GEOLOGY OF THE PLACERITA CANYON AREA

A Thesis

Submitted in Partial Fulfillment

of the Requirements for the Degree

of

Bachelor of Science

California Institute of Technology, Pasadena, California

by

John A. Battle

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C O N T E N T S

I L L U S T R A T I O N S

THE GEOLOGY OF THE PLACERITA CANYON AREA

INTRODUCTION

Location of Area

The Placerita Canyon Region is about seven miles west of Newhall. It lies north of Placerita and Reynier Canyons and and to the west of Sand Canyon. The bounding meridians are Lat. 34° 22' - 34° 25' N. and Long. 118° 27' W. A small section lies south of Placerita Canyon at the foot of the San Gabriels.

The Placerita Canyon Region may be reached by two routes from Newhall. It is necessary either to go through Solamint along the Santa Clara River and up Sand Canyon or directly through Placerita Canyon. The Placerita Canyon road is a rough, one way affair and is usually washed out. The Sand Canyon road is the north end of the Little Tujunga highway, and naturally is quite good. Refer to Fig. 1.

Size of Area

The area is a close approximation to a rectangle of about eleven square miles.

Purpose of Investigation

This work represents research that is required for the degree of Bachelor of Science at the California Institute of Technology.

An attempt was made to gain a more detailed knowledge of the stratigraphic and structural relations of the various rock types.

Method of Investigation

The geology was plotted on a base map by the compass and clinometer method. For this purpose a Brunton Compass was employed. The contacts were followed on foot and most locations were determined by topographic features.

Base Map

The map used in this work is a regular United States Geological Survey topographic map with a scale of one inch equalling twenty-four thousand feet and with a contour interval of twenty-five feet.

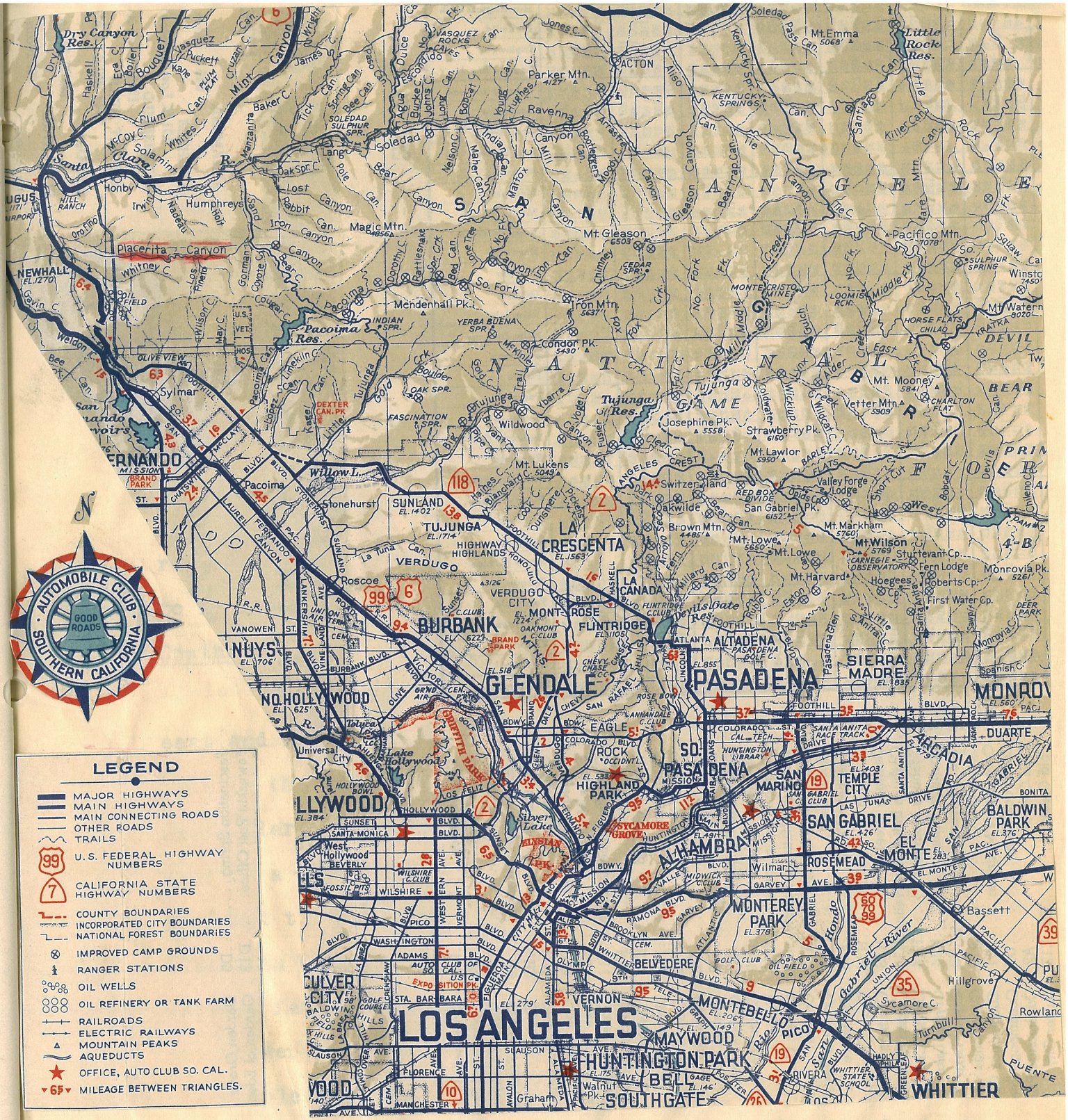
Previous Work

The most outstanding piece of work was that done by Kew[1] in his report of the Los Angeles and Ventura Counties.

Acknowledgements

A great number of thanks is owed Dr. J. H. Maxson for his advice and knowledge concerning this region.

