

Collapse of Vulcan Ecuador,
Isla Isabela, Galapagos Islands

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Project Summary

Vulcan Ecuador is a volcano located in the northwest of Isla Isabela in the Galapagos Islands that at one time experienced a collapse of its western flanks. The objective of this study is to determine the volume of material that was transported during this collapse. The bathymetry will be determined by using the EM300. Using a process called planimetry the volume transported during the collapse can be determined. Taking a sediment sample with a box corer would determine the sedimentation rate and, from that, possibly determine the age of the collapse. Sector collapses in oceanic volcanic islands can lead to the production of tsunamis which can in turn lead to severe destruction of coastal cities.

Introduction

Vulcan Ecuador is just one of many of the Hot Spot produced volcanoes of the region. It is located on Isla Isabela (Simkin, 1984). This island within the Galapagos is a relatively active island with an eruption of one of its six volcanoes as recent as within the last month. Oceanic island volcanoes are majestic in their nature, but can have a deadly consequence under certain circumstances. Vertical and lateral collapses are common in oceanic islands, like the Hawaiian islands, the Canary Islands, and also in the Galapagos Islands. The instability and subsequent collapse of the flanks of large volcanic edifices may result from different causes, such as volcanic spreading, dike intrusion, accumulation of eruptive products on steep slope, earthquakes, magma chamber inflation and deflation, and changing sea levels (Marti, 1997). The lateral collapse of the volcanic flank of one of the ocean island volcanoes can lead to the production of a tsunami. If the tsunami is capable of propagating to a coastal land it could create a mega tsunami that is 10 times the size of the tsunami that devastated Sumatra.

Vulcan Ecuador is one of these volcanoes that seem to have lost its western flank through a geological process. Upon looking at it you can see that it seems to have been sliced in half. The best explanation for this halving of the volcano is a lateral sector collapse. The collapse of this flank had to be deposited somewhere and has been determined to have been deposited in the ocean off the west coast of the island within the last 100,000 years (Geist et al, 2003). Recent bathymetric studies have identified a large volume debris lobe which is commonly seen in landslides which can be seen in Figure 1 (Kurz et al, 2001).

Proposed Research

The object of this study is to determine the volume of material that was transported during this proposed lateral sector collapse. This study will be carried out on board the R/V Thomas G

Thompson between January 12th and 20th, 2006. Figure 2 shows the area that the study will take place in along with ship tract lines and sediment sampling locations. Using the EM300 Simrad high resolution multi-beam mapping system, mounted to the R/V Thompson, a high resolution bathymetric map will be created. From this map the current bathymetric profile is seen, and then an inferred bathymetric map, which shows the bathymetry that was there prior to the collapse, will be created. Using a process called planimetry, where you subtract the inferred profile from the current profile, the volume of the materials transported can be found. Using a box corer, I would like to determine the rate of sedimentation and hopefully use this information to determine the approximate age of the collapse. The rate of sedimentation would be found by using ash layers within the sediment from the 1968 and 1998 eruptions of Fernandina as reference layers. Then I would compare the depth of sediment on top of the basaltic debris flow to the rate found by the process above and this would then determine how long the sediments have been accumulating and theoretically how long ago the collapse occurred. This is all done with the assumption that volcanic lava flows since the collapse have had no effect on the area where samples have been taken. Using side-scan sonar from the DRIFT Leg 4 Cruise Report the locations for sediment sample have been chosen as in Figure 3. The areas that are the lightest are areas of soft sediment and areas that are black are areas of recent lava flows (Kurz, 2001).

In Table 1 you will find the points that I have chosen for the area of proposed research. Points HH1-HH14 are way points for the tract lines of the ship and Points HH15 and HH16 are the two sediment cores that I wish to take.

Budget

Ship cost per day: $\$18,000 \times 8 \text{ days} = 144,000$

Box Core per day: $\$45 \times 8 \text{ days} = 360$

Sieve per day: $\$3 \times 8 \text{ days} = 24$

EM300 per day: included in cost of ship.

References

Geist, D., White, W., Albarede, F., Harpp, K., Reynolds, R., Blichert-Toft, J., Kurz, M. 2002. Volcanic evolution in the Galapagos: The dissected shield of Volcan Ecuador. *Geochemistry Geophysics Geosystems*, Volume 3, Number 10

Kurz, M., Fornari, D., Geist, D., and Shipboard Scientific Party. 2001. Cruise Report DRIFT Leg-4 R/V Roger Revelle.

