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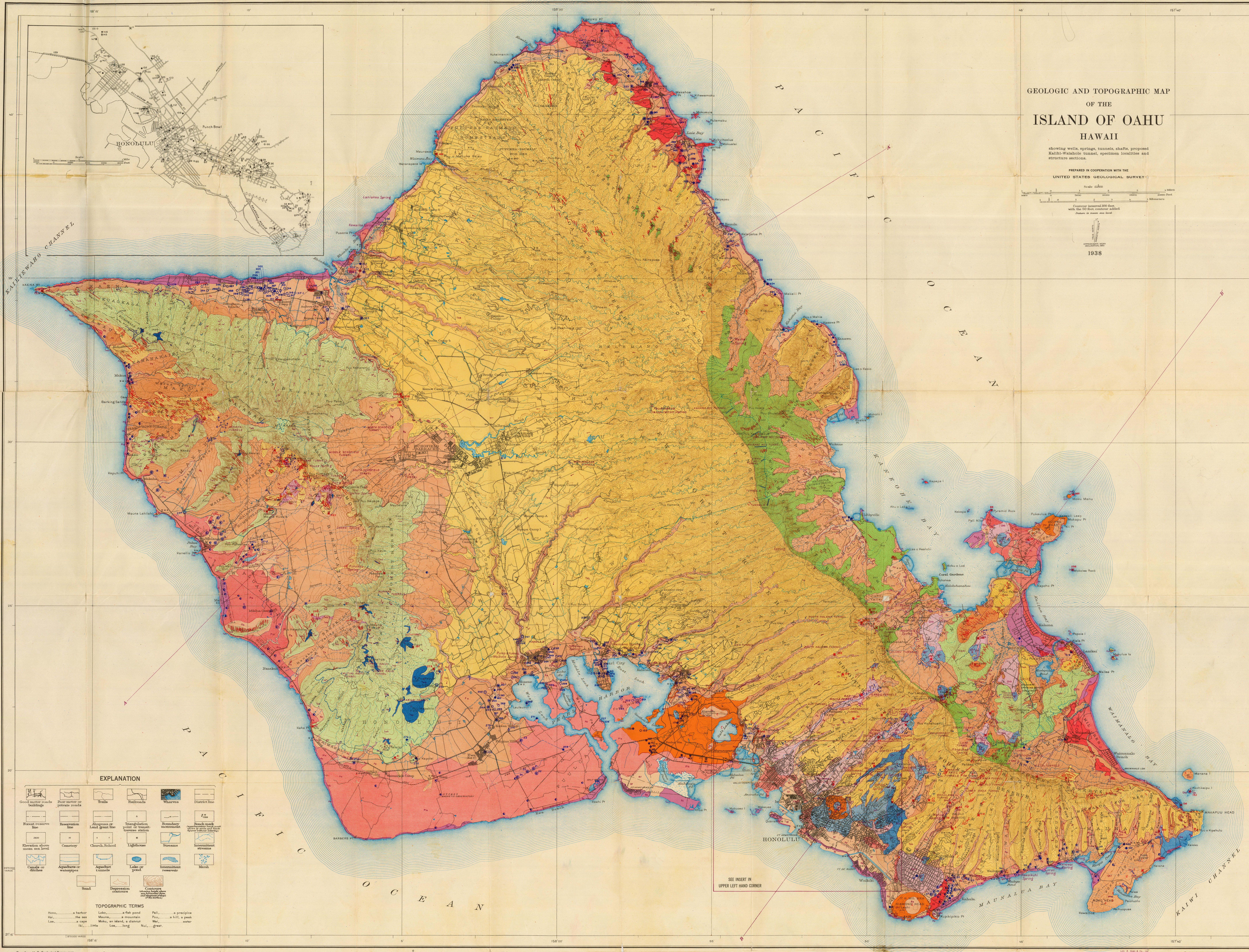


GEOLOGIC AND TOPOGRAPHIC MAP
OF THE
ISLAND OF OAHU
HAWAII

showing wells, springs, tunnels, shafts, proposed Kalihi-Waiahole tunnel, specimen localities and structure sections.

