

Map Unit Properties Table – Tutuila Map Units

Age		Map Unit (Symbol)	Unit Description	Erosion Resistance	Suitability for Development	Hazards	Paleontologic Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
QUATERNARY - RECENT	Recent	Sedimentary Rocks (Ra)	Unit consists of loose calcareous beach sand along coastal areas and may include slope talus at the foot of valley walls and river deposited alluvium on valley floors; units are a maximum of 60 m thick.	Very low	Development not recommended on this highly permeable, erodable, and fragile unit.	Mass wasting (landslides, rockfalls, slumps, slope creep, etc.); extreme beach erosion	Fragments of foraminifera, algae, shells, and corals	Sediments may contain pre- historic artifacts from local populations of indigenous peoples	Sand, gravel	Forms beach and near shore habitat vulnerable to degradation from coastal erosion	Unit is highly desirable for beach and shoreline recreation	Unit is derived from surrounding coral reef, thus an adequate supply of sand demands a healthy reef, unit indicates ecosystem health
	Recent	Leone Volcanic: Leone Volcanic (Rll); stony ash(Rla); cinder cone (Rlc); lithic/vitric (Rlt)	Rll contains olivine pahoehoe basalt flows. Rla contains deposits of stony ash along the source fissure zone. Rlc consists of cinder cone deposits localized at the upper end of the source fissure. Rlt contains at least 2 thick tuff beds from Vailoatai, Fagatele, and Fogāma'a Craters with material from Fogāma'a Crater atop the Fagatele Crater volcanic deposits.	Moderate	Highly porous; may be unsuitable for waste treatment facility and unstable for building foundations	Ash and cinder cone deposits are unstable on slopes and pose mass wasting hazards	Plant and animal casts possible, fragments of drowned coral reef	Humans may have witnessed eruptions	Volcanic glass, ash, and cinders	Unit supports a barrier reef environment	Cinder cone deposits are unstable trail base	Basalt flows covered submerged barrier reef adding 21 square km of new land near Leone.
	Recent	'Aunu'u Tuff (Rat)	Unit comprises 'Aunu'u Island of lithic to vitric tuff deposits. Unit is more than 200 m thick.	Moderate	Highly porous; may be unsuitable for waste treatment facility and unstable for building foundations	Contains sharp, glassy fragments; may pose mass wasting hazards	Plant and animal casts possible	Volcanic glass may have provided tool material	Volcanic ash, glass	Unit supports a barrier reef environment	Unit may be unstable on slopes for trail base and other visitor use	Unit records resurgence of volcanic activity in the area following intense erosion, lava erupted below sea level and caused steam explosions
PIOCENE - EARLIEST PLEISTOCENE		Trachyte Plugs and Dikes: Trachyte Plugs and Dikes (Pt); pumice deposits (Ptp)	Pt consists of 642 m of dense, cream- colored trachyte present in plugs and dikes. Plugs are weathered and exposed as conspicuous eroded bulbous domes which are younger than the surrounding volcanic rocks. Ptp is pumice deposits (highly porous lava) associated with the Vatia Plug.	Pt high; Ptp moderate	Pumice rich areas should be avoided for waste treatment facility development and trails	Rockfall and landslide hazards if undercut on a slope	None	Topographic high may have been attractive to indigenous peoples for rituals and settlers for strategic positions	Trachyte	Units form topographic highs for birds, and support montane, ridge top, mountain- top scrub, and cloud forest	Suitable for most use unless rich in friable pumice	Units record the latter stages of volcanic evolution
PLIOCENE - EARLIEST PLEISTOCENE		Taputapu Volcanics (Po)	Undifferentiated olivine basalts (2 to 15 m thick), dipping 5°- 10° from a rift zone parallel to the Samoan Ridge interlayered with thin- bedded cinder cone deposits, dikes, and thin vitric tuff beds. In some areas the volcanics are capped by thicker flows of porphyritic and nonporphyritic olivine poor basalts. Some red vitric tuff and cinders present locally.	Moderate	Abundance of unconsolidated or loosely consolidated cinder cone deposits may render unit unstable for foundations, avoid heavily fractured basalts	Fractured basalt flows, and cinder cone deposits are unstable on slopes and pose mass wasting hazards	None	Volcanic glass may have provided tool material	Olivine phenocrysts, volcanic glass; cinders	Unit supports a barrier reef environment	Unit attracts shoreline recreation in some areas	Subsidence and erosion of this unit gave rise to a fringing reef and gradually a barrier reef.