Kew, W. S. W., Geology and Oil Resources of a Part of Los Angeles and Ventura Counties, California; U.S.G.S., Bul. 753.



CALIFORNIA

SCALE IN MILES

0 1 2 3 4 5 6 7 8 9 10

MAP SERVICE

AUTOMOBILE CLUB OF SOUTHERN CALIFORNIA

2601 SOUTH FIGUEROA STREET • LOS ANGELES

PHYSICAL CONDITIONS

Relief and Elevations

The maximum difference of elevation is from the floor of the Santa Clara Valley (1400') to a slope of the San Gabriel Mountains (2931'). This represents a difference in altitude of 1531'. However, the average elevation of the area is about 2100'.

The relief is not great. There are a number of small cliffs that are sometimes 200' in height. These cliffs result from different causes; some of these owe their origin to faulting while others are formed by selective erosion.

Drainage

As a whole the major structures of the region trend east and west. Naturally, the drainage runs north and south. This is the case with Sand Canyon. Sand Canyon flows into the Santa Clara river which flows toward the west. Placerita Canyon lies in a depression near the contact between the basement complex and the tertiary sediments and runs east and west. Placerita Canyon seems in part to be controlled by the San Gabriel fault, even though it crosses the fault at an angle of about twenty degrees. The drainage pattern of this area is not simple as it is controlled by the formation as well as the structure. The topographic map brings out the major drainage pattern and it can be seen that these factors play about equally in the shaping of the land forms.

The effect of rock types on the physiography

In the Mint Canyon formation this may be seen very

well developed. The Mint Canyon in the southwestern most valley seems to be composed mostly of mud. This formation is lapped over on the south by the Saugus and on the north by the relatively resistant Modelo. The mean average rainfall at Newhall is 17.05. This rain occurs from November to March. Thus it can be seen that there are apt to be heavy downpours. The mud of the Mint Canyon is very poorly consolidated and being porous absorbs to a considerable extent the rain. This mud becomes plastic and flows. Thus there is developed within certain sections of the area landslide topography. There are in this section of the area fifteen or twenty of these small slumps. In the north eastern section resistant beds form the tops of ridges. (Fig. 2)

Vegetation

A great part of the country is covered with a heavy undergrowth which makes field work difficult as well as uncomfortable.

The basement complex weathers into a coarse rocky soil consequently it supports a heavy brush growth.

The Mint Canyon is composed of several rock types and as a result its vegetation varies considerably. On the shaley and silty areas grass is found. The conglomerates and coarse sandstone are usually covered with a heavy brush growth.

The Modelo Formation in this area is composed of alternating bands of sandstone and shale. In places where the shale is of considerable thickness grass is abundant and where sandstone is predominate brush occurs in varying intensity.

The Pico varies much the same as the Modelo except that in the northern section low bushes and grass occur on shaley soil while in the southern section conglomerates predominate.

The Saugus soils are sandy with a heavy growth of chaparral.

Various wild flowers, oak trees and typical desert plants occur throughout the entire region.

Practically the vegetation offers little or no assistance in mapping the contacts, as the soils change within the various formations. However, the vegetation of the Saugus is bold and high and has offered valuable assistance in mapping the Saugus contacts.

Culture

The country primarily is a cattle region. There are several small farms. Wheat is raised on some of the alluviated areas.

Economic Resources

The ash beds found in the Mint Canyon are at the present moment being mined. The ash is treated and heated to a high temperature. The ash becomes vitrophied and is used as a roofing material. The reserves of this ash seem considerable, however, most of the ash in the assessable region has been mined about as far as possible by the open pit method. As this bed is dipping to the northwest it will be necessary to mine down dip and it is questionable whether or not the extra expense of mining will warrant the extradition and continuing of operation

at this locality.

Oil occurs in the metamorphic rocks of the basement complex. Drilling is being carried on at the present moment on small scale operations. At a depth of two hundred fifty feet æsome jars of a light gravity, almost water white oil was was obtained. It is possible that the oil seeped up through the tertiary sediments along the San Gabriel fault and filtered into the schists along fracture planes or joints. (See Fig. 3)

Analysis of Oil[1]

A.P.I. gravity	37.7
Flash (closed Tag)	73
Color Saybolt	5
Sulphur	0.10
Aromatics	52.5 by weight
Refractive index at 20 C	1.4659
Absorption in sulphuric acid	3 per cent

Characteristics Chemically

1. High percentage of Aromatics
2. Low percentage of unsaturated hydrocarbons
3. Absence of heavy hydrocarbons

Gold occurs as a placer deposit in Placerita Canyon but will not warrant commercial development as the deposits of alluvium are not large enough. When there is sufficient water it is possible to obtain several dollars a day by panning.

