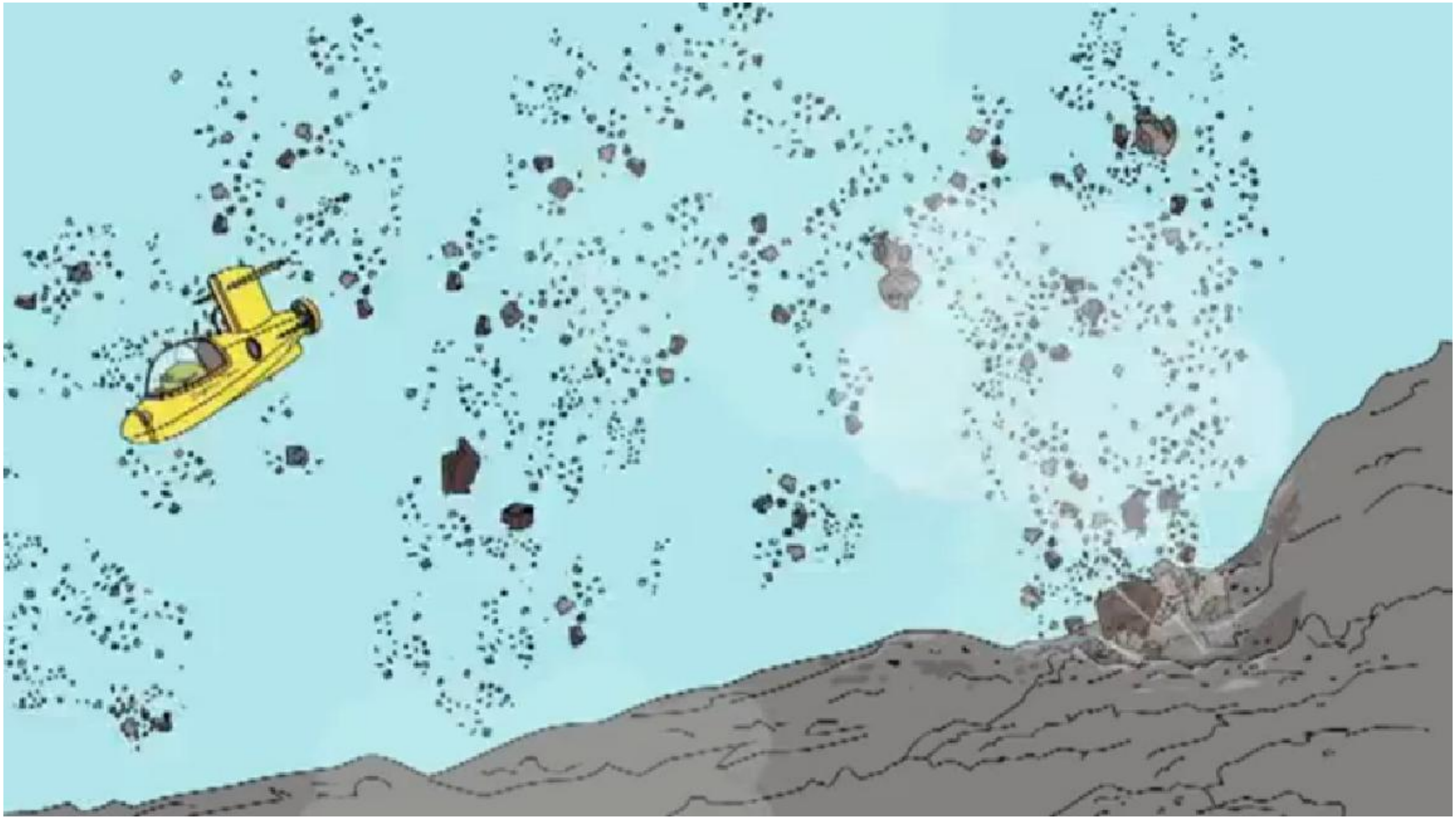
Key Stage 5 - Volcano Eruption!



www.oxfordsparks.net/volcano

Volcano monitoring

Volcanoes often show physical or chemical signals before an eruption. These signals allow volcanologists to monitor active volcanoes, and perhaps predict a future eruption.

One physical signal is the deformation or movement of the volcanic edifice and surrounding crust. Changes in the surface of the volcano are usually related to the arrival of magma at depth, and pressure increases in the magma chamber.

