GEOLOGY OF A PORTION OF THE RAVENNA QUADRANGLE, LOS ANGELES COUNTY

by

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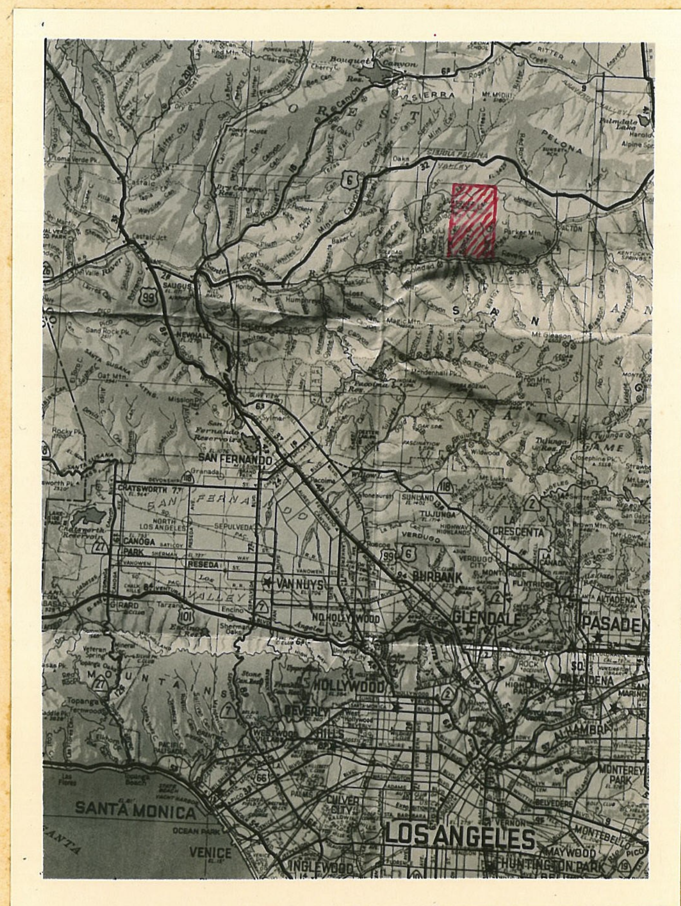
June, 1938



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Abstract

The area investigated contains a section of coarse fanglomerates and basic lavas of middle Tertiary age. It is, as far as known, unfossiliferous. The sediments have been tilted so that they dip in general southwest. Underlying the sediments on the north is a quartz-syenite basement rock. Faulted up on the south is an anorthosite basement. There is a prominent fault with several thousand feet of strike-slip displacement trending NE-SW through the center of the area. There are a number of short faults and steeply plunging open folds which trend in general NE-SW.

Introduction

This paper is concerned with the areal geology of an area covering the north-west one-fourth of the Ravenna Quadrangle. The report was prepared in response to a requirement of the geology course at the California Institute of Technology. Field work was done over a period from November, 1937 to May, 1938.

The area is located in the northern part of Los Angeles County, about five miles west of Acton. It may be reached from the vicinity of Los Angeles by driving to the junction of U. S. highway 99 and State highway 7 at San Fernando Pass, and from there by highway 7 to Solemint store. From Solemint store the southern end of the area can be reached directly by way of the Soledad Canyon Road. No roads cross the area from north to south but the northern end can be reached by driving north from Soledad Canyon on the Agua Dulce Canyon Road, then east on the Escondido Canyon Road. These routes are shown in detail on the index map. (Plate I) The driving time from central Los Angeles or Pasadena is from 1½ to 2 hours and the distance is about 50 miles.

Roads in the area are few and poor. Nearly all are private and are not maintained. Two exceptions are the Soledad Canyon Road which is oiled from Solemint to the area and gravelled east to Acton, and the Escondido Canyon Road which is gravelled throughout.

The actual area investigated is that portion of the Ravenna Quadrangle which lies in the western half and north of Soledad Canyon. It is situated between 34^{0} 26' and 34^{0} 30' North Latitude and between 118^{0} 15' and 118^{0} 18' West Longitude. It's dimensions are approximately 4½ miles N-S by 2½ miles E-W, giving a total area of 11½ square miles.

The investigation was carried out with the aid of a United States Geological Survey topographic map of the Ravenna Quadrangle on a scale of 1:24,000. The map was published in 1934 and is of excellent accuracy and up-to-date with minor exceptions. Geologic mapping was done by topography and Brunton compass.

Physical Conditions

Relief & Topography. The highest point in the area is on the northern boundary which crosses the side of a hill at 3650 feet above sea level. There are several other hills which attain elevations of over 3000 feet. The lowest points are in Escondido and Soledad Canyons which leave the area at 2425 feet and 2050 feet, respectively.

Topography is almost uniformly rough. There is a remarkable regularity in the hardness and resistance to weathering of the different formations. Canyon walls are steep, often overhung by cliffs, but the hills are usually rounded and not of notable steepness. In the conglomerate in the south-west part of the area some unusual topographic forms appear. Along the top of a ridge is a series of huge knobs extending north-south for 1/3 mile. They are from 100 to 300 feet high with vertical sides. (See Fig. 1 below and Plate III)

Fig. 1 Haystack Rocks, looking east.

An isolated individual stands ½ mile to the south-east. They can be easily identified on the topographic map.

Drainage. With regard to drainage the area is divided into two sections by a ridge which lies E-W in the center. South of the divide streams flow directly south into Soledad Canyon. North of the divide and roughly parallel to it is Escondido Canyon which takes all the drainage from the northern half of the area and joins Soledad Canyon several miles to the west. The drainage pattern is shown diagrammatically in Fig. 2.

