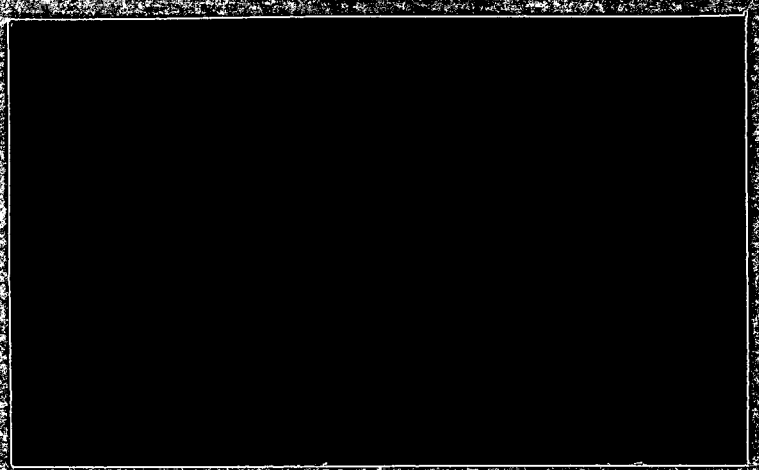

Woodward-Clyde Consultants

Woodward-Clyde Consultants

SUMMARY REPORT ON BASIC DATA FROM TWO ONSHORE AND SIX OFFSHORE GEOLOGIC BORINGS SONGS UNITS 2 AND 3 SAN ONOFRE, CALIFORNIA

Prepared for:

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4 August 1980
Project No. 41299I

Southern California Edison
P.O. Box 800
Rosemead, California 91770

Attention: Mr. H. G. Hawkins

Gentlemen:

SUBJECT: SUMMARY REPORT ON BASIC DATA FROM
TWO ONSHORE AND SIX OFFSHORE GEOLOGIC BORINGS
SONGS UNITS 2 AND 3
SAN ONOFRE, CALIFORNIA

We have completed the drilling operations onshore (north of the Cristianitos fault) and the vibratory core borings to sample seafloor sediments offshore SONGS Units 2 and 3. These assignments were conducted under the direction of Messrs. H. G. Hawkins and J. L. McNey of Southern California Edison. This report provides a summary of field operations, drilling logs, and the results of age dating analyses. The data on onshore borings and offshore borings are presented in Sections 1 and 2, respectively. We hope that this summary report of basic data meets the project needs at this time.

If you have any questions, please call at your convenience.

Very truly yours,

John A. Barneich
Associate

George E. Brogan
Associate

JAB:GEB/ea
Attachments

TABLE OF CONTENTS

SUMMARY REPORT ON BASIC DATA FROM TWO ONSHORE AND SIX OFFSHORE GEOLOGIC BORINGS SONGS UNITS 2 AND 3 SAN ONOFRE, CALIFORNIA

1.0 ONSHORE BORINGS

1.1 Introduction

Two onshore borings were drilled about 500 ft north of the Cristianitos fault at El Camino Real Road. The locations of borings are shown on Figure 1. This program was conducted under the direction of Southern California Edison. Geologic interpretations are being made by Southern California Edison. The purpose of this report is to present the logs of borings and to provide a brief description of the operations. Additional operational details are being kept on file by Woodward-Clyde Consultants.

1.2 Project Organization and Staffing

The program was conducted under the direction of Messrs. H. G. Hawkins and J. L. McNey of Southern California Edison. Messrs. J. A. Barneich and O. S. Ghuman from Woodward-Clyde Consultants coordinated and supervised the effort.

The drilling contractor for the onshore borings was Continental Drilling-U.S. from Madera, California. Mud engineering and supplies were obtained from Baroid and the geophysical logging was done by Welenco from Bakersfield, California. The boring logs were kept by staff geologists.

1.3 Field Operations

The onshore borings were drilled using a Longyear 44 drill rig with HQ size drill pipe. The borings were advanced using

the rotary drilling method to depths at which coring was desired. Continuous wire line coring was then attempted using a 5 or 10 ft Longyear core barrel. Mud, as engineered by Baroid, was used as the circulating fluid. Core diameter was 3-1/2-inches.

Boring B-1

Boring B-1 was started on 22 May 1980. The boring was located about 500 ft north of the projected trace of the Cristianitos fault at its intersection with El Camino Real Road. After drilling into the San Mateo formation, a 4-inch diameter casing was installed to a depth of 58 ft. Attempts to obtain cores of the San Mateo sand were generally unsuccessful. It was decided to attempt further coring in the siltstone of the Monterey formation. Cores were obtained from 480 to 557 ft.

When the boring had advanced to 557 ft, it was decided to advance the casing to improve the drilling rate. During this operation about 100 ft of casing dropped into the hole. Repeated attempts to recover the casing were unsuccessful, and the boring was abandoned for later closure.

Boring B-2

Boring B-2 is located about 30 ft south of Boring B-1 along El Camino Real Road. It was started on 5 June 1980. The boring was advanced rapidly to about 400 ft using a roller tricone bit; and 4-inch-diameter casing was installed to 379 ft. Continuous wireline coring was done from about 483 to 750 ft. An attempt was made to remove the casing following completion of the hole, but only 15 ft of casing was retrieved.

Geophysical logs were run in Boring B-2 after drilling was completed. The runs included an electrical log giving the spontaneous potential and resistivity and a radioactivity log providing gamma ray and neutron logs.

After completion of the drilling and logging operations, the mud was weighted and the viscosity increased for closure. Both Borings B-1 and B-2 were then capped with a 3-sack cement-slurry plug. About 1 cu. yd. of slurry was placed in each boring. The logs of the borings are presented in Appendix 1-A and the geophysical logs in Appendix 1-B.

1.4 Summary of Boring Logs

The following is a summary of the stratigraphy obtained from the borings and a preliminary interpretation of the geophysical logs:

0 to 48 ft - Terrace Deposits - Sand. The colors range from pale brown (5YR5/2) to yellowish brown (10YR5/4) to red brown (10R5/4). The sand is fine to coarse grained, subrounded to well rounded, moderately to well sorted, with occasional lenses of clay and silt. Gravel and cobbles occur at the base of the terrace deposits. The deposit is poorly to moderately consolidated.

48 to 428 ft - San Mateo Formation - Sandstone. The colors of the San Mateo formation sandstone in Boring B-1 from a depth of 48 ft to about 200 ft are shades of yellowish brown, ranging from dusky yellow (5Y6/4) to pale yellowish brown (10YR6/2) to dark yellowish brown (10YR4/2). Between depths of 200 ft and 432 ft, the colors are shades of olive gray, mostly light olive gray (5YR5/2). The San Mateo formation in Boring B-2, consists of sandstone having a color of mostly light olive gray (5YR5/2). The texture of the San Mateo

formation consists of medium-to coarse-grained with some fine-grained sands. The sand grains are subangular to moderately well rounded. The formation is massive to thickly bedded, contains occasional pebbles and cobbles, and is slightly silty and micaceous locally. The approximate minerological composition is: Quartz 85-90%, feldspar 5-7%, and other minerals 5%. The basal contact with the Monterey formation occurs abruptly where drilling becomes harder.

