Table Mountain Mima Mounds (*Draft*)

EarthCache Location = Latitude: 38.932337; Longitude: -120.455854
Parking Area Location = Latitude: 37.943782; Longitude: 120.462008

The Table Mountain Mima Mounds EarthCache is located off of Shell Road, near Jamestown, California, on top of Table Mountain (see Figure 1). There is some hiking involved in getting to the EarthCache site and the terrain is a challenge because the last part of the hike up to the top is pretty steep and rocky.

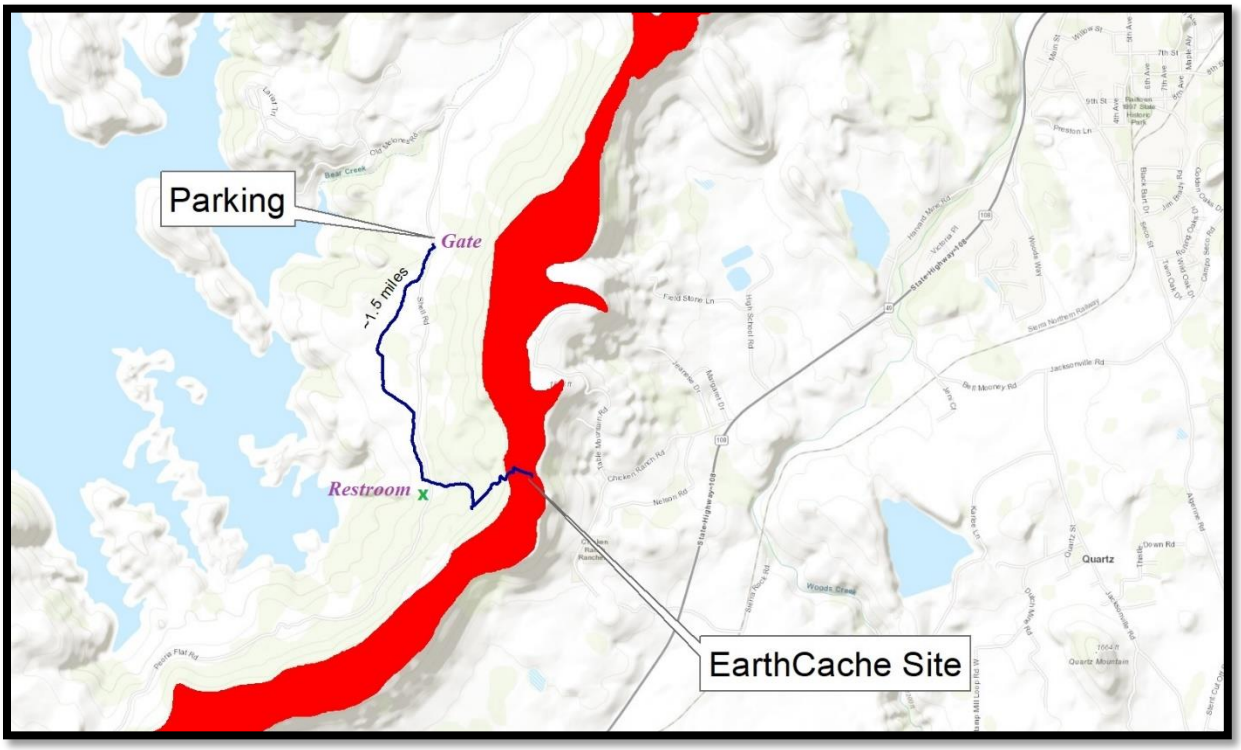

Figure 1: Map showing the parking location, trail, restroom, and EarthCache site. The trail is approximately 1.5 miles long and has an elevation climb of approximately 450 feet. The steepest ascent is just before arriving at the EarthCache, climbing up to the top of Table Mountain. The terrain rating is 4.5 due to the steepness and rocky portion of the trail. Note that it is possible to drive to the base of Table Mountain and park near the restroom, however, the road is for experienced high clearance/4WD drivers only – proceed at your own risk!

Table Mountain, a prominent geologic feature in Tuolumne County, consists of a series of 10 million year old lava flows, that originated approximately 60 miles east, as the crow flies, or more than 90 miles east, if measuring the winding path the lava took downstream in the old paleo Stanislaus River channel (see Figure 2). Geologists currently believe the source of the flows was the Little Walker Caldera, or Volcanic Center, near the intersection of Highways 108 and 395. A supervolcanic eruptive center was active there from roughly 14 to 6 million years ago, producing over 3 dozen lava flows similar to Table Mountain, although smaller in size. There were also numerous other volcanic deposits produced by the Little Walker system – ash deposits, volcanic debris flows, block and ash

flows, lava flows, etc. More can be learned about these deposits and the geological story they tell from other EarthCaches along the Highway 108 corridor on the way to Sonora Pass.