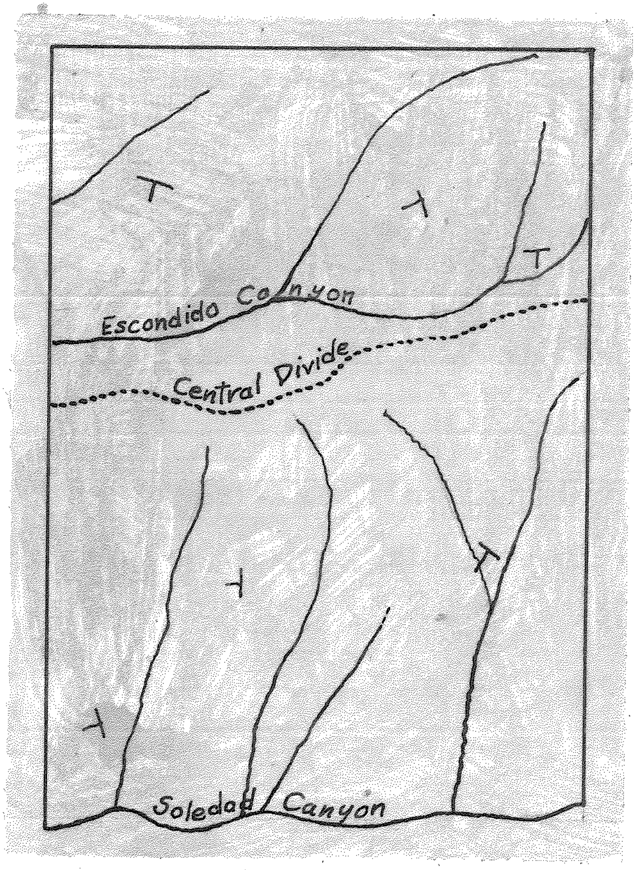

Fig. 2 Drainage Diagram

Soledad Canyon has water flowing all the year; the others only during the rains and in the spring. Some had year-round flow in former times, but numerous wells in the region have lowered the water-table excessively, and it is extremely doubtful that the streams will ever regain their former flow.

Physiography. Escondido Canyon and its major tributaries are all to a certain extent subsequent on the structure whose general attitude is shown in Fig. 2. On the other hand, the major streams on the southern slope are predominantly consequent with their small tributaries usually subsequent.

The steepness of the sides of Escondido Canyon indicates that it has been excavated somewhat more rapidly than most other streams in the area. It lies close to and parallels the central divide while the streams to the south merely approach the divide with their headwaters. From these facts it is evident that the divide is moving southward. (That Escondido Canyon is cutting more rapidly can be explained by the facts that it is subsequent on the structure and that it lies partly in an easily eroded effusive rock.)

The area is in the mature stage of the erosion cycle. There has been at least one recent rejuvenation, shown by the numerous dissected terraces seen throughout the area. Evidence for an older rejuvenation is found on the east side of Little Escondido Canyon where remnants of an old terrace are seen on the ends of spurs from the hills to the east and 20-30 feet above the level of the main terrace. However, it is possible that these may be merely remnants from the down-cutting of the main terrace. (See Plate II)

Vegetation. Vegetation in the area is sparse. There is very little soil; what there is consists of loose with negligible organic material. The more exposed slopes are covered thinly with sage and other knee-high growth and dotted with juniper and yucca. On lower slopes and in gullies juniper, mesquite, manzanita, and oaks grow in patches. Cottonwoods, sycamores, oaks, willows and poison oak are found in canyon bottoms. Only in a few scattered places is the growth thick enough to impede progress.

No part of the area is under cultivation. The exceedingly poor land sustains only a few small farms with bees, poultry, and goats.

A large number of hunters come in during the season. The principal game consists of rabbits, squirrels, doves, and quail; also a few deer. There are also owls, crows, and various small birds. No carnivorous animals are known in the area.

Exposures. Outcrops of bedrock occur in moderate number and are well distributed throughout the area. However, there are very few which permit close examination of contacts or fault surfaces. The best exposures are in canyons near the bottoms. There are no road cuts of any value.

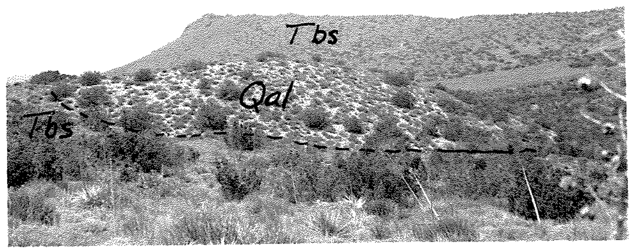

Fig. 1 Remnant of old terrace. Lava in background forms typical cliff. Looking southwest in north central part of the area

Fig. 2 V-shaped valley between flat land surfaces. Indicative of rejuvenation.

PLATE II

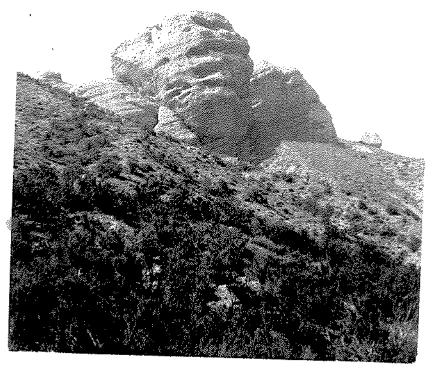

Fig. 1 Haystack Rocks looking north. The buff-colored phase of the Escondido.

