Geophysical Research Abstracts
Vol. 13, EGU2011-2598-2, 2011
EGU General Assembly 2011

Respiratory health hazard assessment of ash from the 2010 eruption of Eyjafjallajökull volcano, Iceland.

Claire Horwell (1), Peter Baxter (2), Sarah Hillman (1), and David Damby (1)

(1) Institute of Hazard, Risk & Resilience, Dept. of Earth Sciences, Durham University, UK (claire.horwell@durham.ac.uk), (2) Institute of Public Health, University of Cambridge, UK

The explosive eruption of Eyjafjallajökull volcano, Iceland during April - May 2010, produced plumes of ash which caused severe air traffic disruption. Closure of parts of European air space for up to six days highlighted the widespread dispersal of ash, and countries were concerned about the potential impacts of ashfall on respiratory health. In fact, ashfall over Europe was negligible, but substantial ash fell on Iceland and remained in the environment following cessation of the eruption, being remobilised by wind and human activity.

Here we present the results of a multi-laboratory mineralogical and toxicological study using a protocol specifically developed for the assessment of human health hazards of ash from volcanic eruptions. 14 samples were analysed from the ash fallout on Iceland. 12 samples were from ash erupted 15-19 April during the early phase (when glacial meltwater is thought to have interacted with the magma, 14-17 April) and the following 2 days. Two samples were from ash erupted 6-9 May in the drier phase (4-22 May).

The samples range from basaltic trachy-andesite to trachy-andesite (XRF). The grain size pertinent to respiratory health of fine samples was variable: 2-13 vol. % < 4 μm and 4-26 vol. % < 10 μm (Malvern Mastersizer). The finest samples were all erupted during the early phase, but as we only obtained 2 samples from the drier phase they may not be representative. Very dark grey/black ash and lighter grey ash were both visible in the plume as it was being erupted. The darkest ash samples were, in general, coarser than the lighter ash samples, independent of the eruptive phase. The crystalline silica content (the main mineral of health concern in volcanic ash), measured by XRD-sPSD, in all ash samples was negligible. Morphology, by SEM, showed mainly angular, glassy particles, typical of volcanic ash. Occasional fibre-like particles in one sample from the drier phase were composed of feldspar, glass, gypsum and an Fe/Mg silicate (determined by TEM) and were unlikely to be of health concern. Surface area varied substantially from 0.3-7.7 m2/g, showing that some samples have high available surface for reactions in the lung. Leachate analysis showed low release of trace elements relevant to respiratory health. In vitro screening tests for potential bio-reactivity of the ash particles showed low hydroxyl free radical generation in comparison to ash samples from other volcanoes (except for one sample with iron-related reactivity akin to basaltic ash); and low values for oxidative potential (ascorbic acid oxidative capacity). Measurement of haemolysis (quartz-like behaviour), cytotoxicity and inflammatory markers also revealed low activity.

The ash fallout examined contains a substantial fraction of fine-grained material which could generate elevated levels of PM4 and PM10 in the ambient air when re-suspended by dry, windy conditions, by traffic and by those working in the ash, until the ash is incorporated into the environment with repeated rainfall. The in vitro toxicity tests suggest that the potential for the ash to trigger acute pulmonary inflammation at ambient levels of exposure is low. Persistence of deposited ash in the soils and environment would not present a significant silicosis hazard, e.g. to outdoor workers, as crystalline silica content is negligible.