

# Eruptions in Grímsvötn, Vatnajökull, Iceland, 1934-1991

MAGNÚS T. GUÐMUNDSSON and HELGI BJÖRNSSON

*Science Institute, University of Iceland*

*Dunhaga 5, 107 Reykjavík*

## ABSTRACT

*During the period 1934 to 1991 evidence has only been found for three or four volcanic eruptions within the Grímsvötn volcanic centre, i.e. the directly observed eruptions in 1934, 1938, 1983, and probably a small eruption in 1984, deduced from seismic tremors. Tephra layers observed by visitors in the northwestern part of the Grímsvötn depression in the period 1934 to the 1960's have been misinterpreted as signs of eruptions; the very same ash cover was observed throughout the period. This ash cover dates back to the eruption of 1934, but earlier Grímsvötn eruptions may have contributed to its formation. Reported openings in the ice shelf (1945, 1954, 1960) are considered not to be signs of eruptions but could be explained by either steam explosions of hydrothermal reservoirs sealed by impermeable caprock or by increased upwelling of hydrothermal fluid in reservoirs of high permeability due to pressure release during lowering of the Grímsvötn lake level in jökulhlaups. Frequent jökulhlaups in the period 1938-1948 can be adequately explained by high melting rate at the site of the eruption of 1938.*

*The eruptions of 1934 and 1983 produced hyaloclastites of volume  $30\text{-}40\cdot 10^6\text{ m}^3$  and  $10\cdot 10^6\text{ m}^3$ , respectively. The eruption of 1938, on the other hand, produced volcanic material of the order of  $400\cdot 10^6\text{ m}^3$  and may have been the third largest eruption in Iceland this century, after Hekla in 1947 and Surtsey in 1963-1967. The volume of material erupted in Grímsvötn since 1600 AD has been estimated of the order of  $2.3\text{ km}^3$  and the total production may have been  $3\text{-}5\text{ km}^3$  in historical times.*

## INTRODUCTION

The history of recent volcanism within the Vatnajökull ice cap, SE-Iceland, has been studied by several authors (Þórarinnsson, 1974; Steinþórsson, 1977; Larsen, 1982; Jóhannesson, 1983; 1984; Grönvold and Jóhannesson, 1984; Björnsson, 1988; Björnsson and Einarsson, 1990; Guðmundsson, 1992). About 80 eruptions have been attributed to the volcanoes beneath Vatnajökull in historical times of which 63 are considered certain. Over the last several hundred years, Grímsvötn (Fig. 1) has been the most active of the volcanoes located within Vatnajökull. This volcanic centre has developed three calderas (Sæmundsson, 1982; Guðmundsson, 1992). The number of eruptions in Grímsvötn over the last 1100 years has been estimated to be between forty and fifty (Þórarinnsson, 1967). Björnsson and Einarsson (1990) list 36 eruptions within or near Grímsvötn in their compilation of known eruptions in historical times.

The volcanic history of the 20th century has been a subject of some discussion in recent years. Three eruptions are known for sure, in 1922, 1934 and 1983 (Þórarinnsson, 1974). There is also a general agreement that an eruption took place to the north of Grímsvötn in 1938, causing a large jökulhlaup (Þórarinnsson, 1974; Björnsson, 1988).

Jóhannesson (1983; 1984) reexamined records on eruptions in Grímsvötn in this century and concluded that eruptions had taken place in Grímsvötn in 1902-1905, 1922, 1933, 1934, 1938, 1945, 1954 and 1983. Moreover, he considered it possible that small eruptions had occurred in 1939, 1941 and 1948. His conclusions are based on reinterpretation of field observations in Grímsvötn, irregularities in the period