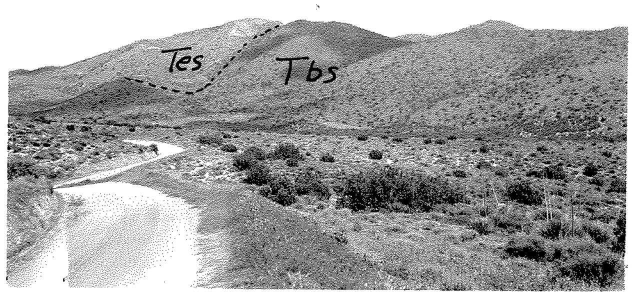

Fig. 2 Topography typical of the lava and the Escondido formation. Looking east in the northern part of the area

PLATE III

Regional Geology

Stratigraphy & Lithology. The area lies in the region known as the upper Santa Clara Valley. The principal rocks in this region are (1) a basement complex of predominantly granitic intrusives and the older metamorphics associated with them, (2) a thick section of Tertiary terrestrial and marine sediments, (3) a series of volcanics and their clastic derivatives, all of Tertiary age, and (4) Quaternary terrace and alluvial deposits.

The so-called "basement complex" rocks are associated with the San Gabriel mountain block and the Sierra Pelona. Areally they flank the upper Santa Clara Valley on the north and, in the San Gabriel Mountains proper, on the south. The bulk of this rock consists of plutonics believed to have been intruded during the Jurassic or early Cretaceous at a time when there was general intrusive activity in California. These plutonics consist of a quartz- or grano-diorite common in the San Gabriels, the "San Gabriel anorthosite" of W. J. Miller[1] and its related facies, and a quartz-syenite. With these are gneisses and schists which are remnants of the pre-Jurassic country rock.

Oldest of the Tertiary sediments is the Escondido formation, named and first described by Hershey[2]. It lies in a limited area in the northern and eastern part of the

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1. Miller, W.J., Anorthosite in Los Angeles County, Journal of Geology, , pp
2. Hershey, O.H., Some Tertiary formations of Southern California, Amer. Geol., , pp

region. Principally it consists of coarse detrital conglomerate, some coarse sandstone, and a little shale, with a considerable thickness of interbedded lavaflows. No fossils have been found. The Escondido has been tentatively correlated by Kew with the Oligocene Sespe formation of the regions farther west on the basis of a close lithologic resemblance. On the other hand, the frequent vulcanism has led Johns and Sharp to place it in the middle Miocene at which time there was widespread vulcanism in California. However, the lack of a satisfactory basis for correlation leaves the question of age wide open.

The lowest formation in the region that can be definitely dated is the Mint Canyon which is early upper Miocene. It consists of fine and coarse sands, conglomerates, and clays deposited terrestrially and under fresh water. Limited vertebrate and invertebrate faunas are present. It is exposed in the north central part of the region, and its thickness averages 4000 feet.

Unconformably upon the Mint Canyon lies the upper Miocene Modelo formation. It is marine and consists of fine sandstone and sandy shale. Its exposures are in the northwest part of the region, and the thickness varies from 400 to 1000 feet.

The Pliocene in the region is represented by the Pico and Saugus formations. The Pico is marine with sandstone, conglomerate and shale, and the Saugus consists of terrestrial gravels. They outcrop in the southwest part of the region and their combined thickness amounts to 6000 feet.

Dissected Pleistocene terrace gravels cover large areas in the southwest part.[1]

Structure[1] Broadly speaking, the sediments of the region lie in a homocline dipping southwest. The oldest formation is found on the northeast, the youngest on the southwest. There are numerous small folds which are mostly flat and open. They are distributed and oriented irregularly. There is one prominent fold, a syncline limited to the Mint Canyon formation and extending in a west-southwest direction for about 7 miles.

The chief faults of the region can be conveniently divided into two groups. One group comprises those faults which separate the body of sediments from the San Gabriel basement. These are high-angle faults on which the major movement is vertical and on which the San Gabriel block has been thrown up against the sediments. The other group of faults is a series of roughly parallel fractures on which there is a large strike-slip component. This group is situated in the northeast part of the region. Horizontal offsets vary from ½ to 1 mile with the southeast sides moving northeast.

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1. Regional structure and stratigraphy were principally obtained from Kew, W.S.W.; Geology & oil resources of a part of Los Angeles and Ventura Counties; U.S.G.S. Bull. 753, 1924.

Local Geology

Stratigraphy & Lithology. Basement rocks exposed in the area are the anorthosite and the quartz-syenite intrusives mentioned above. No attempt was made at detailed study of these rocks, but a few facts may be noted here.

The anorthosite is a white rock composed almost entirely of oligoclase or andesine. It is shot through with dikes of dark fine-grained rock. The whole mass is badly shattered. It occurs in the area as a strip along Soledad Canyon and is in contact with the adjacent sediments only on faults. It has no particular topographic expression, but it is easily identified by its white color which from a distance gives the ground the appearance of being covered with snow. (See Plate VII, Fig. 1)

The quartz-syenite lies along the northern boundary with an arm extending south in the northeast quarter. It is depositionally in contact with the sediments except for short distances of fault contact. Topographically it forms high rounded hills with no cliffs. It contains inclusions of old schist.

Of the Tertiary section described above, the Escondido formation is the only one exposed in the area. For convenience in description it can be divided into several lithologic phases which are somewhat irregular in distribution, both stratigraphic and lateral.

The lowest phase is a basal conglomerate or breccia on the quartz-syenite. It is located all along the contact and is rather thin and irregular. (See Plate IV, Fig. 1)

Fig. 1 Basal conglomerate of the quartz-syenite.

Fig. 2 Anorthosite conglomerate.

PLATE IV

A very peculiar phase is next highest in the section. It is derived entirely from the anorthosite as a fanglomerate of large angular blocks which is remarkably compact and homogeneous. It is so much so that it appears to be solid anorthosite. It is found in the sediments in the northeast quarter below the lava.

