GEOLOGY OF A NORTHERN PORTION OF THE SUNLAND QUADRANGLE

LOS ANGELES COUNTY

By

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In partial fulfillment of the requirements for the degree of Bachelor of Science in Geology.

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ABSTRACT

The region between Little Tujunga Canyon and Akens Canyon is a region of Tertiary sedimentary and intrusive volcanic rocks. The sedimentary section is dominant and is represented by about 1500 feet of Modelo (Upper Miocene), 1600 feet of marine Pico (Lower Pliocene) resting upon the Modelo with slight unconformity, 2200 feet of continental Saugus (Upper Pliocene), and 100 to 200 feet of terrace gravels (Pleistocene).

Structurally the region consists of a large block tilted northward and bounded on the north by the Sierra Madre Fault and on the south by the hypothetical Tujunga Fault. Faulting is the dominant feature of the structure, the only important fold being the Merrick syncline which roughly parallels the Sierra Madre Fault.

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INTRODUCTION

Location and Size of the Area: The area herein described lies near the western extremity of the San Gabriel Mountains, about 18 miles north of the city of Los Angeles in the northern part of the Sunland Quadrangle. It is bounded on the west by Little Tujunga Canyon, on the east by Akens Canyon, on the north by the Crystalline basement, and on the south by Tujunga Wash. The area mapped occupies about 5 square miles and is roughly rectangular in shape.

Purpose of Investigation: The investigation was carried out in partial fullfillment of the requirements for the degree of Bachelor of Science in Geology at the California Institute of Technology. The purpose of the work was to extend the knowledge of the structure and stratigraphy of the Sunland region. It is hoped by the author that the results of this study will be of value to classes in Field Geology at the Institute.

Method of Investigation: Aerial photographs[1] (scale approximately 1600 feet to the inch) and enlargements from United States

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1. Fairchild Aerial Surveys Inc.,Aerial photographs Nos. F-128, F-157

Geological Survey Topographic[2] sheets were used as field maps (scale of enlargements approximately 600 feet to the inch). The use of aerial photographs greatly facilitates location and plotting of data in the field but the writer feels that the error introduced in transferring data to topographic sheets does not warrant the use of aerial photographs as field maps and for that reason does not recommend them. The Brunton compass was used for location and attitude determinations. The field work was carried out during the summer of 1936 and intermittently during the following fall and winter amounting in all to 35 days.

Acknowledgements: The author wishes to express here his hearty appreciation to Dr. F. D. Bode of the California Institute of Technology for his assistance and encouragement in the course of the investigation.

GEOMORPHOLOGY

General Character: The major part of the area is occupied by the low foothills of the San Gabriel Range. The highest peak in these foothills is Mount Oliver with an elevation of 2055 feet. Three of the peaks in the area exceed 2000 feet and several exceed 1900 feet in altitude. These hills are formed entirely of Tertiary sediments. At the southern border

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2. United States Geological Survey, Sunland Quadrangle, Scale1:24,000

PLATE 1

A. View looking north up Akens Canyon. The dark strip of volcanics with their characteristic rugged topography can be seen in the background.

B. The southeast face of the area from the mouth of Tujunga Canyon. The scarp (or fault line scarp) can be seen at the base of the hills.

PLATE I

A

B

of the region the hills end sharply at Tujunga Wash, and to the north end abruptly at the scarp of the San Gabriel Range (See Plate 3).

Physiography: The relief is rugged, of mature age, and with essentially consequent drainage from the northward. Because of the more or less uniform northerly dip of the sediments and the resistance of the Pico section to erosion, typical cuesta topography had developed along the southern margin and less so in the less resistant Saugus section to the north. This has resulted in steep southern faces of the hills with characteristic dip slopes northward (See Plate 2).

The major part of the drainage is southward into Tujunga Wash through canyons developed across the structure. There is, however, a small part of the drainage to the west because of the presence of cuestas. This westward drainage leads to Little Tujunga Canyon which ultimately joins Tujunga Wash in the southwest portion of the area. All the streams in the foothills are intermittent.

Terraces occur throughout the area, being most abundant along the northern and southern borders. They are deeply dissected and slope gently southward (See Plate 3). The streams cutting them show abundant evidence of recent rejuvenation.

Landslides: Landslides are abundant throughout the Modelo exposures (See Plate 4A), occurring in great profusion along

PLATE 2

A. Back face of cuestas.

B. Front face of cuestas showing steep cliffs in lower Pico conglomerate.

PLATE 2

A

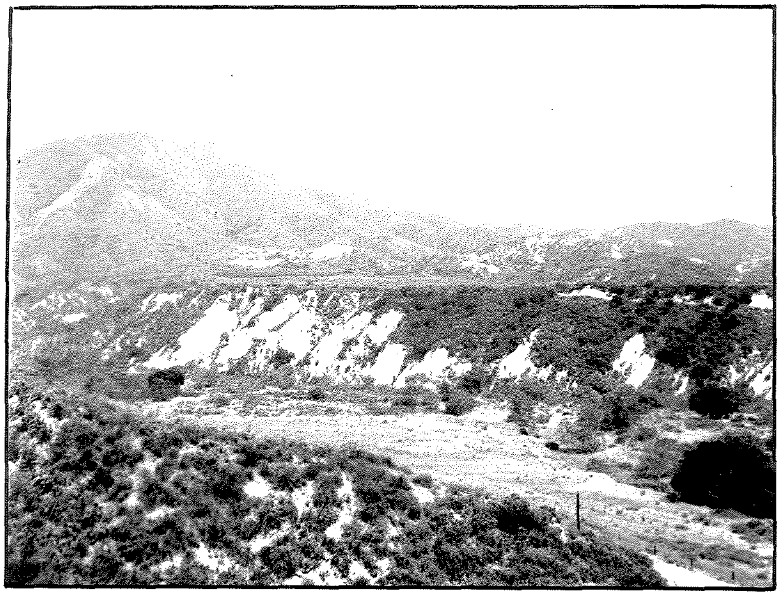
B

PLATE 3

A. Quaternary gravels of the Herreras Terrace resting unconformably on the beveled Saugus Beds. The scarp of the San Gabriel Mountains can be seen in the background.

B. Terrace deposits on the southeast border of the area resting unconformably on Pico.

PLATE 3



A

B

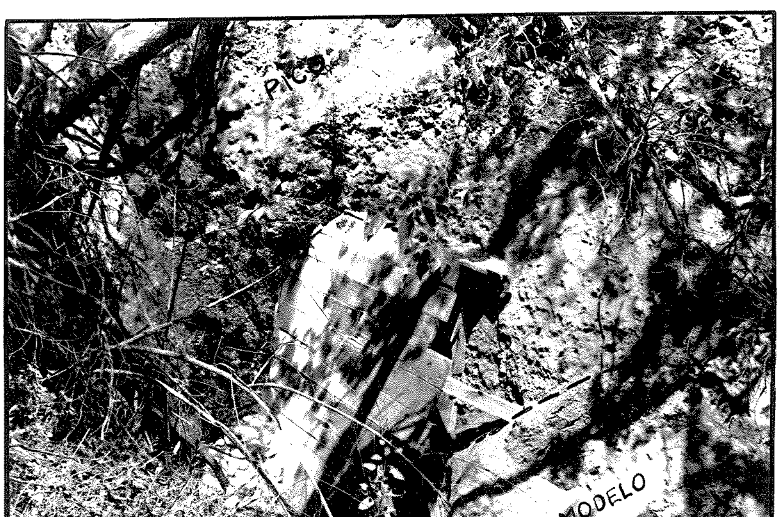
PLATE 4

A. Landslide on the Pico-Modelo contact occurring at the head of Oliver Canyon.

B. Oliver Spring on the Pico-Modelo Contact.

PLATE 4

A



B

the upper contact with the Pico. This landsliding has apparently been brought about by the incompetence of the underlying shales, resulting in the sliding of large masses thus covering the contact and distorting the attitudes so that in the portions yet exposed great care must be exercised in judging the relationships.

