THE GEOLOGY OF A PORTION OF NEWHALL AND SYLMAR QUADRANGLES, LOS ANGELES COUNTY, CALIFORNIA.

Partial Fulfillment For
The Degree Of Bachelor Of Science
at
The California Institute Of Technology

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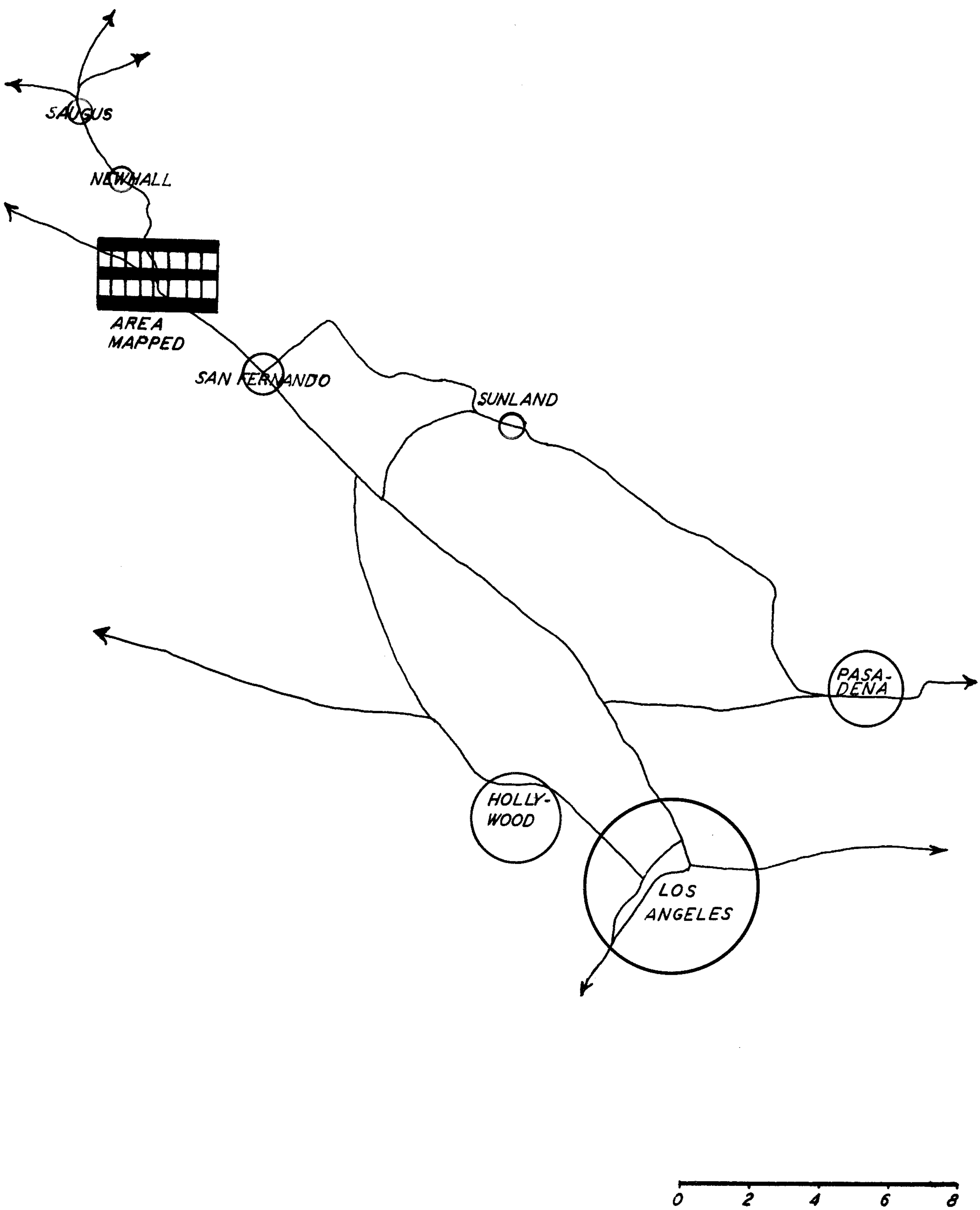
LOCATION OF AREA.



Summary

The area mapped includes nine and one-half square miles of the southeastern portion of the Newhall quadrangle and the southwestern portion of the Sylmar quadrangle, Los Angeles County, California. The work was done as partial fulfillment for the degree of Bachelor of Science at the California Institute of Technology.

The area has been mapped before by W. S. W. Kew, whose work will be found in U.S.G.S. Bull. 753. At that time, however, maps were of a scale of one mile to the inch, and field work could not be plotted with great accuracy. Recently Los Angeles County maps have been issued with a scale of two thousand feet to the inch, enabling the writer to plot the field data very accurately.

The area mapped consists of sediments, and a metamorphic complex in which little was done. The sediments begin with the Middle Miocene Modelo, and include the Pliocene Pico formation as well as the Pliocene-Pleistocene Saugus. The sediments consist of conglomerates, sandstones, and shales. In areal extent the conglomerates are the most important, and the shales the least, but economically the shales are more important as they serve as a source of oil.

The dominant structures in the region are the late Pleistocene folds, and the Sierra Madra fault of the same age. All structures trend in an east-west direction, although the fault makes a 45° turn in this area, and after running in a northeast-southwest direction for about five miles turns again and continues its east-west trend.

Oil is found in the region, collected along the folds to the north and to the west of this area. There is a possibility of oil along the Pico anticline .