The anorthositic phase grades upward into a conglomerate typical of the formation. This consists of boulders up to 10 feet in diameter but most frequently under 12 inches in size in a coarse arkosic sandstone. They are predominantly angular and sub-angular. The matrix is well-cemented and in the uppermost part is red. The color is probably given by hematite resulting from the weathering of the overlying lavas. The materials are granitic rocks, porphyries, diabases and gneisses derived from the San Gabriel complex. This phase is found immediately below and interbedded with the lava flows. (Plate V)

In a few scattered places near the upper contact of the lavas is a fine homogeneous hard red sandstone. Its origin is doubtful, but it is probably sub-aqueous as frequent distinct plane bedding surfaces are seen.

The main body of the Escondido above the lavas is conglomerate like that described above but buff-colored rather than red. (See Plate III, Fig. 1) It grades into patches of another phase which is abundant in this part of the area. This phase is composed of sub-angular fragments of anorthosite and other rocks in a red sandy matrix.

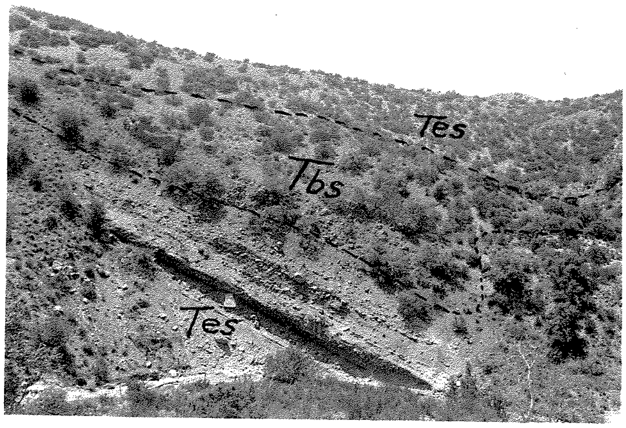


PLATE V

Two exposures of the dark red phase of the Escondido.

The color often darkens so that the rock as a whole has a blueish cast. Another phase is plain gray in color.

Topographically the Escondido is characterized by high rounded hills with bold rounded cliffs. Dip slopes are common. In particular it forms the spectacular knobs known locally as the Haystack Rocks which were described above.

As the top of the Escondido has been faulted off by the basement in the area, the total thickness is not present. However, it attains a measurable thickness of 7000 feet.

The stratification is well defined except in the anorthosite and basal conglomerates which show none at all. The bedding commonly takes the form of gradational sorting, but definite planes are frequent in the sandstone matrix.

The type locality for the Escondido is in Escondido Canyon just west of the area.

Prominent in the area is a thick series of lava flows. They occur low in the Escondido formation. No attempt was made to distinguish the flows in detail. Several flows can easily be distinguished, however, by the presence of lenses of conglomerate, several highly amygdaloidal layers, and an interflow stratum of conglomerate. (Plate VI, Fig. 2)

The exact nature of the rock is somewhat in doubt. Most observers concur in calling it andesite, but examina-

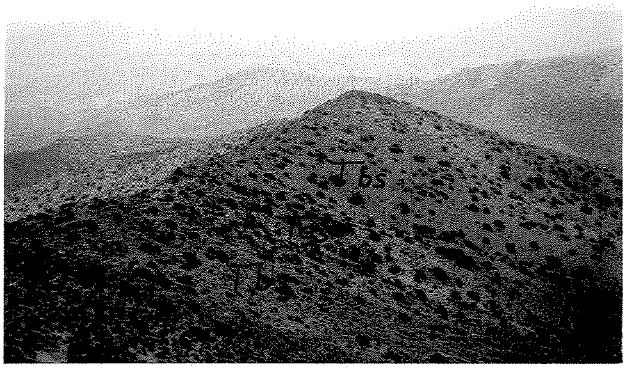


Fig. 2 Lens of sediment in the lava.

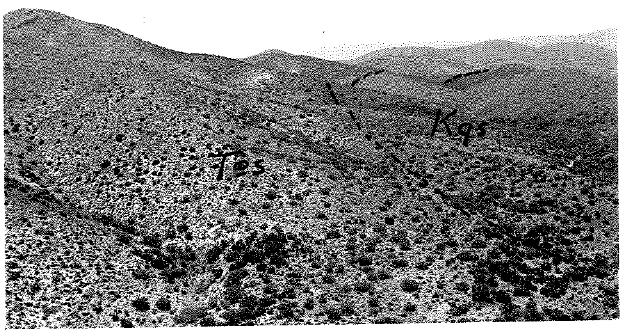


Fig. 1 Looking north in the north-east quarter. Shows strip of white anorthosite conglomerate.

PLATE VI

tion of a thin section shows plagioclase with maximum extinction angles of about 30° on albite twinning. This establishes the feldspar as labradorite and the specimen as basalt. Actually there is probably a slight variation in composition between flows, so that if the average composition is near the boundary between andesite and basalt it may swing across the borderline occasionally.

In the field the lava appears black on fresh surfaces. It weathers to colors varying from dull red or violet to brown and buff. At the tops of the flows it is crumbly and fine-vesicular. Amygdules are extremely numerous locally. They are most commonly of chalcedony, of a bluish milky variety with fine banding. Crystalline quartz is often present, and the chalcedony is sometimes colored dark green with epidote. Infrequently amygdules of coarsely crystalline gypsum occur, which are usually partly leached out. A chalcedony-quartz amygdule was found with its customary hollow center filled with gypsum. This establishes gypsiferous deposits as being of later date than those of silica. The amygdules are usually ellipsoidal in shape and reach six inches in size. Siliceous deposits also occur in fractures.

The lava is a prominent cliff-forming rock. It is eroded faster than it disintegrates in the canyons, thus steep walls and sharp, angular cliffs. The hills in the lava are usually low.

