GEOLOGY OF THE PACOIMA AREA

Los Angeles County, California

by

J. W. Allingham

California Institute of Technology

Pasadena 4, California

May 1947

ABSTRACT

The Pacoima area is located on an isolated hill in the northeast section of the San Fernando, the northeast portion of the Pacoima Quadrangle, Los Angeles County, California. Within it are exposed more than 2300 feet of Tertiary rocks, which comprise three units of Middle Miocene (?) age, and approximately 950 feet of Jurassic (?) granite basement. The formations are characterized by their mode of occurrence, marine and terrestial origin, diverse lithology, and structural features.

The basement complex is composed of intrusive granite, small masses of granodiorite and a granodiorite gneiss with the development of schistosity in sections. During the long period of erosion of the metamorphics, the granitic rocks were exposed and may have provided clastic constituents for the overlying formations.

As a result of rapid sedimentation in a transitional environment, the Middle Miocene Twin Peaks formation was laid down unconformably on the granite. This formation is essentially a large thinning bed of gray to buff pebble and cobble conglomerate grading to coarse yellow sandstone. The contact of conglomerate and granite is characterized by its faulted and depositional nature.

Beds of extrusive andesite, basalt porphyry, compact vesicular amygdaloidal basalts, andesite breccia, interbedded feldspathic sands and clays of terrestial

origin, and mudflow breccia comprise the Pacoima formation which overlies the Twin Peaks formation unconformably . A transgressing shallow sea accompanied settling of the region and initiated deposition of fine clastic sediments.

The marine Topanga (?) formation is composed of brown to gray coarse sandstone grading into interbedded buff sandstones and gray shales. Intrusions of rhyolite-dacite and ash beds mark continued but sporatic volcanism during this period.

The area mapped represents an arch in the Tertiary sediments. Forces that produced the uplift of the granite structural high created stresses that were relieved by jointing and faulting. Vertical and horizontal movement along these faults has displaced beds, offset contacts and complicated their structure. Uplift and erosion have exposed the present sequence of beds which dip gently to the northeast. The isolated hill is believed to be in an early stage of maturity.

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ILLUSTRATIONS

Location of the Pacoima Area.

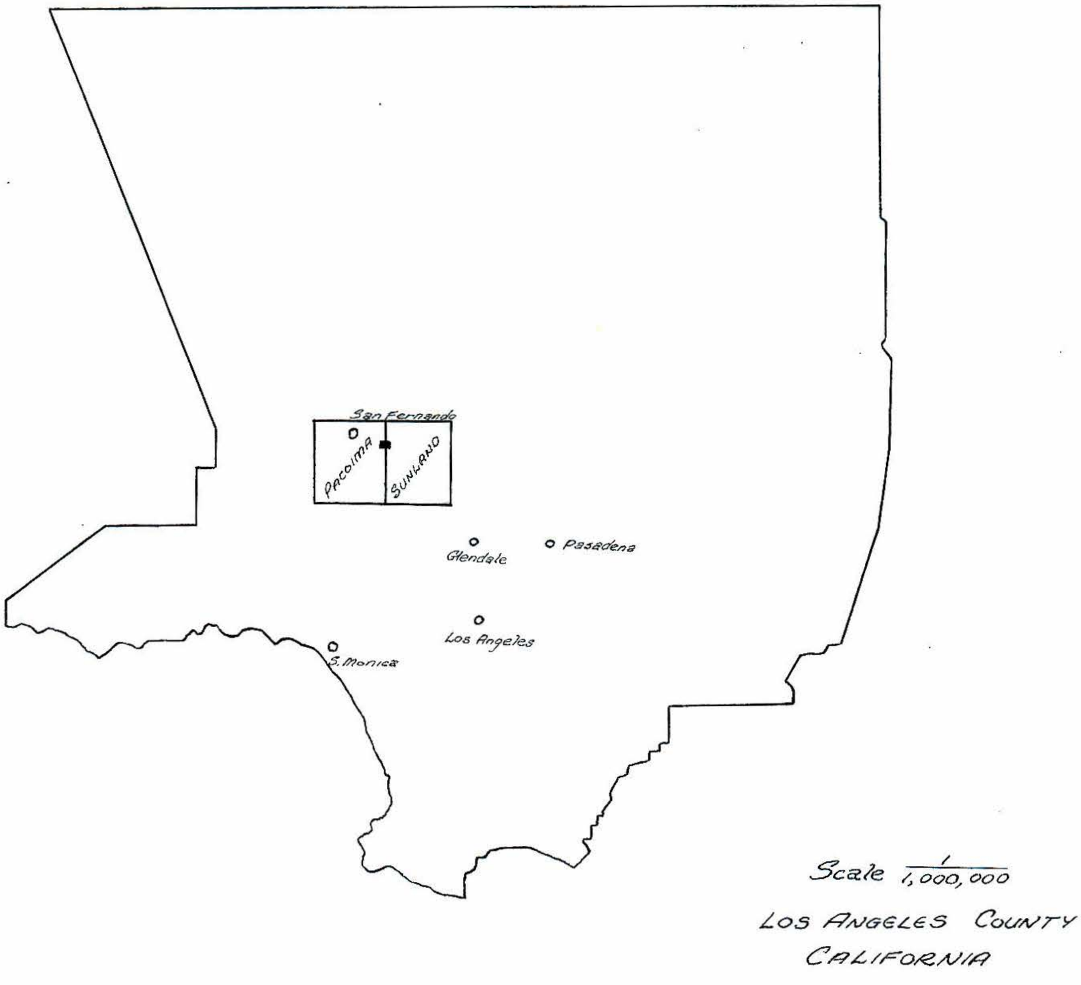


Figure 1.

INTRODUCTION

Nature and Scope of Investigation.

As part of a course in Field Geology, an investigation was made of the Tertiary beds and older basement complex exposed on an isolated hill in the Pacoima area. This work formed an introduction to interbedded sands and lava flows exposed with the igneous basement rock, and afforded an opportunity for further refinement in mapping technique. The base map used in this study was made from a composite of two USGS topographic maps with an original scale of 1/24,000 embracing parts of the Pacoima and Sunland Quadrangles. It has a scale of 1/6000 and a contour interval of 25 feet. Subsequent quarrying operations have produced minor changes in the topography.

