

**Volcanologist *Pro Tem*:
Exploring the Dynamics of Kilauea Volcano, Hawaii**

**A learning activity developed at the VEPP Workshop
July 2010
Hawaiian Volcanoes National Park
Sponsored by the USGS, NASA, and NAGT**

This pdf file contains the following documents:

Worksheet 1: Become a Volcanologist

Worksheet 2: Geologic Processes on Basaltic Shield Volcanoes

Instructions for student presentations on “Volcanic Events at Puu Oo”

Worksheet 3: What Will Happen Next?

Worksheet 4: Volcanologist on Watch: Summary and Prediction of Hawaiian Volcanic Activity

Concept Test: Intended to assess accomplishment of learning goals for this project

Suggested Schedule

Intended for introductory classes in geology, volcanology, geologic hazards, with 20 to 50 students.

Volcanologist *Pro Tem*: Exploring the Dynamics of Kilauea Volcano, Hawaii

1. Become a Volcanologist

Name _____

Objective

Your objective is to become a volcanologist for the semester. In this assignment, you will learn how to monitor the activity of a volcano using a specific instrumental technique or method. You will develop a 1 page summary of the technique and how it is used to describe and predict volcanic behavior.

Procedure

Learn as much as you can about **your assigned** volcano monitoring technique or instrument.

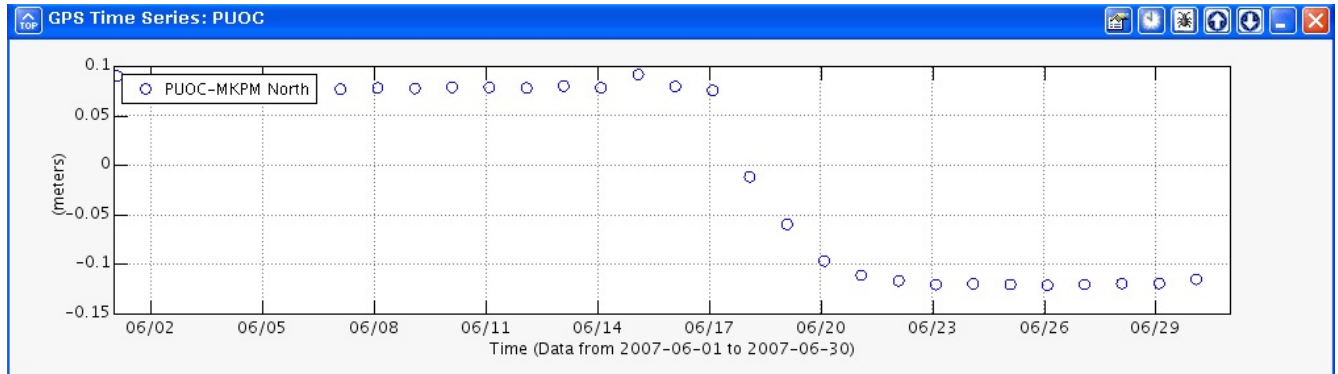
- | | |
|--|---|
| A. Global positioning system (GPS) | https://vepp.wr.usgs.gov/vepp/techniques/gps/ |
| B. Tiltmeter | https://vepp.wr.usgs.gov/vepp/techniques/tilt/ |
| C. Seismometer | https://vepp.wr.usgs.gov/vepp/techniques/seismic/ |
| D. Gravimeter | https://vepp.wr.usgs.gov/vepp/techniques/gravity/ |
| E. Geology (Surface observations, webcams, etc.) | https://vepp.wr.usgs.gov/vepp/techniques/webcams/ |

Activities

Learn all you can about your instrument or technique by referring to the web page listed above. Outside of class, meet together with the other experts in your field and complete this worksheet which each of you will turn in next week.

1. Instrument or Technique Name
2. Brief description of your instrument or technique and what it measures?
3. What could your instrument reveal about an active volcano like Kilauea's Puu Oo vent?