The Quaternary deposits are of two kinds. The most common is the usual recent alluvium, found in all canyon bottoms. There are also several older terraces, derived from the Escondido and from the basement. These are probably Pleistocene in age. It is certain that they are later than the latest faulting and antedate the most recent uplift. (See Plate II, Fig. 1)

Structure. The contact of the anorthosite basement with the Escondido formation is on two intersecting faults. That on the west trends about N 60° E and is approximately vertical. Its movement is also vertical and the total displacement is about 5000 feet. (See Plate VII, Fig. 1) The other fault is the principal expression of the uplift of the anorthosite. It is a normal fault of moderate angle, about 50°, dipping to the north. It has been offset by the movement on the other fault for a horizontal distance of about one mile. The strike of its plane is roughly N 60° W. Its total displacement is about 5000 feet (dip-slip component), estimated on the basis of the observable thickness of sediments and lavas in line with the direction of dip.

The Escondido formation is depositionally in contact with the quartz-syenite basement, except for a short distance on the Little Escondido fault. (See Plate VI, Fig. 1, Plate IX)

The lower contacts of the lava with the Escondido are igneous with the exception of a few fault contacts. The upper contacts are depositional, again except for

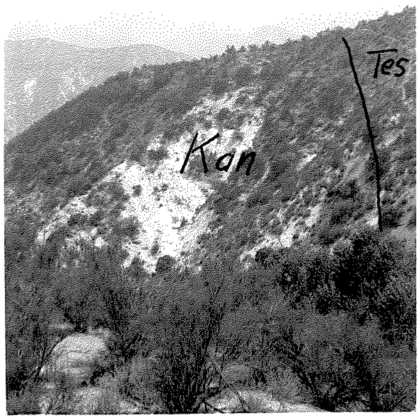


Fig. 1 Anorthosite, at the contact on the vertical fault.

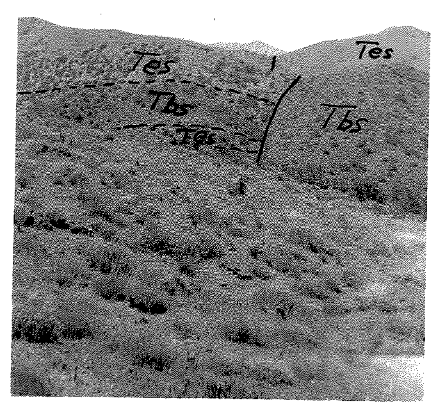


Fig. 2 Little Escondido fault, looking south. Also the interbedded lava and conglomerate.

PLATE VII

fault offsets. This is established by the presence of weathered lava surfaces and by absence of contact metamorphism, dikes and apophyses.

The stratified rocks of the area form a homocline dipping in general southwest at angles of 30° to 40°. (See Plate X, Fig. 2) Local variations in dips and strikes are caused chiefly by flat open folds which plunge steeply to the southwest. They are rather indefinite but are indicated on the map. (See Plate X, Fig. 1)

Aside from those on the anorthosite contact, the major fault in the area is the Little Escondido fault. It trends about N 30° E, and its surface is nearly vertical. Evidence for it is found in the displacement of the lava-sediment contacts (See Plate VII, Fig. 2) and in brecciation and fracture zones in the lava. There is no good exposure of the fault surface so the actual direction of movement cannot be determined. The horizontal offset amounts to about 2000 feet, the east side moving north. It can only with difficulty be traced in the sediments to the south, and it disappears under alluvium to the north.

On the west, near the boundary of the area is another fault displacing the lava contacts. A slickensided surface was found which showed its attitude to be N 25° W, 85° W, the slickensides pitching at 45°. The horizontal offset appears to be about half of that on the Little Escondido fault. A tongue of conglomerate east of the fault is again offset horizontally 100 feet by a smaller fault with the east side moving north.

It is possible that the lava may be in fault contact with the sediments between the fault just described and the Little Escondido fault. There are several points to be considered in this connection: (1) The strike of the sediments (N. 23° W.) is at an angle of roughly 65 with the strike of the contact surface. (2) The uppermost interbedded lava flow is missing. (3) None of the usual surface weathering of the lava is visible here, although the contact is so poorly exposed that this is not a safe criterion. If such a fault is actually present, the three intersecting faults form a block thrust southward under the sediments. Of course, the movement of this block is only part of the total movement on the Little Escondido fault. Also, as the movement of the block must have been at 45° from the horizontal, inclined southward, it gives a clue to the direction of movement on the Little Escondido fault. A hypothetical section is shown on Plate X, Fig. 3.

Toward the southeast the upper interbedded lava flow terminates, and its end has been displaced by a fault. The fault trends N 40° E. Its surface is not distinguishable in the general fracturing of the lava, but the southeast side has been offset 300 feet to the northeast.

The lower contact of the lavas and sediments in the northeast quarter of the area has been offset on a nearly vertical fault. Jointing in the lava indicates that the south side moved up (See Plate VIII, Fig. 1). The amount

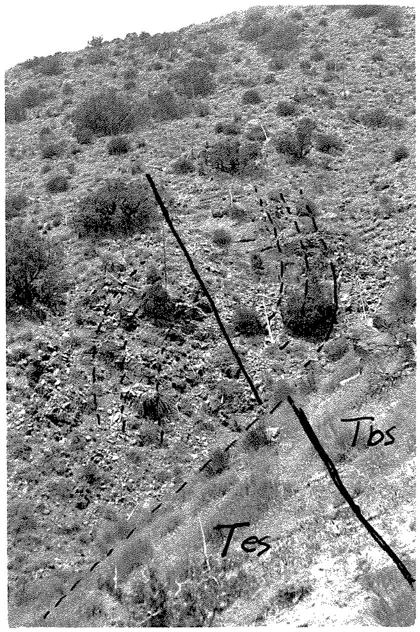


Fig. 1 Fault at lower contact of lava and conglomerate. Shows drag jointing of lava.

