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Analysis of ash from Pacaya volcano for the assessment of health hazard

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Introduction

Two ash samples were sent to Durham by Bill Rose from the eruption of Pacaya Volcano on 27 May 2010. We have carried out basic analyses to test for potential health hazard. Sample information is as follows:

Sample #	Original ID	Time of eruption	Grid / location	Distance from Pacaya	Bearing	Info	Collector
PAC2010_01	VP 5/27/2010	8:10-8:40 pm	14°35'32.34"N 90°29'8.82"W	26.7 km	208 °	part of a 3mm thick layer, collected dry, unaffected by rain	Samuel Bonis
PAC2010_02	VP 5/27/2010 Coban		Coban 15°28' 14.80" N 90°22' 20.09" W;	122km	192 °	wet but not soaked	

Table 1. Sample information

Methods

The following analyses were carried out:

1. Grain size distributions by laser diffraction[1] using a Malvern Mastersizer 2000 with Hydro Mu.
2. Major element analysis (bulk composition) using X-ray Fluorescence.
3. Crystalline silica quantification (cristobalite and quartz) using X-ray Diffraction with static position-sensitive detection (XRD-sPSD)[2].

Results

Bulk composition analyses confirmed that the ash samples are basaltic (51.6 & 50.8 wt. % SiO_2; 3.9 & 4.8 wt. % Na_2O + K_2O).

Grain size analyses showed that there is no respirable or inhalable ash in either sample (Table 2). It is possible that some minor fines component had been lost from PAC2010_02 given that the < 63 μm fraction contained 7.89 vol. % material (which would give a predicted value of ~ 0.44 vol. % < 4 μm and ~ 1.9 vol.% < 10 μm material according to Horwell (2007[1])).

Bin	Fraction	PAC2010_01	PAC2010_02
< 1 µm	Ultra-fine	0.00	0.00
< 2.5 µm	“	0.00	0.00
< 4 µm	Respirable	0.00	0.00
< 10 µm	Thoracic	0.00	0.00
< 15 µm	Inhalable	0.00	0.00
< 63 µm	Sievable	0.00	7.89

Table 2. Quantity of material in health-pertinent size fractions in vol. %. < 63 µm is included as this is the reasonable cut-off size for sieving, after which the equations provided by Horwell (2007) can be applied to predict the health-pertinent fractions, where laser diffractometers are not available.

There was negligible crystalline silica in the samples, although PAC2010_02 has 3.41 wt. %, indicating that there are small quantities of cristobalite in the ash.

Sample #	Cristobalite Wt. %	Quartz Wt. %
PAC2010_01	0.00	0.79
PAC2010_02	3.41	0.00

Table 3. Amount of crystalline silica in the samples. 1-3 wt. % error.

Discussion

From a health perspective, this basaltic ash is not likely to cause significant respiratory issues. Neither sample contained any material that could penetrate into the respiratory system. In addition, as expected for a basaltic eruption, crystalline silica content was negligible. The small amount of cristobalite observed may have been sourced from altered edifice rock entrained into the eruption column. There is the possibility that the ash could be reactive in the lung due to iron-catalysed hydroxyl radical generation, as observed for ash from previous eruptions of Pacaya and other basaltic volcanoes[3]. However, as the ash is not inhalable, we did not carry out these experiments.

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Further information

Further information is available on all techniques upon request.

References

1 Horwell, C.J., Grain size analysis of volcanic ash for the rapid assessment of respiratory health hazard *J. Environ. Monitor.* **9** (10), 1107 (2007).

2 Le Blond, J.S., Cressey, G., Horwell, C.J. et al., A rapid method for quantifying single mineral phases in heterogeneous natural dust using X-ray diffraction *Powder Diffraction* **24**, 17 (2009).

3 Horwell, C.J., Fenoglio, I., and Fubini, B., Iron-induced hydroxyl radical generation from basaltic volcanic ash *Earth Plan. Sci. Lett.* **261** (3-4), 662 (2007).