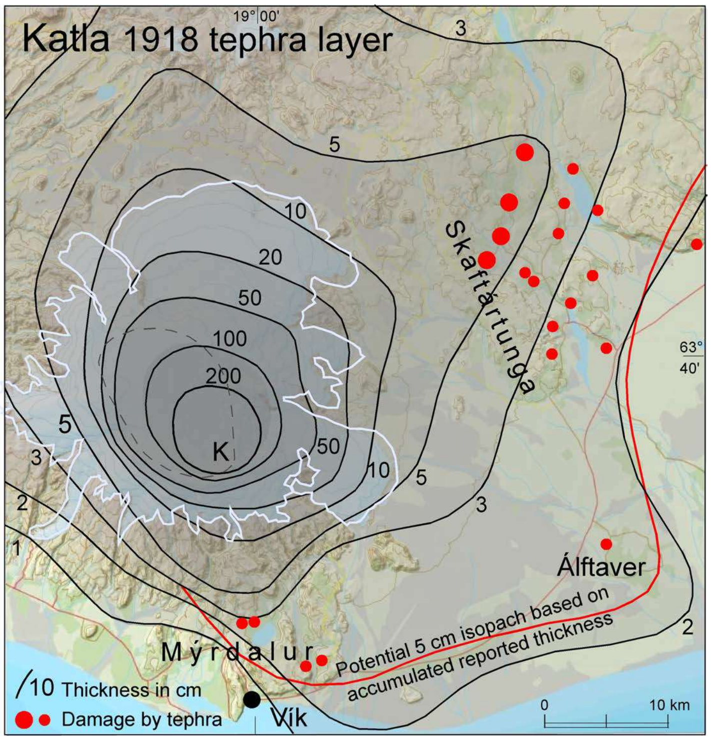


Figure 8. Isopach map of Mýrdalsjökull and its vicinity (blowout from Figure 7). Red dots indicate farms that where seriously damaged by the tephra fall. The larger dots indicate farms that were uninhabitable for >1 year or permanently laid waste, the remaining farms recovered within a year (Sveinsson 1919). For damage by the jökulhlaup see Figure 9. Tephra thickness on the glacier after M. T. Gudmundsson *et al.*, (this issue). – *Þykkasti hluti Kötlugjóskulagsins frá 1918. Rauðir deplar tákna bújarðir sem urðu fyrir tjóni vegna gjóskufallsins 1918, stærri deplarnir tákna jarðir sem fóru í eyði um tíma eða alveg (Gísli Sveinsson, 1919). Sjá 9. mynd um tjón vegna jökulhlaupsins. Gjóskuþykkt á jökli er samkvæmt Magnúsi T. Guðmundssyni o.fl. í þessu hefti.*

2000) and down the Kötlujökull outlet glacier. The jökulhlaups follow the route of the glacier down to the Mýrdalssandur flood plain. The 1918 Katla eruption was accompanied by a large jökulhlaup onto Mýrdalssandur with an estimated 300.000 m^3/s peak discharge of meltwater, suspended sediment and ice (Tómasson, 1996).

The flood routes and the course of events during the floods on October 12 will be briefly described below. The compilation is based on Sveinsson (1919), Jóhannsson (1919), Karlsson (1994), Tómasson (1996) and several others. Aerial photographs from 1945 and 1946 were also consulted.

First phase

The first of the two phases of the jökulhlaup on October 12 flooded a large area (Figure 9). It can be divided into three forks: The southern fork, which advanced on the western part of Mýrdalssandur, down Múlakvísl and Sandvatn rivers: the northern fork, which flowed down Leirá into Hólmsá, Skálm and Kúðafljót rivers; and a small middle fork that flowed onto Mýrdalssandur north of Hafursey.

Southern fork: At about the same time as the eruption plume was noticed ($\sim$3 PM) a large flood was seen advancing towards the south across the Mýrdalssandur plain (Figure 9), following the bed of the Múlakvísl river and that of the Sandvatn river (Jóhannsson, 1919; Sveinsson, 1919). From Vík, a wave of brown floodwater carrying large icebergs was seen flowing along the Múlakvísl river into the sea, forming a spit of sediment and ice. At Hjörleifshöfði hill (a former headland) on Mýrdalssandur, the noise from the floodwater was noticed shortly before 3:30 PM to the east of the hill. By then the flood had filled the bed of the Sandvatn river and soon afterwards the flood had surrounded the hill and reached the sea (Jóhannsson, 1919), 15–20 km from the edge of Kötlujökull. The flood was very turbulent and covered by large and small icebergs and blocks except where the currents were strong. Many icebergs had stranded on the sandur, other were carried into the sea. This first phase lasted for 2–3 hours.

