A Report on the Structure, Stratigraphy, and Fossil Content of a Small Portion of the San Gabriel Range

Senior Thesis - 1936 - 1937

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Illustrations

Introduction

Location and Size of Area

The field work was done at a point some twenty miles to the southwest of Pasadena, California, from which city the spot may be reached by driving west on Foothill Boulevard to the town of Sunland, and there turning to the north. The area lies almost directly to the north of Sunland, and extends from slightly to the west of Ebbie Canyon approximately one-half mile to the west, and from the northern edge of the Tujunga Wash somewhat more than one mile to the north, thus forming a rectangle having north-south and east-west running borders. The total area is approximately three-fourths of one square mile.

Purpose

This paper was written to fulfill the requirements of the California Institute of Technology for the degree of Bachelor of Science. Since the author is more interested in Paleontology than in Field Geology, this area was chosen because of the abundance of fossils in its northern section. This particular small area was selected because it contains a representative fossil assemblage, because there would be ample time remaining after the completion of the field work properly to prepare and identify the fossils collected, and because of its accessibility. It has been attimpted to assign a definite age to those beds lying to the north of the Sunland Fault through a correlation of the fossils of this region with those of other adjacent areas, especially

Introduction (Cont'd)

of the Santa Monica Mountains.

Field Methods and Accuracy

The field map was a photostatic enlargement (Scale: 1/12,000) of the U. S. G. S. advance topographic sheet of the Sunland Quadrangle (Scale: 1/24,000). Locations were made by the use of topography, and by trisection with the Brunton Compass; these should be accurate to within one hundred and fifty feet. Dips and strikes were also taken with the Brunton, and are accurate to about five degrees. The field map was copied with reasonable accuracy to a standard advance topographic sheet which is included in this report.

In later sections certain locations will be given by an azumith and distance from a certain point, this point being a triangulation station (Altitude 2026 feet) located two hundred feet west of 118°20', and five thousand five hundred feet north of the intersection of 118°20' and 34°16'.

Contacts are indicated as dotted lines, faults as solid or dashed lines, and anticlines and synclines as solid lines with the conventional arrow symbols.

Exposures.

As a rule the exposures are good on the southern slopes, and poor on the northern. Quite often there are steep cliffs facing southward which give an abundance of geological information. In other places one must rely upon scattered exposures, stream and road cuts, and float.

Introduction (Cont'd)

Acknowledgments

The author's sincere thanks is due the following men: Mr. Claude Nolte who provided the form for this paper; Mr. Nolte and Mr. Lenord Schombel for information regarding the general location of many of the features in this area; Mr. Richard Hopper who selected the area and gave much valuable advice; and Dr. Willis Popenoe whose assistance in identifying the fossils was indispensable.

Stratigraphy and Rock Types

Miocene

Topango formation

The lower contact of this formation is igneous and depositional with the basement complex, and the upper is a fault contact with the Saugus formation.

At the base of this formation is found an olivene-diabase which has a very lava-like appearance. It is vesicular not only at the top and bottom, but also at various points in the interior of the mass; and the vesicles are usually filled with amygdales of calcite. The color ranges from light grey to dark red and black. The thickness varies from zero to about seven hundred feet. The intrusive character of this sheet is inferred from the fact that there are, at one point, apophyses of the diabase extending into the overlying Topango sandstone.

A fine-grained sandstone lies next above the diabase intrusive. The common color of this member is a light grey. The degree of consolidation varies, in places it is poor, in others quite good. Where the member is well consolidated, jointing obscures the bedding; however, it is possible in spite of this to discern the bedding. This sandstone is about two or three hundred feet thick.

Above the sandstone is the fossiliferous sandstone and conglomerate. In most places this member appears to be some three hundred feet in thickness. The usual color is white or light grey, although in places it becomes yellowish

Stratigraphy and Rock Types (Cont'd)

or a darker grey. The conglomerate is in thin beds, and the sandstone makes up the great bulk of the material. The fossils are found exclusively in the sandstone. The conglomerate consists of sub-rounded fragments of acidic igneous rocks varying up to four inches in diameter, and is usually well consolidated.

Between the sandstone and the fault lies a body of fine-grained shale which varies from a good shale to a rather sandy shale. Near the fault the material is quite distorted, and the bedding can seldom be determined. In the road cuts it can be seen that there are a very few red and yellow colored sandy lenses in the shale. The color of the shale varies from light to dark grey. The material is usually quite finely bedded. The eastern end of the shale is four hundred feet thick, to the best it dwindles to zero, being cut off by the fault.

