Lee Siebert discussion: 25 Jan 2007

Large Volcanic Debris Avalanches; Characteristics, Distribution, and Hazards

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UBC:

1. What are the differences between cohesive and non cohesive debris flows? (Is it only clay content or is the water fraction important also?)

2.* Regarding Figure 4 on p 213 of the GSA paper, what conditions cause the non-volcanic avalanches to approach the mobility and volumes of the volcanic avalanches? i.e. Factors for volcanic avalanches are given in Figure 1: What are the most important factors contributing to the large volume, mobile non-volcanic avalanches?

3.* How is water content assessed / incorporated into hazard modelling? Please compare Socompa pre-avalanche conditions versus Shasta.

* *Rebecca-Ellen Farrell and Heather*

MTU:

1.* Is it possible to identify features in the field that indicate potential slope failure?

2.* I've read that flank spreading was a factor in the Casita landslide (Cecchi and van Wyk de Vries, 2005); is that widely accepted and can information like this aid hazard assessments? How feasible is it to forecast slope failures?

3.* I'm interested in whether or not sector collapse is a recurring event: Is the structure of a volcano changed so much that after a major collapse it is prone to future failures?

4.* How accurately can a landslide event be dated? Are these events too "cold" to create charcoal for dating?

5.** In the paper by Lee Siebert (GSA 2002) it says that "Yoshimoto and Ui reported evidence for two independent sector failures oriented perpendicular to each other during a single eruption at Komaga-take volcano in Japan". I wanted to ask, what is the likelihood of a volcanic edifice collapse to happen as a complex series of avalanches occurring simultaneously and directed in different directions, and what could be the factors controlling this? To cite an example of a case where this could be important in terms of hazard implications, the Santa María volcano in Guatemala has a severely over-steepened south flank, and therefore it has been suggested that an edifice collapse directed to the south is likely in the long term, however the main population center (Quetzaltenango) is located to the north.

6.*** Given a volcano that has experienced repeated edifice failures (e.g. Edgemont or Augustine), is it more probable that future debris avalanches will follow the same or similar direction?

a. If so, is this likely the result of an already existing failure plane or scarp, or does an existing amphitheater help direct the flow?

b. While Augustine appears to have a radial apron of debris-avalanche deposits, is there a direction, or flow path, that seems to receive more of the deposits?

7. *** Is hazard/risk assessment for debris avalanches only focused on the distance of potential flows? Is the hazard zone established radially-based on the 0.2 - 0.06 H/L ratio?

8. *** Are there other factors such as over saturation, heavy snow pack, or ice wedging, etc. that could cause slope failure?

9. *** What processes cause a debris flow to transform directly into a lahar? Does this occur as a result of incorporation of water during transport, or does vibration energy drive water to the surface and front of the flow?

* *Julie Herrick*
** *Rudiger Escobar*
*** *Hans Lechner*

SFU:

1. What are the most current ideas concerning mechanistic explanations of debris flows? Specifically, which of the various fluidization models (e.g., seismic, air, acoustic, etc.) seem to be best supported by the latest data?

University at Buffalo:

1. What new developments have there been since the referenced review papers were written? For example, which flow mechanisms have fallen out of favor and which are considered more likely? (*Marc*)

2. Our generic picture of a DAD comes largely from MSH. How typical is this deposit and what kind of variations do you see in the field in other DADs? What are examples of atypical DADs? (*Marc*)

3. What are some of the practical difficulties encountered in mapping DADs? Are there many deposits whose origin, as a potential DAD, is still debated? (*Marc*)

4. We noticed that on slide #78 there is a debris avalanche listed for Soufriere Hills Volcano, Montserrat in 2003. Those of us who study Soufriere Hills generally think of this event as a major dome collapse event that generated a block and ash flow. We also

noticed that under magmatic debris avalanches, many of the listed volcanoes and eruptions are associated with dome formation. Would you agree that there is a hazy distinction between a major dome collapse event (which may remove the whole lava dome) and a debris avalanche in these cases? Are these types of collapses considered debris avalanches once they surpass a certain volume? (*Sarah*)