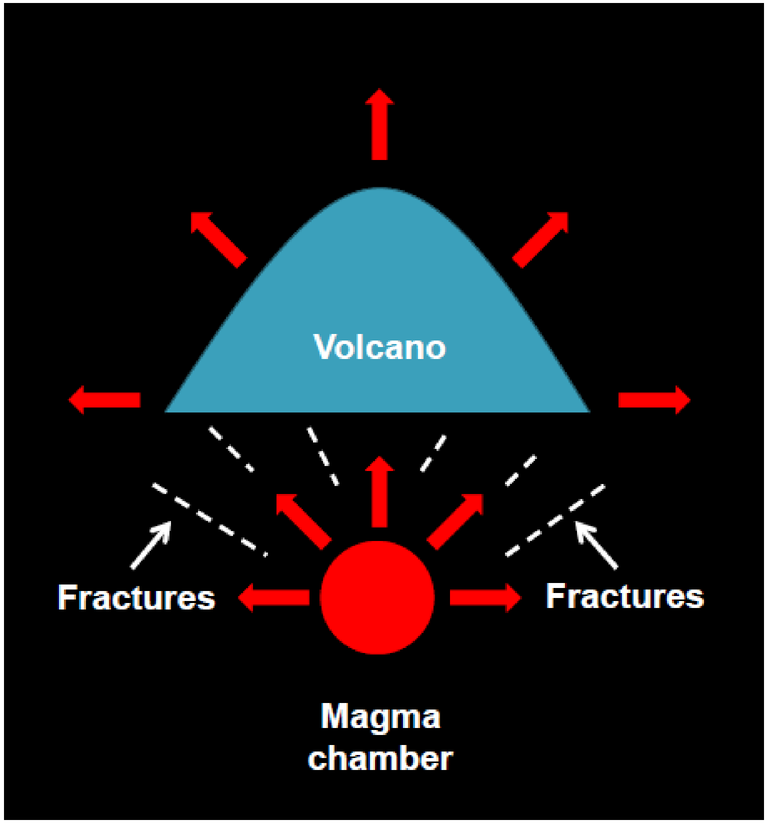


Image: Michelle Parks, University of Oxford

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Volcano monitoring

If volcanic unrest is due to new magma arriving at depth, the volcano should inflate.

We should see this in GPS (global positioning system) and satellite radar interferometry (InSAR) data.

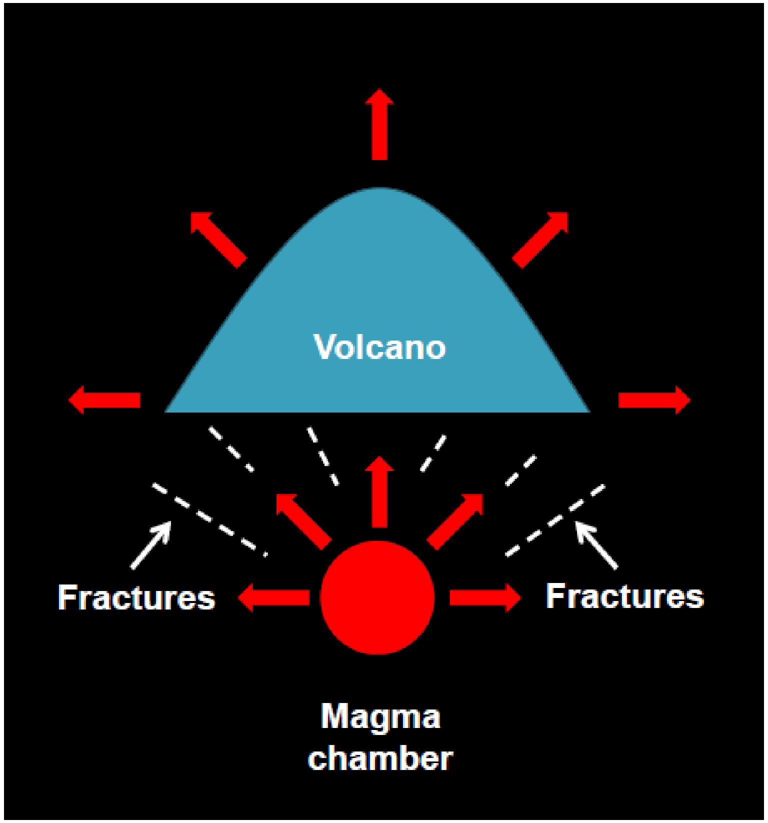

Image: Michelle Parks, University of Oxford

Magma intrusion by surface uplift, followed by eruption and subsidence.

Stage 1:

Inflation begins as magma moves into the volcano, and pressure increases in the magma chamber.

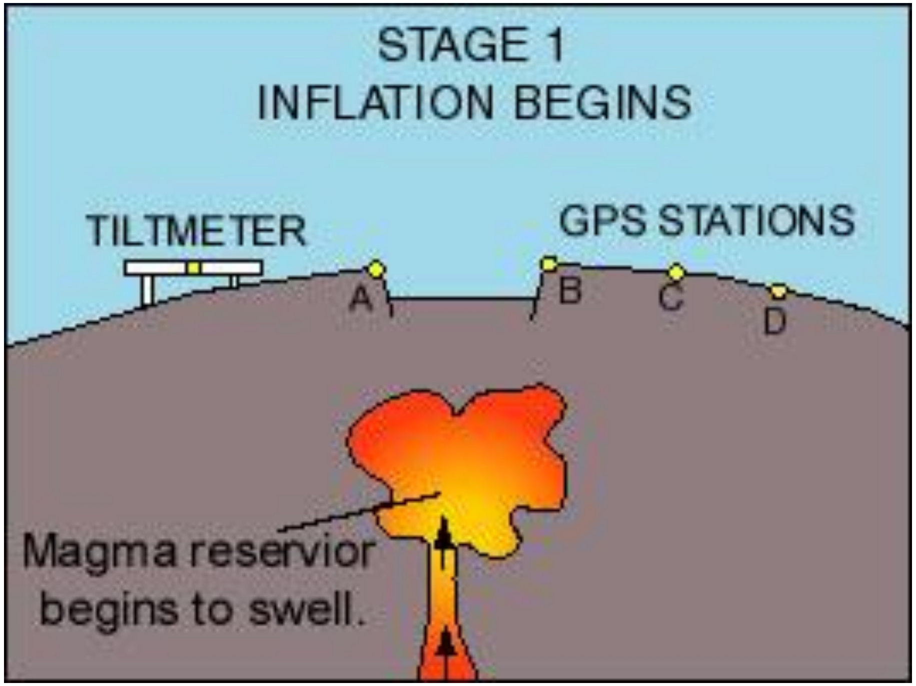

Image: United States Geological Survey, Hawaii Volcano Observatory
http://hvo.wr.usgs.gov/howwork/subsidence/inflate_deflate.html

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Magma intrusion by surface uplift, followed by eruption and subsidence.

