Geology of a Portion of the Eastern Santa Monica Mountains

Senior field geology 1929 California Institute.

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Plates

INTRODUCTION

The area described in this report is located in the Santa Monica Mountains about 15 miles west of the center of Los Angeles. Beverly Boulevard and Mulholland Drive running east and west and several roads running north and south make most of the area immediately accessible by automobile. Subdivision roads on the lower slopes of the mountains near Beverly Boulevard offer numerous cuts that are very valuable in exposing formations. Fire breaks on the ridges and trails in many places on the hillsides offer convenient means of travel on foot, although exceptionally heavy brush makes travel off of the trails very difficult and at times impossible. The canyons are very steep sided and often make contact tracing most trying.

The Sawtelle, Topanga Canyon, Van Nuys and Reseda quadrangles of the U. S. Geol. Survey formed the base map for the area and were supplemented by aerial photographs kindly furnished the writer by the Fairchild Aerial Survey. The total area mapped is about 25 square miles.

Considerably more area was covered in the field wark than was the original intention of the writer; as a result mapping is more detailed in some parts than others. In the vicinity of Landeville Canyon, Rustic Canyon and Brown Canyon rather careful field work was done, but in the other parts of the area the work was of a hasty nature. Twenty-five days were spend in the field in all and at least the first ten of these were occupied in getting the general "lay of the land".

ACKNOWLEDGMENTS

The writer is under particular obligation to the several property owners in the region who gladly allowed him to pass at will over their property during the time spent in field work. Mr. Wilkie Woodard, chief engineer of the Alphonzo E. Bell Corporation granted unlimited leave to pass over the property of that corporation and through his assistant, Mr. Tate, gave the writer valuable information as to outcrops and possible fossil localities. The courtesy extended by the Bell Corporation was especially gratifying since the corporation was engaged in an unpleasant bit of litigation with the city of Los Angeles at the time the field work was in progress that made tresspassing particularly undesireable. Mr. R. G. Gillis, president of the Santa Monica Land and Water Company, likewise extended to the writer leave to pass over all of the property of his company. The California Botanic Garden evinced its interest in the writer's work in many ways and allowed him complete freedom on its property.

Dr. W.P.Woodring, professor of invertebrate paleontology at the California Institute, offered a great many invaluable suggestions and criticisms and furthermore placed at the writer's disposal his collection of fossils from the Santa Monica Mountains, without which identification of species would have been impossible in the limited time available.

Dr. John P. Buwalda, chairman of the department of Geology and Paleontology at the California Institute, by his kindly words of encouragement aroused new hope several times when field work seemed to be proceeding particularly slowly.

If Dr. Buwalda's constant plea to do detailed work had been heeded more fully, the writer feels that the present work would be of much greater value.

CLIMATE AND VEGETATION

The region is semiarid and has an average annual rainfall of about 15 inches. There is rarely any rain from April to October while in the winter months the rain vomes in the form of severe storms of short duration which give rise to floods in the steep walled canyons. There are no permanent streams in the area although springs are quite numerous in the slate basement.

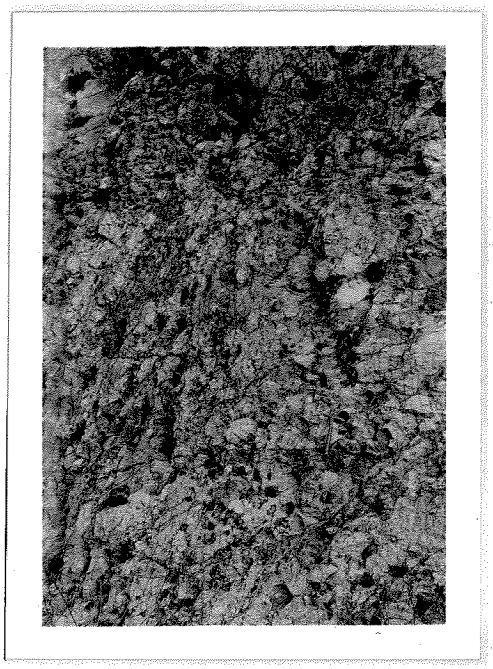
Vegetation of the region consists mainly of greasewood or Adenostoma fesciculatum, poison oak or Rhus toxicodendron and wild flowers of great variety. Especially noticeable in the showy Yucca whipplei whose stalks form the conspicuous Lord's candlesticks when in bloom and whose bases of Spanish needles form an effective barrier to hillside geology. Changes in vegetation mark changes in lithology in several instances, notable in shale-sandstone contacts. The shale bears in all cases a less luxurient growth than the rock in contact with it and generally supports the growth of the leguminous plants.

