TM-268

UNITED STATES ATOMIC ENERGY COMMISSION
GRAND JUNCTION OPERATIONS OFFICE
EXPLORATION DIVISION
AIRBORNE SECTION

AN AIRBORNE RADIOMETRIC RECONNAISSANCE OF THE FILLMORE-OJAI AREA, CALIFORNIA, FINAL REPORT

By
Neil S. Mallory

June 1956
Grand Junction, Colorado

INTRODUCTION

On December 12, 1955, an airborne radiometric survey of the Fillmore-Ojai Area, (see figure # 1) California was started. The project was not completed because poor flying conditions forced the airborne crew to spend the majority of the time on the ground. Consequently, work was stopped April 8, 1956 and the airborne unit was moved to another project to more effectively utilize the aircraft and personnel.

The geographic location of the area was the cause of the poor flying weather. The proximity to the Pacific Ocean and equal nearness to the Mojave Desert cause a climatalogical condition not conducive to low level flying. The hot, dry desert air flows over the mountains and is channeled into the deep cut valleys leading to the ocean. The air mass usually assumes a high velocity (30 to 100 m.p.h.) during its migration. When the point of equilibrium is reached the wind velocity drops to zero. This allows the coastal fog to move inland. Quite frequently the fog does not rise or dissipate until late in the afternoon. As might be imagined the high velocity winds cause downdrafts and turbulence so violent survey work is virtually impossible. The fog also precludes any attempt at flying.

This weather exists in addition to the usual climactic cycle typified by frontal movements. During the stay at Santa Paula 21 days of operation were lost because of fog; 16 days were lost because of high winds. The only available weather records for the general vicinity of the Fillmore-Ojai area are the mean precipitation statistics compiled by the U.S.Weather Bureau. (see table # 1) From these figures it is not possible to forsee the situation just described.

The Fillmore-Ojai area lies within a subdivision of the Coastal Range Geomorphic Province called the Transverse Ranges.

	OJAI	OXNARD	SANTA PAULA	SAN FERNANDO
JANUARY.....	4.71	2.53	3.43	3.14
FEBRUARY....	4.71	2.98	2.50	3.40
MARCH.......	3.70	2.26	3.28	2.87
APRIL.......	1.31	1.06	0.62	1.18
MAY.........	0.46	0.20	0.40	0.44
JUNE........	0.06	0.06	0.04	0.09
JULY........	0.01	Trace	0.01	0.02
AUGUST......	0.04	0.04	0.02	0.02
SEPTEMBER...	0.31	0.11	0.35	0.18
OCTOBER.....	0.67	0.52	0.82	0.63
NOVEMBER....	1.33	1.10	0.87	1.20
DECEMBER....	3.65	3.14	2.82	2.92

Monthly mean precipitation expressed in inches of rainfall. (From U.S. Weather Bureau records.)

—TABLE # I—

The Transverse Ranges trend east-west at the south end of the coastal ranges. Folding and faulting dominate the physiographic development in this area.[1] The canyons are deeply incised and have many small tributaries. The interfluves are well dissected and moderately narrow. The flight lines used during the survey were controlled by the topographic expression of the horizon being surveyed.

PREVIOUS INVESTIGATIONS[2]

The first sample of abnormally radioactive rock from the Fillmore-Ojai area was brought to the Bakersfield Office of the Atomic Energy Commission by

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1 - Robert P. Sharp, Geology of Southern California , Bullitin 170, Department of Natural Resources, State of California. Chapter V, Page 5.

2- William A. Bowes, Personal communication.

Nels Sandquist. It had been taken from the Florence claim, Sec.2,T5N,R23W, Ventura County,California. The sample was a coarse grained, arkosic sandstone containing carnotite. Chemical assay by the Commission showed it to contain 0.42% U_3O_8. Ground investigation,by personnel of the Bakersfield Office,proved the sample came from the transitional contact between the Eocene Coldwater Formation and the Oligocene Sespe Formation. The deposit is very small and not of commercial value.

Another such deposit was brought to the Commissions attention by Max Hoff with a sample from his Cayote # 1 claim, Sec.4,T4N,R24W,Ventura County, California. Mr. Hoff continued to prospect in the transitional zone and found the Payoff claims,Sec.10,T4N,R24W, Ventura County,California.* These claims are on the northeast flank of an anticline and show several pockets of carnotite associated with carbon trash. Further exploration in the vicinity of the Payoff claims uncovered more of the ore grade pockets. Enough interest was created to obtain finances for a small drilling program; which has not yet been put into effect.

To date there are 8 claim owners in the area with claims in the transitional zone. Each claim owner has more than one claim and more than one showing of ore grade material. Even so, there has not yet been any production from the area.

The carnotite from these deposits has a variable equilibrium and vanadium content.In addition to carnotite, minor amounts of autunite have been found. Also, radioactivity, from an unidentified source, is associated with some of the carbon trash.

*For a description of this property see RME-2073 by W. A. Bowes and B. L. Myerson.

GEOLOGY
(see figure 2)

The Ventura Basin is an elongate,east-west trending trough in which a thick section of sedimentary rocks has accumulated throughout the Tertiary period. The formation of the Ventura Basin probably began during the Paleocene epoch. The western half of southern California was downwarped and the invading sea deposited sediments over a vast area. By the end of the Miocene epoch several minor mountain chains had developed. These were the Transverse Ranges. They divided the large basin into several smaller ones. The basins continued to sink until nearly recent time. Finally, sedimentation exceeded subsidence and the basins were filled.

