

Changes in Human Body Fluid Chemistry Following Acute Exposure to Volcanic Gas at White Island, New Zealand

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It is well recognised that gases and aerosols present a human health hazard near to volcanoes, whether to field volcanologists (e.g. at Vulcano, Italy), civilian victims of eruptions or gas bursts (e.g. Dieng, Java), or those downwind of persistently degassing volcanoes (e.g. Masaya, Nicaragua). Health hazards may also be present in distal areas during large fissure eruptions, as was the case across Iceland and Europe during the Laki eruption (1783). Volcanic gases and aerosols therefore present a widespread health hazard which requires, where possible, toxicological investigation to improve risk assessment. In this work we took advantage of an exceptional natural laboratory, White Island, New Zealand's most active volcano, to conduct a small-scale toxicological assessment of body chemistry changes following respiratory exposure to volcanic gases.

Current activity at White Island is characterised by moderate fumarolic activity in the central subcrater plus moderate-strong fumarolic activity in the western subcrater, which contains a crater lake. The former area of the crater complex is readily accessible and three active fumaroles can be approached in safety. We took 10 volunteers to the volcano in a visit which lasted 2 hours; each volunteer spent 20 minutes of this time in close proximity of one of the three active fumaroles, without gas masks. During this time we measured average SO₂ and HCl concentrations of 5ppm and 4ppm respectively, up to 10 m downwind of each fumarole. In addition, participants wore passive SO₂ monitors to gauge personal exposure. Prior- and post-exposure blood and urine samples from each participant were tested for fluorine, chlorine, aluminium, arsenic, rubidium and lead content. Fluids were analysed by Ion Selective Electrode, Colourimetric Mercuric Thiocyanate, Aeroset Analyser, and Carbon and Graphite Furnace Atomic Absorption. Here we present results of these fluid analyses and where possible link blood and urine contamination with personal exposure.

The results are discussed in relation to (a) any acute or chronic health risks of single or multiple exposures to volcanic gas; and (b) any acute or chronic health risks of longer-term exposure from lengthy eruption episodes.