<u>Springs</u>: Small seeps and springs are abundant throughout the region and, with one known exception, are associated with four definite structural features, namely: (1) Pico-Modelo contact, (2) Basalt-basement contact, (3) Basalt-Modelo contact, (4) Sierra Madre and associated faults. These springs and seeps are indicated on the map. Four of the springs in the area produce sufficient water for use. The Herreras Ranch utilizes two which lie to the north of the ranch on the Sierra Madre Fault, the spring at the Pico-Modelo contact in Oliver Canyon (See Plate 4B) supplies a small farm in the canyon, and the spring in Doan Canyon which lies on the Basalt sediment contact supplies a small farm there. The only exception to the association of springs with these four structural features is found in the western portion of the area in a small spring south of De Mille ranch. This spring lies near the upper contact of the Pico formation and is probably due to seepage along either a small fault or a pervious sandstone interbedded in the impervious conglomerates. It is

more probably the latter as no springs are found associated with any of the minor faults known in the Pico.

Roads and Trails: The region is easily accessible by way of two well paved roads. One is in Little Tujunga Canyon and the other in Tujunga Wash. There are a few traversable dirt roads in the region, one leading from Little Tujunga Canyon to the Herreras Ranch, another leading from Tujunga Wash to Fascination Spring by way of Ebbie Canyon, and another leading to the head of Doan Canyon from Tujunga Wash. At this writing the forestry department is constructing a fie road from Doan Canyon to Ebbie Canyon and westward to Little Tujunga Canyon. Trails are abundant in the region and, because of the dense brush covering in parts of the area, arequite useful.

STRATIGRAPHY

Major Features

The area between Little Tujunga Canyon and Akens Canyon is a region of sedimentary rocks with comparatively minor amounts of igneous intrusives (except the large mass of gneiss, granitics, schist, etc. of the basement complex to the north). For several of the sedimentary members there is no definite means within the area for determining the age, and the tentative ages given here are based on a more or less satisfactory correlation with formation beyond the limits of the region considered. There are four great groups of sedimentary rocks which at one time extended over a large part of the area: Modelo (Upper Miocene), Pico (Lower Pliocene), Saugus (Upper Pliocene), and terrace deposits (Pleistocene). Of the igneous rocks only one is considered. It occurs along the northern portion of the area and is known to be a Tertiary volcanic (See columnar section Plate 16).

Basement Complex (Pre-Cretaceous (?) or Pre-Eocene (?))

Distribution: The basement complex is exposed to the north of the area. The contact between it and the Tertiary rocks marks the northern boundary of the area.

Lithology: It is composed entirely of crystalline rocks consisting predominantly of gneiss, and schist, though granitic

PLATE 5

A. Exposure of basement complex in Gold Canyon.

B. Exposure of lower shale member of the Modelo in Oliver Canyon.

PLATE 5

A

B

types also occur. (See Plate 5A).

Age: Mason Hill[3] reports that a few miles north of this region here considered, Cretaceous (?) or Eocene (?) rocks are faulted against the basement.

Tertiary Igneous Rocks

Distribution: These rocks are exposed in the area in an east west strip about 8000 feet long and for the most part about 800 feet wide though in one place west of Fascination Spring it narrows to 100 feet. The strip exposed in the area extends from Akens Canyon (the edge of the region mapped) to a point about 2500 feet west of Fascination Spring.

Character: The megascopic character of this rock varies considerably over the region mapped. In the western portion of its exposures it appears black and dark brown in color and is extremely amygdaloidal. The majority of the amygdules are calcite filled and range in size from that of a pea to 10 cm in diameter. A good exposure of this material is at the head of the Canyon due west of Fascination Spring. The microscopic petrography of this rock was worked out by Claude Nolte and found to be olivine diabase. Easterly the amygdules become less abundant and in the extreme eastern end of the exposures

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3. Mason L. Hill, Structure of the San Gabriel Mountains North of Los Angeles, California, Univ. of Calif. Publ. in Geol. Sci. Vol. 19, 1929-31, pp. 137-163.

they are entirely lacking. The material there is for the most part black, carrying phenocrysts of plagioclase up to 5 mm. in length. The remainder of the igneous exposures there are reddish in color. The reddish material is most abundant near the contacts and frequently appears as flow breccia on both the upper and lower contacts. Excellent exposures of both the reddish and black are found near the head of Akens Canyon. The microscopic petrography of the rock type to the east has not been determined but megascopically it appears to be olivine basalt.

Relation to Adjoining Rocks: Mason Hill[3] dubiously refers to this occurrence as a flow, occurring in early Modelo. It is quite probable that in some parts of the region mapped by him such a relation exists. However, the writer feels that the relations found as a result of mapping this body on a larger scale (630 feet to the inch) than was used for the remainder of the area, demonstrate conclusively the intrusive nature of this volcanic body.

The contact between the basement and the diabase appears to be intrusive in nature and is characterized by a flow breccia in the diabase. The exposures of this contact are quite poor, the best one being on the first ridge west of Fascination Spring where the contact makes a sharp turn to the southeast. West of Doan Canyon a small patch of granite appears on the south side of the diabase exposure (See Plate 7A). The contact here is likewise intrusive. As the basalt extends to the bottom of all canyons it crosses, this relation is undoubtedly that of a dike and not a mesa capping as the writer first supposed it to be. The south side of the diabase is in intrusive contact with the Modelo and for the most part with the basal conglomerate member. This is demonstrated by the baking of the sandstones, and the presence of apophyses. The baked sandstone is well exposed about 20 feet south of the contact on the first ridge east of Fascination Spring. The best exposure of the apophyses is found on the east side of the tongue which is exposed east of Doan Canyon. There they extend several feet into the sandstone (See Plate 8B). In addition the general areal relationships of the diabase indicate its intrusive nature. For example, the sudden thinning and turning a few hundred feet west of Fascination Spring are difficult to explain on the basis of a flow as is also the tongue east of Doan Canyon. The parallelism of the outcrop area to the strike of the underlying Modelo indicate a sill, although the tongue referred to above and several smaller irregularities indicate dike like off-shoots from the main body of rock. The vesicular and amygdaloidal character of the diabase point to a very shallow intrusive body, the sediments into which it was intruded being probably quite wet.

Age: As the body intrudes Modelo and is faulted against Saugus, the only age determination that can be made is that the intrusion occurred after the deposition of the Modelo (Upper Miocene) and before the tilting of the Saugus formation (Late Pliocene or Early Pleistocene).

Tertiary Sedimentary Rocks

Miocene

Distribution: The Miocene rocks are exposed in two east-west strips: One along the southwest border of the region and the other near the northeast border in the Fascination Spring area.
Lithology: The Miocene here can be divided lithologically into three distinct members: (1) Basal conglomerate, (2) Lower shale member, (3) Upper shale member.

The basal conglomerate member is composed of well weathered conglomerate, arkosic sandstone, siltstone, and shale. The cobbles of the conglomerate are well rounded, and average about 4 inches in diameter. They are made up mailly of granitics and metamorphics which undoubtedly have been derived from the range to the north. The arkosic sandstone is interbedded with siliceous shale which becomes increasingly abundant in the upper portion of the member where transgression into the lower shale member takes place and in which sandstone is practically absent. North of Herreras Ranch the exposures of Miocene rocks are limited to soft brown punky sandstone containing a few