The age of this formation is probably Upper Topango, or uppermost Middle Miocene.

Stratigraphy and Rock Types (Cont'd)

Miocene

Modelo formation

In the limited area in which this formation is exposed only the upper contact is visible, this contact being with the basal conglomerate of the Pico formation.

The only exposure of this material is a small patch in the southwestern portion of the area. The formation consists, in this small area, almost entirely of siliceous and chalky shales. The siliceous shales are white, the remaining are tan or grey. There is an abundance of gypsum present, and it is chiefly found between the bedding planes of the more chalky shale.

The bedding and sorting in both bypes are excellent. Both shales tend to cleave parallel to the bedding, and fish scales and some carbonaceous material is found here. The dips and strikes are quite constant and show little crumpling due to the uplift of this formation. The thickness may be estimated at about three hundred and eighty feet.

This formation is presumed to be Upper Miocene in age.

Stratigraphy and Rock Types (Cont'd)

Pliocene

Pico formation

This formation conformably overlies the siliceous shale of the Modelo formation in the western portion of the area. To the east there is no lower contact for the formation dips under the QAl of the Tujunga Wash. The upper contact is with the Saugus formation, and there is a slight angular discordance between the two.

The lowermost member of the Pico formation is a coarse conglomerate. This member consists of thin lenses of shale, slightly larger lenses of sandstone, and heavy beds of conglomerate. The shale is poorly bedded, and might more properly be termed a silt- or mudstone. The sandstone is arkosic, and is colored red or yellow by iron staining. The conglomerate is made up of sub-angular and sub-rounded pebbles, cobbles, and boulders of acidic igneous and metamorphic rocks with small amounts of lava and sedimentary boulders. The conglomerate is well cemented, and, to the west especially, stands out in great cliffs. The thickness varies, but may be said to average about four hundred feet.

Above the conglomerate lies some seven hundred feet of shale. This is not a good, well bedded shale, but instead is very sandy and contains lenses of sandstone and conglomerate. The color in the shales is dark brown, and it ranges to reds, yellows, and light greys in the sandstone and conglomerate. Some of the shale appears to be slightly siliceous.

Stratigraphy and Rock Types (Cont'd)

Pliocene

Above the shale is a thin bed of about one hundred feet of light colored sandstone. This sandstone is highly arkosic, and contains many small pebbles of acidic igneous rocks. Upward, the sandstone grades into another bed of rather fine conglomerate.

According to Mason Hill[1] these beds are of Pico age, since fossils of this age are found at another locality.

1. Mason Hill, "Structure of the San Gabriel Mountains North of Los Angeles, California", U. of Calif. Publication in Geology, Volume 19, Page 143.

Stratigraphy and Rock Types (Cont'd)

Pliocene

Saugus formation

The lower contact of this formation is with the Pico beds, and, as previously mentioned, there is a slight angular discordance between the two. Since there is nothing overlying the Saugus formation except some small patches of the old QAl, there is nothing to be said of the upper contact.

The lower member of this series consists chiefly of sandstone, with some small lenses of a sandy shale, and some scour fillings of conglomerate. The sandstone is highly arkosic, it contains several different feldspars and some quartz. It is in persistant beds and in cross bedded lenses. The shale is rather coarse and poorly bedded, and appears as lenses in the sandstone. The conglomerate contains sub-angular fragments of acidic igneous rocks and metamorphics. The thickness is approximately eight hundred feet. The sandstone is generally white, grey, or brownish; the shale is a darker grey; and the conglomerate is, as a rule, white or grey.

Apparently the sandstone grades rather abruptly into a coarse conglomerate. This conglomerate consists of acidic igneous rocks, schists, gneisses, and lavas. The fragments range from small pebbles to ten inch cobbles. The color is generally white or light grey, with some reddish streaks due to iron staining. The consolidation as well as the sorting are poor, and it is generally impossible to obtain an accurate dip and strike. The thickness is estimated at about five hundred feet.

To the north there is again a thin band of the Saugus sandstone, the band lying between the Saugus conglomerate and the Sunland Fault. The age of these beds has been determined as Pico by Mason Hill[1].