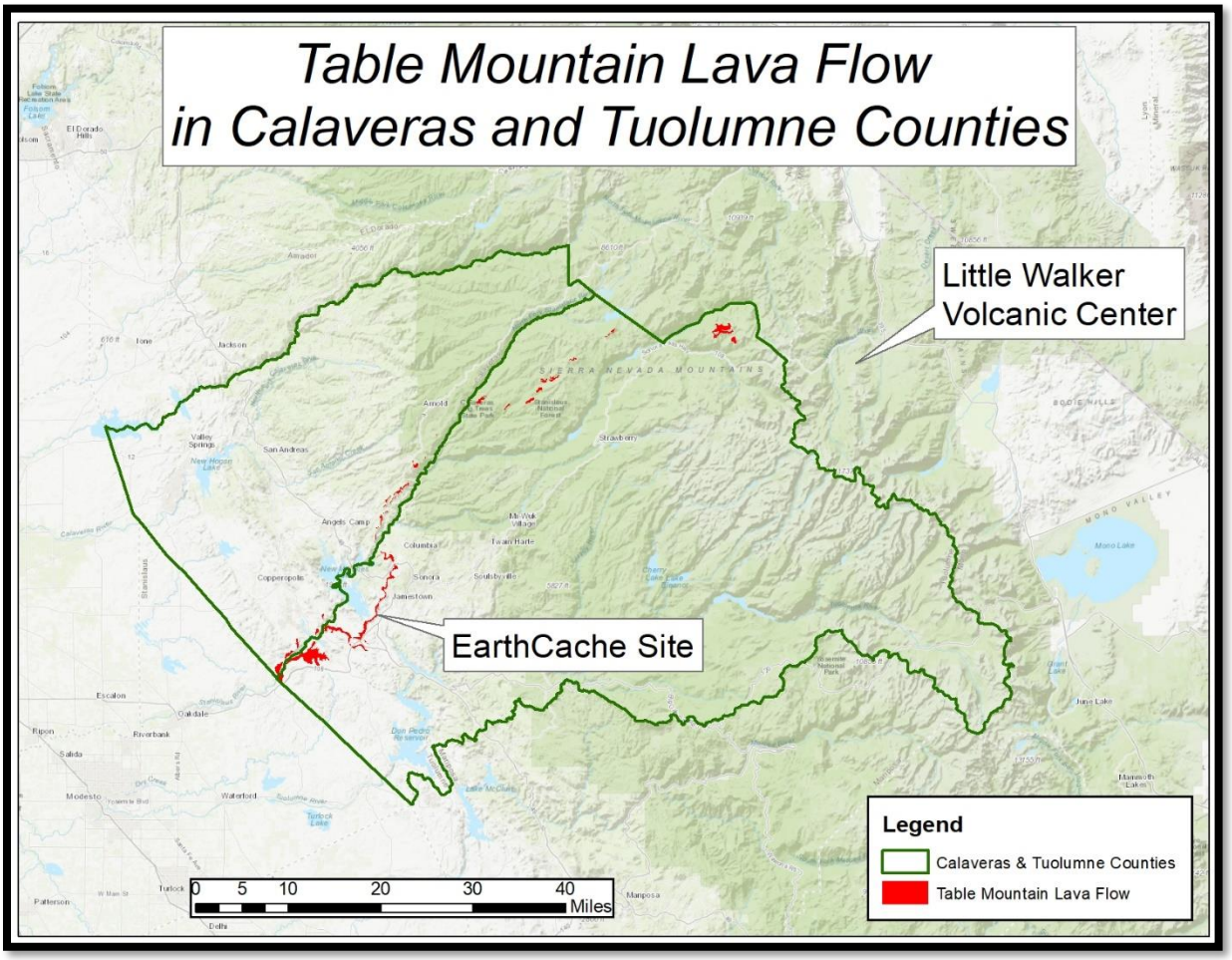

Figure 2: This maps shows the Table Mountain lava flow from near the Little Walker Volcanic Center/Caldera in the east down to the western edge of Calaveras (NW) and Toulumne (SE) Counties. The flow actually extends further to the west of Knights Ferry, where it ends, over 90 miles from the presumed source.