PREPARED IN COOPERATION WITH THE
UNITED STATES GEOLOGICAL SURVEY

Scale $\frac{1}{62500}$

Contour interval 100 feet
with the 50 foot contour added
Datum is mean sea level

APPROXIMATE MEAN DECLINATION, 1930

1938

EXPLANATION

Good motor roads buildings	Poor motor or private roads	Trails	Railroads	Wharves	District line
Forest reserve line	Reservation line	Ahupuaa or Land grant line	Triangulation point or transit-traverse station	Boundary monument	Bench mark (*supplementary bench mark shown by cross and black figures without lettering*)
Elevation above mean sea level	Cemetery	Church, School	Lighthouse	Streams	Intermittent streams
Canals or ditches	Aqueducts or waterpipes	Aqueduct tunnels	Lake or pond	Intermittent reservoir	Marsh
Sand	Depression contours	Contours (*showing height above sea, horizontal form, and steepness of slope of the surface*)			

TOPOGRAPHIC TERMS

Hono, ... a harbor	Loko, ... a fish pond	Pali, ... a precipice
Kai, ... the sea	Mauna, ... a mountain	Puu, ... a hill, a peak
Lae, ... a cape	Moku, an island, a district	Wai, ... water
Iki, ... little	Loa, ... long	Nui, ... great.

970 000 YARDS

2 670 000 YARDS

Base from U. S. Geological Survey map surveyed in 1927-30 in cooperation with the Territory of Hawaii and the War Department.

EXPLANATION

SEDIMENTARY ROCKS

Recent

Rf — Artificial fill composed of marine deposits

(*Brown to white permeable marine mud containing shells, coral, and other calcareous marine organisms dredged from the ocean floor and used to fill up salt marshes and other low lands. Around Pearl Harbor the fills are mostly impermeable brown mud, in places containing numerous shells but very little coral.*)

Rs — Unconsolidated marine calcareous sediments

(*Chiefly cream-colored and light-tan, very permeable beach sand consisting of grains of worn coral, coralline algae, and shells with appreciable amounts of foraminifers and other calcareous marine organisms. In a few places lava detritus occurs sparingly; in other places coral pebbles and shell fragments predominate; and near tuff cones grains of olivine are conspicuous. Abundant water in this sand, but it is either brackish or ocean water.*)

Rd — Unconsolidated calcareous dunes

(*Fine-grained cross-bedded cream-colored, very permeable, calcareous sand blown inland from the present beach and containing brackish or ocean water.*)

Ra — Unconsolidated noncalcareous deposits

(*Chiefly younger alluvium, a black to brown fluviatile deposit generally consisting of coarse permeable detritus only slightly weathered and in many places subangular. In the valley bottoms near the sea it usually consists of nearly impermeable black, sticky mud called taro-patch clay. Much of the younger alluvium is reworked older alluvium. Included also is talus composed of angular blocks, usually with brown interstitial soil, forming aprons on the steep slopes at the base of cliffs. In the mountain areas much of the younger alluvium resembles, includes, and is often inseparable from landslide deposits, because of the torrential character of the streams and the precipitous valley walls. Extensive mantles of hill wash are included. Wells develop water from it in small quantities.*)

Pleistocene sedimentary rocks contemporaneous with Honolulu volcanic series

Pd — Consolidated calcareous dunes

(*Thin-bedded and cross-bedded eolian limestone composed of uniform fine calcareous grains blown inland from ancient beaches and later lithified. It contains sufficient solution channels to be permeable, and locally it carries water, which is apt to be brackish near the sea.*)