The recency of folding and faulting is very evident. Deformation has been going on intermittently during the Tertiary and Quarternary periods. Northwest of the city of Fillmore, Eocene rocks have been thrust over Pleistocene beds. It can be seen where diastrophism has modified the modern topography. Extensive thrust faults and numerous folds exhibit the influence of compression as the major factor in the structual development of the area.[3]

These structual features are readily apparent from the air. The Oak Ridge and San Cayento Thrust faults, the Santa Ynez fault, and numerous unnamed faults and anticlines were briefly surveyed from the air. The uranium deposition was not apparently controlled by these structual phenomena.

The transitional contact between the Eocene Coldwater formation and the Oligocene Sespe formation was the zone of primary interest during the survey. (For a complete list of formations see stratigraphic chart, figure #3)

3- C.W.Jennings and B.W.Troxel,Geologic Guide Through the Ventura Basin and Adjacent Areas, Southern California , Bulletin 170, Department of Natural Resources, State of California.

The Coldwater is, for the most part, a white,marine sandstone. The Sespe is characteristically a red, continental shale with interbedded red sandstone. It is conglomeratic in some places. It also contains some green, white, and grey sandstone and may be marine in part.[4]

The contact between these two formations is gradational and is typified by intertongueing and interfingering of formational members. Also, in this zone are areas which resemble neither formation. Many carbon trash pockets occur along this horizon. Some of the uranium occurences are associated with the carbon trash.

AIRBORNE PROCEDURES

The airborne work was performed with a Piper PA-18 Supercub. The aircraft is a high winged monoplane, powered by a 135 horsepower Lycoming engine. The seating arrangment is tandem. This arrangment is superior to a side by side seating in that it allows the pilot maximum visibility in all directions. The Supercub is a high performance AIRplane. It takes off and lands in a short distance, has a high rate of climb,and is capable of sustained operation at high altitudes. All of these characteristics are essential for an aircraft being used for airborne radiometric survey purposes.

The aircraft has been slightly modified from the factory version. The rudder stops and elevator stops have been altered. The alterations allow the pilot more control travel and consequently more maneuverability.

4- Op. Cit. C.W.Jennings and B.W.Troxel. There seems to be quite a controversy over the deposition of the Sespe formation. Some geologists say the red color is due to the formation of a lateritic clay soil under tropical conditions. Others point out the noteworthy lack of fossil plant remains and say their absence makes the hypothesis somewhat untenable.A lack of marine and lacustrine fossils seem to rule out those two origins. The vertebrate fauna are not only meager but also are not diagnostic of the climate,environment or mode of deposition of the Sespe. Some geologists believe the vertebrate fauna are derived fossils and do not belong in the strata in which they are found. Consequently, the mode of deposition of the Sespe formation remains an enigma.

A Mark VI airborne scintillation counter[5] was used as a detecting instrument during the survey. It is semi-permanently mounted in the aircraft. The instrument has essentially three components: the detector head, the control panel and the meter. The detector head contains the detecting crystal, the photomultiplyer tube and the amplifying circuit. It is mounted in the baggage compartment behind the rear seat. The location of the detector head places it as far as possible from any stray radiation emanating from radium dial instruments in the aircraft panel. The control panel contains the switches and the bias control knob. It is mounted on the left side of the aircraft above the window. The meter registers the changes in radiation measured by the detector head. It is mounted on a "paddle" and is held in the observer's Hand. This arrangement allows the observer to watch the meter and the geologic structure simultaneously. At the beginning of the project the instrument was calibrated over an alluvial fan. The alluvium exhibited no appreciable variation in its radiation, so it was assumed to be an average horizon. The aircraft was flown over the fan at survey height (50') and the background reading was adjusted, by means of the bias control, to 160 counts per second.

The type of coverage used during a project is governed by two factors, the topography and the geologic structure. All airborne work is essentially a modification or a combination of two basic types of flying: rim flying and grid flying. Rim flying is employed where the horizon being surveyed is exposed on vertical or near vertical faces. Flights are conducted at a distance of 50' horizontally from the vertical outcrop. The degree of coverage is controlled by varying the vertical distance between the flight lines. Grid flying is utilized where the horizon being surveyed is exposed horizontally in flat or rolling topography. Flights are conducted at a distance of 50' vertically from the horizontal outcrop. The degree of coverage is controlled by varying the horizontal distance between the flight lines.

[5] Manufactured by, Nuclear Enterprises Ltd. Winnipeg, Canada.

During the Fillmore-Ojai project both types of flying were used. The complex geologic structure and advanced dissection of the topography made it necessary to switch rapidly from one to the other. In the area of saturation coverage (see figure I) the flight lines were 100' apart. In the area of general coverage the flight lines were 200' apart.

RESULTS OF AIRBORNE PROCEDURES

During the survey 61:05 flying hours were logged. For the breakdown of the flying time into seperate categories see table II. No anomalous radioactivity was detected. Some of the known deposits are so small that no appreciable increase in radioactivity was registered when flying directly over the workings.

Two aerial photo reconnaissance flights were made over specific areas. One was conducted with George Hood of S.L.E.B. for color pictures. The other was made by the regular crew to obtain black and white photos. Both sets of pictures were satisfactory.

TYPE OF FLYING	HOURS LOGGED
RIM AND GRID	24:10
RECONNAISSANCE	18:55
CROSS-COUNTRY	18:00
TOTAL FLYING TIME	61:05

——TABLE II——

MISCELLANEOUS

Well's Aircraft and Engine Service,at the Santa Paula Airport, provided hangar space and excellent shop facilities at a nominal fee. Housing facilities at Santa Paula presented no problem. The B &L Motel, within walking distance of the airport, has good accommodations at a moderate cost. Several taxpayers contacted the airborne crew at the airport. They desired assays, mapping and claim investigation. They were referred to the Bakersfield Office.

