Geophysical Research Abstracts
Vol. 19, EGU2017-16774, 2017
EGU General Assembly 2017

Integrating volcanic gas monitoring with other geophysical networks in Iceland

Melissa A. Pfeffer (1) and the Icelandic Volcano Observatory Team

(1) Icelandic Meteorological Office, Reykjavik, Iceland (melissa@vedur.is), (2) University of Iceland, Reykjavik, Iceland, (3) University of Palermo, Palermo, Italy, (4) INGV, Palermo, Italy, (5) Kings College London, London, UK, (6) University of Manchester, Manchester, UK, (7) University of Leeds, Leeds, UK, (8) Dublin Institute for Advanced Studies, Dublin, Ireland, (9) Chalmers University of Technolgy, Gothenburg, Sweden

The Icelandic Meteorological Office/Icelandic Volcano Observatory is rapidly developing and improving the use of gas measurements as a tool for pre- and syn-eruptive monitoring within Iceland. Observations of deformation, seismicity, hydrological properties, and gas emissions, united within an integrated approach, can provide improved understanding of subsurface magma movements. This is critical to evaluate signals prior to and during volcanic eruptions, issue timely eruption warnings, forecast eruption behavior, and assess volcanic hazards.

Gas measurements in Iceland need to be processed to account for the high degree of gas composition alteration due to interaction with external water and rocks. Deeply-sourced magmatic gases undergo reactions and modifications as they move to the surface that exercise a strong control on the composition of surface emissions. These modifications are particularly strong at ice-capped volcanoes where most surface gases are dissolved in glacial meltwater. Models are used to project backwards from surface gas measurements to what the magmatic gas composition was prior to upward migration. After the pristine magma gas composition has been determined, it is used together with fluid compositions measured in mineral hosted melt inclusions to calculate magmatic properties to understand magma storage and migration and to discern if there have been changes in the volcanic system.

The properties derived from surface gas measurements can be used as input to models interpreting deformation and seismic observations, and can be used as an additional, independent observation when interpreting hydrological and seismic changes. An integrated approach aids with determining whether observed hydro/geological changes can be due to the presence of shallow magma. Constraints on parameters such as magma gas content, viscosity and compressibility can be provided by the approach described above, which can be utilized syn-eruptively to help explain differences between erupted volumes and the inferred volume change of magma chambers.

We will describe two recent examples of integrated monitoring in Iceland 1) syn-eruptive gas and deformation measurements used to simulate the subsurface properties of the magma from the 2014-2015 eruption of Bárðarbunga and 2) hydrological, seismic, and gas measurements made during the 2014 Sólheimajökull jökulhlaup used to discriminate between magmatic and hydrothermal origin of the flood and to perform a frequency analysis of past minor hydrothermal jökulhlaups.