Stage 2:

As the magma chamber inflates, the ground surface is pushed up.

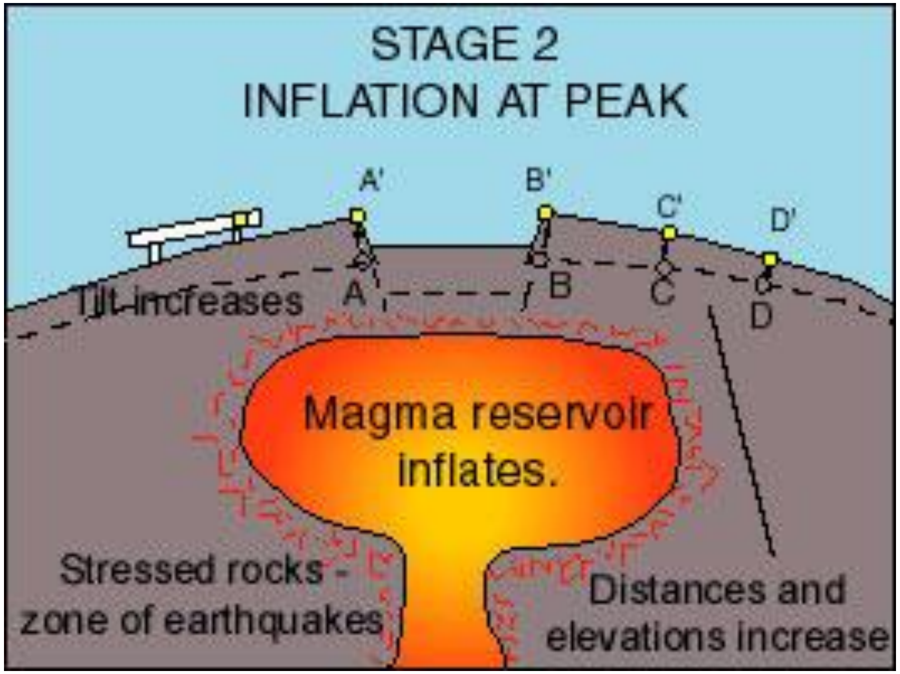


Image: United States Geological Survey, Hawaii Volcano Observatory
http://hvo.wr.usgs.gov/howwork/subsidence/inflate_deflate.html

Magma intrusion by surface uplift, followed by eruption and subsidence.

Stage 3:

After an eruption, the magma chamber deflates.

The ground surface subsides.