1. Ibid., Page 143.

Stratigraphy and Rock Types (Cont'd)

Quaternary

The Quaternary sediments may be divided into two distince members, the old and the recent alluviums. The old alluvium is in the form of terraces which have been plastered on top of the older sediments and subsequently these terraces have been dissected by later erosion and stand as isolated patches. These patches consist of sand, gravel, and coarse conglomerate; and these sediments are made of schists, gneisses, and igneous rocks. Since the old alluvium shows so little relation to the present drainage pattern,it must be assumed that either the whole area has been uplifted, or that a block in the Tujunga Wash has been removed.

The later alluvium consists of much the same material as the old except that it presents a much younger appearance, that is, the fragments of which it consists are generally much less weathered.

Geologic Structure

The Sunland Fault

The Sunland Fault is the chief feature controlling the geologic structures of this region. Its position is shown on the map of a following page, and its trace has been approximately followed for some four thousand feet. A very disturbed area, which is quite probably the fault itself, is found in a cut of the Forest Service road 3,750 feet N56°E of the triangulation point 2026.

As can be seen from the following structure section, the fault is of the reverse type, the older beds to the north having ridden out over the younger beds lying to the south. In most places it is difficult to recognize this fact; however, many observations tend to this view, and it is quite probably true. The Topango beds and the Jurassic "granite" have been raised some four or five thousands of feet, since erosion has removed some four or more thousand feet of sediments from the top of the Topango beds.

The Merrick Syncline

South of this fault is found the Merrick Syncline, whose position is approximately marked on the map. This structure is a drag effect of the Sunland Fault, a fact which seems evident from a study of the structure section. In one place it is clearly visible (3,600 feet N52°E of the 2026 triangulation point), and in many others it is deducible from dips and strikes, that the fold has been overturned; and that the axial plane dips about forty degrees to the north.

Geologic Structure (Cont'd)

In many places are found minor flexures superimposed upon this large structure, but these are found chiefly in the shales, and seldom in the sandstones or conglomerates.

Anticline

In the north-central portion of the region, 4,600 feet N29^{o}E of the 2026 triangulation station, is found a small anticline, another of the drag effects of the Sunland Fault. In this anticline the intrusive lava sheet can be seen as a core, surrounded by a silty sandstone of the Topango formation. It is here that the intrusive character of the lava is best illustrated, for there are apophyses of the lava extending from a few inches to a foot or more into the sandstone.

"Red Gulch" Fault

In the northwestern corner of the area is found the so-called "Red Gulch" Fault, its rough position and its name being given the author by Mr. Nolte. This fault, chiefly by horizontal movement, and hence it is of the strike slip variety, has brought together the Topango diabase and the Jurassic basement complex. From the little the author was able to discern of this fault its total displacement lies somewhere between one and two thousand feet.

Topango Olivene-Diabase

The mass of material hitherto called the Topango diabase deserves some further consideration. According to

Geologic Structure (Cont'd)

Mr. Schombel and Mr. Nolte, this material is not basalt, the name given it by Mason Hill[1], but is, instead, an olivene-diabase[2]. In some few places chilling can be seen on both borders, and, as previously mentioned, in one place the Topango sandstone can be seen overlying the diabase with fingers of the diabase extending into the sandstone. Much of the diabase is vesicular, and nearly all of the vesicles are filled with calcite. This fact does not mean that the diabase was a flow, for a shallow intrusive can also exhibit these features. The apophyses on the upper surface seem to clinch its intrusive character.

1. Ibid., Page 142
2. Claude Nolte, "Senior Thesis, 1936, 1937".

Fossils

Occurrence

Most fossils found in this area are from a rather limited stratigraphic interval, probably not exceeding three hundred feet. All of the forms collected by the author came from a very small portion of the total area in which they may be found, because in this portion a representative collection is quite easily obtained. There are three typical occurrences of the shells: they may be in loosely consolidated beds, in beds which have been cemented by ferruginous material, or in small ferruginous concretions.

Locality one cannot be definitely placed, for the boulder from which these fossils were obtained was float in the bottom of a small canyon. However, it lies stratigraphically above the following locations. Localities two to eight may be grouped as one since they all lie within a few hundred feet of one another. They are located 3,700 feet N30°E of the 2026 foot triangulation point. Locality nine lies 3,600 feet N23°E of the same reference point.

Fossil List

Locality #1.

- Antigona, sp
- Solen, sp
- Sanguinolaria? sp
- Pitar? sp
- Cardium? sp

Locality #2.

