THE GEOLOGY OF THE EASTERN PART OF THE VENTURA QUADRANGLE, CALIFORNIA

BY

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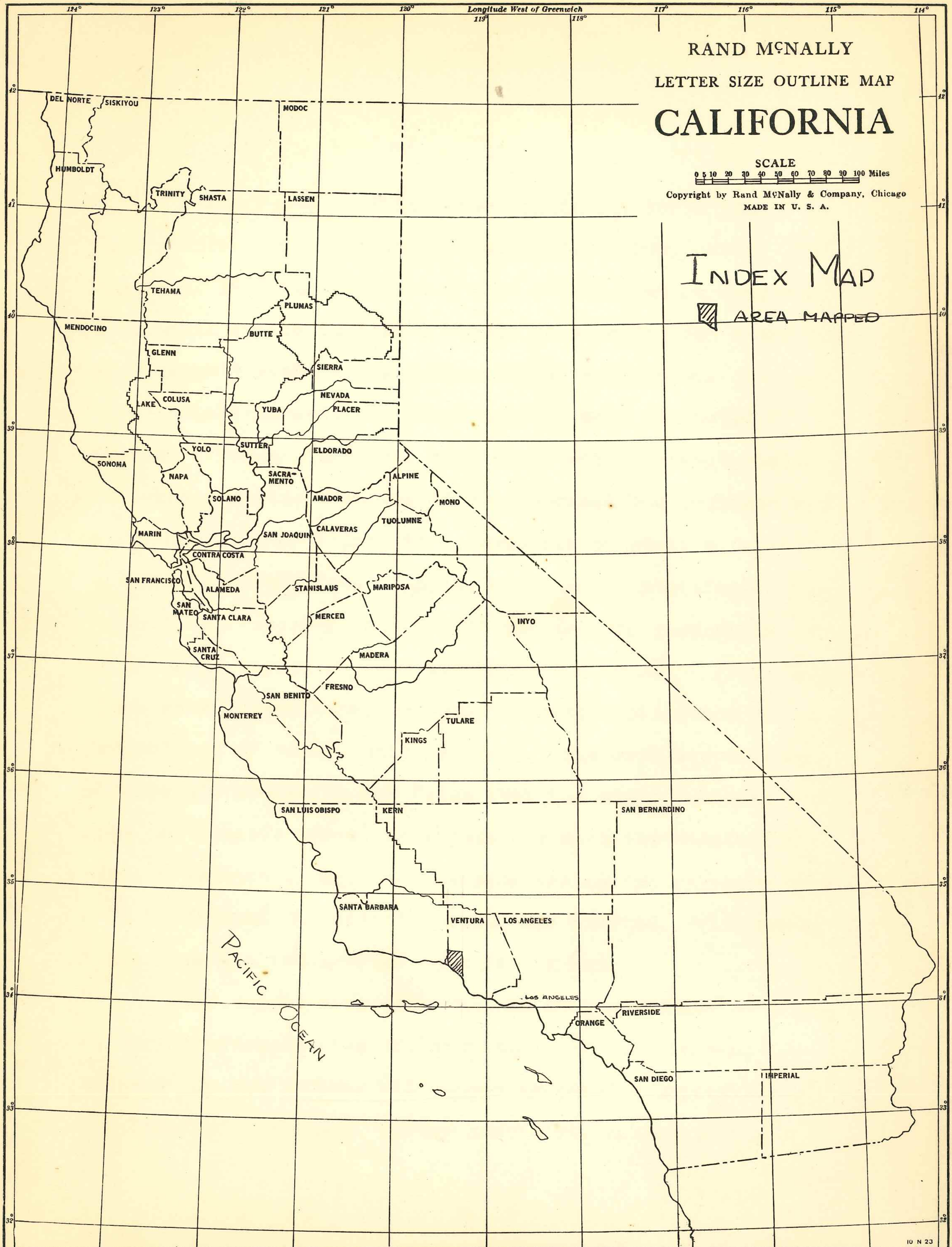
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INTRODUCTION

The purpose of this report is to set forth the data gathered by the Stanford Geological Survey during the summer of 1937 in the eastern part of the Ventura quadrangle, California and to fulfill a thesis requirement for a Bachelor of Science degree at the University Of Washington.

Field investigation and mapping were conducted by two and three-man parties, each party doing several small unit areas during the time of the course. The geologic map published in this report is a composite of small maps made by individual parties. Mapping was done by plotting on the U. S. G. S. topographic sheet of the Ventura quadrangle and on airplane photos for the area near the coast. Field locations were accomplished by Brunton Compass resection and by recognition of topographic features. The work was started by several reconnaissance trips over the area; followed by pace and compass traverses across the most representative exposed sections. With the reconnaissance and traverse work as a background the actual mapping was started. Five weeks field time was required to compile the map.

Many papers have been written on the geology of the Ventura quadrangle (See Bibliography) and much information gathered by the various oil companies remains unpublished. The Stanford Geological Survey previously worked in the

Ventura quadrangle during the summer of the following years: 1912, 1927, 1929 and 1930.

ACKNOWLEDGMENTS

Throughout the field season the guidance and constructive criticism of the instructors: J. D. Barksdale, W. C. Smith and W. C. Putnam made possible the compilation of data for this report. John C. Scales and John S. Shelton, field partners of the writer, made every effort to make the summer's work a success. To the Rancho Casitas for permission to camp on its property. To the Consolidated, Shell and Associated Oil Companies for permission to trespass on private roads and oil properties. To the Ranchos Matilija and Chismahou for permission to trespass in their property. To Mr. Kit Carson of the Associated Oil Company for his time and effort in identifying numerous fossils.

Geography

The area discussed in this report lies in the western half of the Transverse Coast Ranges, between the crest of the Santa Ynez Range and the Pacific Ocean. The area constitutes the eastern two-thirds of the Ventura quadrangle and lies between 34° 15' and 34° 30' latitude and 119° 23' longitude. It is approximately one hundred square miles in area. (See index map) Ventura (population 11600, 1930 census)) is the only important town in the quadrangle being located in the S.E. corner, on the coast.

The principal industries of the Ventura district are;oil production, along a belt paralleling and a few miles back from the coast; citrus fruits, soft fruits (principally apricots) and nuts in the Ventura River and Ojai valleys. Beans are grown in some of the higher hill slopes. Stock raising is important in the Ojai Valley and some of the lower foothills of the Santa Ynez Mountains.

The main line of the Southern Pacific Railroad and the coast highway #101 both cross the quadrangle along its coast margin. The interior of the area is well provided with secondary roads, oil company roads, CCC roads, forest roads and numerous fire trails and breaks making most of the area readily accessible.

Climate, Vegetation and Drainage.

This part of California has a semi-arid-temperate climate; the spring and summers are dry and hot with early morning fogs close to the coast and cool nights. During fall and winter the days are warm and the nights are cool. Most of the rain falls during the months from November to March. Annual rainfall varies from 6 to 20 inches and the yearly

COLUMNAR SECTION

SYSTEM	SERIES	FORMATION	SYMBOL	THICKNESS	LITHOLOGY	DESCRIPTION
QUATERNARY	RECENT	ALLUVIUM	Qal	85±		Unconsolidated, well rounded sands and gravels of local origin. Sandstone cobbles predominate. Valley fill, alluvial fans, and beach deposits.
	PLEISTOCENE	BENCH GRAVELS	Qbg	200±		Poorly sorted, poorly consolidated, well rounded sands and gravels crudely cross bedded. Predominantly sandstone cobbles; contains also cherts, quartzites and occasional igneous elements.
		SAUGUS	Qsg	4000+		Series of alternating sandstones, siltstones, and conglomerates and interbedded thin shaly sandstones. Sandstones white to yellow, poorly sorted and interbedded with conglomerates composed of small gravel to cobbles 18 inches in diameter. Boulders sub-rounded and contain: white and yellow sandstone, rhyolite, chert, quartzite, granite, glaucophane schist and gneiss. Siltstones are finely bedded, poorly sorted, loosely compacted and are interbedded with the sandstones and conglomerates.
TERTIARY	PLIOCENE	MUDPIT	Tmp	2500±		Series of well-bedded, grey to bluish-gray shales and sandy shales with interbedded fine, dense dark brown shales. Bluish shales weather to a grey plastic mud which masks the bedding. Typically gives slump topography. Contains foraminiferal fauna.
		PICO	Tp	4000±		Series of alternating tan to buff sandstones, bluish-gray shales and lenticular conglomerates moderately indurated. Conglomerates up to 25 feet thick predominate near the base of the section and contain cobbles up to 10 inches in diameter of sandstone, diatomaceous shale, cherts, quartzite, and some igneous elements. Few thin [illegible] lenticular conglomerate lenses near the top contain small cobbles and coarse sands of the same composition as the basal conglomerates. Bulk of the section is a series of alternating sandstones and shales. Sandstones poorly cemented, poorly sorted medium to coarse grained and up to 15 feet in thickness. Shales thin-bedded, light to dark brown, exhibit nodular weathering and are up to [illegible] thick. [illegible] seeps; gypsum along bedding planes; frequent landslides along dip slopes; contains several [illegible] horizons.
	MIOCENE	SANTA MARGARITA	Tsm	2400±		Closely compacted, light to dark chocolate brown, finely laminated earthy shale; weathers white and light grey; spheroidal weathering jointing nearly at right angles to bedding, bedding and jointing planes usually coated with gypsum and a sulphur sublimate. Several interbedded sandstones; no fossils; usually highly contorted.
		MODELO	Tm	2500±	BENTONITE	Thinly-bedded, white to chocolate brown, siliceous shale; platy fracture; prominent joint system at right angles to bedding which is prominent upon weathering. Joint and bedding planes usually covered with gypsum and a sulphur sublimate; light weight; fish scales
		RINCON	Trc	2300±		Series of dark gray shales and mudstones and interbedded concretionary layers. Concretions up to 18 inches in diameter. Outcrops typically spheroidally weathered and covered by a yellow to brown skin.
		VAQUEROS	Tvq	100±		Green-gray to brown sandstones and sandy shales. Usually two prominent beds of a calcareous-cemented coarse grained sandstone to conglomerate carrying oysters.
	OLIGOCENE	SESPE	Tsp	4500±		Series of interbedded sandstones, shales and conglomerates principally terrestial in origin and unfossiliferous. Sandstones are coarse grained, massive and cross-bedded. Conglomerates prominent near base composed of cherts, sandstones, quartzites, limestone and igneous elements. Red shales and siltstones predominate near the top and are characterized by a conchoidal fracture.
	EOCENE	COLDWATER	Tcw	2850±		Series of massively-bedded white to yellow-brown sandstones; massive gray shales; light buff to yellow-brown sandy shales and interbedded gray sandstones containing oyster beds; and massively bedded [illegible] grained, red, yellow and white sandstones.
		COZY DELL	Tcd	2900±		Gray to [illegible] siliceous shales, siltstones and sandstones, very indurated; rhythmically banded; weathers to red-brown.
		MATILIJA	Tmj	2500±		[illegible] bedded gray-green, indurated, micaceous [illegible] arkosic sandstones and thin-bedded light gray to dark brown siltstones and shales. Shales more [illegible] near the base.
		UNDIFFERENTIATED	Tu	?		[illegible] brown to black rhythmically bedded siliceous and silty shales highly fractured and jointed, well indurated, and interbedded massive [illegible] sandstones well cemented and indurated. Complexly folded and faulted.

mean temperature is about 50°.

