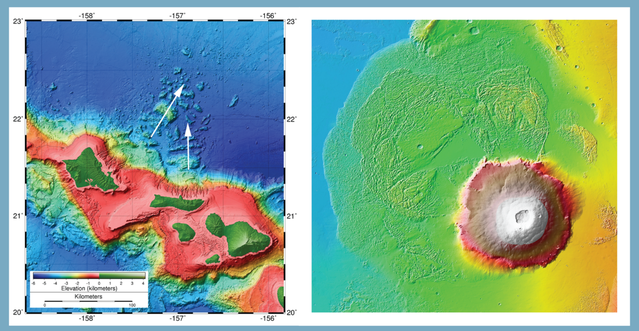
Olympus Mons, Mars:

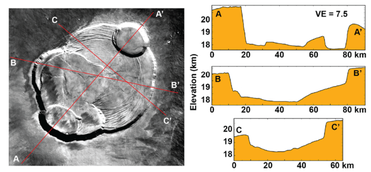
Analogs from Hawaii

One of the best known landforms on Mars is Olympus Mons volcano, which is frequently described as “the largest volcano in the Solar System”. Located at 18.6°N, 226.2°E, Olympus Mons measures more than 500 km across and over 22 km above the surrounding terrain; this is a giant volcano which may have been active for several billions of years! Indeed, Olympus Mons dwarfs volcanoes in Hawaii as the entire island chain from Hawaii Island to Kauai could fit within the Martian volcano (center figure). The morphology and structure of Olympus Mons have been well studied by planetary volcanologists, and show many similarities to volcanic features found in Hawaii. This poster illustrates some of these similarities.

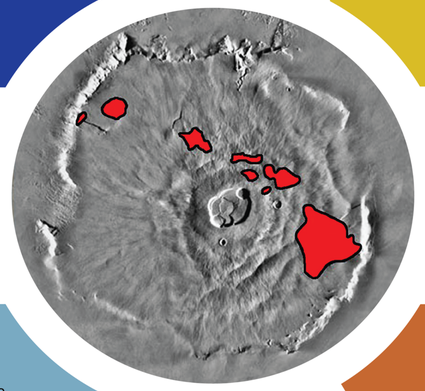
The lower units of Olympus Mons are well exposed in the basal escarpment. At left we see the top of the escarpment and numerous small landslides that moved towards the bottom of the image. The darker flows are the youngest slides in this image. It is possible that this material was formed by explosive volcanism as a result of magma interacting with water or ice. One of the best analogs in Hawaii could be some of the post-erosional volcanics on the island of Oahu. Above we see a series of ash layers formed by this type of activity from Koko Crater.

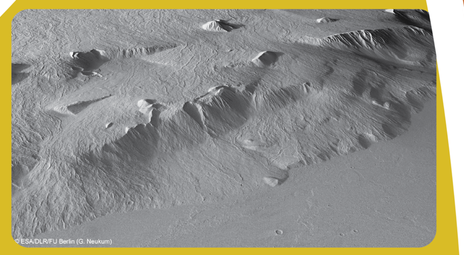


A series of lobate units (figure near left), called the Olympus Mons aureole materials, extend north and west from the basal escarpment of the volcano. Comparisons have been made between the aureole and the giant submarine landslides that are found north of Molokai and NE of Oahu (arrowed at far left). The suggestion is that the aureole materials may also be landslides, formed when unconsolidated material at the base of Olympus Mons collapsed, sending landslide hundreds of kilometers from the base of the volcano.



Topography of Olympus Mons caldera. Three topographic profiles (A to A’, B to B’, and C to C’) across the caldera demonstrate that the floor of the caldera shows considerable relief, with the largest collapse feature showing more than 1 km difference between the perimeter of the caldera floor and the caldera center.



