

Sakurajima volcano: a physico-chemical study of the health consequences of long-term exposure to volcanic ash

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Regular eruptions from Sakurajima volcano, Japan, repeatedly cover local urban areas with volcanic ash. The frequency of exposure of local populations to the ash led to substantial concerns about possible respiratory health hazards, resulting in many epidemiological and toxicological studies being carried out in the 1980s. However, very few mineralogical data were available for determination of whether the ash was sufficiently fine to present a respiratory hazard. In this study, we review the existing studies and carry out mineralogical, geochemical and toxicological analyses to address whether the ash from Sakurajima has the potential to cause respiratory health problems. The results show that the amount of respirable (less than 4 micron.) material produced by the volcano is highly variable in different eruptions (1.1 to 18.8 vol. per cent). The finest samples derive from historical, plinian eruptions but considerable amounts of respirable material were also produced from the most recent vulcanian eruptive phase (since 1955). The amount of cristobalite, a crystalline silica polymorph which has the potential to cause chronic respiratory diseases, is 3 to 5 wt. per cent in the bulk ash. Scanning electron microscope and transmission electron microscope imaging showed no fibrous particles similar to asbestos particles. Surface reactivity tests showed that the ash did not produce significant amounts of highly reactive hydroxyl radicals (0.09 to 1.35 micro mol/m² at 30 min.) in comparison to other volcanic ash types. A basic toxicology assay to assess the ability of ash to rupture the membrane of red blood cells showed low propensity for haemolysis. The findings suggest that the potential health hazard of the ash is low, but exposure and respiratory conditions should still be monitored given the high frequency and durations of exposure.