CONCLUSIONS AND RECCOMMENDATIONS

The weather and the topography,being as they are, make any airborne program in the general area impractical. Inquiries made of the commercial pilots operating from the Santa Paula Airport revealed their opinion to be; at no time during the year is the weather in the area conducive to low level flying. They said the best chances would probably be during September and October. Even then it is doubtful that the crew could operate efficiently.

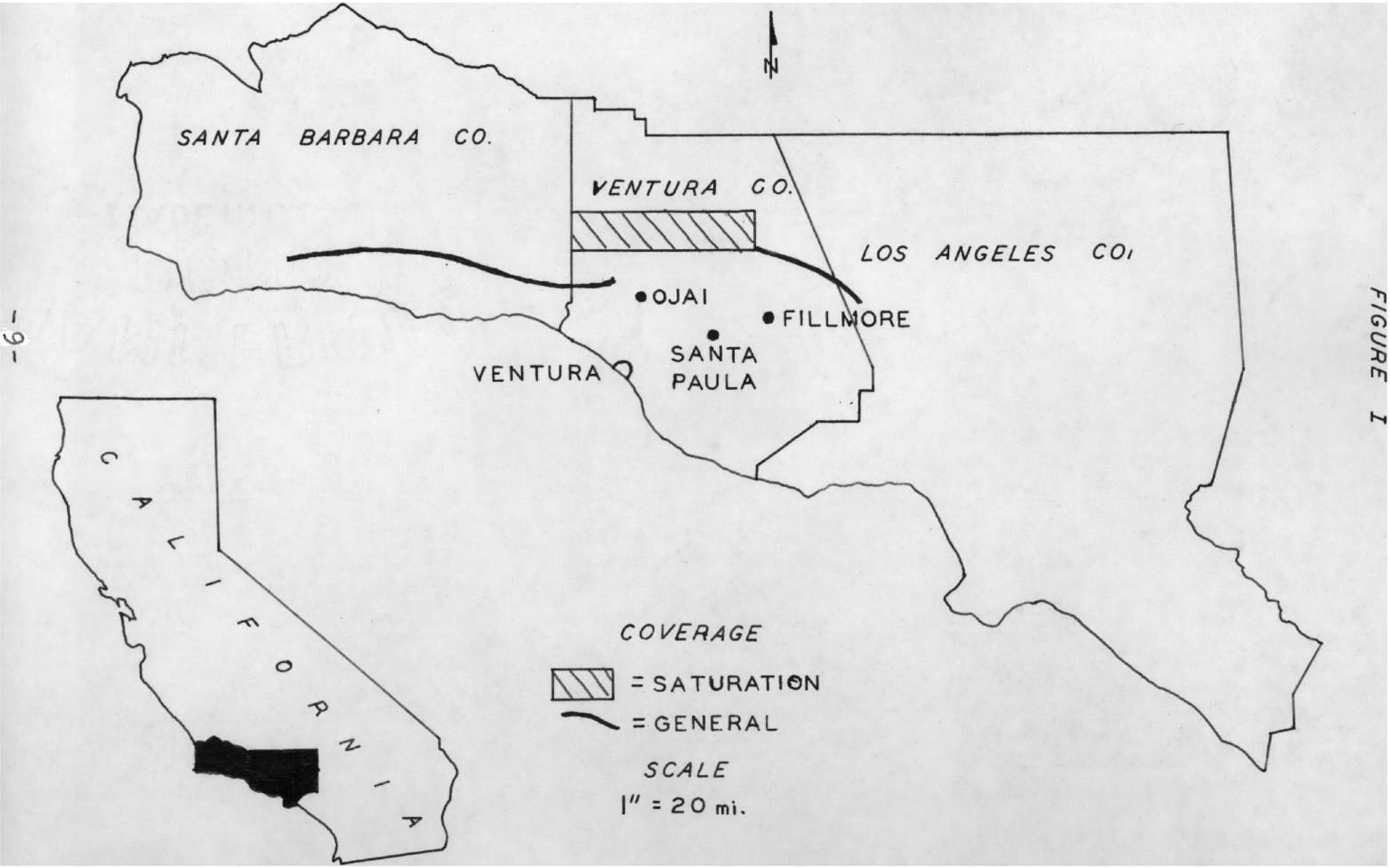

N
SANTA BARBARA CO.
VENTURA CO.
LOS ANGELES CO.
OJAI
FILLMORE
SANTA PAULA
VENTURA
CALIFORNIA
COVERAGE
▨ = SATURATION
= GENERAL
SCALE
1" = 20 mi.

