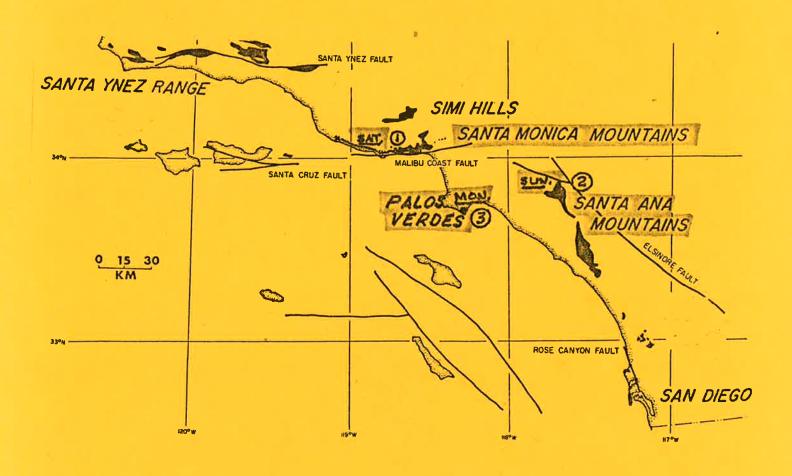
Los Angeles Basin ~ California



A BRIEF INTRODUCTION TO THE

GEOLOGY OF THE LOS ANGELES

BASIN - UPPER CRETACEOUS - TERTIARY
QUATERNARY ROCKS - THE MALIBU COAST

FAULT - THE NEWPORT INGLEWOOD FAULT

ZONE - SOME PROBLEMS (THE BIG ROCK

LANDSLIDE, THE POINT FERMIN AND

PORTUGUESE BEND LANDSLIDES BEACH

EROSION, FLOODING, EARTHQUAKE RISK)

MAJOR STOPS:

(CSUN-BAM)

THE SANTA MONICA MOUNT
AINS-THE OLIGOCENE-MIOCENE

CYCLE - SPECTACULAR PILLOW

BASALTS-THE PT MUGU FAN

ETC - THE MALIBU COAST FAULT

CAMP - SYCAMORE CANYON

1/16-5UNDAY +

THE SANTA ANA MOUNTAINS
- A LATE CRETACEOUS CYCLE
THE BAKER CANYON-HOLE
SHALE-

CAMP- SILVERADO CANYON

1/17 MONDAY -

PALOS VERDES PENINSULA
-A MONTEREY SUBMARINE
FAN, COASTAL LANDSLIDES,
SECOND STREET-'CRITTERS'(if time)

CSUN-BY ABOUT 6 PM-

LED BY: FISCHER, CHERVEN, FRITSCHE

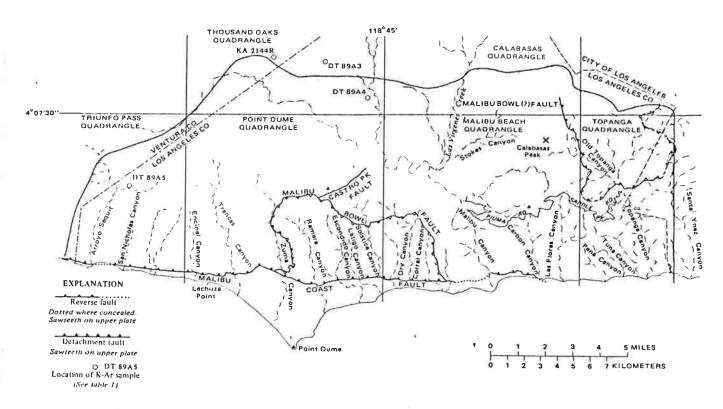


FIGURE 1-10 Map of central Santa Monica Mountains showing area mapped in detail (shaded boundary) and 7½-minute quadrangles.

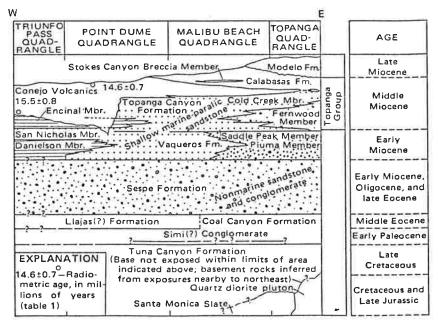


FIGURE I.IL Correlation diagram of units north of the Malibu Coast fault (except for those restricted to the upper plate of the Malibu Bowl fault).

SANTA MONICA MTS.

4		,
	Up.	PLIO.
- Z-Z-R	Low	, 2,0
Modelo Fm	Dolmont.	
N. William Marini	Mohaian	
Cone & Vokania Topanga Croup	<u>Lyis</u> yan Mid. Relizian	MIO.
Vagueros Fm T-	Saucesiai Low	
TITTITUM Sespe Fm	Zomorrizi	
		01160.
Llajas (?) Fin		F
ž.		
Coal Canyon Fm		EOC,
Simi (2) eq1.	777	PALEO.
Tuna canyon Fm	Camp.	
在我们的时间,我们可以在我们的时间,我们就是我们的时间的时间,我们就是一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个		U.K.
		Į.