428 to 669 ft - Monterey Formation - Siltstone. The formation is generally olive black (5Y2/1) in color, micaceous and contains highly fractured, slickensided and contorted areas. Bedding dip varies from horizontal to as much as 70 degrees and commonly includes thin 1/4-inch bluish gray beds. The siltstone is friable to well indurated with occasional sandy interbeds. Some sandy interbeds may contain volcanic ash.

Core samples between depths of 485 ft and 654 ft were examined for microfossils to estimate the age of the cores. The results of these analyses are presented in Appendix 1-C. Foram inifera samples collected from depths of 485 ft to 495 ft yield an age of Lower Mohnian (upper Miocene). Foram inifera samples collected from 654 ft are from the Luisian age (upper Miocene). The base of the Monterey formation from 658 ft to 669 ft contains abundant blue schist fragments and appears to be reworked San Onofre Breccia.

669 to 749.5 ft - San Onofre Breccia. This formation consists of bluish gray sandy breccia (5B5/1), with moderate to well cemented clay and silt matrix. The clasts range in size from sand particles to 4-inch cobbles; larger clasts mostly consist of chlorite and glaucophane schist and smaller clasts consist of quartzite and amphibole. The clasts are generally angular and are less weathered at increasing depths.

2.0 OFFSHORE BORINGS

2.1 Introduction

Vibratory cores were obtained at six selected locations offshore from San Onofre, California. The core locations are shown on Figure 1. This program was conducted under the direction of Southern California Edison. Geologic interpretations are being made by Southern California Edison on the basis of the results of the vibratory coring work. The purpose of this report is to provide a brief description of the field operations, to present the vibratory core logs and the results of age dating analyses. Additional operational details are being kept on file by Woodward-Clyde Consultants.

2.2 Project Organization and Staffing

The program was conducted under the direction of Messrs. H G. Hawkins and J. L. McNey of Southern California Edison. Messrs. J. A. Barneich, O. S. Ghuman and K. Bhushan from Woodward-Clyde Consultants coordinated and supervised the effort.

The vessel M/V Calcasieu belonging to Ocean Services, Inc. was mobilized in San Pedro for the vibratory coring work. Oceanmasters International Inc. provided the vessel Ocean Command as the crew boat. Woodward-Clyde Consultants operated the vibratory coring unit, logged the cores, and provided the navigation.

2.3 Field Operations

The sampling unit consists of a seafloor-supported quadruped frame with a vibrator - drill pipe assembly. The vibrator is operated by air supplied from a shipboard compressor and is mounted on a 40-ft long drill pipe. The drill pipe consists

of a standard 4-in. pipe with a cutting shoe and a sample retainer at the bottom. Samples are recovered in a removable 3-1/2-in. diameter plastic liner. The unit is also equipped for jetting in materials where full 40 ft penetration is not achieved in a single run. The water for jetting is supplied by a shipboard fire pump. Generally, a maximum of 40 ft of core can be recovered using this sampler. However, for the last run in boring 2-1 a 7-ft sampler extension was fitted and an attempt was made to penetrate as much as 47 ft.

Electronic navigation was provided using a Motorola Mini-Ranger III positioning system. This is a short range (20 nautical miles) line-of-sight system. The basic Mini-Ranger consists of a range console, receiver-transmitter, and omni-directional antenna installed on the boat. Two or three reference transponders are located at surveyed ground points. The measured ranges to the transponders are directly displayed in meters. The accuracy of the ranges is $\pm$3 meters at 20 nautical miles. The actual accuracy of the system is a function of the ranges and the angle of intersection of the two range lines. Conventional trilateration techniques are used to reduce the data. For the sampling program, two transponder stations were located along the coastline.

The boat was maneuvered using reference anchor locations that were calculated based on known anchor cable lengths. A three-point mooring system was used to maintain position. The vibratory coring assembly was carried horizontally suspended alongside the boat from two A-frames. After anchoring the boat on location, the bottom end of the corer was released so that the coring assembly was suspended vertically from the A-frame. The corer was lowered to the seafloor using a 20-ton capacity hoist. The air hoses connected to the vibrator were lowered along with the corer. After the

corer was seated on the seafloor, the air compressor was started to begin the coring. The penetration rate was recorded on a strip chart recorder. The air supply to the vibrator was stopped when no further penetration occurred. The core barrel was pulled out of the seafloor and the coring unit was retrieved. The bottom end of the coring unit was pulled with an air tugger to bring the unit into a horizontal position, and to remove the liner. The liner was cut at the point where the core stopped and the length of the core was measured and recorded. The recovered core (inside the liner) was then cut into convenient lengths (3 to 4 ft); logged by a geologist; capped and sealed at both ends; marked and stored. In all cases, full penetration to the desired depth could not be achieved on the first run. For each succeeding run, the liner, cutting shoe and sample retainer were reassembled, the coring unit was lowered to the seafloor, and the core barrel was advanced by jetting to a depth close to the bottom of the penetration achieved in the preceding run. After jetting to the desired depth, the vibratory coring operation was carried out as described previously. The number of runs at each site ranged between 2 and 5 and the maximum penetration achieved ranged between 25.5 and 44.1 ft.

A total of six sites were sampled, five on Line No. 1, and one on Line No. 2. Lines 1 and 2 refer to geophysical lines run by Fugro (Line 1) and Woodward-Clyde Consultants (Line 2). The location of the sites are shown on Figure 1. A summary of the vibratory coring operation is given on Table 1.

2.4 Summary of Cores

The six offshore borings, advanced utilizing the vibratory coring unit, penetrated to depths ranging from 25.5 to 44.1

ft. In these intervals the materials encountered were mainly sands and silty sands with two of the cores (1-1 and 1-3) containing zones of clay and clayey silt.

The sandy sections of the cores were mainly fine grained, dark greenish gray in color, and contained variable amounts of silt. Cores 1-1, 1-2, 1-4 and 2-1 contained intervals of coarser grained sands ranging from fine to coarse grained and having a yellow gray to olive gray color.

The clayey intervals recovered in the cores were greenish black in color, and were found to be from 22.4 to 24.0 ft in Core 1-1, and from approximately 38.0 ft to the bottom (at 39.5 ft) in Core 1-3.