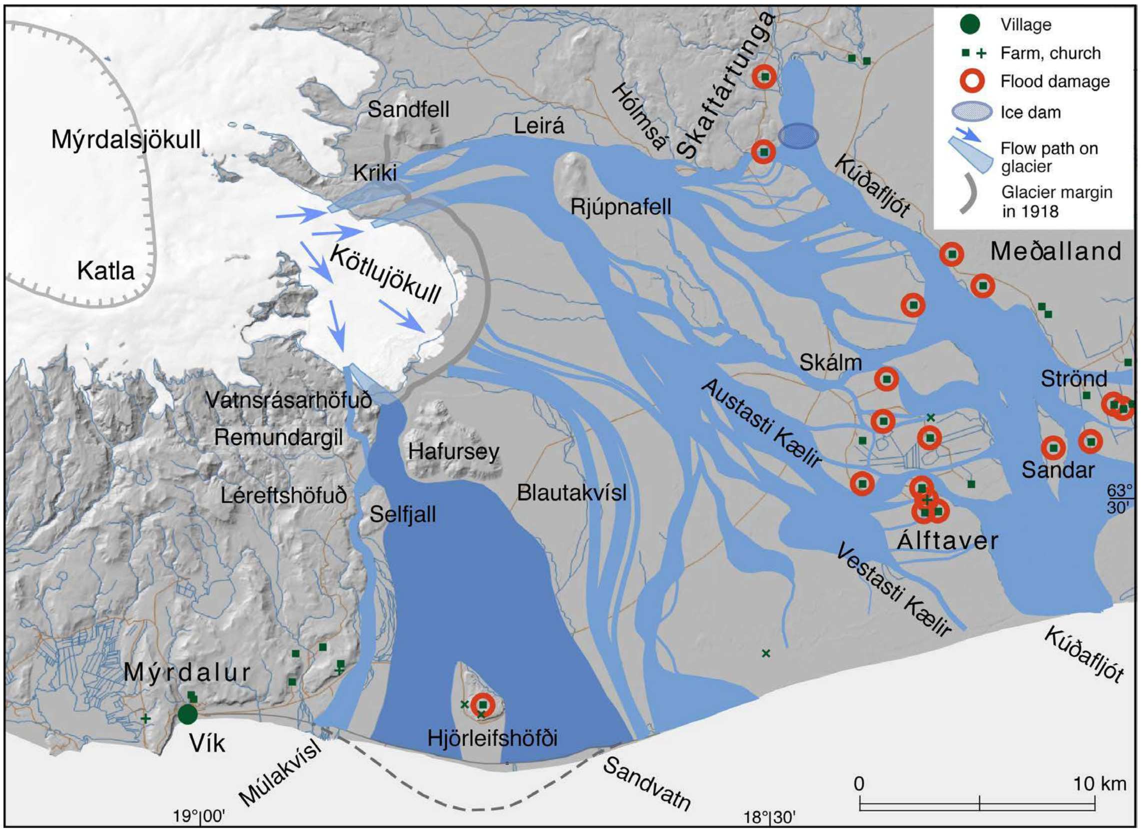


Figure 9. The jökulhlaup routes (blue) on October 12, 1918. The darker shade indicates areas flooded in both phases. The meltwater of the first phase covered a much larger area than that of the second phase, which was mostly confined to the western part of Mýrdalssandur. The second phase carried much more ice and probably more sediment. Most of the damage to property (Sveinsson 1919) was caused by the first phase. Jökulhlaup routes are based on eyewitness descriptions (see main text) and aerial photographs from 1945 and 1946 (Landmælingar Íslands). Base map topography is based on ArcticDEM (Porter *et al.*, 2018) and glacier topography on Lidar data (Jóhannesson *et al.*, 2013). – *Leiðir jökulhlaupsins (blátt) 12. október 1918. Hlaupið skiptist í tvo þætti, dekkri liturinn sýnir svæði sem hlaupið fór um í báðum þáttum. Í fyrri þætti hlaupsins fór bræðsluvatn um miklu stærra svæði en í þeim síðari sem var að mestu takmarkaður við vesturhluta Mýrdalssands en flutti með sér miklu meiri ís og gosefni. Mest tjón varð í fyrri þætti hlaupsins (Sveinsson 1919). Hlaupleiðir eru samkvæmt lýsingum sjónarvotta (sjá megintexta) og loftmyndum frá 1945 og 1946. Landslag skv. ArcticDEM nema jökulyfirborð sem er skv Lidar mælingum (Porter o.fl., 2018; Tómas Jóhannesson o.fl., 2013).*

Northern fork: Another arm of the jökulhlaup flowed towards east into the rivers Leirá, Hólmsá, Skálm, Kælirar and Kúðafljót. Noise from this flood could be heard 1.5–2 hours before it was seen. About 15 km east of the edge of Kötlujökull a group of farmers from Álftaver was waiting at a sheep pen on the north bank of the Skálm river for their farm hands that were herding sheep to the pen. Between 1 and 1:30 PM the farmers noticed an unusual humming sound coming from the west. The sound gradually grew louder and around 3 PM the youngsters in the group were sent home for safety's sake. Shortly afterwards it became clear that a jökulhlaup was approaching along the Skálm river. The remaining farmers hastened across the river as a greyish-black wave of flood water, 2–3 m high, was closing in "about 10 minutes away" from the ford (Jóhannsson, 1919). Although the herding farm hands made a narrow escape, no human lives were lost and all reached safety (Jóhannsson, 1919; Gísladóttir *et al.*, this issue).

