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Volcanic Highpoints

I enjoyed reading the SOS column on volcanic hazards in Apex to Zenith #77, and thought I'd follow up with some things I've learned about the geology of the five volcanic highpoints (HI, OK, WA, OR, AZ), plus two others (VA, MO) with more ancient volcanic origins. Two highpoints, **Mt. Rainier** and **Mt. Hood**, are **active** volcanoes, which means that a source of molten rock (magma) still lies below them and that they have erupted within the last two centuries. Although **Mauna Kea** stopped erupting about 4,000 years ago, it could conceivably erupt again, so it is considered **dormant**. By contrast, no magma is present below the other two, so they are considered **extinct**: the rock of **Black Mesa** was erupted 30 million years ago and **Humphreys Peak** blew up 434,000 years ago! (Nearby Sunset Crater last erupted in 1064 AD - - that's recent to a geologist, but still extinct!)

Mauna Kea, of course, is a Hawaiian type of volcano, with quiet eruptions as described by Rick Hartman in his SOS column. Most of the mountain is a shield, built up by successive layers of relatively runny lava that cooled to form black basalt. A hot spot from very deep in the Earth is responsible for the Hawaiian activity, and as the Pacific tectonic plate inches its way NW across the Earth's surface, a line of volcanoes has formed above the hot spot, migrating slowly SE: in time the activity has shifted SE from Mauna Kea to Mauna Loa, then SE to Kilauea, which is now the most active; a future volcano, Loihi, is growing on the sea floor SE from Kilauea.

It turns out that most of Mauna Kea is much older than Mauna Loa, and had been built to nearly its present height by 65,000 years ago. But then a "last gasp" of activity ending 4000 years ago, more explosive than the usual Hawaiian type, filled the summit caldera with rough "aa" lava flows and created several cinder cones made of potassium-rich basalt called hawaiite. Blobs of magma called bombs were also thrown out all around the summit, cooling as they flew through the air. The four cones at the top, including the highest, Puu Wekiu, lie on top of loose material moved around by glacial ice, for if you had visited Mauna Kea 13,000 years ago, you would have seen an ice cap at the summit! The name means "white mountain" in Hawaiian, because the summit is still covered in snow each winter.

The eruption that produced **Black Mesa** was much like a Hawaiian one: effusive, basaltic lava spread out over the top of sand and gravel of the Ogallala Formation (which also forms the highpoints of Kansas and Nebraska). The source of the lava was Seven L Buttes, about 40 miles WNW, in Colorado. The hard, black lava has protected the underlying material from rapid erosion, thus preserving the table-topped mesa. If you're traveling between the OK and NM highpoints, be sure to take a side trip to

Capulin Volcano National Monument, NM, where you can drive to the top of a dramatic basaltic cinder cone - - somewhat younger than the volcanism that produced Black Mesa.

Mt. Rainier, Mt. Hood, and the rest of the stratovolcanoes in the Cascade Range have the potential for Mt. St. Helens-style explosive eruptions, because their lava is richer in silica than basalt and therefore stickier. The rocks have names like andesite and dacite, and they are generally lighter colored than basalt. The vents get plugged by this sticky lava and steam pressure builds up from below. Steam often escapes continuously from cracks and vents called “fumaroles”. Mostly water, the gases may include CO_2 and H_2S. Changes in the gas content, the temperature, or rate of emission can foretell an eruption. Now and then major steam explosions may occur, for example at Rainier in 1879, 1884, 1961, 1963 and 1967 and at Hood in 1859, 1865 and 1907. Ash was ejected from Rainier from 1820 to 1854. Hood was very active from 1760 to 1805; Lewis and Clark encountered debris flows and lahar deposits from Hood along their route. So the potential for future eruptions at these two highpoints is great. However, USGS geologists monitor earthquakes under the Cascades continuously, so that an increase in seismic activity will provide ample warning. As Hartman explained in the SOS article, the biggest short-term dangers are from rock falls, CO_2 in depressions, and rotten rock underfoot due to hydrothermal activity.

Humphreys Peak is made of andesite and dacite, which should be a clue that it, too, has been explosive in the past. In fact, the peaks of San Francisco Mountain are the eroded remnants of a huge volcano which, like Mt. St. Helens and Mt. Mazama at Crater Lake, was blown apart by a cataclysmic eruption about 434,000 years ago! The mountain had grown over thousands of years. The different layers changed in mineral composition as the chemistry of the magma chamber evolved over time. Some layers are andesite with black crystals of pyroxene, some are dacite with bronze-colored pyroxene, and some are andesite with the green mineral olivine.

Two other highpoints have even more ancient volcanic origins: **Taum Sauk**, MO and **Mt. Rogers**, VA, are both made of metamorphosed rhyolite, the most silica-rich and most sticky of all lavas. The rocks were formed by ash eruptions and pyroclastic flows hundreds of millions of years ago. Some of the ash layers were so thick that the particles became welded together by the retained heat, producing “welded tuffs” or “ignimbrites”. Despite the rocks having been changed by high heat and pressure during metamorphism, some of the original volcanic features can still be observed.

For more information about the geology of these and all the highpoints, please visit http://unh.edu/esci/geology_highpoints.html