Map Unit Properties Table

Units listed in gray rows are not mapped within Hawai‘i Volcanoes National Park

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Development	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
QUATERNARY (Holocene)	Caldera (Qcal) fill (Qf) landslide deposits (Qls) alluvium and colluvium (Qac) eolian deposits (Qe) slope deposits (Qsd)	Unit Qcal encompasses caldera wall rocks where several formations may be exposed but are too thin to show in plan view at common map scales. Unit Qf contains man-made breakwater structures along coastlines. Unit Qls includes blocks of soil, basalt, and vegetation that slid from steep valley walls. Unit contains angular breccia and shattered basalt blocks as much as 1 m (3 ft) in diameter in a muddy orange matrix locally. Unit Qac contains sand and gravel derived from lava flows and pyroclastic flows distributed by seasonal streams and mass wasting; some eolian and coralline beach sand present locally. Unit Qe includes very fine grained to fine-grained dune sand of dark-gray, unconsolidated, crossbedded, reworked ash deposits. Unit Qsd contains interlayered fluvial, eolian, debris-flow, and tephra-fall (volcanic) deposits.	Low	With exception of unit Qcal, deposits are unconsolidated and units Qcal, Qls, Qac, and Qsd are associated with steep slopes and should be avoided for heavy development or wastewater treatment facilities.	Units are prone to mass wasting and erosion, especially where present on a slope. Seismicity of magnitude greater than 4 or 5 may trigger mass movements in these units.	Sedimentary units may contain recent plant and animal remains.	Unit may contain ancient Hawaiian artifacts. Unit Qls contains a landslide from 1868 (Wood Valley) that buried a village and killed 31 people.	Sand, ash, gravel	Units form substrate for many habitats throughout the mapped area.	Avoid areas of steep slopes for recreation development.	Units record landscape evolution following volcanic eruptions as well as anthropogenic alterations to the landscape.
QUATERNARY (Holocene–Pleistocene	Puna Basalt (Qp1o, Qp1y, Qp2, Qp3, Qp4, Qp4o, Qp4y, Qp5, Qpa2, Qpa4o, Qpa5, Qpc2, Qpc3, Qpc4o, Qpc4y, Qpc5, Qpld3, Qpld4o, Qpld5)	Various subunits contain spatter or tuff cones (Qpc5, Qpc4y, Qpc4o, Qpc3, Qpc2), lava flows (Qp5, Qp4, Qp3, Qp2, Qp1y, Qp1o), littoral deposits in cones (Qpld5, Qpld4o, Qpld3), and tholeiitic basalt tephra deposits (Qpa5, Qpa4o, Qpa2). Compositions vary between tholeiite and transitional alkalic basalt. Cones consist of spatter and scoria deposited during brief explosive eruptions. Lava flows vary from vesicular pāhoehoe to blocky ‘a‘ā. Littoral deposits are localized along the coast where lava flows entered the water and fragmented during explosive cooling. Deposits include ash, lapilli, and bombs of dense, gray basalt. Tephra deposits include widespread ash and lapilli.	Moderately low to moderate	Avoid areas of active volcanism for all major development.	Unit is strongly associated with potentially dangerous active volcanism (lava flows and pyroclastic events). Recently emplaced lava may still be hot, causing burns. Unit also subject to lava tube collapse and steam explosions. Noxious fumes may still issue from these units.	Tree molds and other casts from recent lava flows and ash falls.	A party of Hawaiian warriors was killed during a pyroclastic surge-steam explosion southwest along Kīlauea Crater. Human footprints are preserved in the Keanakāko‘i Ash.	Olivine, plagioclase, pyroxene, basalt, ash, cinders	Very recent volcanic activity provides habitat for early, opportunistic species on Kīlauea Volcano.	Avoid for most recreation due to active nature of formation.	These units record accurately dated, recent volcanic activity around Kīlauea Volcano.