PLATE 6

A. Road cut exposure of upper shale member of the Modelo in Fascination Spring area.

B. Exposure of Saugus mudstones and sandstones near Fascination Spring.

PLATE 6

A

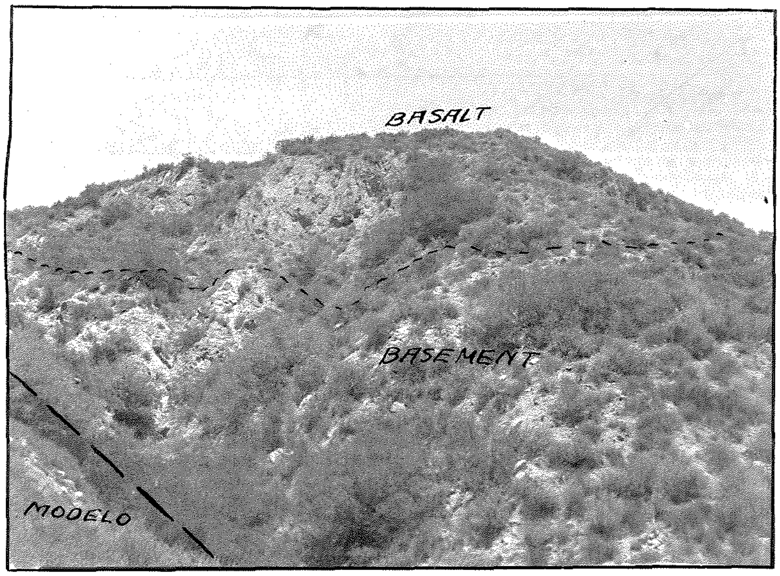
B

PLATE 7

A. Basement occurring between basalt and Modelo. East of Doan Canyon.

B. Rejuvination evidence at the mouth of Doan Canyon.

PLATE 7



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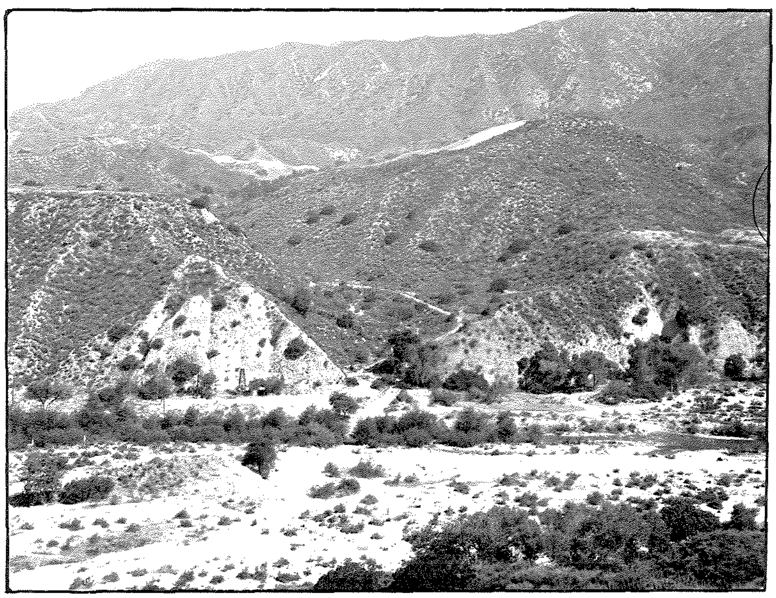

B

PLATE 8

A. Flexure in basal member of the Modelo with volcanic core. West of Fascination Spring.

B. Apophyse extending into basal Modelo. The sandstone is here overturned. East of Doan Canyon.

A

B

thin beds of coarse, pebbly arkose. The best exposures of this member occur at the western extremity of the region.

The most prominent and characteristic feature of the lower shale member is the abundance of thin bedded, hard white to light grey and light brown platey siliceous shale. These light colored siliceous shales are everywhere beautifully bedded and, although composed predominantly of the hard platey type, contain partings and thin beds of soft earthy shale. Some beds are chertlike in character and contain opaline veins. Others are not so highly siliceous but are hard compact, and just as distinctly bedded. Fish scales are plentiful on many of the bedding planes. Isolated imprints of leaves also occur. In the southwest portion of the area soft light grey beds of volcanic ash occur. These beds are comparatively thin, the thickest being only 6 feet. Good exposures of this member occur throughout the region, the best of which is found on the east slope of Oliver Canyon (See Plate 5B).

The upper member is composed largely of soft brown earthy shale. Shale of this type is remarkably well bedded and is composed of distinct laminae. Bedding planes reveal abundant fish scales and carbonaceous particles. The member is highly gypsiferous throughout and in the eastern exposures is highly sulfurous in addition. East of Schwartz Canyon near the base of this member a conglomerate bed occurs with a thickness of about 20 feet. It lenses out on the east slope of Schwartz canyon and probably is a fanglomerate representing a local flood. The material is well rounded and was no doubt derived from material already in the stream channels which, due to heavy floods, was carried out to the zone of shale deposition. Good exposures of this member are found along the cuts made by the forestry road between Doan and Ebbie Canyon (See Plate 6A). Fine exposures are also round in any of the canyons along the southwest border of the region, particularly in Oliver Canyon above the ranch house.

Correlation: The stratigraphic succession here shows a striking resemblance to that of the Santa Monica Mountains where the same general succession occurs. Lithologically the sediments are strikingly similar[4].

Age: The basal conglomerate member is the only one to supply definite age criteria. No fossils were found in the southern exposures of this member but in the exposures at the northeast margin of the area fossils are abundant. Hill[3] reports the following fossils from an outcrop at Sec. 35, T. 3 N., R. 14 W.

Amiantis cf. communis Nomland
cf. Antigona willisi Trask
Chione cf. semplicata Nomland
Pectin raymondi cf. brionianus Trask
Solen perrini Clark.

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4. H. W. Hoots, Geology of the Eastern Part of the Santa Monica, Mountains, Los Angeles County, California. U.S.G.S. Professional Paper 165,pp. 83-134.

These fossils, according to Dr. A. J. Tieje as quoted by Hill[3], are of Miocene age and probably upper Miocene. H. W. Hoots[4] also reports P. raymondi cf. brionianus Trask from the Santa Monica Mountains in the basal graywake of the Modelo. Lockwood similarly reports it from the basal conglomerate south of Tujunga Wash. Russell Hayward at this writing is determining the age of the invertebrate fauna found in the Fascination Spring Miocene section and by personal communication states that the age appears to be upper Miocene. Hence, on the basis of fossil indications and stratigraphic correlation with the Modelo of the Santa Monica Mountains, the section will be designated as upper Miocene, corresponding to the Modelo formation.

Summary of Miocene Rocks

Distribution: Exposed in two east west strips along the southwest and northeast borders of the area.

Lithology: Composed of three lithologic units: Basal conglomerate and sandstone, lower shale member composed of siliceous shale, upper shale member composed of brown earthy shales.

Thickness: Basal conglomerate 500 feet, middle member 500 feet, upper member 450 feet making a total thickness of 1450 feet.

Correlation: On the basis of fossil and stratigraphic similarities the formation is correlated with the Modelo of the Santa Monica Mountains.

Age: From tentative fossil indications and correlation it appears to be upper Miocene.

Notes on the Stratigraphic Succession: Deposition was more or less continuous throughout the formation as no time breaks in the form of unconformities were found between the various members.

Origin: The presence of marine invertebrates, marine shales, and correlation with the marine Modelo of the Santa Monica Mountains indicate a marine origin for this formation. The gypsum, whose occurrence usually indicates a continental sediment, occurs as crystals and plates along bedding and jointing planes. It undoubtedly owes its origin to oxidation of the sulfur which is known to be present.

Pico (Lower Pliocene)

Distribution: The Pico formation is represented by a thick section overlying the Modelo. As the strike is practically parallel to the Modelo, this formation is also exposed in an east west strip which extends the full length of the area.

Thickness: The maximum thickness approaches 1700 feet (See section AA', Plate 13) with gradual thinning to the east about 850 feet (See BB').

Lithology: The Pico occurring here can be divided roughly into two members: A lower one predominantly conglomerate and an upper one predominantly sandstone. The lower conglomerate can be differentiated from the Modelo conglomerate by its uniformity, massiveness, and lesser degree of weathering. The proportion of volcanics appears to be slightly less than that in the Modelo but this varies from place to place and can by no means be used as a criteria. The upper member into which the lower member gradually transgresses is composed largely of tawny colored massive sandstone in beds up to 100 feet in thickness. They sometimes carry numerous concretions which may reach 2 feet in diameter. Interbedded with the sandstones are minor amounts of conglomerate, siltstone, and sandy shale. Except for the presence of concretions in the sandstones and absence of interbedded siliceous shale, this upper member is quite similar to the sandstones of the basal member of the Modelo. The lower member of the Pico is well exposed on the cuts at the mouth of Ebbie Canyon and good exposures of the upper member may be found on the ridge leading up to and south of Mr. Tujunga.

