Volcano Seismology & Infrasound Summary 9/19/08
Breakout Group Report
Steve McNutt and Greg Waite

1) Description of key scientific problems

What is the physical state of volcano plumbing systems and how do they change with time?

- Need repeat tomography at higher resolution (shear-wave information is critical), including full-waveform nonlinear inversions
- Should employ high-resolution active source experiments, perhaps beginning with logistically less-challenging submarine volcanoes
- What seismological observations can we use to determine the physical changes that inform eruption prediction and style of eruption?
  - Stress changes and percent of non-double couple component in mechanisms
- Why do some intrusions lead to eruption while others do not?
- Current eruption prediction methods are primarily empirically-based, because we typically don't have the data to explore the physics. We need new data to investigate volcanic earthquake (including LP, VLP) and tremor mechanisms in order to provide physical basis for rate changes and eruption forecasting

- View volcanoes as part of a larger system
  - How do volcanoes and earthquakes interact? (triggering)
  - How do volcanoes interact with each other? (simultaneous eruptions)
  - How do volcanoes interact with hydrosphere and atmosphere (infrasound)

2) Importance of the topics within Earth and other sciences
-Heat and mass transfer;
-highly interdisciplinary;
-volcanoes have high rates of seismic activity and provide input signals for other/complementary studies
-subareal volcanoes – about 10 percent land area and 25 percent of magmatic activity on Earth
-submarine volcanoes – about 75 percent of magmatic activity on Earth

3) Importance for broader society
-Hazards (sidebar – dramatic and easy to understand and see),
-Modern analog for mineral ore bodies,
-change landscapes and add land to the planet on human time scales,
-education (illustrate a broad range of scientific issues; attract attention to Earth sciences just as NASA gets a lot of public attention for Mars rovers),
-enhance geothermal energy

4) Existing and required resources for fundamental advancements

- Order of magnitude increase in instrumentation is needed

    - Replace existing short-period analog stations with digital broadband 3-component stations
        - Need “bombproof” sensors near vent so we can continue to receive (or at least record) data during eruptions
    - Add instruments to unmonitored volcanoes
    - Add infrasound sensors and arrays
- 4D active source studies
    - Also ambient noise as a function of time
- Complementary data (infrasound, video, lightning detection, MT, LIDAR, GPS) with sensors coordinated across disciplines
- Open access to data from all volcano observatories
- More people and improved international collaborations.
- Form a “learning from eruptions” program similar to EERI learning from earthquakes.
- A USGS volcano hazards external grants program - point to success of NEHRP
- Improved interdisciplinary links
    - Atmosphere, Oceans, Analogue modeling, Geochemistry, Geodesy, Satellite remote sensing

Suggested figures:
Photo of Volcano erupting with visible propagating shock wave
Photo of volcano erupting with lightning in plume
Seismic station in foreground with volcano erupting in background