= Hual?lai =

Hual?lai (pronounced [huw??la?l?i] in Hawaiian) is an active volcano on the island of Hawai?i in the Hawaiian Islands . It is the westernmost , third @-@ youngest and the third most active of the five shield volcanoes that form the island of Hawai?i , following K?lauea and the much larger Mauna Loa . Its peak stands 8 @,@ 271 feet (2 @,@ 521 m) above sea level . Hual?lai is estimated to have risen above sea level about 300 @,@ 000 years ago . Despite maintaining a very low level of activity since its last eruption in 1801 , Hual?lai is still considered active , and is expected to erupt again some time within the next century . The relative unpreparedness of the residents in the area caused by the lull in activity would worsen the consequences of such an event .

The area near the volcano has been inhabited for centuries by Hawaiian natives , dating back to before recorded history . The coast west of Hual?lai in particular had several royal complexes . The volcano is also important ecologically , is home to many rare species and several nature reserves near the summit , and is a popular hiking attraction . Today the coast near Hual?lai is dotted by vacation resorts , some built on historic flows , and a National Historical Park .

= = Geology = =

= = = Structural features = = =

Hual?lai stands at 8 @,@ 271 ft (2 @,@ 521 m) with a prominence of 3 @,@ 071 ft (936 m) . It is the westernmost of the five major volcanoes which form the island of Hawai?i . Being in the post @-@ shield stage of development , Hual?lai is overall much rougher in shape and structure than the more youthful Mauna Loa and K?lauea . Hual?lai 's structure is denoted by three rift zones : a well @-@ developed one approximately 50 ° to the northwest , a moderately developed one to the southeast , and a poorly developed one trending northwards about 3 mi (5 km) east of the summit . There are over 100 cinder and spatter cones arranged along these rift zones . Hual?lai has no summit caldera , although there is a collapse crater about 0 @.@ 3 mi (0 @.@ 48 km) across atop a small lava shield . Much of the southern slope (above the modern town of Kailua @-@ Kona) consists of lava flows covered by a layer of volcanic ash from 10 to 100 cm (4 to 39 in) thick . In comparison with the other volcanoes of the island of Hawai?i , it is the third tallest , third oldest , third most active , and second smallest , making up just 7 % of the island .

A major subfeature of Hual?lai is Pu?u Wa?awa?a , Hawaiian for " many @-@ furrowed hill " , a volcanic cone standing 372 m (1 @,@ 220 ft) tall and measuring over 1 @.@ 6 km (1 mi) in diameter . It extends for 9 km (6 mi) , and has a prominence of 275 m (902 ft) , north of the summit at 19 ° 46 ? 15 ? N 155 ° 49 ? 56 ? W. The cone is constructed of trachyte , a type of volcanic lava that exists at no other volcano on Hawai?i . Trachyte flows move more slowly than the typically " runny " Hawaiian lavas , a characteristic caused by its high (over 62 %) silica composition (typical basalt is only 50 % silica) . Geologists hypothesize that Pu?u Wa?awa?a originally formed during a pumice eruption a little over 100 @,@ 000 years ago , and has continued to build itself since then , with at least three distinct trachyte flows recognized . The eruptions , although partially covered by flows from Hual?lai and Mauna Loa , have built a distinctive structure known as the Pu?u Anahulu ridge .

The westward @-@ facing flank of Hual?lai forms a large underwater slump known as the North Kona slump . An area of about 1 @,@ 000 km2 (390 sq mi) , the slump consists of an intricate formation of beaches and scarps 2 @,@ 000 to 4 @,@ 500 m (6 @,@ 600 to 14 @,@ 800 ft) below the waterline . This area was explored more closely in a 2001 joint Japan @-@ United States project to explore the volcano 's flanks , utilizing the Remotely operated vehicle ROV Kaik? . Data collected showed that the lava flows there originated in shallow water 500 to 1 @,@ 000 m (1 @,@ 600 to 3 @,@ 300 ft) deep , and that unlike similar slumps at other volcanoes , the slump at Hual?lai formed gradually .

Haul?lai is a known source for xenoliths , rock from the Earth 's mantle that have been brought up

in lava flows . Many prehistoric deposits , as well as those from the 1801 event , contain xenoliths of large size and abundant quantity .

= = = History = = =

Lava attributed to a shield @-@ stage Hual?lai has been found just offshore of the volcano 's northwest rift zone . Tholeiitic basalt , indicative of the submarine subphase of the volcano 's construction , has been found in wells driven into the volcano at a depth of 75 ft (23 m) . These lavas persisted until an estimated 130 @,@ 000 years ago . Hual?lai entered the post @-@ shield stage , the stage it is presently in , about 100 @,@ 000 years ago . Pumice and trachyte eruptions at Pu?u Wa?awa?a may be a sign of this change .