Figure 1.12 'Cycle' chart santa Monica Mtns (north of Malibu Coast fault.). J'70

	This report	Provincial stage ¹⁴		
South of Malibu Coast fault	North of Malibu Coast fault	Mega- invertebrate	Foraminiferal	
Monterey Shale	Modelo Formation	''Margaritan''	Mohnian	
Zuma Formation 10	Calabasas Tcom Tcos Stokes Canyon Breccia Member Tcos Tcic Tce Tce Tcos Tcor Tcos Tcor Tcos Tcor Tcos Tcor Tcos Tcor Tcos Tcor Tcos Tcos Tcor Tcor Tcos Tcor Tcor Tcor Tcor Tcor Tcor Tcor Tcor	"Temblor"	Luisian Relizian	
	San Nicholas Member Vaqueros Piuma Danielson Member Formation Member	"Vaqueros"	Saucesian	
	7 - 7	(Unnamed)	Zemorrian	
	Sespe Formation	"Refugian"	Refugian	
		"Tejon"	Narizian	
	Llajas(?) Formation	"Transition"	LUcaicina	
	Ciajasti Formation	"Domengine"	Ulatisian	
	Malibu	"Capay"	Penutian	
		"Meganos"	Bulitian	
	Coal Canyon Formation Simi (?) Conglomerate	"Martinez"	Ynezian	
	3	Maest	richtian	
	Tuna Canyon Formation	Cam	panian	
		San	tonian	
	Not exposed	Cor	niacian	

Figure 1.13 Stratigraphy of the Santa Monrez Mtns (Yarkas & Campbell)

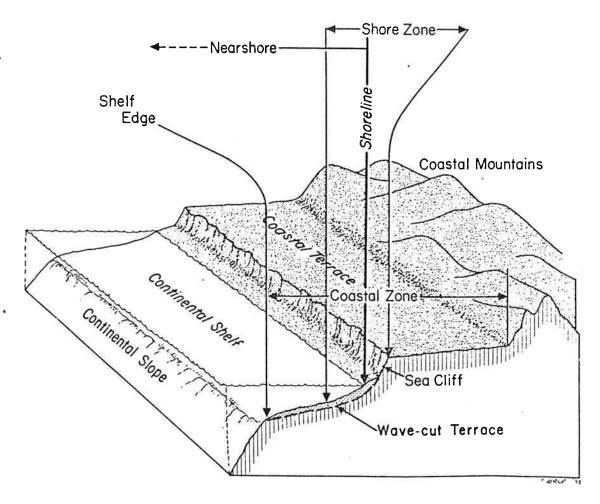


Figure 1.1. Definition sketch of coastal zone nomenclature for coasts similar to the California coast (from Inman and Brush, 1973).

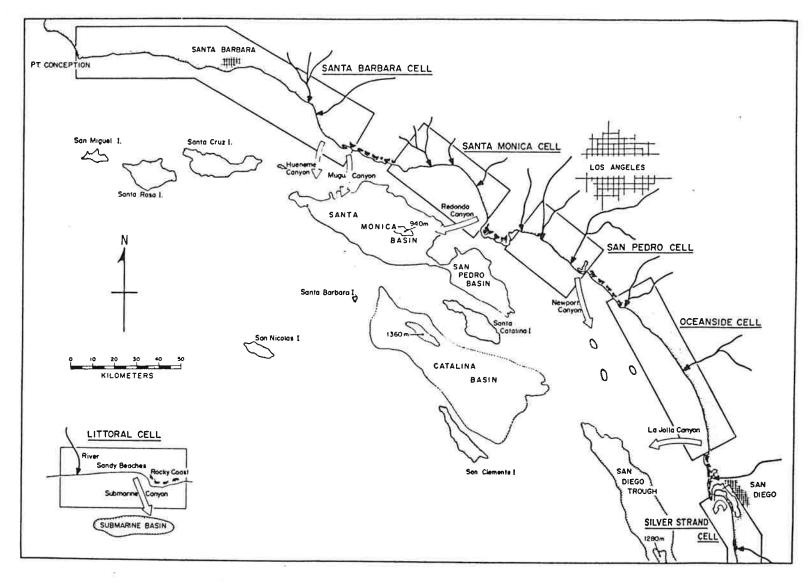
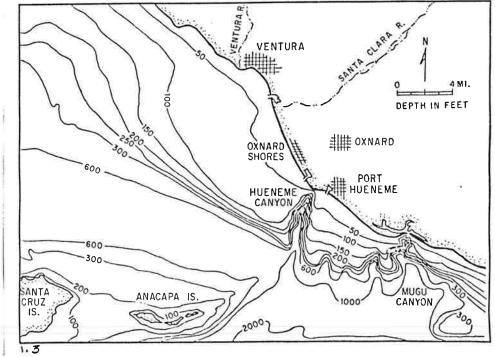


Figure 1.2. Southern California littoral cells, showing cell limits, major streams supplying sediment and sinks. (Inman'76)



