Reviewed research article

Pleistocene rhyolitic volcanism at Torfajökull, Iceland: eruption ages, glaciovolcanism, and geochemical evolution

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Abstract — *The Torfajökull central volcano lies in Iceland's southern flank zone (a non-rifting zone) and last erupted in the 15th century. Peralkaline rhyolites from its pre-Holocene formations have been dated by the Ar-Ar method. Ages from 67±9 ka to 384±20 ka indicate Pleistocene eruptions, with the oldest age (384 ka) also being from the most evolved rhyolite (a pantellerite). The oldest age indicates that a mature and evolved magmatic-volcanic system was well established by the mid-Pleistocene and that the central volcano has been active for at least 400 ka. Good correlation is found between the Ar-Ar ages of sustained rhyolite eruptions into ice sheets (i.e. rhyolite tuya formation) and oxygen isotope stages dominated by cold conditions. This is the first stage of developing a new proxy that uses rhyolitic glaciovolcanic edifices to provide estimates of past Icelandic ice sheet thicknesses. The geochemistry of the dated samples corroborates earlier work showing a simple but enigmatic trend of steadily-decreasing alkalinity towards the present (i.e. older rocks are more evolved). The new ages reveal a hitherto-unrecognised drop in rhyolite alkalinity after 83 ka, which may be linked to the evacuation of c. 16 km^3 of rhyolite during a subglacial eruption into the last (Weichselian) ice sheet, for which two new and overlapping Ar-Ar ages of 67±9 ka and 72±7 ka have been obtained. This rhyolite eruption, which is the largest known from Torfajökull, heralded a major change in the magma system as all subsequent eruptions are of small volume (<0.3 km^3), dominated by subalkaline compositions, and characterised by interactions with mafic magmas. This change may be linked to lower rhyolite magma replenishment rates and/or to the increasing influence of rift zone volcano-tectonics.*