The vegetation depends a great deal upon the underlying rocks; however the north slopes usually support a more luxuriant growth. As a general rule, grass, mustard and light growths of sage grow in the shaly soils. Chaparral and several other heavy growths grow thickly on the coarse grained sandstones and conglomerates while heavy growths of sage cover the finer sandstones. A striking example of this vegetation difference is to be noticed at the contact of Pliocene sandstones and shales. Here the contrast is traceable across country by noting the change from mustard to sage. Except for the Pliocene shales near the coast most of the soils support growths of trees. The number increasing toward the Santa Ynez Mountains.

With the exception of the Ventura River the streams are intermittent and only carry water during the rainy season.

Stratigraphy

General Features

The rocks in the Ventura quadrangle represent one of the thickest sections of Tertiary sediments known. They range in age from lowermost Eocene to Recent and comprise the Undifferentiated Eocene (lower Eocene), Tejon group - Matilija, Cozy Dell and Coldwater formations (upper Eocene), Sespe formation (Oligocene), Vaqueros formation (lower Miocene), Rincon formation (lower to middle Miocene), Modelo formation (upper Miocene), Santa Margarita formation (upper Miocene), Pico formation (lower Pliocene), Mudpit formation (upper Pliocene), Saugus formation (Pleistocene) Pleistocene bench and terrace gravels, and Recent valley alluvium, terrace and bench gravels. In lithology they represent marine sandstones, shales and conglomerates and continental sandstones and conglomerates. No major breaks in deposition are represented. The character of the sediments and their contacts seems to suggest that deposition took place in a comparatively small basin and that the unusual thickness of sediment must have necessitated a rather rapidly sinking basin.

Tertiary System

Eocene Series

Undifferentiated Eocene General Features

The Eocene rocks underlying the Tejon group were not studied in any detail and little time was spent in mapping their outcrop. They consist of a series of dark brown to black shales and arkosic sandstones which are complexly faulted and folded. The base is not exposed.

Distribution and Lithology

The undifferentiated Eocene rocks are exposed as a band across the northern part of the area, (see map) and are best exposed in both forks of Matilija Creek above Matilija Springs. Here they are apparently underlying the Tejon group conformably. This series is predominantly shale; dark brown to black, micaceous, highly indurated and have a distinct platy fracture habit. Typically it weathers spheroidally to give nodular dark brown to black fragments which form distinct talus slopes rather than the mud which is so characteristic of the Miocene and Pliocene shales. The sandstones of this series vary from fine grained micaceous sandstones to arkosic sandstones. Both are massively bedded, highly indurated, well cemented and badly jointed and fractured. Above the forks in Matilija Creek the sandstones are principally arkosic and range in thickness from a few inches to twenty feet.

The following fossil forms reported indicate that in part this series is the correlative of the type Meganos.

Venercardia hornii Gabb

Turritella andersoni

Turritella c f *meganoensis*

For the purposes of this report it will be considered to be in age; below the upper Eocene Tejon Group and above the Cretaceous Chico.

Tejon Group

General Features

In this paper, Tejon Group will be used to include three distinct lithologic units which are given formation names. They are upper Eocene in age and include from bottom to top; the Matilija formation, Cozy Dell formation and the Coldwater formation. This group is apparently conformable upon the Undifferentiated Eocene and beneath the Sespe beds with which it is in part gradational. The outcrop of the Tejon group is a curving band across the northern part of the quadrangle. (see map)

Matilija Formation

General Features.

The Matilija Formation was first used by Kerr and Schenck (see bibliography) as Matilija SS, a division of the Tejon Formation, the type locality being on Matilija Creek at Matilija Springs. It consists of about 2500 feet of massive gray indurated sandstones and interbedded shales. A greenish cast to the sandstones and shale is a peculiarity of this unit.

Distribution and Lithology

This division of the Tejon group outcrops as steeply dipping strata for a distance of approximately ½ mile north of Matilija Springs. Its outcrop is a band extending across the northern part of the quadrangle and paralleling the underlying Undifferentiated Eocene. Sandstone predominates over shale. Massive arkosic and micaceous sandstone, dark gray to brown and with a greenish cast is prominent near base with intercalations of an indurated light to dark gray, thin bedded shale. These shale members become fewer towards the top of the formation. Some of the sandstone members carry small lenses of loosely compacted conglomerate.

Fossils from localities along Matilija Creek include:

Turritella uvasana Conrad

Spatangus tapinus Schenck

Cozy Dell Formation

General Features

The Cozy Dell like the Matilija was first proposed by Kerr and Schenck as a division for the Tejon formation and used merely as a lithologic unit. The type locality is in Cozy Dell Canyon on the east side of the Ventura River. It consists of about 2900 feet of rhythmically bedded gray to green micaceous shales and sandstones.

Distribution and lithology

The Cozy Dell formation outcrops as a curving band across the northern part of the area. The massively bedded, well indurated green and buff sandstones range from a few inches to 150' in thickness. They stand out as strike ridges and are separated by contorted shales. The shales have varied characters. Brown to gray evenly bedded indurated beds, gray, poorly cemented, obscurely bedded, sandy shales; brown, loosely cemented nodular weathering, highly fractured shales. The top of the Cozy Dell is apparently comformable beneath the Coldwater formation.

Coldwater Formation

General Description

The term "Coldwater was first used by Watts (see bibliography) as a local name for a white sandstone unit in the Tejon formation. He described its type locality in Coldwater Canyon on Sespe Creek in the Piru quadrangle. In this report Coldwater formation includes a series of sandstones and shales which overlie the Cozy Dell conformably and underlie conformably the Sespe beds. They appear to grade into the Sespe.

Distribution and Lithology

The Coldwater formation outcrops as a band paralleling the other Eocene formations across the northern portion of the quadrangle. The sandstones outcrop as strike ridges along the southern part of the Santa Ynez Mountains and the less resistant shale members outcrop as low divides and saddles. The following section for the head of Santa Ana Creek is typical for the Coldwater formation.

Section at Head of Santa Ana Creek.

Medium to coarse grained, moderately indurated, red, green, yellow, purple and white sandstones with occasional conglomerate lenses and one well defined oyster reef.	500'+
Series of fine to coarse grained massively bedded, friable, white to buff sandstones and fine, well bedded, yellow to brown siltstones and sandy shales with several 1-3 feet gray calcareous medium grained sandstone beds carrying quantities of oysters.	1000'+
Medium to coarse grained, massively bedded, poorly consolidated, arkosic, white, yellow, brown, green and red sandstones.	1100'+
Massively bedded red to gray siltstones and shales with interbedded green siltstones.	350'

Oligocene (?) Series

Sespe formation

General features

The Sespe formation was first named Sespe Brownstone by Watts (see bibliography) in his description of its type locality on Sespe Creek in the Piru quadrangle. At Sespe Creek the formation consists of about 3500 feet of sandstones, shale and conglomerate. The greater part being sandstone interlaid with red or purple shale. In the Ventura quadrangle the formation consists of about 4500 feet of sandstones, shales and conglomerates - principally continental deposits and unfossiliferous. Conglomerates predominate near the base and are composed of cherts, sandstones, quartzites, limestones and numerous different igneous rock types. Red shales and siltstones prevail in the upper half of the section. The Sespe probably represents deposition in large alluvial fans in a sub-aerial climate. The Sespe is exposed in the Ojai Valley where it extends up on the flanks of Santa Ynez Mountains. It makes up the most part of Red Mountain.

Distribution and Lithology

Red Mountain Area

The Sespe exposed in Red Mountain is represented by the upper portions of the formation. Sandstones and siltstones predominate. Sandstones vary in color; red, brown, yellow-brown, lavender, gray and white. The colored sandstones lose their color upon weathering by leaching to give buff and gray colors. The coarse grained sandstones are light in color with depth of color increasing as material becomes finer. Sandstones are poorly sorted, coarse to medium grained and arkosic. The grains in the sandstones are angular to sub-angular and are comprised of quartz, feldspar, biotite, chert (green, red, black, lavender). The color is as a coating on grains and included in the cement. Included also, frequently are clay galls up to 5 inches in diameter. The sandstones are friable yet moderately well indurated. Seldom are the members evenly bedded; in general they are much cross-bedded and very lenticular. Near the top of the Sespe the material becomes finer and the coarse sandstones give way to siltstones and shales. The shales and siltstones have the same colors as the sandstones but are usually a deeper hue. They break down with a conchoidal frature very easily to form a thick mantle of soil. The only conglomerates in the Red Mountain area are small pebble lenses in the sandstones and shales.