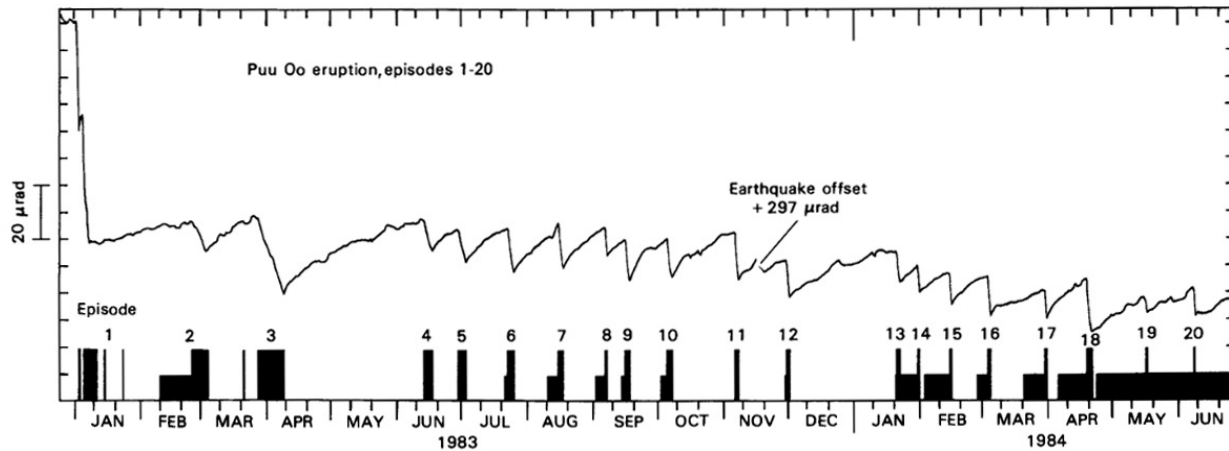
4. Examine this record of horizontal movement at Puu Oo and suggest what event(s) may be occurring. Explain the justification for your hypothesis.



This graph shows the northward motion of the **GPS (global positioning satellite receiver)** station (called PUOC) on the north rim of Puu Oo crater, during June 2007. (VEPP/USGS)

5. Describe the procedure for acquiring data, such as that shown above, for your instrument from the Volcano Exploration Project (VEPP: <https://vepp.wr.usgs.gov/vepp/>) or Hawaiian Volcano Observatory (HVO: <http://hvo.wr.usgs.gov/>).

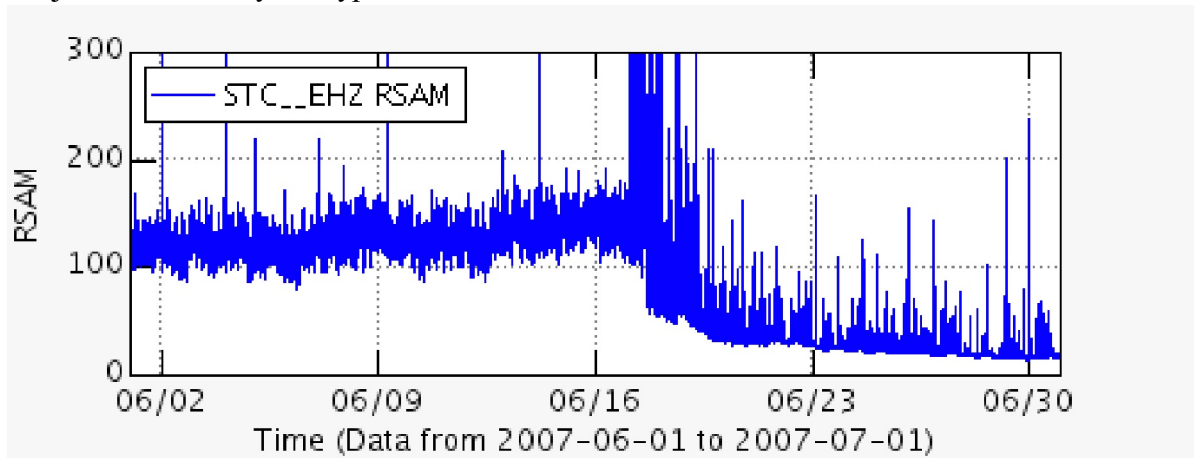
4. Examine this **tiltmeter record** for Kilauea and suggest what event(s) may be occurring. Explain the justification for your hypothesis.



This line on this graph shows changes in the tilt (in microradians) of the summit of Kilauea volcano in 1983 and 1984. A **tiltmeter** was used to make these measurements. The black boxes show when eruptions at Puu Oo happened.

5. Describe the procedure for acquiring data, such as that shown above, for your instrument from the Volcano Exploration Project (VEPP: <https://vepp.wr.usgs.gov/vepp/>) or Hawaiian Volcano Observatory (HVO: <http://hvo.wr.usgs.gov/>).