- Crepidula, sp
- Lunatia, sp

- Phacoides, cf. P. richthofenii (Gabb)
- Dosina, cf. D. ponderosa Gray

Fossils (Cont'd)

Cardium (Trachycardium) vaqueroense Arnold
Nuculana, sp
Solen, sp

Locality #3.

Calyptraea costellata (Conrad)
Cancellaria? sp
Bulla, sp

Venus (Chione) temblorensis Anderson
Cardium (Trachycardium) vaqueroense Arnold
Pecten, sp
Pecten, cf, P miguelensis Arnold
Macoma, cf. M. nasuta (Conrad)
Chione, sp
Ostraea, sp
Dosinia, cf. D. ponderosa Gray

Locality #4.

Lunatia, sp
Oliva californica Anderson
Turritella? sp
Cancellaria? sp
Calyptraea, sp
Cerithium? sp
Neverita, cf. N. reculuziana Petit

Cardium (Trachycardium) vaqueroense Arnold
Nuculana, sp
Panope, sp
Venus (Chione) temblorensis Anderson
Echinochama? sp (or Chama)
Ostraea titan? Conrad
Clementia (Egesta) pertenuis (Gabb)
Dosinia, cf. D. ponderosa Gray

Locality #5.

Oliva californica Anderson
Lunatia, sp
Neverita, sp

"Pecten" raymondi brionianus Trask
Dosinia, cf. D. ponderosa Gray
Solen, sp

Worm burrows

Locality #6.

Dosinia ponderosa Gray
Nuculana, sp

Locality #7.

Macoma, sp
Nuculana, sp

Fossils (Cont'd)

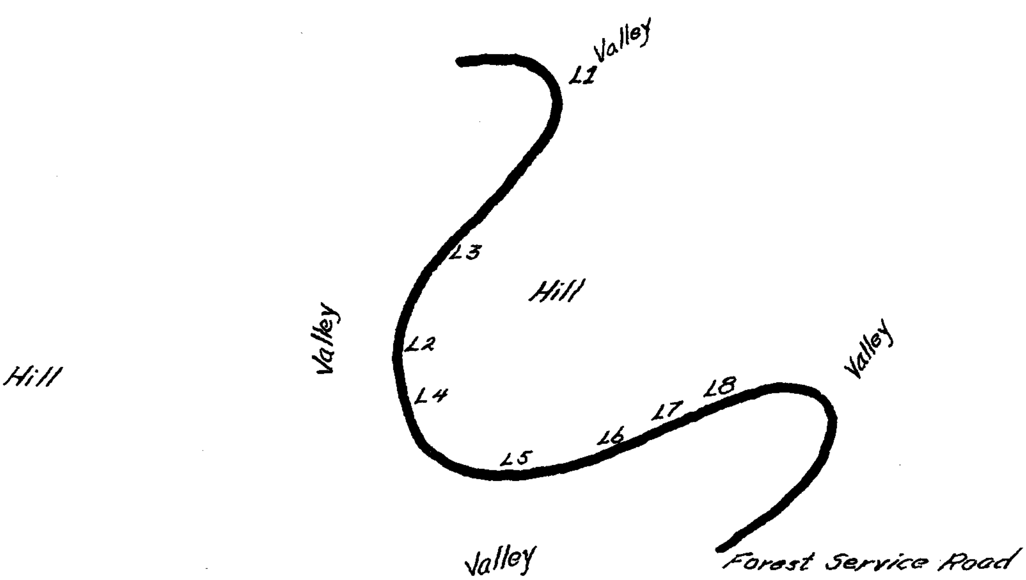
Locality #8.
Neverita, cf. N. recluziana Petit
Lunatia, sp