Marti, J., Hurlimann, M., Ablay, G., Gudmundsson, A. 1997. Vertical and Lateral Collapses on Tenerife(Canary Islands) and other volcanic ocean islands. *Geology*. Volume 25, Number 10 p 879-882

Simkin, T. 1984. *Geology of the Galapagos Islands* In: Perry R. (ed)Galapagos, Oxford: Pergamon. P 15-41

Tables

Table 1. Way points for ship tract lines. HH1-HH14 are for EM300 Surveying and HH15-HH16 are the two sediment sampling locations.

Label	Latitude	Longitude	Equipment
HH1	0.0263	-91.639	EM300
HH2	-0.1033	-91.529	EM300
HH3	0.0257	-91.6453	EM300
HH4	-0.1073	-91.5365	EM300
HH5	0.0151	-91.658956	EM300
HH6	-0.119409	-91.552413	EM300
HH7	-0.131922	-91.5641	EM300
HH8	0.004933	-91.671094	EM300
HH9	-0.004451	-91.680085	EM300
HH10	-0.140524	-91.579386	EM300
HH11	-0.158511	-91.600964	EM300
HH12	-0.014617	-91.693571	EM300
HH13	-0.029476	-91.714251	EM300
HH14	-0.171805	-91.622542	EM300
HH15	-0.0526	-91.6056	Sed core
HH16	-0.0762	-91.6586	Sed core

Figure Captions

Figure 1. Picture of bathymetric profile which identifies the debris lobe, which is common to landslides both on land and in the water taken from the DRIFT Leg-4 Cruise Report (Kurz et al, 2001).

Figure 2. Picture of track line way points and sediment collection points off the coast of Isla Isabela to the west of Vulcan Ecuador.

Figure 3. Sidescan bathymetric profile off the coast of Isla Isabela, west of Vulcan Ecuador