		Pago Volcanic Series: Pago Volcanic Series (Ppe); andesite/basalt flows (Ppi); lithic/vitric tuff (Ppt)	The series comprised of extra- caldera volcanics of the largest shield forming Tutuila: upper member - basaltic and andesitic flows with associated cones, dikes, and trachyte plugs; lower member predates caldera formation of primitive basalt flows, and associated cones and dikes (1 to 15 m wide). Pisolitic beds present locally. Ppt is confined to within the 10- km wide Pago Caldera and consists of interbedded lithic to vitric tuffs. Flows are as much as 150 m thick.	Ppe moderate to high; Ppi and Ppt moderate	Heterogeneity of unit may render unit unstable for foundations; avoid development if highly fractured and/or degraded	Rockfall and landslide hazards if undercut on a slope, especially if highly fractured or heterogeneous	None	None documented	Crystalline quartz trachyte (Matafau, Pioa, and Papatele plugs)	Unit forms harbor, shoreline, and marine habitats	Unit attracts shoreline recreation in some areas	Unit eroded differentially as a result of weathering upon exposure to sulfuric gases and explosive eruptions, caldera now forms Pago Harbor.
		Alofa Volcanics (Pa)	Thin- bedded pahoehoe basalt flows, some of which are primitive olivine- bearing associated with cones, vitric tuff beds, and numerous cross cutting dikes; unit forms a shield- shaped dome.; total thickness more than 962 m.	Moderate	Suitable for most development unless highly fractured or undercut on a slope.	Rockfall and landslide hazards if highly fractured and undercut on a slope	None	None documented	Olivine grains, dikes may contain phenocrysts	Unit supports evergreen forest and wet tropical climax vegetation	Suitable for most uses unless undercut on slope	Cross cutting dikes present dating opportunity for the volcanic evolution of the area
		Olomoana Volcanics (Pol)	Areally restricted thin bedded primitive olivine basalt flows dipping 10° north; flows cap andesite deposits and associated cones, vitric tuff beds, and volcanic plugs. Locally trachyte lavas form domes. Some flows are interbedded with palagonitized vitric tuffs; thickness as much as 322 m.	Moderate to high; low to moderate for loose pumice rich material.	Unit suitable for most development unless highly fractured or undercut on a slope.	Rockfall and landslide hazards if tuffs are weathered out below more resistant trachyte on slopes	None	Pumice may have been used as tool material	Pumice, trachyte, basalt	Domes form topographic highs for birds and support montane, ridge top, mountain- top scrub, and cloud forest	Suitable for most use unless highly fractured	Succession of lava types from basalts to trachytes and andesites records evolution of Olomoana volcano
		Masefau Dike Complex (Pm)	Narrow basaltic dikes (a few cm to 2 m wide) and associated intraformational slope talus breccia cut older thin, basaltic flows; dikes are vesicular and platy with local amygdaloidal textures.	Moderate to high where dikes are coarsely crystalline	Avoid areas where flows are underlain by slope talus breccia as instability may occur.	Rockfall and landslide hazards if undercut on slope	None	None documented	Vesicles may be filled with secondary minerals	Vesicles may provide nesting habitat or burrow type habitat	Suitable for most use unless highly vesicular rich in slope talus breccia	Cross cutting dikes and intervolcanic episode slope talus breccia present dating opportunity for the geologic evolution of the area

Map Unit Properties Table – Tau Map Units

