The Rising Socorro Magma Body

New Mexico

Supercomputing Challenge

Final Report

April 6, 2010

Team 48

Freedom High School

<u>Team members</u>:

-Joel Sandoval

-Marika Plugge

-Yoshua Reece

-Jasmine Jensen

<u>Teachers</u>:

-Joe Vertrees

<u>Mentor</u>:

-Paula Rimmer

I. Intro
- A. Dangers of a volcanic eruption
  - 1.Detrament to urban developments
    - a. hospitals, schools, etc.
  - 2. Detrament to wildlife
    - a. national wildlife reserves (Sevilleta & bosque del apache)
  - 3. detrament to Rio Grande
    - a. importance of rio grande to NM
II. Description
- A. Pinpointing an eruption point
  - 1. Faultline map
  - 2. Seismic activity map
- B. Mapping out lava flow paths
  - 1. Topography map in netlogo (color-code trained turtles)
  - 2. Overlaying road map to observe road damage.
III. Results
- A. Lava flow paths with netlogo.
  - 1. We found the lava damage zones.
- B. Damage estimate
  - 1. Urban developments: I-25, hospitals retirement homes, etc.
  - 2. Wildlife: national wildlife reserves (Sevilleta & bosque del apache)
- C. Rio grande
  - 1. Blockage, possible forming of a lake.
  - 2. Elephant butte reservoir
  - 3. bosque
IV. Conclusion

Team 48 Executive Summary

Impact of the Socorro Mid-Crustal Magma Body

As the magma body below Socorro is rising 2-4mm annually, it is important to analyze the likelihood of a future volcano in the area, and especially what that could mean for the local community and geography. Through observation of regional faultlines, combined with knowledge of the seismic activity of the area, we were able to pinpoint the most possible location of the potential eruption. For the purpose of predetermining damage done by lava flow, we used Netlogo combined with topographical maps of the region to map the paths to be taken by the lava, and in turn, the areas that will experience the most damage in the case of an eruption. We conclude from this experiment, that massive damage will come to much of the surrounding eco-system, communities, and especially the interstate and Rio Grande River, which is an important source of living for many communities downstream.

The Socorro wilderness is habitat to countless species, many of which are endangered. The Sevilleta national wildlife reserve lies directly within the target zone of damage, and is a significant monument to New Mexico's natural world, home to many of these endangered species. The Rio Grande would also carry ash and debree downstream, where it would affect the Bosque Del Apache wildlife reserve, as well as the Elephant Butte reservoir. With the predicted damage to the land, the prospect of long-term damage to the biological life of Socorro and it's ecosystem is urgent.

The community of Socorro and other urban developments would also sustain heavy damage that should come into consideration. Such an eruption put off debree and gas that would affect nearby hospitals, schools, retirement homes, etc. With our simulation mapping the lava flows, we used a regular road map of the region to figure damages done to interstate 25. Inhibited transportation could mean problems on a bigger scale, involving other cities with delivery routes, and traffic , especially in evacuation.

The most prominent geographical change that could come of such an eruption as we've figured, is to the Rio Grande river. The Rio Grande plays a central role in the agriculture and economy of new mexico, and the supposed area of lava damage lies directly over a section of this river. In the case of an eruption, it is likely that the lava flow may cause a blockage in the flow of the Rio Grande, which, based on the layout of the surrounding terrain, we predict could mean the forming of a new lake in central new mexico.

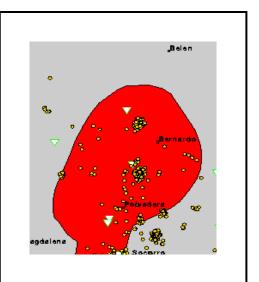# Impact of the Socorro Mid-Crustal Magma Body

Team 48

Deep underground, 19 kilometers below the feet of the people of Socorro lies a giant body of magma. What does the Socorro magma body mean to us? What would it mean for our cities and surrounding ecosystems were it to erupt? The purpose of our project is to answer these questions and lay out an idea of what the area of devastation would be on the volcano's surrounding environments. As the magma body is pushing upward 2-4 millimeters every year, we begin to see the beginnings of what could be an active volcano. Volcano means lava flow, and lava flow means dead trees, destroyed habitats, homeless animals, and ruination of our cities. It is important for us, now, to be trying to determine beforehand where this lava will course through the immediate terrain.