On 14 February 1947, a detailed study of the various beds was started. A preliminary, brief reconnoissance of the area was made. Information was accumulated by carefully mapping contacts, measuring dips and strikes with a Brunton compass, estimating distances by the use of topography, pacing and compass bearings and fitting the geology to the map. Quarries, roadcuts, outcrops, sample holes, and excavations were examined to determine the lithology and correlate the beds. Specimens of each formation were examined megascopically. A few specimens were studied microscopically to determine their exact nature. Upon completion of the lithologic studies, photographs were taken of each type of formation and contacts, but due to their irregularity and colour, they were largely unsuccessful. The work was completed 2 May 1947.

Acknowledgments.

The author wishes to thank Dr. R. H. Jahns and Mr. H. W. Menard for assistance in the interpretation of structural features during early reconnoissance, and to express his indebtedness to Messrs. White and MacNeill for helpful suggestions and guidance in the field. Finally, he desires to declare his appreciation for identification by Dr. J. W. Durhams of fossils collected in the area and for petrographic assistance in the determination of rock specimens by Dr. Ian Campbell.

Location and Geography.

The Pacoima area is located on an isolated hill in the northeast portion of the San Fernando Valley, 19 miles northwest of the Los Angeles Civic Centre on U. S. Hwy. 99 and on the southern extremity of Pacoima. The area is bounded on the northwest by Whitman Airport, forms the west abutment of Hansen Flood Control Dam, and covers an area of ½ square mile. It is of moderate relief with a maximum difference of elevation of 325 feet. The average elevation is 1200 feet above mean sea level. The drainage is well established and is controlled by the Tujunga Wash to the east. The valley has a rainfall of about 15 inches and is classified as semi-arid. Noted for its variety of formations outcropping from the valley alluvium, the area has good exposures in its quarries and roadcuts. A westerly section is planted by a government

Generalized section of formations in the Pacoima area.

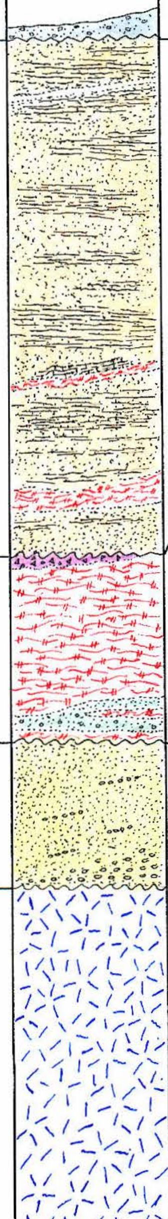
Age	Formation	Symbol	Section	Thickness	Character
Quaternary		Qal		0 - 30	Alluvial material: stream gravel and sand containing pebbles of igneous and metamorphic rocks.
	Unconformity				
Tertiary (Middle Miocene)	Topanga (?) formation	Ttp		1400	Brown to gray coarse even-grained sandstone grading into fine-grained buff sandstone and gray shales; blue-gray intrusive outcrop rhyolite-dacite; waxy bentonite clay bed; dolomitic limestone; white caliche zone; fossil horizon. Marine.
	Unconformity				
	Pacoima formation	Tpa		500	Interbedded yellow sands and red clay, extrusive andesite, basalt porphyry, compact, vesicular, amygdaloidal, scoriaceous basalt, mudflow breccia and andesite breccia.
	Unconformity				
	Twin Peaks formation	Ttw		400	Yellow to pale gray pebble and cobble conglomerate grading to coarse yellow sand.
	Unconformity				
Jurassic (?)	Basement Complex	Jgr		950	Intrusive granite, granodiorite and granodiorite gneiss, fractured and faulted.

Table 1.

agency, and several slopes are under cultivation with flower gardens. The brush, which covers most of the hills, is moderately heavy but offers little or no impediment to travel.

STRATIGRAPHY

General Statement.

The Pacoima area is underlain by the Topanga (?) Miocene formation, the Pacoima Miocene(?) formation, the Twin Peaks Miocene(?) formation and the intrusive granite of the basement complex (Jurassic?), each resting unconformably upon the succeeding formation. The Tertiary rocks comprise three units consisting of coarse conglomeratic sands, interbedded volcanics and feldspathic argillaceous sands believed to be of terrestial origin, andesite breccia, mudflow breccia, buff to brown well-bedded coarse sandstone grading into fine-grained laminated sandstone and shales with thin cherty beds and bentonite seams. The total thickness of the Miocene exposed is about 2300 feet. Approximate thickness of the the exposed section of granite basement is about 950 feet. The Miocene is dominately marine, whereas the lavas and interbedded sands are believed to be landlaid.

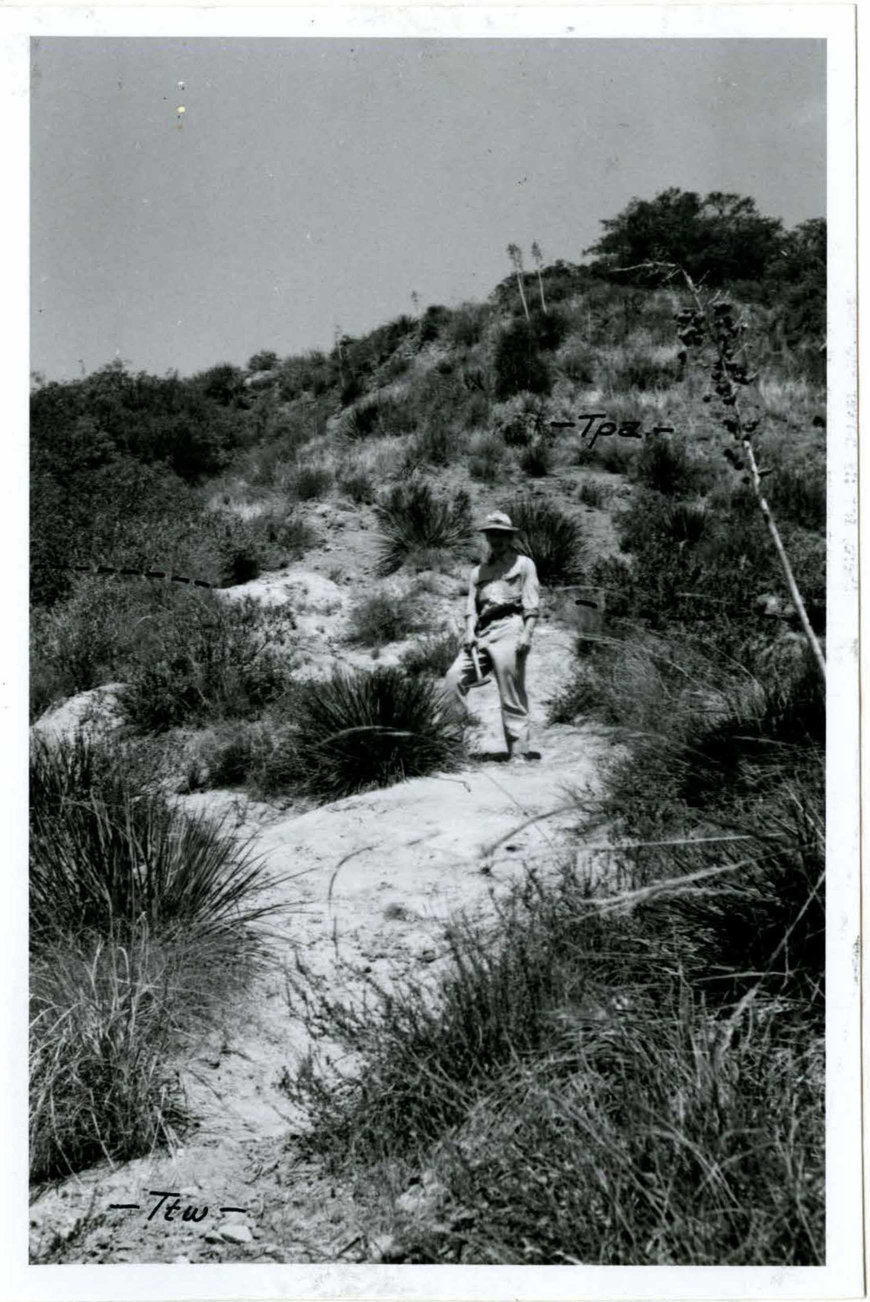
Basement Complex.

