Cinder Cone Degradation Project

Problem:

This Project combines GIS analysis with the observations, maps, photos, and surveys you made during the field trip to the SP Mountain area of the San Francisco Volcanic field. The GIS analysis is intended to help you synthesize an understanding of cinder cone degradation and morphological evolution – the bulk of your analysis will be based on your field observations, tied together with the GIS analysis. Radiometric dates for 4 cinder cones in the area (SP Mountain and 3 others) have been determined: <70ka, ~400ka, 770ka, 1040ka. You will study these cones using imagery and DEM, and use their morphologies and characteristics to estimate approximate ages of the 3 undated cinder cones we studied in the field. GIS Tasks are kept to a minimum as your time is best spent thinking about the problem and drafting and refining your interpretative cross-sections (see below). **Due Date: Mon. Oct. 7, midnight by email or in my mailbox, 7th floor SESE office, ISTB4.**

Data Available:

GIS data loaded onto the GLG490 CITRIX Instructor Volume (Q drive), C:geomorphology on PCs in PSH461, and posted in a zip archive on class website:

- 1-meter resolution Digital Ortho-photographs
- 10-m pixel Digital Elevation Models co-registered with the orthophotos.
- Field notes, surveys, maps, and photos.

Tasks:

- Field groups need to compile their field observations and survey data to share with all other groups. This data and an annotated survey (morphologic zones and process zones) must be turned in and shared with others by **Thursday, September 19** (first interim deadline).
- From the DEM create a slope map, and shaded relief map, and a contour shapefile (10m contours).
- Use the 3D Analyst Interpolate Tool to extract multiple topographic x-sections of each cone of interest. Each group will measure 6-10 sections on the cinder cone they surveyed in the field plus one of the unknown-age cones we are looking at. The results will be shared with all in the class. The Info tool and Measure tool are also very useful to pick spot elevations and distances between points, which is all you need for an estimate of average slope.
- From your field surveys and these x-sections, characterize as a function of age (use your best judgment to pick x-sections and slope measurements at locations that are comparable among the cones):
    - Average Slope (Sc) and Height (Hc) of the cinder cone proper (not apron)
    - Maximum slope (Smc) of the cinder cone proper (not including apron) – not a local maximum but the average slope of the steepest (often straight) section.
    - Average Slope (Sa) and Height (Ha) of any debris apron
    - Average Slope (St) and Height (Ht) of cone plus apron (total)
    - Note Ave Slope = $\tan^{-1}(\Delta z/\Delta x)$ (in degrees) and = $\Delta z/\Delta x$ is "gradient"
    - These are the results you will share with all other groups for the cone you studied

in the field plus one of the cones of unknown age we are looking at.

- Comparing your field surveys with DEM profiles at the same locations can help you evaluate the accuracy of the DEM profiles and indicate what to trust and what details not to trust.

Deliverables:

1. Your field maps and topographic survey – these include information on process dominance and morphologic domains (convex up, straight, concave up) as they vary in space. **Due Thursday Sept. 19th**.
2. Share Sc, Smc, Sa, St data will all other students (email to class email list or place on class Dropbox folder) by **Monday, Sept. 23**.
3. Prepare and submit Plots of Sc, Smc, Sa, St versus time for the four cones of known age (four data points on each curve, show both data points and an idealized interpretative curve). Make analogous measurements on the different cones as discussed in lab. **Due before lab on Wednesday, Sept. 25**.
4. Compare Smc(t) with expectation for a linear diffusion model [to be discussed in the field and in Lecture] – that is use excel to compute curves for Smc(t) and plot on the same graph with your data and ask: "how good or bad is the best fit of this model to the data?". **Due Friday, Sept. 27**.
5. Idealized Geologic/Geomorphic x-sections of cinder cone degradation over ~1 Myr – show 4 stages of degradation (4 separate x-sections), indicate process zones, morphologic zones (convex, straight, concave), areas of erosion and deposition. In each indicate the original cone as a dotted line for comparison. The idea here is to summarize all you have learned about cinder cone degradation from the field and GIS analysis. I encourage you to also provide simple, idealized plan-view maps to go with each cross-section, but this is not strictly required. Required: These are GEOLOGIC cross-sections, so show an interpretation of the sub-surface, which results from patterns and modes of erosion and deposition. **Due Monday, Sept 30** (scan or snap a photo and send in by email. *Also Include these in your Project Report*).
6. Your report – 4 pages max, 1.5 spacing, 12 point font, not including figures (details below). Your report should be framed around the interpretation put forward in your x-sections and the mapping you did in the field. Make sure you are addressing the questions and issues raised in the field trip handout, especially: (1) an interpretation of the dominant erosion/transport/deposition processes, (2) both how and why these may vary in space and time (as recorded in your field maps and your cross-sections), and (3) how the dominant processes are related to morphological domains (convex, straight, and concave). Finally, make sure you include a brief discussion (a few sentences to a short paragraph) on the applicability of "diffusion modeling" to simulation of cinder cone evolution. [Diffusion modeling will be discussed in lecture, and is discussed in Cinder Cone papers available on the course webpage]. **Due Monday, Oct 7, midnight**.

Guidelines for the Written Report.
Maximum 4 pages, 1.5 spaced, 12-point font, with 1" margins (or equivalent). This means you should aim for 1500-1700 words.

The 4 page limit is serious. I will only read the first 4 pages. Figures, tables, captions, and appendices do not count against the 4 page limit.

Consider the report as an extended abstract (see Scrutiny of the Abstract). The report must convey: what you are trying to do; what important conclusions you have reached; what limitations the interpretative map entails; what outside sources of information you have used; and what key recommendations you can make for further exploration of the problem or area.

The maps, cross-sections, illustrations, and processed images are the backbone of your report. They must be integrated effectively into the report. Each illustration must be used to MAKE A POINT. Maps or illustrations not directly referred to will be ignored (*including REQUIRED Figures*). Make effective and efficient use of captions and appendices: place only the essentials in the report text. For instance, the "map unit definitions" or mapping criteria are best reported as a legend (or stratigraphic column) to interpretive maps. Illustrations must be clearly labeled and annotated such that a busy executive (like your instructor) can quickly breeze through your report and understand clearly what you did and both how and why you made the interpretations outlined in the report by reviewing your opening paragraph (see below), figures, and captions *alone*.

Beware: avoid "lazy" use of appendices -- do not overburden your boss (or instructor) with reams of poorly organized supplementary data. Do not simply attach a spreadsheet without annotation and explanation. The report must be free of spelling errors and written in a crisp, clear, efficient style. Use active voice. Do not repeat yourself.

Recommendations for Report Structure

1. Opening paragraph: State your claim – what is the goal of the report and what is your essential conclusion/ what is your fundamental interpretation presented in the report (See Scrutiny of the Introduction, but for these short reports condense to one paragraph).
2. Review the bare essentials of your methods, materials, and approach but avoid procedural details (like steps used in software) – max ¾ page.
3. Present and discuss your interpretation (leveraging and explaining the figures, calculations, and tables). ~ 1-1.5 pages.
4. Identify Future Research needs. Provide a useful guide to further work. Identify critical areas – where to go to best resolve remaining uncertainties (ie. critical age relations, nature of critical contacts, etc). ~ ¾ page.