Geophysical Research Abstracts
Vol. 12, EGU2010-606, 2010
EGU General Assembly 2010

Rhyolite volcanism at Öræfajökull Volcano, Iceland - geochemistry, field relations & 40Ar/39Ar geochronology

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Öræfajökull is Iceland's largest stratovolcano, situated at the southern tip of Vatnajökull Glacier in the south east of the island. Its position away from the extensional tectonic forces of the rift zone has enabled the build-up of a substantial edifice 2110m in height. The majority of the volcanic edifice, including its 5km wide caldera is covered by glacial ice, leaving only the southern flanks of the volcano exposed. This area of South East Iceland has been completely glaciated at least 16 times in the last 5 million years (Helgason and Duncan, 2001) and evidence from previous field studies suggests that throughout periods in the geological past, Öræfajökull and the surrounding area were covered by ice to a much greater extent than we see today (Stevenson et al., 2006).

The volcano has erupted twice since historical records began, in 1727 and 1362, the latter being one of Iceland's most explosive historical eruptive events producing over 6x109m3 of rhyolitic tephra (Selbekk and Trønnes, 2007). However, the abundance of hyaloclastite present across much of the exposed southern flank of the edifice suggests that Öræfajökull has been at its most active during glacial periods (Prestvik, 1979). The post-eruptive geomorphic evolution of volcanic deposits at Öræfajökull has been dominated by volcano-ice interaction and characteristic glaciovolcanic landforms are evident at many exposures.

A multidisciplinary approach combining field observation, geochemistry and isotope geochronology is being utilised in order to establish the geological evolution of the Goðafjall area on the southern flanks of Öraefajökull and a record of regional minimum ice thicknesses during the development of the volcanic edifice throughout the varying climatic conditions of the mid to late Quaternary.

Individual eruptive events have been identified in the field using a combination of traditional field mapping techniques and geochemistry, and the units are being dated using 40Ar/39Ar method. Obtaining robust Ar-Ar ages for Quaternary eruptions can be a challenging process due to the small amount of radiogenic 40Ar present in young samples. To complicate matters further, both subaerial and subglacial Icelandic silicic rocks of all ages have been found to contain relatively high levels of atmospheric argon, which can result in large errors on the determined ages (Gale et al., 1966; Flude et al., 2008). Rhyolitic lavas are preferred because of their higher potassium contents compared to basalts. Feldspar phenocrysts are avoided because they give unrealistically old apparent ages (Flude, 2005), possibly from long-term pre-eruptive storage below their closure temperature, in partially crystallised magma chambers.

We are tackling these challenges with a laser Ar-Ar step-heating method and stringent sample selection. Our analyses have revealed that unaltered, unhydrated microcrystalline rhyolite groundmass produces the most consistently reliable result. Using this technique we have obtained an average age of $\approx$115Ka for the upper subglacial rhyolite unit. We are currently using this technique to determine the age of older rhyolites in order to obtain a more detailed picture of the distribution of eruptive events compared to ice sheet activity over time.

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