FIGURE I

DIVISION OF MINES
OLAF P. JENKINS, CHIEF

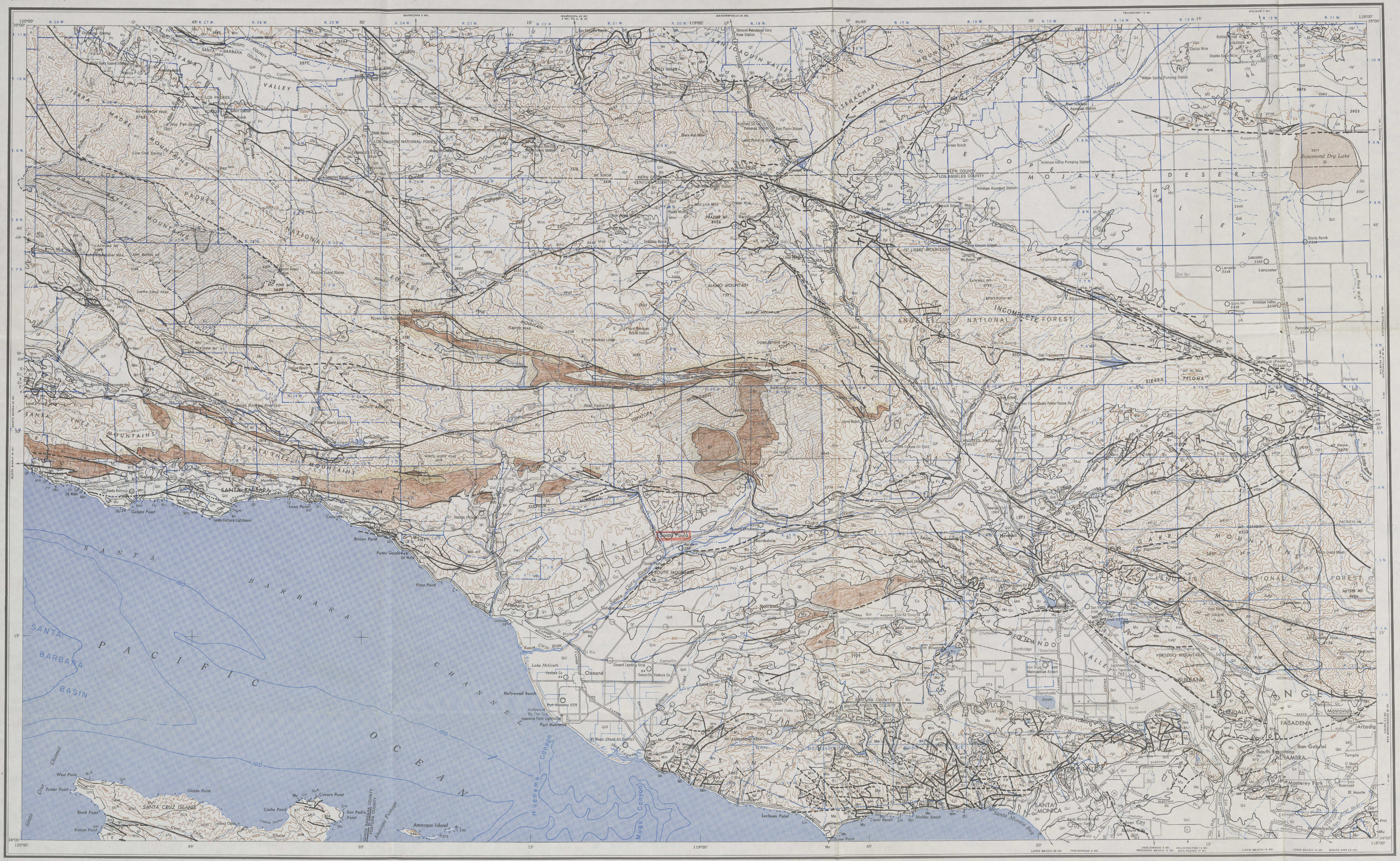
[illegible] Miocene Horizon

Bakersfield Hospital

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

GEOLOGIC MAP OF CALIFORNIA
LOS ANGELES SHEET

FIGURE 2



Topographic base prepared under the direction of the Chief of Engineers by the Army Map Service, Corps of Engineers, Department of the Army, Washington D.C. Compiled in 1947 from the Corps of Engineers and U.S. Geological Survey topographic quadrangles; County Highway Maps; U.S. Coast and Geodetic Survey Charts. Planimetric detail partly revised by photo - planimetric methods from available aerial photographs. Road and railroad data verified by state authorities 1947. Control by U.S. Coast and Geodetic Survey. Land-net by U.S. Geological Survey.

Culture revised by California Division of Mines 1954.

Scale 1:250,000

5 0 5 10 15 20 25 Miles
5 0 5 10 15 20 25 30 35 Kilometers
5000 0 5000 10000 15000 20000 25000 30000 35000 Yards

CONTOUR INTERVAL 500 FEET
DATUM IS MEAN SEA LEVEL

TRANSVERSE MERCATOR PROJECTON
1927 NORTH AMERICAN DATUM

SUBMARINE CONTOUR INTERVAL 100 FATHOMS

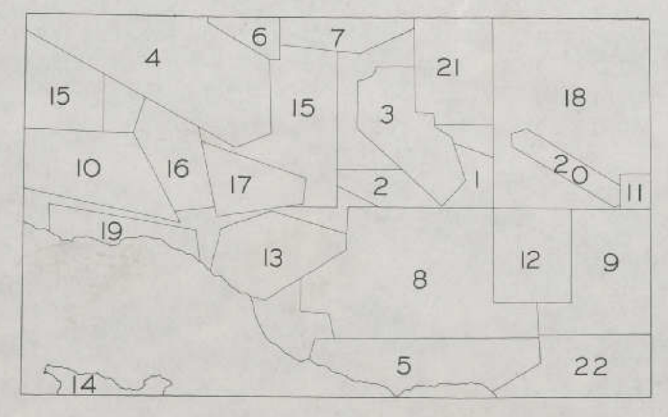
GEOLOGIC MAP OF CALIFORINA
LOS ANGELES SHEET