Age	Map Unit (Symbol)	Unit Description	Erosion Resistance	Suitability for Development	Hazards	Paleontologic Resources	Cultural Resources	Mineral Specimens	Mineral Resources	Habitat	Recreation	Global Significance
QUATERNARY	RECENT	Calcareous Sediments (Qb)	Very low to low	Development not recommended on this highly permeable, erodable, and fragile unit.	Extreme beach erosion associated with this unit	Coral and shell fragments	Sediments may contain pre-historic artifacts from local populations of indigenous peoples	Coquina	sand	Unit forms beach and near shore habitat vulnerable to degradation from coastal erosion and sand mining	Unit is highly desirable for beach and shoreline recreation	Units contain benches at 4 and 1.5m above present sea level as past indicators of higher eustatic stands
	RECENT	Noncalcareous Sediments: alluvium (Qa); marshes (Qm)	Very low	Development not recommended on this highly permeable, erodable, and fragile unit.	Mass wasting hazards (landslides, rockfalls, slumps, slope creep, etc.) associated with this unit	Plant and animal debris	Sediments may contain pre-historic artifacts from local populations of indigenous peoples	None documented	Sand, clay, gravel, peat	Units support riparian and marsh-wetland habitat	Marsh units should be avoided for recreational use	Units reflect weathering and geomorphological processes active on the islands
	RECENT	Fiti'uta Formation: lava flows (Qfl); cinder cone (Qfc)	Moderate	Where abundant cinder cone deposits exist, unit is highly porous and might prove unsuitable for waste treatment facility development	Bench of basalt may be susceptible to rockfall and landslides if undercut or sitting atop weathered cinder cone deposits on a slope.	Coral blocks interbedded in tuff layers, plant and animal casts possible	Humans may have witnessed eruptions	Dunite-bearing flows (olivine); dunite xenoliths and coral blocks	Basalts, cinders	Unit supports evergreen forest and wet tropical climax vegetation	Suitable for most use unless rich in friable, unstable cinder cone deposits	Unit contains tuffs with xenoliths and coral fragments indicating longstanding hiatuses between flows, buries a former sea cliff showing evolution of island shorelines
	RECENT	Faleāsao Formation (Qft)	Moderate	Unit is highly porous and might prove unsuitable for waste treatment facility development, may be unstable for building foundations	Ash, tuff, and cinder cone deposits are unstable on slopes and pose mass wasting hazards. Some units also contain sharp, glassy fragments	Plant and animal casts possible	Humans may have witnessed eruptions	Volcanic glass	Basalt	Depressions may support wetland development and provide shelter	Units may contain sharp fragments unsuitable for trail base	Unit is limited by extensive erosional surface, indicating a long-term intervolcanic period
PLIOCENE	Luatele Formation: pahoehoe flows (Qlp); ponded lava flows (Qlc)	Qlp contains thin pahoehoe lava flows of olivine basalt and picrite-basalt. Unit forms the Luatele shield on the northeastern portion of the island of Tau. Qlc contain 300 m thick ponded lavas from flows which partly fill local depressions in the caldera.	Moderate	Unit is suitable for most development unless highly fractured or undercut on a slope.	Rockfall and landslide hazards associated with this unit if undercut on a slope	None	None documented	Olivine phenocrysts	Basalt	Depressions may support wetland development and provide shelter	Suitable for most use unless highly fractured	Following summit collapse, ponded lavas record the end of local volcanic activity.