The branch that came down Hólmsá swiftly removed the bridge in the canyon, around 3 PM (Jóhannsson, 1919). It advanced down Kúðafljót and reached the farm Sandar in Meðalland not later than 5 PM, where the farmer's family made a narrow escape. The water in Kúðafljót continued to rise and by 8 PM the flood had reached the homefields of Strönd in Meðalland, not receding until 10 PM and leaving 2–3 m thick heaps of ice on its banks (Jóhannsson, 1919).

The northern fork flooded large areas in the districts of Álftaver and Meðalland (Figure 9). In Álftaver the flood water entered local rivers and brooks and left up to 4 m thick heaps of ice and sludge on their banks (Jóhannsson, 1919).

An excursion to the outlet of the 1918 jökulhlaup at the southern tip of Kötlujökull (Jóhannsson, 1919) found that the first phase of the jökulhlaup had travelled on the surface of Kötlujökull and part of it had overtopped the adjacent hills into the gully Remundargil (Figure 9). Flooding over the surface of the northern part of Kötlujökull was also confirmed (Sveinsson, 1919).

Second phase of the jökulhlaup on October 12

A much larger flood was seen from Hjörleifshöfði on Mýrdalssandur around 5 PM as it pushed through the 1.5 km wide gap between Selfjall and Hafursey (Figure 9). It carried huge amounts of ice, flooded the area around Hjörleifshöfði and continued into the sea (Jóhannsson, 1919). The farmer in Hjörleifshöfði described it as if "snow-covered hills" were rushing over the sandur plain. The width of the flood on the east side of Hjörleifshöfði was about 5 km (extending to the east of Lambajökull hill) and about 3 km on the west side. The flood lasted into the evening, but receded during the following night.

From Vík it was noticed that the flood in Múlakvísl had receded around 5:30 PM (by then Múlakvísl river had been blocked at Selfjall by ice carried by the jökulhlaup), but at the same time a much larger flood had reached Hjörleifshöfði, carrying huge icebergs (Jóhannsson, 1919). The flood formed a large spit of sediment and ice blocks into previously navigable waters. Offshore, the icebergs formed a large pack of ice slowly moving towards the west.

The "main flood" broke up the edge of the glacier and created an ice canyon. Members of an excursion dispatched by the sheriff at Vík estimated this canyon to be 1300–1700 m long and 300–500 m wide with ice walls up to 130 m high (Sveinsson, 1919). This second phase of the jökulhlaup was confined to the western part of Mýrdalssandur and did not reach Álftaver or Meðalland.

The flow front of the jökulhlaup apparently advanced the 9 or 10 km from Hafursey to Hjörleifshöfði in about 30 minutes, a velocity of 20 km/hour ($\sim$6 m/s).

Flooding on Mýrdalssandur 14–28 October

On the morning of October 13, the jökulhlaup was over and had left large icebergs on the sandur plain (Figure 10), from "20 m to 60 m high" (Loftsson, 1930). The coast had advanced and a second spit had formed from the flood deposits, with numerous stranded icebergs.

The flood resumed on October 14, forming channels with fast flowing waters that buried or carried off icebergs left on the sandur in the first two days (Jóhannsson, 1919). During the following day the water flow had decreased and bars had appeared between the channels, some of which appeared quite deep. The next four days saw similar conditions where the water flow decreased and increased again. On October 20 the flood was smaller than before and continued to decrease until October 26, when the sandur plain was more or less dry (Jóhannsson, 1919). The last flood occurred on October 28. About three weeks after the eruption was over, on November 26, a substan-

Figure 10. a) Jökulhlaup deposits on the upper part of Mýrdalssandur, north of Selfjall and Léreftshöfuð. Photo taken sometime between October 16 and 19, 1918. Vatnsrásarhöfuð hill at upper left, Kötlujökull black with ash upper middle, Kurl (cone shaped hill) and Hafursey at upper right. The photo was taken from Léreftshöfuð looking NNE. Huge icebergs and thick sediments have piled up in front of Léreftshöfuð and Selfjall, now breached by the Múlakvísl river that flows towards the viewer. Much more water follows the main flood route closer to Hafursey. Photo Þorlákur Sverrisson. – *Jakahrannir og setbunkar á efri hluta Mýrdalssands, norðan Selfjalls og Léreftshöfuðs. a) Ljósmynd Þorláks Sverrissonar, ódagsett en vafalítið tekin milli 16. og 19. október 1918. Vatnsrásarhöfuð er ofarlega til vinstri, Kötlujökull svartur af ösku fyrir miðju, Kurl (topplaga hæð) og Hafursey til hægri. Allmikið vatn er enn á sandinum, mest í farvegi meginhlaupsins næst Hafursey en Múlakvísl hefur grafið sér leið gegn um hrönnina og rennur í átt til ljósmyndara.*

tial flood removed some of the new guide posts along the path that had been marked across Mýrdalssandur after the eruption (Sveinsson 1919).

Enormous heaps of ice and sediments had been left on the Mýrdalssandur plain, in particular on its upper part (Figure 10a and b) and remained there for months. On the lower part of the sandur the flood had cleaned the ice from the channels, leaving bars studded with ice in between. These bars, with pockets left by melted ice blocks (Figure 11), were visible until the sandur was revegetated.