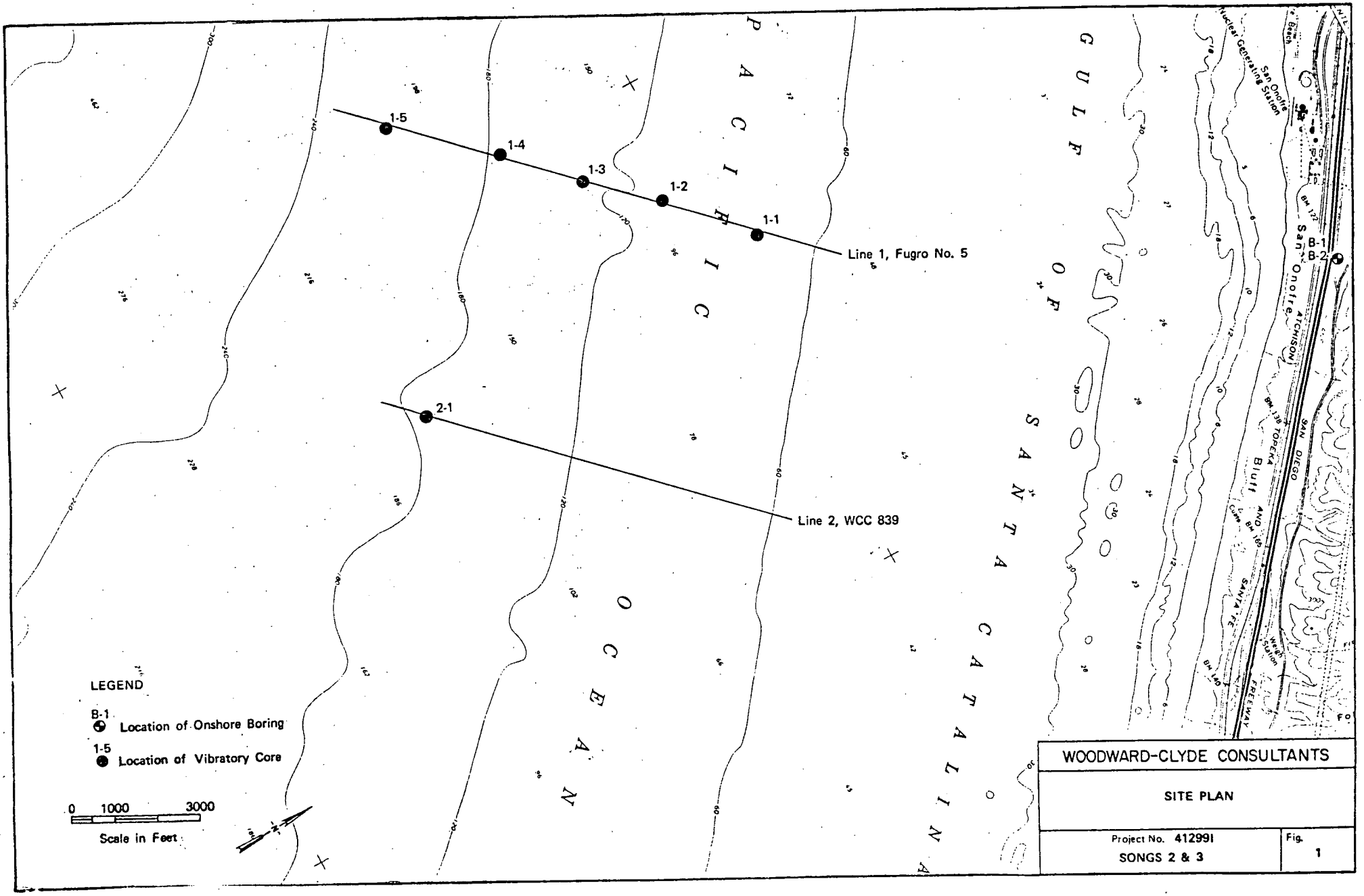
Fossils and other organic debris, such as wood and carbonaceous fragments, were also encountered in the cores. All of the cores contained random shells and shell fragments, and all of the cores, except 2-1, had small horizons that were rich enough in organic debris to collect samples for age dating. These organic rich horizons were mainly encountered from 0 to 25 ft, with the exception of Core 1-5 which had an abundance of organically rich material as deep as 38.5 ft.

Detailed logs of the cores are presented in Appendix 2-A. Age dates obtained from the analysis of organic materials and shells are presented in Appendix 2-B.

TABLE 1

SUMMARY OF VIBRATORY CORING

CORE NO.	RUN NO.	PENETRATION BELOW SEAFLOOR, FEET FROM	TO	RECOVERY, FEET	APPROXIMATE WATER DEPTH, FEET
1-1	1	0	7.0	6.0	72
	2	5.0	25.5	20.1	72
1-2	1	0	22.4	22.4	100
	2	21.0	34.8	11.3	100
	3	32.0	39.5	6.5	100
1-3	1	0	22.4	24.4	125
	2	19.0	24.0	8.0	125
	3	25.0	30.8	9.2	125
	4	31.0	39.5	8.5	125
1-4	1	0	20.0	22.0	165
	2	16.0	23.0	9.0	165
	3	22.0	31.0	4.0	165
	4	31.0	39.5	10.0	165
1-5	1	0	21.5	21.5	200
	2	21.0	32.0	11.0	200
	3	31.0	35.8	5.0	200
	4	36.0	39.5	3.0	200
2-1	1	0	18.0	20.0	165
	2	19.5	30.0	11.0	165
	3	30.0	34.5	5.5	165
	4	35.0	39.3	4.5	165
	5	40.0	44.1	4.0	165



WOODWARD-CLYDE CONSULTANTS

SITE PLAN

Project No. 412991
SONGS 2 & 3

Fig. 1

APPENDIX 1-A

LOGS OF BORINGS

Project No. 41299I Field Log of Boring No. B-1 Sheet 1 of 30

BORING LOCATION El Camino Real, East Side		ELEVATION AND DATUM El. 145 (approx.)	
DRILLING AGENCY Continental Drilling	DRILLER	DATE STARTED 5/22/80	DATE FINISHED 6/2/80
DRILLING EQUIPMENT Longyear 44		COMPLETION DEPTH 557'	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Standard		NO OF SAMPLES: DIST.	UNDIST. / CORE
DRILLING METHOD Rotary: HQ Drill pipe with wireline coring		WATER ELEV. FIRST	COMPL. / 24 HRS.
CORE BARREL Longyear HQ / N/A	LENGTH 5' and 10' / N/A	BIT / N/A	LOGGED BY: J. Glomb / CHECKED BY: O. S. Ghuman

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
1	SAND, moderate yellowish brown, 10YR5/4, coarse grained, well sorted. SM	BAG SAMPLE NO. 1			
2					
3	becomes more dense.				
4					
5	some gravel to 1" diameter.				
6	cobbles and gravel sand becomes medium to coarse grained.				
7					
8	no gravel, color change to pale yellowish brown, 10YR6/2.				
9					
10	CLAY, very sandy, dark yellowish brown, 10YR4/2, medium grained, some gravel, 3-4" thick clay. CL				
11	SAND, reddish brown, 10R5/4, medium to coarse grained, with occasional gravel 1/4-1/2" in diameter, dense. SP	BAG SAMPLE NO. 2			
12					
13					
14	less dense.				
15					
16					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
17	SAND, pale yellowish brown, 10YR6/2, medium to coarse grained with some fines. SM				
18					
19					
20	becomes more dense yellowish brown, 10YR5/4, fine to medium grained, moderately well rounded, well sorted.				
21					
22					
23					
24					
25					
26	grades to grayish orange, 10YR7/4.				
27					
28					
29					
30					
31					
32	less dense moderate yellowish brown, 10YR5/4, grades to medium grained.				
33					
34					
35					

BAG SAMPLE NO. 3

BAG SAMPLE NO. 4

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
36	SAND, moderate yellowish brown, 10YR5/4, fine and medium grained, well rounded, well sorted, bright yellow grains comprise about 5%. SP				
37					
38					
39					
40					
41					
42					
43	gravel about 3" in diameter.				
44					
45	cobble layer				
46	medium grained, moderate yellowish brown, 10YR5/4, rounded quartz grains comprise 50-70%.				
47					
48	SANDSTONE (San Mateo Formation), moderate yellowish brown, 10YR5/4, coarse grained, well sorted, subangular, dark and colored grains 85% quartz. SP				
49	cuttings are darker in color, probably due to ground-up cobbles, dark gray cobble chips, angular, comprise 30-40%.				
50					
51					
52					
53	grades to medium grain size.				
54					