Relation to the Modelo: The change in lithology from the upper shale member of the Modelo to the massive conglomerates of the Pico is immediate. On the south side of Tujunga Wash at the end of the bridge the contact is well exposed and displays an angular discordance of about 10°. However, the contact is poorly exposed on the north side because of the great amount landsliding. There are a few small exposures at the head of Oliver (See Plate 4B), Cactus, and Schwartz Canyons, and all show a slight angular discordance. On the other hand, from a regional point of view, very little such evidence is found. The upper shale member of the Modelo shows a slight thickening and thinning which may or may not be due to an unconformity. However, for the most part a thicker section is exposed in the canyons than on the ridges, thus indicating that the Modelo may have been slightly tilted parallel to its present strike before the deposition of the Pico. (See Plate 13).

Age: Mason Hill[3] reports the following fossils from the SE cor. Sec. 32, T. 3 N., R. 14 W. which Dr. A. J. Tieje considers to be lower Pliocene in age.

Cardium quadrigenarium Conrad
Chione cf.
Dosinia cf. ponderosa Gray
Paphia cf. jacalitosensis Arnold
Pecten cf. cerrocensis Gabb
Pecten cf. healeyi Arnold
Trophosyncon nodiferum (Gabb)

On the basis of this determination the section will be considered as Pico.

Origin: Because of the lack of crossbedding, fairly good sorting, and the occurrence of marine fossils the Pico section occurring here will be considered as of marine origin.

Saugus (Upper Pliocene)

Distribution: The Saugus occurs in a strip which lies between the Sierra Madre Fault and the Pico formation.

Lithology: The formation is composed of coarse, pebbly, poorly-sorted arkosic sandstone with interbedded conglomerate, silts and mudstones. The sandstones are white to cream in color, highly crossbedded, and occur as massive beds 25 to 150 feet thick. The interbedded conglomerates consist of cobbles averaging 4 inches in diameter and made up of semi-rounded fragments of gneiss, granitics, and anorthosite. The siltstones and mudstones are buff in color and occur as massive beds and lenses 1 to 10 feet thick (See Plate 6B). In the lowermost part of the section well-rounded beach pebbles occur. The lower part of the section is quite similar to the upper Pico and is difficult to distinguish from it. However, in general, the two formation differ in the greater abundance of conglomerate in the Pico, the lighter color of the Saugus, the coarseness and poor sorting of the Saugus sandstones, the presence of concretions in the Pico sandstones and the poor cementation and slight compaction of the Saugus conglomerates. These criteria are true only for the two sections in general, for as the contact is neared the formations become more and more alike, resulting in a transition zone about 300 feet thick. Differentiation from the Pico on the basis of the lighter color of the Saugus was found to be the most satisfactory. The best exposures of the Saugus formation can be found in the road cuts of Little Tujunga Canyon (See Plate 6B).

Relation Between the Saugus and Pico: There was apparently little or no break in sedimentation between the Saugus and the Pico. No evidence within the area for an unconformity was found. In this paper the marine portion is considered to be Pico, and the continental, Saugus; the distinction between the two having been made on the basis of the lighter color of the Saugus. Such a contact probably does not represent a true time division as it is quite improbable that the change from littoral to playa deposition was made at the same time over all the area. In the transition zone rounded beach pebbles occur and as the sea probably receded toward the west, the beach deposits at the eastern end would therefore be the oldest. This is substantiated by the fact that the marine section is much thicker in the western end of the area where the sea remained for a longer time.

Quaternary

Distribution: Quaternary formations occur as terraces blanketing the older Miocene and Pliocene rocks (See Plate 3). They are most abundant along the northern and southern boundaries of the region.

Lithology: The terrace gravels are composed for the most part of poorly sorted semi-angular fragments of gneiss, and other crystalline rocks up to two feet in diameter, characteristic of the main block of the San Gabriel Range. A few lenses of pebbly sandstone occur. The terraces are from 20 to 100 feet thick and are grey to brown in color depending upon the extent of the weathering.

Age: Because of the great angular unconformity upon the Saugus these terraces are assigned to the Quaternary Period (Hill[3])

Origin: In view of the poor sorting and rounding the terraces are considered as land laid and representing the remains of now dissected alluvial fans.

STRUCTURE

General Description

Broadly considered, the area consists of a block of Tertiary sediments dipping northward into the basement where the section is terminated by the Sierra Madre Fault. On the south, the block is terminated by the Tujunga Fault. The Sierra Madre Fault is the dominant structural feature of the region. It trends slightly north of west as do all the major structural features of the region, and, because of the overlying of the basement and Modelo on Saugus, is found to be reverse in nature. The Tujunga Fault, the exact nature of which is undeterminable, on the south is entirely conjectural. The only major fold in the area is the Merrick syncline paralleling the Sierra Madre Fault to which it is undoubtedly related. Many minor faults occur throughout the area, the majority of which have a decided north-south trend.

Sierra Madre Fault

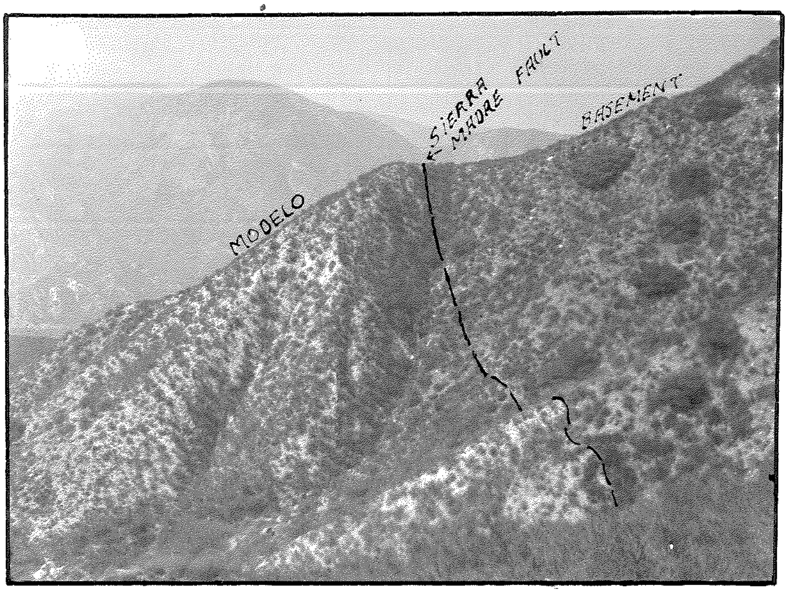
General Description: The eastern and central portion of this structure trends about N 60°W while in the western portion of the area it turns northward, resulting in a trend there of about N 20°W. The exposures and the trace of this fault on the topography indicate a dip of about 60°NE though locally the fault sometimes appears to be almost vertical, particularly in the eastern portion of the region (See Plate 14). Because

PLATE 9

A. Modelo faulted against basement. North of Herreras Ranch.

B. Small recent scarp of the Sierra Madre Fault near Fascination Spring.

PLATE 9



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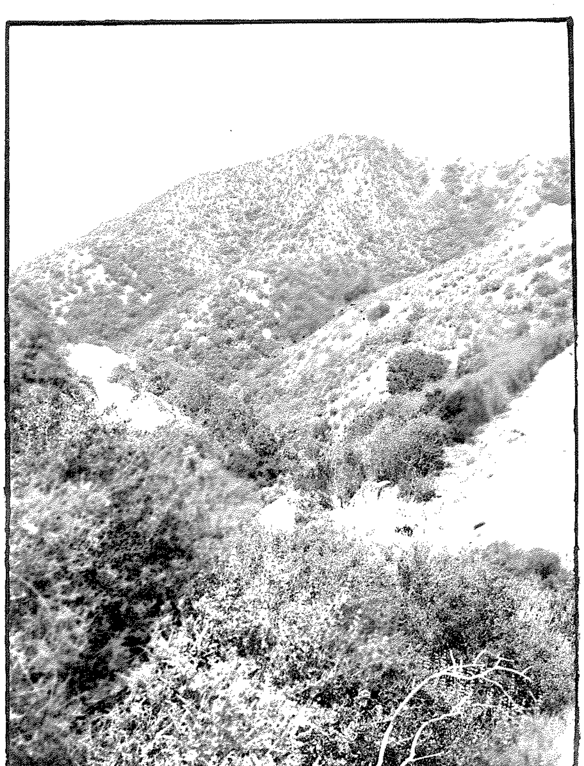


B

of the uniformity of adjoining rocks and scarcity of outcrops, detailed structure could not be determined. From the few outcrops that are available, however, an anastomosing pattern is denoted. These subsidiary branches are well exposed in the cuts along the forestry road in the Fascination Spring region. North of Herreras Ranch are two patches of basal Modelo. Hill[3] indicates the southern one as lying on the west side of the fault and being in depositional contact with the Saugus and the northern patch as lying on the east side of the fault and being in depositional contact with the basement. From the large displacement which the fault is known to have, this relation seems unlikely. Unfortunately the contact os the southern patch with the Saugus is not well exposed, but it seems probable that this patch is a horse and a further indication of the branching nature of the fault. The contact of the northern patch is well exposed and from the attitude is undoubtedly depositional as Hill[3] has indicated.