The 1918 jökulhlaup extended the shoreline temporally up to 4 km beyond the 1904 shoreline (Jóhannsson 1919) and raised the surface of the sandur deposit by 5–10 m locally (Gudmundsson *et al.*, 2018).

SOME REFLECTIONS ON THE 1918 KATLA ERUPTION AND THE JÖKULHLAUP

The contemporary descriptions of the 1918 Katla eruption contain much greater detail than could be included in this paper. Frequent changes in direction and strength of the wind resulted in rather complicated tephra dispersal, as evidenced by the isopach map. Photographs taken during the eruption allow estimates of the plume height at the time of photography and a better location of the source vents (Larsen and Högnadóttir, this issue). Measurements of the tephra layer within the Mýrdalsjökull ice cap provide a new, previously unused data set (Gudmundsson *et al.*, this issue). These papers should be regarded as steps in deciphering the details of the 1918 Katla eruption.

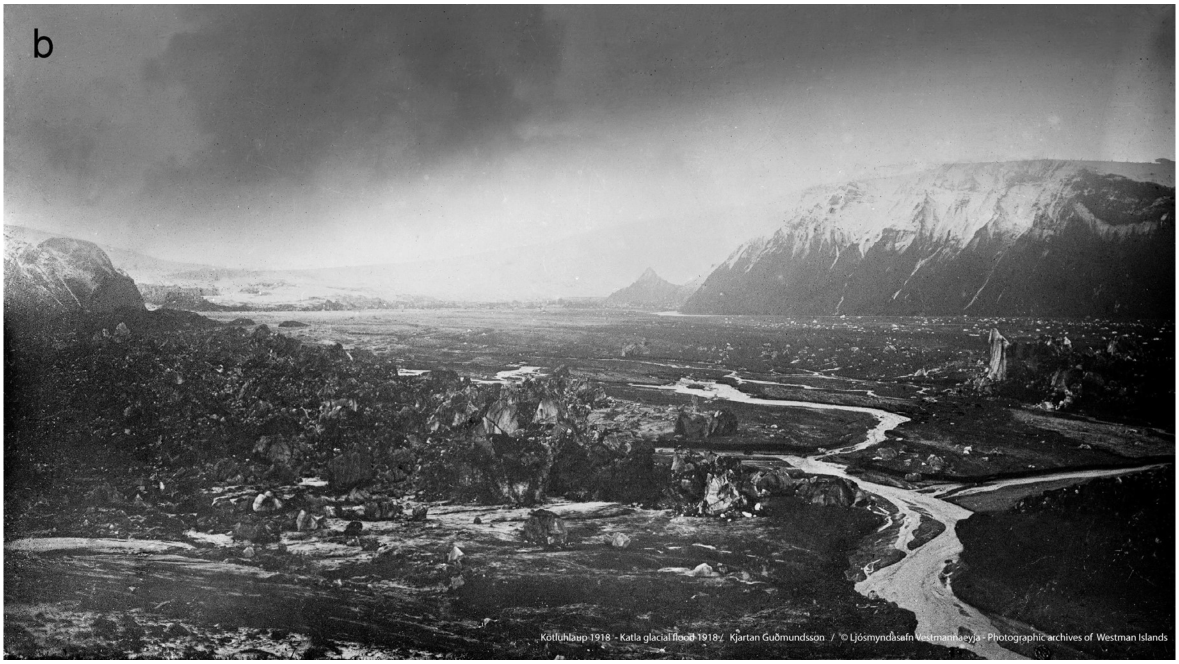
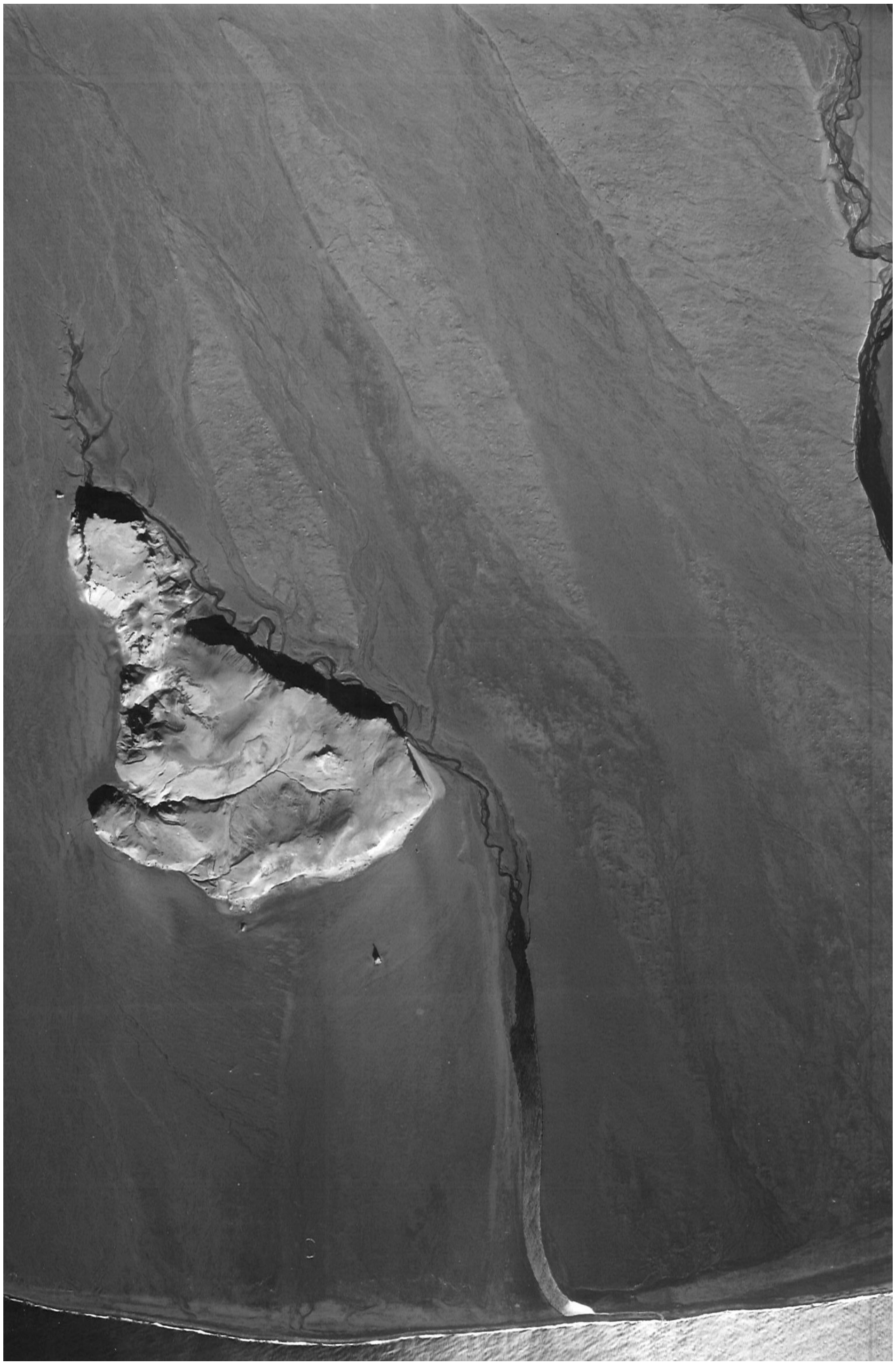