Pls — Consolidated calcareous marine sediments

(*Chiefly emerged coral reefs but in places, especially near Pearl Harbor, finely laminated lagoon limestone. Beach deposits resembling the various types of present calcareous beaches in lithified form are included, as well as a few inextensive consolidated beach deposits that may have been formed at the present stand of the sea. Extremely permeable because of primary and secondary cavities and yields water copiously, but the water is apt to be brackish.*)

Pa — Consolidated noncalcareous deposits

(*Chiefly older alluvium, generally consisting of mottled brown to red-brown, deeply weathered, poorly assorted, and nearly impermeable friable conglomerates, in places cemented with limonite or hematite and usually forming conspicuous terraces along the principal streams. Near the mouths of the valleys and especially around Pearl Harbor and near Waialua the older alluvium grades into partly consolidated sands and silts that are emerged delta deposits. The degree of consolidation is largely dependent upon the amount of rainfall, for in dry regions the material is much better cemented than in wet regions. Near the heads of valleys the older alluvium grades into coarse angular talus and landslide deposits which, in places, carry considerable water. In the large semiarid valleys in the Waianae Range these deposits are firmly cemented breccias. Poorly permeable in wet areas and hold up perched water in the Honolulu volcanic series, but in the dry areas they yield small supplies of potable water.*)

QUATERNARY

IGNEOUS ROCKS

Middle (?) Pleistocene, late Pleistocene, and Recent (?)

Qtb	Qtf	Qkt	Qkf Qkb
Qhb	Qhf	Qht	Qhbr

Honolulu volcanic series

(Qtb: *Dense aa flows of gray nephelite-melilite basalt, generally containing much nodular clinker, very permeable, erupted from Tantalus and Sugar Loaf craters, and composing parts of Tantalus and Sugar Loaf volcanics.* Qtf: *Very permeable, friable, bedded black firefountain deposits from Tantalus and Sugar Loaf craters, and forming parts of Tantalus and Sugar Loaf volcanics; in places cemented by secondary calcite, coarse near the vents, but elsewhere mostly small fragments of glassy ribbon bombs and pumice mantling preexisting surfaces.* Qkt: *Slightly permeable gray to red-brown bedded deposits of vitric-crystal-lithic tuff composed of angular fragments of Koolau and post-Koolau basalt, limestone, and other ejecta in a matrix of palagonite or glass, generally cemented by calcite or zeolites; caused by phreatomagmatic explosions along the Koko fissure, and forming part of Koko volcanics.* Qkb: *Permeable thin vesicular black aa and pahoehoe flows from several vents along Koko fissure, and forming part of Koko volcanics. The separate flows are shown. They cover dry areas close to the sea, hence usually contain brackish water, or, if above sea level, are probably dry.* Qkf: *Permeable friable red to brown coarse firefountain deposits consisting chiefly of cinders and spatter forming cones around vents along the Koko fissure and forming part of Koko volcanics; too small in area to be water bearers.* Qhb: *Dense and vesicular jointed aa and pahoehoe flows of olivine, nephelite, and nephelite-melilite basalt, from about 10 to 300 feet thick, generally flooring valleys in the Koolau Range and poured out of numerous vents. The source of the various volcanics is indicated on the map by the name of the vent, if known; most of the flows carry perched water at their base.* Qhf: *Firefountain deposits of friable red to black bedded cinders, spatter, pumice, and bombs, coarse, thick, and forming cones near the vents but thin and finer-grained elsewhere; they are permeable but too local to carry water except in a few places as in Nuuanu Valley.* Qht: *Consolidated gray, lavender, and brown bedded, only slightly permeable deposits of basic vitric-crystal-lithic tuff composed of angular fragments of Koolau and post-Koolau basalt, limestone, and other ejecta in a matrix of palagonite and glass, commonly cemented by calcite, forming cones near the vents but thin elsewhere and caused by phreatomagmatic explosions.* Qhbr: *Coarse gray to brown, usually structureless, nearly impermeable breccia containing angular and subangular blocks of extrusive and intrusive basalt as much as 6 feet in diameter and filling explosive vents.*)

GREAT EROSIONAL UNCONFORMITY

Tertiary and early Pleistocene (?)