BAG SAMPLE NO. 5

BAG SAMPLE NO. 6

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
55	SANDSTONE (San Mateo Formation), pale yellowish orange, 10YR8/6, medium to coarse grained, well sorted, quartz 85% sub-rounded, dark gray grains 10% subangular to sub-rounded, others 5% sub-angular. SP drilling slow, formation very dense.	BAG SAMPLE NO. 7			
56	grades to medium grained, some angular grains.				
57					
58					
59		BAG SAMPLE NO. 8	1	No Recovery	
60					
61					
62					
63					
64					
65					
66					
67	very uniform coring.	BAG SAMPLE NO. 9	2	No Recovery	
68					
69					
70					
71					
72					
73					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
74	SANDSTONE, pale yellowish brown, 10YR6/12, medium grained, very dense, well sorted, quartz 85% sub-rounded to rounded, dark gray grains 10% subangular to sub-rounded, others 5%. SP				
75		BAG SAMPLE NO. 10	3	No Recovery	
76					
77		BAG SAMPLE NO. 11	4	No Recovery	
78					
79		BAG SAMPLE NO. 12	5	No Recovery	
80					
81					
82					
83					
84					
85		BAG SAMPLE NO. 13	6	No Recovery	
86					
87					
88					
89					
90			7	No Recovery	
91					
92					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
93	SANDSTONE, pale yellowish brown, 10YR6/2, medium to coarse grained, well sorted, quartz 85-90% sub-rounded, dark minerals 10% subangular. SP	BAG SAMPLE NO. 14	7	No Recovery	
94					
95					
96		BAG SAMPLE NO. 15	8	No Recovery	
97					
98					
99					
100					
101		BAG SAMPLE NO. 16	9	No Recovery	
102					
103					
104					
105					
106					
107					
108	grading to coarse grained.	BAG SAMPLE NO. 17	10		
109					
110					
111					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	ROD
112	SANDSTONE, pale yellowish brown, 10YR6/2, medium grained, well sorted, dense, quartz 85% sub-rounded to rounded, dark gray grains 10% subangular to sub-rounded, others 5% sub-rounded to subangular. Some silt present. SP		10	No Recovery	
113					
114		BAG SAMPLE NO. 18	11	No Recovery	
115					
116					
117					
118					
119	SANDSTONE, grayish orange, 10YR7/4, coarse to medium grained, well sorted, massive crumbly, occasional 1/4-1/2" pebbles, dense, 85% sub-rounded quartz, 15% sub-rounded others. SP		12	27% - 41%	
120					
121					
122					
123					
124		BAG SAMPLE NO. 19	13	2% - 4%	
125					
126					
127					
128					
129			14		
130					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
131		BAG SAMPLE NO. 20	14	No Recovery	
132					
133					
134	SANDSTONE, silty, moderate yellowish brown, 10YR5/4, medium to fine grained, predominately sub-rounded quartz grains. SW				
135					
136		BAG SAMPLE NO. 21	15	No Recovery	
137					
138					
139					
140	SANDSTONE, silty, dusky yellow, 5Y6/4, fine grained, massive, subangular (gritty feel). SW				
141					
142			16	No Recovery	
143					
144					
145					
146					
147	dusky yellow, 5Y6/4, grades from fine to medium grained, slightly silty, massive, subangular, predominately quartz. SP	BAG SAMPLE NO. 22	17	No Recovery	
148					
149					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
150	gravel layer 2" thick, 1/2-1" diameter, rounded.	BAG SAMPLE NO. 23	18	8" - 10%	
151	SANDSTONE, dark yellowish brown, 10YR4/2, coarse grained, gravelly, subangular to sub-rounded quartz (60%) and feldspar (25%).				
152					
153					
154					
155					
156		BAG SAMPLE NO. 24	19		
157					
158					
159					
160			20		
161					
162					
163					
164					
165					
166					
167					
168					