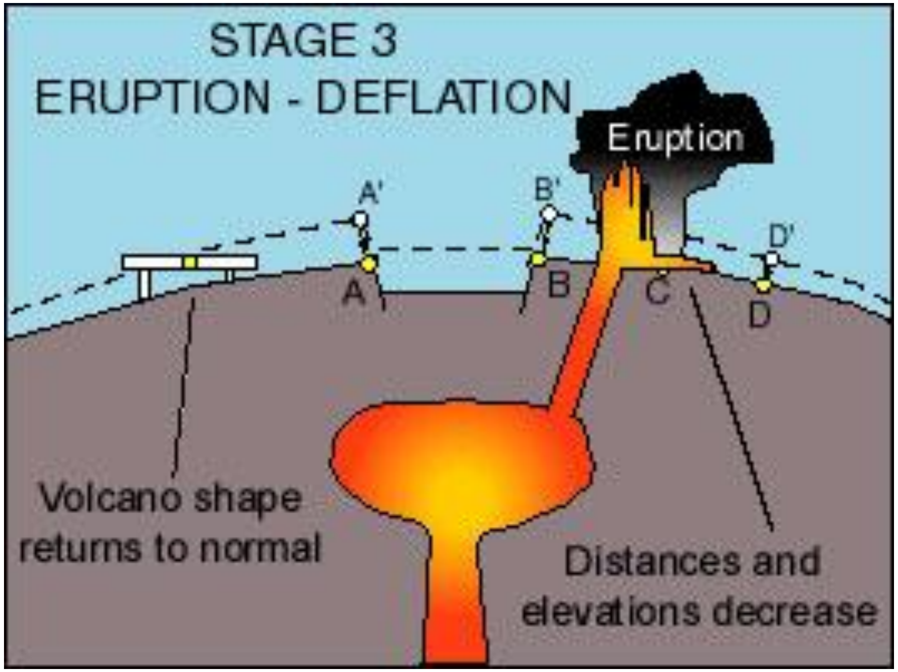
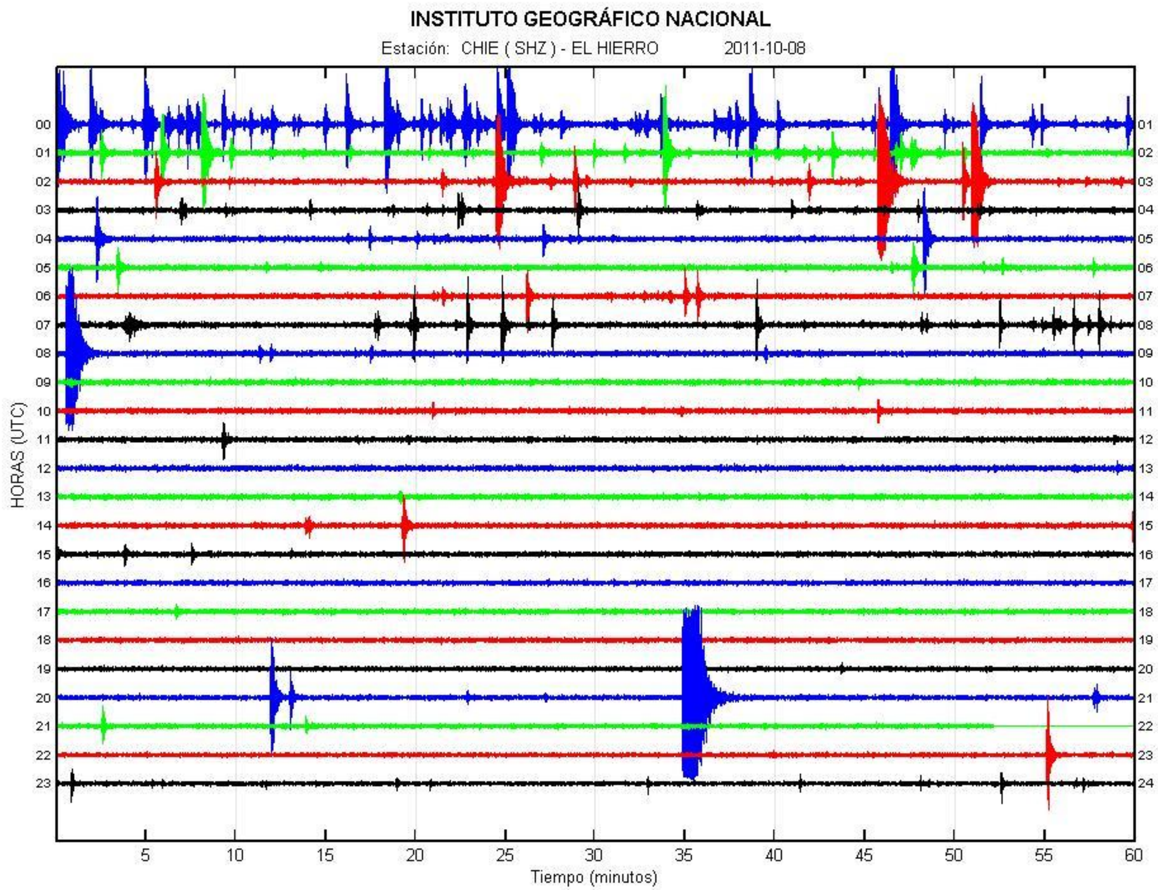


Image: United States Geological Survey, Hawaii Volcano Observatory
http://hvo.wr.usgs.gov/howwork/subsidence/inflate_deflate.html

Pre-eruption signals, El Hierro, Canary islands, 2011

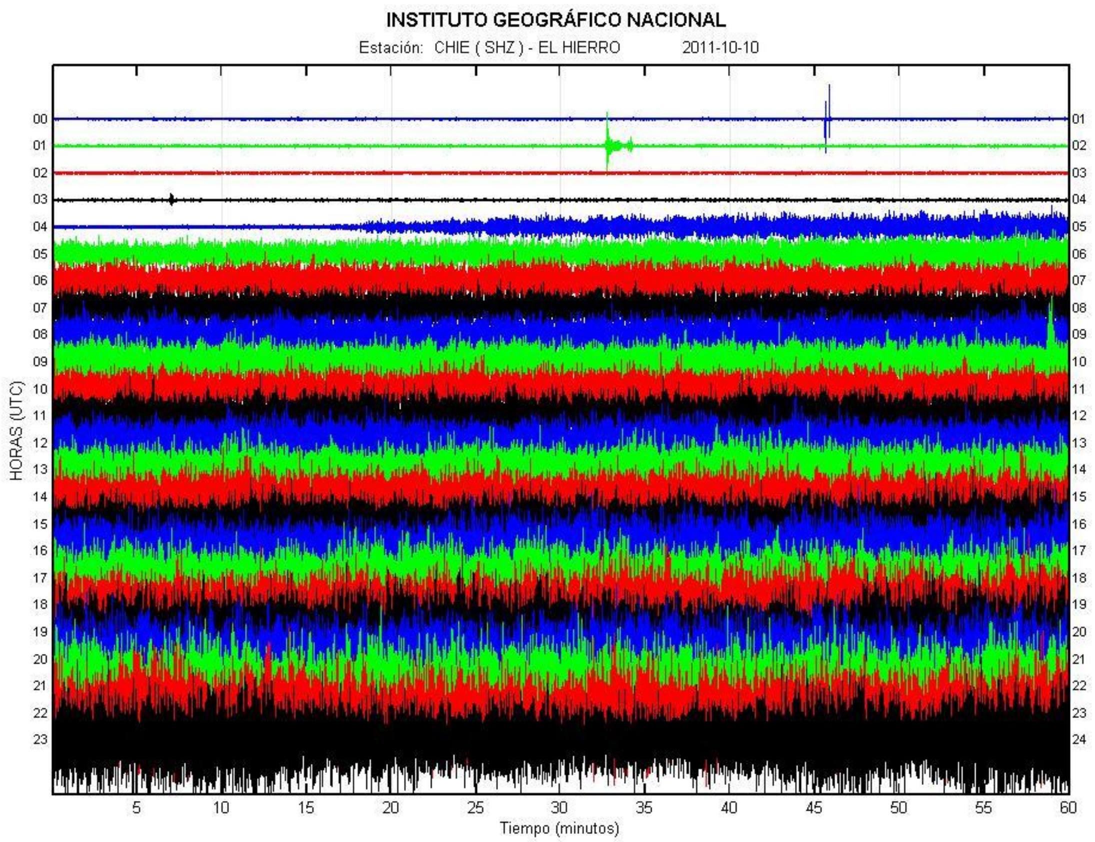


Typical record of pre-eruption quakes.

