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Tephra layer formed in the 1996 eruption of Gjalp, Iceland

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Gjalp is a hyaloclastite ridge situated beneath the western part of the ~8000 km² Vatnajökull ice cap, located midway between the subglacial calderas of Grímsvötn and Bárðabunga volcanoes. The tephra erupted at Gjalp has affinities fitting with the Grímsvötn volcanic system while the associated seismicity and unrest preceding the eruption suggest that the eruption was caused by lateral magma flow from Bárðabunga. Eruptions occurred at Gjalp in 1938 and 1996 but only the 1996 eruption is thought to have broken through the ice. The 1996 eruption was first detected on the 30th of September at about 22:00 GMT by the onset of seismic tremor; the following day heavily crevassed ice cauldrons were noticed. Around 30 hours after detection of the tremor the eruption broke through the ice sheet. The eruption lasted for 13 days, during which a 6-7 km long subglacial, hyaloclastite ridge was formed. The subglacial eruption melted large volumes of ice that accumulated within the Grímsvötn caldera until early November, when it was released in a major jökulhlaup, destroying bridges and damaging roads. In comparison with the subglacial eruption the subaerial part was relatively modest. The style of activity was mostly Surtseyan and the tephra erupted is mildly intermediate in composition.

The tephra fall began on October 2 and continued intermittently until October 13. The first tephra was seen at 05:18 on October 2. By 08:50 the largest explosions threw tephra about 1 km above the ice surface and the plume rose to 4-4.5 km above sea level. This tephra was carried north and north-northeast across North and Central Iceland and was detected as far as 250 km from source. On October 3 the plume was reported to have reached 8-9 km a.s.l. Tephra was also dispersed to the east and south and most of the tephra accumulated on the Vatnajökull glacier. During the eruption, repeated snow fall caused layering within the tephra deposit. In the following year samples were collected from the tephra fall area on the glacier. These consist mostly of snow cores with tephra thickness ranging from dm to mm. The samples were processed to estimate the tephra volume and to create a dispersal and isopach map. The tephra layer deposited on the glacier is volumetrically only a few percent of the bulk volume (~0.7 km³) of the subglacial ridge formed in the 1996 eruption.