The lava that forms Table Mountain is called latite and is very similar to basalt (black lava rock that is common in Hawaii). Latite can be classified two different ways: 1) using the QAP ternary diagram if the crystals are macroscopic (visible to the naked eye); and 2) using the LAS ternary diagram if the crystals are microscopic (too small to see; see Figure 3). A freshly broken, unweathered piece of latite contains both larger plagioclase feldspar and smaller pyroxene crystals, visible to the naked eye. According to Andrew Alden (2008) Table Mountain is:

> “the locality where latite was originally defined by F. L. Ransome in 1898. He detailed the confusing variety of volcanic rocks that were neither basalt nor andesite but something intermediate, and he proposed the name latite after the Latium district of Italy, where other volcanologists had long studied similar rocks. Ever since then, latite has been a subject for professionals rather than

amateurs. It is commonly pronounced "LAY-tite" with a long A, but from its origin it should be pronounced "LAT-tite" with a short A."

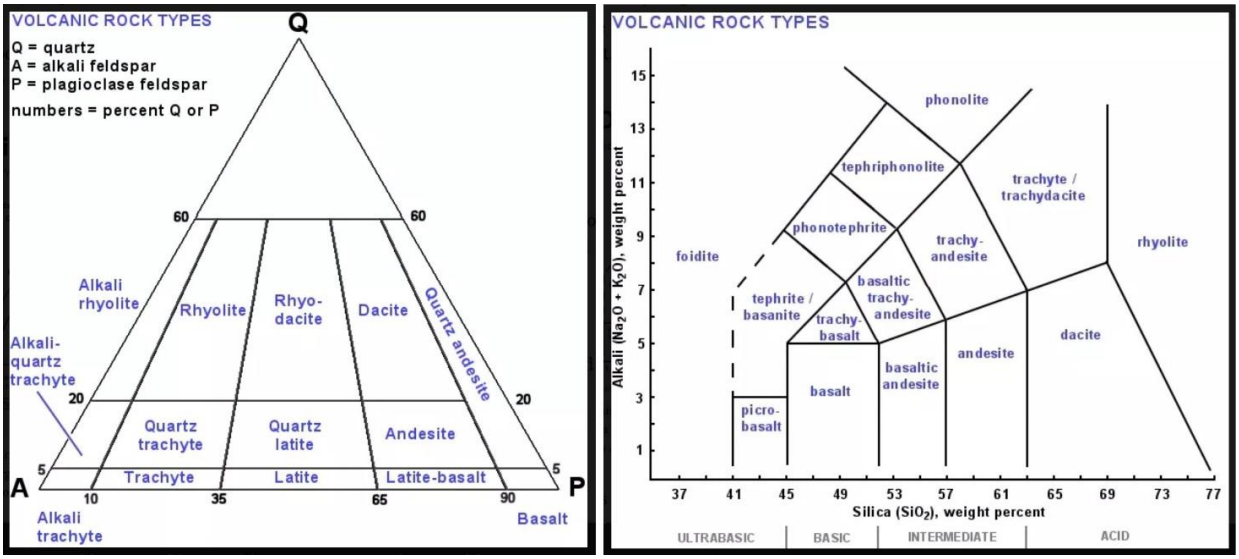

Figure 3: QAP and TAS diagrams used to identify extrusive, volcanic rock types. QAP stands for **Q**uartz/**A**lkali Feldspar/**P**lagioclase Feldspar. TAS stands for **T**otal **A**lkali **S**ilica. Table Mountain latite is shown on the bottom, center of the QAP diagram and is equivalent to basaltic trachy-andesite in the center of the TAS diagram. The QAP diagram is used in the field when examining hand samples that have ***visible*** mineral crystals (Table Mountain latite has plagioclase feldspars and smaller pyroxene crystals). The TAS diagram is used when geochemical analysis is performed on the samples, commonly when crystals are ***invisible***.

The Table Mountain geologic feature is a world class example of inverted topography and another EarthCache, by Troutpro, called "Table Mountain Inverted Topography" (GC2MF7F), does a good job of explaining what that is and how it works, so that will not be covered here. What isn't mentioned in that EarthCache is that Table Mountain is comprised of at least 4 different lava flows discovered by Carolyn Gorny, who analyzed drilling core data in 2009. After finding 3 different soil horizons in the core data, she concluded there were at least 4 separate lava flows comprising Table Mountain and they occurred likely within "a few centuries". Additionally, it is hoped this EarthCache will clarify some misconceptions listed in a nearby EarthCache (Blowing Chunks: GC2JG13), that states, "it must have been a rather violent eruption to have spewn rocks this far" and "when rocks are throw (sic) violently", both of which are inaccurate descriptions of processes associated with Table Mountain, which produced lava flows, not explosive eruptions.