PREPARED UNDER DIRECTION OF OLAF P. JENKINS
COMPILATION BY CHARLES J. KUNDERT

1955

INDEX NUMBER N 3400 W 11800/100x200

INDEX TO GEOLOGIC SOURCE DATA



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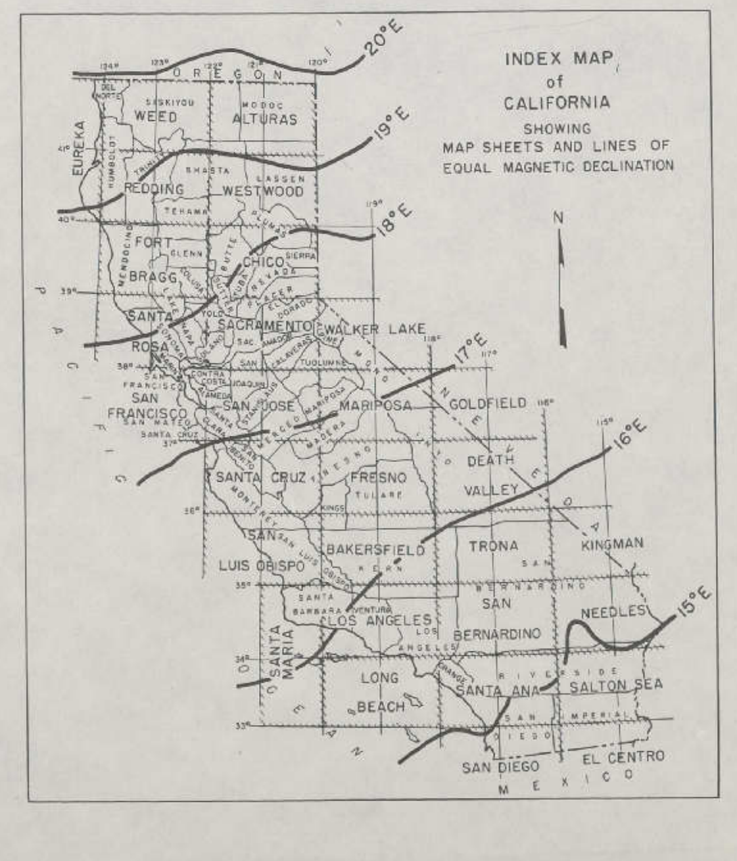


LEGEND

				SEDIMENTARY AND METASEDIMENTARY ROCKS		IGNEOUS AND META-IGNEOUS ROCKS
CENOZOIC	QUATERNARY	RECENT	Qs	Sand dunes	Qrv^c	Recent cinder cones
			Qal	Alluvium: Qf-fan and flood deposits; Qb-basin deposits; Qsc-stream channel deposits	Qmf	Recent volcanic mud flows
		PLEISTOCENE	Qst	Salt deposits	Qrv	Recent volcanic: Qrv^r-rhyolite; Qrv^a-andesite; Qrv^b-basalt
			Qt	Terrace deposits		
			Qgl	Glacial deposits		
			Qc	Pleistocene non-marine; Ql-lake deposits		
			Qm	Pleistocene marine	Qv	Pleistocene volcanic: Qv^r-rhyolite; Qv^a-andesite; Qv^b-basalt
			QP	Plio-Pleistocene non-marine		
	TERTIARY	PLIOCENE	Pc	Undivided Pliocene non-marine		
			Puc	Upper Pliocene non-marine		
			Pmlc	Middle and lower Pliocene non-marine		
			Pu	Upper-Pliocene marine	Pv	Pliocene volcanic: Pv^r-rhyolite; Pv^a-andesite; Pv^b-basalt
			Pml	Middle and lower Pliocene marine		
		UNDIVIDED	Tc	Tertiary non-marine; Tl-lake deposits	Ti	Tertiary intrusive
		MIOCENE	Mc	Undivided Miocene non-marine	Tv	Tertiary volcanic: Tv^r-rhyolite; Tv^a-andesite; Tv^b-basalt
			Muc	Upper Miocene non-marine		
			Mmc	Middle Miocene non-marine		
			Mu	Upper Miocene marine		
			Mm	Middle Miocene marine		
			Ml	Lower Miocene marine	Mv	Miocene volcanic: Mv^r-rhyolite; Mv^a-andesite; Mv^b-basalt
		OLIGOCENE	ϕc	Oligocene non-marine		
			ϕ	Oligocene marine	ϕv	Oligocene volcanic
		EOCENE	Eg	Eocene auriferous gravels		Formations of interest
			Ec	Eocene non-marine		
			E	Eocene marine	Ev	Eocene volcanic
		PALEOCENE	Ep	Paleocene marine		
MESOZOIC	CRETACEOUS		K	Undivided Cretaceous marine		
			Ku	Upper Cretaceous marine		
			Kl	Lower Cretaceous marine		
			Jk	Knoxville formation	gr	Granitic: age undetermined - gr; Cret.-Kgr; Jur.-Jgr; Cret-Jur.-KJgr pre-Cambrian - p€gr.
	JURASSIC		Jf	Franciscan group	Jfv	Franciscan volcanic
			Ju	Upper Jurassic marine	Jbi	Jurassic basic meta-igneous
			Jml	Middle and lower Jurassic marine	Jub	Jurassic and other ultrabasic intrusives
	TRIASSIC		₸	Triassic marine	J₸v	Jura-Trias metavolcanic
	UNDIVIDED		pK	Undivided pre-Cretaceous metamorphic rocks		
			pfs	Undivided pre-Franciscan metamorphic rocks		
PALEOZOIC			ℙ	Paleozoic marine (ls) limestone	ℙv	Undivided Paleozoic metavolcanic
	PERMIAN		₽	Permian	₽v	Permian metavolcanic
	CARBONIFEROUS		C	Undivided Carboniferous marine	Cv	Carboniferous metavolcanic
			CP	Pennsylvanian marine		
			CM	Mississippian marine		
	DEVONIAN		D	Devonian marine	Dv	Devonian metavolcanic
					pDv	Undivided pre-Devonian metavolcanic
	SILURIAN		S	Silurian marine		
	ORDOVICIAN		O	Ordovician marine		
	CAMBRIAN		€	Cambrian marine		
PROTEROZOIC	PRE-CAMBRIAN		p€	Undivided pre-Cambrian metamorphic rocks		
			A	Algonkian metamorphic rocks		
			AR	Archean metamorphic rocks		