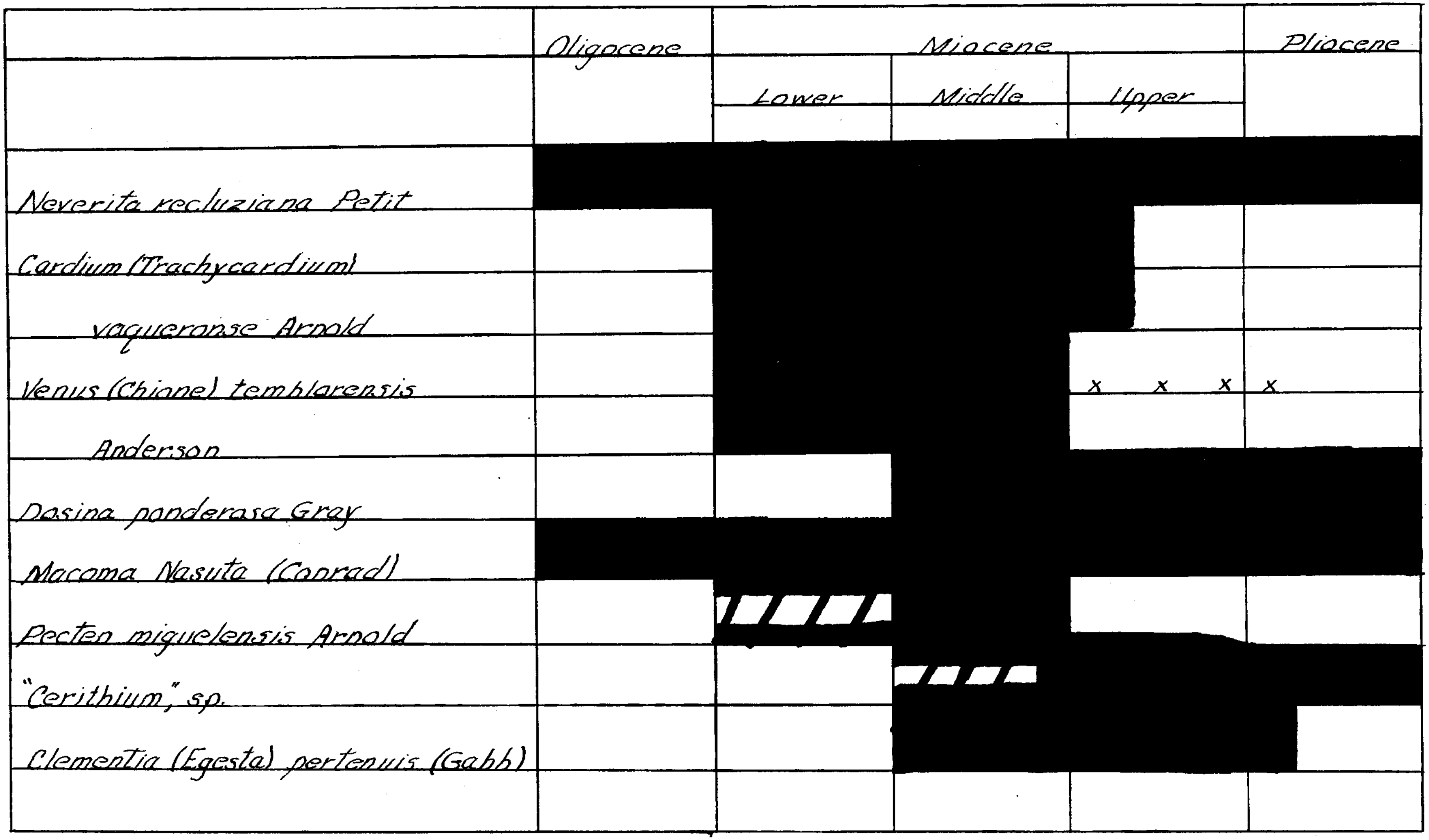
Mytilus expansus? Arnold
Nuculana, sp
Tellina, sp

Locality #9.
Lunatia? sp
Neverita recluziana Petit
Calyptraea costellata (Conrad)

"Pecten" raymondi brionianus Trask

Miscellaneous
Neverita recluciana Petit
Ostraea, sp




Oligocene
Miocene
Pliocene
Lower
Middle
Upper
Neverita recluziana Petit
Cardium (Trachycardium)
vaqueronse Arnold
Venus (Chione) temblorensis
Anderson
Dosina ponderasa Gray
Macoma Nasuta (Conrad)
Pecten miguelensis Arnold
"Cerithium" sp.
Clementia (Egesta) pertenuis (Gabb)

Geologic History

1. Sometime during the Jurassic period an unknown rock was intruded by "granite". It is assumed that this happened during the Jurassic period because that is the time of maximum intrusive activity in the California region.

2. Following a period of erosion upon this intrusive mass, the Topango beds were laid down in depositional contact with the intrusive.

