FIELD REPORT: Volcano

PI Dr. Hazel Rymer

Research site/ region Masaya volcano, Nicaragua; Poás volcano, Costa Rica

Country Nicaragua; Costa Rica

Protected area status Masaya Volcano National Park; Volcán Poás National Park

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Report completed by Hazel Rymer

Faculty of Science

Earth and Environmental Sciences

The Open University
Walton Hall
Milton Keynes
MK7 6AA
United Kingdom

Tel +44 (0) 1908 653 012
Fax +44 (0) 1908 655 151
www.open.ac.uk

Dear Volunteers,

Thank you for your contribution to the project this year. I can honestly say that we could not have achieved as much as we did without you. I am always amazed at how much Earthwatch volunteers get done in the field and this year was no exception. You worked incredibly hard and I am very grateful for all your efforts.

At Masaya this year we deployed sulphation plates, measured microgravity and Bouguer gravity, established VLF and magnetic surveys and ran FLYSPEC profiles. We identified butterflies and plants within the park - and even some bones.

We ran high precision GPS surveys throughout and without these the rest of the work is meaningless.

The big changes since the teams fielded in January, February and March 2010 are that Mel and Guillermo have passed their second year and first year probations and are now well on the way towards their PhD awards. The data you collected are critical for their projects. Guillermo's project is focussing on the Bouguer gravity measurements we began this year at Masaya and Mel's project is integrating the gas flux measured through FLYSPEC with the plant and soil data we collected. Both projects have been inspired by the work you did this year and will lead to PhDs for these talented young scientists in due course.

We are still hard at work crunching the data, but already we can see some important trends in the microgravity, suggesting a shift in the sub-crater magma level since 2009. We have also noticed a surprising pattern in the colonisation of some species of 'air plants' as well as some previously unrecognised fractures which may indicate the build up of stress within the volcanic edifice.

As more results start coming through, we will keep you informed of progress, but do feel free to get in touch at any time to find out the latest. And if you are passing Milton Keynes in your travels, do please pop in and say hello.

Thank you once again for your hard work. It was a pleasure to work with you and I hope that we meet again on a volcano somewhere in the world.

Very best wishes,

Hazel

Dr. Hazel Rymer
Volcano Dynamics Group

SECTION ONE

Top highlight from the past field season

This year we consolidated previous work, extending our microgravity, very low frequency (VLF) and magnetic field networks as well as plant and soil surveys in order to evaluate long term trends and to correlate changes with variations in the output from the volcano. We are still processing samples to look for the accumulation of pollutants from the volcano in the soils and plants. However this year we did make some very exciting discoveries with the Bouguer gravity surveys; we identified the full extent of the lava tunnel system beneath the park.

Probably the most exciting result though was from mapping the distribution of the air plants (*Tillandsia recurvata*) within and around the park. We found that the location of these highly sensitive plants mirrors very well the results we have from the sulphation plates and so we may have identified a new plant assay to monitor gas flux from the volcano by proxy. This result will have major implications for the monitoring of volcanoes of this type, but locally, the implications for pineapple crops may be that there is an accumulation of pollutants within the fruit. We need to do some more work on this!

Non-technical overview of results

Hazards related to volcanoes are eruptions, earthquakes and landslides. These hazards can cause wide spread, even global devastation depending on the vulnerability of the local environment and the magnitude of the effects. Less well known are the ongoing or ‘chronic’ effects associated with persistently active volcanoes that can be just as damaging in many ways as they restrict biodiversity and impede economic development and poverty reduction over long periods. A persistently active volcano emits gas continuously, but is often not even thought of as ‘active’ because it doesn’t seem to change much and does not usually explode or erupt lava. This project is about understanding how natural variations in persistent activity affect the local environment. The impact is even wider when economic consequences are taken into consideration. The cost of key export commodities such as coffee and cut flowers is affected and this can have global significance.

The idea is to characterise the interactions between key volcano derived elements (so called heavy metals, such as lead, copper and zinc) and the environment and to identify the risks they pose. Heavy metals may enter the food chain as a result of their uptake by edible plants. So factors controlling the total concentrations of heavy metals in soils are of great importance for human toxicology and agricultural productivity. As a result of the high concentration of gas at persistently active volcanic sites, heavy metal pollution of soil, water, and the atmosphere presents an environmental problem affecting food quality and consequently human health.