In the southern portion of this area, the basement rock outcrops and extends southward under the alluvium of the San Fernando Valley. The basement complex is composed of intrusive granite, small masses of granodiorite and a granodiorite gneiss with the development of schistosity in sections. The original sediments into which the granite was intruded appears to have been eroded away before deposition of the overlying formation as the conglomerate shows no evidence of contact metamorphism but may have derived some of its constituents from reworked metamorphics and the underlying granite.

The fresh granite is uniform in colour and composition, but many exposures have weathered to a brown or brownish gray. The granite is dominately quartz and feldspar with flakes of biotite and hornblende in small amounts. ~~The~~ The brown weathered granite found in the shallow quarries has derived its colour from decomposition and alteration of biotite and hornblende and, as a result, has become friable. In the far eastern quarries, large segments of granodiorite are exposed. Plagioclase has replaced most of the orthoclase feldspar, and the hornblende has increased in amount. Sections of the granodiorite have undergone sufficient dynamic metamorphism as to develop gneissic texture and, in parts, a slight schistocity. Small aplite dikes, about ½ to 2 inches in thickness, cut the granodiorite and were shattered or diplaced by movement in the basement. Granite is fractured in three directions and indicates upward movement from a southern direction. The maximum exposed thickness, measured in section, is more than 950 feet. A zone of weathered granite, about five feet thick, underlies the contact of basement and conglomerate. It is composed of loose friable, gray to buff granite, generally stained by the decomposition of ferromagnesium minerals. The basement complex is overlain unconformably by the Twin Peaks formation. The contact is partly depositional and partly faulted.

Twin Peaks formation.

Skirting the lower and southern portion of Twin Peaks and Triangulation Hill is a large thinning bed of yellow to buff conglomerate and coarse sandstone. The lower section along the unconformity in the eastern part of the formation is a light yellow to pale gray, moderately compacted conglomerate. Above the eastern quarry, the rounded pebbles and cobbles (15-20cm) are dominately quartzite with some granites, granodiorites and granite gneisses. These are cemented with a very coarse subrounded well-sorted yellow sand, predominately quartz with 15-20% clay and feldspar. In the center section, the cement changes to a subrounded, even-grained medium feldspathic sand with abundant silt and clay. Laterally, the cobbles grade to buff pebbles cemented with a well-sorted medium-grained sand. The conglomerate changes to a subrounded to subangular medium to coarse-grained sandstone with rounded quartz granules and pebbles in 1 to 4 inch layers. The granules are 2-3mm. Pebbles are composed of quartzites and granites, 5-15mm. Upper sands increase in feldspar content, much of which has weathered to clays. Sorting indicates a possible transitional environment of deposition. Near the basalt contact, they assume a reddish baked appearance. Above



Contact of Conglomerate and Basalt

Photo. 2.

the lower unconformity, a layer of caliche has formed. This white, light calcareous material is twelve to twenty inches thick and extends along most of the contact. The maximum thickness of the Twin Peaks formation, measured in section, is about 400 feet. Unconformable with this unit are the interbedded lavas and sands, mudflows and andesite breccia of the Pacoima formation.

Pacoima formation.

Extending over the central portion of the area is a well-defined formation of extrusive andesite, compact and scoriaceous basalt, andesite breccia and interbedded yellow sands and reddish clays, covered by mudflows. It is buried at both ends by heavy alluvium and is easily traced across Twin Peaks and Triangulation Hill.

The dark gray-black, hard basalt (Tpa) on the east side near Twin Peaks has a dull lustre, with small white feldspar microlites. Toward Hill "1200", the basalt becomes vesicular, and portions are highly calcareous. The lava is dark gray-black to purple and amygdaloidal, with calcareous and ferruginous material filling fractures and some of the drusy cavities. The amygdules are rounded calcite, 3-6mm. Westward, the shattered basalt changes to a more dense reddish purple vesicular texture and structure. Vesicles are 2-4mm, elongated and ellipsoidal.

In the saddle, approaching Triangulation Hill, the purplish dark basalt develops partially weathered feldspar phenocrysts (½-3mm), which have a random orientation. Near the top of the hill, the basalt is essentially free from vesicles; the groundmass is dark, heavy and aphanitic. At the summit, the gray-black basalt has small feldspar phenocrysts and microlites. Farther west, the microlites do not line up with the vesicles. On the west side of the area, the flow is a gray-black, partially vesicular, basalt porphyry with large plagioclase phenocrysts (2-4mm). Vesicles ($\frac{1}{2}$-3mm) are filled with a red ferruginous clay. The light basalt has vesicles filled with a dull olive-green zeolite. The section of the flow in contact with the sands of the underlying conglomerate contain small fragments of this formation and give it a characteristic red baked appearance.

The interbedded yellow sand (Tpa_1) is highly feldspathic and grades upward into a red silicious clay. It is about 10 to 25 feet thick. A small prominent point between the hill and the forested saddle is composed of fragments of sand, ferruginous clay and red-brown andesite (2-3mm; max.1.5cm). Small quartzite and granitic pebbles and cobbles are distributed abundantly thru the sand. Over most of the western area, the fine-grained andesitic, clay-like breccia lies above the yellow sand and gray-black basalt.