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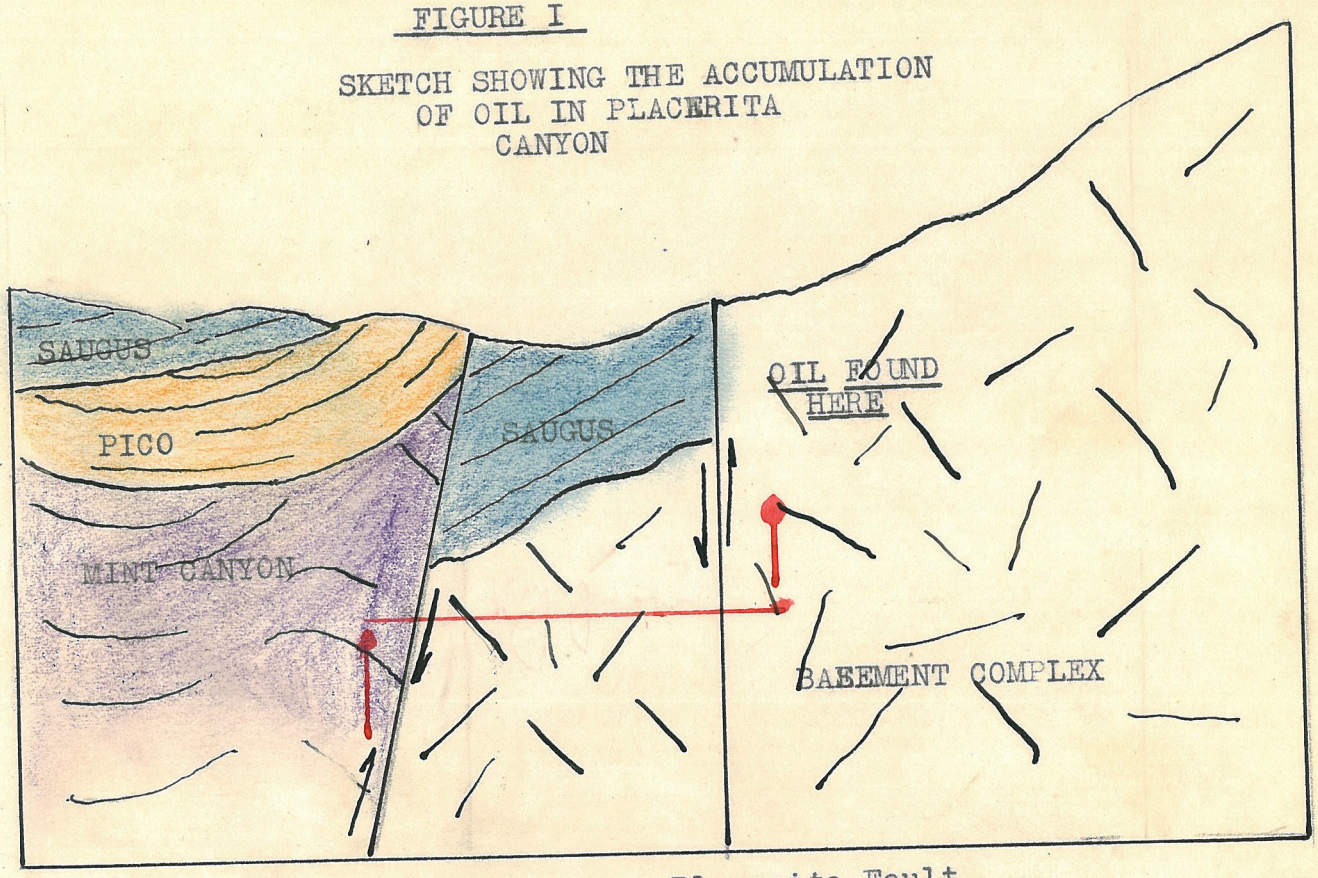
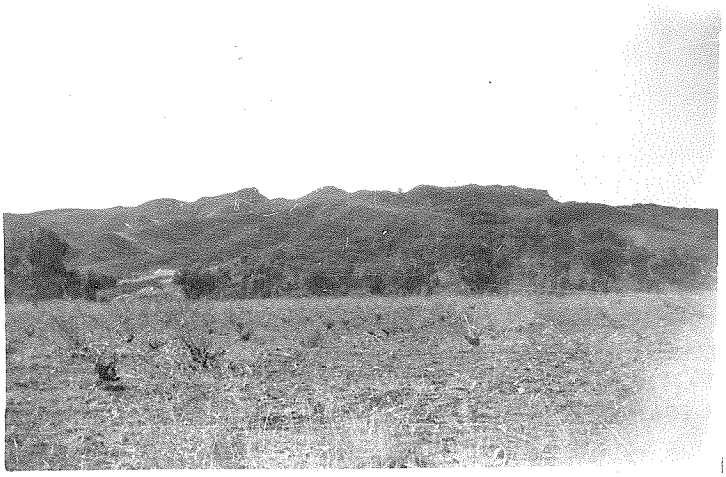
1. Analysis performed by G. J. Ziser

FIGURE I

SKETCH SHOWING THE ACCUMULATION
OF OIL IN PLACERITA
CANYON



In the Placerita Canyon Area the oil seeps from sediments pre-Mint Canyon in age. This migrating oil probably follows the break caused by the San Gabriel Fault till it reaches a zone sufficiently brecciated to allow accumulation in the metamorphics that are on the south side of the San Gabriel Fault. During this process the heavier ingredients may have been filtered out; thus accounting for the lightness of this oil.



VIEW OF THE PLACERITA CANYON
AREA FROM SAND CANYON

PLACERITA AREA FROM THE
SAN GABRIELS

SUMMARY

The Placerita Canyon Area is composed in the main of tertiary sediments bounded on the south by a great fault block. This fault block is composed of schists and granitic rock types. The sediments are folded into a series of gentle synclines and anticlines and are faulted to some extent. These sediments are marine and non-marine in origin.

S T R A T R I G R A P H Y

Basement Complex

This formation is found at thesouth end of the area and is bounded on the north by the San Gabriel and Placerita Falls. The basement complex is composed of schists of a varied composition which have been intruded by a granadiorite or diorite. No attempt was made to determine the relation between these two rock types. However, it is interesting to note that the basement complicated being folded and faulted to a high degree.

The metamorphic rock of the region are sedimentary in origin and are related to the Peloma schist. The plane of schistosity averages 50° north with a strike of north 70° west next the Placerita Falls. Some limestone that has been highly metamorphorized and carrying a garnet are found in this formation. The granitic masses which intrude the sediment are of Jurassic age[1] Thus, the metamorphic rocks are pre-Jurassic. Research of these has shown them to be probably pre-Cambian. In some localities the granite material has been highly weathered. The oil seeping up on the north side of the San Gabriel has been allowed to accumulate in these pockets formed in the granite. It is in some of these decomposed spots that wells have been drilled. However, the production from such wells is small although drilling is carried on at the present moment.