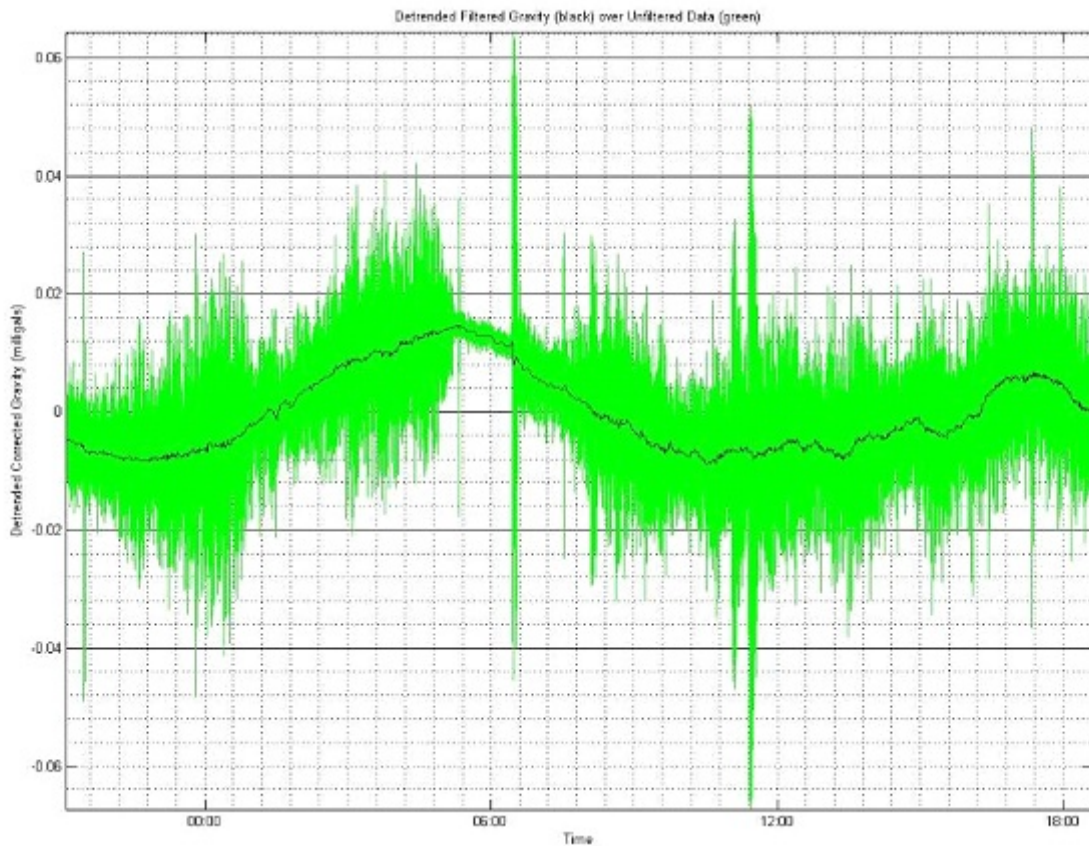
4. Examine this **seismic record** at Puu Oo and suggest what event(s) may be occurring. Explain the justification for your hypothesis.



This graph shows the average amplitude (called RSAM) of earthquake wave as recorded by a **seismometer** near the Puu Oo vent during June 2007 (VEPP/USGS)

5. Describe the procedure for acquiring data, such as that shown above, for your instrument from the Volcano Exploration Project (VEPP: <https://vepp.wr.usgs.gov/vepp/>) or Hawaiian Volcano Observatory (HVO: <http://hvo.wr.usgs.gov/>).

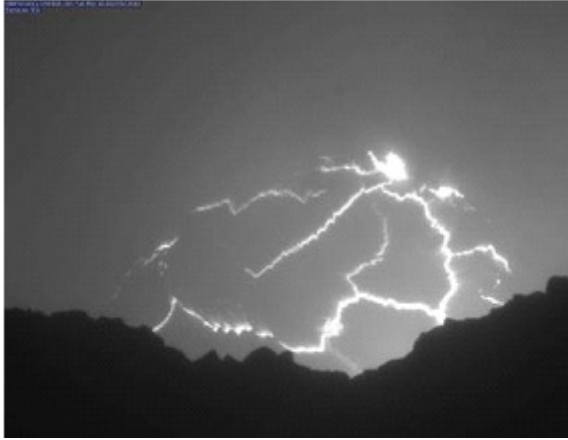
4. Examine this data record at Puu Oo collected by a **gravimeter** and suggest what event(s) may be occurring. Explain the justification for your hypothesis.