QUATERNARY (Holocene–Pleistocene)	Ka‘ū Basalt (Qk, Qk1, Qk1o, Qk1y, Qk2, Qk3, Qk4, Qk5, Qka3, Qkc, Qkc1, Qkc1o, Qkc1y, Qkc2, Qkc3, Qkc4, Qkc5, Qkld1, Qkld2, Qkld3, Qkld4, Qkld5)	Unit comprises various subunits including spatter or scoria cones, lava flows, littoral cone deposits, and tephra deposits. Spatter cones (Qkc5, Qkc4, Qkc3, Qkc2, Qkc1, Qkc, Qkc1y, Qkc1o) contain spatter and minor scoria in steep-sided mounds as large as tens to hundreds of meters in diameter. Lava flows consist of pāhoehoe and ‘a‘ā (Qk5, Qk4, Qk3, Qk2, Qk1, Qk, Qk1y, Qk1o). Pāhoehoe flows contain vesicular basalt in long, narrow flows confined by self-made levees. Cone-building littoral deposits (Qkld5, Qkld4, Qkld3, Qkld2, Qkld1) formed during steam explosions as lava reached the ocean and violently cooled. These deposits contain dense glassy basalt as ash, lapilli, and bombs. Tephra deposits (Qka3) contain ash and lapilli that was blown chiefly toward the southwest by prevailing winds.	Moderately low to moderate.	Unit is associated with recent volcanism on an active volcano and should be avoided for major development.	Unconsolidated cinder cones may be unstable on slopes. Lava tubes may collapse in lava flows within this unit. Sharp fragments are present throughout these units.	Tree molds and other casts from recent lava flows and ash falls.	Formation of these units was witnessed and revered by ancient Hawaiians.	Olivine, plagioclase, pyroxene, ash, basalt, cinders	Very recent volcanic activity provides habitat for early, opportunistic species on Mauna Loa volcano.	Avoid unstable areas and areas with sharp substrates for recreation development.	Deposits and flows are historically datable from Mauna Loa volcano and formed during brief eruptive spurts. Ash and pyroclastic deposits can record prevailing wind and current directions. Radiocarbon ages from unit Qk range from 31,000 to 10,000 years old.
QUATERNARY (Holocene–Pleistocene)	Laupāhoehoe Volcanics, younger volcanic rocks member (Qlcy, Qly, Qlay) Laupāhoehoe Volcanics, older volcanic rock member (Qlc, Ql, Qla, Qlbc, Qlb)	The younger volcanic rocks member contains scoria cones (Qlcy), lava flows (Qly), and tephra deposits (Qlay). Unit Qlcy consists of scoria cones containing vesicular lapilli and lesser amounts of ash and bombs with local agglutinated spatter. Fresh exposures are dark gray to red. Unit Qly deposits are predominantly ‘a‘ā and blocky ‘a‘ā with some localized pāhoehoe flows. Flow surfaces are brown to gray with dense, massive, gray interiors. Surfaces are relatively fresh. Unit Qlay contains lapilli and ash distributed by pyroclastic flow. Exposures are black where fresh and yellowish-brown where weathered. The older volcanic rock member contains scoria cones (Qlc, Qlbc), lava flows (Ql, Qlb), and tephra deposits (Qla). Compositions range from hawaiite and mugearite to benmoreite. Units are more weathered than the younger counterparts and may be mantled by eolian, tephra-fall or colluvial deposits.	Moderately low to moderate.	Unconsolidated areas of these units should be avoided for major development.	Younger units contain sharp ‘a‘ā lava flows. Weathered units may contain clay that can cause unsafe conditions and slip surfaces if overlain by intact rock, posing landslide hazards.	Tree molds and other casts from recent lava flows and ash falls.	None documented	Hawaiite, mugearite, benmoreite, ash, basalt, cinders	Weathered units contribute to fertile, clayey soil in localized areas.	Blocky ‘a‘ā flows can be suitable trail bases if properly constructed; avoid young flows for recreation development.	Potassium-Argon radiometric ages for older Laupāhoehoe Volcanics range from 65,000 to 14,000 years old.