Ojai Valley

Ojai Valley is a broad syncline in Sespe. Here the base is exposed as it laps upon south front of the Santa Ynez Range. A thin member of reddish shale forms the base and is apparently gradational down into the red and white sandstones of the upper Coldwater. Immediately underlying this shale member are considerable thicknesses of conglomerates interbedded with coarse sandstones mineralogically similar to those described in Red Mountain. The conglomerates outcrop as cuestas which dip to the south. One count showed the following rock types to make up the conglomerate; red, green, lavender, yellow, brown, and black cherts; oyster-reef fragments; red, yellow, brown and gray sandstone, felsite, and several other igneous rock types. All of the constituents are sub-rounded and are well cemented together. The individual pebbles and cobbles range up to 4 to 5 " in diameter. The cement is usually a ferruginous one but some beds contain small amounts of calcite as a cementing material. The conglomerates are very lenticular and are much cross-bedded and usually are traceable only a short distance as a mappable unit. The sandstones and shales of the Ojai Valley Sespe are identical with those of Red Mountain and here constitute the most part of the upper portion of the Sespe.

The age of the Sespe is in some question because of lack of good fossil remains - some phases of it in other localities have been definitely assigned to the Miocene on the basis of vertebrate remains. In the most part however the Sespe is placedin the Oligocene simply because it lies conformably above the Eocene Tejon and conformably below the Miocene Vaqueros.

Miocene Series

Vaqueros formation

General features

In the Ventura quadrangle the Vaqueros is represented by 100±feet of green-gray shales and sandstones, often containing two well-defined beds of a calcareous cemented coarse gray sandstone to conglomerate which carries quantities of fossil oysters. The correlation of these sandstones and shales with known Vaqueros is on the basis of similarity of contained fauna and that both this series and known Vaqueros in the Santa Paula quadrangle are overlain by a similar foraminiferal shale. The type section of the Vaqueros is in Vaquero Canyon, Salinas Valley and was described by Homer Hamlin.

Distribution and Lithology

The sandstones range from fine to coarse grained to conglomerates, are poorly sorted, and cemented in a calcareous matrix. The individual grains are principally sub-angular and are composed of quartz, cherts and shell fragments.

San Antonio Creek Section

Rincon shales	
Shell bed	1'
Green-gray shale	10'
Interbedded sandstones and shales (ss. 8 "thick)	6'
Green-gray shale	34'
Conglomeratic sandstone	4'
Tan to dark gray nodular shale	45'
Red and purple shales of Sespe	

Section along Ventura River
West of "Rock"

Rincon shales	
Olive, sandy shales	20'
Oyster reef in gray sandstone	18"
Green-gray shales	33'

At the head of Ayers Creek, along the north side of Red Mountain the basal shales of the Vaqueros are missing and the Sespe is overlain by the sandstone member.

Rincon formation

General features

The name "Rincon" just appeared in the literature in a paper by P. F. Kerr (See bibliography) in which he refers to the unpublished type section of the Rincon formation at the head of Los Sauces Creek. In the Ventura quadrangle the Rincon comprises 2300 feet ± of dark gray shales and interbedded dolomitic concretionary layers. The concretions weather out as boulders and litter the surface. They are important in tracing contacts.

Distribution and Lithology

The Rincon outcrops as a band around Red Mountain and to the north of Red Mountain in a broad syncline which gives it a widening outcrop to the east. It appears again in the Ojai Valley north of Sulfur Mountain.

Section along Ventura River
just north of Casitas -
Thickness 2200'

Platy, siliceous shales; white to buff in color.
Finely laminated shaly sandstones and sandy shales.
Color; red, yellow, gray, weathering spheroidally.
Deep red siltstones, finely bedded, with concretionary beds up to 14" thick.
Gray, brown, red and yellow finely bedded siltstones; concretionary layers interbedded.
Gray, red-yellow calcareous, finely bedded siltstones and interbedded thin layers of yellow siltstone in shale.
Gray, calcareous, finely-bedded siltstones.

Section at Head of Los Sauces Creek,
Immediately west of Ventura Quadrangle-
Described by Cushman and Laming (see Bibliography)

Hard, gray, siliceous shale and interbedded tan and brown shales	400'
Dark brown, massive, silty mudrock, iron stain, calcareous sandstone lenses.	380'
Dark brown to chocolate brown, conchoidally weathering, compact mud rock, hard limestone lenses; dolomitic concretions.	1219'
Greenish to buff massive mudstone, weathers to mud, lenses of hard gray sandstone	700'

In general, the first few hundred feet of the top

Rincon concretionary shales, Santa Ana road of the Rincon are siliceous platy shales similar to the overlying Modelo. The silty shales and mudstones of the Rincon weather to give a slump topography which is difficult to distinguish from that of the Pliocene shales.

The age of the Rincon is based on foraminifera and is placed by Cushman and Laming (See bibliography) as an equivalent of the basal Temblor.

Modelo formation

General features

The Modelo formation in the Ventura quadrangle comprises about 2500 feet of thinly bedded, white to chocolate brown siliceous shales. Most outcrops show the Modelo folded into tight folds. The type section of the Modelo as described by W. S. W. Kew (See bibliography) is in Modelo Canyon, Piru Creek, Piru quadrangle.

Distribution and Lithology

The Modelo outcrops along San Antonio Creek and to the top of Sulphur Mountain. A narrow band extends around the south front of Red Mountain.

The Modelo shales are monotonously the same except for an occasional limestone and sandstone lens. The shales are thinly-bedded, light-weight, white to chocolate brown in

Minor folds in the Modelo; along Santa Ana road

Modelo siliceous shales along San Antonio Creek

Contorted Modelo at the head of Fresno Canyon color, and diatomaceous; typically exhibit a strong platy fracture which combined with their opaline composition gives them a distinctive clinkery sound when struck with the hammer. A prominent joint system at right angles to the bedding, the planes of which are usually coated with gypsum and a sulphur sublimate. Small, brown fish scales are generally found along bedding planes. Some of the sandstone lenses are black and soaked with oil. Numerous tar seeps are exposed on the flanks of Sulphur Mountain. Within a few feet of the base of the Modelo there usually occurs a 15 foot bed of Bentonite which is traceable throughout the quadrangle. P. F. Kerr (See bibliography) has written a paper on this occurence in which he suggests a water-laid volcanic ash origin for the Bentonite.

The age of the Modelo is based on the presence of a Miocene foraminiferal fauna and a few mega-fossils. The most common being

Pecten peckami

Santa Margarita

General features

The Santa Margarita like the Modelo is a thickness of siliceous shales, light to dark brown in color, finely bedded and with a spheriodal weathering habit. It contains several sandstone members which stand out as strike ridges. The type section of the Santa Margarita is on the Santa Margarita Rancho at San Luis Obispo. There it comprises a platy shale in the lower part overlain by sandy shales and sandstones.

Distribution and Lithology

The Santa Margarita outcrops as an east west band from the top of Sulphur Mountain to the head of Coche Canyon. Traces of it are found on the south front of Red Mountain where it and the Modelo shales are faulted againt Pliocene shales. The Santa Margarita shales are light to dark brown, earthy, finely bedded siliceous shales near the base. Towards the top of the formation the shales become a gray spheroidally weathering shale with occasional concretionary layers which resemble the shales of the Rincon. The lower Santa Margarita shales weather into nodules and the bedding in outcrops is soon obscured. The bedding is cut nearly at right angles by a prominent joint system and both bedding and joint planes are coated with gypsum and a sulphur sublimate. The contact of the Modelo and Santa Margarita shales is very gradational and was mapped as a line at which the predominance of platy Modelo gave way to spheroidally weathering Santa Margarita. The included sandstones near the middle of the formation are white to yellow in color and moderately compacted. Along the south front of Sulphur Mountain there are several oil seeps in the shales and sandstones of the Santa Margarita.

The Santa Margarita is barren of fossils and its position in the uppermost Miocene is based on its stratigraphic position. It is apparently comformable upon Miocene Modelo and apparently comformable beneath Pliocene fossil bearing Pico sandstones and conglomerates.

Pico Formation

General features

The term Pico Formation as used in this paper is to apply to the Pliocene sandstones and conglomerates and interbedded shales. Cartwright (See bibliography) includes the upper Pliocene shales in the Pico and terms the sandstones and conglomerates and interbedded shales, "Lower Pico". The Pico was first described as such by W. S. W. Kew in Pico Canyon near Newhall. The presence in the Ventura quadrangle of a correlative of the lowermost Pliocene, the Repetto formation (Repetto Hills), is in question and is not distinguished as such in this report. The Pico formation then, is to comprise the 9000 feet ± of tan to buff and gray sandstones; interbedded bluish-shales and lenticular conglomerates - all moderately indurated. The Pico is important in the Ventura quadrangle because of oil operations. All of the producing wells in the Ventura Avenue Oil Field are producing from horizons in the Pico.

Distribution and Lithology

The Pico outcrops as a wide east-west band crossing the lower part of the map and as a short wide band in the east central portion. The best exposures of Pico from base to top are in the section which is exposed in the divide between Coche and Aliso canyons.

Section Along Aliso Canyon About 9000' thick

Conglomerates with calcareous sandstones matrix pebbles up to 4" in diameter of diatomaceous shale, cherts, quartzite and several different igneous rock types.

Shales - thin bedded, brown stain, nodular weathering

Sandstones - up to 15 feet; buff to yellow, poorly cemented, poorly sorted, medium to coarse grained, earthy non-calcareous cement and interbedded thin shales and sandstones up to 6 inches.

Conglomerates; very lenticular, pinch out quickly to the west.

A 28 foot conglomerate bed, calcareous sandstone matrix; pebbles up to 10" of diatomaceous shale, cherts, quartzites, and igneous types.

Shales, dark gray to bluish gray and interbedded sand-

Pico basal conglomerates dipping south; head of Aliso Canyon

Sandstones overlying shales in Pico; head Hall Canyon

Minor fold in Pico sandstones and shales; head of Hall Canyon stone. Repetto foraminifera found at this horizon.

Sandstones, compacted, poorly cemented, calcareous cement, white to gray, well sorted quartz sandstone with conglomerate lenses carrying siliceous shale pebbles.

The Pliocene age of the Pico is based on many foraminiferal assemblages and many mega-fossils.

Mudpit formation

General features

In this report, Cartwright's (See bibliography) upper Pico is named the Mudpit formation. The name being suggested by the rotary mud pits being excavated in these Pliocene shales for use in oil well drilling. The Mudpit formation comprises about 2500 feet of well-bedded, gray to bluish-gray shales and sandy shales and interbedded fine, dense, dark brown shales. The shales weather to give a soft mud which is responsible in turn for the slump topography. These upper Pliocene shales are distinctive throughout the Ventura quadrangle; but when traced eastward a few miles into the Santa Paula quadrangle they contain intercalated sandstones and conglomerates.

