A Preliminary Investigation of Volcanic CO_2 and H_2O at Sulphur Springs St Lucia, Using a Multicomponent Gas Analyzer System (Multi-GAS)

Thomas E. Christopher[1, 2], Erouscilla Joseph[1], and Viveka Jackson[1]

[1]*Seismic Research Centre, University of the West Indies, St Augustine, Trinidad and Tobago*
[2] *Montserrat Volcano Observatory, Salem, Montserrat, West Indies*

Abstract

The Lesser Antilles volcanic arc comprises island states with land areas on the order of tens of km^2 to a few hundreds of km^2. This scenario surmounts to population centres in locations proximal to volcanoes that may erupt in the future. Arc volcanism is dominated by products of intermediate to silicic magmas, thus their eruptions are often explosive. Magma mixing, for which there is plenty of evidence (e.g. mafic enclaves), is commonplace at arc volcanoes and has been accepted as a regular process in triggering eruptions at such volcanoes by heating up the intermediate to silicic magma and remoblizing it. Magma mixing at arc volcanoes normally occurs when a mafic magma is intruded into a reservoir where the intermediate to silicic magma resides; the enclaves are generated due to the quenching of hotter mafic magma by the cooler intermediate to silicic host. Quiescent volcanic degassing is commonplace throughout the Lesser Antilles volcanic arc and is highlighted by the presence of fumaroles and sulphur deposits on some islands. Intrusions of mafic magmas are not only hotter, but also rich in volatiles (e.g. CO_2 and H_2O); exsolution of these volatiles would occur as the magma ascends and decompresses. Magma mixing, cooling and subsequent crystallization will also promote further separation of volatiles from the host melt. The exsolved volatiles will arrive at the surface before any magma. Thus, an intrusion of mafic magma should be characterized by increases in the CO_2 and H_2O flux relative to the quiescent volcanic degassing, and changes in the ratio of the two species. Monitoring of these two relevant species can be a useful tool for observing temporal changes in the hydrothermal system and in forecasting potential eruptions. We carried out a field campaign from March 24th to 27th 2014 at the fumaroles of Sulphur Springs, Saint Lucia. We measured concentrations of both species using a LI-840A CO_2 and H_2O analyzer set in a Multi-GAS instrument system. We found H_2O concentrations >20000 ppm and CO_2 concentrations >3000 ppm, and H_2O/CO_2 ratios in the range (5.7 ±0.5 to 9.8 ±0.6) from Sulphur Springs St Lucia. This is the first study of this kind to be carried out at Sulphur Springs St Lucia. Continued monitoring of CO_2 and H_2O emissions and their ratio (H_2O/CO_2) will help to announce the future arrival of hot, mafic, volatile rich magma from depth that may possibly lead to an eruption.