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1. Kew, W. S. W., Geology and Oil Resources of a Part of Los Angeles and Ventura Counties, Calif; U.S.G.S., Bul. 753.

Mint Canyon

The oldest sedimentary formation shown on the map is Mint Canyon. It consists in the main of non-marine sands, gravels, and clays of upper miocene age.[1] The Mint Canyon is known to lie under beds which contain fossils of Santa Margarita age (upper Miocene). This formation also contains a vertebrate fauna, of which only fragments were found in the Placerita Canyon area. These vertebrates indicate the middle part of upper Miocene.[2]

Nowhere in the area is the base of the Mint Canyon exposed. Thus the thickness of the Mint Canyon must be at least 2000'.

According to the rock types and the vertebrate fauna found within this formation the Mint Canyon must be a lake deposit. This lake was probably a very large playa lake.

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1. W. S. W. Kew, "Geology and Oil Resources of a Part of Los Angeles Basin and Ventura Counties, Calif., U. S. Geol. Survey Bul. 753 (1924) pp. 52-55

2. J. H. Maxson "A Tertiary Mammalian Fauna from the Mint Canyon Formation of Southern California," Carnegie Institution of Washington Pub (August 1930) pp. 77-112.

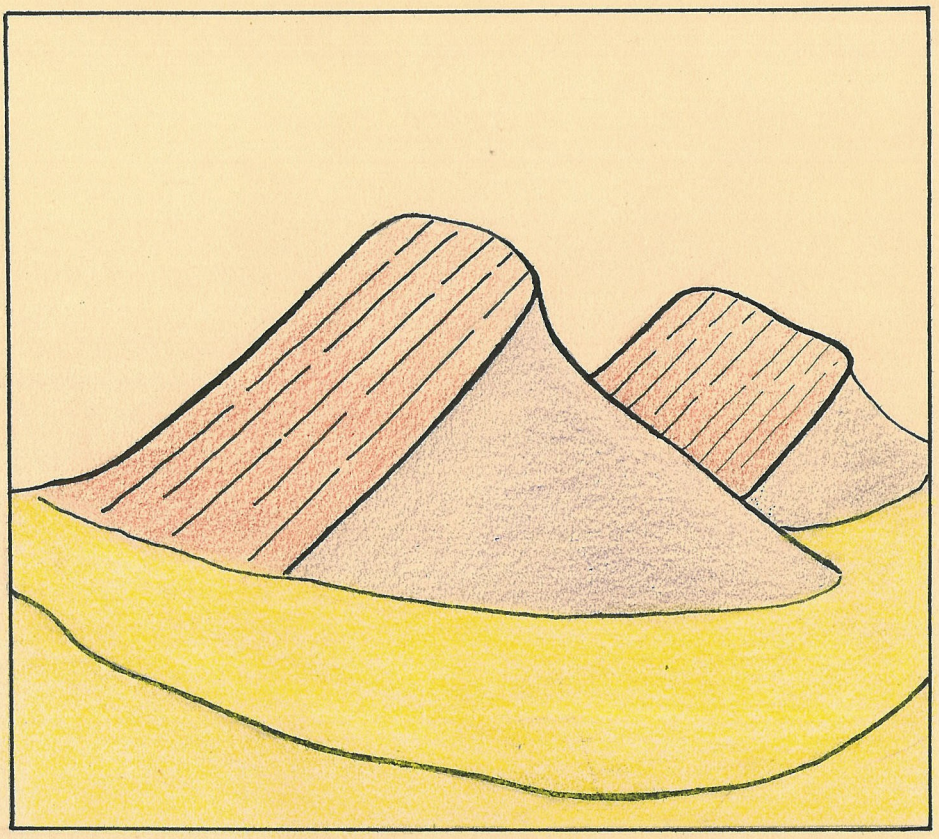
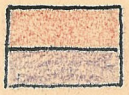


FIG. II

— Mint Canyon —

Topography controlled by resistant sandstone member

Mint C.  Alluvium 

Lower Mint Canyon

The lower Mint Canyon is exposed in the northern section along the Santa Clara River. This formation is composed mostly of a coarse conglomerate loosely consolidated interbedded with sandstone. The sandstones are or are not consolidated. These sandstones sometimes grade into mud or a gray clay. This all indicates changing conditions during deposition. The boulders in the conglomerate are composed of all rock types. Lavas, granites, diorites, aplites are not uncommon. The consolidated conglomerates are usually well-rounded boulders and iron stained, and they are very similar to the consolidated conglomerates in the Pico.

There is no outstanding distinction between the upper and lower Mint Canyon except for the conglomerates, which in the upper Mint Canyon are composed mostly of boulders about a foot in diameter and light in color. Also the upper Mint Canyon is composed mostly of a light gray dried out mud. (This mud seems to swell when wet making it treacherous to walk upon.)

The Mint Canyon contains ash beds. These are beds of volcanic ash that have been deposited by water. This is indicated by the remains of plants that have been found in them. The wood preserved in them in some cases has not been replaced. The ash seems to have been silicified to some degree. There are, as well as can be told in the time allotted for this work, five distinct sets of ash beds. It was possible to follow outcrops of the ash beds along and to plot the trace of the beds. I could find no set rule for the occurrence of these beds but they seem to be above the coarse multi-colored conglomerates of the lower Mint Canyon.

The ash bed near Sand Canyon which is being mined at the present time is older than the horse found by Dr. J. H. Maxson.

Through information obtained from John Griffiths it was learned that the beds to the east of Sand Canyon have about the same general attitude as the ash bed and that there is no apparent change of structure to the fossil locality.

The bed was projected into the area east of Sand Canyon and the thickness of the Mint Canyon measured between the projection and the fossil locality. The thickness of the Mint Canyon between these two points is therefore 2000'. So it can be concluded that the ash beds are older and that two thousand feet of Mint Canyon deposited before the horse found by Dr. J. H. Maxson was buried.