Quartz veins are present in the basement and may be of some economic value.

Introduction

The area covered in this survey includes the southeast portion of the Newhall quadrangle and the southwest portion of the Sylmar quadrangle, Los Angeles County, California. The area lies between longitude 118°28' west and 118°32' west and latitude 34°18' north and 34°20' north. The Los Angeles-San Francisco inland highway (No. 99) passes through the center of the area. The nearest towns are San Fernando four and one-half miles to the southeast and Newhall three and one-half miles to the northwest. The area is rectangular, being three and three-fourths miles in an east-west direction and two and one-half miles in a north-south direction, or about nine and one-half square miles in total.

The area covered in this report lies in the southern part of the Coast ranges. Directly to the east are the San Gabriel Mountains and to the west the Santa Susana Mountains. To the south is found the fertile San Fernando Valley. The area may be reached by means of the Southern Pacific railroad which traverses the area, or by Stage which follows the main highway through the area.

The area was mapped as partial fulfillment for the degree of Bachelor of Science at the California Institute of Technology. The work is designed to give the graduate in geology more familiarity with field mapping, and to acquaint him with some of the more important formations found in California.

The regular field procedure was followed, the area being covered on foot and attitudes of beds being taken with a Brunton Compass. Attitudes were taken very close together on the limbs of anticlines and synclines in order to enable the writer to plot the axes of these structures with great accuracy.

Acknowledgments

The area has been mapped by W. S. W. Kew, J. P. Buwalda, C. M. Wagner, and W. A. English. Their work was done in 1917, 1918, 1919, and 1922 and was published in 1924 by the Government Printing Office. For reference see U.S.G.S. Bull. 753. At that time the maps were of a scale $\frac{1}{62,500}$, recently the area has been re-surveyed and maps are now obtainable of a scale $\frac{1}{24,000}$. The newer maps enabled the writer to plot the field data much more accurately than had been possible by former workers using the older maps. The writer is indebted to Dr. Kew for the determination of the Modelo shale and the Modelo sandstone. These two beds were not fossiliferous and the writer was not well enough acquainted with their lithology to determine them. The beds determined as Saugus and Pico were fossiliferous and the writer had had enough former experience in these beds to enable him to name them.

Accessibility and Culture

With the exception of the northeastern and southwestern part the area is easily accessible by car. The main road through the area is paved, but the branch roads are of dirt and in places extremely steep.

The area is very sparsely populated. The main occupation is cattle raising although along the southern border of the area mapped grape and citrus fruit culture are important.

Several notable oil fields are located in the area, but are not producing large quantities of oil. These oil fields have given rise to the town of Newhall which lies to the northwest.

Physical Conditions

The elevation of the region is varied and ranges from twelve hundred and fifty feet in the valleys to three thousand feet in the rocks and crystalines to the northeast. The nature of the sediments is such that the canyons walls weather very steeply giving rise in places to almost vertical clifs. The extreme north end of the area is drained to the northward; to the south of San Fernando Pass the drainage is toward the southeast on the west side of the main highway, and to the south or southwest on the east side of the main highway. The exposures of the Pico formation are not as steep as those of the Saugus or Modelo due to the shale members in the Pico which tend to give rise to a less rugged topography.

The region is one of a typically semiarid type and, therefore, the streams are dry in the summer. The rainfall of the region is about seventeen inches, most of it falling in the months between November and March. The water of most of the small streams found in the sedimentary deposits is almost unfit for human consumption due to sulphur derived from the oil sands and the oil seeps.

In the summer the temperatures are high, often reaching over 100°F. It is, therefore, advisable to do most work in the spring when rains are not so frequent and the heat is not excessive.

Outcrops are very numerous due to the relatively soft nature of the sediments. Most of them are very fresh as in the rainy season the streams are almost turned into torrents, eroding their courses very rapidly. Good exposures are to be found in all the sedimentary deposits as well as in the basement complex. The shale of the Modelo due to its siliceous nature gives very good exposures while, as has been said, the Pico shale tends to give more rounded forms.

The vegetation of the area is varied and is most abundant on the north sides of the slope, due to the less direct rays of the sun and, therefore, the more moist soil. On the shale members a vegetation of grass is found which forms pasturage for cattle. In the more moist places along the stream beds trees are found as well as an abundant growth of poison oak. In the sandstone and conglomerate is found a dense growth of sage brush making work very difficult, and in some places being so thick that geologic observation is practically impossible. In the spring of the year the hills are covered with many wild flowers, adding greatly to the beauty of the scene.

Stratigraphy

The rocks of this area fall into two types - a metamorphic and granitic complex called "basement complex" and a series of sediments. Little work was done in the basement complex except to map its boundary. The metamorphic rocks are of pre-Jurassic age while the intruded granite may be correlated with the Sierra Nevadan intrusion and is, therefore, late Jurassic in age. The sedimentary rocks in this region, which are by far the more important than the crystalline rocks, range in age from Upper Miocene to Recent. In order of age they are: Modelo shale (Upper Miocene), Modelo sandstone (Upper Miocene), Pico formation (Lower Pliocene). Saugus formation (Upper Pliocene to Lower Pleistocene), and valley alluvium (Recent). In lithology the sedimentary rocks are very much alike, so much so that at times contacts were extremely hard to locate. This was especially true of the Pico-Saugus contact and the Upper Modelo-Pico contact.