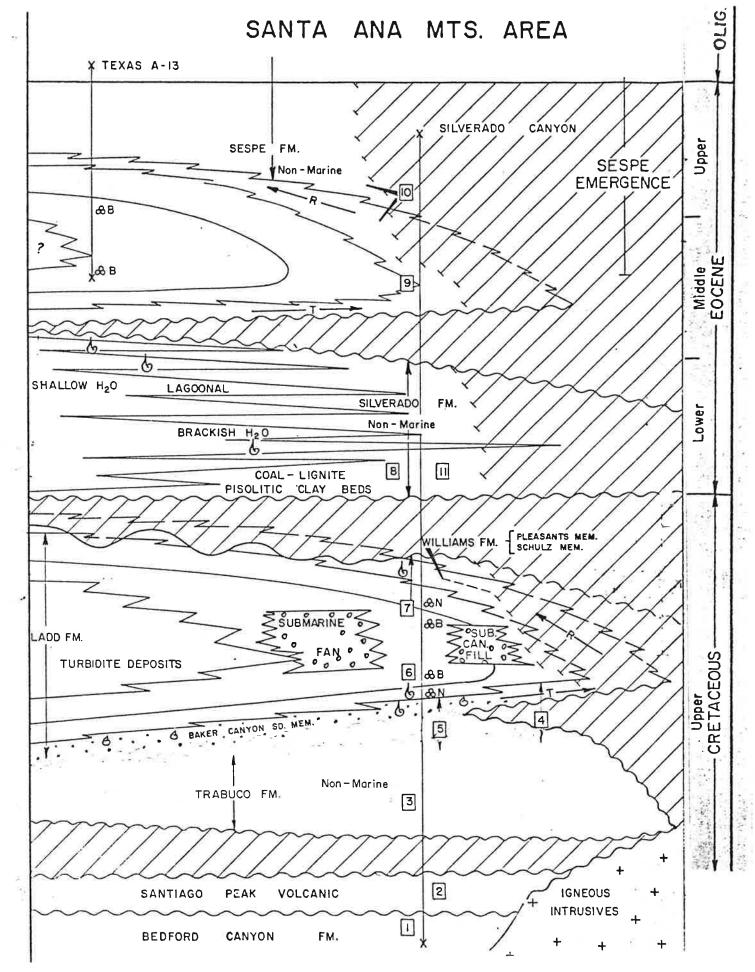


Figure 2.0 "Cycle" chart - Santa Ana Cretaceous - Paleogene

LATE CRETACEOUS DEPOSITIONAL ENVIRONMENTS AND PALEOGEOGRAPHY, SANTA ANA MOUNTAINS, SOUTHERN CALIFORNIA

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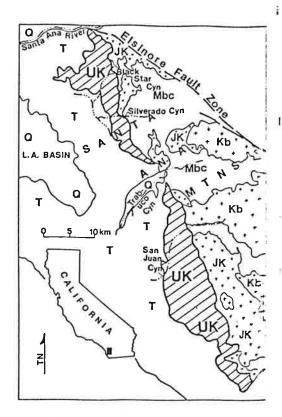


Figure 2.1 Generalized geologic map of northern Santz Ana Mountains showing outcrop belt of Upper Cretaceous sedimentary rocks (UK). Other rock units shown include the Triassic (?) - Jurassic Bedford Canyon Formation (Mbc), the Jurassic - Cretaceous Santiago Feak Volcanics (JK), and granitoid rocks of the Southern California Batholith (Kb), which collectively make up the basement complex. Tertiary (T) and Quaternary (Q) sediments of the southeastern margin of the Los Angeles Basin are also indicated. (After Rogers, 1955;

GEOLOGIC SETTING

The Santa Ana Mountains are in the northern part of the Peninsular Range Province and border the southeastern margin of the Los Angeles Basin (Fig. 5). The Upper Cretaceous rocks in the Santa Ana Mountains comprise a thick (500 to 1500 m) succession of predominantly marine terrigenous clastics sandwiched unconformably between rock assemblages of Jurassic-Early Cretaceous and Paleogene ages.

The oldest rocks in the northern Santa Ana Mountains are the Bedford Canyon Formation, a thick (greater than 5000 m) Triassic (?), Jurassic (Imlay, 1963, 1964; Silberling et al., 1961; Criscione et al., 1978) succession developed mainly as flysch (Moscoso, 1967) deposits of a forearc basin (Buckley et al., 1975) and exposed in the overturned limb of a large nappe (Moscoso, 1967). Bedford Canyon rocks locally are cut by shallow intrusives and overlain unconformably by extrusive andesitic rocks of the

Santiago Peak Volcanics of Late Jurassic to Early Cretaceous age (Fife et al., 1967; Colburn, 1973). Intrusive rocks of the Southern California batholith (Larsen, 1948; Woyski, 1972) of Early to Middle Cretaceous age (Evernden and Kistler, 1970; Krummenacher et al., 1975) are exposed several km south of the trip route (Fig. 5).

The intensely deformed Bedford Canyon flysch, the andesitic Santiago Peak Volcanics, and the magmatic arc rocks of the Southern California batholith comprise the ancestral Santa Ana Mountains assemblage and reflect an orogenic history related to Late Mesozoic subduction (Hill, 1971; Yeats, 1974; Gastil, 1975). The overlying post-orogenic Upper Cretaceous rocks, which comprise the lower part of a pre-Middle Miocene, pre-inception of Los Angeles Basin (Yerkes et al., 1965; Yeats, 1968) coastal clastic wedge, are the subject of this field trip.

UPPER CRETACEOUS STRATIGRAPHY

The Upper Cretaceous sedimentary rocks of the northern Santa Ana Mountains crop-out as a northweststriking homocline that dips west to southwest at 15 to 40 degrees (Schoellhamer et al., 1954). The succession is subdivided into the following units, in ascending order: Trabuco Formation, Ladd Formation (including the Baker Canyon and Holz Shale Members), and Williams Formation (including the Schulz, Pleasants, and Starr Memhers). This sequence provides an instructive example of a non-marine to shallow marine to equivocal deep marine transition, as well as exemplifying facies products of alluvial fan, fan-delta, fan-delta fringe, shallow marine shelf, and equivocal hay, outer shelf, upper slope, and submarine channel depositional systems. These strata record a major marine transgression as well as several major progradational events during Late Cretaceous time in the Santa Ana Mountains district.