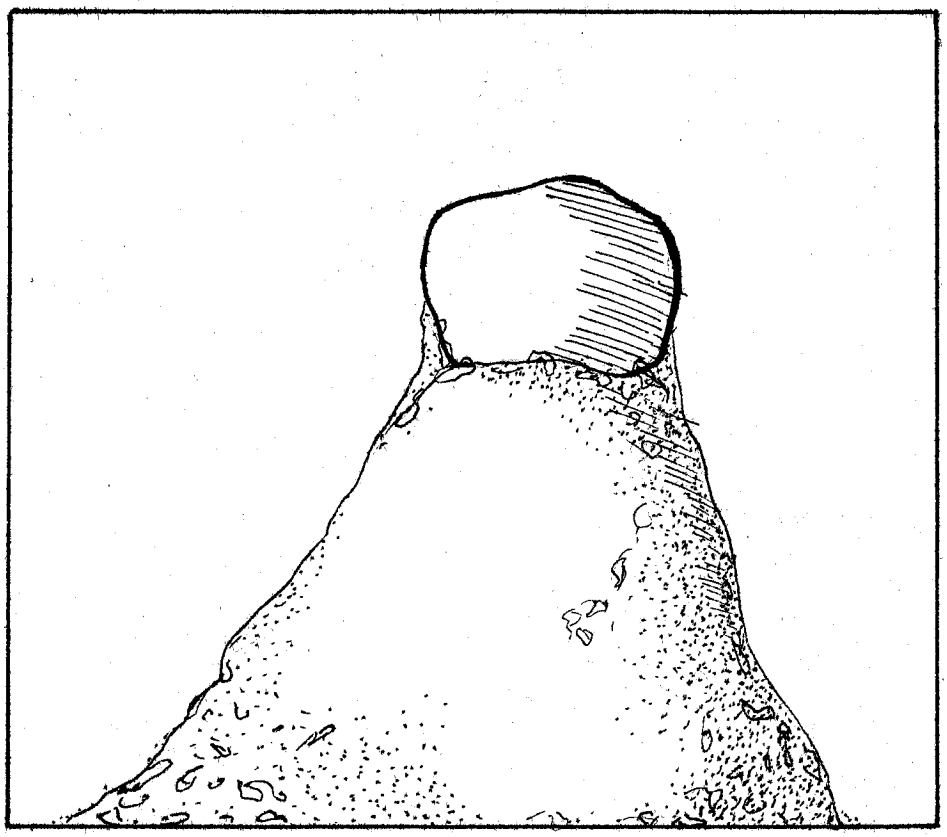


FIG. III

Erosion
Controlled by compaction of silt, due to weight of pebble
Typical of Mint Canyon

Modelo

There is an angular unconformity between the Modelo and the Mint Canyon. This unconformity in some places reaches as high as twenty degrees.

The contact between the two formations is not always clearly defined so where the actual unconformity could not be seen contact was taken at the change of dip or difference in topographic expression.

The Modelo is considered to be upper Miocene in age as fossils were found in this formation of this age of marine origin.[1] They were for the most part pelecopods. A fish related to the herring family was found in this formation. The determination of this fish has not yet been made.

For the most part the Modelo consists of sandstones and shales with minor amounts of conglomerate. The shales vary in their lithology. They are coarse grained and grade from one texture into another. These shales contain forams but no work was done with them.

The Modelo is more resistant than the Mint Canyon and thus stands up in a bold cliff, and as the Modelo beds are not stained to any great degree the structure can at some places be clearly seen.

The Modelo occurs in the central section of the area. As it is not found underlying the Pico at the southwest corner it is assumed that part of the area was not covered by the Modelo sea, or the Modelo has been eroded off before the

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1 T. W. Mor[illegible]

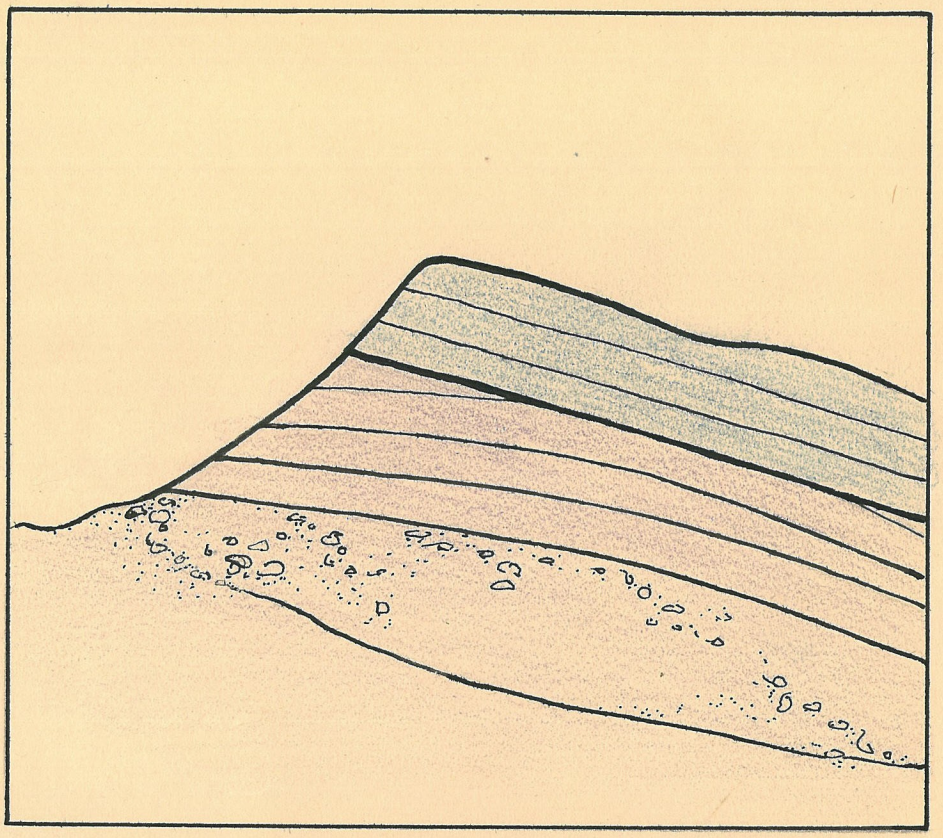

FIG. IV

Contact— between Mint Canyon and Pico

Mint C. ▭ Pico ▭

deposition of the Pico. The thickness of the Modelo Formation is about 1400'.