Distribution and Lithology

The Mudpit formation outcrops as two parallel bands, one on either side of the Pico contact. Fresh exposures of the shale arerare and are found only in the rotary mud excavations. Onfresh surfaces the shale is a dark, bluish-gray, well bedded (up to 6") clay shale which weathers to an obscurely bedded, light gray, brown stained, mud shale. Some phases carry quantities of small yellow-stained limonitic concretions. About 50 feet above the Pico contact these occurs an 8 inch bed of volcanic ash and about 350 feet above the Pico contact is another ash bed, about 4 inches thick. These ash beds have been used extensively in mapping oil horizons in the Pliocene shales. At the mouth of Canada Larga occur lenses of coarse sandstone and fine conglomerates in the Mudpit; but they lens out quickly and are mappable only as local features. Several thin beds of a coarse, yellow sandstone outcrop in the Mudpit shales in Hall Canyon.

The lower contact of the Mudpit with the Pico is conformable and very gradational. On the north side of Manuel Canyon the uppermost Pico conglomerates interfinger with Mudpit shales to make the contact very irregular. The upper contact of the Mudpit with the overlying Saugus is apparently conformable. The age of the shales is placed at upper Pliocene on the basis of a foraminiferal fauna and also a few mega-fossils.

Mudpit shales on south limb Ventura Avenue anticline
just west of Ventura River

Typical slump topography in Mudpit shales; Canada Larga

Saugus Formation

General features

The type section of the Saugus is at Saugus, California and was described by Hershey. There it is a continental deposit. In the Ventura quadrangle the Saugus comprises about 4000 feet of poorly consolidated sandstones and conglomerates and interbedded minor amounts of shale, all marine.

Distribution and Lithology

The Saugus outcrops as a band along the coast in the southeastern corner of the map. The best section is in Hall Canyon. Here 3000 feet of a series of alternating beds of sandstone, siltstone and conglomerate with a few thin beds of shaly sandstone. Sandstones are white to yellow, poorly sorted and interbedded with conglomerates composed of small gravel to cobbles 18 inches in diameter. Boulders are sub-rounded and contain: white and yellow sandstone, rhyolite, chert quartzite, granite, glaucophane schist and gneiss. Siltstones are finely bedded, poorly sorted, loosely compacted and are interbedded with the sandstones and conglomerates . In an unnamed canyon about 2 miles west of Ventura the Saugus is well exposed. The heavy, loosely, compacted, poorly sorted conglomerates are closer to the base of the section and the basal member is a white to yellow sandy shale. Some localities show a Dendraster reef within several hundred feet of the base. The Saugus is apparently conformable upon the Pliocene Mudpit and itself is uncomformably overlain by Pleistocene bench and terrace gravels. The upper limit of the Saugus is not exposed.

The age of the Saugus has been definitely assigned to the Pleistocene in the evidence of a Pleistocene horse tooth -- Equus occidentalis.

Bench and Terrace Gravels

The bench and terrace gravels lie unconformably upon older formations and consist of poorly sorted, poorly consolidated, well rounded sands and gravels of local origin, crudely cross bedded. Predominantly sandstones; also cherts, quartzites and occasional igneous elements.

Alluvium

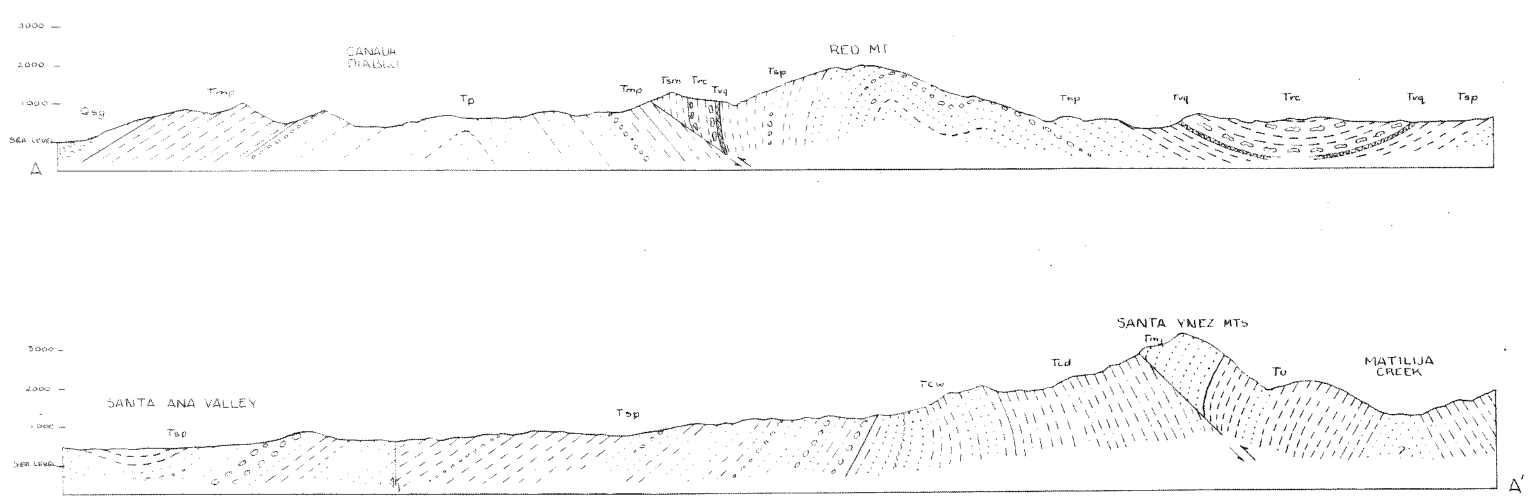
The alluvium comprises valley fill, alluvial fans and beach deposits. The material is of local origin and represents nearly all the rockstypes in the area. It is composed of unconsolidated, well-rounded sands and gravels. Sandstone cobbles predominate.

Marine terrace just west of the city of Ventura

GEOLOGIC CROSS SECTION
VENTURA QUADRANGLE

SCALE 0 ½ 1 2 MILES

M.G. SMITH



- LEGEND -

PLEISTOCENE	SAUGUS	Qsg
PLIOCENE	MUDPIT	Tmp
	PICO	Tp
	SANTA MARGARITA	Tsm
MIOCENE	MODELO	Tm
	RINCON	Trc
	VAQUEROS	Tvq
OLIGOCENE?	SESPE	Tsp
EOCENE	COLDWATER	Tcw
	COZY DELL	Tcd
	MATILIJA	Tmj
	UNDIFFERENTIATED	Tu

Structure

General Features

A series of parallel, nearly east-west trending folds complicated by faulting, briefly describes the structure in the Ventura quadrangle. Actually, the structural units are quite distinct and are expressed plainly in the physiographic features. On the basis of physiographic and structural units the area can be divided into four provinces: (1) Coastal Lowlands -- the low hills and wide valleys extending from the south fronts of Red and Sulphur Mountains to the Pacific ocean. (2) Red Mountain and Sulphur Mountain province -- comprised of Red and Sulphur Mountains lying just north of the Coastal lowland. (3) Ojai-Santa Ana Valley province -- a low and immediately north of Red and Sulphur Mountains. (4) Santa Ynez Range province -- a region of high relief just north of the Santa Ana and Ojai valleys.

As no major unconformities are found in the entire Tertiary section in the Ventura quadrangle, it has been assumed that deposition was nearly continuous and that apparently the deformation which gave rise to the structures, involved all of the formations at the same time. This post-Saugus deformation has been termed the "Pasadenan Orogeny" by Reed and Stilla (see bibliography).

The amount of time spent in the field was too short to permit detailed mapping of structures; as a result this report serves only to outline the major structures and to present some of the problems involved. As an aid in following the descriptions of the various structures, a skeleton map of the Ventura quadrangle with structural axes and trends has been included in the pocket of this report.

The author proposes to discuss the folds of the entire area and the faults of the entire area, rather than by their provinces.

Folds

The Ventura Avenue Anticline

The Ventura Avenue Anticline is a well-known structure in Southern California geology because of its importance in oil production. It has been mapped in great detail both from the surface and from well logs by the interested oil companies. The trend of the axis is shown in the structure skeleton map. Its gently curving pattern is of interest to note that it corresponds with the general trend of both the faults and folds. The Anticline is confined in the area mapped, to the Pliocene formation, Pico and Mudpit. It is nearly symmetrical and its surface outcrops give little clue as to whether it tends

Crest of Ventura Avenue anticline in Pico sandstones
shales; near western margin of map area

to pitch in any one direction. From the Ventura river to a point about 4 miles west the dips show a gentle convergence; but diverge again a short distance to the west. The most westerly portion of the map shows the Pico -- Mudpit contact closing in on the axis. To use this evidence for closure, it would first be necessary to show that the contact was wholly depositional. Field relations along this part are obscure and much more detailed work is necessary. Well logs show that the apparently simple surface expressed Anticline is at depth much complicated by thrust faulting.

Canada Larga Syncline

On the east side of the Ventura river immediately north of the Ventura Avenue anticline, the Canada Larga Syncline is mapped. (See structure maps.) This anticline involves both Mudpit and Pico formations and is traceable from the eastern edge of the quadrangle to the Ventura river. At the river the structure is terminated completely. An extension of its axis projects squarely into Oligocene, Sespe and Miocene Vaqueros strata. A possible explanation for this will be discussed later along with other similar patterns. On the north flank of the Syncline occurs some peculiar attitudes. As shown in the map, they are explained by a fault; however, much more detailed field work is warranted to satisfactorily account for the unusual attitudes.