Tkt, Boss, Dike, Tkb, Tkdc, Tkbr — Koolau volcanic series

(*Gray, blue, red, and black jointed dense to very vesicular, holocrystalline and microcrystalline, aphanitic and porphyritic permeable effusive basalts,* Tkb; *the conspicuous phenocrysts are either olivine or feldspar or both; the basalt was poured out of fissures and vents in rapid succession as short and long pahoehoe and aa flows 10 to 80 feet thick; the pahoehoe flows occur chiefly near the crest of the Koolau Range; aa flows, some platy, with their clinker beds make up about 60 percent of the range; the basalt is deeply weathered except where it forms cliffs; in the lower flanks of the range it is covered with a deep-red lateritic soil, but in the higher areas, where rain is abundant, the soil is brown or black; the basalt exceeds 3,500 feet in thickness, and the individual beds have dips as steep as 15°; it is the great aquifer of Oahu and yields water copiously to wells, tunnels, and springs. The beds of vitric and lithic tuff are from a few inches to 10 feet thick and are intercalated with the basalt, in places perching small quantities of water,* Tkt. *A denuded rift zone consisting of gray to black, usually almost vertical single and multiple basalt dikes a few inches to 15 feet thick, usually microcrystalline, a few with olivine phenocrysts, chiefly cross-jointed, some platy and vesicular, intruded into Koolau and Kailua amygdaloidal lava beds and filling the fissures through which the Koolau basalt flows issued,* Tkdc; *the amount of extrusive basalt present is negligible in the deeply eroded central part but increases toward the edges as well as in the less eroded parts; in many places, below an altitude of 800 feet the soil of the dike complex is brilliant orange-red; most of the high-level ground water in the Koolau Range is confined in Koolau basalt by these dikes; similar dikes outside of the main rift zone are indicated by red lines; a few of the dikes in the dike complex are also shown by red lines to indicate dike trends. Firmly cemented, usually structureless impermeable gray throat breccia containing angular intrusive and extrusive basalt fragments as much as about 6 feet in diameter filling ancient craters,* Tkbr.)

Tkab, Tkadc — Kailua volcanic series

(*Dense gray, greenish-gray, and reddish-brown massive, aphanitic and porphyritic, nearly impermeable basalt flows with well-developed columnar jointing, indurated clinker beds, and vesicle fillings of silica, calcite, and zeolites,* Tkab. *A denuded rift zone consisting af greenish-gray to black, usually vertical single and multiple basalt dikes, a few inches to 6 feet thick, usually microcrystalline, a few with olivine phenocrysts, chiefly cross-jointed, some platy and amygdaloidal, intruded into the basalt flows and filling fissures through which the basalt flows issued,* Tkadc; *the amount of extrusive basalt present is negligible; the joint cracks in the dikes are nearly all filled with secondary minerals, chiefly quartz, and water does not occur in them; the dikes outside the rift zone are not differentiated on the map from the dikes of the Koolau volcanic series. It is believed that the Kailua volcanic series was formed in and under the caldera of the Koolau volcano.*)