This year we identified some exciting new changes in the gravity signature in the vicinity of the active crater. By mapping these results, we have found that there is an increase in gravity on the south side and this may be an indication of a build-up of magma level there prior to increased activity. If so, we expect the vent to move towards the south of the crater.

We also identified a new plant, whose distribution correlates very well with the results we have gathered from our air quality studies. This means that we have an independent 'proxy' for the volcanic gas plume measurements. We hope to be able to use this plant (*Tillandsia recurvata*) as an indicator of volcanic gas flux elsewhere.

SECTION TWO: TECHNICAL RESULTS

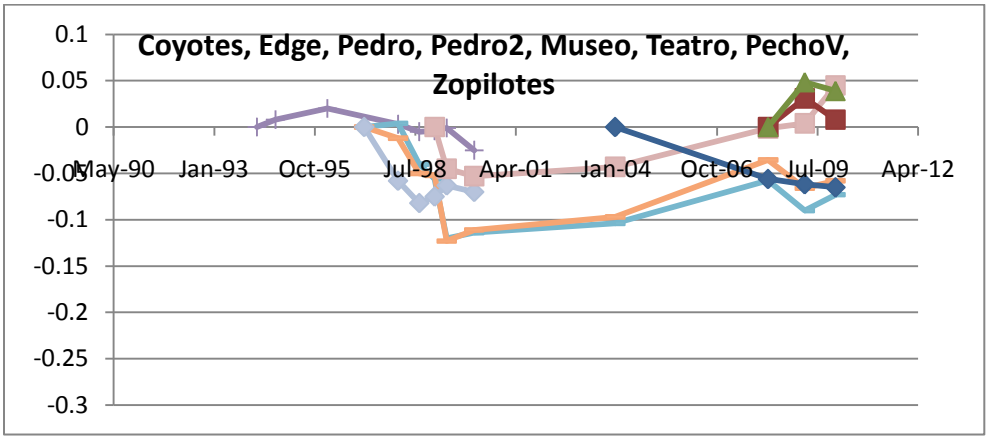
1. REPORTING ON RESEARCH OBJECTIVES

Objective 1

Identify the physical and chemical signatures associated with persistent activity and to identify changes in these signatures through time.