FIGURE 3

DIVISION OF MINES
Ferry Building, San Francisco II
OLAF P. JENKINS, Chief

STATE OF CALIFORNIA
GOODWIN J. KNIGHT, Governor
DEPARTMENT OF NATURAL RESOURCES
DeWITT NELSON, Director

EXPLANATORY CHART LOS ANGELES SHEET

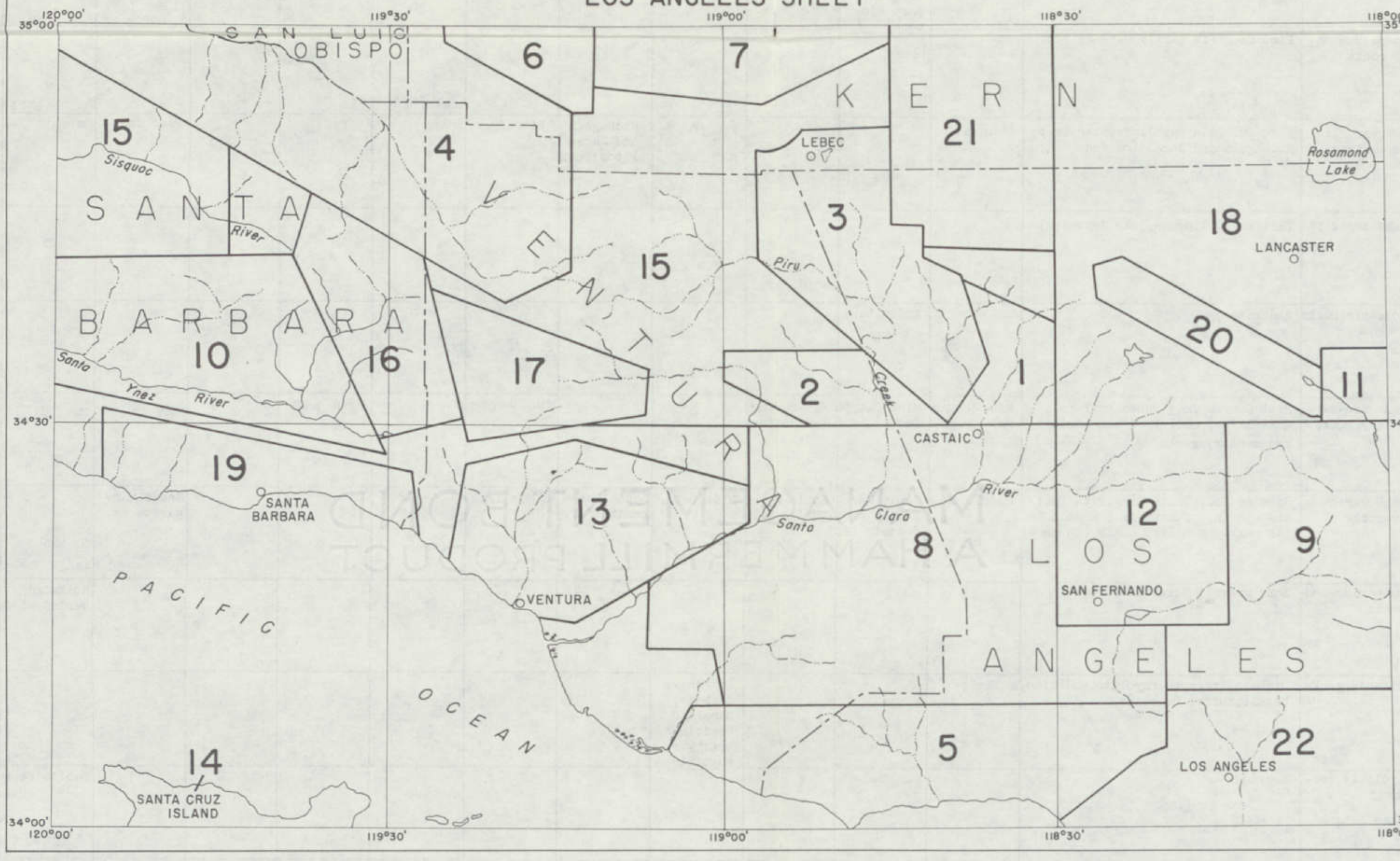
GEOLOGIC MAP OF CALIFORNIA

Prepared under direction of Olaf P. Jenkins
Compilation by Charles J. Kundert
1955