Figure 10. b) Photo of the same area as Figure 10a, taken about a month later, during a trip on November 17, 1918. The hills and Kötlujökull are now partly snow-covered. Múlakvísl river has receded and the main flood route is dry. A large amount of sediment has been removed by Múlakvísl, revealing the true size of the icebergs. The largest one towers at least 45 m above the sandur plain. Photo Kjartan Guðmundsson. The top of the largest iceberg on b) can also be seen sticking out of the sediment on a). – *b) Ljósmynd Kjartans Guðmundssonar af sama svæði og er á mynd 10a, dagsett 17. nóvember 1918. Kötlujökull og hæðarkollar eru hvítir af snjó. Rennsli í Múlakvísl hefur minnkað mikið og ekkert vatn sést í farveginum við Hafursey. Múlakvísl hefur grafið hlaupsetið frá jakahrönninni svo raunveruleg stærð ísjakanna kemur í ljós. Stóri upprétti jakinn til hægri rís a.m.k. 45 m yfir sandinn. Aðeins efsti hluti hans stendur upp úr hrönninni á mynd a).*

Tephra fall was reported somewhere in Iceland almost every day from October 12 to November 1, most often to the northeast of Katla, in Skaftártunga and Síða, or on 12 out of the 20 days of recorded tephra fall. In Álftaver and Meðalland, east-southeast of Katla, eight days of tephra fall were recorded. Areas to the south, west and north experienced tephra fall on five days or less. The tephra fall during the 1918 Katla eruption produced the most voluminous tephra layer of the 20th century in Iceland (Gudmundsson *et al.*, this issue). The area within the 0.5 cm isopach is considered to be about 20,000 km^2 and it is likely that traces of tephra were carried over most of Iceland although no reports exist from the extreme west and northeast. Outside the Mýrdalsjökull glacier the 1918 Katla tephra layer is mostly in the ash size range (grains $\leq$2 mm), which is in accordance with eyewitness descriptions of the tephra fall (Jóhannsson, 1919; Sveinsson, 1919). Bedding is not prominent (Figure 6a), which may in part be due to remobilization, as described in the contemporary records (Jóhannsson 1919; Sveinsson 1919). However, tephra deposited within the accumulation area of Mýrdalsjökull is buried by snow and preserved intact until it reappears on the ablation area. This tephra is in the ash and lapilli size range with distinct bedding preserved (Figure 6b).



The timing of events is given in this paper as reported in the contemporary sources, except where the old division into one-eight (Icelandic eykt) of the solar day was used, then the time is given as PM or AM as appropriate. The term "miðmundi" refers to 1:30 PM, which is the time when the humming sound of the jökulhlaup was heard by farmers some 15 km east of Kötlujökull. This implies that the jökulhlaup had broken up through the glacier at about 1:30 PM and was flowing on its surface.