Relationships of Adjoining Rocks: The whole section of Miocene and Pliocene rocks dips northward to the Sierra Madre fault thus bringing the Saugus in contact with the basement, Modelo, and diabase which lie to the north of the fault. In view of the north dip and the resulting overlying of the Modelo upon the Saugus the Sierra Madre fault can be seen to be essentially reverse in nature. The Modelo of the Fascination Spring region has been highly distorted and for the most part is overturned as can be seen by the fact that the lower shale member overlies the upper shale member. Such a relation is undoubtedly associated with the compression and dragfolding of the fault.

Displacement: The section of Modelo exposed north of the fault is much thinner than that exposed south of it and indicates that the fault is near the shore of the basin in which the Modelo shales were deposited. Even in view of such a thinning the displacement of this fault is readily seen to be measurable in thousands of feet and Hill's[3] figure of 2000 feet seems a little small.

Age: From the tilting which occurred following the deposition of the Modelo and in view of the fact that the tilting occurred approximately parallel to the present fault, it is evident that the region has been subjected to compressional forces at least since the end of the Miocene. Whether or not a fault existed then cannot be determined. The age of the fracture as seen now, however, is post Saugus as this formation is involved in the faulting.

Tujunga Fault

The presence of this fault is purely hypothetical. As the same horizons of the Modelo occur on the south side of Tujunga

Wash as on the north, the occurrence of either an intervening fold or fault is indicated. However, on the basis of the field evidence a fault seems the most likely.

The occurrence of fresh gravels on the southwest border of the region similar to those now in Tujunga Wash indicates a very recent uplift of some nature. The level of these deposits is approximately the same as that of terraces near the mouths of Ebbie and Doan Canyons. As there is no evidence of tilting of these recent gravels, folding seems unlikely. It is known from the section south of Tujunga Wash that the basal Modelo lies on the basement and is only hundreds of feet in thickness. Hence, in view of this, the granite must not lie very far below the surface at the south border of the region and faulting would be expected rather than folding. A straight steep cliff marks the south central portion of the area (See Plate 1B). Hill[3] regards this as an erosional feature and places the Tujunga Fault farther out in the wash. However, were it an erosional feature the stream in Tujunga Wash would tend to be driven out into the Wash by encroaching alluvium and would not form a straight cliff. This is not the case; the stream tends to parallel closely the face of the cliff as would be expected along a fault scarp where the grade of the tributaries coming from the north was steepened from time to time thus removing the alluvium which had collected. Such an indication is found in the evident rejuvenation of these tribuatries. It is particularly evident at the mouth of Doan Canyon (See Plate 7B).

As this fault is associated with the same compressional forces which express themselves in the Sierra Madre fault it is likely that this fault is also reverse in nature. The age of this fault probably corresponds to that of the Sierra Madre.

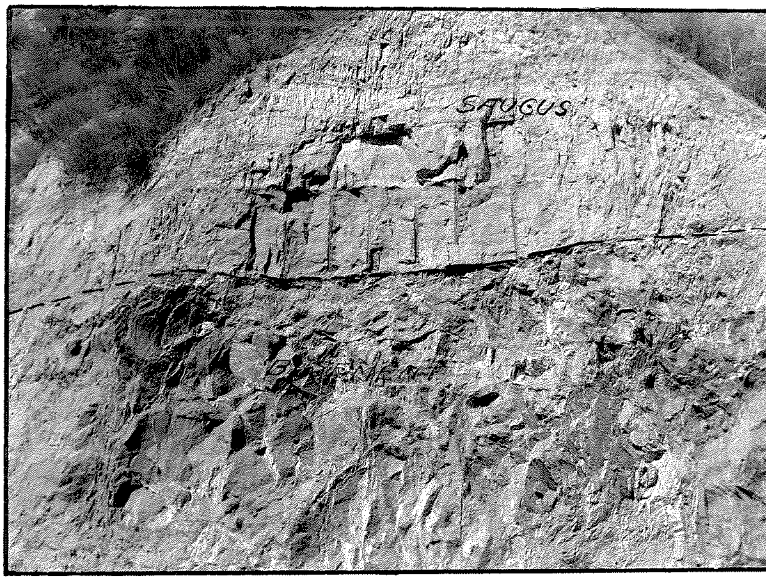
Minor Faults

Doan Canyon Group: East of Doan Canyon a group of three faults was found involving the basement, Modelo, and diabase (?). No exposures of these faults themselves exist, but they are well indicated by the attitudes of the sediments which strike obliquely to the traces of the contacts. From the meager indications given by the topography these faults appear to be rather steep. As Modelo sediments are involved this group can be designated as post Modelo. The exposures of the contact around the tongue of diabase in this region are insufficient to determine whether the fault trending into the nose of the tongue was post-intrusion or pre-intrusion with the diabase flowing into the old fault surface. On the other hand, as the upper contact appears to be continuous in spite of the overlying terrace, it seems that the latter occurrence is the most correct. A small off shoot from the basalt also occurs in the fault

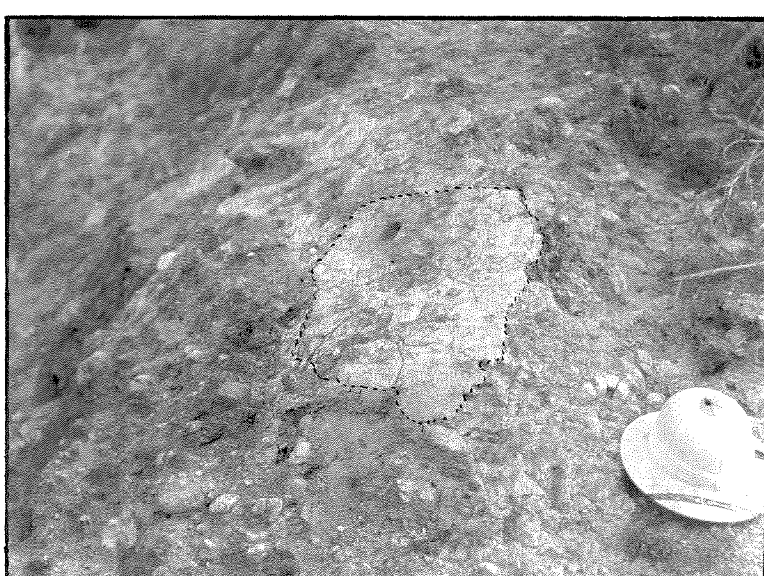
PLATE 10

A. Saugus resting on basement. Road cut in Little Tujunga Canyon.

B. Fault surface in the Pico formation. The horizontal slickensiding is faintly visible.



A



B

separating the basement from the basal Modelo.

Other Minor Faults: Throughout the Modelo and Pico sections minor adjustment faults are present, the majority of which exhibit a north south trend. With the exception of the small thrust on the eastern end of the Pico-Modelo contact, all are relatively steep. Because of the lack of exposures and marker horizons in the Saugus small faults could not be located there, but they undoubtedly exist. Along the crest of a north south ridge a few hundred feet north of the Pico-Modelo contact in Oliver Canyon, one of these fault surfaces is well exposed (See Plate 10B), and exhibits distinct horizontal slickensiding. The displacement on this particular fault is about 200 feet horizontally, the east side moving north. The age of these faults is difficult to determine as thost that trend into the Saugus are lost due to the massive character of the Saugus. Because of the landsliding on the Pico-Modelo contact, faults are difficult to trace across into the massive conglomerates of the lower Pico.