Project No. 41299I Field Log of Boring No. B-1 Sheet 10 of 30

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
169	SANDSTONE, dusky yellow, 5Y6/4, medium to fine grained, subangular to sub-rounded quartz (65%) with occasional rounded gravel (1/2"-2" diameter). SP		20	1/2' - 4%	
170					
171	CLAY, sandy layer, light olive brown, 5Y5/6, with rounded pebbles.	BAG SAMPLE NO. 25	21	No Recovery	
172					
173					
174					
175					
176					
177					
178					
179					
180					
181					
182					
183			22		
184					
185					
186					
187					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
188	SANDSTONE (San Mateo Formation), dusky yellow, 5Y6/4, medium grained, quartz 95% sub-rounded, others 5% sub-rounded, occasional gravel. SP	BAG SAMPLE NO. 26	22	No Recovery	
189					
190					
191					
192					
193					
194		BAG SAMPLE NO. 27	23		
195					
196					
197					
198	gravel 3/4"-1" diameter.				
199					
200					
201					
202					
203					
204			24		
205					
206					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
207	SANDSTONE, light olive gray, 5Y5/2, fine grained, slightly silty, gritty, with occassional (0-5%) very coarse sand and pebbles, massive, friable. SP	BAG SAMPLE NO. 28	24	No Recovery	
208					
209					
210					
211					
212					
213					
214		BAG SAMPLE NO. 29	25	1⅞	
215					
216					
217	Thin hard layer.				
218		BAG SAMPLE NO. 30	26	No Recovery	
219					
220					
221					
222					
223					
224					
225					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
226	hard layer SANDSTONE, medium light gray, N6, medium to fine grained, silty, very dense, sub-rounded quartz (85%) with small (1 mm) blebs of silt and 2-5% biotite flakes. SW	BAG SAMPLE NO. 31	27	18	
227					
228					
229					
230					
231					
232					
233					
234	alternating 6" hard layers with 12-18" softer layers SANDSTONE, dark gray, N3, fine to coarse grained with sandy SILT (40%). SW	BAG SAMPLE NO. 32	28		
235					
236					
237					
238					
239	CLAY, sandy, dark gray, N3, fine to medium grained (scraped from core barrel tip). CL	BAG SAMPLE NO. 33	29		
240					
241					
242					
243					
244					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
245		BAG SAMPLE NO. 34	30	No Recovery	
246					
247					
248	SANDSTONE, light olive gray, 5Y5/2, silty, with trace of clay, fine-grained, some iron oxide stains. SW				
249					
250					
251					
252					
253					
254	SANDSTONE (San Mateo Formation), yellowish gray, 5Y7/2, medium grained, sub-rounded to subangular, quartz 95% other dark minerals 5%, sub-rounded. SP	BAG SAMPLE NO. 35	31	No Recovery	
255					
256					
257					
258					
259					
260					
261					
262					
263					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
264					
265	SANDSTONE, yellowish gray, 5Y7/2, medium grained, sub-angular to sub-rounded. Quartz 95%, other dark minerals 5% subangular. SP				
266					
267					
268		BAG SAMPLE NO. 36	32	No Recovery	
269					
270					
271					
272					
273	SANDSTONE (San Mateo Formation), dusky yellow, 5Y6/4, very dense, poorly sorted, with gravel to 1/4", quartz 85% subrounded, feldspars 10% sub-rounded, other 5% angular to sub-rounded, trace of clay. SW				
274		BAG SAMPLE NO. 37			
275					
276					
277					
278		BAG SAMPLE NO. 38	33		
279					
280					
281					
282					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
283	SANDSTONE (San Mateo Formation), yellowish gray, 5Y7/2, medium to fine grained 90% quartz sub-rounded. SP	BAG SAMPLE NO. 39	33		
284					
285					
286					
287	SANDSTONE, medium light gray , N61/2, fine grained, gravel 1/4" sub-rounded, massive, no bedding 90% quartz sub-rounded, feldspars 5% sub-rounded, dark minerals 5% subangular to sub-rounded. SW	BAG SAMPLE NO. 40	34	2' 8 1/2"	
288					
289					
290					
291					
292					
293					
294					
295					
296					
297		BAG SAMPLE NO. 41	35	No Recovery	
298					
299					
300					
301					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
302	SANDSTONE (San Mateo Formation), medium light gray, N61/2, fine to medium grained, some 1/4" gravel, gravel sub-rounded, massive no bedding 90% quartz sub-rounded, feldspars 5% sub-rounded, dark minerals 5% subangular to sub-rounded. SP	BAG SAMPLE NO. 42	35	No Recovery	
303					
304					
305					
306					
307		BAG SAMPLE NO. 43	36	3%	
308					
309					
310					
311					
312					
313		BAG SAMPLE NO. 44	37		
314					
315					
316					
317					
318					
319					
320					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
321	SANDSTONE (San Mateo Formation), light olive gray 5Y5/2, fine to medium grained, some 1/4" diameter gravel, sub-rounded, massive no bedding quartz 85% sub-rounded, feldspars 10% sub-rounded, others 5% sub-rounded. SP	BAG SAMPLE NO. 45	37	No Recovery	
322					
323					
324					
325					
326					
327					
328					
329					
330					
331		BAG SAMPLE NO. 46			
332					
333					
334					
335					
336					
337					
338	SANDSTONE, light olive gray, 5Y5/2, fine to medium grained, predominately subangular to sub-rounded quartz, massive slightly silty. SP		38		
339					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
340	SANDSTONE (San Mateo Formation), light olive gray, 5Y5/2, medium to carse grained, sub-rounded, quartz 80%, feldspars 10%, dark minerals 10%. SW	BAG SAMPLE NO. 47	38		
341					
342					
343					
344					
345					
346					
347					
348		BAG SAMPLE NO. 48	39		
349					
350					
351					
352					
353					
354					
355					
356					
357					
358					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
359	SANDSTONE, light olive gray, 5Y5/2, medium grained, sub-rounded, quartz 80%, feldspars 10% dark minerals 10%. SP	BAG SAMPLE NO. 49	40		
360					
361					
362					
363					
364	hard layer encountered only a few inches thick.				
365					
366					
367					
368		BAG SAMPLE NO. 50	41		
369					
370					
371					
372					
373					
374					
375					
376					
377					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
378	SANDSTONE, light olive gray, 5Y5/2, medium to coarse grained, sub-rounded, quartz (70%), feldspars (15%) and dark minerals (15%), massive. SP	BAG SAMPLE NO. 51	42		
379					
380					
381					
382					
383					
384					
385					
386					
387					
388		BAG SAMPLE NO. 52	43		
389					
390					
391					
392	hard layer				
393					
394	hard layer dark minerals make up noticeably greater percentage (20%).				
395					
396					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
397			43		
398					
399					
400					
401					
402					
403			44		
404					
405					
406					
407					
408					
409	SANDSTONE, light olive gray, 5Y5/2, sub-rounded to subangular, medium grained, quartz (80%), feldspar (10%), and dark grains (10%), occasional coarse grains to 1/4". SP				
410					
411	hard layer		45		
412					
413					
414					
415					

BAG SAMPLE NO. 53

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
416					
417			45		
418					
419	SANDSTONE, medium gray, N5, medium grained, quartz 75% sub-rounded, feldspar 10% sub-rounded, dark minerals 15% sub-rounded to subangular. SP				
420					
421					
422		BAG SAMPLE NO. 54			
423			46		
424					
425					
426					
427					
428					
429					
430		BAG SAMPLE NO. 55			
431			47		
432					
433					
434					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
435	SANDSTONE, medium gray, N5, medium grained, quartz 75% sub-rounded, feldspars 10%, dark minerals 15-20% sub-angular to sub-rounded.	BAG SAMPLE NO. 56	47		
436					
437					
438					
439		BAG SAMPLE NO. 57			
440					
441					
442					
443			48		
444	Harder drilling, color of drilling mud changed to olive gray.				
445	SILTSTONE, dark gray, N3, with fine grained micaceous sand. ML				
446					
447					
448					
449					
450			49		
451					
452	easier drilling.				
453					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
454	SILTSTONE, olive gray, 5Y4/1, parallel horizontally bedded 1/2 thick, with very thin lenses of fine grained sand, micaceous. No visible joints or fractures, little or no weathering, low permeability. ML		50		
455					
456					
457					
458					
459					
460	Light weathering, and lightly jointed generally at 50°.		51	100%	
461					
462					
463		BAG SAMPLE NO. 58	52	No Recovery	
464					
465					
466					
467		BAG SAMPLE NO. 59	53	No Recovery	
468					
469					
470					
471					
472	Sample yields age of Lower Mohnian (Upper Miocene)				