3. At some later time, a time which cannot be definitely fixed, these newly deposited Topango sediments were intruded by the olivene-diabase.

4. Next, from a source of moderately low relief, or at a point a considerable distance from the shore line, the Modelo shales were deposited.

5. After an uplift of the source region, the Pico beds began to be deposited. Since the Pico beds alternate between coarse and fine sediments, it must be assumed that the source region was worn down and uplifted several times, or that the sea fluctuated back and forth across the source area.

6. Later, after some tilting and possible some erosion of the depositional basin, the Saugus beds were deposited; first from a source of moderate relief (Deposition of sandstone), then from a higher source (Deposition of conglomerate).

7. The next stage was movement on the Red Gulch Fault, which was soon followed by movement on the Sunland

Geologic History (Cont'd)

Fault; since the Red Gulch Fault is apparently cut off or displaced (Purely a guess since the author did no work in that area) by the Sunland Fault.

8. Following the movement on these faults, the old Quaternary alluvium was deposited.

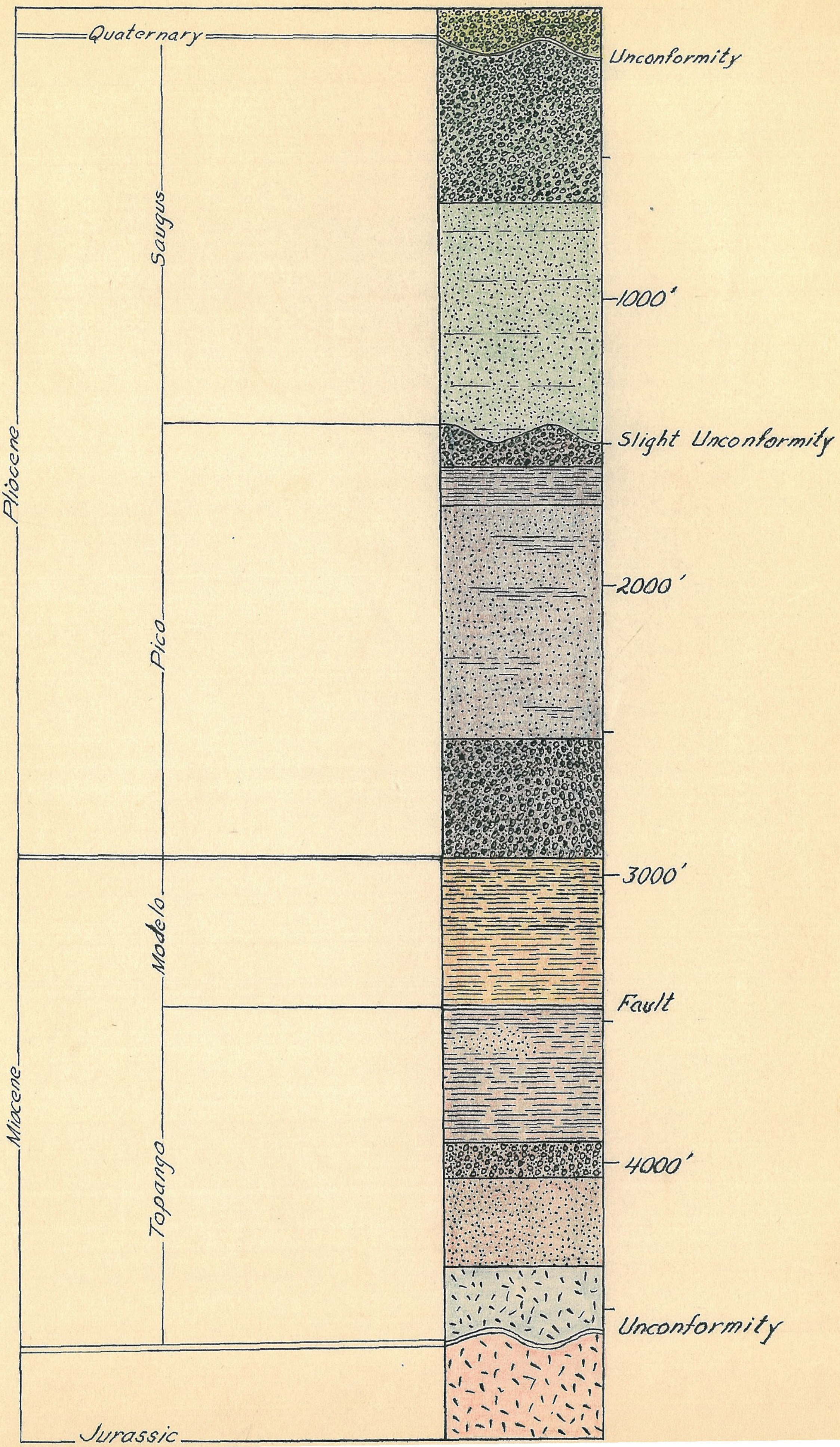
9. After an uplift, or after the removal of a dam in the Tujunga Wash, the old Quaternary alluvium was dissected and the later Quaternary alluvium was deposited.