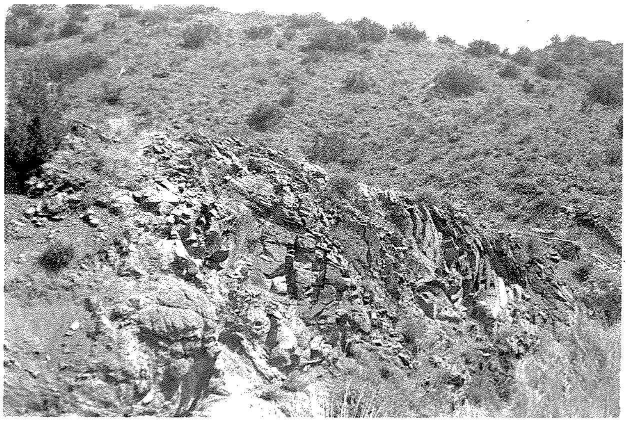
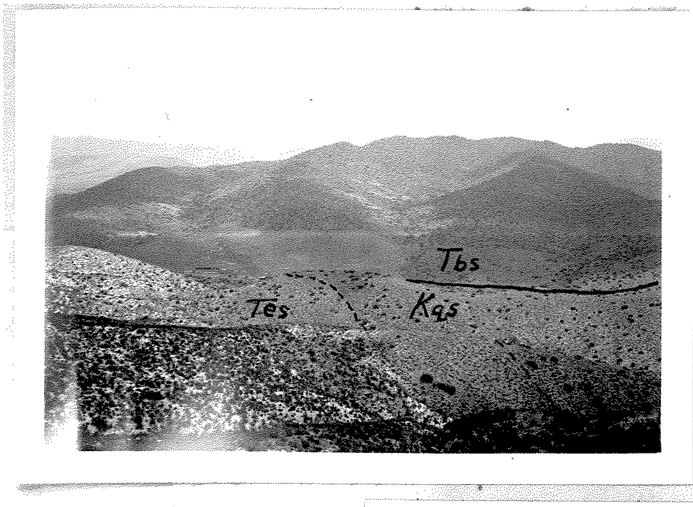
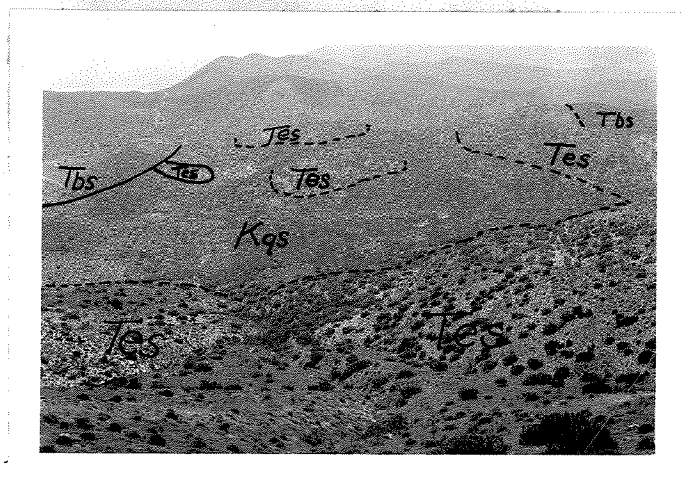


Fig. 2 Long N-S fault, looking south at fork of Escondido Canyon. Shows drag jointing. (NE $\frac{1}{4}$)

PLATE VIII





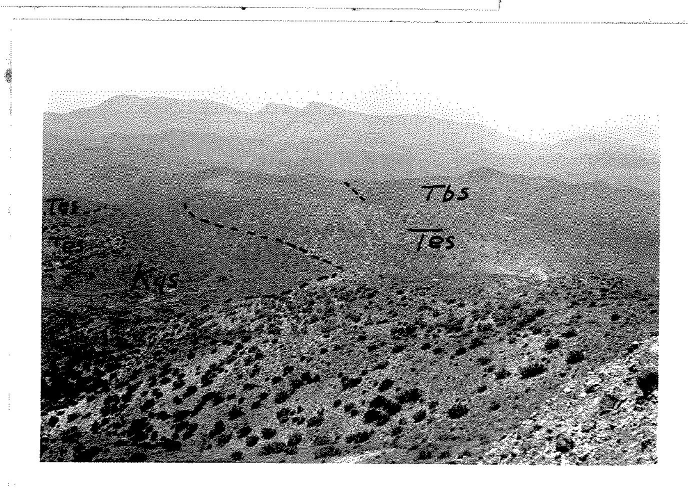


PLATE IX

Series in the northeast corner, looking east and southeast. Shows erosional remnants of the Escondido.

of offset is 550 feet, which indicates a possible vertical movement of 400 feet.

A fault trending almost north-south and a mile in length crosses the sediments in the north-east quarter. It is identifiable by a brecciated zone, but the actual fault surface cannot be seen. Jointing in the lava shows a large vertical component with the west side moving up, but there is no offset on either of the two contacts which it intersects. A direction of movement parallel to the slope of the traces of the contacts in the fault surface would result in no displacement of the contacts on the ground surface. (Plate VIII, Fig. 2)

There are three faults in the basement in the north-east quarter which are characterized by large brecciated zones. They are not traceable into the sediments.

A lava in the extreme northeast corner of the area is contacted only on a fault. There is a prominent clastic zone, but the fault surface is not exposed in the area. Its relationship to the other formations in the area was not investigated.

In the extreme northwest corner the sediments have been terminated against the basement by a fault of considerable displacement. It was not investigated.