Twp, Twb, Dike, Boss, Twdc, Twbr — Waianae volcanic series

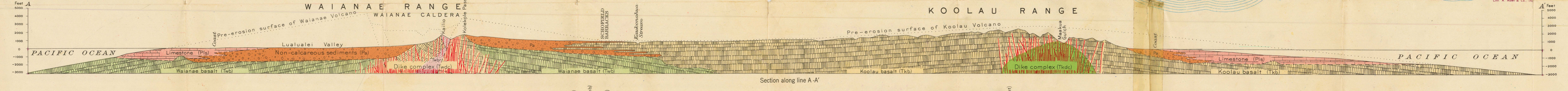
(*Consists chiefly of lower, middle, and upper basalt members, not differentiated on this map,* Twb; *the lower member includes one thick trachyte flow with the remainder chiefly effusive aphanitic and porphyritic pahoehoe basalts, with small amounts of aa, varying from 10 to 200 feet in thickness and having a total thickness of over 2,000 feet; the middle member consists of both aa and pahoehoe in nearly equal amounts, and the upper member comprises chiefly massive aa flows; the total thickness of the flow lavas exceeds 4,000 feet. The conspicuous phenocrysts are olivine and feldspar; the three basalt members are all very permeable and are the important aquifers of the Waianae Range. Beds of tuff, chiefly red and yellow firefountain deposits, consisting of friable bedded basaltic cinders, spatter, pumice, and bombs, coarse, thick, and forming cones near the vents but thinner elsewhere,* Twp; *locally they hold up perched water and give rise to numerous small springs. A denuded rift zone consisting of gray to black, usually nearly vertical single and multiple dikes a few inches to 15 feet thick, usually microcrystalline, a few with olivine and feldspar phenocrysts, chiefly cross-jointed but some platy and vesicular, intruded into all members of the Waianae volcanic series and filling fissures through which the Waianae flows issued,* Twdc; *the amount of extrusive basalt present is negligible in the deeply eroded central part but increases toward the edges, as well as in the less eroded parts; water is confined by the dikes and supplies most of the tunnels in the Waianae Range; similar dikes outside of the main rift zone are shown by red lines; a few of the dikes in the dike complex are also shown by red lines to indicate dike trend. Firmly cemented, poorly bedded gray breccia, in places cut by dikes and containing angular fragments of intrusive and extrusive basalt as much as 6 feet in diameter, which accumulated as talus at the base of ancient cliffs and is believed to serve as barriers to the movement of ground water when in the zone of saturation,* Twbr.)

TERTIARY AND QUATERNARY (?)

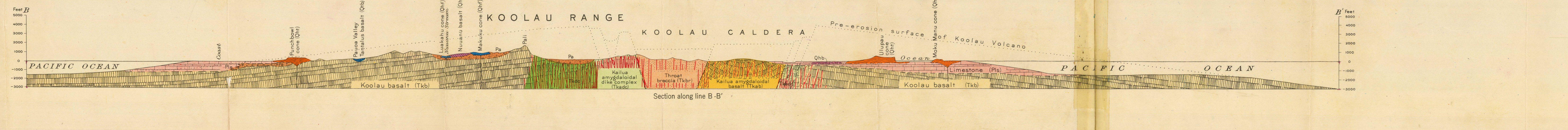
- 88° Fault and dip
- 6° Strike and dip of beds
- Axis of plunging syncline showing direction of pitch. Only one shown on map near Lanikai
- Prevailing dip of beds
- C c Volcanic vents
- 29 Location and number of specimen described in table p. 189, Bulletin 1
- ○ Drilled well entering either Koolau or Waianae basalt showing new number. (See p. 463, Bulletin 1. A complete record of all drilled wells is given in Bulletin 4)
- ● Drilled well with log available
- Sealed drilled well
- Sealed drilled well with log available
- ◎ Battery of drilled wells at pumping plant
- Battery of drilled wells at pumping plant with log available
- Dug well or shaft with tunnels at sea level equipped with pumping plant on the coastal plain. (Number refers to table on p. 220, Bulletin 1)
- ◐ Dug well on the coastal plain
- Maui type of well developing water from basalt described in Bulletin 2
- Spring
- Water-development tunnel described on pp. 386-434, Bulletin 1
- ⚒ Quarry
- Transpiration and evaporation station in Nuuanu and Kaukonahua Valleys only

NOTE: Some outcrops of rock too small to show on this map. The black ash at Black Point has been omitted for this reason.

LIBRARY



Section along line A-A′



Section along line B-B′

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Geology by Harold T. Stearns, 1930-32.
Hydrology compiled from Hawaii Divison of Hydrography, Honolulu Board of Water Supply, and various plantation maps, supplemented by surveys by H. T. Stearns and K. N. Vaksvik.