The first thing to do is to accurately figure the most likely point of eruption. The magma body itself covers 3400 square kilometers, and nothing can be deduced if we do not know where the volcano itself will be. In order to do this, we studied a map of the regional fault lines, combined with a map of the seismic activity of the area. We found, near the center of the magma body, a major fault line with a history of great seismic activity. This is the point that we concluded most probably the site of our predicted volcano. Now in order to map out the paths that the lava will take, we incorporated a chrome-based topographical map of the region into Netlogo and programmed the turtles to simulate the lava by following areas based on color. This came from Earth Explore. Our final simulation of these lava flows looks like this. With the target zone of lava damage now established, we researched roadmaps and Google maps of the area to learn what major roadways and wildlife would be lost to the eruption.

Aside from pinpointing the most likely site of the volcano and plotting the areas of lava damage that can be expected, our team has noted the most major concerns that this volcanic eruption would raise for Socorro and it's surrounding lands. As far as damage done to the city itself, it is notable to consider the fact that I-25 runs directly through the volcano's target zone of lava damage. In the eye of an emergency, we must realize that this could hinder aid, delivery of supplies, and most importantly evacuation. Also, depending on the nature of the eruption, it may be important to consider the possible dangers of airborne ash and gases coming into contact with hospitals, retirement homes, schools, etc.

Damage done to the land itself is also an issue. Within the target zone of lava damage lies the Sevilleta National Wildlife Reserve, whose habitat is a monument to the natural world of New Mexico, and houses many endangered species. Further downstream of the Rio Grande lies the Bosque Del Apache National Wildlife Reserve, whose ecosystem would be impacted by the ash and debris carried down in the Rio Grande, running directly through the reserve.

The most significant geographical impact that the eruption would have would be on the Rio Grande River itself. The river is a central part of the agriculture and economy of New Mexico, and it gives life to a number of communities downstream. The target area of direct lava damage lies directly over the river itself. Based on the regional terrain, we can assume that, were there to be a blockage in the river, a new lake could possibly develop in central New Mexico. This would be detrimental to all communities and ecosystems downstream, as well as to the Bosque and the Elephant Butte Reservoir.

In conclusion, a volcanic eruption such as we have predicted is very much possible, and would be catastrophic to its surrounding communities as well as ecosystems. It could severely alter the face of the land here in central New Mexico, creating massive changes geographically. Although the entire project has proven to be a challenge for us all, we believe our greatest achievement overall to be the pinpointing of the most likely site for a potential volcano, as well as the mapping of the lava flows to deduce an accurate prediction of the target zone of lava damage.

We would like to offer our sincerest thanks to our teacher Joe Vertrees, whose help and encouragement we could not have accomplished everything without. Thanks.

```
turtles-own [age]

to setup
  clear-all
  ;; imports elevation data
  import-pcolors "Elevation.jpg"
  ;; slightly smooth out the landscape
  ;repeat 20 [ diffuse pcolor 1 ]


end

to go

    ;sets location of eruption along the Intrabasin faults on the Llano de
Albuquerque (2121 on map)
    ;Fault coordinates x = -325 y = -20 to -170
  ask patch -325 -20 [
    sprout 1 [
      set color red
      set age 0
      pen-down
    ]
  ]

  ask turtles [
   downhill pcolor

   set color color - .03    ;changes color of aging flow

   set pcolor pcolor + .1   ;raises the elevation under a flow

   set age age + 1
   if age > cool [die]
  ]
  tick
end


; Copyright 2007 Uri Wilensky. This code may be freely copied,
distributed,
; altered, or otherwise used by anyone for any legal purpose.
```

References

Earthquakes in New Mexico and the Socorro Magma body-

http://earthquake.usgs.gov/regional/qfaults/nm/soc.html

Geophysical research Letters, Vol. 28, No. 18, pages 3549-3552, September 15, 2001

Google Maps

http://www.ees.nmt.edu/Geop/nmquakes/R81/R81.HTM

U.S. Geological Survey (USGS)-

http://earthexplorer.usgs.gov

Magma beneath Socorro, New Mexico-

http://scienceblogs.com/stressrelated/2009/03/magma_beneath_socorro_new_mexi.php

National Center for Computational Sciences -

http://www.nccs.gov/2009/05/19/modeling-

New Mexico Earth Matters, winter 2009, Pages 1-5

NEW MEXICO GEOLOGY, February 2004, Volume 26, Number 1 Pages 34-35

Rio Grande rift -

http://en.wikipedia.org/wiki/Rio_Grande_rift

The Socorro Midcrustal Magma Body-

http://www.ees.nmt.edu/Geop/magma.html