Metamorphic Rocks

The basement complex is made up of various metamorphic rocks and of igneous rocks varying from granite to almost pure quartz. The metamorphic rocks are mostly schists varying from a blue to a dark grey in color. The planes of schistosity dip to the southwest. In general the metamorphics seem to be of sedimentary origin but in places an igneous origin seems possible. These metamorphics have been intruded by igneous rocks of a composition close to that of granite. Some quite pure quartz veins are found in the area directly east of San Fernando Pass. In one locality beds of quartzite were found which clearly showed the original bedding.

The metamorphic rocks are pre-Jurassic in age if the granite which intrudes them can be correlated with the Sierra Nevadan intrusion. According to Dr. Kew this is the probable case.

Sedimentary Rocks
Miocene System

Modelo Formation (after Kew) Upper Miocene.

Distribution and Lithology

The Modelo formation was encountered only in the southwestern part of the area. Its relation to the underlying formation was not investigated as the contact lay outside the area mapped. In this report the Modelo is divided into two large divisions: the older shale series which is considered Middle Upper Miocene in age, and the sandstone series.

The shale member of the series is quite easy to distinguish from shales of other formations found in the area. The lower part consists of a clay-like, fine grained, thinly bedded shale. It is grey in color and weathers to rusty brown. Little can be seen with the aid of a hand lens but it seems to contain a great deal of quartz, some feldspar, and probably considerable iron minerals. As far as the writer could determine it contained no foraminifera. Toward the top of the shale series the material becomes coarser grained and more siliceous and weathers to a blue-grey color. These shales are thinly bedded, very hard, ring when struck with a hammer, and grey in color. The shale series in general contains a large quantity of organic material making it much darker than other formations. Considerable yellow, very hard chert is found in small beds or in small masses in the shale. The chert weathers slower than the shale and, therefore, forms rather prominent protrusions. According to Dr. Kew this chert is characteristic of the Modelo shale throughout California. The shale member as a whole is very hard and weathers quite steeply. In the canyons a number of oil seeps were noted. Many springs also rise in the formation, but their water is so impregnated with sulphur that it is unfit to drink. Soil weathered from the shale supports a vegetation of grass in the more level places and on the slopes much sage brush.

The sandstone member of the Modelo formation is also readily distinguished from other formations found in the area, although in the western part of the area the contact between the Modelo sandstone and the Pico was traced with much difficulty, due to what appears to the writer to be continuous deposition. The sandstone is very coarse-grained, yellow-brown to white in color, and well indurated. It is composed of much quartz and lesser amounts of feldspar and mica. Interbedded with this sandstone are found beds of conglomerates and a few shale beds. The conglomerate is very hard and well cemented. It occurs in thick beds, from five to eight feet, and in places is strongly cross-bedded. The pebbles which compose it are sub-angular to rounded and range up to three inches in diameter. They are mostly composed of igneous rock although some metamorphics are found as well as an occasional shale boulder.

The shale members of the formation mapped as Modelo sandstone are much like the beds of the Modelo shale member except that they are more siliceous and more grey in color. These shales are in rather thin beds in the southwestern part of the area; toward the west they become more numerous, forming a large part of the formation.

The sandstone member of the Modelo, taken as a whole, is commonly nodular, and the cavities left when the nodules fall out gives it a characteristic cavernous appearance. This member, due to its hardness, weathers very steeply giving rise to canyon walls that are impossible to climb.

Origin and Age

The Modelo series in this locality is typically marine probably being in part (the shale) deep water, or at least very still water, and in part (the sandstone) marginal deposition. The material in the conglomerate was probably derived from a terrace some distance to the east, or to the northeast. According to Dr. Kew there is no diagnostic fossil evidence for the age of the Modelo formation. Its age has been based entirely upon its stratigraphic position with reference to formations of known age.

Pliocene System

Fernando Group

In the mapping of the Pliocene series the writer has made the same divisions that Kew made in his work in Los Angeles and Ventura Counties. The Fernando group as used in Southern California includes both Pliocene and Pleistocene formations. In this report it has been divided into two distinct formations- the Pico and the Saugus..

The Pico consists of the beds of lower Pliocene age. They are entirely marine in origin and vary with the type of strand line. They are in part massive conglomerate, in part sandstone, and in part shale. Fossils are common and their age may be very closely determined.

The "Saugus" as originally used by H. Hamlin applied to Pleistocene terrace deposits which lay above the Upper Pliocene marine and terrestrial beds. However, in 1902 Hershey used the name Saugus to apply to the upper part of the Fernando group, or Upper Pliocene-lower Pleistocene deposits.. In this report this usage of Saugus is accepted. It consists of both marine and terrestrial beds. In the western part of the area the Saugus appears to be almost wholly marine and contains inverterate fossils, while in the eastern part it looks much like a fanglomerate deposit. Throughout it is very strongly cross-bedded and in no part is there evidence of deep water deposition.

Pico Formation (Lower Pliocene)

Distribution and Lithology

The Pico formation is exposed in the central portion of the area to a great extent forming nearly half of the sediments mapped. It extends in small bands from the center to the northeast, northwest, southwest and east. In general the Pico rests on the Modelo with a marked unconformity, but in the western portion of the area there seems to be no break in sedimentation. In the extreme western portion one can again plainly see an unconformable relation between the two formations. The area of apparent continuous deposition probably represents an arm of the sea which ran back in the ancient land area.

In some places the lithology of the beds, near the contact of the Pico on the Modelo, was remarkably similar. The contact could be traced for a considerable distance by means of a basal conglomerate bed which lay between a grey-yellow sandstone bed of the Pico and a grey sandstone member of the Modelo. The Pico sandstone has in it very characteristic yellow limonitic concritions which enabled the writer to separate it from the

Modelo in many places where the lithology of the two formations was similar.