Red Mountain Dome and Overturn

The Red Mountain Dome and Overturn forms a striking pattern in the geologic map and its extent is readily traceable by noting the outcrop of the Oligocene Sespe and Miocene Vaqueros. The axial trend corresponds very closely with that of the Ventura Avenue Anticline. Along its northern margin this structure is that of an elongated dome with one minor syncline and one minor anticline in its flank (see axes diagram). Along the western and eastern margins the Sespe and Miocene formations are seen to change their strikes nearly through 180 degrees as they swing around the ends of the dome. The southern margin is somewhat more complex. Here the Normally south dipping Sespe and Miocene beds are gradually overturned until they have in some outcrops overturned dips to the north as low as 40 degrees. This overturning involves Sespe, Vaqueros, Rincon, Modelo, and Santa Margarita formations. The narrow and irregular outcrop patterns are to be noted and a possible explanation offered later in the text.

Ayers Creek Syncline

The trend of this synclinal axis can be traced down Ayers Creek, across Coyote Creek and just across the Ventura

Overturned Sespe along south front of Red Mountain; note the vegetation change: trees on Sespe, sage and grass on Miocene shales which outcrop in right half of picture

Overturned Sespe along south front of Red Mountain; this picture taken in centerground of the above photograph

River (see structure diagram). The fold is in Oligocene Sespe and Miocene Vaqueros, Rincon and Modelo. From a point half-way between the western margin of the map and the Ventura River the axis pitches opposite directions. Tracing the axis eastward it terminates just east of the Ventura River in Modelo shales. Control is very poor in this area because reliable attitudes are seldom found in the much crumpled and fractured Miocene shales. The plotted attitudes would permit swinging the synclinal axis south at its termination and terminating it about one-half mile further south in a shallow north pitching fold (see geologic map). Much more field work is necessary to explain why these structures seem to terminate just east of the Ventura River.

Coyote Creek Anticline

(for trend see diagram)

The Coyote Creek Anticline follows the regional trend and involves Oligocene Sespe and Miocene Vaqueros, Rincon and Modelo. Here again the axis is lost as it crosses the Ventura River. Does it pinch out or is its expression lost in the crumpbed Miocene shales?

Santa Ana Valley Syncline

(see diagram)

The Santa Ana Valley Syncline parallels and lies immediately north of the Coyote Creek Anticline. It involves Sespe, Vaqueros Rincon and Modelo formations and as the Coyote Creek Anticline it is lost at Ventura River.

Wills Canyon Anticline

Rice Canyon Syncline

(see diagram)

These two folds are traceable only for a short distance eastward where they are buried by valley alluvium and bench gravels. They originate as southeasterly pitching folds in the Eocene Coldwater and Oligocene (?) Sespe formations. Their northwesterly termination is readily recognizable in the field because of its well-definied 'S' pattern.

Matilija Overturn

The Matilija Overturn involves the Eocene formations along the south front of the Santa Ynez Range. The peculiar 'S) curve in their outcrop pattern and the axis of the overturn both seem to bear out the regional structure trends; notably the trend of the Red Mountain Overturn. Just west of the

Matilija sandstone overturned to the south; Ventura River mapped area, the Eocene rocks dip southward in a normal order. Traced eastward the massive ridge-forming Eocene sandstones are seen to acquire first vertical dips, then overturned dips to the north. East of the Ventura River the entire Eocene section is upside down as is part of the Oligocene (?) Sespe.

Fold on South Front of Sulphur Mountain

Along the south face of Sulphur Mountain the Santa Margarita shales are found to have varying attitudes. South dips on top of the mountain change to vertical and north dips in the south face. Determination of top and bottom of beds is extremely difficult in the Santa Margarita; consequently the relation of the vertical and north dips to the normal south ones is an indefinite one. The most likely explanation seems to be that the north dips are overturned and that the south face of Sulphur Mountain is a monocline over-turned to the south. Attitudes in the Santa Margarita and Pico are all to the south near the west end of Sulphur Mountain, showing that the disturbance dies out before reaching the western end of Sulphur Mountain.

Faults

Red Mountain Thrust

Overturned(?) Santa Margarita on the southfface Sulphur Mt.
note the rib-like sandstones

The trace of the thrust is a line around the south front of Red Mountain (see diagram). Toward its western extension it branches into two mappable faults. Its eastern extension is traceable into the Ventura River alluvium. The fault brings Miocene Modelo and Santa Margarita siliceous shales against Pliocene Mudpit shales at one point and Miocene Rincon against Mudpit immediately west of Ventura River. The westerly multiple fault brings Sespe against Santa Margarita and limits the Modelo to a sliver of siliceous shales. The much narrowed outcrops of all the Miocene formations and the Pliocene Mudpit around the southern front of Red Mountain suggest that possibly a series of multiple faults trend parallel to the one mapped. The faulting along this mountain front was most likely a result of the overthrusting from the north.

Weldon Canyon Fault

A nearly north-south fault (see diagram) extends up Weldon Canyon from its junction with Ventura River. It brings Santa Margarita against Pico with a difference in strike of 90°. Attitudes are difficult in this area and therefore control for structure is weak; however, the presence of a fault can be demonstrated in the field and requires an explanation. What is its relation to the Red Mountain over-thrust and does it explain the termination of any of the east-west structures?

Chismahoo Fault

(see diagram)

This fault apparently is confined to the Sespe and underlying Eocene rocks. At its most westerly trace in the map, Eocene Coldwater is brought up in its south side and outcrops as wedge lensing out quickly to the east.

Discussion

An understanding of the faults and folds in the Ventura quadrangle must necessarily be the result of a great deal of detailed work. Although only a short time was spent in the field in preparing the accompanying geologic map, the author feels that enough evidence is present to justify presenting a possible explanation for the structures. It seems that the thrust fault around the south side of Red Mountain and its probable continuation as the Weldon Canyon Fault provides a clue as to the absence of some 9000 feet of Pico and several thousand feet of Miocene shales in the west side of Ventura River. Possibly, the Red Mountain mass rode over the upturned edges of missing formations which are now buried. It is suggestive, that most of the minor structures in the Sespe and

Miocene shales are in the west side of Ventura River and that they developed when the rocks west of the Ventura River were being shoved southward in respect to those in the east side of the river. This is a nice point realizing that a recognition of minor structures on the east side of the river is impossible because of the bench gravel and alluvial covering. The same curved pattern is shown in the Santa Ynez Mountains with the west side being bowed further southward than the east side.

The possibility that the great thickness of Pico and Miocene shales represented on the east side of the river were never deposited in the Red Mountain area seems to be less favorable. First, no great changes in lithology in the Miocene shales indicate a near shore deposition and second, the Weldon Canyon fault is known to exist and brings beds of different lithology together with a 90 degree difference in strike.

It is unfortunate that the most critical area, namely, the section including Weldon and Fresno Canyons, is the most difficult in which to map accurate attitudes.

A third possibility, not widely different from the first is worthy of noting. Deposit the "missing rocks" over the Red Mountain area, dome Red Mountain, strip off this mantle of "missing rocks"; then thrust Red Mountain southward to its present position. The author presents these possibilities only as working hypotheses, nothing more.

Other anomalous structures are the minor folds in the Sespe which apparently terminate at the western end of Sulphur Mountain. Are these structures lost in the crumpled Miocene shales or do they die out while still under the Oakview Terrace, or do they terminate at the river? The last possibility is a weak one because the folds reach the river with their flanks dipping 40 to 45 degrees and showing no tendency to pinch out. Only careful and detailed field work will provide the answer to these problems and this report is intended only to present the problems and discuss them insofar as the field knowledge goes.

Physiography

General Features

For ease in discussing the physiography of the Ventura Quadrangle, it will be done by the provinces outlined under "Structure." As a general statement for the entire area --- streams working in a series of folded and faulted sediments have developed a surface which varies from late youth to early maturity in age.

Santa Ynez Province

The Santa Ynez Range is a member of the Transverse Coast Ranges which are unique in trend in that they are elongated in a nearly east-west direction. The accordance of summit levels in the Santa Ynez Range suggests an erosion surface now greatly dissected. Within the Ventura Quadrangle the crest of the Santa Ynez Range makes a peculiar offset which is born out by the structure. This offset provides an outlet for the Ventura River to the coast. West of the Ventura River, the crest is in Matilija sandstone and just east of the river the crest has been offset to the north until it is held up by the arches of the Undifferentiated Eocene. Lowlands and deep saddles with occasional outstanding ribs mark the outcrop of the Cozy Dell. The Coldwater is a prominent ridge former and west of the Ventura River it flanks the south front of the Santa Ynez Mountains as "flat-irons" or dip slopes. The Ventura River channel through the range is marked by high abandoned terraces and a notched valley profile is indicative of more than one cycle of downcutting.

Ojai Lowland

Physiographically the Ojai Valley can be divided into two halves, one on either side of the Ventura River. The eastern half is being aggraded as borne out by the large alluvial fans accumulating on it in front of the Santa Ynez. Also, the old river terraces (Oakview Terrace) are now inclined 1 to 3 degrees to the north suggesting a sinking and tipping to the north. The west side of the Ventura River is a plain of degradation and is typified by a stripped Sespe surface with a mantle of residual soil. In connection with the sinking or tilting of the eastern half of Ojai Valley, it is interesting to note that the greatest amount of downsinking is opposite the point where the Matilija has suffered the greatest amount of overturning. The downsinking to the northeast is further evidenced by all the streams cutting at their east banks.

The river terraces in the Ojai valley are known as the Oakview Terrace series and comprise about six different levels up to a 1000 feet. The upper terraces can be correlated with the terrace levels at the Tip Top Oil Field in the west end of Sulphur Mountain. The terraces in the eastern half of Ojai Valley evidence that an old stream once flowed westerly through it to join the Ventura River. Mirror Lake on the Oakview Terrace is an oxbow lake.

The bulk of the present drainage of the Ojai Valley is through San Antonio Creek.

Sulphur and Red Mountain Province

This province acts as a barrier between the Ojai Valley and the Coastal Hills. The elevation of Sulphur Mountain is due for the most part to erosional resistance of the siliceous Modelo shales. The south front of Sulphur Mountain is in Santa Margarita and these spheroidally weathering shales are responsible for the rapid recession of the south face of the mountain. The top of Sulphur Mountain is a mature erosion surface and its stream profiles project out over the scarps on either side to be left hanging in air. It is interesting to note that this mature erosion surface on Sulphur Mountain corresponds closely to a small remnant of a similar surface on the top of Red Mountain. On the west end of Sulphur Mountain, between Weldon Canyon and the Ventura River there is a set of terraces which correspond to the Oakview series. The fact that corresponding terraces are higher in the Sulphur Mountain series suggests an uplift of the Sulphur Mountain series and a downwarp of the Oakview series.