Macrofaunal (Popenoe, 1942, 1973) and microfaunal (Almgren, 1973; Lang, 1976) successions indicate an age of Turonian through Campanian. The Turonian age of the unfossiliferous Trabuco Formation is based on the gradational relationship with the overlying fossiliferous Baker Canyon Member of the Ladd Formation; however, the Trabuco could be as old as Cenomanian (Lang, 1976). Fossils of possible Maastrichtian age have been reported from the upper part of the Williams Formation in the southern part of the outcrop belt (Morton, 1972).

Some questions have arisen regarding the internal conformity within the Cretaceous section. Although Yerkes et al. (1965) reported a Santonian and Coniacian age for the lower part of the section, the basis for this age assignment was not discussed. Almgren (1973; this volume) and Saul (this volume) find little evidence for the existence of Santonian and Coniacian strata in the succession.

Bottjer, D.J., Colburn, I.P., and Cooper, J.D., eds., 1982, Lais Cretaceses Depositional Environment and Poleogeography, Santa ann Mountains, Southern Cullfornia, Pacific Scripe, SEPM, Field Trip Volume and Guidebook, pg. 3-10.

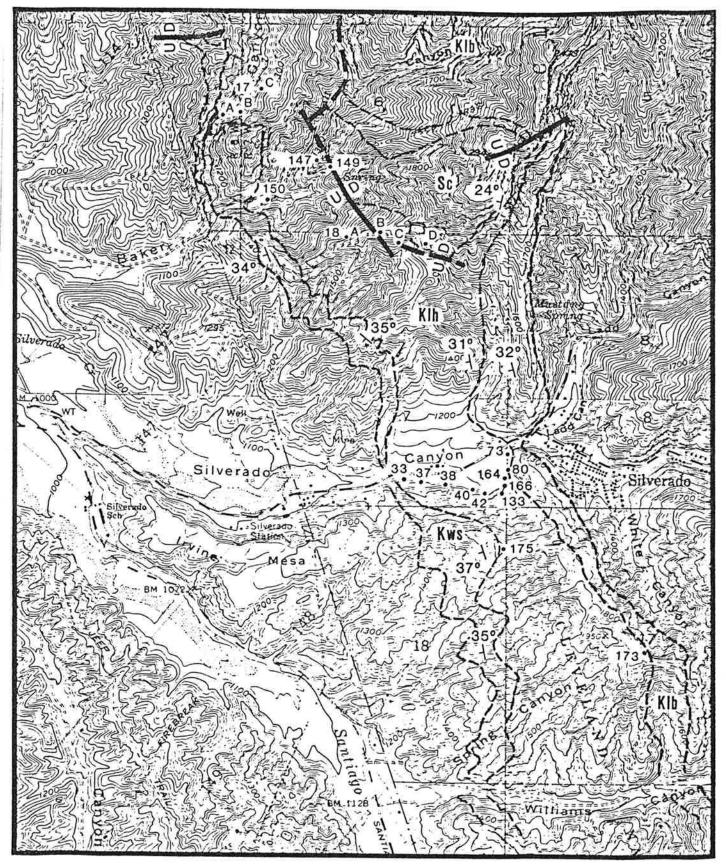


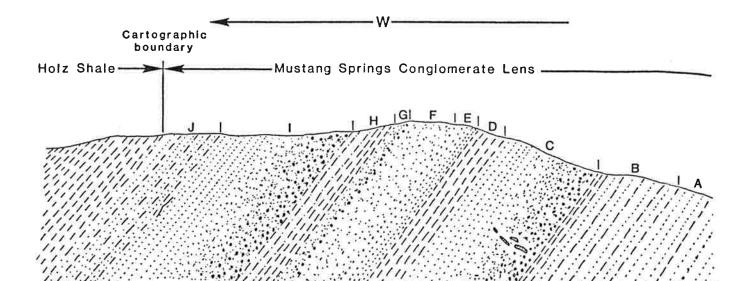
Figure 2.2 Map showing locations of foraminiferal samples from Silverado Canyon and Baker Canyon-Mustang Spring area. Stratigraphic positions of these samples are shown in Fig. 3, and foraminifera present are shown in Table I and Table II. Formation boundaries are those of Schoellhammer, et al., 1954. Formation designations are as follows: K1B=Baker Canyon Member; K1h=Holz Shale Member of the Ladd Formation; Sc= Mustang Spring Conglomerate Member of the Holz Shale; Kws=Schulz Member of the Williams Formation.