In the western part of the area the Pico rests normally on the basement complex where it has probably overlapped the Modelo. It dips greatly to the west at about 20^{0}. At the base of the Pico is found a basal conglomerate about fifteen feet thick in which invertebrate shells are found. This basal conglomerate is derived from the basement upon which it rests.

The Pico consists of sandstone, conglomerate, and shale (in the order of importance). The sandstone in some places is fine-grained and in others coarse-grained. On the whole it may be said that the sandstone in the eastern part of the area is somewhat coarser than in the western portion. In general it is light yellow to grey in color but in the western portion of the area where the Pico rests directly on the basement oil has stained the sandstone, as well as the conglomerate and shale, a chocolate color. The sandstone over the entire area is quite quartzitic and well cemented forming hard beds which weather very steeply and give good outcrops. As has been said, the Pico sandstone has many large (up to one foot in diameter) concretions of limonitic sandstone which enable one to distinguish it at a glance.

The conglomerate of the Pico is second in importance only to the sandstone. It is composed chiefly of granitic and metamorphic boulders although some sandstone pebbles are found. Scattered throughout the conglomerate are found boulders of anorthosite which must be derived from the head of Santa Clara Valley. The material of the conglomerate ranges up to four inches in diameter and is sub-angular to rounded. Some few boulders of lava were found in the Pico conglomerate which probably also had their origin to the northeast near the head of the Santa Clara Valley. In general the conglomerate is yellow-grey to a grey-brown in color and fairly well cemented. It weathers into steep slopes and gives good outcrops. In places, however, the material is badly cross-bedded and attitude must be selected with care.

The least important member of the Pico formation is the shale. It is blue-grey to grey in color and medium to fine-grained. It is composed of quartz and feldspar with other lesser minerals. In general it does not form large beds but is found interbedded in the sandstone and the conglomerate. The shale weathers to a grey color and does not give good outcrops due to its soft nature.

The Pico formation in general gives steep exposures affording good attitudes. Care must, however, be taken for cross-bedding is common throughout the formation.

ORIGIN AND AGE

Judging from the conglomerate it is safe to conclude that the Pico was derived from the basement on which it rests and also in part from the material at the head of Santa Clara Valley. The nearest lava and anorthocite is found to the northeast at the head of Soledad Canyon. This with the evidence offered by cross-bedding leads the writer to think that some of the material came from this locality. However, a majority of the material is metamorphis and granitic, and was in all probability derived from the basement complex directly to the east. The Pico is quite fossiliferous and a determination of the invertebrate forms found has placed the formation in the Lower Pliocene.

Saugus Formation (Upper Pliocene and Pleistocene)

Distribution and Lithology

The uppermost Pliocene formation, the Saugus, is found in the northwestern and southeastern part of the area. In the north it is unconformably in contact with the underlying Pico. In the south the Sierra Madra fault has brought the Pico up into contact with the Saugus.

The northern patch of Saugus is most certainly marine for a bed of re-worked fossil shells was found extending from station eleven to station fourteen. In the southern section it appears to the writer that the material is land laid. In the few poor exposures seen, the material showed little bedding, and what could be found was badly cross-bedded.

The Saugus consists of conglomerate, sandstone and shale, named in the order of importance. The conglomerate of this formation consists of pebbles ranging in size from sand to one foot in diameter and sub-angular to round. In the southern portion the conglomerate is very poorly consolidated and upon weathering gives rise to slopes presenting few or no outcrops. The material composing the conglomerate is of both igneous and metamorphic origin, with igneous rocks being most abundant. This indicates that the material was derived in part from the basement at hand, and in part from a distance. In the Saugus conglomerate we also find anorthosite indicating an origin in the vicinity of Soledad Canyon. The conglomerate is very badly corss-bedded and in many places shows no sign of any bedding. It is surely of continental origin at this locality.

In the north of the area the conglomerate is better sorted and shows more bedding. The material is the same as in the south, but here marginal marine conditions seem to be indicated.

The Saugus conglomerate in general is light in color and weathers to a rusty brown, rocky, soil.

The sandstone of the Saugus is coarse to medium grained, poorly bedded, quite arkosic and light yellow in color. It is fairly well consolidated and gives rise to good outcrops. As in the conglomerate it is very badly cross-bedded. Very little sandstone is found in the southern section, while in the northern section it is interbedded with the conglomerate. It occurs in thin beds six to twelve inches thick and in large beds ten to twenty feet thick. Kew states that the beds of the Saugus are continental and do not contain marine fossils east of Bull Canyon, but the writer will say again that a fossiliferous marine sandstone was found just west of San Fernando Pass (station eleven to founteen).

The shale in the Saugus is of little importance for it is quite rare. It does not seem to occur in the southern part, as is to be expected, for it is continental, and only in thin beds interbedded in the sandstone and conglomerate of the northern part. It is fine-grained, light brown in color, and fairly well consolidated.

Origin and Age

As we have said before, the conglomerate contains igneous rocks and metamorphic rocks. It also contains boulders of anorthosite. The metamorphics and some of the igneous rocks were probably derived from the basement in the eastern part of the area. The anorthosite could have been derived from the erosion of the Pico, which contains a great deal of it, but in all probability it came from the Soledad Canyon area, as it has been a positive land area since Miocene time. The sandstone and the shale were also derived from these two areas.

