Lab #4 — Astronomy 184L — Life in the Universe

Sunset Crater

Field trip on Saturday, September 26, 2009

Lab due by Friday, October 2, 2009, at 3 pm

There are five main scientific goals of this lab: (1) Learn about the history of the San Francisco volcanic field; (2) Learn about the different types of lava flows; (3) Learn about the different types of volcanos; (4) Learn where volcanos and lava flows exist in the Solar System; and (5) Understand the astrobiological relevance of volcanos.

The assignment is described below, and is due by 3 pm on Friday, October 2.

For this assignment, please work in pairs, and please work with someone you have not worked with before. You can turn in just single lab for your pair. Naturally, you need to show all your work.

For this assignment, I'd guess you probably would want to turn in something like 2–3 pages or so.

The assignment

Estimate the volume of the Bonito lava flow by using the map on the web page for this lab and ground truth estimates from our field trip.

Imagine that the lava flowed out of the crater in something like one year total (intermittently over the course of a couple of decades, perhaps). What was the average flow rate for this eruption?

If the San Francisco peaks were created with that same flow rate, how long would it have taken to create those peaks? Is this a reasonable possibility for how the peaks formed? Discuss briefly. (Remember that the volume of a cone is $\frac{\pi}{3}hr^2$, where r is the radius of the base of the cone and h is the height.)

How long would it take to resurface the entire Earth to the same thickness as the Bonito lava flow, assuming that same flow rate?

Olympus Mons, on Mars, is the largest volcano (known) in the Solar System: 27 kilometers tall. It is a shield volcano, which means that the slope of its flanks is around 6 degrees or so. How wide is Olympus Mons at its base? Using the flow rate you calculated above, how long would it take to create Olympus Mons?

The density of basalt is around 3000 kg/m^3. What is the mass of Olympic Mons? The mass of Mars is 6.4×10^{23} kg; what percentage of this is Olympic Mons?

Where else in the Solar System are lava flows found? What planets or moons have been observed to have lava flows? What planets do not have observed lava flows?

Briefly discuss the habitability of the other places in the Solar System where volcanos are found. Is the presence of volcanos indicative of habitability, or uninhabitability, or neither? Briefly discuss.

What is the astrobiological significant of volcanism?