A bright reddish brown andesite is found irregularly distributed down the face of the most westerly quarry and onto a small headland overlooking the airport. The andesite varies in character and is partially brecciated. The groundmass is reddish brown and aphanitic with white feldspar microlites, or sometimes it has bright red

about 500 feet. A marine formation of considerable thick-weathered clay particles and angular feldspar fragments with dark scoria. Fragments are 4-8mm. Part of the deep red andesite has tabular and needle-like phenocrysts of feldspar and contains light pink inclusions (1-3 cm). In the southwest quarry is exposed an andesite-basalt. The basalt porphyry is grayish black, uniformly dull, fine-grained to aphanitic with partially altered olivine crystals and calcite amygdules. A few biotite flakes, not normal to basalts, indicate this section is probably part andesite and part amygdaloidal basalt.

The northern side of Triangulation Hill is covered with a mudflow breccia containing angular fragments of basalt and andesite, silt, sandy soil and clay. Fragments vary between ½ and 5 inches and usually average about 2 inches. In general, a zone of weathered basalt is found underlying the upper contact. The basal sands of the Topanga formation are unbaked and the basalt at this point does not contain fragments of the overlying sediments. Pillow structure, characteristic of marine formations, is lacking. In the interbedded sand and red clay directly west of Triangulation Hill, the teeth and jaw bone of an artiodactyla (oreodont?) was found by Howes and Rigsby (personal communication). It indicates approximately Miocene age and may date this formation, because of its possible terrestial origin, as Uppermost Oligocene (?) or Lower Miocene(?). The lavas are extrusive and not intrusive by the evidence available. The maximum thickness of the Pacoima formation, measured in section, is about 500 feet. A marine formation of considerable thick-

Contact of Mudflow Breccia and Basalt

Photo. 3.

ness overlies the lavas unconformably.

Topanga (?) formation.

The northern portion of the area is overlain by a comparatively great thickness of marine sediments composed of brown to gray well-bedded coarse sandstone grading upward into fine-grained buff sandstones and gray shales with intrusive rhyolite-dacite outcrops. The thickness of this formation, measured in section, is greater than 1400 feet. Above the zone of weathered basalt lies a light gray, well-sorted medium-grained sandstone. This friable sand is loosely cemented with silica and contains less than 15% feldspars. The contact between the lavas and the overlying clastic sediments is sharp and well-defined with the exception of a short section obscured by the soil mantle of a meadow. The sands are unaltered. A zone of caliche, varying in thickness, extends across the entire area and is particularly prominent near the highway. Here the bed is about 8 feet thick and is dominately carbonates with quartz impurity. Gray sandy shale containing biotite and partially weathered feldspar is found bedded next to the caliche layer. The sandstone grades laterally to a coarse buff granular sand. An argillaceous clay cements the small rounded quartz granules. Weathered biotite and feldspars are abundant. Towards the ridge the sandstone grades to a buff to reddish brown sandy shale. It is composed of very fine quartz grains, subangular to subrounded feldspars, biotite, compacted, hard and bonded with a silty silicious cement.

Thin laminae of gray mudstone are interlayered with the sandy shale. Resistant beds of hard coarse buff sandstone outcrop on Hill "1200" and extend over a greater portion of the northern area. These beds are good markers for locating and determining the displacements of faults in the area.

Near the summit of Hill "1200" is an outcrop of intrusive rhyolite-dacite. The area occupied by this intrusive igneous mass is roughly 50 feet wide and 130 feet long with one end (downslope) tapered. The bluish gray rhyolite-dacite has an apparent flow structure and contains white feldspar microlites in a hard aphanitic groundmass. Sections near the top are vesicular, but other parts do not display this structure. Feldspar microlites do not line up with the probable flow flines; hence, this feature is somewhat doubtful. The outer edge is a vesicular rhyolite-dacite (3-8mm). The gray dacite has hornblende phenocrysts and irregular vesicles (3-15mm). Surrounding the outcrop is a hard yellow-red, baked fine-grained sand with a ferruginous and silicious cement and small amounts of limestone in the fractures. The sandstone is interlayered with a flinty red ferruginous shale composed of fine quartz grains, silt, biotite and red clay. In the vicinity of the rhyolite-dacite, the sandstone is medium to fine-grained, well-sorted and friable. At the edge of the outcrop, a hard flint-like sandstone-dacite breccia composed of baked fragments is rolled up in the intrusive mass. Baking on all sides of the contact and brecciation at the edge indicates in-

Resistant Sandstone on Hill "1200"

Photo. 4.

trusion of this igneous mass into the surrounding sandstones and thin-bedded shales.

On a small ridge extending northward from Hill "1200", a small mass of igneous rock outcrops in a similar manner. The rock is partially covered with a thin mantle of soil and is limited in extent. It has all the features of a highly indurated arkosic, biotitc rhyolite-dacite with weathered feldspar crystals. One hundred feet east of this outcrop are layers of hard gray-brown argillaceous dolomitic limestone, which are partially metamorphosed and have a single surface containing minerals closely resembling those of the rhyolite-dacite. It is possible for the outcrop to be a high indurated clastic sediment, but the characteristics of the exposure favor rock of igneous origin.

In the extreme northern part of the area, the interbedded sandstones and shales are characterized by fine-grained laminated gray silty shales with flakes of biotite and a silicious cement; fine-grained reddish brown compacted, laminated sandstones, highly feldspathic with biotite and subrounded to subangular quartz grains; thin brown laminated silty shale with chocolate brown seams (possibly petroliferous) and small yellow ~~with~~ coatings of crude sulphur. In the roadcuts are a couple of thin beds of impure bentonite clay. It is soft, sectile, waxy but changes to a dull white when sun-dried, and its fractured surfaces are covered with manganese dendrite. The clay has a concoidal fracture, a low silica content and was probably derived from an altered volcanic ash.

A friable buff sandstone bed, four hundred feet southeast of the summit of Hill "1200", marks a fossil locality. Fossils identified from this bed are as follows:

Pecten andersoni Arnold

Nassarius sp. indef.

Nemocardium sp.

Dentalium sp.