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QUATERNARY (Holocene–Pleistocene)	Hualālai Volcanics, basalt member (Qhc, Qh, Qh1o, Qh1y, Qh2, Qh3, Qh4, Qh5, Qhc1o, Qhc1y, Qhc2, Qhc3, Qhc4, Qhc5, Qha4)	Units include spatter or scoria cones (Qhc5, Qhc4, Qhc3, Qhc2, Qhc1y, Qhc1o, Qhc), lava flows (Qh5, Qh4, Qh3, Qh2, Qh1y, Qh1o, Qh), and tephra deposits (Qha4). Compositions range from alkalic and transitional basalt to hawaiite. Vent deposits comprise small spatter cones with larger scoria and spatter cones deposited locally by short extrusive events. Flows are pāhoehoe and/or ‘a‘ā. Unit Qha4 contains weakly consolidated light-gray tuff with lapilli and large alkalic basalt, tholeiitic basalt, and trachyte blocks.	Moderately low to moderate.	Unconsolidated tephra and cinders should be avoided for major development.	Unconsolidated units may fail on even moderate slopes during heavy precipitation or seismic events. Recent flows may pose hazard for lava tube collapse.	Tree molds and other casts from recent lava flows and ash falls.	Formation of younger units may have been viewed by ancient Hawaiians.	Olivine, pyroxene, plagioclase, basalt, ash, cinders, trachyte, hawaiite	Unit provides substrate for upland, scrubby vegetation locally.	Suitable for most recreation unless fresh and sharp fragments exist.	Unit Qha4 records steam-driven explosive events at 700 years before present. Flows are at least as old as 13,000 years, but historic activity was as recent as A.D. 1800–1801.
QUATERNARY (Pleistocene)	Kahuku Basalt (Qkh) Nīnole Basalt (Qn)	Unit Qkh contains tholeiitic basalt flows from Mauna Loa that resemble Ka‘ū basalt but underlie unit Qpha. Unit Qn contains lava flows of tholeiitic basalt that crops out as erosional remnants. Unit contains deep lava flow canyons partially filled by ash and younger lava flows. Flows of this unit are thin pāhoehoe and ‘a‘ā, interlayered with some basaltic tuff, dikes, and ash beds.	Moderate	Heterogeneous nature of this unit may render it unstable on slopes; canyons should be avoided for development.	Unit Qn is associated with steep canyon slopes and landslides, which may have contributed to canyon growth.	Tree molds and other casts from recent lava flows and ash falls.	Canyons may have been preferred travel routes.	Olivine, plagioclase, ash, basalt.	None documented	‘A‘ā can be a suitable trail base if trail is properly constructed. Canyons may be dangerous for recreation.	Unit Qkh is useful in relative age dating, predates unit Qpha and the 31,000 year old part of unit Qk. Unit Qn is 300,000 to 100,000 years old as determined by Potassium-Argon radiometric dating.
QUATERNARY (Pleistocene)	Hualālai Volcanics, Wa‘awa‘a Trachyte Member (Qwc, Qw)	Units consist of a scoria cone (Qwc) and a lava flow (Qw). Unit Qwc contains loose fragments of pumice, obsidian, some sheared trachyte flows, and altered volcanic rocks. Unit Qw contains sheared flows of trachyte, now slightly altered and appearing light brown.	Moderately low to moderate	Friable nature of this unit renders it relatively unsuitable for major development, especially if exposed on steep slopes.	Unit may be extensively altered locally and unstable on steep slopes.	Tree molds and other casts from recent lava flows and ash falls.	Obsidian and pumice may have provided tool and trade material.	Biotite, plagioclase, pyroxene (phenocrysts are rare), trachyte, obsidian, pumice.	Unit provides substrate for upland, scrubby vegetation locally.	Suitable for most recreation unless sharp fragments exist.	Unit is Potassium-Argon radiometric age-dated to approximately 105,000–100,000 years old. Unit is present as xenoliths elsewhere on Hualālai.