There are repeated Volcano-Tectonic events. Fractures are starting to open up at depth.

Image: Instituto Geográfico Nacional, Spain. www.ign.es/ign/resources/volcanologia/HIERRO.html

Pre-eruption signals, El Hierro, Canary islands, 2011



The signal changes to a continuous tremor, due to flowing or erupting magma.

Image: Instituto Geográfico Nacional, Spain. www.ign.es/ign/resources/volcanologia/HIERRO.html

Pre-eruption signals, El Hierro, Canary islands, 2011

The rate of energy release by earthquakes increases before the eruption starts.

Image: Instituto Geográfico Nacional, Spain. www.ign.es/ign/resources/volcanologia/HIERRO.html

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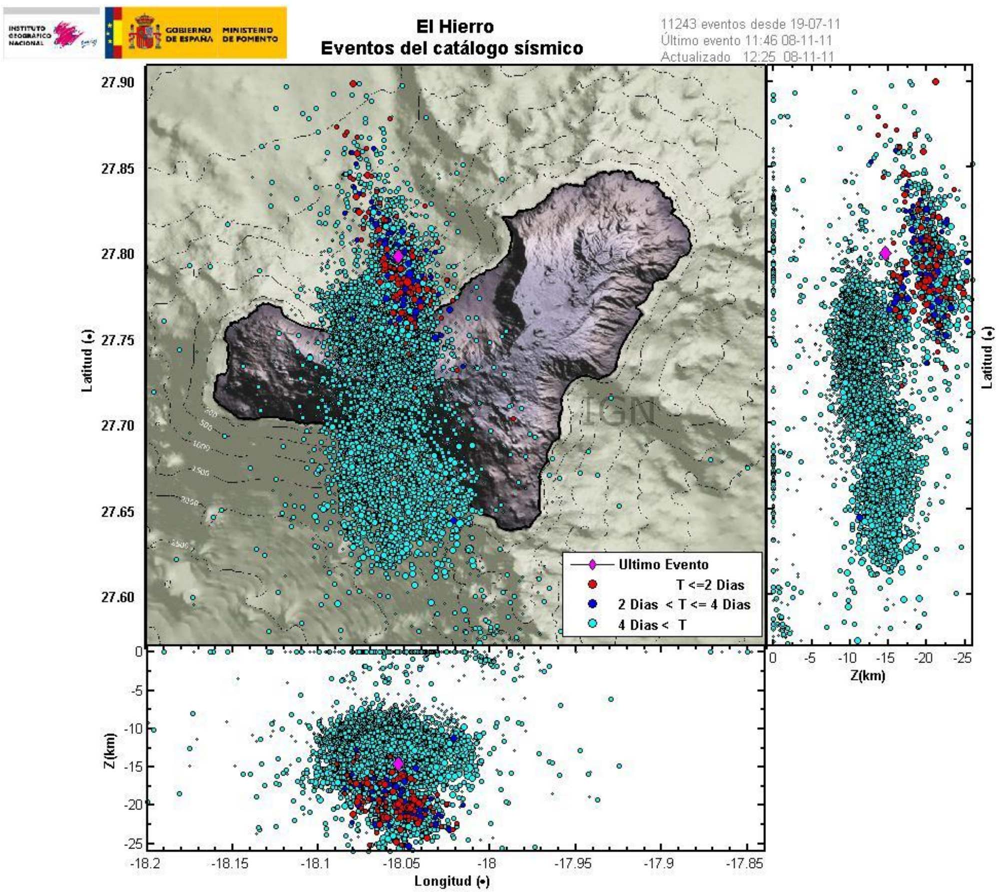
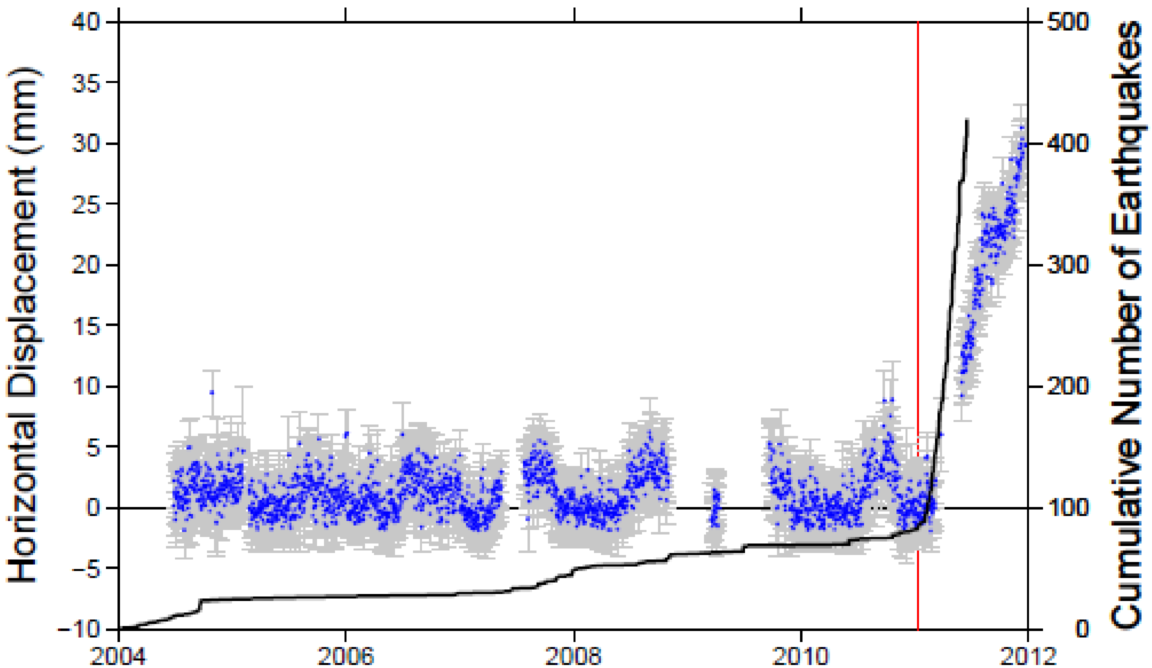
Pre-eruption signals, El Hierro, Canary islands, 2011