Nuculana ochsneri (Anderson and Martin)

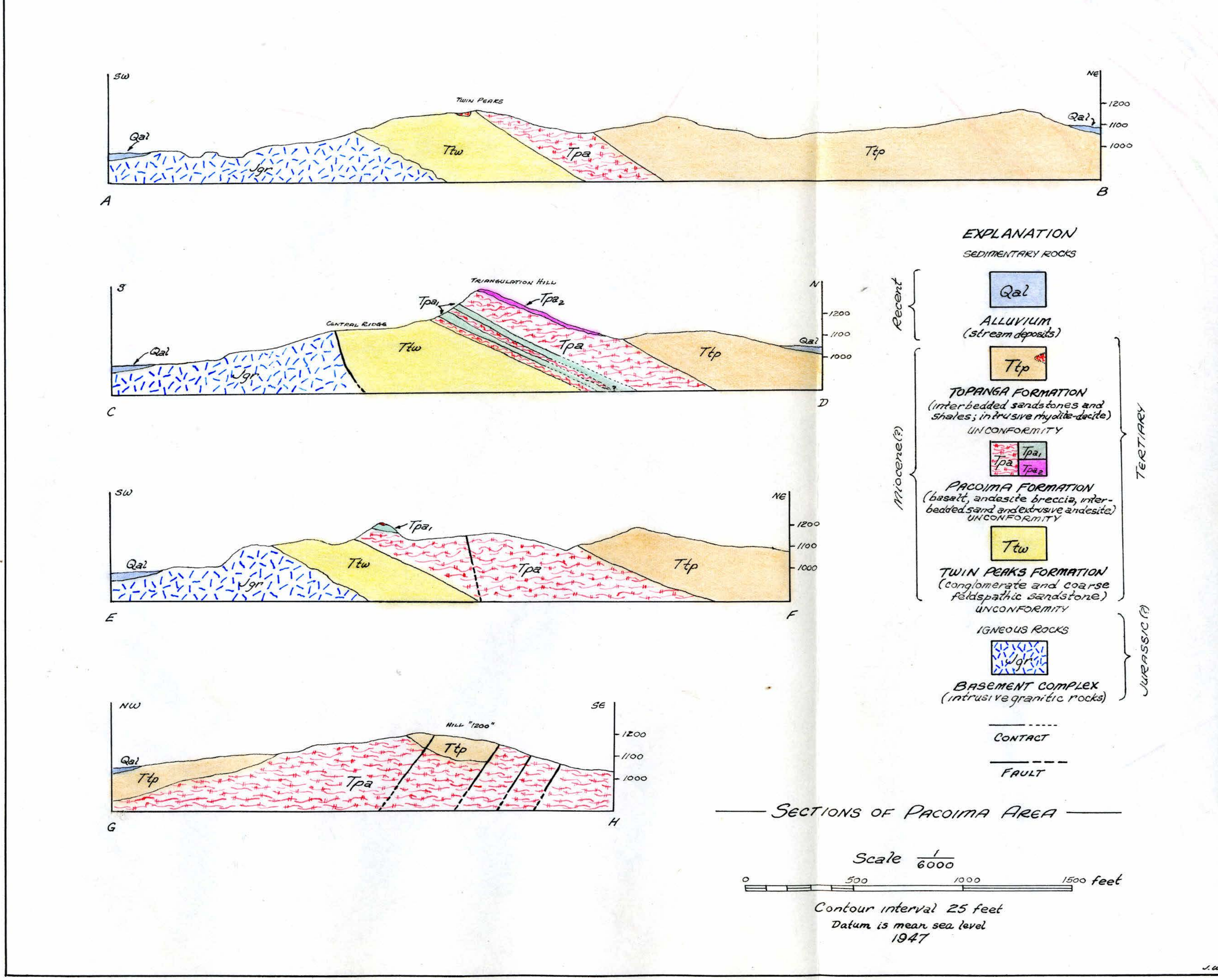
Coral indef.

According to Durhams, this formation as exposed at Pacoima appears to be of Middle Miocene (Temblor) age on the basis of Pecten andersoni Arnold. It may be possible to correlate this fossil assemblage and lithology with the type Topanga. Alluvium surrounds the entire hill and is composed of recent stream sands, gravels and silt.

Origin and Source of Beds.

It is believed that the sediments, into which the granite basement complex was intruded, have eroded away and may have supplied clastic material for the overlying sediments. The nature of the pale variegated clays and sandy silts cementing the poorly-sorted cobble conglomerate of the Twin Peaks formation closely resembles the terrestial beds exposed along U.S. Hwy.101 north of Santa Monica. The yellow sands and pebbles of the western portion of this formation suggests marine deposition. Lack of fossil evidence, foreset beds and silts make a determination of the environment difficult. The lower portion may

Figure 2.


SW
NE
TWIN PEAKS
Qal
Jgr
Ttw
Tpa
Ttp
1200
1100
1000
A
B
S
N
TRIANGULATION HILL
CENTRAL RIDGE
Tpa_1
Tpa_2
C
D
Tpa_1
E
F
NW
SE
HILL "1200"
G
H
EXPLANATION
SEDIMENTARY ROCKS
Recent
ALLUVIUM
(stream deposits)
TOPANGA FORMATION
(interbedded sandstones and shales; intrusive rhyolite-dacite)
UNCONFORMITY
PACOIMA FORMATION
(basalt, andesite breccia, interbedded sand and extrusive andesite)
UNCONFORMITY
TWIN PEAKS FORMATION
(conglomerate and coarse feldspathic sandstone)
UNCONFORMITY
Miocene(?)
TERTIARY
IGNEOUS ROCKS
BASEMENT COMPLEX
(intrusive granitic rocks)
JURASSIC(?)
CONTACT
FAULT
SECTIONS OF PACOIMA AREA
Scale 1/6000
0
500
1000
1500 feet
Contour interval 25 feet
Datum is mean sea level
1947
J.W.R.

represent a littoral environment with rapid deposition changing it to a valley type of environment giving the fine, even sediments of the upper section. The apparent lack of pillow structure in the Pacoima formation would indicate the sediments were sufficiently uplifted to receive the lavas on a surface of erosion. The character of the feldspathic sands of the Pacoima formation indicates partial weathering in the upper section, partly obliterated by brecciation, a moderately short transportation distance and preclude a nearby source. The volcanic may have had their source along the fault zones at the base of the San Gabriel Mountains. A marine fossil horizon and the occurrence of layered dolomitic limestone in the Topanga formation indicate a marine environment for these sediments. Layers of altered ash (bentonite clay) and intrusions of rhyolite-dacite point to continued volcanism. To the northeast, a possible source of sediments would occupy the present position of the San Gabriel Mountains. This potential source is known to contain rocks similar in composition to those of the formations found in the Pacoima area.

STRUCTURE

General Features.