Red Mountain owes its elevation to doming and comparative resistance to erosion with surrounding rocks. The incised meanders on Coyote Creek with the stream cutting to the north side suggest a tilting to the north. The seaward-inclined river terraces at the head of Padre Juan Canyon indicate a seaward tilting. These two pieces of indirect evidence are used, with the terrace tilting on the west end of Sulphur Mountain, to show an uplift of the Sulphur-Red mountain Province.

Coastal Hills

A belt of low-lying hills and graded valleys. Most of the hill tops are at the same elevation, suggesting the reflection of an old lowered erosional surface which was cut after the folding of the Coastal Hills rocks. The Pliocene Mudpit and Pico and Pleistocene Saugus underlie this surface. Physiographic expression of the anticline is marked by a saddle along the axis flanked by ridges.

West of the Ventura River and south of Diablo Canyon there are six terrace levels up to 900 feet. The surface is littered with river transported boulders from every formation in the area, including some from the Coldwater. The gradient of these terraces is greater than that of the present Ventura River and indicates an uplift of the surface in respect to its old gradient. The marine terraces are difficult to differentiate from river terraces because they are cut in conglomerates, unconsolidated Saugus.

Briefly then the Pleistocene events were as follows: deposition of 4000 feet Saugus, deformation of entire Tertiary section, development of mature erosion surface, and uplift and warping of surface to initiate a new cycle of erosion.

Historical Geology

A brief outline of the more important events will be attempted as a summary of the history of the Ventura Basin. The Ventura Basin came into existence as a part of the Santa Barbara embayment near the close of the Jurassic as evidenced by Cretaceous Chico deposits in the Santa Ynez Mountains.

At the opening of Eocene time sediments were being deposited in a basin comparable to the Modern Los Angeles Basin. The rythmic banding in the undifferentiated Eocene rocks must have necessitated graded streams carrying fine detrital material and deposition of the fine sandstones and shales in relatively shallow water. The fine material suggests a distant source.

Matilija time saw the beginning of deposition of coarser material, the sandstones being predominantly coarse grained and well sorted, high in quartz, low in feldspar and cross-bedded. The terrain furnishing sediment to the Matilija basin was moderately high and probably granitic. Deposition was mostly a close-to-shore facies.

Cozy Dell time ushered in a resumption of pre-Tejon conditions; fine material, a predominance of shale. Alternations of sandstone and shale show oscillating conditions. The land mass which was furnishing the material must have been lowered because no deep water deposition is indicated to explain the quantities of very fine detritus.

Coldwater deposition was close to shore. Coarse sandstones, red beds and heavy arkoses near the base bear this out. Fossil palm leaves give a clue as to the climate which must have been sub-tropical and oyster reefs in the top of the Coldwater show that depths of water were not great and predict the coming of Sespe time.

Sespe deposition took place in several land-locked basins and was principally terrestrial sedimentation; probably as alluvial fans and coalescing flood plains and land-locked lagoonal deposits. A gradation westward into marine deposits evidences that the sea had not entirely withdrawn. The very lenticular conglomerates carry abundant Franciscan elements. The quartz-feldspar ratio is 1:1 and there is a noticeably low ferro-magnesium minerals content; but a good amount of mica. The terrain must have been high in feldspar and the ferro-magnesium minerals lost in weathering. Towards the close of Sespe time finer detritus water laid indicates an encroaching sea.

Vaqueros time, with water still shallow, sandstones deposited and abundant oyster reefs.

Rincon time saw sandy shale deposition and towards its close the beginnings of siliceous shale deposition and the deposition of a bed of volcanic ash to give Bentonite. Whether the volcanic activity was responsible for the increase of silica in the sea water or not is a moot question.

During Modelo time the siliceous shale deposition reached its maximum. The lands must have been very low to account for the lack of terrestial sediment and the purity of the shales. The few fossils found are those which fell in; they are not bottom dwellers. Toward the end of Modelo time, the influx of detrital material began and Santa Margarita time saw a mixing of siliceous shales and fine detritus. At the end of Miocene time, deposition was going on at an even rate with the basin receiving very fine muds and occasional sands.

The Pliocene epoch began with a marked change from Miocene deposition. Heavy, coarse conglomerates and sandstones were being laid down as deltaic deposits as the epoch opened. The lower Pliocene is now represented by coarse sandstones and conglomerates which lens rapidly along both the dip and strike. Pliocene deposition represents one complete cycle of sedimentation; from coarse sandstones and conglomerates, through fine sandstones and ending up with a thick section of very fine shaly material, now represented by the Mudpit formation. The Pliocene basin must have been sinking slowly to receive this amount of material and a long period of very quiet conditions was necessary to permit the accumulation of 2500 feet of fine shale.

The Saugus epoch opened with the beginnings of deposition of coarser material into the basin. First fine sands, followed by coarser sands and then very coarse conglomerates. The conglomerates acted as a forerunner of the events to come. Sometime during Saugus time, post-deposition of conglomerates, the Ventura Basin was uplifted and the sediments folded and faulted to give the structures now traceable. This deformation has been called the Pasadenan orogeny.

The Pleistocene history has been outlined in an earlier part of the report.

Economic Geology

Economic geology will consist of a brief discussion of the oil industry. The earliest wells in the quadrangle were shallow ones in seeps along the south front of Sulphur Mountain. The next development was that of the Tip Top field at the head of Fresno Canyon. The Tip Top wells are shallow and draw their oil from fracture seepage in the Modelo. A few are still producing small amounts of oil. The big-scale production began in 1916 with the discovery and development of the Ventura Avenue field. To date it has produced some 180 million barrels. Two more fields have since come into production: the San Miguelito Field 1931 and the Padre Juan field in 1936.

Summary

It has been the purpose of this report to set forth the data gathered in five weeks field time and to attempt a discussion of the structure, physiography and historical geology of the eastern part of the Ventura Quadrangle. The author hopes that some of the problems in the Ventura Quadrangle have been outlined clearly enough to warrant further interest in them.

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A BRIEF REPORT

ON THE

GEOLOGY OF TUNNEL HILL AREA

MOJAVE QUADRANGLE, CALIFORNIA

BY

MAURICE G. SMITH

STANFORD GEOLOGICAL SURVEY

J.D. BARKSDALE, ACTING DIRECTOR

1937

The Topography and Geology of a Part
of the Mojave Quadrangle, California

This discussion is to accompany the topographic map made of a part of the Mojave Quadrangle near Tehachapi, California. It intends to give a brief outline of the mapping methods and then to discuss the geology of the particular area.

The map was made in conjunction with the Topographic Mapping course offered by Stanford University in their summer geology survey of 1937. The work was conducted by three-man parties, each party mapping an area approximately one square mile. An accurate base line and primary triangulation system was first established by the entire survey; then each party plotted their own secondary triangulation system with the plane table and proceeded with the topography and geology.

A general statement of the geology of Tunnel Area (see map in pocket): a series of pre-Jurassic (?) metamorphic marbles, quartzites, schists and gneisses, intruded by a granitic mass which outcrops just outside the area. Stratigraphy is extremely difficult.

Rock Types: Marble; most distinctive because of its relative purity. It is a coarsely crystalline limestone, white to blue-gray in color, locally carrying small quantities of graphite.

Quartzite: white to gray to red-brown in color, usually badly fractured and cut by vein quartz.

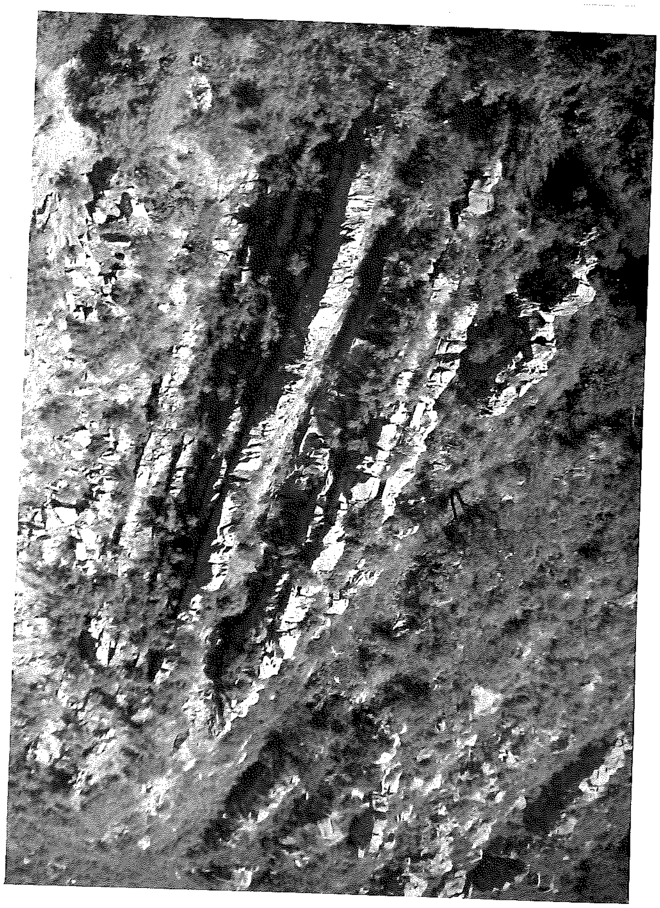
Schists: black biotite schists, badly fractured and cut by quartz veins and stringers; no distinctive schistosity. Biotite content highly variable.

Quartz-Gneiss: apparently a metamorphosed shale and quartz sandstone series. Mineral content highly variable.