5. In the same way a block-and-ash flow creates a block-and-ash flow deposit can we define a debris avalanche as the process that forms a DAD? (*Marc*)

On the Ui, Takarada and Yoshimote paper:

6. Regarding acoustic fluidization: What range of frequencies will result in the fluidization of a typical volcanic breccia stream as described on page 623 of Debris Avalanches by Ui, Takarada, and Yoshimoto? (*Craig*)

7. Have lab experiments been conducted to test whether or not these frequencies are actually generated within debris avalanches? (*Craig*)

8. How would such a mechanism affect the internal structure or flow behavior of a debris avalanche since a higher acoustic amplitude for these frequencies would presumably result in a higher degree of fluidization? (*Craig*)

9. Do we see a higher degree of fluidization in the center of avalanches relative to the outer portions? (*Craig*)

10. Have velocity profiles been modelled for past or hypothetical volcanic debris avalanches? (*Craig*)

UNAM:

1. What is the mechanism by which toreva blocks are transported, do the blocks move as a part of the avalanche or is the movement independent from the avalanche?

2. Why are volcanic landslides larger in volume than non volcanic landslides

3. Which possible causes for a land slide would be the most dangerous, for example earthquakes, hydrothermal activity, gravity, etc.?

4. The general characteristics that are taken into consideration to classify debris avalanches are in our opinion quite general. Are there some other parameters that can be used to classify debris avalanches?

5. The article says that jigsaw structure is typical of debris avalanches, but they have been found in lahar deposits too, can you discuss something about this?

6. In Figure 1 it seems that hydrothermal alteration produces clays, so this reduces permeability and increases pore pressure, but the article text says that increasing permeability means increasing pore pressure?

McGill:

1. What are some ways to predict the size, volume, direction and location of the debris avalanche?

2. Is there a volcano stability threshold? Does a volcano reach a point where it is more susceptible to collapse?

ASU:

A. Volcanic Instability Monitoring Questions

1. What observed precursors to debris avalanches might indicate changes in volcanic stability when monitored? i.e. pore fluid pressure, creep, etc. What about non-volcanic situations?

2. What instruments have been used to monitor stability of volcanoes? Have strain meters been used anywhere to monitor pore fluid pressures at volcanoes susceptible to frequent collapses? What about at non-volcanic situations?

B. Volcanic Debris Avalanche Mechanics and Deposit Questions

1. How are the collapse volume estimates made? Has there been any attempt to use relative DEMs to estimate the volume change after a collapse? Aren't they using relative DEMs to estimate the volume of material filling up St Helens?

2. How do features such as natural levees suggest that the flow mechanism of volcanic debris avalanches is in the Bingham flow regime?

3. More generally, how are initial flow mechanisms deduced from deposits when the mechanism can change throughout the time of the entire avalanche?

4. Based on differences in morphology and depositional characteristics, have different flow mechanism been determined within the avalanche with distance from source?

5. Within pyroclastic flows/ignimbrites, there are typically steep rheologic gradients depending on which part of the flow you are in (just referring to the total thickness at a certain time in the flow, base to top, not changes with distance from source). Do any rheologic gradients exist in debris avalanches, or is the rheology the same throughout the flow thickness because the movement is en masse and does not inflate due to the entrainment of air?

Questions on the Effect of Climate on Instability, Flow Dynamics, and Deposit Characteristics

1. How does climate affect volcanic stability? Does there appear to be a link between edifice failure and wetter climates?

2. How does climate affect identifying older volcanic debris flows? For example, terrace formation occurs at a much faster rate in locations with high rain fall. Do you think, for example, that a well preserved landslide in the dry Altiplano of Chile may look more voluminous or longer than one that's been more eroded in the severely vegetated Latin American regions?

3. Has anyone examining these avalanche deposits ever felt the need to correct for variations in local climate conditions?

4. How are estimates of debris avalanche magnitude and/or run out affected by local climate and topography? We know that climate plays an important and significant role in topography, and thus, should affect various parameters like water content, vegetation etc., all which may impede or constrain run out.

Brittany, Kim, Kirsten