The structure of the Pacoima area is essentially that of an uplifted high in the granite basement, which produced arching or doming and subsequent exposure of sediments and interbedded lavas. The mapped area represents a small arch extending northward. The forces causing the upward movement and tilting have produced stresses that have been relieved by movement along old erosion surfaces, faulting in the basement complex, faulting normal to the strike of the beds, and jointing in the granited, basalt and andesite.

Faulting.

In general, the faults in this area trend northeast and are normal to the strike of the beds. Faulting is predominately strike-slip with a minor dip-slip component. Near the basement contact, the faulting is dip-slip with wide gouge zones exposed.

Faulting in the granitic rocks is most noticeable on the central ridge. The fault on the contact of granite and conglomerate has largely vertical displacement and dips steeply to the north. To the east, it splits up into several faults that diappear into the granite. These faults are characterized by comparatively wide zones of breccia (1-2 ft.). Displacement along the faults is difficult to ascertain because their direction is roughly parallel to the contact. The northeast trending fault that forms part of a hinge of a granitic segment has striations, dipping southward in the fault plane at an angle of 40^{o} with the horizontal. A narrow zone of fine gouge and breccia on the east side of the intervening valley is believed to form the other hinge to this granite segment that has been pushed upward; thus, the valley is bounded on the east and west by two hinge faults. Slickensides and breccia zones are exposed in the quarry.

Faulting and Jointing in the Granite

Photo. 1.

The contact of conglomerate and basalt is offset in three locations by small strike-slip faults. These trend northeast and have horizontal displacements not to exceed ten feet. They are found in the east, center and western sections of the contact. A small dip-slip fault has produced a 30 foot vertical displacement in the sandstone bed, Tpa_1, on the southwestern headland. The displacement is up on the north side and down on the south. The horizontal component is unknown. In the southwestern quarry, several vertical faults have produced marked drag effects in the basalt. The fractures are three to six inches wide; the displacement is undetermined. Slickensides were observed along the ridge to Triangulation Hill. Together with satterzones, they mark the location of two faults dipping 55 to 80 degrees southeast. Two large strike-slip faults cut across the northeast ridge of Triangulation Hill. Excellent slickensides are exposed. The width of the brecciated fault zone is about 2 feet. Absence of both gouge zone and displacement in the mudflows overlying the andesite-basalt shows that no recent movement has occurred on these faults. They dip westward 70-80 degrees. The small headland overlooking the airport is shattered by numerous faults. These trend northeast and have small displacements.

At the base of Hill "1200", the contact of basalt and sandstone is offset by three large, northeast parallel trending faults. They dip northwest at about 40^o and are characterized by left-handed displacements along the strike and apparently insignificant dip-slip components. The west fault has an apparent offset of 70 feet. Verification of this displacement was unsuccessful because of poor, shallow exposures in the resistant sandstones prominent on the higher slopes. This fault is believed to be continuous with a small fault located farther east on approximately the same c ntour level. The center fault marks a large discontinuity in the contact. Measured by bearings, pacing and estimation of distance between men on this irregularity in the contact, the apparent displacement is about 160 feet. The pronounced swing in the contact may be partly due to a shift in the direction of shoreline during deposition of the sediments. The east fault follows closely the strike of beds in the immediate vicinity. Here the apparent horizontal displacement is about 100 feet with left-handed movement along the strike. A small fault was located west of the rhyolite-dacite outcrop by following a resistant sandstone bed across the hill. It has a horizontal displacement of about 15-20 feet, which may have been caused by forces exerted upon the surrounding beds by the intrusive outcrop.

The extent and nature of faulting in the northern part of the Topanga formation is unknown. Most of the faulting in the Pacoima area directs attention to the major compressional forces from the south causing uplift and subsequent tilting of the formations.

Jointing.

In the granite basement and the Pacoima formation, jointing is prominent and suggests the possible directions of the forces responsible for the present structure. Jointing in the Pacoima formation trends north, dipping 40-45° east and also trends west, dipping 40° north; this is accompanied by normal vertical jointing, north and south. Northeast and northwest jointing in the granite basement dips west and north respectively. The third set of joints dip gently south from a horizontal plane. Irregularity in the direction of joints in the southwest quarry may be due to slumping, but they indicate compressional forces upward from the south. Jointing in the vicinity of the contact of conglomerate and basalt is closely spaced and uniform in direction. One set is normal to the strike of the faults and the other set of joints is approximately parallel to the strike. These joints are still consistant with the other joints and point to north-south forces in an upward direction.

Folding.

Evidence of folding is obscure or almost entirely lacking in the Pacoima area. The sands, Tpa_1, of the Pacoima formation are gently domed in a northwest-southeast direction. The Twin Peaks formation is gently arched east to west. It changes strike and dip in the western secction and gradually thins out. In the Topanga formation, there is no evidence of a reversal in direction of dip. The axis of the arch trends approximately northwest-southeast.

Unconformity.

Between the granite basement and the conglomerate of the overlying formation is an irregular contact, which is partly depositional and partly faulted. It represents the old erosion surface of the intruded Jurassic (?) granites upon which later Tertiary sediments have been deposited. The shallow dipping sections of the extreme western and eastern ends of the contact denote the depositional parts and, hence, the original surface below which extends a zone of weathered, dark-stained granite. Caliche and sands of the Twin Peaks formation immediately overlie the granite unconformably. The faulted portion of the contact on the central ridge dips steeply northward at 80 °. Slickensides at the point of contact are well-marked on a narrow spur. Most of the slippage is believed to be caused by the same forces that initiated the uplift in the basement complex.

During the deposition of the sands and conglomerate of the Twin Peaks formation, either the rate of sedimentation exceeded the settling in the basin of deposition, which increased the formation's effective elevation above sea level and allowed erosion, or gradual uplift brought about a similar condition. Later, lavas were laid down unconformably on this surface. These lavas are believed to have been partially intruded into the sands and account for the isolated masses found near Twin Peaks. The early flows rolled up the top of the sand to form a breccia, which is plainly marked, in part, along the unconformity.

Across the northern part of the area, a sinuous, well-defined contact marks the unconformity at the base of the Topanga formation. The western end is obscured by mudflows and soil; the center section is covered by a heavy soil mantle. Swings in the contact are believed to represent a variable shoreline, similar to the irregularities found along the present day seacoasts. Change in strike and dip in the resistant sandstone beds on Hill "1200" and truncation of probable foreset bedding in road-cut exposures substantiate this belief. Sedimentation of coarse marine clastics occurred on the partially eroded and weathered basalt. Later, faulting offset the contact and increased the irregularity of the surface.