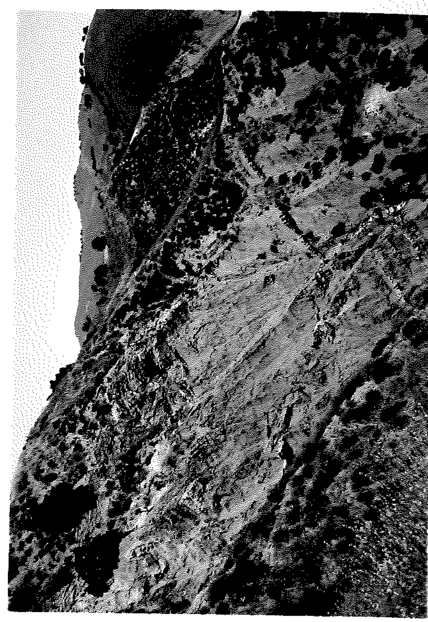
In the Tunnel Area, only two rock units were mapped: the marble and the quartzite, quartz-gneiss-schist complex. In general the metamorphics seem to be dipping gently to the south and the marble member is stratigraphically above the complex (see map). A fault is mapped between marble and complex extending nearly across the center of the map. This fault dips to the north and the downthrown side is in the north, in the marble. The trace of the fault is marked by a crush breccia. Sometimes it occurs in the quartzitic complex, then is found for a short distance in the marble, suggesting that probably the fault is a multiple one and is represented by several crush zones in both the marble and quartz complex. The faulted zone is not traceable across the entire area. A lack of outcrops and sufficient field time to devote to geology necessitated leaving the problem unsolved.

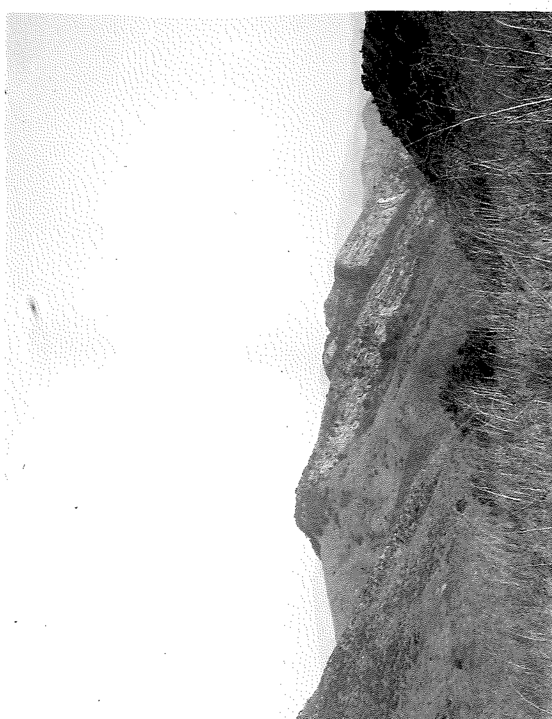
The complexity of the quartz-gneisses sbhists, and quartzites made mapping of minor structures in them almost impossible, consequently they were lumped as one unit and mapped as such. Much more time would be necessary to make anything more than a reconnaissance map of the Tunnel Area.

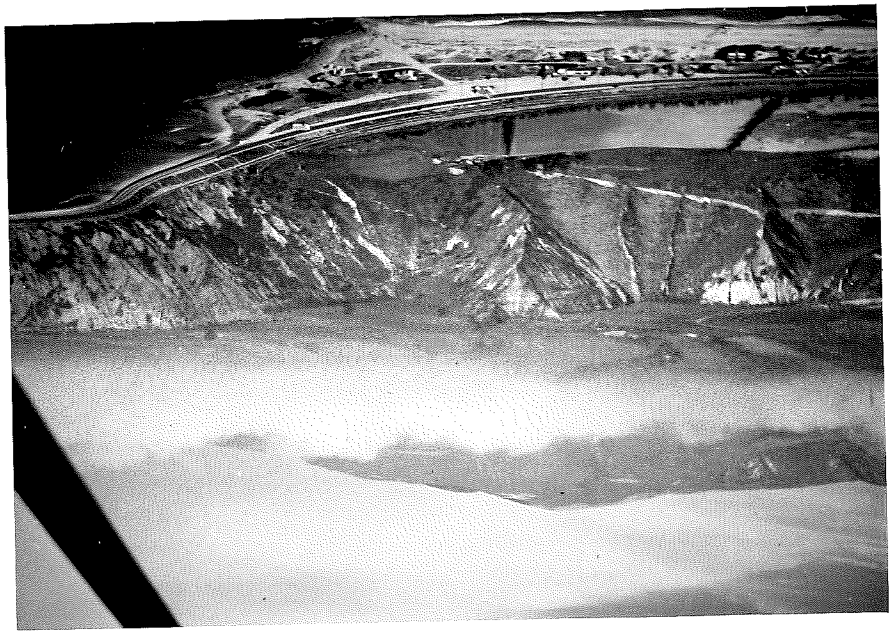
Peculiar topography due to soil creep(?) just east of Tehachapi. Looking south