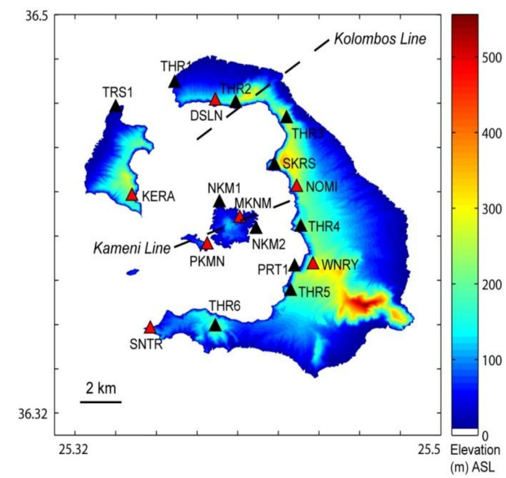


The locations of earthquakes through time.

Image: Instituto Geográfico Nacional, Spain. www.ign.es/ign/resources/volcanologia/HIERRO.html

Continuous Global Positioning System (cGPS)

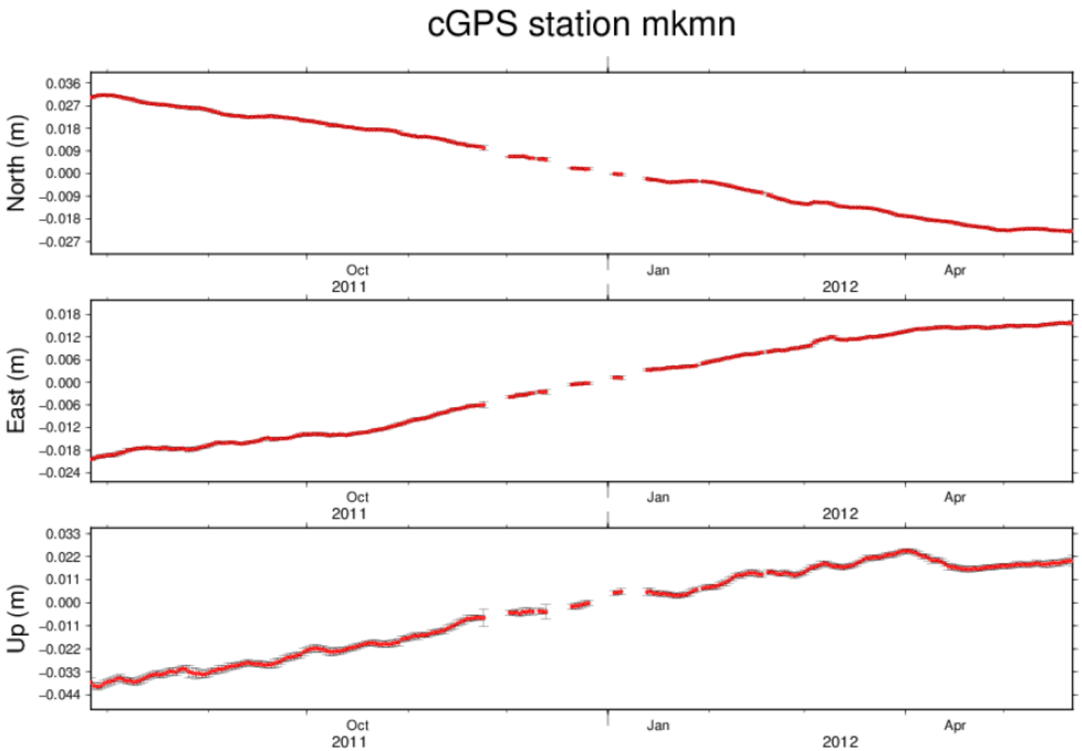




Daily location of the cGPS station SNTR (Akrotiri, southern Santorini, Greece) from 2004 – 2012. The solid line shows the cumulative number of recorded earthquakes.

Image: Parks et al., Nature Geoscience 5, 749–754 (2012)

Continuous Global Positioning System (cGPS)



Daily cGPS solutions for site MKMN, on the central island of Santorini, for 2011-2012.