Primary Structure.

Doming in the lower formations is believed to be the result of deposition on a granite high in the underlying basement complex and of later uplift increasing the dip and arching the sediments. As previously mentioned, the change of dips and strikes in the Topanga formation is due to variations in an ancient shoreline. Continued uplift in the granite rocks produced tilting, which placed the beds in their present position where subsequent erosion removed part of the sediments exposing the present sequence of formations.

GEOLOGIC HISTORY.

The sequence of geologic events in the Pacoima area may have occurred as follows:

1. Granites were intruded into early sediments during Jurassic (?) time. Erosion removed the overlying metamorphics exposing an irregular basement surface. Processes of erosion sculptured sharp features in the landscape,

which later became structural highs as the landmass settled to receive sediments. This period is marked by a surface unconformity at the base of the Tertiary formations and denotes an interval of non-deposition or prolonged erosion. Settling of the basement commenced and the granite high reached a position below the profile of equilibrium where sediments would be preserved.

2. During the Middle Miocene(?) or earlier, four hundred feet of clastic sediments were deposited in a transitional environment on the basement complex. Either an increase in the rate of deposition over the rate of settling or gradual uplift produced sufficient change in elevation or change in conditions for the commencement of erosion.

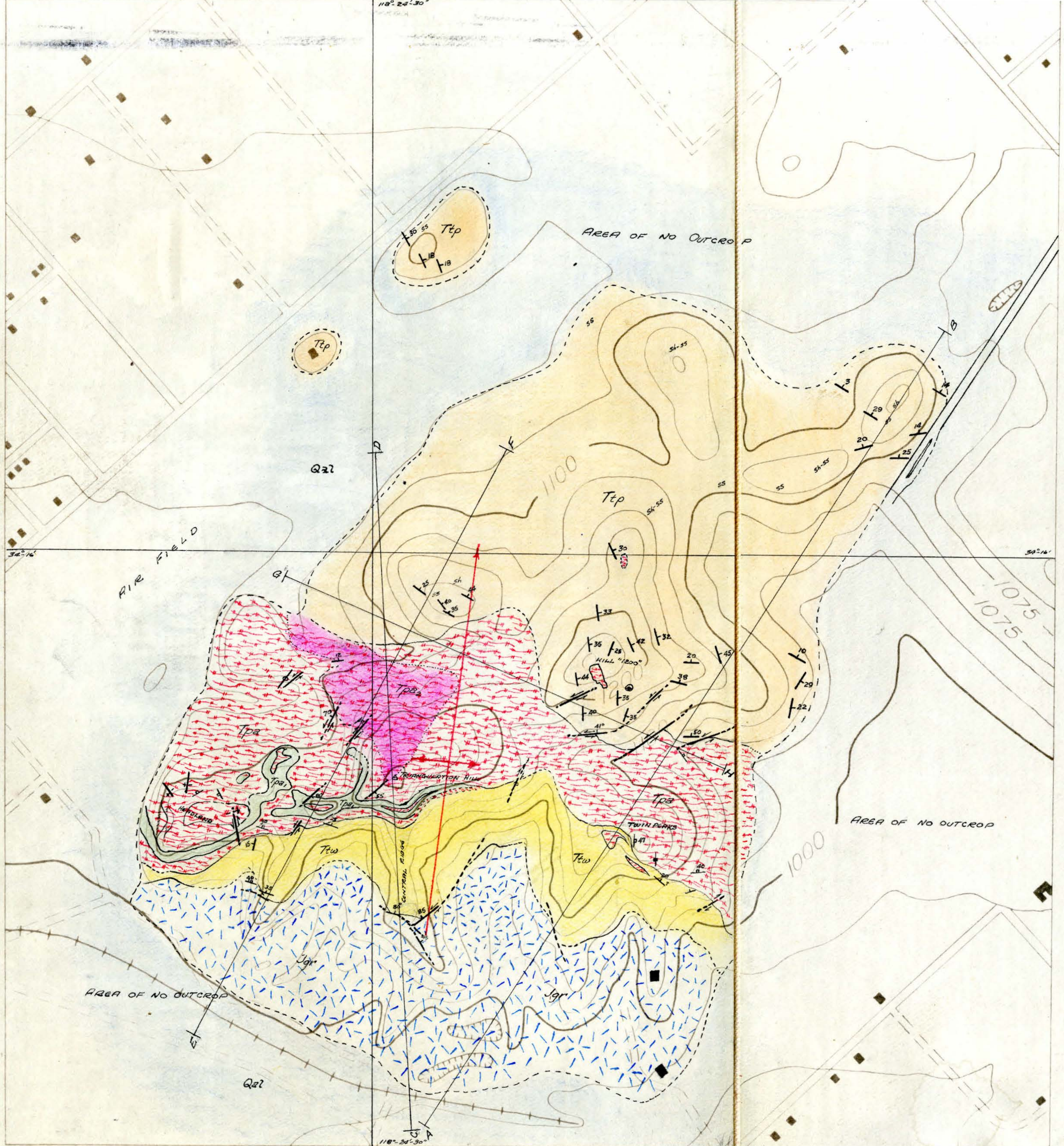
3. During this period of erosion, volcanism probably took place along the fault scarps of the northern highlands and covered the region with extrusive rocks. Coarse clastic sediments from the surrounding highlands were deposited, in a terrestial environment, conformably with the extrusive basalts and andesites. Subsequent flows formed breccias with the sands and weathered fragments of previous flows. Settling of the region brought a transgressing sea. Sedimentation was resumed during this inundation of the area by a shallow sea. Fossil evidence, ripple marks and limestone (dolomitic) in the Miocene beds substantiates a marine environment with shallow deposition.

During the third period of sedimentation, more than

1400 feet of clastic material was deposited unconformably on the basalts, interbedded sands and andesite of the Pacoima formation. An irregular undulating surface in the lavas and a sinuous shoreline gave rise to uneven deposition with a change in dip and strike of the sediments. Intrusions of rhyolite-dacite and ash beds mark continued by sporatic volcanism during this period.

5. Compressional forces, which caused later uplift, set up stresses that were relieved by subsequent jointing and faulting. These faults produced vertical and horizontal displacements in the beds, offset contacts and complicated their structure. Contacts were in part depositional and in part faulted.

6. Uplift, tilting and erosion have exposed the present sequence of beds, which dip gently to the north-east, and have left and isolated hill standing above the valley floor. Successive uplift has rejuvenated the small intermittant streams that are at present cutting back into the low hills that are now surrounded by alluvium. The hill is believed to be approaching maturity.