PHYSIOGRAPHY

The relief of the area is medium showing a difference of elevation of about 1500 feet between the south base of the Santa Monica Mountains and the crest at Mulholland Drive. Since the folding that blocked out the present structural features, erosion has proceeded at a rapid rate and now the region is at early maturity in the physiographic cycle. Drainage is changing from dendritic to complete; nothing is seen of the original land surface that existed prior to the folding; the upper reaches of the canyons are still quite steep and contain waterfalls.

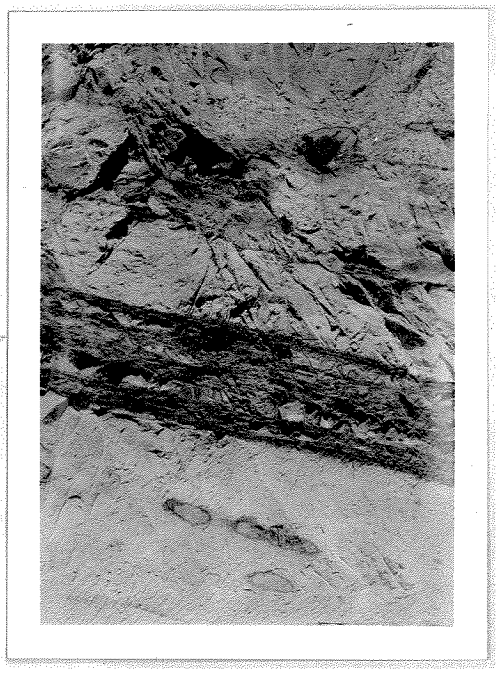
Canyons and ridges run north and south on both sides of the range which trends east and west. Several of the canyons in the region have been dammed by the city of Los Angeles to provide water storage reservoirs. The water in these reservoirs in mainly spring water since the drainage area is small and rainfall intermittant.

J3



Typical exposure of Modelo conglomerate on ridge east of Rustic Canyon ½ mile north of Beverly Blvd.

J47



Typical exposure of Modelo about 300 feet above base showing rather large percentage of sandstone and concretions, typical at this horizon.

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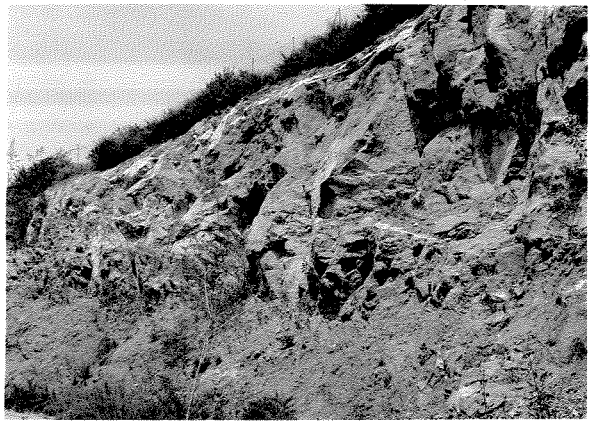
Contact between detrital basal Modelo and overlying shaly bed. West side Sepulveda Canyon, ½ mile north of Beverly Blvd.

J45



Outcrop of fossiliferous facies of detrial basal Modelo on east side of Brown Canyon. Slate to be seen below.