-,	YBE 3	_		S	X X	STOPS	STRATIGRAPHIC SECTION FOR SILVERADO TRUCK TRAIL
FORAM ZONES	MOLLUSCAN STAGE	FORMATION	MEMBER	HICKNESS	GRAPHIC COLUMN	FIELD TRIP ST	IVAN P. COLBURN & MARK McKEOWN 1882
Ē	MOLL	-			68.A	臣	DESCRIPTION
i	PALEBOENE	SILTEBADO			09		Light tan, medium to very coarse-grained, cross-bedded sandatone. Cross-bed sets are 1m thick and contain pebble sandatone lenses.
انا	300	Ē			2000	1	Unstructured pebble and cobble conglomerate, UNCONFORMITY
	'		PLEASAUTS	135 Belleri			Tan, poorly bedded, medium-grained sandstone.
	П		PLEA	2.0	00000		Tan,poorly bedded, coarse-grained sandstone with poorly developed cross-bedding common. — GRADATIONAL CONTACT
		2		_	3888		Unstructured medium to very coarse-grained sandstone with pebble bed at the top of the sequence, Lenses of unstructured medium to coarse-grained sandstone and poorly developed cross-bedding.
		WILLIAMS	SCHULZ	410' 125 motoral	00000	Ŧ	Light brown, medium to coarse-grained sandatons and interbedded lenses of unatructured cobble conglomerate. Sandatons beds range from 1° to 8° thick.
	CAMPANIAN		SCH	10.1126			Gray, sity and sandy mudatone and slitstone. Fissility and stratification are poorly developed, Limestone nodules weather out of the exposures. Similar in appearance to Holz Shale.
	3				188 de	+	Tan, fine to coarse-grained sandstone, pebbly sandstone and pebble, cobble and boulder conglomerate lenses. Stratification is poor to well developed; cross-bedding.Wood fragments abundant.
					130		Light-brown, unstructured, medium to fine-grained sandstone with lenses of shells and pebbles. GRADATIONAL CONTACT
1					co 0	1	age and a second a
	П						
1 12	ادا			ш	026 as		
UNDIFF.	ľ					1	No.
5							
	~			-	(E) (C)		
			HOLZ	motors)		1.1	Black to dark gray to gray-green mudstone and siltatone comprise 95% of this unit. The other 5% of the
			-			1	section consists of thin-beds of medium to fine-grained sandstone beds less than .3m thick, thin lenses of limestone less than .3m thick, and nodules of limestone ranging up to 1m in diameter. The sandstone beds
GELLACEDUS G-1 -	П			802,1284			are turbidity current in origin.
	~	2		20	000		
	ľ	LADO		-		7	
3 1							
10						1	
=	L						
-	10				20.60		
					mi	ş	<u>1</u>
1		1 1		8	25.4	1	SECTION FAULTED
1/E - 2	3		H				Greenish-gray mudatone, unstratified, highly bioturbated and rich in molluscan shells. GRADATIONAL CONTACT
	TUROR		5	1	1000	H 4 H	Tan, fine to coarse-grained sandstone, unstratified to well-stratified and cross-bedded comprise 90% of the unit with 10% being comprised of pebble and cobble conglomerate lenses and lenses of thick-shelled mollusik
	-		DAKER CYN	205'163 meteral	000000	2-	Green, poorly sorted to moderately sorted pebble, cobble and boulder conglomerate comprise 90% of the usend 10% being lenses of coarse to medium-grained sandatone and pebbly sandatone lenses rarely exceeds 1m thick; unfossiliferous.
		Н	-		190		- GRADATIONAL CONTACT
	1			_	9.10		~
		L		metere	000	17	Old consider to positive ported, public probble and boulder problems to provide a COM of the civil civils.
700					10.00	1	Red, unsorted to poorly sorted, pebble, cobble and boulder conglomerate comprises 90% of the unit, with 1 being lenses of coarse sandstone and pebbly sandstone moderately to poorly stratified and rarely exceed
Ш		TEABUCO		Ξ	99		.3m thick.
			1	3857117	00000	\vdash	
	1			"	0.00		
		L	L	_	100	2	UNCONFORMITY
<u>.</u>	1	E		Ħ	员	6	2948 (858M4 Y yrs okt) Dark green to gray-green andesite autobreccia.
		SAITAR		BOT TO SCALE			2 2 2 2 2 2 2
انس		_		1	220		2840 (108MM yrs old) Gray to white dacite lapilli tuff and autobreccia.
		1.111	Γ	SCALE	200		UNCONFORMITY Basement rock comprised of Mesozoic leucocratic plutonite and Jurassic Bedford Canyon Formation.
	1						

Figure23. Silverado truck trail stratigraphic section.

PERIOD	FORAM ZONES	MOLLUSCAN STAGE	FORMATION	MEMBER	THICKNESS	GRAPHIC COLUMN	FIELD TRIP STOPS *	STRATIGRAPHIC SECTION FOR MUSTANG SPRING CONGLOMERATE LENS BY IVAN P. COLBURN & RICHARD G. BLAKE 1882	0 T 0
	티	_				EB/	HE	DESCRIPTION	10 T 111
		Fi.	WILLTAWS			6a.as		Tan to yellow-brown cobble to boulder conglomerate beds interbedded with medium-grained. The conglomerates are structureless. The candistone beds are tabular. The base of the second more city than higher up.	
	A GIELE	2 - CAMPANIAN			700' (213 maters)			Tan to gray-greenish brown mudatone, weak fissility with scattered gray limestone nodules. Co poorly and is recognized mainly by greenish-gray mudatone chips in the soil. Thin, medium to furbidite sandstone bads are present toward the base of this lithosome. The upper 9m of unit sillstone and the upper contact is marked by the transition to coarse-grained sandstones and of the Schulz Member of the Williams Formation.	ine-grained grades into
LATE CRETACEOUS			LADD	MOLZ SHALE	550' [168 maters]	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	PB 45 44 4342 41	Tan-colored pebble and cobble conglomerate with interbedded sandatone and pebbly sandaton Conglomerate is poorly sorted and often internally structureless. Beds of conglomerate range thick. Sandatone beds are medium to coarse grained, poorly sorted and range between lentice tabular bed shapes. Numerous atructureless conglomerate-filled channels, trough and planar cropressed beds, reverse graded beds, isminated beds and lunate and straight created ripples are Sandatones are locally bioturbated with vertical and horizontal burrows. No shells preserved. I mudatone lense within the conglomerate interval has the same lithology as the Holz Shale.	up to 5m der end es-beds present.
		CONTACTARY			meters!	888	14	POSSIBLE EROSIONAL CONTACT	
	G -17	-7- CON			275' i84 met			Same lithology as upper part of Holz Shale.	
		TUBONIAN		DAKER CANTON	450' [137 meters] 2			Tan-colored sandstone makes up the major and most conspicuous constituent lithosome. Also present greenish-gray moddy sitistone. The sandstone beds are commonly highly blotutisted with numerous ve Layers of thick-shelled moliusks are well preserved in the upper sandy part of the lithosome. Bed structures best displayed in the sandstone part of the lithosome include structureless to parallel bedd through cross-bedding, dish structures and ripple marks. The sandstones are moderately to poorly sort conglomerate beds are tan-colored and are tabular-shaped with clasts in the beds ranging from structure to preferentially sligned. The greenish-gray muddy sitiations layers are interbedded with sandstone be conspicuously in the upper part of this fithosome. Bedding in all thologies ranges up to 1m thick. —GRADATIONAL CONTACT	rtical burrow imentary ng planer an ed. The tursiess fabri de most
		1		=	450	0000		Gray-green to yellow-brown, poorly to moderately sorted cobble conglomerate with interbedde medium to coarse-grained sandatone. Conglomerate comprises 95% of this lithocome and sand. Conglomerate intervals range up to 6m thick and are generally internally structuraless. Stratific lithocome is generally defined by the presence of sandatone lenses and by bedding within sand.	stone 6%. stion in this
			TRABUCO			10.00		GRADATIONAL CONTACT Deep red-colored, unsorted and very poorly stratified boulder, cobble and pebble conglomera lithosome is 97% conglomerate and 3% sandstone in the form of lenses of coarse sandstone sandstone. Incomplete section.	