Folds

Merrick Syncline

A syncline referred to by Hill[3] as the Merrick Syncline occurs in the Saugus formation and is the dominant fold of the region. It trends about N 60 W roughly paralleling the Sierra Madre Fault. In this region the axis is difficult to determine accurately because of the scarcity of the outcrops.

However, a general indication of attitude can be obtained from the meager exposures available. The axis is well exposed on the east side of Little Tujunga Canyon. No other exposures of the axis are known in the region. However, it can be roughly located by the presence of adjacent dips which are almost vertical. In the area to the west mapped by W. S. White the exposures are much better along the axis and it was found to parallel definitely the Sierra Madre Fault. The north limb of the syncline exposes only Saugus gravels dipping about 50° and steeper to the north. From the Little Tujunga exposure the axis appears to dip gently to the northwest, while the south limb exposes Modelo, Pico, and Saugus dipping from 30° to 60° northward.

From the close association of this fold with the Sierra Madre Fault particularly indicated by White it is evident that this feature is closely associated with the fault. Hill[3] discards the Merrick Syncline as a drag fold on the basis of its large size. This is purely a matter of definition. The fold is definitely related to the fault. However, if the term "drag fold" is restricted to those folds which are dependent only upon the friction along a fault surface, Hill's[3] view appears to be correct. The writer feels that the syncline is mainly an expression of the same compressional forces which cause the Sierra Madre Fault, the drag effect being slightly contributary,

Minor Folds

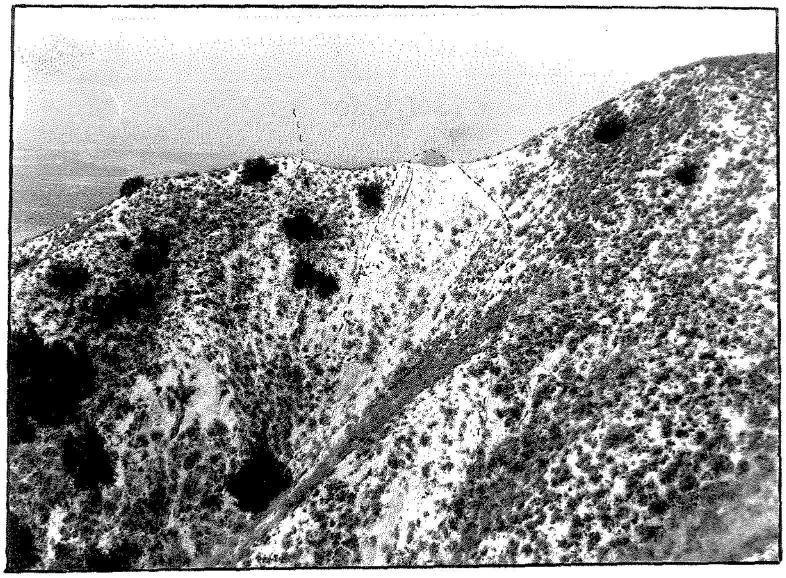
Minor folds are abundant in the upper and lower shale members of the Modelo. The fold whose axes die out near the mouth of Cactus canyon is the only one large enough to be of any importance. This fold was indicated by Hill[3] to be a fault. By carefully tracing the outcrop of the tuffaceous shale bed occurring near the axes, Hill's[3] fault was found to be a converging anticlinal and synclinal axis. This feature was verified by White who reports the presence of a similar pair of axes in line with those located by the writer.

PLATE 11

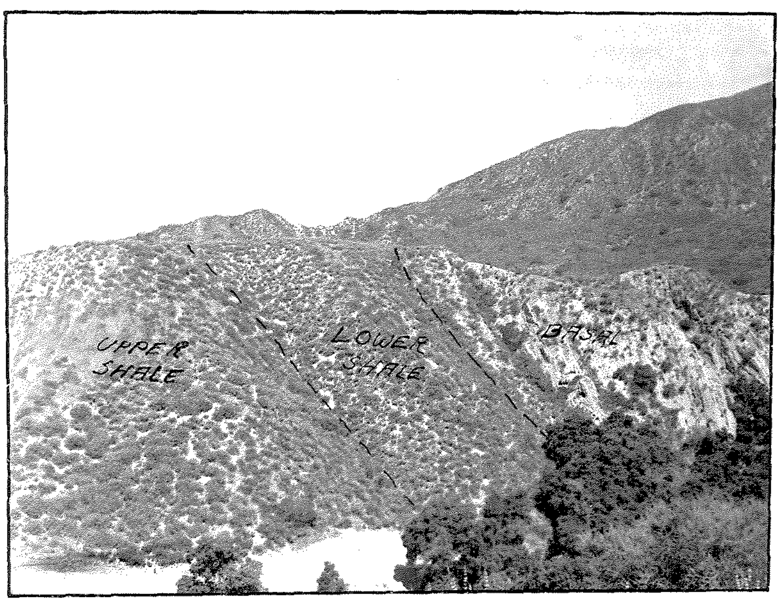
A. Flexure in the Modelo. This structure was interpreted by Kew and Hill as a fault.

B. Overturned section along the west side of Doan Canyon.

PLATE II



A



B

GEOLOGIC HISTORY

The geologic history may be briefly summarized in the following way:

(1) Intrusion and metamorphism in pre-Cretaceous.

(2) Uplift and erosion ofmetamorphic and intrusive rocks.

(3) Deposition of Modelo.

(4) Compression and subsequent tilting of Modelo, regional uplift (?).

(5) Deposition of Pico conglomerates and sandstones getting progressively finer as the uplifted mountain blocks were eroded.

(6) Regional uplift and withdrawal of sea.

(7) Deposition of Saugus playa deposits in abandoned sea basin.

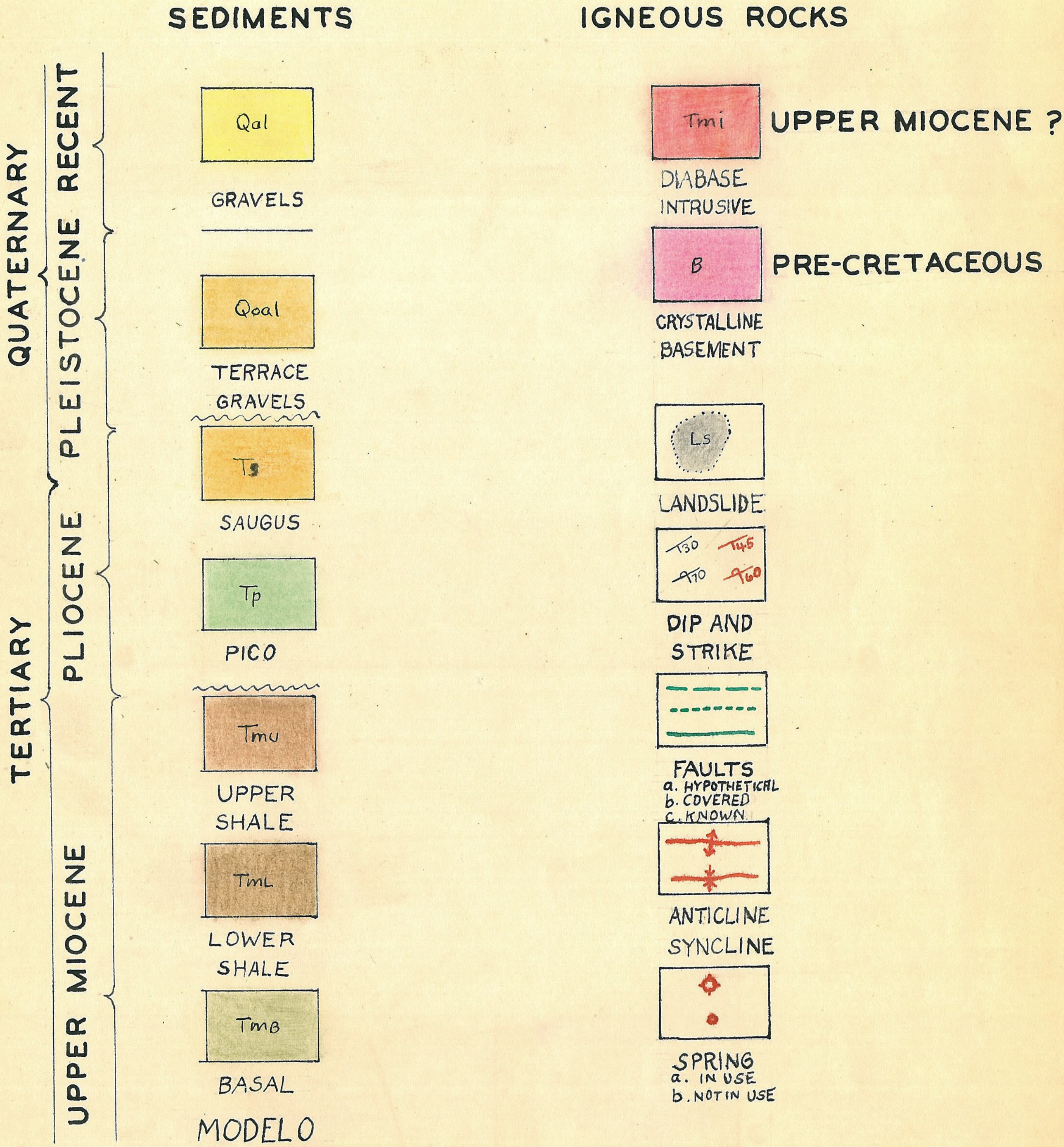
(8) Late or post Pliocene deformation resulting in the main uplift of the present range, folding, and faulting.