J40

Contact between detrital basal Modelo and overlying shaly bed as outlined by ve vegetation. East from Sepulveda Canyon. Note cliff of basal bed to right

STRATIGRAPHY

Modelo Formation

The more important of the two sedimentary formations in the area is the upper Miocene series of shale, sandstone and conglomerate here referred to the Modelo described by W.S.W. Kew (Kew, W.S.W., Geology and Oil resources of a part of Los Angeles and Ventura Counties, California: U.S. Geol. Survey Bulletin 753). Mr. Kew recognized the Modelo formation in the Santa Monica Mountains when he wrote the above report and records the presence of "Pecten raymondi Clark" from the detrital basal sandstone of the Modelo near the head of Sepulveda Canyon.

Nowhere in the area convered by Mr. Kew's report does he record the thickness of conglomerate assigned to the Modelo here. There is some doubt in the writer's mind as to the age of certain of the conglomerate beds and further field work will be necessary before a complete separation of them will be possible. For the present, howeverm all of the conglomerate exposed in the area mapped is considered to be of upper Miocene age and is referred to the Modelo formation.

Abundant fossil evidence of the age of the Modelo formation was obtained on the ridge to the east of Brown Canyon immediately below "Misty Mountain", residence of the late Fred Thompson.

Chlamys andersoni raymondi (Clark)
Lima sp.
Acmaea (?) sp.
Cardium sp. cf. C. corbis (Martyn)
Tegula sp.
Barnacles and bryozoa

Numerous impressions of fish skeletons were found in

the sandy shale overlying the detrital basal Modelo near the head of Mandeville Canyon.

A few carpal bones that have been somewhat doubtfully identified as belonging to Merychippus were found several years ago by workmen of the A.E.Bell Corporation near the head of Sepulveda Canyon in the sandy shale noted above. These bones are now in the possesstion of the Los Angeles Museum.and constitute the only recorded occurrence of land vertebrate material in the Santa Monica Mountains. A portion of a whale vertebra was taken out at the same time as the Merychippus (?) material from a locality near the head of Dry Canyon. It is assumed that the Merychippus(?) material was rafted out to sea when the Modelo sediments were being deposited, which would account for the lack of any other material at all in the vicinity.

The basal bed of the Modelo formation in which the invertebrate fossils noted above were found is the most characteristic horizon marker of the Modelo and is easily recognized wherever it occurs. It is very hard, deep blue, coarse snadstone made up largely of fragments from the underlying slate basement. No bedding can be seen but the attitude is quite accurately defined by the contacts with the slate below and the shaly Modelo above. The thickness of the "detrital basal Modelo" as this bed is called throughout this report varies from 25 to 75 feet.

Overlying the detrital basal Modelo bed is a series of alternating sandstone and sandy shale beds with frequent conglomerate lenses. The conglomerate becomes more important higher in the section until at a distance varying from 0 to 1000 feet from the base the Modelo is entirely conglomerate.

The varying distance of the conglomerate from the base of the section is caused by faulting oblique to the anticlinal axis. On the west side of Rustic Canyon the conglomerate rests directly on the slate basement whereas a considerable thickness of sandstone and shale underlies it at Sepulveda Canyon. At Stone Canyon the conglomerate again rests on the slate on the north limb of the anticline.

The detrital basal Modelo forms cliffs at most outcrops because of its relatively great hardness. On the south side of the range just below Mulholland Drive these cliffs may be traced for a considerable distance across the topography;

Chico Formation

The lower of the two sedimentary formations mapped in the area is assigned to upper Cretaceous time and to the Chico formation of Waring (Waring, C.A., Stratigraphic and faunal relations of the Martinez to the Chico and Tejon of southern California: California Acad. Sci. Proc., 4th ser., vol.7,pp.41-124,1917). Fossil evidence of the age of the formation was secured in the small canyon about three fourths of a mile to the west of Rustic Canyon and a mile north of Beverly Boulevard.

Metaplacenticeras sanctaemonicae (Waring)
"Mactra" gabbiana Anderson
Aphrodina varians (Gabb)
Glycymeras veatchi (Gabb)
Trigonia inezana Packard

These fossils may be seen in Dr. Woodring's collection as may the Modelo forms described above.