Figure24... Mustang Spring conglomerate lens stratigraphic section.



Stop 2 illustrates the lithologic characteristics of the stratigraphic upper units of the Mustang Spring Conglomerate Lens and its contact with the overlying Holz Shale. It can be seen at this stop that the upper part of the lens has a number of beds exhibiting partial Bouma bed form sequences thereby establishing that turbidity currents were depositionally active in the later phase of the lens development. Beds at this stop are finer grained and thinner bedded relative to beds stratigraphically lower in the lens (see Fig. 12). This relationship indicates an overall fining and thinning upward transition beginning in about the stratigraphic middle of the lens. (State Colburne 82)

gradational interval

1 meter

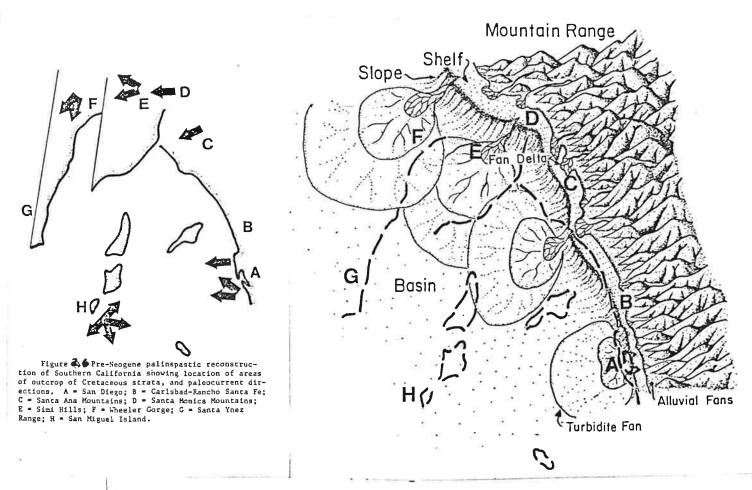


Figure 27 Paleogeographic reconstruction of Southern California during the Late Cretaceous (Campanian). Dashed lines represent the pre-Neogene geographic locations of the present-day coastline. Letters indicate pre-Neogene locations of present-day outcrop areas of Cretaceous strata (see Fig. 2.6 for explanation).

POINT FERMIN SUBMARINE FAN PALOS VERDES, CALIFORNIA

Regional Setting

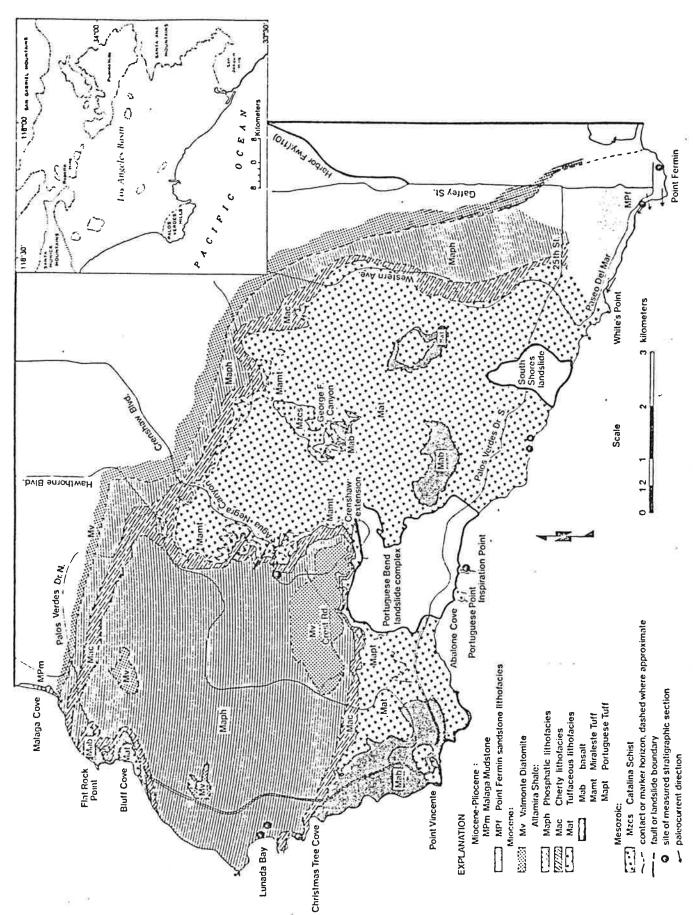
The Point Fermin submarine fan is within the Monterey Formation of the Palos Verdes Peninsula, California (Fig. 1). The Palos Verdes Peninsula contains rocks of a portion of an extensive, predominantly submarine terrane of the inner California Continental Borderland where middle Miocene and younger strata rest unconformably on a tectonically disrupted basement of Mesozoic Catalina Schist (Platt, 1975; Howell and Vedder, 1981). The Monterey Formation of the Palos Verdes Peninsula, which contains remarkably abrupt changes in lithofacies in the time interval from 16 Ma to 4 Ma (middle Miocene to early Pliocene) (Rowell, 1982) and has been divided by Woodring and others (1946), into three members (in ascending order): the Altamira Shale (300 m), Valmonte Diatomite (125 m), and Malaga Mudstone (125 m). They further subdivided the Altamira Shale into (in ascending order): tuffaceous lithofacies, cherty lithofacies, and phosphatic lithofacies (Fig. 2).