Image: Parks et al., Nature Geoscience 5, 749–754 (2012)

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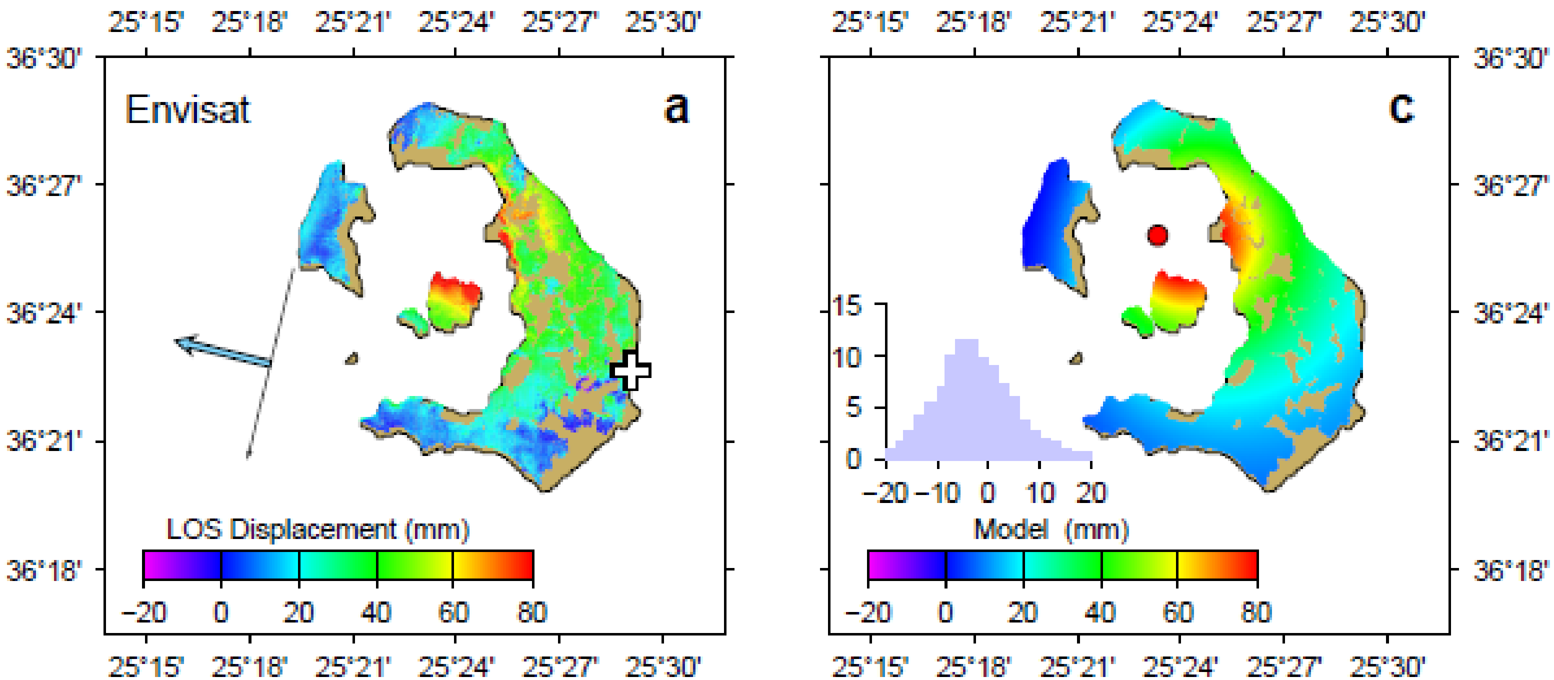
Radar interferometry (InSAR) example

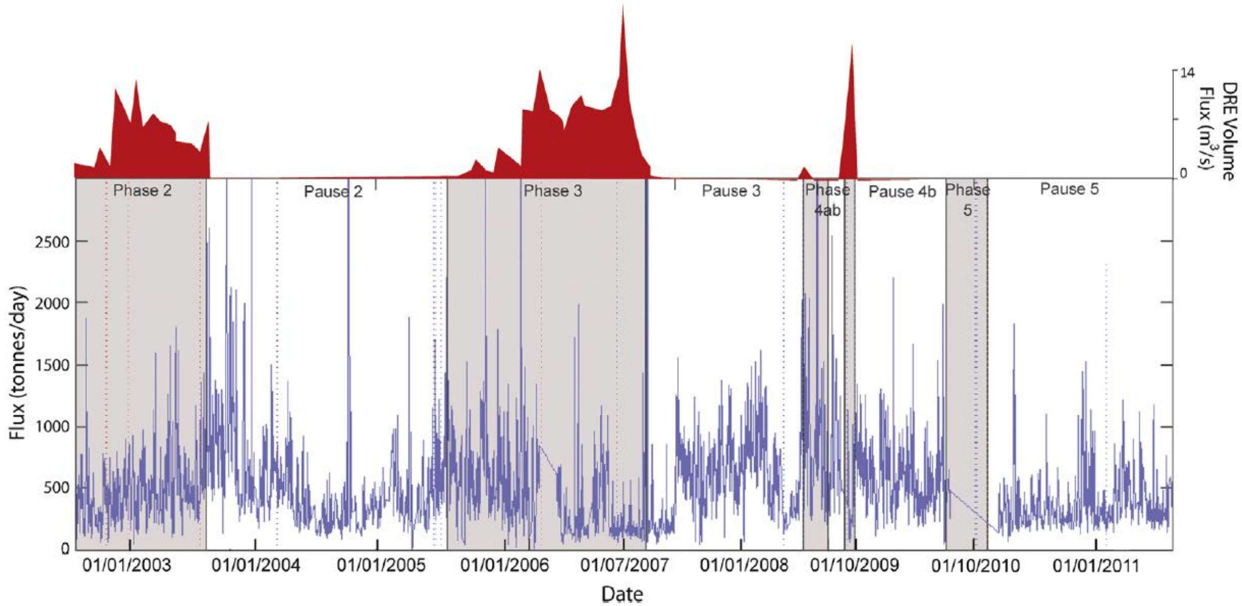


InSAR interferogram for Mar-Dec 2011, Santorini.

