



## Electrochemical sensor monitoring of volcanic gases

Tjarda Roberts (1,2), Ray Freshwater (2), Clive Oppenheimer (3), John Saffell (4), Rod Jones (2), Paul Griffiths (2), Christine Braban (5), and Iqbal Mead (2)

(1) Norwegian Polar Institute, Tromso, Norway (tjarda@npolar.no, tjarda@cantab.net), (2) Department of Chemistry, University of Cambridge, UK, (3) Department of Geography, University of Cambridge, UK, (4) Alphasense, Great Notley, UK, (5) Centre for Ecology and Hydrology, Penicuik, Midlothian, UK

Advances in instrumentation have fuelled a recent growth of interest in using portable sensor systems for environmental monitoring of pollution. Developments in wireless technology are enabling such systems to operate remotely and autonomously, generating a wealth of environmental data. We report here on the application of miniature Alphasense electrochemical sensors to the detection and characterisation of gases in volcanic plumes.

A highly portable sensor system was developed to operate an array of 6 low cost electrochemical sensors to detect CO, H<sub>2</sub>, HCl, SO<sub>2</sub>, H<sub>2</sub>S and NO<sub>2</sub> at 1 Hz. A miniature pump draws air over all sensors simultaneously (i.e. sensors arranged in parallel). The sensor output in these campaigns was logged on PDAs for real-time viewing, and later download (with a view to future data-streaming). The instrument was deployed at a number of volcanoes and was subject to extremely harsh conditions including highly acidic environments, low (Antarctic) temperatures, and transport over rough terrain. Analysis methods are demonstrated that consider calibration, cross-sensitivities of the sensors to multiple gases, differing sensor response times, temperature dependence, and background sensor drift with time. The analysis is applied to a range of plume field-measurements to extract gas concentrations ranging from 100's ppmv to sub-ppmv and to characterise the individual volcano emissions.

Applications of similar sensor systems for real-time long-term monitoring of volcanic emissions (which may indicate and ultimately predict eruptive behavior), and UAV and balloon-borne plume sampling are now already being realised. This work focused on demonstrating the application of electrochemical sensors to monitoring of environmental pollution from volcanoes. Other applications for similar sensors include the near-source monitoring of industrial emissions, and of pollutant levels enhanced by traffic emissions in the urban environment.