This graph shows the strength of the gravity field (in units called miligals) as recorded by a **gravimeter** near the Puu Oo vent over the course of a single day in June 2010 (Michael Poland, USGS)

5. Describe the procedure for acquiring data, such as that shown above, for your instrument from the Volcano Exploration Project (VEPP: <https://vepp.wr.usgs.gov/vepp/>) or Hawaiian Volcano Observatory (HVO: <http://hvo.wr.usgs.gov/>).

4. Examine this web camera photographs of Puu Oo and suggest what event(s) may be occurring. They are taken from a camera on the rim looking down into the crater (VEPP/USGS). The one on the left was taken 1 hour before the one on the right on a night in June 2010..



5. Describe the procedure for acquiring data, such as that shown above, for your instrument from the Volcano Exploration Project (VEPP: <https://vepp.wr.usgs.gov/vepp/>) or Hawaiian Volcano Observatory (HVO: <http://hvo.wr.usgs.gov/>).

Volcanologist *Pro Tem*: Exploring the Dynamics of Kilauea Volcano, Hawaii

2. Geologic Processes on Basaltic Shield Volcanoes

Objective

Discover the important processes that shape basaltic shield volcanoes at the Puu Oo vent. Show how monitoring techniques reveal more than just visual observations about the nature and origin of volcanic processes.

Procedure

Form several new teams with one technique expert in each interdisciplinary team. Each expert will teach his or her team about their expertise, focusing on the data acquired by their instrument and what it can reveal about the volcano's behavior. You will then intensely study an important segment of Puu Oo's history using real data acquired by volcanologists monitoring Kilauea volcano and report your interpretations to the class.

Activities

Study the volcanic event assigned to your team. These events include the important processes that shape basaltic shield volcanoes.

- A. 2007 June Father's Day
- B. 2007 Jul 2-30 Harry Potter event
- C. 2010 Jan-Mar
- D. 2005 Feb 5-14 Martin Luther King event
- E. 2010 May-June

1. Using the time frame listed above, examine and selectively download and graph the data for your specialty using the web pages of the Volcano Exploration Project (<https://vepp.wr.usgs.gov/vepp/>) and the Hawaiian Volcano Observatory (HVO: <http://hvo.wr.usgs.gov/>). Study the information carefully and construct one or two hypotheses regarding the cause of the "signal" provided by your instrument and what it tells you about Puu Oo.
2. Meet with your interdisciplinary team and present your data and any hypotheses you have constructed about what happened at this time. Consider the information provided by other instruments and the interpretations of the other experts on your team.
3. Collectively, construct a coherent series of data graphs and photographic images that describe your event—eventually these will be used in an oral presentation using PowerPoint. Cooperatively complete the work sheet on the back to describe the event and how it was expressed in data acquired by each instrument or monitoring specialty. Turn in one copy that includes the names of all the volcanologists on your team.
4. As you fill out the form, reconsider your hypotheses regarding the cause of the "signal" provided by your instrument and what it tells you about Puu Oo. Formulate an explanation of or hypothesis about the volcano's behavior during your event that best explains all of the data.

Volcanologist *Pro Tem*: Exploring the Dynamics of Kilauea Volcano, Hawaii
2. Geologic Processes on Basaltic Shield Volcanoes

Team Name _____

Volcanologists Names _____

Event Name

Dates

Instrument reports

Describe the signal provided by each of the techniques listed below during your event?

A. Global positioning system

B. Tiltmeter

C. Seismometer

D. Gravimeter

E. Geology

What geologic events or processes explain the data best (e.g., overflow of a lava lake, intrusion of new magma, destruction of a volcanic cone)? Briefly explain how this event appeared on each instrumental record. Note any problematic parts of your interpretation.

Volcanologist *Pro Tem*: Exploring the Dynamics of Kilauea Volcano, Hawaii

Instructions for presentations on Volcanic Events at Puu Oo

Objective

Prepare a short (<10 slides) PowerPoint file and have a spokesperson present it orally to the class.

Activities

1. Choose your team's spokesperson.
2. Each member of the team will prepare at least one PowerPoint slide with images, maps, videos, and graphs of the data from each of the instruments. Be sure to construct a separate slide that succinctly describes your collective interpretation of the geologic cause of the instrumental record.
3. Report your results and new hypotheses verbally to the entire class in a **5-minute** presentation.
4. Be prepared as a group to answer questions about your report.

Suggested Outline

Title slide with your names, your team's name and the geologic event you have studied.

Slides on each technique—time variations of seismicity, tilt, GPS locations, webcams, etc.