Since the contacts in the area dip at angles averaging 35, the amounts of horizontal offset cannot be used to indicate directions of movement. However, it can be said that faults with considerable strike-slip components

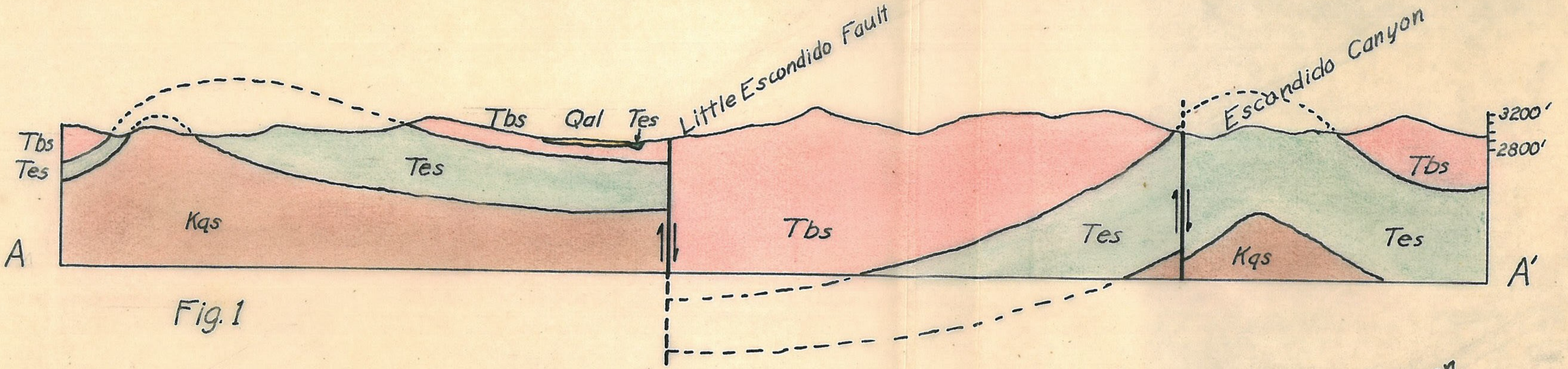


Fig. 1

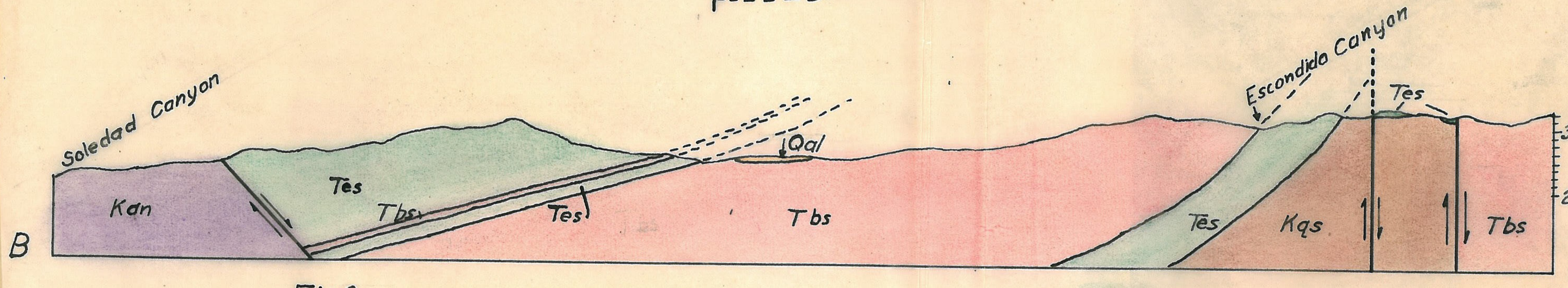


Fig 2

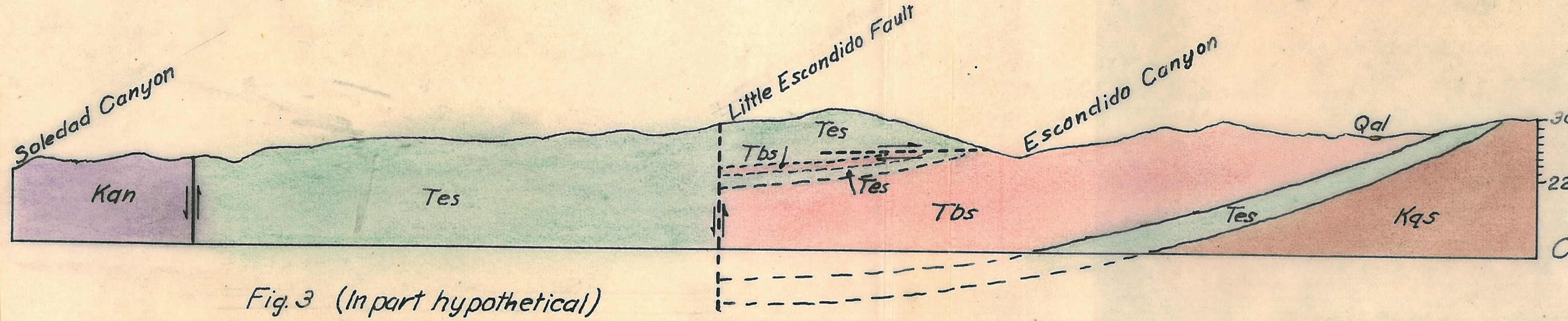


Fig. 3 (In part hypothetical)

Quaternary

Tertiary

Cretaceous (?)

Known contact

Possible contact

Known fault

Possible fault

Scale -- 1:24,000 1 inch = 2000

PLATE X

are much longer in proportion to their displacements than faults with large vertical components.

It is noticeable that the axis of the folds and the fault surfaces trend NE-SW. This indicates that the region has been subjected to a shearing stress with the forces exerted northward on the east and southward on the west. As a result, the region was shortened in a NW-SE direction with the movement taken up on high-angle short reverse faults and open folds, and lengthened in a NE-SW direction with movement on strike-slip faults in that direction and on normal faults trending at right angles to the lengthening.