The Saugus being fossiliferous in a number of places, and many marine forms having been identified, the age is probably exactly known. It is considered as Upper Pliocene and Lower Pleistocene.

Quaternary System

Alluvium

Alluvium fills all the valleys and extends up many of the large streams. It is lying flat and is composed of coarse to fine gravels. It is now being rapidly cut by streams, some of which have entrenched themselves many feet below the level of the floor of the valleys.

Structure

General Features

The structure of this area is typical of the California Coast ranges. It consists of a series of parallel folds and a large reverse fault. The general trend of the folds is nearly east-west although they run a little to the north. The structural features have been strikingly reflected in the topography of the region for almost all the main canyons run parallel to the folds. It seems safe to the writer to say that the folding in this area took place in post-Saugus time (after low Pleistocene).

The Sierra Madra fault passes through the area. In the eastern part it runs almost due east and west but it makes a sharp turn and runs about south 47° west throughout the rest of the area. It appears to the writer that the faulting, which is post-Saugus can be correlated with the folding. This will be developed later.

Structural Details

Contacts

It might be well to consider briefly again the contacts of the formations. The Modelo shale, the lowest member mapped is overlain conformably by the Modelo sandstone. The Modelo may have been deposited on the basement to the east and overlapped by the Pico. The writer could not say this for certain without the aid of core samples which he could not obtain. The Pico overlies the Modelo unconformably but without any angular difference. The Pico was deposited on the eastern basement and is in an unconformable relation with it. The Saugus overlies the Pico without an angular unconformity, but a period of erosion of the Pico is clearly indicated. The alluvium is is overlying the older formation in the valley bottom and is, in nearly all cases, unconformable, angular difference being noted in a number of regions.

Since the sediments dip away from the basement at about

20° to 30° it must dip a little steeper, but the writer believes that the basement dips only slightly more than the sediments, about 25° to 35°. This idea is supported by an island of basement protruding through the Pico, as well as the exposed Basement-Pico contact in many of the canyons.

Folding (Beginning to South and Working to North)

Syncline #1

Formed in the Pico formation and runs practically parallel to the western part of the Sierra Madra fault. It seems to die out on both ends as it converges toward the fault. It has rather steeply dipping north limb (55°) but south limb is indeterminate. It may plunge slightly to the east.

Syncline #2

Formed in the Modelo shale, and runs almost perpendicular to the western part of the fault. It is not quite symmetrical, the northern limb dipping more steeply (50°) than the southern one (30°). It does not seem to plunge in either direction.

Anticline #2

Also formed mostly in Modelo shale but closer to its northern contact with the Modelo sandstone. It cuts through the Modelo sandstone and dies out in the Pico. It is nearly symmetrical, its southern limb probably dipping slightly more than the northern one (50°). As it approaches the fault it turns from being almost perpendicular to it and runs about parallel to it. The attitudes of the beds indicate that it dips to the northeast.

Syncline #3

This syncline runs parallel to the Pico anticline, the dominant fold of the area. It is found in the Modelo sandstone and in the Pico. It is rather broad, dips of limbs about 45°, and almost symmetrical. As with anticline No. 4 this syncline turns from its east-west direction and runs parallel to the fault. It dies out in the Pico but does not seem to plunge in either direction.

The Pico Anticline

This is the most important fold of the region. It is formed in the Modelo shale, sandstone and in the Pico, in which it dies out to the east. It may plunge slightly to the west but in this limited area it seems almost normal. It is very closely folded dipping as great as 70°. It is quite symmetrical, if anything the north limb being the steepest. As with the two other folds it turns and runs parallel to the fault.

Syncline #4

This fold occurs in the Saugus and Pico, dying out in the Pico against the basement as well as to the west in the Saugus. It is a rather broad fold, the limbs dipping about 30°. It is roughly symmetrical. It plunges inward toward the center from both ends, forming a basin-like depression. It does not turn and run parallel to the fault, but contains in its east-west direction until it dies out against the basement.

Anticline #3

This fold is found just north of the Newhall tunnel at San Fernando Pass. It is found in the Pico and the Saugus and dies out to the east against the basement. It is fairly symmetrical and may plunge to the west. The limbs dip about 40°.

Syncline #5

Formed in the Pico up against the basement. Put in on poor evidence, one dip and strike, so may be only local folding.

Faulting

The major structural feature of the area is the Sierra Madra fault. It has cut through the Tertiary sediments of the area and is bordered on the north by the Pico formation and on the south by the Saugus formation. Being located in such soft sediments it was very hard to trace, and almost impossible to find its dip. However, the writer believes that it is a high angle reverse fault and the movement has been almost all vertical. Outcrops of gouge and striated rock tend to bear out the above assumption. The vertical movement has been at least two thousand feet for the northern block has gone up enough to allow erosion to remove all the Saugus. In the area the fault makes a sharp turn of about 43°. This can easily be explained if both sections are reverse, and will be done so in a later discussion of relations of faulting to folding. The fault is, of course, post-Saugus for it has displaced this formation. It is probably Upper Pleistocene in age. As far as could be ascertained, the fault is dead for no evidence of recent activity was at hand. There has been no movement since the deposition of the alluvium, for it passes over the fault without a break.