(9) Erosion and beveling of Tertiary section.

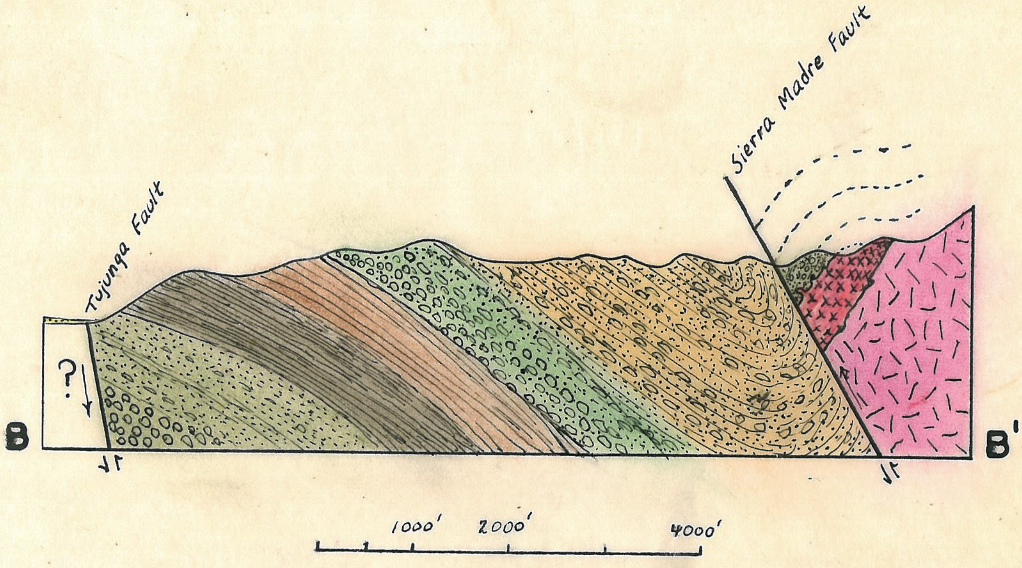
(10) Deposition of Terrace gravels, as alluvial fans.

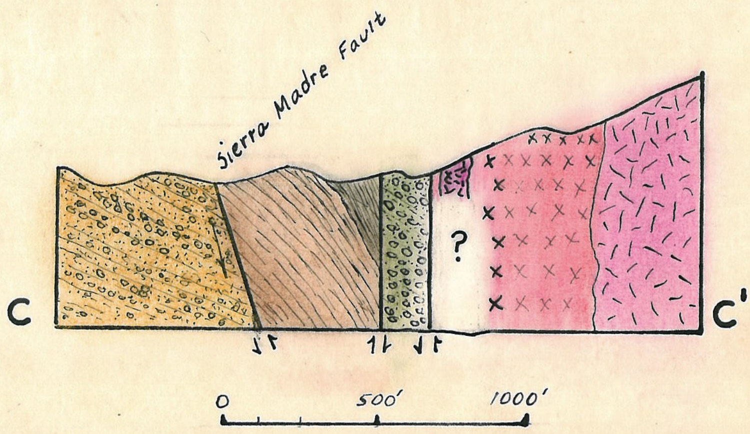
(11) Uplift, faulting and dissection of fans.

LEGEND


SEDIMENTS
IGNEOUS ROCKS
QUATERNARY
TERTIARY
RECENT
PLEISTOCENE
PLIOCENE
UPPER MIOCENE
Qal
GRAVELS
Qoal
TERRACE GRAVELS
Ts
SAUGUS
Tp
PICO
Tmu
UPPER SHALE
TmL
LOWER SHALE
TmB
BASAL
MODELO
Tmi
UPPER MIOCENE ?
DIABASE INTRUSIVE
B
PRE-CRETACEOUS
CRYSTALLINE BASEMENT
Ls
LANDSLIDE
30
45
10
60
DIP AND STRIKE
FAULTS
a. HYPOTHETICAL
b. COVERED
c. KNOWN
ANTICLINE
SYNCLINE
SPRING
a. IN USE
b. NOT IN USE

GEOLOGIC CROSS-SECTIONS





GEOLOGY

FASCINATION SPRING AREA

SCALE 1:8930

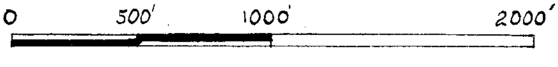
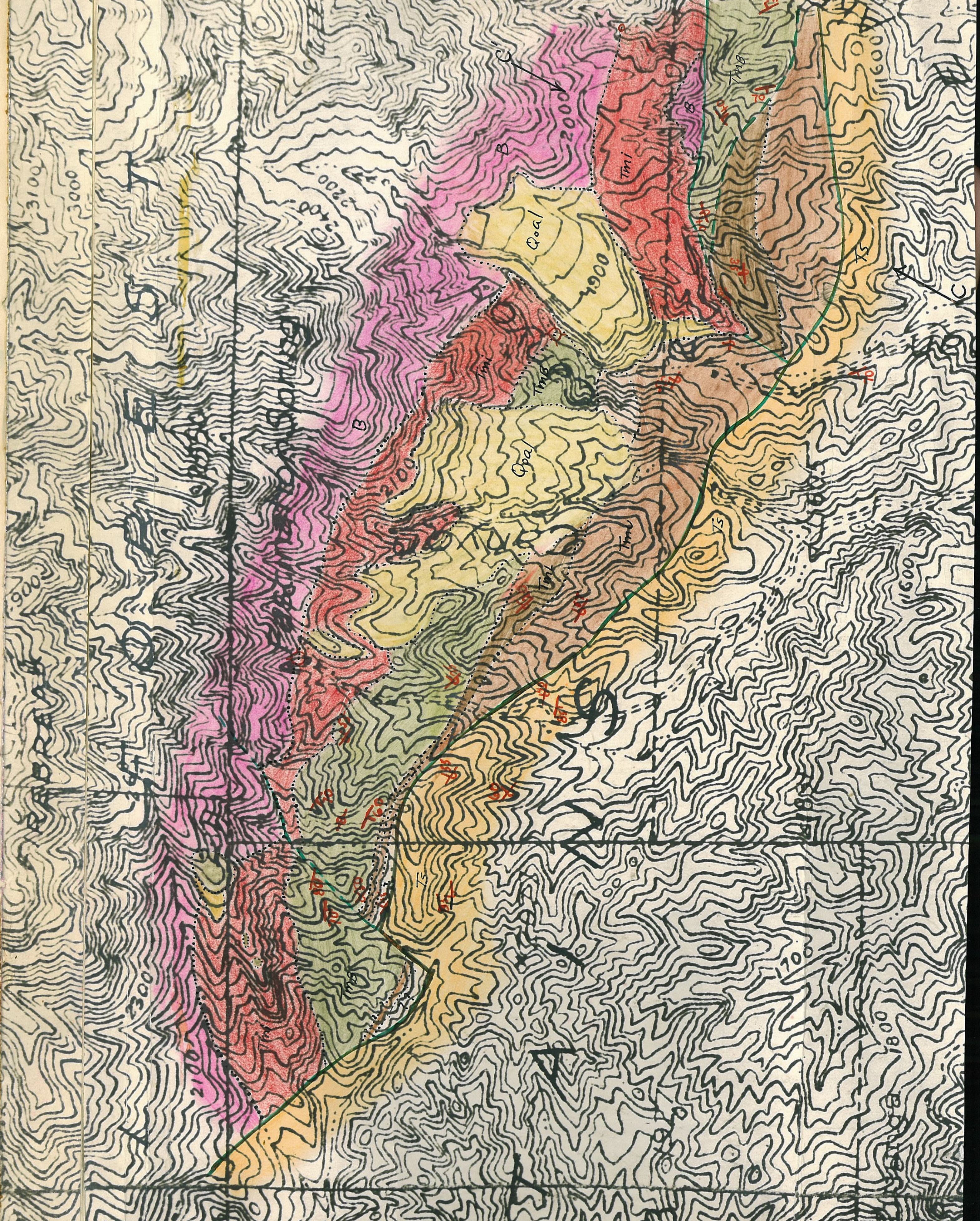