LEGEND GEOLOGIC MAP OF CALIFORNIA LOS ANGELES SHEET				PUBLISHED SOURCE DATA NUMBERS REFER TO INDEX MAP AND BIBLIOGRAPHY OF SELECTED REFERENCES													
AGE	MAP SYMBOL	STATE MAP UNIT	GROUPING OF GEOLOGIC UNITS	Clements 1	Crowell 3	Dibblee 4	Durrell 5	Hoots 7	Kew 8	Miller 9	Noble 11	Page 10	Putnam 13	Simpson 18	Upson 19	Wiese 21	Woodford 22
CENOZOIC QUATERNARY Recent	Qs	Recent sand dunes	Dune sands											Sand dunes			
	Qal	Recent alluvium	Alluvium; Qf- fan and flood plain deposits of San Joaquin Valley	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Younger alluvium, older alluvium	Alluvium	Alluvium	Alluvium	Younger alluvium	Younger alluvium	Alluvium
Pleistocene	Qt	Pleistocene river and stream terrace deposits	Terrace deposits	Terrace	Terrace deposits and surfaces	Fanglomerate and undivided Quaternary deposits	Terrace deposits	Terrace deposits					Terraces and older alluvium	Terrace gravels, older alluvium	Terrace deposits and older alluvium	Terrace deposits and older alluvium	Terrace deposits
	Qc	Pleistocene non-marine deposits	Older alluvium, Nadeau gravel, Harold fm.; Casitas fm.; Pacoima fm., Saugus fm. (in part)	Saugus fm.							Nadeau gravel, Harold fm.		Saugus fm.		Casitas fm.	Continental deposits	
	Ql	Pleistocene lake deposits	Playa deposits											Playa deposits			
	Qm	Pleistocene marine and marine terrace deposits	Marine terrace deposits and Palos Verdes sand, San Pedro sand, Timms Point silt, Lomita marl; Santa Barbara fm.; Las Posas fm.				Marine beds								Santa Barbara fm.		Marine terrace deposits & Palos Verdes sand, San Pedro sand, Timms Pt. silt
	QP	Pliocene-Pleistocene non-marine deposits	Tulare fm.; Paso Robles fm.; Saugus fm., (in part), Sunshine Ranch member of Pico fm.					Tulare fm.	Saugus fm.								
TERTIARY Pliocene	Puc	Upper Pliocene non-marine sedimentary rocks	Hungry Valley fm.		Hungry Valley fm.												
	Pc	Pliocene non-marine sedimentary rocks	Ridge basin group; Ridge Route fm.; Peace Valley beds, Violin breccia; Morales fm.; Chanac fm.; Anaverde fm.	Ridge Route fm.	Peace Valley beds, Violin breccia (in part Miocene)	Morales fm.		Chanac fm.			Anaverde fm.						
	Pu	Upper Pliocene marine sedimentary rocks	Pico fm. (in part); Careaga sand												Unnamed fm.		Upper Pliocene rocks and rocks commonly called Pico fm.
	Pml	Middle and lower Pliocene marine sedimentary rocks	Pico fm. (in part); Repetto fm.; Etchegoin and Jacalitos fms.	Pico fm.			Pico fm.	Etchegoin and Jacalitos fms.	Pico fm.				Pico fm.				Rocks commonly called Repetto fm.
Undivided	Tl	Tertiary lake deposits	Tertiary (Pliocene lake deposits)													Pliocene lake deposits	
	Tv	Tertiary volcanic rocks	Andesite		Andesite												
Miocene	Muc	Upper Miocene non-marine sedimentary rocks	Mint Canyon fm.: Punch bowl fm.; Quatal fm.; undivided non-marine sedimentary rocks	Mint Canyon fm.	Mint Canyon fm.	Non-marine sedimentary rocks			Mint Canyon fm.		Punch Bowl fm.					Continental deposits	
	Mu	Upper Miocene marine sedimentary rocks	Sisquoc fm.; Santa Margarita fm.; Castaic fm.; Puente fm.; Modelo fm. (in part); Monterey shale (in part)	Modelo fm.	Santa Margarita fm.; Castaic fm.	Santa Margarita fm.	Modelo fm.	Santa Margarita fm.	Modelo fm.				Santa Margarita fm.			Santa Margarita fm.	Puente fm.
	Mc	Miocene non-marine sedimentary rocks	Bena gravel; Rosamond series											Rosamond series			
	Mv	Miocene volcanic rocks	Diabase, trachyte, rhyolite, andesite, basalt, tuffs, breccias				Intrusive diabase, basaltic breccia, trachyte, rhyolite									Volcanic rocks	Basalt, intrusive and extrusive
	Mv^r	Miocene rhyolitic volcanic rocks	Dacite											Dacite flows			
	Mv^a	Miocene andesitic volcanic rocks	Andesite flows, tuffs, and agglomerates					Andesite (lower Miocene)									
	Mv^b	Miocene basaltic volcanic rocks	Basalt					Basalt (lower Miocene)	Andesite and basalt								
	Mmc	Middle Miocene non-marine sedimentary rocks	Caliente fm.; Tick Canyon fm.; undivided non-marine sedimentary rocks			Non-marine sedimentary rocks (in part, lower Miocene)											
	Mm	Middle Miocene marine sedimentary rocks	Modelo fm. (in part); Monterey sh., (in part); Maricopa sh.; Tequepis ss., Salinas sh.; Topanga fm.; Bitter Creek ss.; Temblor fm. (in part)	Temblor fm.		Monterey sh.	Topanga fm, in three members (Middle mem. andesite, basalt, etc.	Maricopa sh.	Topanga fm.			Monterey sh. "Temblor" ss.	Modelo fm.		Monterey sh.		Topanga fm.