The course of events in the 1918 jökulhlaup can be summarized as follows (Jóhannsson 1919; Sveinsson 1919; Karlsson 1994; Tómasson 1996): In the first phase of the jökulhlaup, the meltwater broke through the ice of the Kötlujökull glacier, probably several kilometers above its snout and flowed subaerially/supraglacially down the glacier in three forks (Figure 9). The second phase began when the meltwater had created a subglacial channel below the western part of Kötlujökull and broke out from under the southwest corner of the glacier, breaking up the glacier snout and carrying huge icebergs onto Mýrdalssandur and into the sea. The previous channels became inactive and all meltwater was confined to this channel from then onwards (Figure 9).

The 1918 Katla jökulhlaup is the largest such event observed in the 20th century in Iceland, with a peak discharge estimated at about 300,000 m^3/s (Tómasson 1996). Comparison with descriptions of earlier jökulhlaups and the size of the areas that they affected (Larsen, 2018), classifies the 1918 event together with 1755 and 1625 CE as the largest three jökulhlaups known to have accompanied Katla eruptions.

It is beyond the scope of the present paper to make a full account of Katla 1918 eruption. Besides the large tephra layer, juvenile pyroclasts formed subglacially on the first day of the eruption may have had a similar volume (Tómasson, 1996; Larsen, 2018; Gudmundsson *et al.*, 2018). The total volume of fragmented material (tephra, water-transported pyroclasts) may therefore have been in the range of 2 km^3, equivalent to 0.5–0.9 km^3 DRE (Dry Rock Equivalent).

SUMMARY AND CONCLUSIONS

The explosive basaltic 1918 Katla eruption lasted 23 days, beginning on October 12 and ending on November 4. The eruption produced 0.9–1.0 km^3 of airfall tephra, corresponding to 1.1–1.2 km^3 of freshly fallen tephra. Two phases of intense activity, with a lull in between, occurred on eruption days 1–3 and 11–13. The highest reliably estimated eruption column height was 14.3 km a.s.l. on day 1.

The most intense tephra fall in the vicinity of Mýrdalsjökull occurred on October 12–14 (days 1–3) and October 22–24 (days 11–13). The longest consequent tephra fall lasted for 13 hours, depositing up to 4 cm of ash, on October 24–25 (days 13–14).

Two separate eruption columns were observed on October 20. The location of the most active vent(s) had apparently shifted, implying that a new fissure or new source vents had opened up, which then fed the second intense phase.

Figure 11. Aerial photograph of a 6 km wide part of the Mýrdalssandur plain from Hjörleifshöfði hill (middle left) to the Blautakvísl river (right). Note the channels (dark grey) and bars (lighter grey) between Hjörleifshöfði and Blautakvísl. The surface of the bars still shows pockets where stranded ice bergs melted and furrows left by the jökulhlaups of the first days. The channels that were cleared of ice by the flood water, as described by Kjartan L. Markússon, were modified in the years to come by the Sandvatn river but the bars were at least partly preserved. ©Landmælingar Íslands 1975. – *Loftmynd sem sýnir um 6 km breiða spildu á neðanverðum Mýrdalssandi, frá Hjörleifshöfða að Blautukvísl með farvegum (dekkri) og eyrum (ljósari). Yfirborð eyranna er eins og jökulhlaupið skildi við þær í október 1918. Það er mishæðótt með bollum eftir jaka og vatnsrásum með annarri stefnu en farvegirnir. Eftir fyrsta gosdaginn mynduðust straumálar þar sem jökum var skolað burt eða þeir grafnir niður, skv. lýsingu Kjartans L. Markússonar. Næstu árin eftir 1918 rann Sandvatnið austan Hjörleifshöfða og farvegirnir sem hér sjást hafa vafalaust breyst við það en eyrarnar hafa varðveist að hluta. ©Landmælingar Íslands 1975.*

Tephra fall was most frequently observed in the areas east of Mýrdalsjökull, reported on 12 days out of the 23 days the eruption lasted. There the reported thickness of freshly fallen tephra some 30 km from the source was 6.5–10 cm and after redeposition tens of cm in topographic lows.

The jökulhlaup on day 1 consisted of two separate phases. The first phase broke through Kötlujökull glacier and flowed supraglacially in three forks, covering a much larger area outside the glacier than the second phase. In the second phase, the meltwater had created a subglacial flood route with a single outlet at the southwest corner of the glacier, breaking masses of ice from the snout.