The Pico

The Pico overlies the Modelo in the southern part and the Mint Canyon in the northern section of the area. The base of the Pico is a white more or less consolidated conglomerate. The conglomerate is in some places quite consolidated, in others fairly soft. Toward the northwestern part of the Pico there was found a whale rib in this white conglomerate which at that point is more of a sandstone. Below this bed in the Mint Canyon were found some bone fragments. Thus this bottom of the white conglomerate when exposed is taken as the contact between the Pico and the Mint Canyon. The same bed lies uncomformably over the Modelo at one point.

The Pico is extremely fossiliferous. Marine invertebrates are found in great quantities. Gastropods and pelecopods seem to predominate.

Lithologically the Pico seems to grade from coarse well consolidated conglomerates to fine shales. This graduation seems to take place from the south to the north. This change indicates that the water during Pico time was getting deeper toward Santa Clara Valley. The San Gabriels probably formed a natural shore for the ocean at that time.

The conglomerates have been stained with iron toward the San Gabriels becoming less so as one proceeds toward the Santa Clara Valley. These beds are consolidated

but not extremely so. They can easily be broken up with the pick. The conglomerates of this group are very similar to those of the Mint Canyon, but the dip is usually not so steep.

The shale and silt stone of this group is highly gypsiferous and very soft. In this soft material are found beds of sandstone that are well consolidated. These sandstone members seem to be silicified.

The southern most exposure of Pico has been correlated with the Pico of Elsmere Canyon and is considered to upper Pliocene[1].

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1 W.S.W. Kew

Saugus:

The Saugus is a non-marine formation of Upper Pliocene or Pliestocene age. It consists mainly of non-consolidated sands, gravels, and conglomerates. There are though within this formation well consolidated beds of conglomerate which closely resemble the typical Pico even though they tend to be more highly colored. The Saugus is difficult to differentiate from the lower Mint Canyon. The Mint Canyon has however more outcrops than the Saugus.

The Saugus can be divided into two divisions -- the upper and the lower. The Upper Saugus is light colored sands interbedded with brilliant colored conglomerates. The Lower Saugus is gray with well consolidated breccia (composed of small gravel particles).

Boulders of Ilmenite are characteristic of this formation. Quartz and feldspar rocks are abundant.

The Saugus occurs at three places in the area. There are two patches in the south western section and a section in the central part.

There were found no fossils in the Saugus.

Terraces

Bounding the fault through the central part of the area are a few small terraces. These were not mappable units, and as they bore no relation to the structure were not mapped. These are composed of stones derived from the older formations.

Quaternary Alluvium

This is composed of rocks derived from older

formations and are deposited recently by the present drainage system. These deposits contain illmenite and magnetite sands. Gold is sometimes present in these deposits.

SYSTEM	SERIES	FORMATION	SYMBOL	COLUMNAR SECTION	THICKNESS IN FEET	CHARACTER & DISTRIBUTION
Quaternary	Recent	Alluvium	Qal		40' ±	Alluvial Material.
	Pleistocene	Saugus	S_t		350' ±	Unconsolidated Sands and Gravels. Some Conglomerate. (non-marine)
Tertiary	Pliocene	Pico	P_t		350' ±	Conglomerates and Gypsiferous Shales. (Marine)
	Upper Miocene	Modelo	M_t		1400' ±	Shales and Sandstones. (Marine)
	Middle Miocene —	Mint Canyon	M_{ct}		2000' ±	Silts, Conglomerates, and Sandstones. (Non-Marine)
	Jurassic —	Basement Complex	Bc		?	Undifferentiated Shists and Granites.

GEOLOGICAL COLUMN

STRUCTURE

Faulting

In the Placerita Canyon Area are three major faults. They run roughly parallel. The names of these are the San Gabriel, the Placerita and the Central Faults.

The San Gabriel Fault

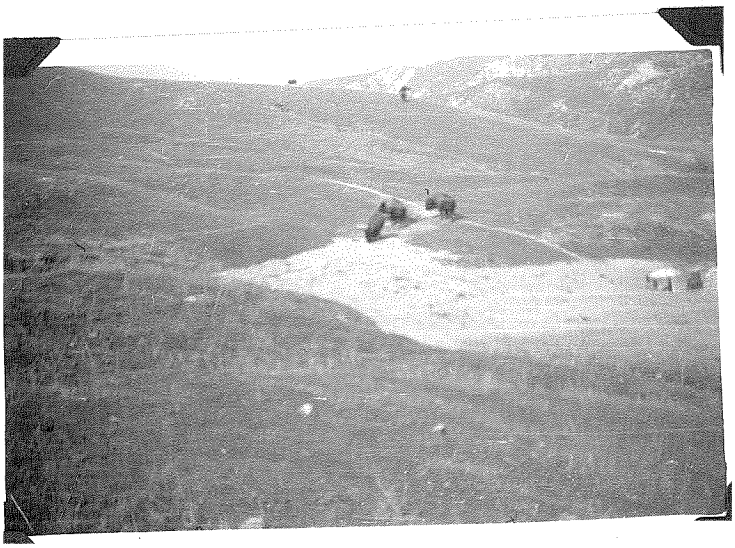
This is the major fracture of the region. It is along this break that the San Gabriel Mountains were uplifted. It is possible by means of Aeroplane Photographs to follow this fault for miles.