	Tūnoa Formation: lava flows (Qte); cinder cone (Qtcc); volcanic deposits (Qtc); cinder cone (Qtcc)	Qte contains cinder cone deposits from the Tūnoa shield which is comprised of basalt and olivine basalt lava flows on the northwestern portion of Tau. Qtcc is composed of volcanic deposits of red vitric and crystal ash, lapilli tuff, and associated olivine basalt lava flows; these units and associated cinder cone deposits partly fill the depression formed during the collapse of the volcanic shield.	Moderate	Heterogeneity of unit as well as abundance of unconsolidated or loosely consolidated cinder cone and lapilli deposits may render unit unstable for foundations	Ash and cinder cone deposits are unstable on slopes and pose mass wasting hazards. Some units also contain sharp, glassy fragments	None	None documented	Olivine phenocrysts, volcanic glass, lapilli, red crystal ash	Cinders, basalt	Collapse features provide shelter, subterranean habitat and may support marsh development	Suitable for most use unless rich in friable, unstable ash and cinder cone deposits	Unit records discrete volcanic episode at the Tūnoa shield in the northwestern portion of Tau
	Lata Formation: post-caldera (Qle); post-caldera cinder cone (Qlec); post-caldera lava flows (Qlel); intra-caldera (Qli); intra-caldera cinder cone (Qlic); intra-caldera lava flows (Qlil)	Formation is comprised of olivine basalts, picrite-basalts, basalts, and hawaiites present as flows, cinder cone deposits, and other eruptions associated with the caldera collapse on Tau.	Moderate	Unit is suitable for most development unless highly fractured, rich in cinder cone deposits or undercut on a slope.	Ash and cinder cone deposits as well as fractured basalt flows are unstable on slopes and pose mass wasting hazards	None	None documented	Olivine phenocrysts	Cinders, basalt	Unit supports evergreen forest and wet tropical climax vegetation	Unit is suited for light recreational use unless highly fractured and/or degraded	Units record the caldera collapse of Lata Mountain
	Lata Formation: pre-caldera (Tle)	The pre-caldera member consists of interlayered lava flows of olivine basalt, picrite-basalt, basalt, feldspar-phryic basalt, and hawaiite. Occasional tuff beds are interlayered locally.	Moderate	Unit is suitable for most development unless highly fractured or undercut on a slope.	Rockfall and landslide hazards associated with this unit if undercut on a slope	None	Phenocrysts may have provided trade materials	Feldspar and olivine phenocrysts	Basalt	Unit supports montane, ridge top, mountain-top scrub, and cloud forest	Unit is suited for light recreational use unless highly fractured and/or degraded	Largest volcanic center along the crest of the easternmost portion of the Samoan Ridge, over 3600 m thick of volcanic layers at top of Lata Mountain

Map Unit Properties Table – Ofu and Olosega Map Units

Age	Map Unit (Symbol)	Unit Description	Erosion Resistance	Suitability for Development	Hazards	Paleontologic Resources	Cultural Resources	Mineral Specimens	Mineral Resources	Habitat	Recreation	Global Significance
RECENT	Calcareous Sediments (Qb)	Modern beach deposits consisting of unconsolidated fragments of shells and other marine organisms. May be present as coquina or beachrock.	Very low to low	Development not recommended on this highly permeable, erodible, and fragile unit.	Extreme beach erosion associated with this unit	Coral and shell fragments	Sediments may contain pre- historic artifacts from local populations documenting 3,000 years of occupation of indigenous peoples	Coquina	sand	Units contain benches at 4 and 1.5m above present sea level as past indicators of higher eustatic stands	Units contain benches at 4 and 1.5m above present sea level as past indicators of higher eustatic stands	Units contain benches at 4 and 1.5m above present sea level as past indicators of higher eustatic stands