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
473		BAG SAMPLE NO. 60	54	No Recovery	
474					
475					
476					
477					
478	SILTSTONE, grayish olive, 10Y4/2, parallel horizontally bedded 1 1/2" thick with very thin lenses of fine grained sand, micaceous. Some 3/4-1" gravel sub-rounded, slickensides, moderately weathered, and fractured, no visible joints, low permeability. Forams and fish scales.		55	60%	
479					
480					
481					
482					
483					
484			56	33%	
485	Sample yields age of Lower Mohnian (Upper Miocene). SANDSTONE, olive gray, 5Y4/1, cross bedded, fine grained well cemented, very well indurated. Jointed at 30° and 85°, moderately fractured. SP				
486	SILTSTONE, olive black, 5Y2/1, parallel horizontally bedded 1/2" to 1 1/2" thick, micaceous with mineral spots possibly gypsum. ML				
487					
488			57	60%	
489	highly weathered, highly fractured.				
490					
491					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
492	SILTSTONE, olive black, 5Y2/1, parallel bedding ranging from horizontal to 35°, 1/2" thick with very thin interbedding of fine grained sand, has bluish gray 1/4" thick beds. ML				
493					
494	Samples taken at 493.5' and 495' yield age of Lower Mohnian (Upper Miocene). Highly weathered, moderately fractured, joints vertical to 45°		58	100%	
495					
496	Well indurated, no fracturing, joints at 30°, 1/4" bluish gray beds are irregularly laid.				
497					
498	SILTSTONE, olive black, 5Y2/1, fissile to moderately fractured, fractures generally parallel to bedding but also highly angled oblique to bedding, siltstone poorly indurated, irregularly bedded with medium bluish gray micaceous clay, bedding horizontal to 30°, at 500' beds highly contorted suggesting slumping, clay beds 1/16" to 1/2" thick. Generally in uniform lenticular shape but minor oblate pods also. ML		59	100%	
499					
500					
501					
502					
503			60	No Recovery	
504					
505					
506					
507	SILTSTONE, olive black, 5Y2/1, moderately fractured, fractures generally parallel to bedding, becoming more indurated brittle with lenticular white sand size grains of a micaceous material, also inclusions to 1/2" diameter sub-rounded, tan, fine grained sandstone, interbedded with irregular spaced lenses of bluish gray micaceous siltstone, bedding dips 15-30°, lenses to 1/4" thick. ML				
508			61	100%	
509					
510					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
511			61	10%	
512	SILTSTONE, olive black, 5Y2/1, with irregular spaced lenses and irregular shaped pods of bluish gray micaceous siltstone. ML				
513			62	70%	
514					
515			63	No Recovery	
516					
517	SILTSTONE, olive black, 5Y2/1 with irregular spaced beds of bluish gray micaceous siltstone, bedding 10-30°, lenses 1/8"-1/4" thick, at 518.5' many lenses offset 1/8" along high angle fractures (50-65°). ML		64	91%	
518					
519					
520	SILTSTONE, interbedded olive black, 5Y2/1, and bluish gray micaceous siltstone, highly contorted bedding with minor offset of beds, compaction or slumping of soft sediments causing pinching out and irregular structures within bedding. ML		65	25%	
521					
522					
523					
524	SILTSTONE, fragments, olive black, 5Y2/1, disoriented siltstone fragments within matrix of bluish gray micaceous silty clay, one siltstone fragment contains imprint of fossil of unknown affinity. ML		66	17%	
525					
526					
527					
528	SILTSTONE, olive black, 5Y1/2, very brittle to moderately indurated, disoriented, fractures generally parallel to bedding, dips horizontal to 20°, siltstone more indurated below 529', irregularly spaced bluish gray lenses 1/16-1/8" thick. ML		67	70%	
529					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
530			67	70%	
531					
532					
533	SILTSTONE, brownish black, 5YR2/1, bedding generally parallel ranging from horizontal to 40°, fracture parallel to bedding planes, bedding 1/2-2" thick, some vertical joints visible, bluish gray beds 1/8-1/4" thick, highly fractured and weathered at 532-534', more indurated below 534'. ML		68	100%	
534					
535					
536					
537					
538	Highly fractured zone, siltstone crumbles easily.		69	100%	
539	Siltstone more indurated.				
540					
541					
542					
543	less indurated fractured, weathered.		70	27%	
544					
545					
546					
547					
548	Highly fractured				

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
549	SILTSTONE, brownish black, 5YR2/1, bedding ranging from horizontal to 40° dip, bedding thickness from 1" to 3", fracturing generally in direction of bedding, moderately indurated, crumbles easily, some bluish gray beds present generally 1/8 to 1/4" thick. ML		71	100%	
550					
551	SILTSTONE, brownish black, 5YR2/1, bedding generally horizontal to 35° dip, highly fractured below 551' with fractures ranging from horizontal to near vertical. ML.		72	18%	
552					
553					
554					
555	parallel bedding, highly weathered.				
556				50%	
557	unable to reenter boring after loss of casing. Bottom of boring at 557'.				
558					
559					
560					
561					
562					
563					
564					
565					
566					
567					

Project No. 41299I Field Log of Boring No. B-2 Sheet 1 of 40

BORING LOCATION El Camino Real Sta. 67 + 55 PMF Survey Work		ELEVATION AND DATUM El. 145 (approx.)	
DRILLING AGENCY Continental Drilling	DRILLER Mike Kuchler	DATE STARTED 6/05/80	DATE FINISHED 6/18/80
DRILLING EQUIPMENT Longyear 44		COMPLETION DEPTH 749.5	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Standard		NO OF SAMPLES: DIST.	UNDIST. / CORE
DRILLING METHOD Rotary: HQ Drill pipe with wireline coring		WATER ELEV. FIRST	COMPL. / 24 HRS.
CORE BARREL Longyear HQ	LENGTH 5' and 10' / BIT Diamond	LOGGED BY: Hector Reyes	CHECKED BY: O. S. Ghuman

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
1	SAND, silty, pale brown, 5YR5/2, medium to coarse grained, angular to sub-rounded, sand is mainly quartz, some broken rock fragments. SM				
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13	SAND, silty to clayey, pale brown, 5YR5/2, fine to coarse grained, angular to sub-rounded, poorly sorted, silt and clay mixed with some gravel and broken rock fragments. SM-SC				
14					
15					
16					

BAG SAMPLE NO. 1

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
17	SAND, light olive gray, 5YR5/2, medium grained, sub-angular to sub-rounded, well sorted, mostly quartz with some rock fragments. SP				
18					
19		BAG SAMPLE NO. 2			
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33		BAG SAMPLE NO. 3			
34					
35					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, fine to medium grained, sub-rounded, well sorted, mostly quartz with some rock fragments, poorly cemented, formation denser than above. SP	BAG SAMPLE NO. 4			
48					
49					
50					
51					
52	SAND, medium grained, gradational change. SW				
53					
54					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
55	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium grained, sub-rounded, well sorted, mostly quartz with some rounded rock fragments. SW	BAG SAMPLE NO. 5			
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70		BAG SAMPLE NO. 6			
71					
72					
73					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
74					
75					
76					
77					
78	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, coarse grained, sub-rounded to subangular, well sorted, poorly cemented, mostly quartz with some rock fragments. SW	BAG SAMPLE NO. 7			
79					
80					
81					
82					
83					
84					
85	grading to coarse grained.				
86					
87					
88					
89		BAG SAMPLE NO. 8			
90					
91					
92					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
93	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium grained, sub-rounded, quartz 90%, feldspar 5%, other 5%. SW				
94					
95					
96					
97	grades to medium grained.				
98					
99		BAG SAMPLE NO. 9			
100					
101					
102					
103					
104					
105					
106					
107	grades fine to medium grained.				
108					
109					
110		BAG SAMPLE NO. 10			
111					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
112	SANDSTONE, (San Mateo Formation), light olive gray 5YR5/2, medium grained, sub-rounded. SW	BAG SAMPLE NO. 11			
113	grades to coarse grained.				
114					
115					
116					
117					
118					
119					
120					
121	START RECORDING RUNS.				
122					
123					
124					
125		BAG SAMPLE NO. 12			
126			12		
127					
128					
129					
130					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
131	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium grained, sub-rounded, quartz 90%, feldspar 5%, others 5%, dense formation. SP				
132					
133					
134					
135					
136					
137					
138					
139					
140					
141		BAG SAMPLE NO. 13	13		
142					
143					
144					
145		BAG SAMPLE NO. 14	14		
146					
147					
148					
149					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
150			14		
151	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium grained, sub-rounded, quartz 90%, feldspar 7%, others 3%. SP				
152					
153					
154					
156		BAG SAMPLE NO. 15	15		
156					
157					
158					
159					
160					
161	grades to fine grained.				
162					
163					
164		BAG SAMPLE NO. 16	16		
165					
166					
167					
168					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	ROD
169			16		
170	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium grained, sub-rounded. SP				
171					
172		BAG SAMPLE NO. 17	17		
173					
174					
175					
176					
177					
178					
179					
180					
181					
182		BAG SAMPLE NO. 18	18		
183					
184					
185					
186					
187					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
188	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium to fine grained, sub-rounded, well sorted, dense, quartz 90%, feldspar 7%, others 3%. SP		18		
189					
190					
191					
192		BAG SAMPLE NO. 19	19		
193					
194					
195					
196					
197					
198					
199					
200					
201					
202		BAG SAMPLE NO. 20	20		
203					
204					
205					
206					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
207					
208	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium to fine grained, sub-rounded, well sorted, quartz 90%, feldspar 7%, others 3%. SP		20		
209					
210					
211					
212					
213					
214					
215					
216					
217					
218					
219					
220	BAG SAMPLE NO. 21		21		
221					
222	BAG SAMPLE NO. 22				
223			22		
224					
225					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
226					
227	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, medium to fine grained, sub-rounded, well sorted, quartz 90%, feldspar 5%, others 5%. SP		22		
228					
229					
230					
231					
232					
233					
234					
235	BAG SAMPLE NO. 23		23		
236					
237					
238					
239					
240					
241					
242			24		
243					
244					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
245	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, mostly fine grained with some medium grained, subangular to sub-rounded, well sorted, quartz 90%, feldspar 5%, others 5%. SP	BAG SAMPLE NO. 24	24		
246					
247					
248					
249					
250					
251					
252		BAG SAMPLE NO. 25	25		
253					
254					
255					
256					
257					
258					
259					
260					
261					
262			26		
263					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
264	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, mostly fine grained, subangular to sub-rounded, well sorted, quartz 90%, feldspar 5%, others 5%. SP				
265					
266		BAG SAMPLE NO. 26	26		
267					
268					
269					
270					
271					
272		BAG SAMPLE NO. 27	27		
273					
274					
275					
276					
277					
278					
279					
280					
281					
282			28		