The Chico exposed in the area mapped is chiefly massive sandstone with a few fossiliferous limestone beds. It is not impossible that some of the conglomerate assigned to the Modelo in this report is of Cretaceous age, but poor exposures and limited time prevented the careful examination necessary to separate the two conglomerates. In Santa Ynez Canyon , about 2 miles to the east of the fossil locality described above, the Chico contains a considerable thickness of very pure limestone that is being exploited by the Bell Corporation. Underlying this limestone is a thick series of conglomerates which is exposed at the upper quarry in Santa Ynez Canyon.

The fossiliferous limestone of the Chico is hard blue-gray nearly pure calcium carbonate. This grades into a sandstone of the same general appearance making a separation of the members

difficult in the field.

Basement Complex

Granite

The granite mapped in the area was not studied in any detail and was shown merely to indicate the general areal relations at the eastern margin of the region studied.

Slate

The basement of practically all of the area studied is a metamorphic rock referred to variously as a "schist" and a slate. Since the micas and other platy minerals that give schist its character are wholly lacking in the rock of the area, the writer has given the name slate to the basement.

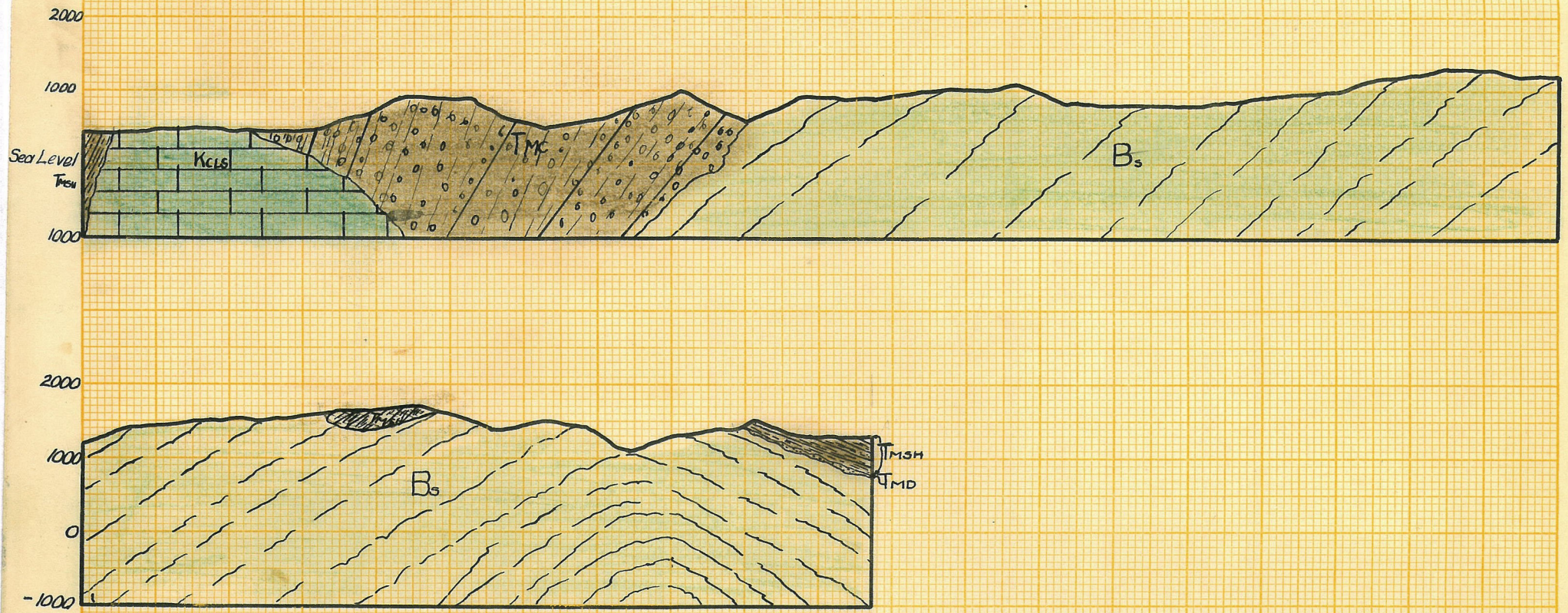
This slate is hard, bluish in color, easily fractured and is particularly characterized by the presence of frequent quartz veins, some of which are poorly mineralized with pyrite and associated minerals. On exposure to weathering the slate turns a rusty brown, and on further weathering forms a dark brown to black soil that is very fertile.