Relation of Faulting to Folding

Since the folds affect beds of Miocene, Pliocene, and early Pleistocene age and not the alluvium, it is safe to assume that they are late Pleistocene in age (post-Saugus and pre-alluvium). This fault also affects Miocene, Pliocene and early Pleistocene sediments and not the alluvium. Therefore, we can say that it is in all probability late Pleistocene in age. Another safe assumption is that the fault is a high angle reverse one, for to the west it passes into the Santa Susana overthrust. The traces of the fault on the ridges and in the valleys tend to strengthen this assumption. It is postulated that the forces which caused the faulting were compressional. It is important to note that the change in direction of the fault takes place in accordance with the outcrop of the western border of the basement complex.

The axis of the folds are generally parallel to the trace of the fault. This correspondence is illustrated in the accompanying diagram.

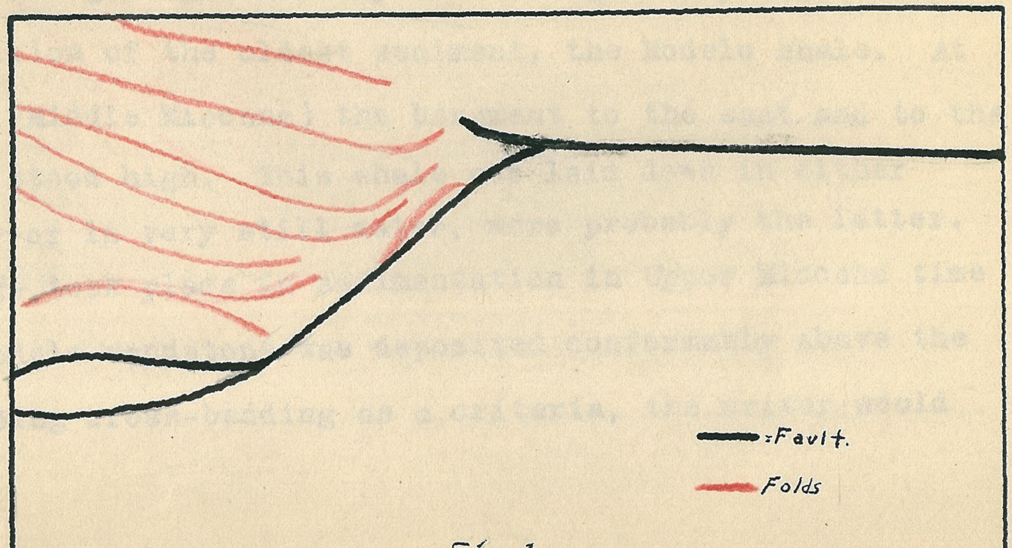


Fig 1

The writer wishes to present the following ideas:

In this area arose a set of complex compressional forces. One component was in a north-south direction and one in a northwest-southeast direction. The folding began due to these two sets of forces, the resulting folds in this locality are bent from an east-west to northeast-southwest trend. The folding was not sufficient to completely relieve the stress and faulting occurred, the northeast-southwest fault first and later the east-west fault transcending it. It seems to the writer that the evidences of parallel structure and of the same age of the structure is sufficient to uphold the theory of similar origin and age of the folding and faulting.

Geologic History

The oldest geologic formation in the area is the basement complex. It is of pre-Jurassic age and nothing is definitely known of its origin or age. Probably in Jurassic time it was intruded by granitic material. This activity may be correlated with the Sierra Nevadan intrusion. At some later date the "complex" was again intruded, this time with quartzitic material.

The real geologic history of the region may begin with the deposition of the oldest sediment, the Modelo shale. At this time (Middle Miocene) the basement to the east and to the northeast stood high. This shale was laid down in either deep water or in very still water, more probably the latter. Some change took place in sedimentation in Upper Miocene time and the Modelo sandstone was deposited conformably above the shale. Using cross-bedding as a criteria, the writer would say that the material for the Modelo formation was derived from the north or east.

After the deposition of the Modelo there was a general emergence of the area. In almost all of the area erosion of the Modelo followed but in places continuous deposition of the Pico over the Modelo indicates that in these parts the land did not protrude above the level of the sea. After the early Pliocene period of erosion the land was again immersed, this time a little deeper than before, for the Pico overlaps the Modelo toward the east.

The land remained under the sea all through the lower and middlePliocene. To the northeast lay the high mountain masses which furnished the material laid down as the Pico formation. The Soledad canyon area was a positive one because much anorthosite is found in the Pico conglomerate.

Toward the close of Middle Pliocene time the land began to rise, and by the end of the MiddlePliocene was again emerged. Erosion of the Pico took place and the land sank. Very little or no folding took place in the area either after deposition of the Modelo or of the Pico, for there seems to be no angular unconformity between any of the sediments, except the Saugus and the recent alluvium.

The land did not sink to a very great depth after the Upper Pliocene erosion interval, because the Saugus is in part marine (to the northwest), and in part continental (to the southeast). The material for the Saugus was derived in part from the basement, close at hand, and in part from the Soledad Canyon area. Since the deposition of the Saugus, the land has risen and the region has been a positive area.

In post-Saugus time the region was subjected to compressional forces, in general from the north and south. Faulting and folding took place on a large scale, forming the structures now present in the area.

The region is now undergoing rapid erosion. This and deposition of alluvium are reducing the topography from youth to middle age.

Economic Considerations

In the basement complex a number of quartz viens are to be found. The possibility of them being mineralized is present but improbable. The ones that were investigated by the writer contained nothing of worth.

Oil in the area is not only a possibility but a reality. The conditions for its accumulation are all at hand. The formations that serve as the source of oil are present. The sediments capable for holding the oil are in contact with the "oil sands". The region is folded and faulted, forming features that will trap the oil; and lastly, water is present, which may be necessary to carry the oil to the places of storage.