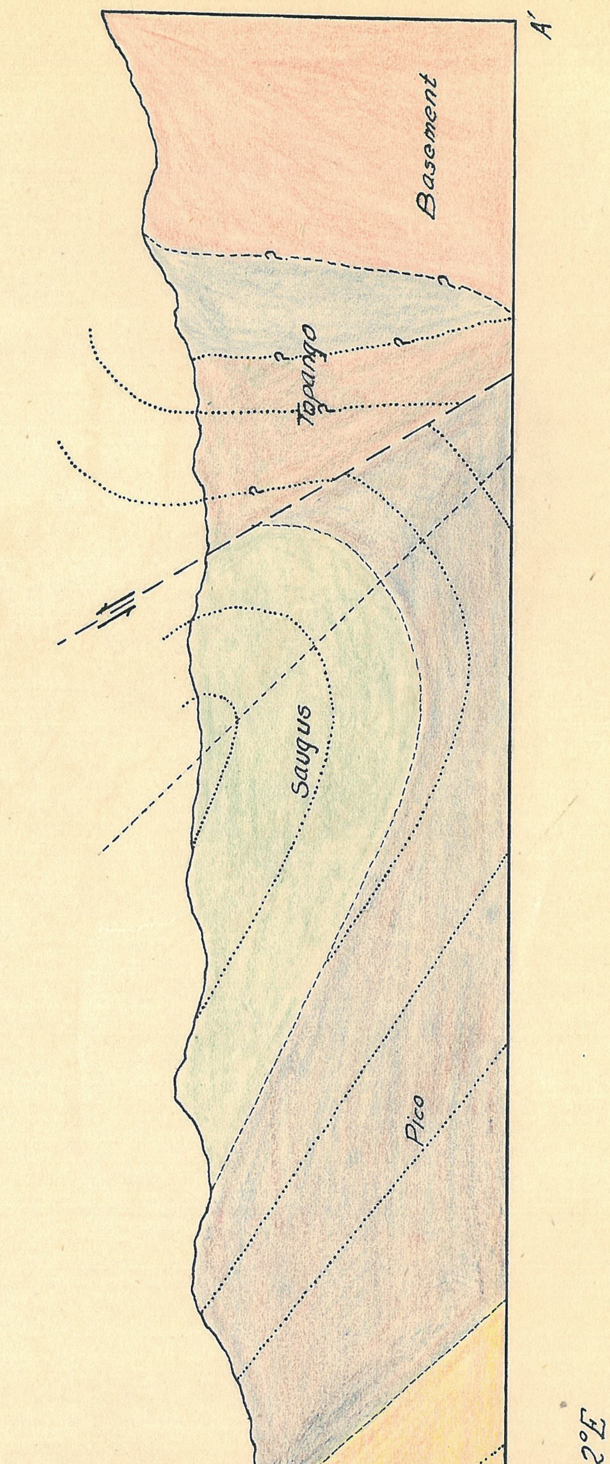
References

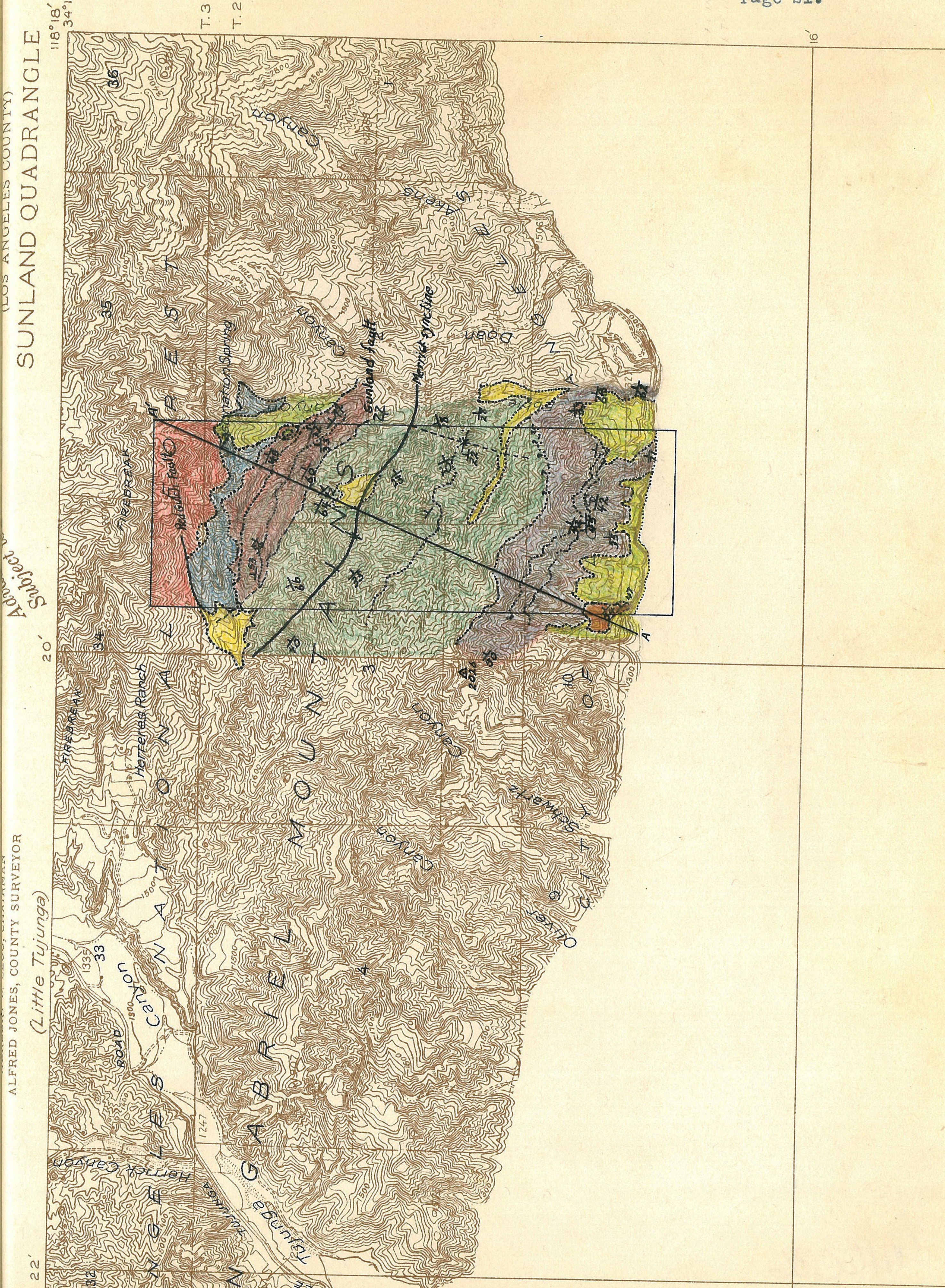
Mason Hill, "Structure of the San Gabriel Mountains North of Los Angeles, California", U. of Calif. Publications in Geology, Volume 19.

H. W. Hoots, "Geology of the Eastern Part of the Santa Monica Mountains, Los Angeles County, California", U. S. G. S. P. P. 165 C.

Grant & Gale, "Catalogue of the Marine, Pliocene and Pleistocene Mollusca of California", San Diego Society of Natural History, Memoir, Volume 1.


Quaternary
Unconformity
Saugus
1000'
Pliocene
Slight Unconformity
Pico
2000'
3000'
Modelo
Fault
Miocene
4000'
Topango
Unconformity
Jurassic


A
A'
Basement
Topanga
Saugus
Pico
Modelo
3000'
2000'
1000'
0'
N22°E


SUNLAND QUADRANGLE
(LOS ANGELES COUNTY)
ALFRED JONES, COUNTY SURVEYOR
(Little Tujunga)
118°18′
34°18′
T.3 N.
T.2 N.
SAN GABRIEL MOUNTAINS
ANGELES NATIONAL FOREST
Sunland fault
Herrera's Ranch
Firebreak
Tujunga
Canyon
A