Figure 1

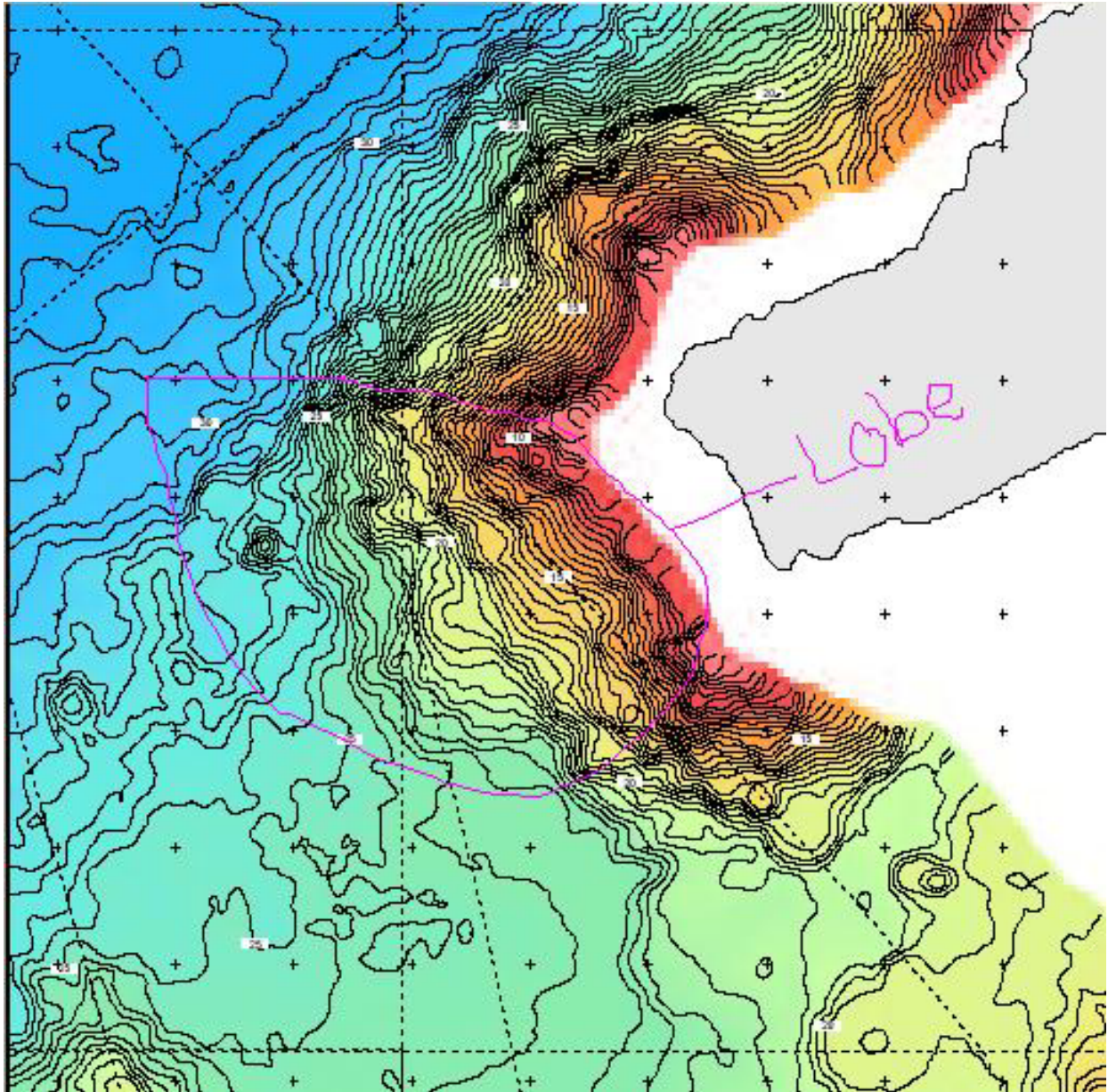


Figure 2

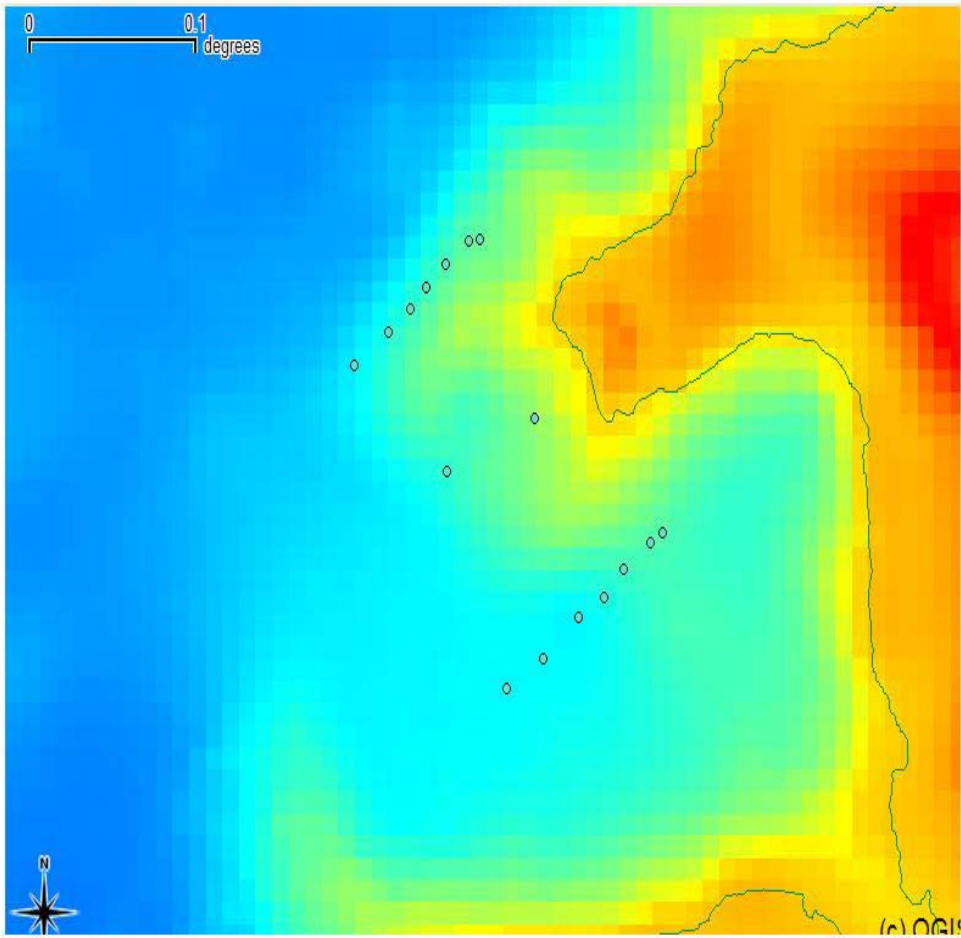


Figure 3