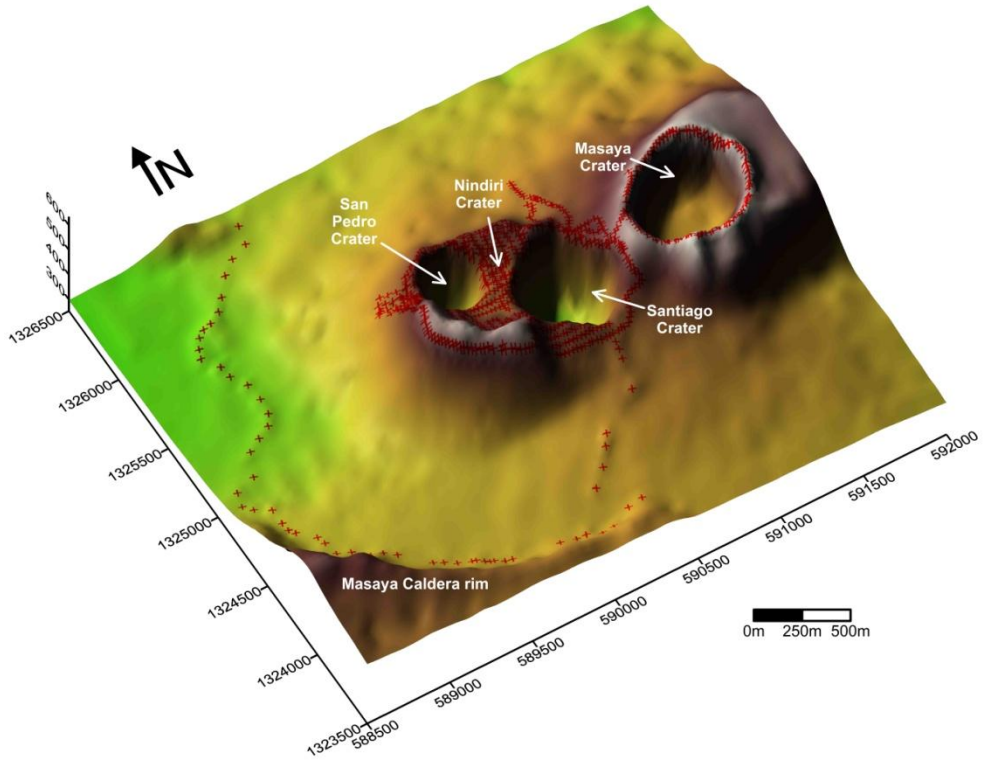
Progress report on objective 1

Progress: We identified variations in gravity this year between the north and south parts of the crater.



The graph shows the northern stations (Teatro, Pecho V and Zoplotes, in dark blue, red and green respectively) decreasing in gravity between 2009 and 2010 while the stations close to the crater but on the southern side (Edge, Pedro and Pedro2 in light blue, orange and pink respectively) increase. This suggests that magma is moving towards the south side and this may indicate the location of the next eruption. From the distribution of these stations and the magnitude of the gravity changes we can estimate the amount of magma involved to be of the order of 10^{11} kg.

We expanded the VLF survey network to include over 1500 new points (see locations below).



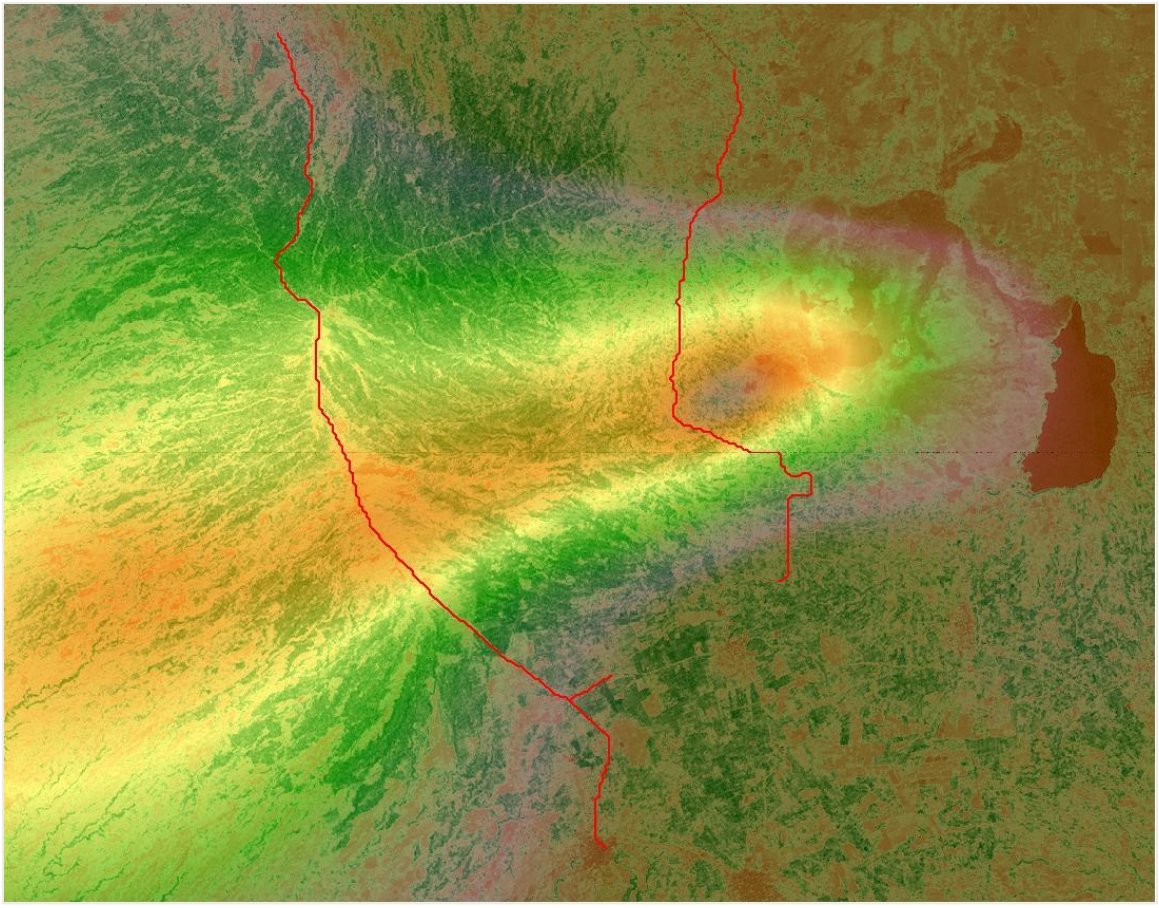
We mapped variations in the VLF signal that identify new fractures forming within the volcanic structure.