QUATERNARY (Pleistocene)	Pāhala Ash (Qpha)	Unit is widespread and contains deeply weathered ash deposits that are commonly altered to yellowish-orange to reddish-brown clay minerals and hydrated oxide residues. Unit commonly crops out in kīpukas surrounded by younger lava flows and interlayered ashes. Unit ranges in thickness from a few centimeters to as much as 15 m (45 ft).	Moderately low	Easily weathered ash material may form clays that pose development challenges, especially if shrink-and-swell clays are present. Avoid areas close to active flows.	Ash horizons weathered to clay may pose rockfall hazard if overlain by intact rock and exposed on even moderate slopes.	None documented	Weathered clay may have provided materials for domestic use. Thick ash units may have provided abrasive material.	Clay, hydrated oxides.	Unit contributes to fertile volcanic soils.	Clays may provide slippery recreational base.	Origin is likely reworked and primary tephra-fall deposits; distribution is linked to prevailing wind direction. Age dates range from 31,000 to 23,000 years old. Important marker unit.
QUATERNARY (Pleistocene)	Hilina Basalt (Qhi)	This unit crops out in kīpukas surrounded by younger units and contains lava flows and intercalated ash deposits. Approximately 95% of the exposed unit is pāhoehoe and ‘a‘ā lava flows at least 300 m (1,000 ft) thick. Compositions are mostly tholeiite. Ash layers can reach 4 m (13 ft) in thickness with vitric to lithic textures. Unit weathers to reddish-brown clays.	Moderately low to moderate	Suitable for most development unless close to active flows of Kīlauea Volcano.	Ash horizons weathered to clay may pose rockfall hazard if overlain by intact rock and exposed on even moderate slopes.	None documented	Thick ash units may have provided abrasive material.	Olivine, plagioclase, pyroxene, ash, basalt.	Weathered areas of this unit support soil and palagonite horizons.	‘A‘ā can be a suitable trail base if trail is properly constructed.	Unit predates unit Qpha and is older than 23,000 years old.
QUATERNARY (Pleistocene)	Laupāhoehoe Volcanics, Mākanaka Glacial Member (Qlmt, Qlmo)	Glacial till unit (Qlmt) contains massive, poorly consolidated diamict with angular to subrounded cobbles and boulders. Some individual clasts may be larger than 2 m (7 ft) in diameter and consist of dense, light- to medium-gray hawaiite or mugearite. The matrix is gray to light yellowish brown, fine grained, and unsorted. Unit Qlmo contains unconsolidated gravel with subrounded to rounded cobbles and boulders of similar composition to those in unit Qlmt.	Low	Due to poor consolidation and heterogeneous nature of this unit, avoid for most major development.	Poorly consolidated or unconsolidated parts of these units are prone to mass wasting and erosion, especially if exposed on slopes.	Some remains may be present in glacial member.	Unconsolidated parts may have provided construction material for early Hawaiians.	Cobbles, boulders.	None documented	Jumbled nature of unit makes it an unstable trail base.	Relative age dating of nearby flows suggest that the age of these units is between 40,000 and 14,000 years old, during the Mākanaka glaciation.