The Modelo serves as a source of oil. Overlying this formation we find sandstone and conglomerates, both porous members and forming excellent reservoirs for the petroleum.

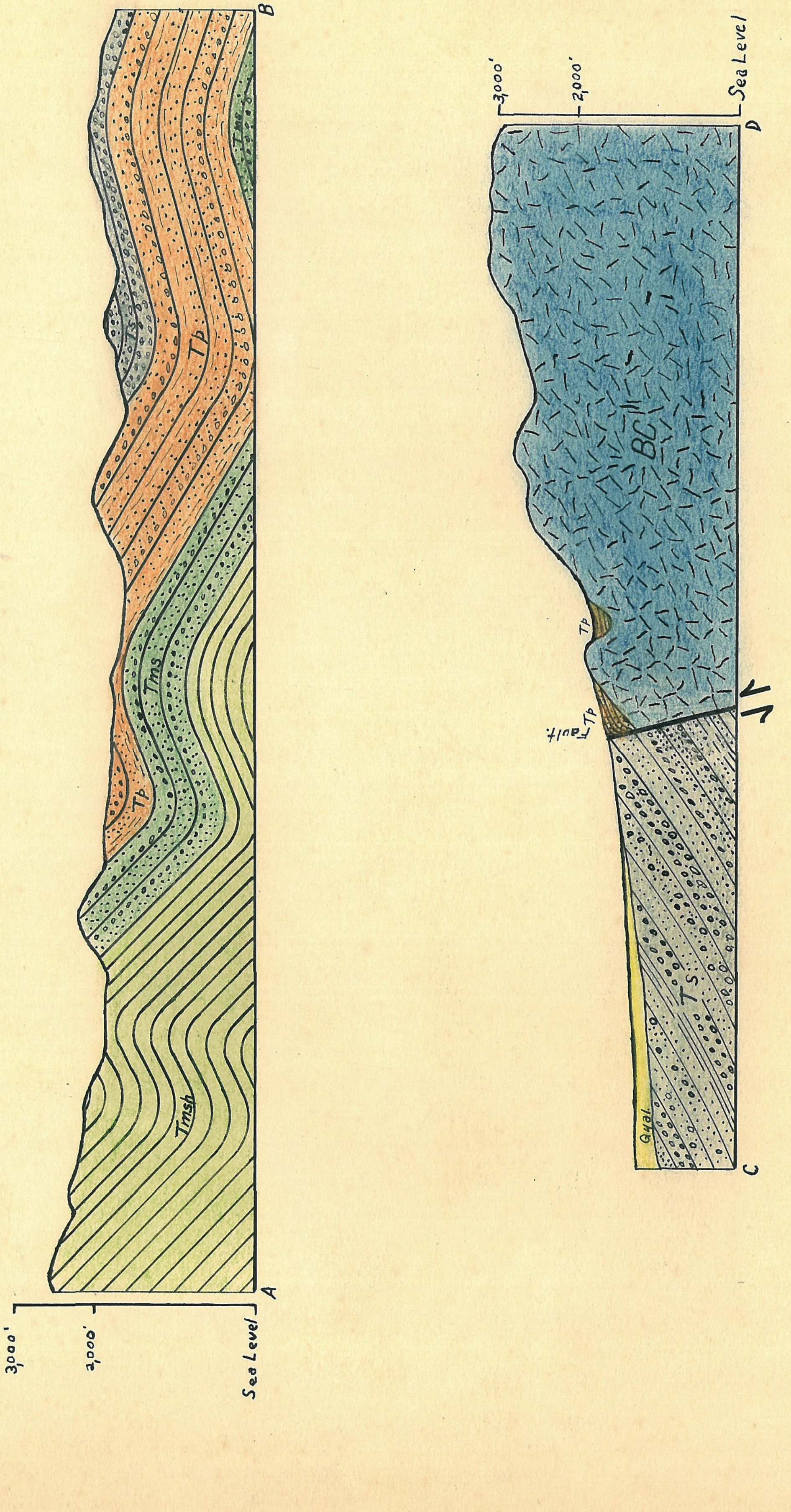
Kew in U.S.G.S. Bull. 753 has gone into a lengthy description of the oil fields in the area, and the possibility of new fields, so the writer will only say that producing fields are found just north of San Fernando Pass, and there is a possibility of oil collection in the area along the Pico anticline.

Bibliography

W. S. W. Kew - U.S.G.S. Bull. No. 753

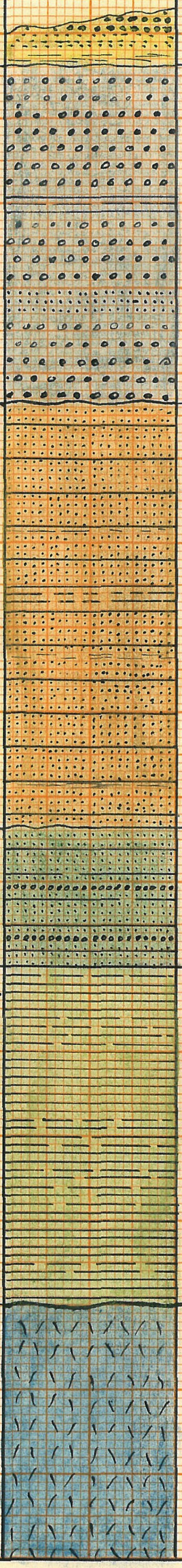
STRUCTURE SECTION. E.N. Harshman Plate I