	Ml	Lower Miocene marine sedimentary rocks	Temblor fm. (in part); Painted Rock fm., Soda Lake fm.; Rincon sh., Vaqueros fm.	Vaqueros fm.		Temblor fm. Painted Rock fm., Soda Lake fm.	Vaqueros fm.	Vaqueros fm. and undifferentiated later beds	Vaqueros fm.				Rincon sh., Vaqueros fm.		Rincon sh., Vaqueros ss.		
Oligocene	ϕc	Oligocene non-marine sedimentary rocks	Sespe fm.; Simmler fm.; Tecuya fm.; Vasquez fm.	Sespe fm.		Simmler fm., and undivided non-marine sedimentary rocks	Sespe fm.		Sespe fm.		Vasquez fm.		Sespe fm.		Sespe fm.		
	ϕv	Oligocene volcanic rocks	Basalt														
	ϕ	Oligocene marine sedimentary rocks	Pleito fm.; San Lorenzo fm.; Alegria fm., Gaviota fm.					San Lorenzo fm.									
Eocene	Ec	Eocene non-marine sedimentary rocks	Undivided non-marine sedimentary rocks														
	E	Eocene marine sedimentary rocks	Coldwater sandstone, Cozy Dell sh., Matilija ss., Juncal fm., Sierra Blanca ls.; Domengine fm.; Las Llajas fm.; Santa Susana fm.; Tejon fm., Meganos fm.; Mono sh.; San Emigdio fm.			Eocene rocks undivided		Tejon and Meganos fms.	Tejon and Meganos fms.			Coldwater ss., Cozy Dell sh., Matilija ss. Juncal fm., Sierra Blanca ls.	Coldwater ss., Cozy Dell sh., Matilija ss. Undiff Eocene		Undifferentiated Eocene		
Paleocene	Ep	Paleocene marine sedimentary rocks	Martinez fm.	Martinez fm.	Martinez fm.		Martinez fm.		Martinez fm.					Martinez fm.			Martinez fm.
MESOZOIC CRETACEOUS	Ku	Upper Cretaceous marine sedimentary rocks	Chico fm., Trabuco fm.; Pendola sh., Debris Dam ss.; undivided marine sedimentary rocks			Cretaceous rocks, undivided	Chico fm., Trabuco fm.		Chico fm.			Pendola sh., Debris Dam ss.					Chico fm., Trabuco fm.
	Kl	Lower Cretaceous marine sedimentary rocks	"Knoxville" group; undivided marine sedimentary rocks									Unnamed marine sedimentary rocks					
	KJgr	Cretaceous-Jurassic granitic rocks	School Canyon granite, Lebec quartz monzonite, Tejon Lookout granite, Liebre quartz monzonite; undivided granitic rocks		School Canyon, granite, Lebec quartz monzonite, Tejon Lookout granite, Liebre quartz monzonite; diorite, granodiorite												
	gr	Granitic rocks, age unknown	Echo granite, Rubio diorite and metadiorite; undivided granitic rocks														
JURASSIC	Jgr	Jurassic granitic rocks	Lowe granodiorite, Wilson diorite, Parker diorite; undivided granitic rocks	Granite, granodiorite, and diorite			Quartz diorite		Pre-Jurassic metamorphic sedimentary rocks and intrusive granite	Lowe granodiorite, Wilson diorite, Parker diorite				Quartz monzonite and other acid intrusive rocks, granodiorite, diorite		Quartz monzonite, quartz diorite, granite, diorite gabbro	
	Jub	Upper Jurassic serpentine and associated igneous rocks	Serpentine									Serpentine					
	Jf	Upper Jurassic Franciscan group	Franciscan group									Franciscan group					
TRIASSIC	TR	Triassic marine metasedimentary rocks	Santa Monica slate (fm.)				Santa Monica fm.							Bean Canyon series			
	pK	Pre-Cretaceous marine metasedimentary rocks	Placerita series (fm.); San Gabriel fm.; undivided metasedimentary rocks	Gneiss, marble and quartzite		Basement complex		Granodiorite, granite, diorite, and associated dark-colored sch.		San Gabriel fm.	Basement rocks (plutonic)			Granitic rocks, gneiss			Basement rocks, Mesozoic
PALEOZOIC UNDIVIDED	pfs	Pre-Franciscan marine metasedimentary rocks	Undivided metasedimentary rocks														
	IP	Paleozoic marine metasedimentary rocks	Bean Canyon series; ls-limestone; undivided metasedimentary rocks		Limestone, hornfels, schist											Ls. and marble, minor quartzite and hornfels	
PROTEROZOIC PRE-CAMBRIAN	p€gr	Pre-Cambrian granitic rocks	Anorthosite, gabbroic and noritic rocks							Anorthosite and related rocks; Echo granite, Rubio diorite and metadiorite							
	p€	Pre-Cambrian metamorphic rocks	Pelona schist; undivided metamorphic rocks	Pelona schist						Placerita fm.				Pelona schist		Biotite gneiss, minor mica schist, quartzite and marble; Pelona schist	

INDEX MAP
OF
LOS ANGELES SHEET
SHOWING AVAILABLE
TOPOGRAPHIC QUADRANGLES
OF THE
U. S. GEOLOGICAL SURVEY
1955

INDEX MAP
TO
PRINCIPAL SOURCES OF GEOLOGIC MAP DATA
USED IN COMPILATION OF
LOS ANGELES SHEET



GEOLOGIC MAP OF CALIFORNIA
SCALE 1:250,000
1955

LOS ANGELES SHEET
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    Geology of entire sheet modified by T. W. Dibblee Jr.