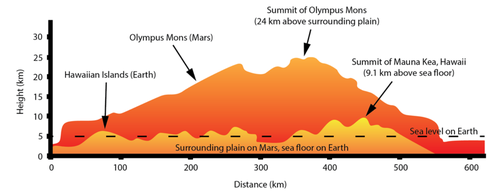


Numerous blocks can be found around the perimeter of Olympus Mons up-slope from the basal escarpment (lower image). Similar blocks, called the Ninole Hills, can be found on the SE flank of Mauna Loa (upper image). These Hills are known to be older than the surrounding lava flows (perhaps by ~100,000 – 200,000 years), and may either represent remnants of an earlier surface that subsequently collapsed, or they could be uplifted blocks from the oldest parts of Mauna Loa.

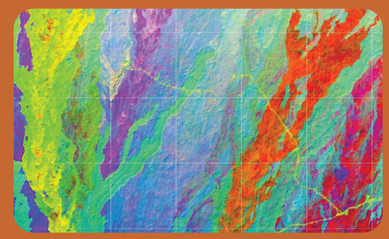
Mauna Loa has probably been erupting for at least 700,000 years and emerged above sea level perhaps 400,000 years ago. Mauna Loa last erupted in March 24th to April 15th, 1984.

Moku‘āweoweo Caldera dominates the summit of Mauna Loa volcano. This caldera is 5 km long by 3 km wide, and was formed by several collapse events following large flank eruptions, most likely about 600 – 750 years ago. The caldera rim (image above) is ~180 m above the caldera floor.

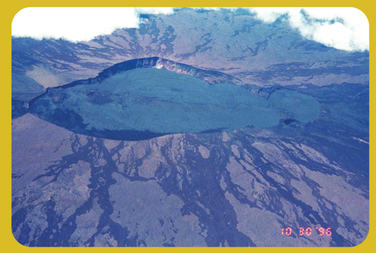
Based on geophysical models, it is calculated that the magma chamber is ~1 km wide at a depth of ~4.5 km (or ~0.5 km below sea level).



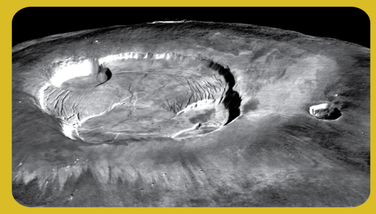
The size of Olympus Mons compared to Hawaii. Note the dramatic break in slope at the edge of the Martian volcano, which is called the “basal escarpment”. This escarpment is ~7 km high and is probably very steep due to landslides around the perimeter of the volcano.



The emplacement of multiple small lava flows can be studied in detail along the eastern flank of Kilauea volcano. Many pahoehoe flows from the 1969 – 1974 eruptions from the Mauna Ulu shield are seen here as they froze on the steep slopes of the Holei Pali.

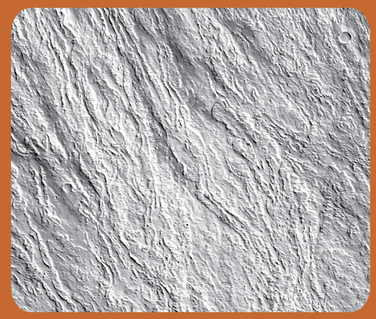


Air view of Moku‘āweoweo Caldera looking west. Note the numerous dark flows that have been truncated by subsequent collapse events; similar flows can also be identified on the rim of the Olympus Mons caldera.



Computer generated oblique view of the Olympus Mons caldera, looking NE. The largest pit is ~60 km wide. The impact crater Pangboche is seen at far right on the upper flanks of the volcano.

Many of the lava flows from Mauna Loa are difficult to map due to their similar chemistry and weathering products. But when studied in the thermal infrared, the flow boundaries are clearly seen due to subtle variations in the glass content of the flows. This is a principal component image of Thermal Infrared Imaging Spectrometer (TIMS) data.



Many hundreds of individual lava flows are located on the middle and upper slopes of Olympus Mons. Some of these flows have lava channels. Direction of flow is towards top of image.

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