Geological mapping of the volcano has indicated that as much as 80 % of the volcano 's surface has been topped by lava flows during the last 5 @,@ 000 years , entirely composed of shield alkalic basalt . More than half of this is under 3 @,@ 000 years old , and about 12 % is less than 1 @,@ 000 years of age . Between the years 1700 and 2016 , eruptions originated from six vents ; four of these lava flows poured into the sea to the west coast .

= = Eruptive history = =

Hual?lai is the third most active volcano making up the island of Hawai?i , behind K?lauea and Mauna Loa . Although the two larger volcanos have each erupted over 150 times in the last 1 @,@ 000 years , Hual?lai has done so but 3 times . The recurrence of activity at the volcano seems to be every 200 to 300 years .

A recent calm period , with almost no earthquake or magmatic activity at Hual?lai , has seen the growth of homes , businesses , and resorts on the mountain 's flanks . The most recent major activity at the volcano was in 1929 , when an intense earthquake swarm rocked Hual?lai , most likely caused by magmatic action near the volcano 's peak . Although it has been relatively placid in the recent past , Hual?lai is still potentially active , and is expected to erupt again within the next 100 years .

= = = Lava stratigraphy = = =

The USGS has divided the exposed lava flows and tephra erupted by Hual?lai volcano during the last 112 @,@ 000 years into 419 rock units of 8 chronostratigraphic age groups . These are summarized in the table below :

= = = 1800 ? 1801 eruption = = =

Hual?lai last erupted in 1800 ? 1801 . This eruption produced very fluid alkalic basalt lava flows that entered the ocean off the western tip of Hawai?i island . Although five vents were active at the time , only two produced flows that eventually reached the ocean . The total output volume of the flow is estimated at over 300 @,@ 000 @,@ 000 m3 (0 @.@ 072 cu mi) . One volcanic vent , situated high on the slope , produced a large a 'a flow , dubbed the Ka??p?lehu flow , that reached the ocean as two distinct lobes . On its way down , it overran a village and a valuable 3 mi (5 km) fishing pond . There is a local legend that after the failure of several offerings of animals and other items to the gods , the flow was finally stopped when Kamehameha I threw a lock of his own hair into the fire . The Ka '?p?lehu flow is also known for the particularly large quantity of mafic and ultramafic xenoliths that came up with it .

The other major outflow from the event reached the sea south of Kiholo Bay , destroying the village of Ka??p?lehu . This 1801 flow , known as the Hu?ehu?e flow , formed Keahole Point where Kona International Airport is now located , 11 km (6 @.@ 8 mi) north of Kailua @-@ Kona . The eruption at Hual?lai was concurrent with an eruption at the nearby Mauna Loa . It is theorized that , in the near past , Hual?lai has had synchronous eruptions with both Mauna Loa and Kilauea .

= = = Recent activity = = =

Hual?lai last erupted in 1801 . A severe earthquake swarm shook the volcano in 1929 , lasting about a month . This caused $ 100 @,@ 000 worth of damage to the Kona district ($ 1 @.@ 2 million as of 2010) , and two earthquakes with magnitudes of 5 @.@ 5 and 6 @.@ 5 were felt as far away as Honolulu . This was probably caused by magma movement near the surface , but there was no surface activity or eruption .

The 2006 Hawaii earthquake , with epicenter just to the north in Kiholo Bay near M?hukona , caused much damage in the area .

= = = Future monitoring = = =

Although Hual?lai last erupted over 200 years ago , it will erupt again in the near future , as a 200 ? 300 year estimated pause in activity is coming to an end . It presents a distinct hazard to the communities around it as well ; for example , in the event of an eruption similar to the 1801 event , Kailua @-@ Kona , which is 15 mi (24 km) from the volcano 's summit , could be covered completely in a matter of hours . According to the USGS Lava Flow Hazard Zones , on a scale of 5 to 9 , all of Hual?lai is listed as threat level 4 . For comparison , almost all of K?lauea and Mauna Loa is listed as threat levels 1 through 3 . The flanks of the volcano do not pose a lower threat to the population than the area near the rift zones because the distance is short and the slopes are steep ; lava poses as much of a threat as it does near its source .

Since 1991 , the Hawaiian Volcano Observatory (HVO) has maintained a seismic recording station 3 km (1 @.@ 9 mi) east of Hual?lai 's summit to monitor the volcano . During this time , not a single earthquake swarm or harmonic tremor , indicative of activity at the volcano , has occurred . Although Hual?lai does experience several magnitude 4 earthquakes per year , these are attributed to a deep source off the coast of the north @-@ western rift zone and are not related to the movement of magma . The USGS is currently in the process of upgrading its aging monitoring and telemetry equipment , using American Recovery and Reinvestment Act funds . The agency plans to add another seismometer and three more sensors to help monitor activity . In addition , the HVO uses GPS to measure slight changes in tilt and slope of Hual?lai , indicative of magmatic movement . A survey has been conducted every two years since 1986 , but as of 2010 changes have been recorded .