Curious observers will notice additional features on top of this section of Table Mountain that are intriguing. Once arriving at the EarthCache site, look out across the top of Table Mountain. Observe the rock, topography, vegetation, slope, etc. Do you notice any patterns? Is Table Mountain completely flat? Is the rock the same throughout, or do you notice any differences? Are the features observed natural? Biological? Geological? Human-influenced? As you stand at the GPS location listed for this EarthCache, you should see a vegetated area. One hypothesis suggests these features originally formed in areas with low-draining soils, as gophers built them up in response to low water tables. They presumably pushed the sediment up into what are called Mima mounds. "Mima" is a name derived from a Native American language meaning "a little further along" or "downstream". Other hypotheses exist, but the rodent model has gained prominence lately. One conclusion suggests "that, scaled by body mass, Mima mounds are the largest structures built by nonhuman mammals (in other areas on Earth, some are up to 8 feet tall and 30 feet wide!) and may

provide a rare example of an evolutionary coupling between landforms and the organisms that create them."

What do you think? Are there any gopher holes associated with the hypothesized Mima mounds? Are the mounds thicker in their centers than on their edges? What other evidence do you observe to support, or refute, this hypothesis?

For this EarthCache, you will estimate the sizes of some of these features (see Table 1). To get as accurate an estimate as possible, use either a tape measure, or a smartphone app (for the iPhone download EasyMeasure from the app store; for the Android you can download Easy Measure; both apps are free and easy to use).

Figure 4: This image shows a distinct and curious pattern on a portion of Table Mountain (lighter colored, polka dotted, rounded features) that may be Mima mounds.

Variable Measured	Length (L in ft)	Width (W in ft)	Area (A in ft)
Sample #1			
Sample #2			
Sample #3			
Sample #4			
Sample #5			
Sample #6			
Sample #7			
Sample #8			
Sample #9			
Sample #10			
Mean =			

Table 1: Measure the Length and Width, then calculate the Area (Length X Width) for 10 Mima mound features on top of Table Mountain.

TO LOG THIS EARTHCACHE INCLUDE

1. The name of this EarthCache on the first line of your email.
2. The number of people in your group.
3. Using an app on your phone (see suggestions above), you will measure the ***length and width*** (longest side and shortest side) ***of 10 Mima mounds*** and determine their **means** (or averages) (in feet).
4. After determining the **mean lengths and widths** (in feet) of the Mima mounds observed, determine the ***area*** of each.
5. Which Big Ideas (1-9) are connected (list)?
6. Which GeoPrinciples (1-7) are relevant (list)?
7. Include a photo or 2 if you're so inclined (optional).

Note: In order to manage email volume, you may assume your responses are accurate if you do not get an email after logging this EarthCache. If a response is grossly inaccurate, you will not receive credit for the cache.

REFERENCES

1. Alden, Andrew, “Igneous Rock Classification Diagrams”, (2008), licensed to About.com, https://www.thoughtco.com/igneous-rock-classification-diagrams-4122900, updated February 24, 2019.

2. Bright, William (2004). Native American Placenames of the United States. University of Oklahoma Press. p. 284. ISBN 978-0-8061-3598-4. ...'downstream', from Lower Chinook.

3. Gabet, Emmanuel J., Perron, J., Johnson, D. L., (2013), “Biotic origin for Mima mounds supported by numerical modeling”, Elsevier Geomorphology 206 (2014) 58-66, www.elsevier.com/locate/geomorph.

4. Gorny, Busby, Pluhar, Hagan, & Putirka, (2009), “An In-depth Look at Distal Sierra Nevada Palaeochannel Fill: Drill Cores Through the Table Mountain Latite near Knights Ferry”, International Geology Review, 51:9-11, 824-842, DOI: 10.1080/00206810902944960, (2009).

5. Kerr, Richard, “Mima Mound Mystery Solved”, (Dec. 20, 2013), American Association for the Advancement of Science (AAAS), Science News webpage, https://www.sciencemag.org/news/2013/12/mima-mound-mystery-solved.

6. Ransome, Fredrick Leslie, (1898), “Some Lava Flows of the Western Slope of the Sierra Nevada, California”, Washington, DC, Government Printing Office, US Geological Survey bulletin., United States Geological Survey, 89.

7. "Thurston County Place Names: A Heritage Guide" (PDF). Thurston County Historical Commission. 1992. p. 52. Retrieved 28 March 2018.