

Potential Hazards to Great Britain from major explosive eruptions: a cross-disciplinary study of the subglacial Katla volcano (S. Iceland)

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Katla is one of Iceland's most active volcanoes, as shown by historical record and persistent seismic activity (Larsen, 2000; Einarsson and Brandsdóttir, 2000; Larsen et al., 2001). One of the major hazards of a Katla explosive eruption is the atmospheric dispersal of ash and aerosol across the British Isles, with subsequent environmental and human consequences. To date the largest explosive eruption occurred about 11,980 years ago and erupted about 7-8 km³ of magma (Lacasse et al., 1995). Studies of lake sediments and peat bogs show evidence that fine ash (i.e., Vedde Ash) from this eruption was transported as far as northern England, Scotland and southern Sweden (e.g., Wastergård et al., 2000). Model-derived predictions of the distance travelled as a function of particle size suggest an eruption column of the order of 20 to 30 km in height (Lacasse, 2001). Since this major event, Katla has been the locus of regular small-volume eruptions of rhyolitic and/or basaltic magma, with the latter occurring every 50 years on average during the last millenium (Larsen et al., 2001). A future major Katla explosive eruption would be a notable volcanic event in the North Atlantic with subsequent disruption of air traffic. VAFTAD and HYSPLIT atmospheric transport models from the NOAA/Air Resource Laboratory were used to simulate the pattern and trajectories of ash dispersal from a hypothetical Katla eruption on the 1st of November 2000 whilst north-westerly winds were prevailing. The results for an initial 20-km eruption column clearly indicate that part of the ash cloud would be transported over the British Isles within 48 hours. Computed single trajectories of air parcel show that the elevation at which the particles (ash, aerosol) are entrained from the volcanic plume in the wind field plays a major role on whether or not they reach Great Britain. Several new studies on Katla volcano are being initiated to better understand the proximal development of a future large eruption and its pan-European environmental consequences. They will include geochemical investigations aimed at: (1) determining the age (⁴⁰Ar/³⁹Ar dating) and frequency of past major eruptions; and (2) assessing the origins of magmas (U-series) and the relative roles and time scales of crystallisation and magma mixing. The main hypothesis to be tested via dating and geochemical modelling is whether major explosive eruptions are triggered by deglaciation. If supported, this

might provide a link between the gradual reduction in the mass of the overlying Myrdalsjökull ice cap in past decades and recent seismic unrest at Katla volcano. The effect of atmospheric conditions (e.g., temperature, relative humidity) on the rise of the volcanic plume and the settling of the ash cloud near the source will be studied using the Active Tracer High Resolution Atmospheric Model (ATHAM) (e.g., Graf et al., 1999).