RECENT	Noncalcareous Sediments: alluvium (Qa); marshes (Qm)	Units consist of noncalcareous alluvium, slope talus, and stream deposits. Marsh deposits are fine-grained with organic material and mud, located behind constructional beaches.	Very low	Development not recommended on this highly permeable, erodible, and fragile unit.	Mass wasting hazards (landslides, rockfalls, slumps, slope creep, etc.) associated with this unit	Plant and animal debris	Sediments may contain pre- historic artifacts from 3,000 years of uninterrupted occupation of indigenous peoples	None documented	Sand, clay, gravel, peat?	Units support riparian and marsh- wetland habitat	Marsh units should be avoided for recreational use	Units reflect weathering and geomorphological processes active on the islands
RECENT - PLEISTOCENE	Nu'u Formation: tuff (Qnt); lava flows (Qnl)	Qnt is present as young palagonitized lapilli tuff forming Nu'utele and Nu'usilaelae islets. Qnl is present as flows of hawaiite and olivine basalt, unit also fills former eroded stream valleys on western Ofu.	Moderate	Unit is highly porous and might prove unsuitable for waste treatment facility development, may be unstable for building foundations	Ash and cinder cone deposits are unstable on slopes and pose mass wasting hazards. Some units also contain sharp, glassy fragments	Plant and animal casts possible	Humans may have witnessed eruptions from 3,000 years Bp	Ejected lapilli	Basalt	Unit supports evergreen forest and wet tropical climax vegetation	Units may contain sharp fragments unsuitable for trail base	Unit records renewed volcanic activity after prolonged period of quiescence and erosion, units comprise remnant islets
PLIOCENE	Tuafanua Formation: A'ofa shield (Ttae); Sili shield (Tts); A'ofa caldera volcanic deposits (Ttai)	Ttae is composed of coalescing shields (A'ofa) of pahoehoe and a'a olivine basalt, basalt, picrite- basalt, and hawaiite flows dipping 10- 20 degrees with interlayered ash, tuff, and breccia beds. Shields and the Fatuaga breccia cone are cut and intruded by numerous igneous dikes locally. Similarly, the Sili shield is comprised of coalescing layers of olivine basalt, picrite- basalt, basalt, and hawaiite flows with interbedded ash, tuff, and breccia layers. Ttai contains thick, ponded flows of olivine basalt, hawaiite, and ankaramite locally within the A'ofa Caldera deposits.	Moderate	Heterogeneity of unit as well as abundance of unconsolidated or loosely consolidated cinder cone and lapilli deposits may render unit unstable for foundations	Mass wasting hazards (landslides, rockfalls, slumps, slope creep, etc.) associated with this unit especially where flows are present above more easily eroded ash, tuff, and breccia layers	None	None documented	Olivine phenocrysts, ankaramite	Volcanic ash	Depressions may provide wetland habitat and shelter	Suitable for most recreation unless friable volcanic breccias are present	Units record volcanic evolution across several distinct shield areas and fissures.
PLIOCENE	Asaga Formation: Fatuaga Point breccia cone (Tafb); Fatuaga Point plug (Tafi); Toaga composite cone (Tat); Lemaga Point tuff cone (Tam); Samoi tuff cone (Tas); Taugā point cinder cone (Tac)	Tafb is volcanic breccia in a cone formation. Tafi is a volcanic plug associated with the volcanic flows at Fatuaga Point. Tat contains various volcanic ejecta in a composite cone. Tam is comprised of interlayered tuffs in a cone at Lemaga Point. Tas is also a tuff cone located at the west end of Samoi. Tac is composed of a series of older cinder cones oriented along the regional rift zone.	Tafi is moderate to high, Tafb, Tam, Tat, Tas, and Tac are moderate	Volcanic ejecta may be too permeable for waste treatment facility development and pose mass wasting hazards. Some units also contain sharp, glassy fragments	Ash and cinder cone deposits are unstable on slopes and pose mass wasting hazards. Some units also contain sharp, glassy fragments	None	None documented	Volcanic ejecta	Dense crystalline rock for building material, basalt, cinders	Unit supports evergreen forest and wet tropical climax vegetation	Suitable for most recreation unless friable volcanic breccias are present	Units cover older pyroclastic cones and now compose 3300 m thick shields of the islands.