FIELD GEOLOGIC MAP
N.W. HANSEN DAM ABUTMENT HILL
a portion of the
PACOIMA - SUNLAND QUADRANGLES

SCALE: $\frac{1}{6000}$

0 500 1000 Ft.

CONTOUR INTERVAL: 25 Ft.

DATUM: SEA LEVEL

GEOLOGY BY
J.W. ALLINGHAM
GEOLOGY DEPT.
CALIF. INST. OF TECH.
PASADENA 4, CALIF.

STARTED: 2-14-47 FINISHED: 5-2-47

EXPLANATION
SEDIMENTARY ROCKS

Recent — Qal — ALLUVIUM (steam deposits)

Middle Miocene (?) — TERTIARY

Ttp — TOPANGA FORMATION

UNCONFORMITY

Tpa, Tpa1, Tpa2 — PACOIMA FORMATION

UNCONFORMITY

Ttw — TWIN PEAKS FORMATION

UNCONFORMITY

IGNEOUS ROCKS

Jurassic (?) — Jgr — BASEMENT COMPLEX

CONTACT

AXIS OF ANTICLINE

FOSSIL LOCALITY

FIELD COPY

J.W.A.

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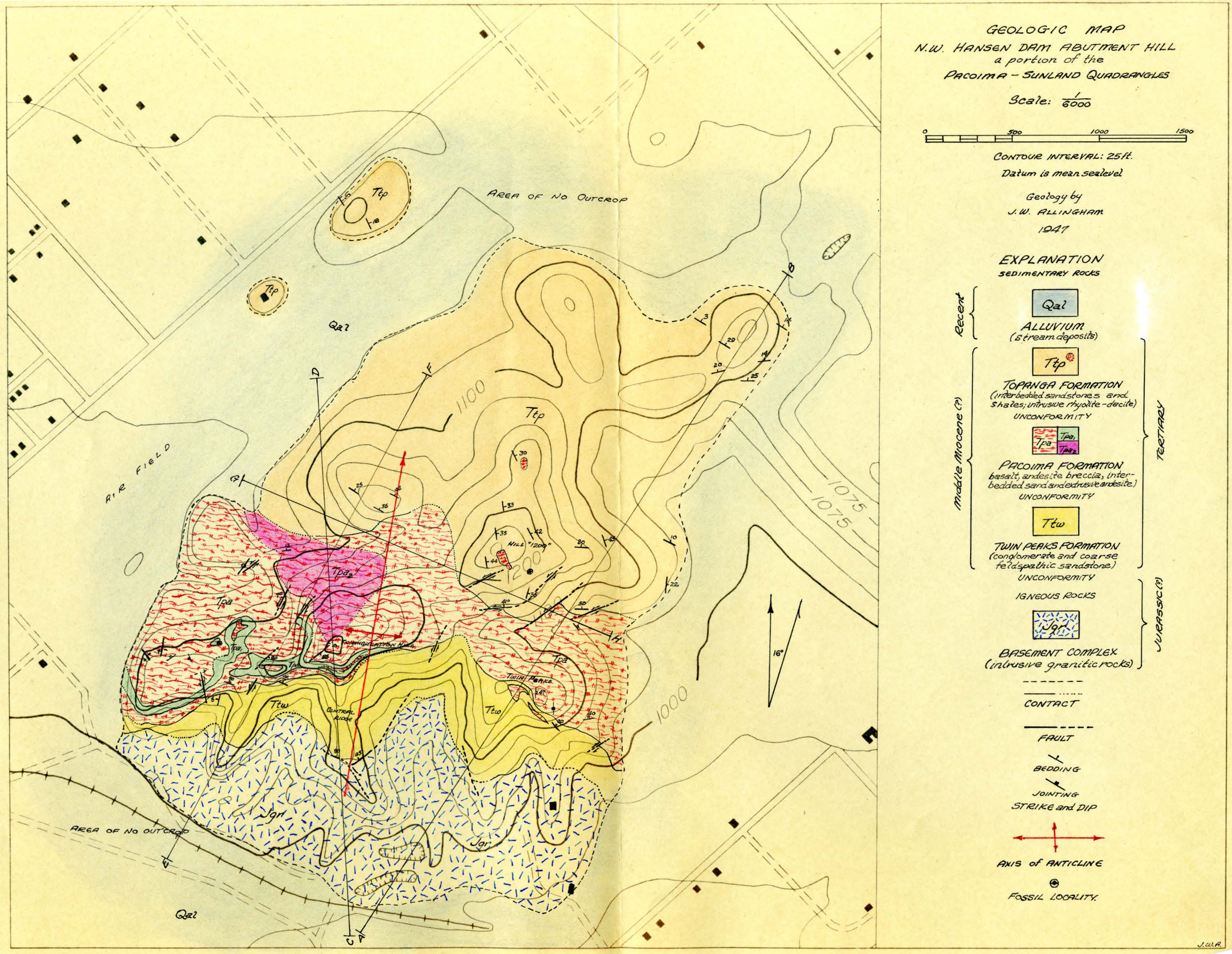
GEOLOGIC MAP
N.W. HANSEN DAM ABUTMENT HILL
a portion of the
PACOIMA - SUNLAND QUADRANGLES
Scale: 1/6000
0 500 1000 1500
CONTOUR INTERVAL: 25 ft.
Datum is mean sealevel
Geology by
J.W. ALLINGHAM
1947
EXPLANATION
SEDIMENTARY ROCKS
Recent
Qal
ALLUVIUM
(stream deposits)
Middle Miocene (?)
Ttp
TOPANGA FORMATION
(interbedded sandstones and shales; intrusive rhyolite-dacite)
UNCONFORMITY
Tpa
Tpa1
Tpa2
PACOIMA FORMATION
basalt, andesite breccia, interbedded sand and extrusive andesite)
UNCONFORMITY
Ttw
TWIN PEAKS FORMATION
(conglomerate and coarse feldspathic sandstone)
UNCONFORMITY
TERTIARY
IGNEOUS ROCKS
JURASSIC (?)
Jgr
BASEMENT COMPLEX
(intrusive granitic rocks)
CONTACT
FAULT
BEDDING
JOINTING
STRIKE and DIP
AXIS of ANTICLINE
FOSSIL LOCALITY
AREA OF NO OUTCROP
AIR FIELD
Qal
Ttp
Tpa
Tpa2
Tpa1
Ttw
Jgr
HILL "1200"
TWIN PEAKS
CENTRAL RIDGE
1100
1075
1000
16°
J.W.A.