Scale - 2000'=1"

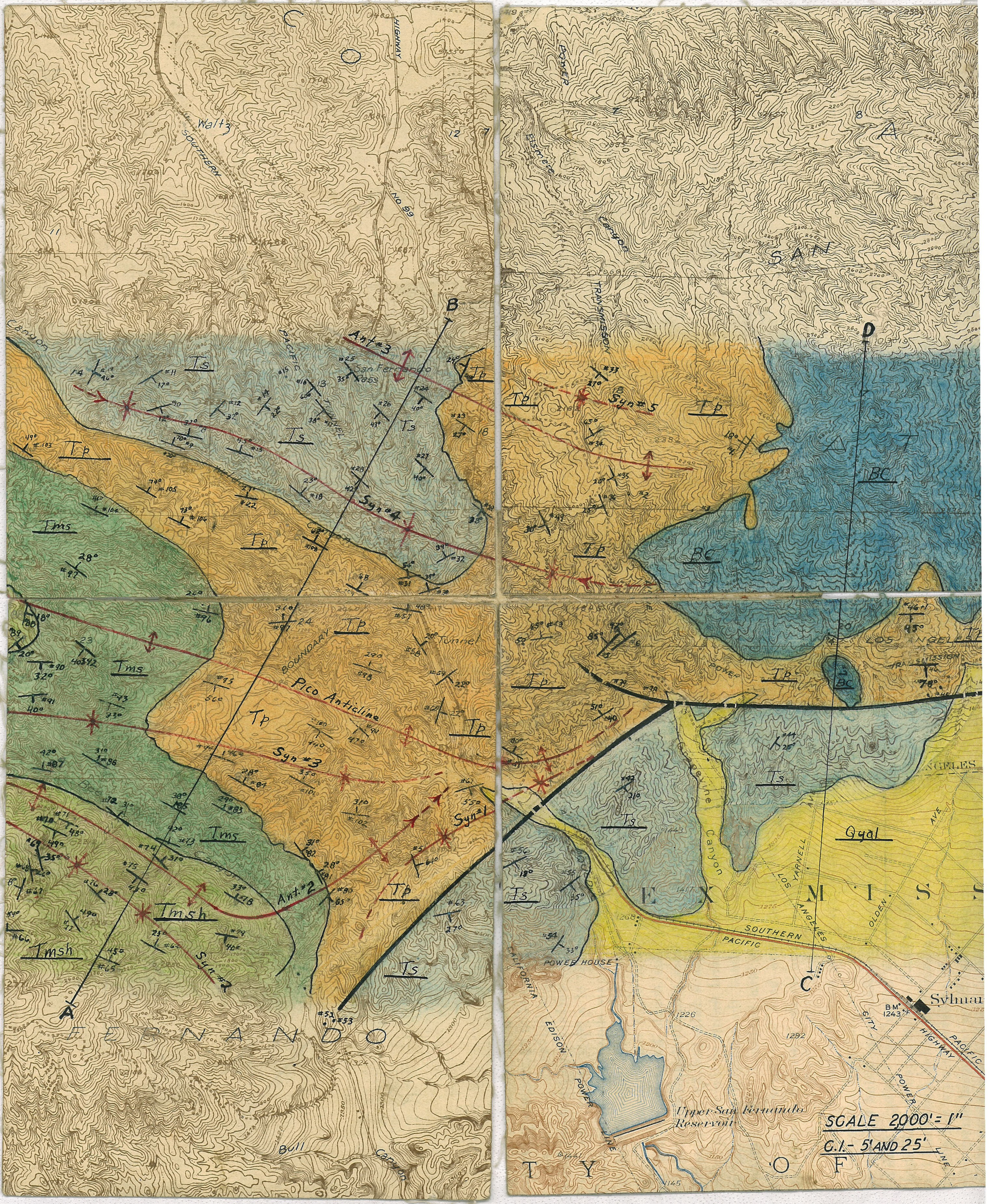


E. N. Harshman Plate 2

COLUMNAR SECTION.

System	Series	Formation	Symbol	Columnar Section	Thickness in feet.	Character
QUAT.	REC.	Alluvium	Qyal		200±	Alluvium
	PLEISTOCENE.	Saugus.	Ts		2,000±	Light colored sandstone and conglomerate, very little shale. In part marine and in part terrestial.
		UNCONFORMITY.				
TERTIARY	PLIOCENE.	Pico.	Tp		2,500±	Fine grey to coarse brown sandstone and conglomerate of marine origin.
		UNCONF. (in part)				
	MIOCENE.	Modelo sandstone.	Tms		800±	Massive sandstone with some conglomerate and shale.
		CONFORMABLE				
		Modelo shale.	Tmsh		2,000±	Thin bedded siliceous to clay shales.
		UNCONFORMITY				
MESOZOIC	Pre-JURASSIC.		BC		?	Metamorphics. Of igneous and sedimentary origin. Intruded by granite and cut by many quartz veins.

Scale- 1,000' = 1"


Ant #3
Syn #5
Syn #4
Pico Anticline
Syn #3
Syn #1
Ant #2
Syn #2
Tp
Ts
Tms
Tmsh
BC
Qyal
B
D
A
C
SAN
FERNANDO
MISS
Upper San Fernando Reservoir
POWER HOUSE
SOUTHERN PACIFIC
Sylmar
SCALE 2000' = 1"
C.I. - 5' AND 25'