Geology of Yellowstone

As usual, we’ll begin our study of Yellowstone National Park with a slide show. Then we’ll spend some time studying samples of new rock types, and the geologic map of the park. Our goal is to make the connection between the distribution of rocks and the processes by which they formed.

# Part 1: Rocks

When magma cools to form igneous rock, what kind of rock it forms depends on how quickly it cools and on the composition of the magma. Throughout this term, we will learn to associate particular rocks with their stories of formation. Vesicular basalts speak of escaping gases; obsidian sounds like water sizzling into steam as lava pours in. What stories do other igneous rocks have for us? Examine the samples of rhyolite, pumice, and tuff. First, describe each of them, making sure you include their textures in your descriptions. (By texture, I mean igneous rock texture, as defined on p. 66-69 in your text, *not* the more common English usage of surface roughness or smoothness.) Also, if the rock includes smaller fragments within it, describe them. Are they round or angular? Blocky or needle-like? What size(s) are they? Are they the same color as the rest of the rock? Then, think about how those rocks formed. What is the texture of each rock telling you about its history? How are these rocks similar to/different from each other? How do they compare to Hawaiian rocks?

Part 2: Geologic map

Take a minute to get your bearings....  Remember that the legend is arranged so that the rocks go from younger at the top to older at the bottom; rocks of the same age are in the same horizontal row. We’ll start with the recent geologic history and work our way back in time….

Find the Yellowstone volcanic rocks (those associated with the formation of the Yellowstone calderas) in the legend. To what geologic time periods do they belong?  From what composition magmas did they form (see fig. 3.7)?  Very approximately, what percentage of the map area is covered by volcanic rocks from the Yellowstone hotspot?

Find the approximate location of the Lava Creek caldera on this map.  The West Thumb of

Yellowstone Lake is a little bit bigger than the summit caldera on Kilauea.  How do the Yellowstone calderas compare to the Kilauea caldera in size?

The Huckleberry Ridge Tuff was by far the most voluminous of the three caldera-forming eruptions in Yellowstone.  Why is it so sparsely represented on the geologic map?

Study the pattern of the Qyl (Lava Creek Tuff of the Yellowstone Group, Quaternary in age).  How would you describe its spatial distribution? (What geometric shape does it have on the map?)

Now consider the pattern of the Plateau Rhyolite units (there are bunches of them!).  Are they older or younger than the Lava Creek Tuff?  Where are they found in relation to the Lava Creek Tuff?  Why is that? [Hint: think about the sequence of events. Tuff forms from ash falling out of the air. What happened to the magma chamber immediately after that ash was erupted? Rhyolite forms from lava flows. Lava flows downhill, filling valleys or other low spots. So…. Why are the Plateau Rhyolite units found where they are?]

Now consider some of the older rocks on the map.  Without worrying about the details, notice that before the hotspot eruptions, other volcanic rocks, sedimentary rocks (sandstone, shale, limestone, and so on) and, even farther back, metamorphic rocks formed in this region.  We will be learning about such rocks later this term, but as a sneak preview, I will just say that these rocks tell us stories of ancient mountain-building events (the metamorphic rocks) and the advance and retreat of shallow seas (the sedimentary rocks), through the hundreds of millions of years before this land was shaken by volcanic eruptions.  Where are those rocks found on the map?  Why were they NOT covered by the volcanic eruptions?

Consider the “normal” faults on the map.  Normal, in this geologic context, means that these are fractures that formed as a result of extensional forces (localized stretching of the Earth’s crust), and where the rocks subsequently slipped past each other vertically.  Where do you find most of those faults? Could they be related to the volcanic activity? How so, or why not?

Summing it all up… In two or three sentences, what does this map show you about the volcanic activity of the Yellowstone hotspot?