= = Human history = =

Hual?lai has been a home to native people since ancient times . Centuries ago , the Ahu A Umi Heiau was built on the dry plateau east of the mountain . The Kaloko @-@ Honok?hau National Historic Park lies on the shore west of Hual?lai , over the site of an ancient Hawaiian settlement . Although it is called kekaha ?a?ole wai (lands without water) , the rugged volcanic terrain attracted much sea life , making it an appealing place to settle . There are two main attractions within the park : the Kaloko fishpond , an area of loko kuapa (rockwall fishponds) constructed of interlocking rocks across a natural embayment on the coast , and Honok?hau , a former extensive settlement on the south side of the park .

Kamakahonu , Holualoa Bay , and Keauhou Bay were favored retreats of Hawaiian royalty long before the westernization of Hawaii . It was here that Kamehameha I rested after his eight @-@ year campaign to unite the Hawaiian isles . His death in 1819 triggered social chaos . Mokuaikaua Church , built for missionaries in 1837 of lava rock and crushed coral , still stands today . Hulihe?e Palace , where many of Hawaii 's last kings spent their time , has been maintained as a museum since 1927 .

Today , the coast west of Hual?lai is a popular location for vacation resorts , since the rain shadow of the mountain causes many sunny days . The first , Kona Village resort , was built in 1961 . Since then the Four Seasons Resort and the K?ki?o golf course and vacation home complex have also

been built on the 1800 flow . Both the Kona Village Resort and the Four Seasons Resort were damaged by the tsunami generated by the 2011 Sendai earthquake . The Hawaii Belt Road traverses the western slopes with an upper route called the Mamalahoa Highway and lower route named for Queen Ka?ahumanu .

Much of the Kona coffee crop grows on Hual?lai 's western slope near the town of Holualoa . The family of early coffee merchant Henry Nicholas Greenwell owned a large ranch on the western side of the volcano . The road from Kailua @-@ Kona up the slopes of Hual?lai is named for Frank " Palani " Greenwell . Hawaii Route 200 known as the Saddle Road , crosses the plateau north of Hual?lai , where the Pohakuloa Training Area provides a remote training ground for the United States Army and United States Marine Corps .

= = Recreational significance = =

Hual?lai 's many interesting features , most especially its volcanic cones , make it a popular destination for hikers . Although it is relatively easy to climb , much of the land at and around the summit of the volcano is owned by Kamehameha Schools , which routinely denies access to hikers attempting to climb it . As most , if not all , routes up to Hual?lai pass through the estate , hiking on Hual?lai is more or less illegal . However , the laws are not stringently enforced , and many hikers slip through anyway . One of the most popular mountaineering features is Luamakami and its sister Puhia Pele , two pit craters on Hual?lai that are the deepest on the island . Puhia Pele , also known as " Pele 's Pit " , has been explored to a depth of 862 ft (263 m) , and Luamakami is known to be even deeper . The walls are scalable with the proper technical equipment .

= = Ecology and environment = =

Although some of Hual?lai is bare volcanic rock , most of it is covered by some form of vegetation . Bushes , ferns , and grass are common , and even a few ?hi?a lehua trees (Metrosideros polymorpha) grow along the summit . Many of the collapse craters in particular have vegetation , and a few even have respectably @-@ sized " vertical forests " inside , including several Eucalyptus tree groves . The volcano is populated by many birds and animals ; the coast in particular attracts many fish and sea @-@ dependent animals , such as the green sea turtle (Chelonia mydas) and the black @-@ winged stilt (Himantopus himantopus) . Hual?lai averages 18 @.@ 27 in (46 cm) of rainfall per year . The summit gets more rain than the coast and is typically obscured in heavy cloud cover and vog .

Several ecological reserves lie on the flanks of Hual?lai . The Pu?u Wa?a Wa?a forest sanctuary was established in 1992 (along with the Laupahoehoe sister reserve on Mauna Kea) as a testbed for long term ecological research about Hawaiian moist forest and dry forest biomes , and lies within a mile of the volcano 's summit on its northwestern flank . Elevation differs from sea level near the coastal edge to 6 @,@ 300 ft (1 @,@ 920 m) near the summit . Median annual rainfall is about 46 @.@ 7 in (119 cm) . Plentiful lava flows from the 19th century provide unique niches for vegetative and soil growth in the region . The southern section of the reserve , closest to the summit , has been split into a bird sanctuary .

The Honuaula forest reserve on the southwestern flank of the volcano at 19 ° 30 ? 25 ? N 155 ° 54 ? 41 ? W , preserves an extensive koa (Acacia koa) forest stand , with smaller Naio (Myoporum sandwicense) and M?mane (Sophora chrysophylla) trees and an undergrowth of ??kala (Rubus hawaiensis) and various ferns . The reserve measures 655 acres (265 ha) and protects an ecosystem that has since been largely deforested in the surrounding area . The Wai Aha spring reserve on the lower slopes of the mountain is somewhat swampy and is home to the flowering evergreen ?hi?a (Metrosideros polymorpha) , the woody climber ?le?ie (Freycinetia arborea) , and a dense undergrowth of ?Ama?u (Sadleria cyatheoides) .