In the vicinity of the Placerita Canyon this fault is practically vertical, striking about N. 75° West. The Gouge zone is in some places thirty to forty feet wide containing a whitish gray gouge.

The movement uplifting must have occurred before the deposition of the Mint Canyon, as there is found upon the San Gabriels no remnants of the late tertiary formations. There is relatively little deformation of the beds. This also indicates that the movement on this fault was probably predeposition of these sediments. Therefore, the vertical displacement must have been at least 3500'. The displacement may have been considerably more than that as the fault is probably pre-tertiary, thus it would be the thickness of the buried sediments plus the thickness of the exposed formations.

In post-Saugus time there occurred a reversal of movement on this fracture. This in conjunction with the Placerita has down dropped a section of Saugus. The reversal

THE MINT CANYON IS REPRESENTED BY THE MEADOW. THE MODELO AND PICO ARE IN THE BACKGROUND



TYPICAL OF THE MINT CANYON-NOTICE THE SLUMPING DUE TO THE INCOMPETANCY OF THE BEDS.

of movement was about four hundred feet vertical, because the Saugus is dropped down in contact with the upper Pico. A fault scarp is present due to this recent movement. The scarp stands out as a bold cliff in the Pico.

The Placerita Fault

This fault can be dated as post-Saugus as the Saugus formation seems to be affected by the movement on this break.

The fracture is not a single break but seems to be a zone of three or more breaks. An attitude on one of the fault surfaces is S80°E -- 75°N.

The Gouge zone varies in thickness from ten feet to twenty-five and is well oxidized by iron stains. This break must be active as all of the fractures are not completely closed. Some very fine pebbles that had been polished by friction were found in this zone.

The Placerita fault brings the recently deposited Saugus down in contact with the Basement Complex. The displacement along this break is primarily vertical as the fault grooves are vertical and probably approaches the recent movement along the San Gabriel fault in magnitude. Thus the displacement is about four hundred feet.

The Central Fault

This is a unique feature. Its age is probably lower Pliocene. It is post-Modelo and pre-Pico. The evidence for this feature is the faulting out of the Modelo and a gouge zone that could be traced for a short distance.

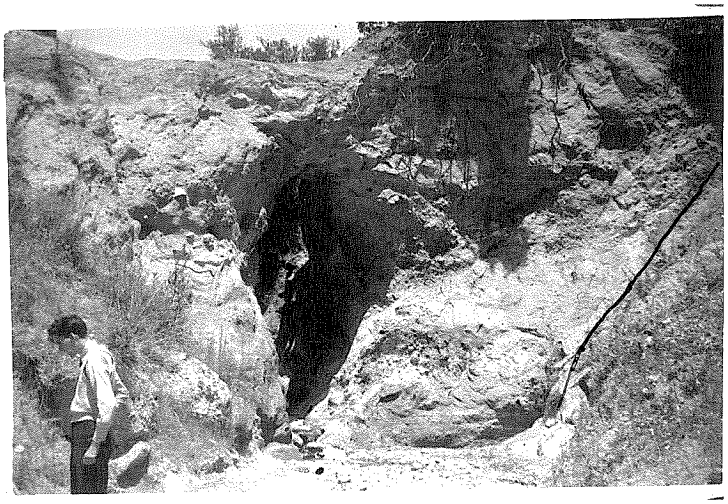
The displacement must have been equivalent to the thickness of the Modelo which is about seven hundred feet. There was no place found where one could obtain an attitude of this feature, but it was a high angle fault, as the beds are not highly disturbed by the movement as would be expected in thrust faulting. There is toward the Western extremity of this feature considerable disturbance of the beds; probable overturning of them. However, it would be necessary to work further to the west to determine the actual relations.

Minor Faulting

The region is full of minor breaks and fractures. These features could only be traced for a few feet, and as they were not important structurally were not mapped. These small breaks run roughly east and west and are usually high angle thrusts.

Faulting in the Basement Complex.

No determination of structure was done within this group but it is interesting to note that this great mass is full of faults and folds. This uplifted body is very complicated in structure and would make a very interesting problem.



NATURAL BRIDGE -- NOTICE SMALL THRUST
FAULT TO THE RIGHT

Folding

Due to compressional forces from the north and south there has developed a series of folds. These folds have been developed in the sediments and have a general east-west trend. There are a few minor ones that tend differently but are of no importance. These can best be seen on the map.

The fact that there are a number of small thrusts running east-west in the area with the north side the over-riding member indicates additional evidence of the north south compressional forces.

As the older members seem to be more compressed than the overlying members the forces have probably been acting for quite a period. Thus they were probably active during the actual deposition of the sediment. The folds are gentle and are not greatly deformed.

Historical Geology:

Pelona Schists

These sediments are the oldest in the region. They are either pre-cambrain or paleozoic in age. They are considered as a general rule to be pre-cambrain. These sediments were deposited probably in a great basin covering several thousand square miles. Then due to great internal stresses and strains folding took place on a large scale being aided by a great intrusion of granitic character.

After this revolutionary event faulting took place, the San Gabriels were upraised, thus the San Gabriel Fault became active, forming the northern boundary of the San Gabriel Range. As the granitic intrusion is considered to be Jurrasic, therefore, all other sediments found in this region must be either Cretaceous or younger.

Sediments

When the uplift of this granitic mass was completed or in progress there must have been periods of deposition and erosion. It is known from oil well cores that eocene sediments underlie the miocene beds exposed in this area.

The oldest formation exposed is middle miocene (Mint Canyon). These beds were formed in a playa lake. As they are tremendously thick this lake must have occupied a vast area.

The Modelo is upper miocene and represents the next of a series of sediments. It is of marine origin, so there must have been a considerable lapse of time and change

of conditions in the deposition of the two members. During the hiatus there was considerable folding of the Mint Canyon on a large not, however, intense scale, forming gentle hills and valleys. It is on this surface that the Modelo is deposited.

