

## **Volcanic gases: a window into the interior of our planet**

Volcanoes are spectacular manifestations of material and heat transfer from the interior of our planet. Volcanic activity shapes the surface of Earth as well as maintaining the atmosphere and driving the biological and geochemical cycles that make our planet equitable. Volcanic activity fuels the formation of many of the metal resources that our Society depends on, as well as providing a critical source of energy. But volcanoes also have a dark side: eruptions can be major hazards. Monitoring and forecasting volcanic eruptions effectively is a grand challenge for the future as our planet's population, particularly at sites of tectonic and volcanic activity, grows.

As well as erupting magma and resurfacing the planet, volcanoes are the principal pathway through which the Earth's volatiles (water, carbon dioxide, sulfur, halogens and trace metals) are transferred from the interior of our planet to the surface environment. Much progress has been made in quantifying volatiles in the different reservoirs of Earth, the fluxes between them, and the role that volcanoes play in regulating and perturbing volatile cycles, both in the present day and in the geological past. Much of this understanding is based on improved observation and measurement. Volcanic gas monitoring has been revolutionised by new techniques based on spectroscopy and remotely-operated vehicles. The volatiles that exsolve from magma as it rises through the crust accelerate magma rise, fuel eruptions, and control their dynamics and style. We reconstruct magmatic and volcanic processes using cutting edge microanalysis of volcanic rocks and through experiment. Volcanic gases also give us a window on deeper crustal and mantle processes. Some volcanoes emit large fluxes of gas over millenia and very little magma. These 'persistently degassing volcanoes' supply much of the volcanic outgassing flux to the atmosphere and derive their volatiles from deep, unerupted magmas in extensional tectonic regimes. Volcanic gases also carry volatile metals such as copper, lead and bismuth. Their abundance and composition in volcanic gases give us clues about how hydrothermal ore deposits may form in the crust.

This lecture will explore, on a range of scales, the ways in which volcanoes have shaped our atmosphere and regulated and perturbed climate though volatile emissions; as well as looking at how volcanic gases may be used for monitoring and hazard forecasting; and what they may tell us about the formation of ore deposits in the crust. The lecture will focus on the grand challenges facing society in this field, and what the future may hold in terms of research, opportunities, technical development and impact.