PLATE 14



GEOLOGY OF THE AREA SOUTH OF THE SIERRA MADRE FAULT

Scale 1:24000

PLATE 15

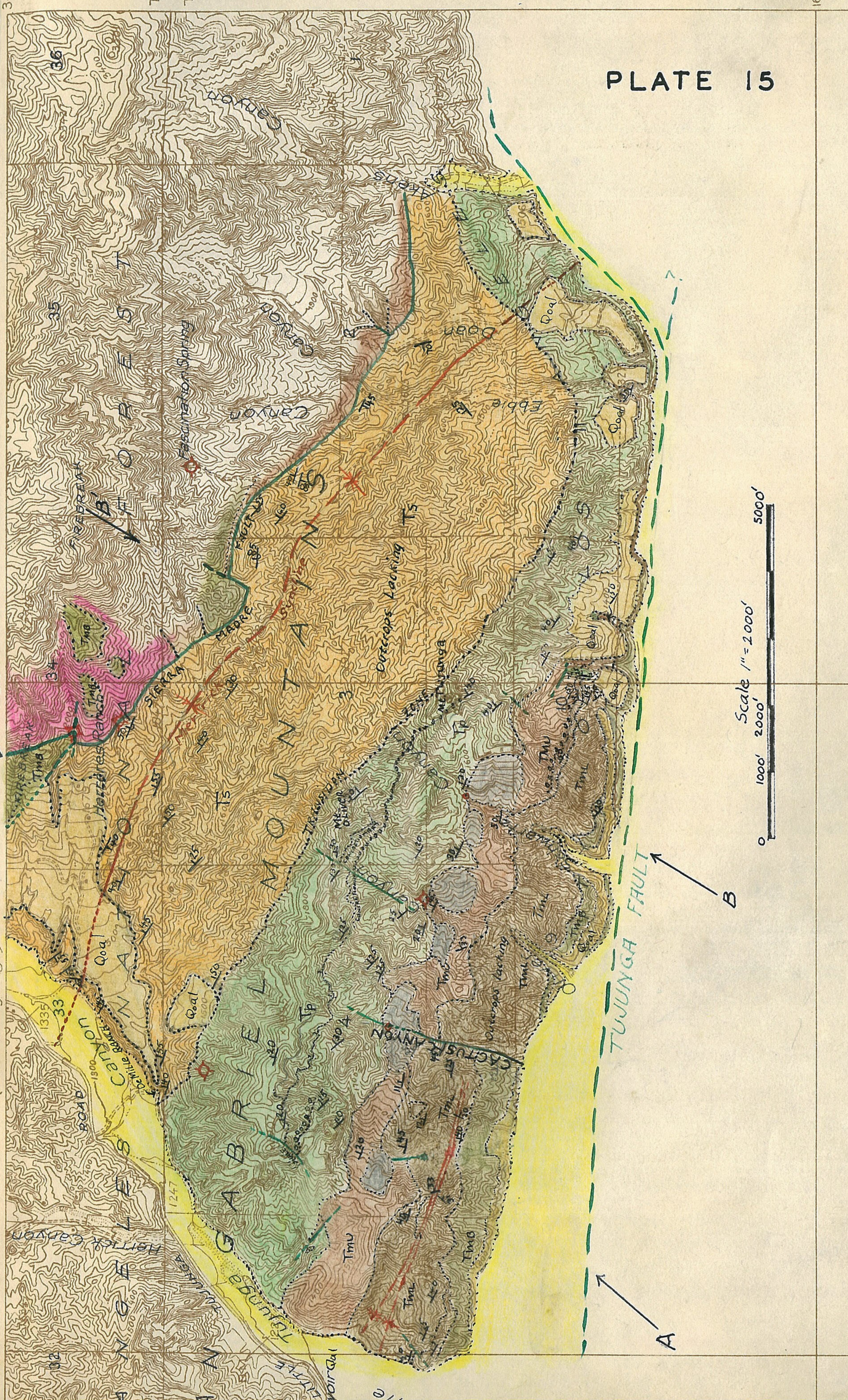
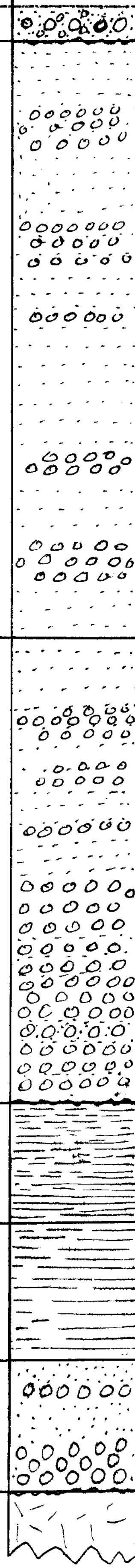

LOS ANGELES COUNTY, CALIFORNIA
BOARD OF SUPERVISORS
HERBERT C. LEGG, CHAIRMAN
ALFRED JONES, COUNTY SURVEYOR
CALIFORNIA
(LOS ANGELES COUNTY)
SUNLAND QUADRANGLE
Advance sheet.
Subject to correction.
(Little Tujunga)
SAN GABRIEL MOUNTAINS
SIERRA MADRE
CACTUS CANYON
TUJUNGA FAULT
Scale 1" = 2000'
0 1000' 2000' 5000'
A
A'
B

PLATE 16

COLUMNAR SECTION



Age		Formation	Thickness	Lithology
Quaternary			100'-150' UNCONFORMITY	poorly sorted sand and gravel
TERTIARY	UPPER PLIOCENE	SAUGUS	2200'	Poorly sorted, white, pebbly, arkosic sandstone with minor amounts of conglomerate and silstone.
TERTIARY	LOWER PLIOCENE	PICO	1700' UNCONFORMITY	Largely tawny sandstone with minor amounts of conglomerate. Largely well consolidated conglomerate with minor amounts of sand stone.
TERTIARY	UPPER MIOCENE	MODELO	450'	Sulfurous, gysiferous, punky shale.
TERTIARY	UPPER MIOCENE	MODELO	500'	Siliceous shale.
TERTIARY	UPPER MIOCENE	MODELO	at least 500' UNCONFORMITY	Tawny sandstone and well consolidated conglomerate.
PRE-CRETACEOUS				Gneiss, Schist, granitics, etc.