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QUATERNARY (Pleistocene)	Hāmākua Volcanics, basalt member (Qhmc, Qhm) Hāmākua Volcanics, Waihū Glacial Member (Qhmw)	The basalt member is divided into scoria cones (Qhmc) and lava flows (Qhm). Compositions range from alkalic and transitional basalt to minor hawaiite, tholeiitic, and strongly undersaturated basalt. Unit Qhmc contains vesicular lapilli, ash, and bombs with surfaces locally mantled by tephra-fall and eolian deposits. Unit Qhm contains ‘a‘ā and pāhoehoe with fresh dark-gray exposures and weathered yellowish-brown to brown exposures. Flows are locally mantled by eolian, tephra-fall, and colluvial deposits. Unit Qhmw contains glacial drift of diamict and gravel. Much of the unit is massive to crudely layered with subangular to subrounded cobbles and boulders of Hāmākua lava flow remnants encased in an indurated, gray to yellowish-reddish-brown, unsorted matrix. Layered, sorted gravel lenses and tongues are present locally.	Moderately low to moderate	Avoid weathered and/or unconsolidated units for heavy development.	Intense erosion and mass wasting associated with these units. Areas exposed on slopes are vulnerable to fail during moderate seismic events.	Some remains may be present in glacial member.	Unconsolidated parts may have provided construction material for early Hawaiians.	Olivine, plagioclase, clinopyroxene, basalt, cinders, ash.	Weathered areas contribute to primitive, fertile soils when combined with mantling younger deposits.	‘A‘ā can be a suitable trail base if trail is properly constructed.	Unit includes an unmapped glacial till of the Pōhakuloa Glacial Member on the flanks of Mauna Kea. Potassium-Argon radiometric age dates range from 250,000–200,000 years to 70,000–65,000 years. Unit Qhmw is poorly constrained by Potassium-Argon radiometric age-dating at 150,000–70,000 years old.
QUATERNARY (Pleistocene)	Hāwī Volcanics (Qhwc, Qhw, Qhwa, Qhwb, Qhwbc, Qhwbd, Qhwd, Qhwt, Qhwtd)	Unit is divided into scoria cones (Qhwc, Qhwbc), lava domes (Qhwd, Qhwbd, Qhwtd), lava flows (Qhw, Qhwb, and Qhwt), and tephra deposits (Qhwa). Compositions range from hawaiite, mugearite, and benmoreite to trachyte. Flows are light to medium gray and blocky. Flows may be as much as 30 m (100 ft) thick. Tephra-fall deposits flank cinder cones with ash and lapilli clasts. Most of this unit is mantled by younger tephra-fall and eolian deposits.	Moderately low to moderate	Suitable for most development unless steep slopes are present.	Units are prone to rockfall if undercut and/or exposed on steep slopes. Areas exposed on slopes are vulnerable to failure during moderate seismic events.	None documented	Unconsolidated parts may have provided construction material for early Hawaiians. Hāwī is an ancient royal site.	Trachyte with strongly aligned plagioclase crystals in a finer matrix, benmoreite, hawaiite, mugearite.	Unit supports a wide variety of vegetation and associated animal habitat. Weathering contributes material to fertile soils.	Suitable for most recreation except where steep slopes are present.	Potassium-Argon radiometric ages for lava flows range from 230,000 to 120,000 years old.
QUATERNARY (Pleistocene)	Pololū Volcanics (Qpl, Qplc, Qpld, Qplm, Qplmc)	Unit contains basalt scoria cones (Qplc), lava flows (Qpl), and a lava dome (Qpld), as well as mugearite scoria cones (Qplmc) and lava flows (Qplm). Basalt ranges in composition from tholeiitic, through transitional, to alkalic (hawaiite) with textures varying from porphyritic to aphyric. Flows are mostly ‘a‘ā, but most surface expression has been muted by weathering and erosion. Most surfaces are mantled by eolian and younger tephra-fall deposits.	Moderately low to moderate	Avoid areas especially rich in clay or weathered on slopes for major development.	Weathered ash horizons may pose rockfall hazard if overlain by intact rock and exposed on even moderate slopes.	None documented	None documented	Olivine, plagioclase, clinopyroxene, mugearite, basalt, cinders.	Extensively weathered, this unit provides material for fertile volcanic soils locally. Unit supports forests on the windward side of the island.	‘A‘ā can be dangerous trail base if trail is not properly constructed, but weathering has dulled the sharpness of many areas.	Potassium-Argon radiometric age dating suggests the magma evolved from tholeiitic basalt to transitional and alkalic basalt 400,000 years ago and erupted until at least 250,000 years ago. Older lava flows are as old as 700,000 years and are the oldest exposed rocks on Hawai‘i. All exposed Pololū Volcanics strata were emplaced during the Brunhes Normal-Polarity Chron (they are younger than 780,000 years old).