



## **The widespread ~10ka Saksunarvatn Tephra: A Product of three large Basaltic Phreatoplinian Eruptions?**

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The Saksunarvatn tephra is a remarkably widespread tholeiitic layer from the subglacial Grímsvötn volcano in South-Central Iceland. Its deposition took place during the last glacial to interglacial transition, about 10200 years ago ( $\sim 9000$   $^{14}\text{C}$  yr), making the layer an important marker horizon in late Quaternary to early Holocene marine and lake sediment sequences.

The Saksunarvatn tephra has been identified throughout the North Atlantic, including outcrops and lake sediment cores in Iceland, Norway and Germany, as well as the Faeroe Islands where it is  $\sim 1$  cm thick at the type locality of Lake Saksunarvatn. Furthermore, it has been found in marine sediment cores across the Greenland-Norwegian Seas and has been identified as a visual layer in the Greenland ice cores. Existing data indicates a minimum dispersal of  $1500000 \text{ km}^2$  and a volume in excess of  $15 \text{ km}^3$ . Major element analysis of onshore and offshore tephra samples reveal a tholeiitic composition (e.g.,  $\text{SiO}_2$ , 49.5 wt.%;  $\text{TiO}_2$ , 3.1 wt.%;  $\text{MgO}$ , 5.6 wt.%;  $\text{K}_2\text{O}$ , 0.45 wt.%) that corresponds well with the composition of magmas produced by the Grímsvötn volcano throughout the Holocene.

We have identified three tephra layers of Saksunarvatn age and composition in sediment cores from Lake Hvítárvatn in central Iceland. These layers range in thickness from 12 to 69 cm and are separated by 2 and 4 cm thick laminated sediment horizons, clearly indicating that they were produced by three separate eruptions. The four cm thick sediment horizon between the lowest and the middle layer is estimated to represent 80-100 year repose period between the two, whereas the two cm thick horizon

between the middle and the top layers indicates  $\sim 30$  years between eruptions. All three layers are tholeiitic and have identical major element compositions that indicate origin at the Grímsvötn volcano. They consist of fine to medium ash; poorly to moderately vesicular, blocky sideromelane grains suggestive of fragmentation by explosive water-to-magma interaction during subglacial eruptions. Therefore, we conclude that these Saksunarvatn-age tephra layers were formed by three successive large-volume, explosive subglacial eruptions at the Grímsvötn volcano over a period of  $\sim 120$  years. Whether one or all of these three layers correspond to the layer collectively known as the “Saksunarvatn tephra” is not known at this stage.