Conclusion slide

Suggestions for Good PowerPoint Design

Consider the suggestions listed here:

http://articles.techrepublic.com.com/5100-22_11-6117178.html

Don't put too many words or pictures on one slide.

Make sure the text is big enough to be legible from the back of the room

Don't use busy backgrounds

Volcanologist *Pro Tem*: Exploring the Dynamics of Kilauea Volcano, Hawaii
3: What Will Happen Next?

Team Name _____

Volcanologists Names

Objective

Using the monitoring techniques that we have studied, create a short list of predictive criteria for a specific kind of volcanic event on a basaltic shield volcano.

Group Activity

You have honed your skills as a volcanologist and studied a variety of volcanic events. You have seen how volcano monitors may (or may not) respond to these different events. Together with your team, prepare a list of three “signals” that could be used to predict an eminent volcanic event OR to predict that a volcanic event has occurred in the absence of visual confirmation.

Choose one volcanic process from this list.

- Onset of an eruption after a long period (5 years) of quiescence on Kilauea
- Collapse of the vent cone
- Intrusion of new magma
- Lateral injection of a dike of magma from a central source
- Tectonic earthquake “unrelated” to volcanic eruption

Criteria

Volcanologist *Pro Tem*: Exploring the Dynamics of Kilauea Volcano, Hawaii
4: Volcanologist on Watch: Summary and Prediction of Hawaiian Volcanic Activity

Team Name _____

Volcanologists Names

Objective

Observe, record, and report the weekly behavior of Kilauea near the Puu Oo vent and prepare predictions of subsequent behavior.

Procedure

Day in and day out, volcanologists at the Hawaiian Volcano Observatory spend much of their time collecting information of the activity of the volcanoes on Hawaii. Using real-time data from the VEPP and HVO web pages, compile a summary of the volcanic events for a one week time period. Then, using the present as a guide to the future, predict the types of volcanism you expect to occur in the following week. Consider the signals of the monitoring instruments, the extent of surface flows, development of new fissures, fountains, lava deltas, cone collapses, inflation or deflation cycles, extent of new homes, explosions, vapor plumes, homes destroyed, etc. etc.

Monday Morning Report

1. Dates: _____ to _____

2. Summary of the week's events at Puu Oo.

2. Prediction for next week and reason for your prediction.

Volcanologist *Pro Tem*: Exploring the Dynamics of Kilauea Volcano, Hawaii
Concept Test

Name _____

The goals for this project, *Volcanologist Pro Tem*, were to show that volcanoes are dynamic systems that change in size, shape, and eruptive behavior. A variety of observations and field instruments are used to show this. Such changes help us understand a volcano's structure and predict changes in its eruption behavior. Now it's time to see if we meet these goals.

Answer These Short Essay Questions

1. Construct a graph showing how (a) the tilt of a volcano's flanks and (b) seismicity typically vary with time in response to an intrusion of a "slug" of new magma into a large basaltic shield volcano. Use correct units of measurement and label the time axis with appropriate numbers for Kilauea volcano.

2. Describe the three types of events that have shaped the volcanic system at Puu Oo, the currently active vent on Kilauea volcano, Hawaii

3. Draw a vertical cross section showing how magma moves through the Puu Oo volcanic system.

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Suggested Schedule

Week 1	
Week 2	Preliminary discussion of Plate Tectonics, including Mantle Plumes
Week 3	Minerals
Week 4	Igneous Rocks and Volcanoes
Week 5	Worksheet 1: Become a Volcanologist
Week 6	Worksheet 2: Geologic Processes on Basaltic Shield Volcanoes
Week 7	Student presentations on “Volcanic Events at Puu Oo”
Week 8	Worksheet 3: What Happen Will Happen Next?
Week 9	
Week 10	Worksheet 4: Volcanologist on Watch: Team 1 : Monday morning meeting
Week 11	Worksheet 4: Volcanologist on Watch: Team 2 : Monday morning meeting
Week 12	Worksheet 4: Volcanologist on Watch: Team 3 : Monday morning meeting
Week 13	Worksheet 4: Volcanologist on Watch: Team 4 : Monday morning meeting
Week 14	Worksheet 4: Volcanologist on Watch: Team 5 : Monday morning meeting
Week 15	Sum up by professor
Week 16	Concept Test

Sequence of assignments for a typical 16 week semester.

Should take about 5 minutes per week in Weeks 5 to 6, 8, and 15; an entire class period for Week 7 presentations; and 10 minutes per week in Weeks 10-14 for Monday Morning Meeting.