Acknowledgements

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ÁGRIP

Kötlugosið 1918 hófst 12. október og síðast sást til reyks í Mýrdalsjökli 4. nóvember. Stóð gosið því yfir í 23 daga. Kötlugjóskan féll víða um land frá 12. október til 1. nóvember og segja má að flesta dagana meðan gosið stóð hafi hennar orðið einhversstaðar vart. Í nærsveitum féll gjóska fyrstu 4–5 gosdagana en varð þó hvergi þykkari en hálfur þumlungur eða 1,3 cm. Mesta gjóskufallið í byggðum var dagana 22. til 25. október, á 11.–14. gosdegi. Skaftártunga varð verst úti í gosinu og varð þykkt gjóskunnar "alls fyllilega 2,5 þumlungar og í lautum 3–4 þumlungar" (Gísli Sveinsson, 1919) eða 6,5–10 cm, en miklu þykkari þar sem hún safnaðist í skafla. Ein jörð, Svartinúpur, fór alveg í eyði og þrjár um tíma. Mesta gjóskufallið í Vík stóð meira og minna í 13 klukkustundir 24. til 25. október en jafnfallin aska og vikur var þá orðin 2–4 cm. Gjóska barst til Hornafjarðar og Reykjavíkur á öðrum gosdegi, 13. október. Í Reykjavík var magnið um 40 grömm á fermetra þennan dag og þykktin aðeins brot úr millimetra en gjóskufalls varð vart fjórum sinnum í Reykjavík meðan á gosinu stóð. Á þriðja gosdegi féll gjóska á Norðurlandi og síðar náði gjóskufall bæði til Austurlands og Vesturlands.

Kötlugjóskan er illa varðveitt í jarðvegi enda nefna heimildir að strax um haustið hafi hún fokið og skolast burt í rigningum. Í ísnum í Mýrdalsjökli, þar sem hún huldist fljótlega snjó, er hún nokkuð vel varðveitt og kemur nú fram sem kolsvört rönd á skriðjöklum hans. Búið er að kortleggja gjóskulagið utan jökuls og meta þykktir í jökli. Lágmarksrúmtak eins og það er í jarðvegi og ís nú er um 0,9–1,0 km^3 en það samsvarar um 1,1–1,2 km^3 af nýfallinni gjósku.

Jökulhlaupinu á fyrsta degi Kötlugossins 1918 má skipta í tvo fasa. Í fyrstu braust hlaupvatn út úr Kötlujökli ofan jökulsporðsins og rann ofan á ísnum niður á Mýrdalssand í tveimur meginálum og einum minni. Hlaupvatnið náði niður að Hjörleifshöfða og að Álftaveri á tímabilinu kl. 15–15:30. Vestasta álman fór niður Mýrdalssand vestanverðan um farvegi Múlakvíslar og Sandvatns. Austasta álman kom fram í Krika og rann um farvegi Leirár og Skálmar í Kúðafljót en einnig um Kælira og Landbrotsá niður í Álftaver. Þriðja álman var lítil en rann fram miðjan sandinn, norðan Hafurseyjar. Tjón á jörðum varð mest í þessum fasa hlaupsins. Í seinni fasa jökulhlaupsins braust hlaupvatnið undan sporði Kötlujökuls nokkru á eftir fyrsta hlaupinu og kom eingöngu fram á vestanverðum Mýrdalssandi. Í honum barst óhemju magn af ís og seti fram á sandinn og til sjávar. Jökulhlaupið færði ströndina fram og myndaði tanga, Kötlutanga, sem náði í fyrstu allt að 4 km út fyrir strandlínuna frá 1904.

REFERENCES

Ásbjörnsson, S. 1994. *Heimildakönnun á gosmenjum frá Kötlugosinu 1918: Jökulhlaupin og áhrif þeirra.* Greinargerð til Nýsköpunarsjóðs námsmanna ásamt fylgiskjölum. Jarð- og landfræðiskor Háskóla Íslands, Reykjavík.

Björnsson, H., F. Pálsson and M. T. Gudmundsson 2000. Surface and bedrock topography of Mýrdalsjökull ice cap, Iceland: The Katla caldera, eruption sites and routes of Jökulhlaups. *Jökull* 49, 29–46.

Dagur, November 5, 1918.

Eggertsson, S. 1919. Ýmislegt smávegis viðvíkjandi Kötlugosinu 1918 (Some points about the Katla 1918 eruption). *Eimreiðin* 1919, 212–222.

Einarsson, P. 2018. Historical accounts of pre-eruption seismicity of Katla, Hekla, Öræfajökull and other volcanoes in Iceland. *Jökull* 69, 35–52.

Fram, November 2, 1918.

Galeczka, I., E. H. Oelkers and S. R. Gíslason 2014. The chemistry and element fluxes of the July 2011 Múlakvísl and Kaldakvísl glacial floods, Iceland. *J. Volc. Geoth. Res.* 273, 41–57.

Gísladóttir, G., D. Bird and E. Pagneux 2021. What can we learn from previous generations? Álftaver's experience of the 1918 Katla eruption. *Jökull* 71, 71–90.

Guðmundsson, G. 2017. *Veiðivötn á Landmannaafrétti II.* Bókhlaða G. Guðmundssonar, Laugalandi, Rangárþingi ytra.

Gudmundsson, M. T., G. Larsen, Á. Höskuldsson and Á. G. Gylfason 2008. Volcanic hazard in Iceland. *Jökull* 58, 251–268.

Gudmundsson, M. T., G. Larsen, Th. Högnadóttir and M. H. Janebo 2018. *Þar brunuðu fram heilar heiðar snævi þaktar: Ísbráðnun í gosinu 1918, tengsl hlaups og goss og eðliseiginleikar stórra Kötlugosa.* Kötluráðstefna. Vík í Mýrdal, 12.–13. okt. 2018, abstract volume, 57–59.