After the deposition of the Modelo the ocean retreated, giving rise to a vast period of erosion and folding. During this period there developed one of the major faults. This fault lies half way between Placerita Canyon and Santa Clara Valley. The north side is the upthrow block. The displacement in connection with erosion brings the Modelo in contact with the Mint Canyon.

It is interesting to note that some of the area stood as hills above the Modelo sea.

After continued folding on a minor scale the ocean encroached again covering all of the area and lapping against the San Gabriel Mountains. The result of this sea is the Pico of upper Pliocene.

At the end of upper Pliocene time the sea retreated leaving deposited over many square miles the Pico conglomerate, sandstone and shale. When the ocean had or during its retreat there was formed by mountain making forces a great basin in which all of the debris from the surrounding and mountains (i.e. San Gabriels) poured. This material consolidated and unconsolidated is known as the Saugus Formation. Naturally, it lies unconformably over the upper pliocene sediment.

Folding and faulting took place at the end of this period and erosion has carved and dissected the country to

to its present condition.

—LEGEND—

Quaternary Alluvium — Recent — Qal

Unconformity

Saugus — Pleistocene — S_t

Pico

Unconformity

Modelo — Pliocene — P_t

Unconformity

Mint Canyon — Upper Miocene — m_t

Unconformity

Volcanic Ash (Mint C.) — Middle Miocene — m_{ct}

Unconformity

Basement Complex — Jurassic or Older — B_c

Fault

Contact

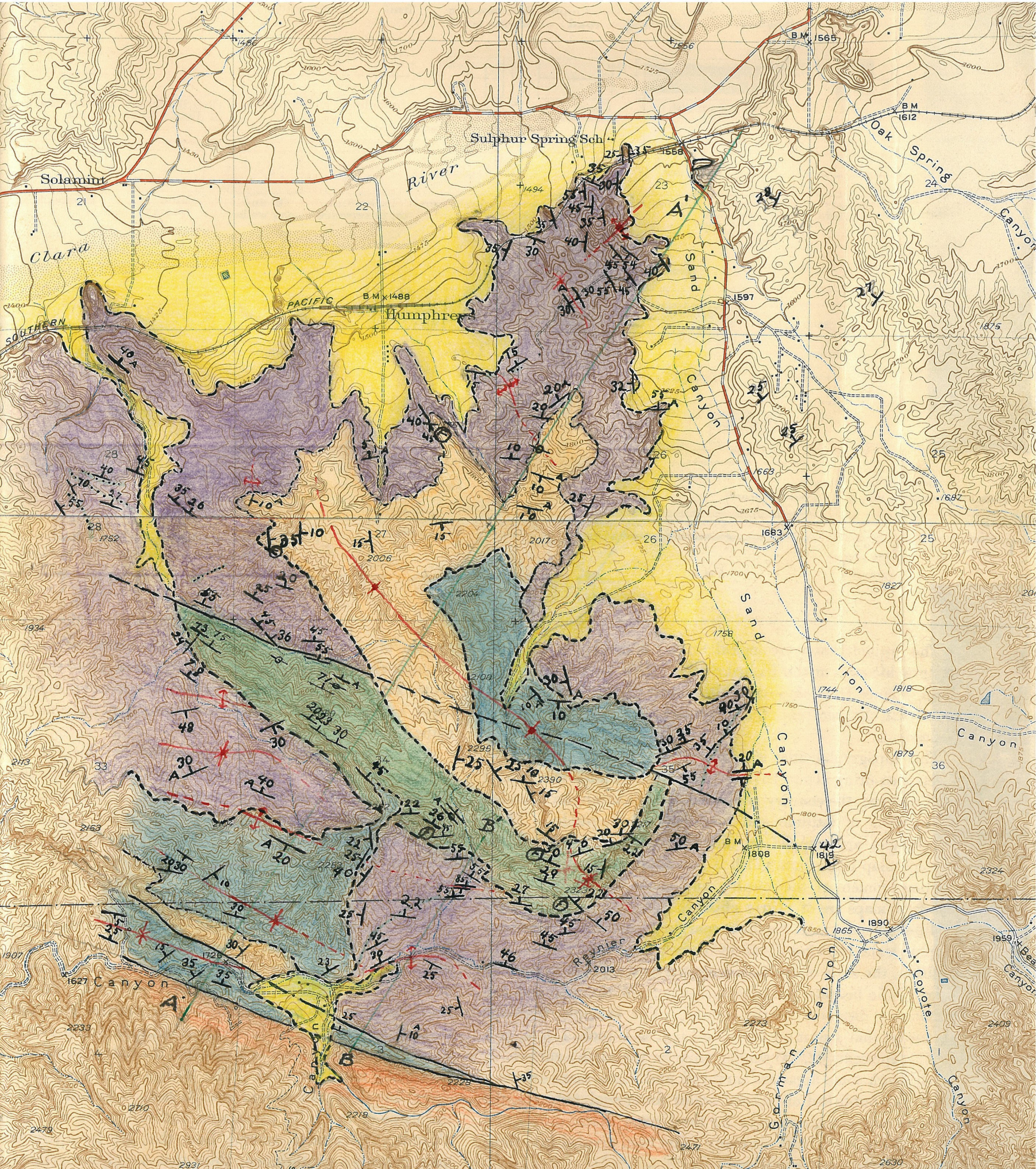
Axis of Anticline

Axis of Syncline

Dip and Strike — 35

Fossil Locality — F

Structure Section


Sulphur Spring Sch.
Solamint
Clara River
PACIFIC SOUTHERN
B.M. 1488
Humphreys
B.M. 1565
B.M. 1612
Oak Spring Canyon
Sand Canyon
Iron Canyon
Reynier Canyon
Coyote Canyon
German Canyon
B.M. 1808
1627 Canyon
A
A'
B
B'
C
C'
D
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