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
283	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, fine to medium grained, sub-rounded to sub-angular, well sorted, quartz 90%, feldspar 5%, others 5%. SP	BAG SAMPLE NO. 28	28		
284					
285					
286					
287					
288					
289					
290					
291	medium grained with fewer fines.	BAG SAMPLE NO. 29	29		
292					
293					
294					
295					
296					
297					
298					
299					
300					
301					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
302	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, fine to medium grained, sub-rounded to sub-angular, well sorted, quartz 90%, feldspar 5%, others 5%. SP	BAG SAMPLE NO. 30	30		
303					
304					
305					
306					
307					
308					
309					
310					
311		BAG SAMPLE NO. 31	31		
312					
313					
314					
315					
316					
317					
318					
319					
320					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
321	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, fine to medium grained, subangular to subrounded, well sorted, quartz 90%, feldspar 5%, others 5. SP		31		
322		BAG SAMPLE NO. 32	32		
323					
324					
325					
326					
327					
328					
329					
330					
331		BAG SAMPLE NO. 33	33		
332					
333					
334					
335					
336					
337					
338					
339					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
340	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, fine to medium grained, subangular to sub-rounded, well sorted, quartz 90%, feldspar 5%, others 5%. SP		33		
341					
342					
343					
344					
345					
346		BAG SAMPLE NO. 34	34		
347					
348					
349					
350					
351					
352					
353					
354		BAG SAMPLE NO. 35	35		
355					
356					
357					
358					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
359	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, fine to medium grained, sub-rounded to sub-angular, well sorted, quartz 90%, feldspar 5%, others 5%. SP		35		
360					
361		BAG SAMPLE NO. 36	36		
362					
363					
364					
365					
366					
367					
368					
369					
370					
371		BAG SAMPLE NO. 37	37		
372					
373					
374					
375					
376					
377					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
378	SANDSTONE (San Mateo Formation), light olive gray, 5YR5/2, coarse to medium grained, sub-rounded, well sorted, quartz 90%, feldspar 5%, others 5%, trace of 1/4" gravel. SP		37		
379					
380					
381					
382					
383					
384		BAG SAMPLE NO. 38			
385			38		
386					
387					
388					
389	SANDSTONE, light olive gray, 5YR5/2, Coarse grained, sub-rounded, with some 1/4" diameter gravel. SW				
390					
391					
392		BAG SAMPLE NO. 39			
393			39		
394					
395					
396					

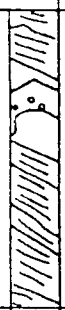
DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
397	SANDSTONE, (San Mateo Formation), light olive gray, 5YR5/2, coarse to medium grained, well sorted, subrounded, quartz 90%, feldspars 5%, others 5%, trace 1/4" gravel. SP		39		
398					
399					
400					
401					
402					
403					
404	Color change to medium light gray, N5, medium grained.				
405		BAG SAMPLE NO. 40			
406			40		
407					
408					
409					
410					
411					
412					
413			41		
414					
415					

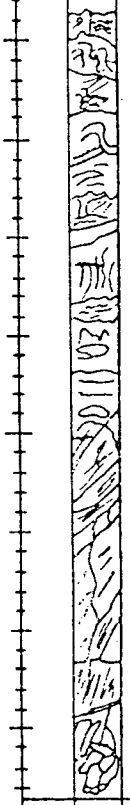
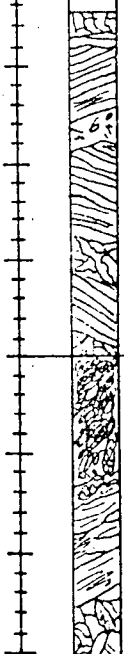
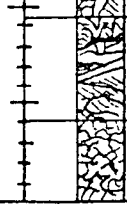
DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
416					
417	SANDSTONE (San Mateo Formation), light olive gray, 5YR4/1, medium grained, sub-rounded, well sorted, quartz 85%, feldspar 5%, others 10%. SP		41		
418					
419					
420					
421					
422					
423					
424					
425		BAG SAMPLE NO. 42			
426			42		
427					
428					
429					
430					
431	SILTSTONE (Monterey Formation), medium dark gray, N4, highly micaceous. ML				
432			43		
433					
434					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
435	SILTSTONE (Monterey Formation), medium dark gray, N4, very micaceous. ML		43		
436					
437					
438					
439					
440					
441			44		
442					
443					
444					
445					
446					
447					
448					
449					
450					
451			45		
452					
453					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
454	SILTSTONE (Monterey Formation), medium dark gray, N4, abundant mica, some fine sand, possible chert lense or concretion from 456' to 457'. ML		45		
455					
456					
457					
458					
459					
460	SANDSTONE, olive gray, 5YR3/2, fine to coarse grained (mostly medium grained), with a small amount of rounded pebbles and broken gravel, sand is subangular to sub-rounded, poorly to moderately sorted (high percentage of silt), quartz 80%, feldspar 5%, others 15%. Note: Some of the above material may be the solids the driller is trying to wash out from the inside of the rod.				
461					
462					
463					
464					
465					
466					
467			46		
468	sand becomes darker in color and fine grained below 468'. Also silt content increases.				
469					
470					
471	SILTSTONE, dark olive gray, 5YR2/1, very micaceous, slightly sandy.		47		
472					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
473	SILTSTONE (Monterey Formation), dark olive gray, 5YR2/1, high mica content, some very fine sand. ML	BAG SAMPLE NO. 43	47		
474					
475					
476					
477					
478					
479					
480					
481					
482	Began coring at 482.8' (slight caving in hole at start of run #49).		48		
483					
484			49		
485					
486	SANDSTONE, light olive gray, 5YR6/1, fine grained, very well indurated, bedding at 25°, 1/16" to 1/8" thick.				
487	SILTSTONE, olive black, 5YR2/1, parallel bedding 15°, 1" to 4" thick, interbedded with very fine grained sand, highly micaceous, little to no weathering, highly fractured zone, slickensides in some fragments. ML				
488					
489			50	75%	
490	Unfractured siltstone.				
491					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
492	SILTSTONE (Monterey Formation), olive black, 5YR2/1, parallel bedding dipping 15° to 23°, 1" to 2" thick with many interbeds of bluish gray micaceous siltstone 1/16" to 1/4" thick parallel to bedding, many very small white, lenticular, sand sized grains of micaceous material (?) within the dark siltstone, moderately fissile with most joints parallel to bedding, well indurated, little or no weathering. ML		50	75%	
493					
494					
495			51	100%	
496					
497					
498					
499					
500					
501	SILTSTONE, olive black, 5YR2/1, with bluish gray interbeds, occasional dark olive green fine sand lenses, dips range from vertical to horizontal, with fractures parallel to bedding, most of the cored section is highly brecciated with contorted bedding, minor offsets of beds and irregular compaction or slumping structures, also with some slickenside surfaces indicating movement, bedding thickness ranges from less than 1/16" to 4", material is highly micaceous, weathering ranges from very little to moderate. ML		52	100%	
502					
503					
504					
505					
506					
507					
508					
509					
510					