Subdivision_	Dominant Lithology	Thickness in type area in meters	Age Range in million years	Duration in million years
Malaga Mudstone	radiolarian mudstone	125	6.9 to 3.5	3.4
Valmonte Diatomite	diatomite and phosphatic diatomaceous shale	125	13.0 to 6.9	6.0
Point Fermin sandstone lithofacies	sandstone derived from a Catalina Schist source	30	14.5 to 10.0	4.5
Phosphatic lithofacies	phosphatic diatomaceous shale and phosphatic mudstone	25	14.2 to 13.0	1.2
Cherty lithofacies	porcelanite and chert	16	14.5 to 14.2	0.3
Tuffaceous lithofacies	porcelanite, silty and sandy shale, basalt and tuff	275	15.5 to 14.5	1.0

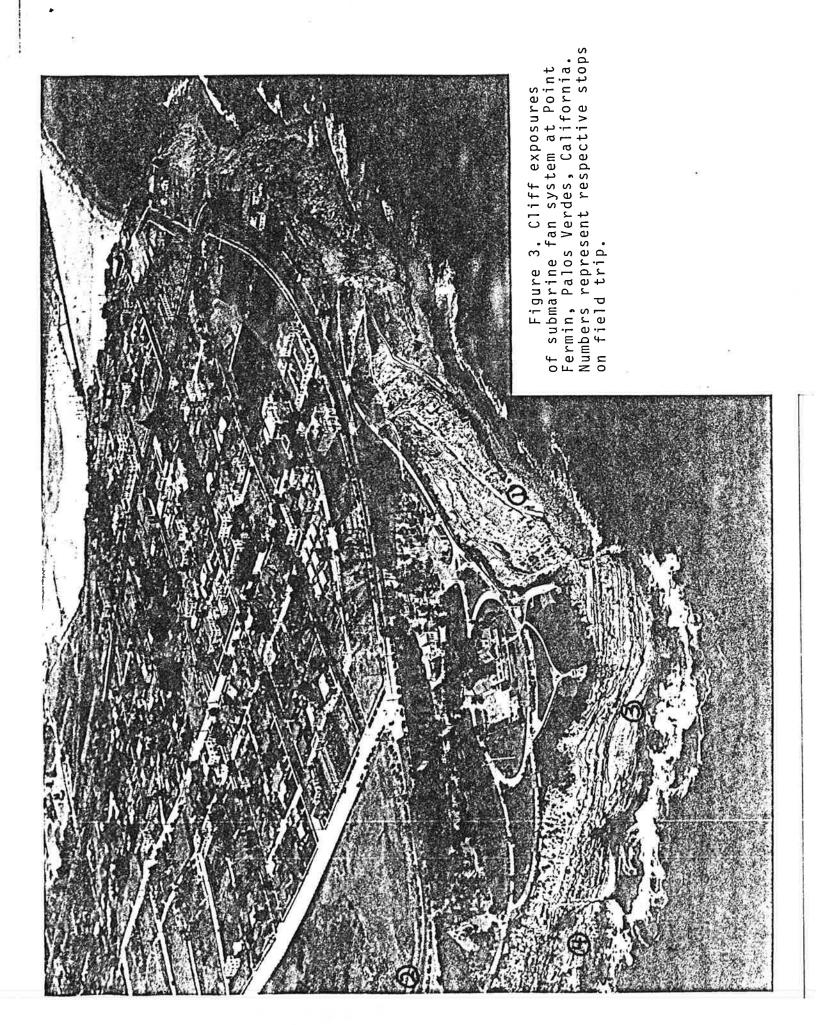
Figure 2. Subdivisions and selected features of the Monterey Formation of the Palos Verdes Peninsula. Chronostratigraphy by Rowell (1982) (Conrad and Ehlig, 1983).

Local Setting

In the Point Fermin area, a portion of a submarine fan system occupies the stratigraphic position of the cherty and phosphatic lithofacies and the lower part of the Valmonte Diatomite (Fig. 3). Beds consisting predominantly of blue-schist-bearing sandstone and breccia, intraformational breccia, and interbedded silty and phosphatic shale occur within a channel system which has scoured into the upper tuffaceous lithofacies. Paleocurrent, grain orientation, and imbrication studies indicate a southeastward sediment source



Bedrock distribution of the lithofacies of the Monterey Formation of the Palos Verdes Peninsula (Conrad and Ehlig, 1983). Figure 1.