The erosional remnants in the N-E quarter (Escondido on basement) have probably been faulted down by one of the three faults in the basement mentioned above. (Plate X, Fig. 2)

Historical Geology

The events in the history of the area took place in the following order:

The plutonic rocks were intruded into the old country rock. This occurred in Jurassic or early Cretaceous time. It was followed by a cycle of erosion during which the intrusives were laid bare.

The area then became a basin of deposition. This was probably a result of initial uplift on the San Gabriel block. The deposits were of heavy angular fan conglomerates with materials derived from rock types known in the San Gabriels, which is strong evidence for a sudden uplift in that region.

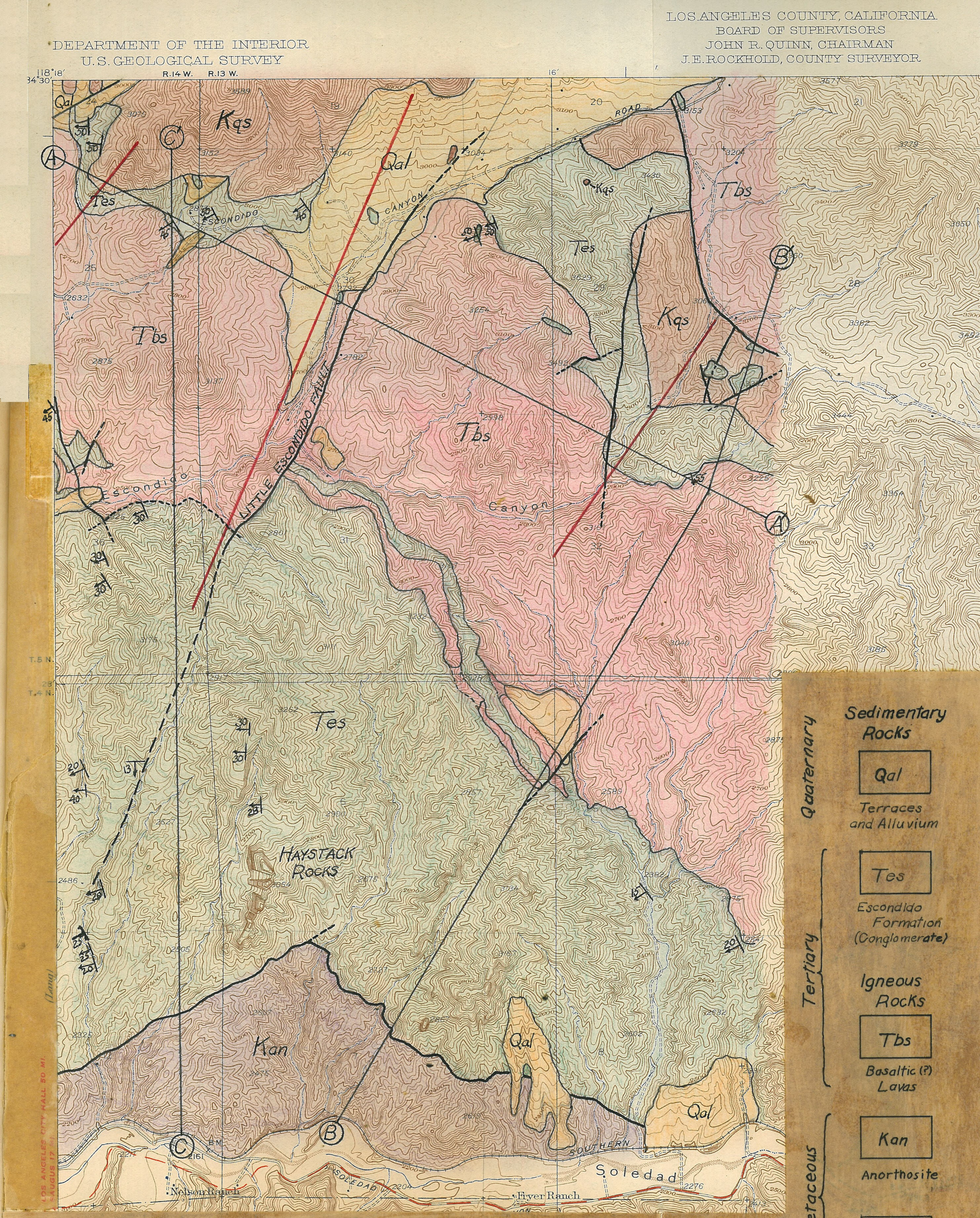
Deposition was interrupted by great outpourings of lava. There was an interval after the first flow great enough to permit accumulation of small lenses of sediments. Then there was an uninterrupted series of flows followed by a longer interval of deposition before the final flow. Several hundred feet more of the Escondido were laid down before cessation. The coarseness and volume of the material indicates that it was formed under arid conditions.

There was definite folding and faulting before Mint Canyon time, but how many such periods of activity occurred in the early Tertiary it is hard to say. There was at least one before the Escondido shown by faults in the basement, and one after it, shown by unconformity farther west.

After the Mint Canyon formation was laid down there was a marine invasion and the Modelo formation was deposited. During the early Pliocene there were oscillations of the sea (Pico formation), and in late Pliocene the land emerged to receive the terrestrial Saugus deposits.

In the Pleistocene epoch there was a period of diastrophism. The sediments were tilted, folded and faulted. A period of erosion ensued during which all sediments which may have existed in the area above the Escondido were removed and the Escondido was truncated.

There followed an unknown number of small uplifts and erosional intervals. Then the area was eroded to late maturity and terraces were deposited. Another small uplift brings us to the present day.



NORTH-WEST QUARTER OF THE RAVENNA QUADRANGLE
LOS ANGELES COUNTY, CALIFORNIA

SCALE – 1/24,000

1 ½ 0 1 mile

Contour Interval = 25 feet

TOPOGRAPHY BY U.S. GEOLOGICAL SURVEY, 1930 GEOLOGY BY R.H. COWIE, 1938