The location of the best-fitting (spherical) pressure source at depth is shown by a red dot. This was found by comparing observations (left-hand image) to the model (right hand image), for a range of pressure-source locations.

Image: Parks et al., Nature Geoscience 5, 749–754 (2012)

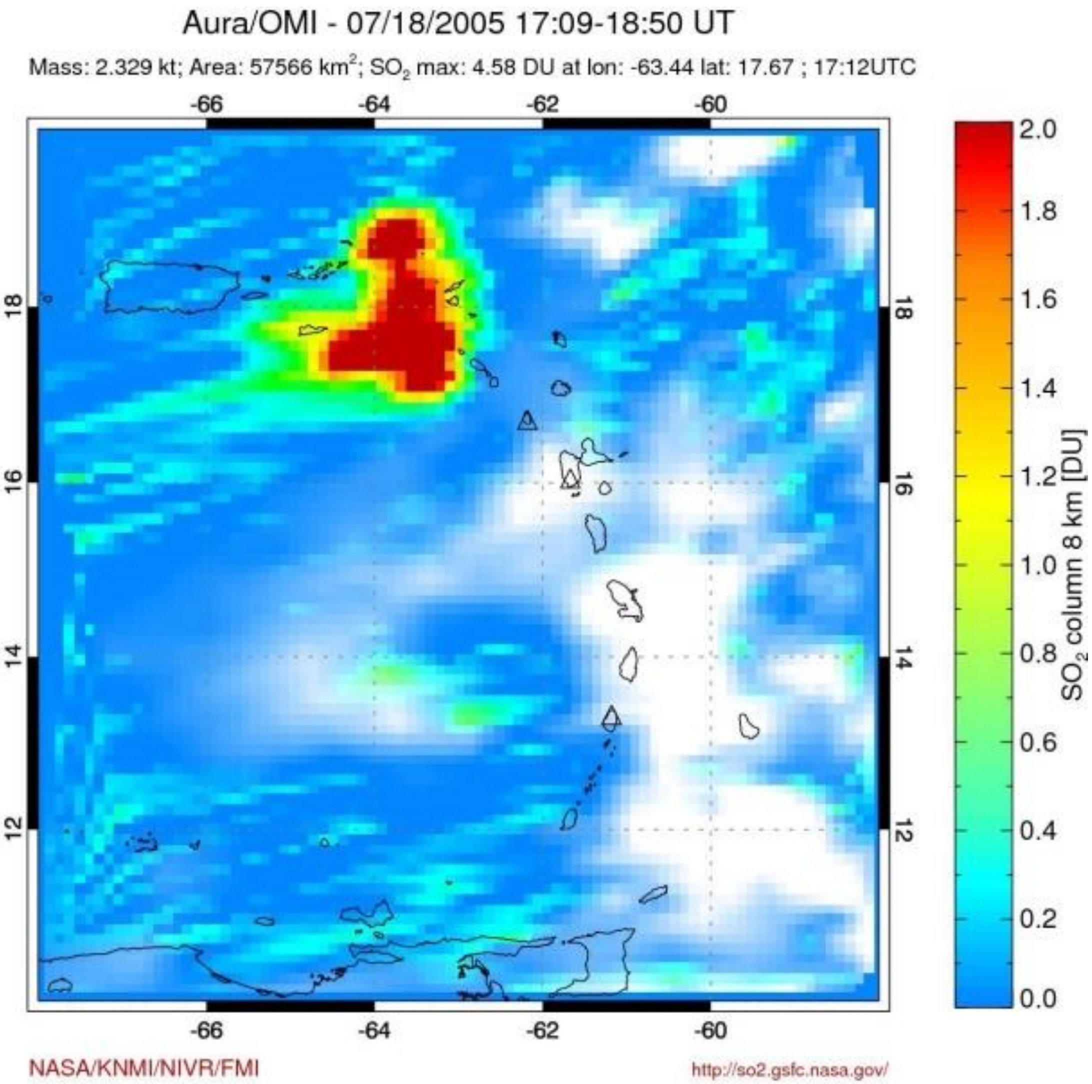
Daily SO_2 gas emissions, Montserrat.



Graphs of daily gas emission rate (SO_2 gas, tonnes/day) along the lower panel, and the eruption rate of dense lava (DRE = dense rock equivalent), upper panel) with time, from 2002 – 2012.

Image: Nicholson et al., Earth and Planetary Science Letters, 375, 209–221 (2013).

Daily SO_2 gas emissions, Montserrat.



Satellite image of SO_2 plume on July 18, 2005.

Image from the Ozone Measuring Instrument.

Image credit: NASA. http://so2.gsfc.nasa.gov/

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