The planes of cleavage in the slate follow closely the overlying stratified rocks which would indicate that the schistosity was developed prior to the folding of the region since cleavage developed at the same time as the folding would tend to be at right angles to the limbs of the anticline.

In the upper part of Kandeville Canyon several springs in a line suggest faulting but the general fractured condition of the slate makes accurate determination impossible. In general little of the structure may be made out in the slates because of this fracturing and because of the dense brush on the hillsides.

J4

Exposure of fault between slate basement (left) and Modelo (right) on north side of Mulholland Drive at upper end of Mandeville Canyon. Contact plane is vertical.



Cross section along line AA'

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STRUCTURE

The main structural feature of the Santa Monica Mountains in the region mapped is a major anticline trending about S60E that intersects the physiographic crest of the range near the head of Mandeville Canyon and that runs south from that point until it runs into the Los Angeles basin near the mouth of Coldwater Canyon. The trend of the physiographic crest of the range is nearly east and west and the dips along the north flank as far east as Cahuenga Pass are uniformally steeply to the north. This indicates that the deformation that created the major anticline affected the beds for a very considerable distance from the axial plane and that the original anticlinal crest originally stood much higher than at present.

Minor folds on the flanks of the major anticline are exposed in several localities and generally occur only in the incompetant Modelo shale beds. In Rustic Canyon a few hundred feet north of Beverly Boulevard a minor fold is exposed whose axial plane is nearly vertical. The axis cannot be followed for any distance however, so nothing can be inferred about the main fold. Other minor folds are similarly of little aid in determining the trend or general character of the main anticline.

Small faults with displacements of only a few feet may be traced at certain places on the south limb of the anticline and by their oblique position relative to the anticlinal axis have brought about a complicated areal pattern that is as yet incompletely worked out.

An important fault of considerable displacement occurs in the northern part of the area mapped and acts as a contact between the slate and Modelo for some of its length. It cannot be traced accurately through the slate but its position may be inferred from certain features of the topography such as the northerly flowing branch of Rustic Creek on the south side of the ridge. This fault was recognized by Mr. Kew and is mapped on the field map accompanying U.S.Geol. Survey Bulletin 753.

HISTORY

The oldest rocks in the region are the slates since they everywhere underlie the sedimentary formations are are intruded by the granite. Since no fossils have ever been obtained from these slates, their age determination can only be by correlation with similar slates elsewhere. In most of the California coast ranges the slates whose age is definitely known are Triassic, so until further evidence is advanced, the writer will consider the slates of the Santa Monica Mountains to be Triassic. The igneous intrusive is likewise correlated with the Jurassic intrusives of California tentatively.

After a considerable erosion interval the Cretaceous rocks were deposited. Their limey character would indicate deposition in quiet water. Another period of erosion followed that was sufficient in the region mapped to strip off most of the Cretaceous sediments and an undetermined thickness of Eocene material that supposedly was once present since Eocene outcrops are known to occur less than two miles to the east of the area studied.

The deposition of the detrital basal Modelo on the eroded surface of the slates followed and then another short perood of erosion suffieient to remove some of this basal Modelo ensued. The remainder of the Modelo was then deposited under conditions that alternated rapidly from those favoring shale to those favoring sandstone or even conglomerate.

Since the end of Modelo time the region has stood above the sea and no other sediments are present except for recent gravels in the streams and palisade material.

The folding of the region cannot be dated more accurately than post Miocene. The faulting in the southern part of the area has elevated the palisade material and is therefore probably late Pleistocene. The fault in the northern part of the area that separates the slate and the Modelo cannot be dated ore accurrately than post Miocene.