(Spotts, 1964; Conrad and Ehlig, 1983). Previous reports (Woodring and others, 1946; unpublished report by Biostratigraphics, 1981) indicate that the fan developed within the time interval between about 15.0 and 10.0 Ma. The total thickness is difficult to estimate, but is at least 300 ft (Woodring and others, 1946).

Stop 1

On the east side of Point Fermin, the above strata consist of two sandstone units and a shale unit. The upper sandstone unit forms a 100-foot sheer cliff and grades easterly down into the shale unit. The lower sandstone unit forms the base of the beach cliff and fines upward into the shale unit. The two sand units merge at the base of the sheer cliff. This is interpreted to be the amalgamation of two channel systems. Thinning and fining upward is characteristic of channel deposits (Fig. 4). Large rip-up clasts can be seen in some sand beds (Fig. 5).

Stop 2

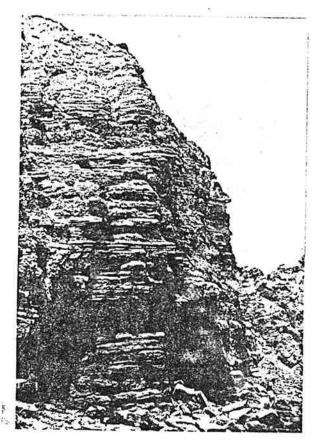
The roadcut on the northwest side of Point Fermin displays characteristic channeling features such as lenticularity, erosive scour, rip-up clasts, and amalgamated beds. Layers of shale can be traced into breccia composed of shale fragments of identical composition and embedded in a sandstone matrix like that interbedded with the shale. The channel margin can be seen in the western portion of the outcrop.

Stop 3

The channel axis is generally evident at the southern end of the Point. Lenticularity of bedding is readily apparent. It is in this region of the outcrop that the most diverse and well-displayed sedimentary structures can be found. These include flame structures and convoluted bedding (Fig. 6), ripple bedding (Fig 7), contorted rip-up clasts (Fig. 8), and cut-and-fill structures (Fig 9).

Stop 4

A channel margin is evident on the west side of Point Fermin. An irregular, scoured base can be seen where coarse-grained sandstone and pebble conglomerate rest unconformably on interbedded shale and sandstone (Fig. 10). These interbedded shale and sandstone beds represent levee deposits. Slump folds, typical of levee deposits, can be seen just below the irregular sandstone contact (Fig. 11).



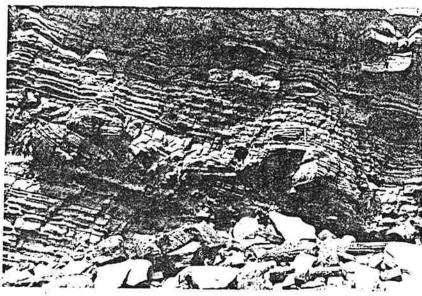


Figure 5. Large shale rip-up clasts in channel deposits.

Figure 4. Thinning and fining upward of channel deposits.

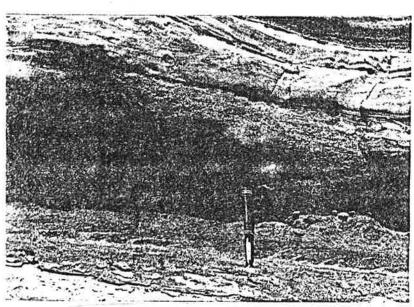


Figure 6. Flame structures and convoluted bedding in channel deposits.



Figure 7. Climbing ripples in channel deposits.

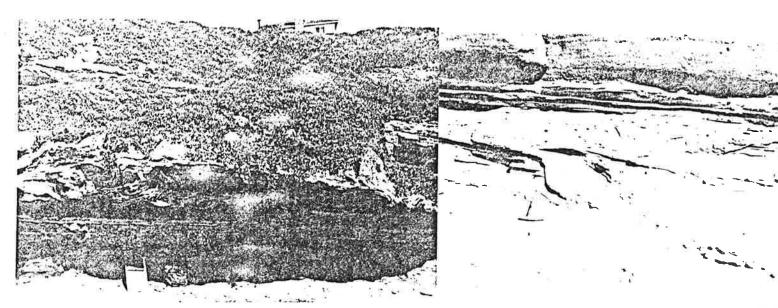


Figure 8. Contorted shale rip-up clasts.

Figure 9. Cut-and-fill channel structure.

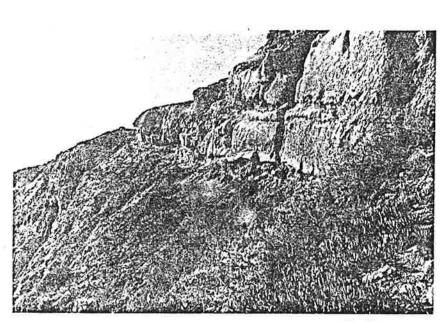


Figure 10. Irregular, scoured base of channel margin.

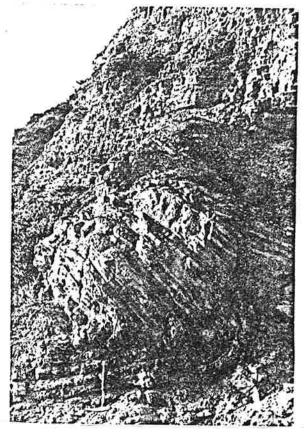


Figure 11. Slump fold in levee deposits.

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