Gudmundsson, M. T., M. H. Janebo, G. Larsen, Th. Högnadóttir, J. Gudnason and T. Jónsdóttir 2021. The explosive basaltic Katla eruption in 1918, south Iceland II. *Jökull* 71, 21–38.

Jóhannsson, G. 1919. *Kötlugosid 1918.* Bókaverslun Ársæls Árnasonar, Reykjavík, 72 pp.

Jónsdóttir, T. 2015. *Grain size distribution and characteristics of the tephra from the AD 871±2 Vatnaöldur and Katla 1918 eruptions, Iceland.* M.Sc. Thesis, Univ. of Iceland, Reykjavík, 142 pp.

Karlsson, Þ. 1994. *Kötluhlaup 1918 – vangaveltur um eðli hlaupsins og hámarksrennsli (The Katla jökulhlaup in 1918 – some thoughts about properties and maximum discharge).* Kötlustefna 26. febrúar 1994, Jarðfræðafélag Íslands, 10–12.

Landmælingar Íslands. AMS aerial photographs 1945 (13/1206/II/1 – 87/1206/II/1) and 1946 (017 10005/2-1 - 049 10005/2-1).

Landmælingar Íslands 1975. Aerial photograph 8797, 13.09.1975

Larsen, G. 2000. Holocene eruptions within the Katla volcanic system, south Iceland: Characteristics and environmental impact. *Jökull* 49, 1–28.

Larsen, G. 2002. A brief overview of eruptions from ice-covered and ice-capped volcanic systems in Iceland during the past 11 centuries: frequency, periodicity and implications. In: *Volcano-Ice Interactions on Earth and Mars* (eds.). Smellie, J. L. and M. G. Chapman, Geological Society, London, Special Publ. 202, 81–90.

Larsen, G. 2018. *Jökulhlaup til austurs og suðurs frá Mýrdalsjökli I. Kötluhlaup eftir 1600: Umfang, hlaupleiðir, tjón og umhverfisbreytingar.* Research Report RH-13-2018, Science Institute, University of Iceland.

Larsen, G. and Þ. Högnadóttir 2021. Ljósmyndir Þorláks Sverrissonar í Vík: Kötlugosið 1918 í nýju ljósi. *Jökull* 71, 95–114.

Loftsson, M. 1930. *Rit um jarðelda á Íslandi* (Earth fires in Iceland), 2. edition. Published by Skúli Markússon, Ísafoldarprentsmiðja H.F., Reykjavík.

Lögrjetta, November 27, 1918.

Morgunblaðið, October 16, 17, 18, 26, 27, 28, 31, 1918.

Óladóttir, B. A., G. Larsen, T. Thordarson and O. Sigmarsson 2005. The Katla volcano S-Iceland: Holocene tephra stratigraphy and eruption frequency. *Jökull* 55, 53–74.

Óladóttir, B. A., O. Sigmarsson, G., Larsen and T. Thordarson 2008. Katla volcano, Iceland: Magma composition, dynamics and eruption frequency as recorded by tephra layers. *Bull. Volcanology* 70, 475–493. www.doi.org/10.1007/s00445-007-0150-5

Porter, C., P. Morin, I. Howat, M.-J. Noh, B. Bates, K. Peterman, S. Keesey, M. Schlenk, J. Gardiner, K. Tomko, M. Willis, C. Kelleher, M. Cloutier, E. Husby, S. Foga, H. Nakamura, M. Platson, M. Wethington, C. Williamson, G. Bauer, J. Enos, G. Arnold, W. Kramer, P. Becker, A. Doshi, C. D'Souza, P. Cummens, F. Laurier and M. Bojesen 2018. "*ArcticDEM*", https://doi.org/10.7910/DVN/OHHUKH, Harvard Dataverse, V1.

Russell, A. J., F. Tweed, M. J. Roberts, T. J. Harris, M. T. Gudmundsson, O. Knudsen and P. M. Marren 2010.

An unusual jökulhlaup resulting from subglacial volcanism, Sólheimajökull, Iceland. *Quaternary Science Rev.* 29, 1363–1381.

Skeggi, October 12, 18, 1918.

Sveinsson, G. 1919. *Kötlugosid 1918 og afleiðingar þess* (The Katla eruption of 1918 and its consequences). Prentsmidjan Gutenberg, Reykjavík, 61 pp.

Thorarinsson, S. 1955. Öskufall svo sporrækt var og Kötlugosið 1721. (Ashfall so that footprints were traceable and the eruption of Katla in 1721). *Náttúrufræðingurinn* 25, 87–98.

Thorarinsson, S. 1975. Katla og annáll Kötlugosa (Katla and its historical eruptions). *Árbók Ferðafélags Íslands* 1975, 125–149.

Thordarson, T. and G. Larsen, G. 2007. Volcanism in Iceland in historical time, Volcano types, eruptions styles and eruptive history. *J. Geodynamics* 43, 118–152

Thordarson, T. and Á. Höskuldsson 2008. Postglacial volcanism in Iceland. *Jökull* 58, 197–228.

Tíminn, December 14, 1918.

Tómasson H. 1996. The Jökulhlaup from Katla in 1918. *Ann. Glaciology* 22, 249–254.