Objective 2

Understand the response to persistent volcanism within niche ecosystems and understand their role in regulating volatile pollution levels in the environment

Progress report on objective 2

The distribution of sulphates was mapped using sulphation plates over various periods of time to reveal an integrated picture for the effects of volcanic degassing. The distribution shows a concentration downwind as expected, but there are subtle variations due to local conditions (mainly topography).



The image shows the increasing concentration (yellow to orange) towards the centre of the plume remaining discernable with distance SW of the vent. The image is about 40km x 40 km and the red lines are the two main roads cutting the plume used for measurements of gas flux.

Especially interesting is the way in which the pollution effect spreads out with distance from the vent and that there is significant pollution upwind.

A new species was identified which mirrored the sulphation plate results and we will establish over the coming field seasons whether we can use variations in the viability of this plant (*Tillandsia recurvata*) as a proxy for gas flux measurements.

Objective 3

Integrate fully the geophysical/geochemical and environmental data with global estimates of annual fluxes of acid aerosols from volcanoes to the surrounding land surface.

Progress report on objective 3

Work on this objective is underway, but there is nothing new to report here yet.

2. PARTNERSHIPS

The most exciting new partnership we developed this year involved the signing of a Memorandum of Understanding between Earthwatch and the Open University. This enables Earthwatch volunteers to gain OU credit by using their Earthwatch experience as the practical experience in the new BSc Natural Sciences. This agreement means that volunteers worldwide can gain university credit for participation in Earthwatch expeditions. The degree is available globally on-line so it can reach huge numbers of students unable to study conventionally. This new qualification should be of value to local field assistants working on a large number of Earthwatch projects as well as to volunteers.

Several OU students have studied on this project already, and used the data collected in the field for their final project assessment.

3. CONTRIBUTIONS TO CONVENTIONS, AGENDAS, POLICIES, MANAGEMENT PLANS

We are working closely with INETER, the Nicaraguan government body tasked with volcano and environmental monitoring. Our results are made freely available to them through a memorandum of understanding. We also work closely with the national park office and have provided educational material based on this project, which they are using in their visitor centres to inform the public about the volcanic risk and the environmental impact of the volcano.

This year we also began working with local farmers to investigate water quality with a view to advising on safety for agriculture.

4. DISSEMINATION

A blog is available at

http://www.open.ac.uk/openlearn/science-maths-technology/science/geology/getting-geophysical-central-america

A video blog is available at

http://www.youtube.com/watch?v=Dfvc0T7e29w

A poster of the project results is displayed in the Masaya volcano visitor centre and at the hotel Regis, Masaya.

5. DEVELOPING ENVIRONMENTAL LEADERS

A high school group formed one of the teams this year. These volunteers all engaged very effectively with the project and as the school expected them to carry out pre and post work, the degree of reflection and motivation of these students was impressive. All said that the experience was positive and that they had learned a lot.

Some volunteers used the expedition to gain field work experience for OU environmental science or geosciences degrees.

6. ANY OTHER ACTIONS OR ACTIVITIES THAT ENHANCE NATURAL AND SOCIAL CAPITAL

This project has a very positive effect on the wardens of the Masaya National Park as we are educating them on the important species to monitor. We are also helping them to monitor the volcano more effectively. We have helped them to develop a more systematic recording system for activity.