Urban and health

Montserrat ash

A potential hazard to health

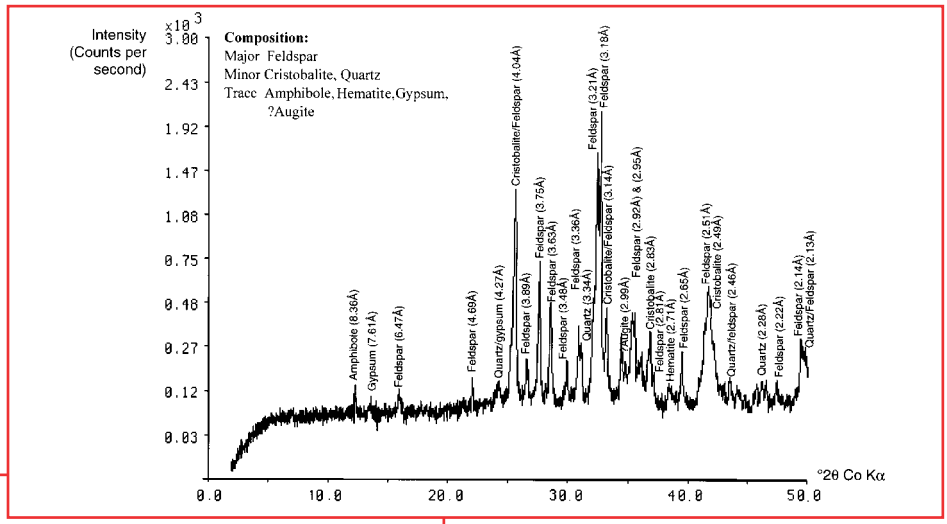
by Dick Nicholson, Vicky Hards & Barbara Vickers, *Keyworth*

The Soufriere Hills volcano on the Caribbean island of Montserrat started erupting in July 1995. At the height of the eruption it became necessary to evacuate much of the population to neighbouring islands such as Antigua, and further afield to the UK. The main phase of the eruption appears to be over (early 1999) and evacuees now wish to return to their own homes. However, the accumulated volcanic ash deposits are hampering the resettlement of many areas and rendering it almost impossible in others. Living in a dusty environment for a prolonged period is likely to have implications for the long-term health of the population, as has been shown by epidemiological studies carried out during the eruption.

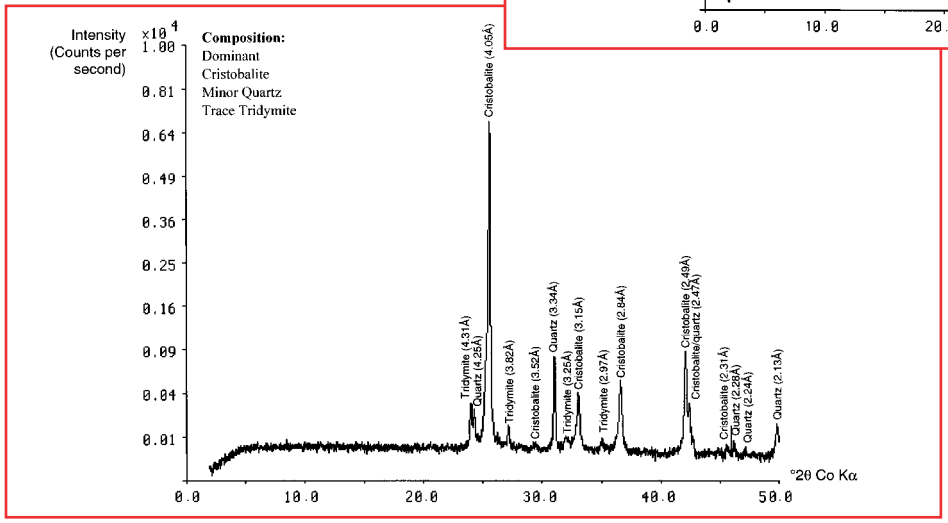
Volcanic ash is a potential hazard to human health for two principal reasons. When freshly erupted, or remobilised by atmospheric disturbance, fine particulate material (smaller than 10µm) can be inhaled and lodge in the lung, and even finer particles smaller than 2.5µm (the so-called respirable fraction) can penetrate even deeper into the lung. All volcanic rocks contain silica, and depending on their composition, and the duration and type of the eruption, this may be in a toxic form, with the potential to cause silicosis, a disease more commonly associated with the mining industry.

There are three main forms of crystalline silica: quartz, tridymite and cristobalite, and an amorphous form more generally known as opal. At high temperatures quartz inverts to tridymite, which in turn inverts to cristobalite. Of these cristobalite is known to be the most toxic, and in prolonged high-temperature eruptions, may be the dominant form. At the Soufriere Hills, the crystalline silica content of the fine ash smaller than 10µm from pyroclastic flow material released during collapse of the andesitic lava dome, was found to be high, ranging 10 to 24 weight percent.

X-ray diffraction is the preferred technique for identifying the minerals present in volcanic ash, although the amounts of the individual components cannot always be quantified. In order to obtain a better estimate of the proportions of crystalline silica present, chemical leaching techniques designed to isolate the crystalline silica from the other minerals in the ash have been used effectively at the BGS. The purity of the silica residue can then be verified against the diffraction pattern obtained for the whole rock, as shown in the diagrams. In this particular sample cristobalite is identified as being the principal silica mineral present.



Vicky Hards © BGS, NERC



Vicky Hards © BGS, NERC

Above: *X-ray diffraction profile of bulk ash sample.*

Left: *X-ray diffraction profile of silica residue separated from bulk ash.*