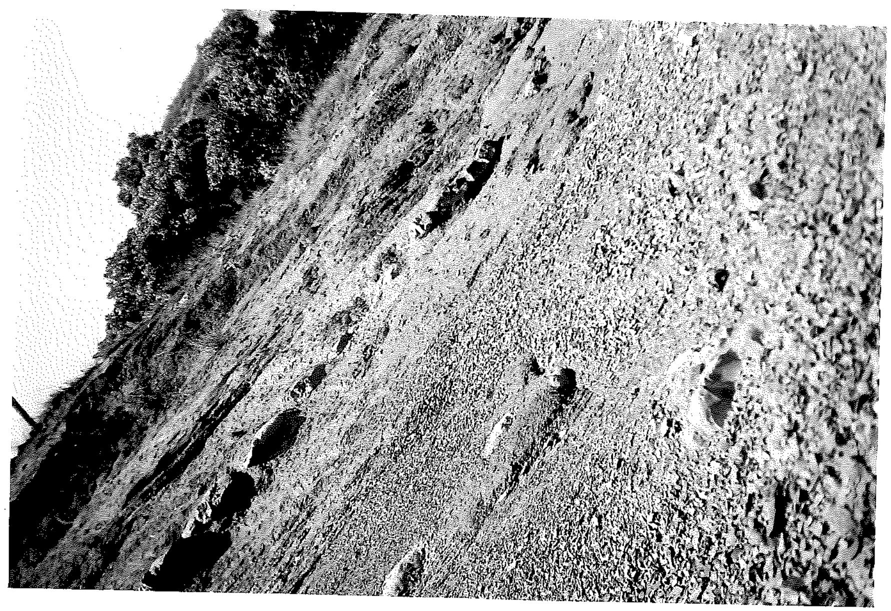








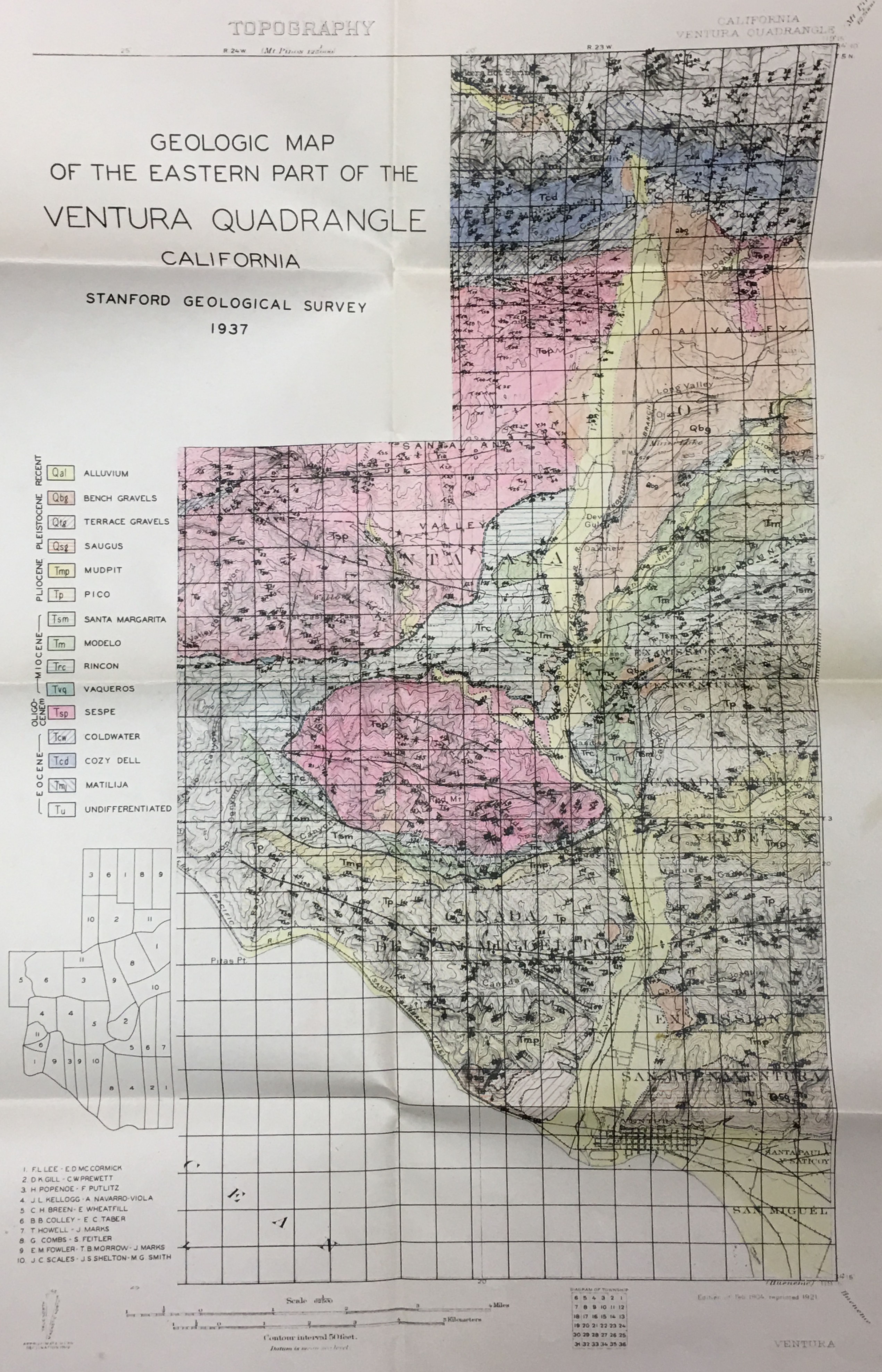



STRUCTURE DIAGRAM

To accompany geologic map

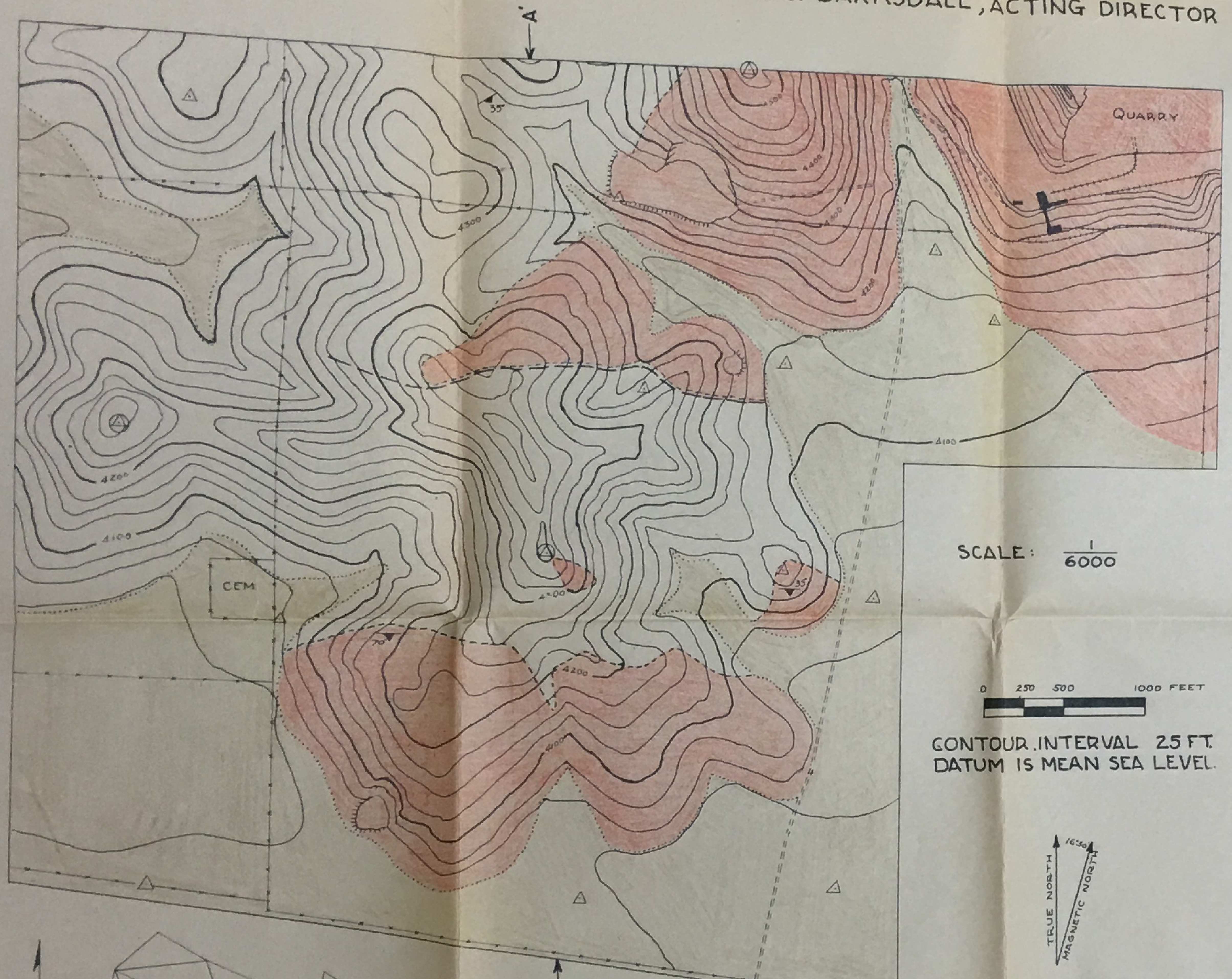
EASTERN PART VENTURA QUADRANGLE

SCALE: SAME AS GEOLOGIC MAP


TOPOGRAPHY
CALIFORNIA
VENTURA QUADRANGLE
GEOLOGIC MAP
OF THE EASTERN PART OF THE
VENTURA QUADRANGLE
CALIFORNIA
STANFORD GEOLOGICAL SURVEY
1937
RECENT
Qal ALLUVIUM
PLEISTOCENE
Qbg BENCH GRAVELS
Qtg TERRACE GRAVELS
Qsg SAUGUS
PLIOCENE
Tmp MUDPIT
Tp PICO
MIOCENE
Tsm SANTA MARGARITA
Tm MODELO
Trc RINCON
Tvq VAQUEROS
OLIGOCENE
Tsp SESPE
EOCENE
Tcw COLDWATER
Tcd COZY DELL
Tmj MATILIJA
Tu UNDIFFERENTIATED
1. F.L. LEE - E.D. MCCORMICK
2. D.K. GILL - C.W. PREWETT
3. H. POPENOE - F. PUTLITZ
4. J.L. KELLOGG - A. NAVARRO-VIOLA
5. C.H. BREEN - E. WHEATFILL
6. B.B. COLLEY - E.C. TABER
7. T. HOWELL - J. MARKS
8. G. COMBS - S. FEITLER
9. E.M. FOWLER - T.B. MORROW - J. MARKS
10. J.C. SCALES - J.S. SHELTON - M.G. SMITH
SANTA ANA VALLEY
OJAI VALLEY
Long Valley
CANADA LARGA
CANADA DE SAN MIGUELITO
EX MISSION
SAN BUENAVENTURA
SANTA PAULA Y SATICOY
SAN MIGUEL
Pitas Pt
PACIFIC
VENTURA
R 24 W
R 23 W
Scale
Contour interval 50 feet
Miles
Kilometers

TOPOGRAPHY AND GEOLOGY
TUNNEL AREA MOJAVE QUADRANGLE, CALIFORNIA

STANFORD GEOLOGICAL SURVEY
J.D. BARKSDALE, ACTING DIRECTOR



GEOLOGIC LEGEND

	AREAL	STRUCTURAL	
RECENT	Qal		
	ALLUVIUM AND ALLUVIAL FAN		
PRE-JURASSIC ?	Jtm		TEHACHAPI GNEISS
	MARBLE MEMBER		
	Jtgn		
	QUARTZITE ; QUARTZ-MICA GNEISS + SCHIST		

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

0 250 500 1000 FEET

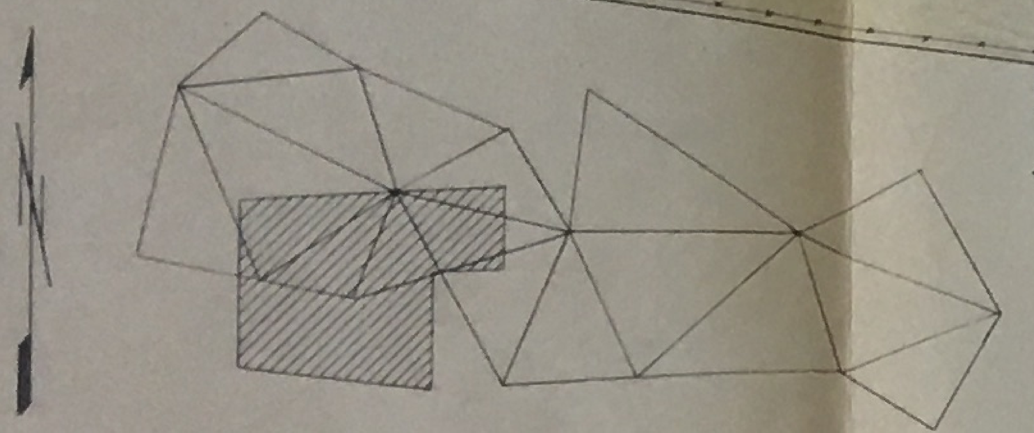
CONTOUR INTERVAL 25 FT.
DATUM IS MEAN SEA LEVEL.

TRUE NORTH
MAGNETIC NORTH
16°30'

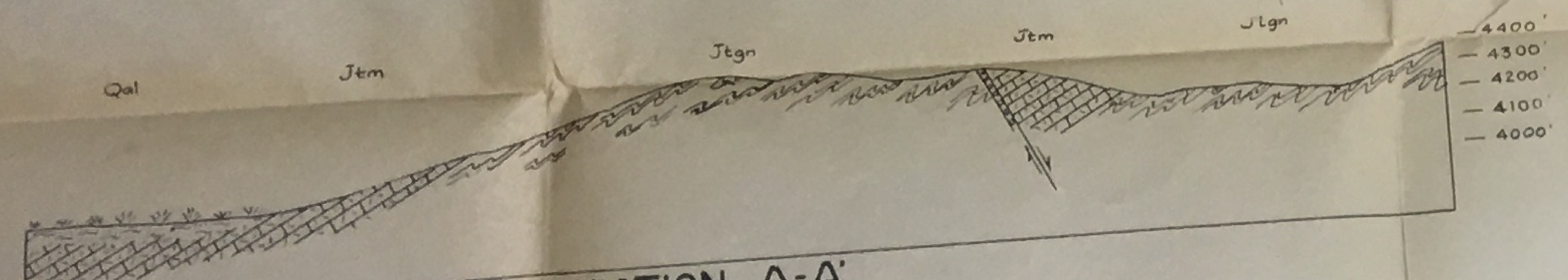
APPROX. DECLINATION 1937

SYMBOLS

STRIKE AND DIP OF SCHISTOSITY
KNOWN FAULT NOT ACCURATELY LOCATED
CONTACT
ALLUVIUM CONTACT
SECONDARY ROADS
TUNNEL
NARROW GAUGE RAILROAD
BARBED WIRE FENCE
PRIMARY TRIANGULATION STATION
SECONDARY STATIONS
BUILDING
CONTOURS



PRIMARY TRIANGULATION SYSTEM
SCALE: 1" = 5000'



CROSS SECTION A-A'

SURVEYED AUGUST 1937
TRIANGULATION BY STANFORD GEOLOGICAL SURVEY
TOPOGRAPHY AND GEOLOGY BY: J.C. SCALES
J. S. SHELTON
M.G SMITH

DRAFTED BY SMITH