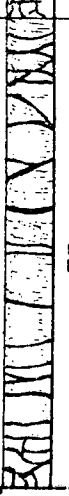
DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
511	SILTSTONE (Monterey Formation), olive black, 5YR2/1, contains 1/8" to 1/16" thick bluish gray contorted interbeds (to 516'), horizontal bedding 1/4" thick, fractures parallel to bedding, slickensided surfaces, some thin lenses of very fine grained sand, very highly fractured (to 512'), angular unconformity at 516', bedding dips 70°, still displays slickensides along bedding planes and fractures, moderate weathering. ML		53	82%	
512					
513					
514					
515					
516					
517					
518					
519					
520	SILTSTONE, olive black, 5YR2/1, bedding 1/4" to 2" thick with thin 1/4" to 1/16" bluish gray interbeds and discontinuous lenses of claystone, dips range from 20° to 35° with an apparent angular unconformity at 522', fractures generally parallel bedding, very highly fractured at 523' with slickenside surfaces common throughout cored section, moderate weathering. ML		54	80%	
521					
522					
523					
524					
525					
526	The upper 16" of the core in Run #55 appears to be material that has fallen into the bottom of the hole and was then shoved into the core barrel. No structure to it.		55	42%	
527	32" of Run #56 was extracted from the core barrel, however the upper 16" of this core appeared to be material that had fallen into the hole while the rods were pulled. The actual cored material is as above with angular unconformities in the core, with dips of approximately 20°. ML		56	100%	
528			57	100%	
529					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
530	Part of core very jumbled, lower part is intensely fractured siltstone with slickensides and a small concretion @ 529', with a poorly preserved clam shell cast. ML	?	57	100%	
531	SILTSTONE (Monterey Formation), olive black, 5YR2/1, with some bluish gray interbeds of clayey material 1/16" to 1/8" thick, upper 10" of core is rubble from caving of the hole (not calculated in % recovery), the majority of the core is very jumbled with randomly oriented siltstone particles in a clayey matrix, some bedding is contorted and some is parallel with dips 30° to 45° and fractures along bedding planes, many slickenside surfaces and intensely fractured zones. ML		58	71%	
532					
533					
534					
535			59	No Recovery	
536					
537	SILTSTONE, olive black, 5YR2/1, upper 20" of core is rubble that has fallen into hole, jumbled and contorted to 537.8', last 2 to 3" is a very fine sandy layer. ML		60	54%	
538					
539	SILTSTONE, olive black, 5YR2/1, interbedded with bluish gray siltstone ranging from 1/16 to 1" thick, bedding generally diping 30° to 45°, displacement of 1/2" in beds displayed across fractures normal to bedding planes, slickensides exhibited along bedding planes, moderately fractured and weathered. ML		61	75%	
540					
541					
542					
543	Upper 2' of core very jumbled with broken siltstone particles in a bluish gray clay matrix, some minor offsets beds and a few slickensides. ML		62	100%	
544					
545					
546					
547	SILTSTONE, olive black, 5YR2/3, with very few bluish gray clayey interbeds (1/16" to 1/4"), bedding is parallel and dips at 20° to 25°, high percentage of fine sand in the lower 1 1/2' of the cored section, most fractures are along bedding planes although some range to >70°, a few		63	80%	
548					

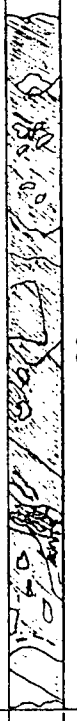
DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
549	slickensides found along fractured surfaces, weathering and fracturing are moderate. ML				
550					
551	SILTSTONE (Monterey Formation), olive black, 5YR2/1 poorly defined bedding planes distinguished by sand size lenticular micaceous (?) grains, many bluish gray lenses of clayey material which pinch out, some of which show offset and display "flame-like" structures, dips from 0° to 90°, some intensely fractured zones, and slickensides on many fractured surfaces, moderately weathered. ML		63	90%	
552					
553			64	90%	
554					
555	SILTSTONE, upper 1' of core intensely fractured with many slickensides and bluish gray clayey layers, from 555' to 556' a clayey zone with broken, angular siltstone particles mixed in, below this is another fracture zone followed by a contorted, jumbled siltstone zone, dips highly variable, some fine sandy lenses and offset bedding. ML		65	92%	
556					
557					
558			66	No Recovery	
559					
560					
561					
562					
563	SILTSTONE still highly fractured with may slickensides, much of the core consists of fractured siltstone particles with offset bedding and variable dips in a bluish gray clay matrix. ML				
564					
565			67	100%	
566					
567			68	94%	

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
568	SILTSTONE (Monterey Formation), olive black, 5YR2/1, interbedded with bluish gray siltstone and occasional thin beds of claystone, siltstone beds range in dip from horizontal to 50°, fractures occur parallel to bedding planes, intermittent zones of contorted bedding with minor offset of beds, slickenside surfaces common, highly fractured in zones, moderately weathered. ML		68	94%	
569					
570					
571					
572					
573					
574					
575	SILTSTONE, bluish gray claystone beds become thicker, ranging from 1/16" to 1/2".		69	95%	
576					
577					
578					
579					
580	Lens of fine grained sand.				
581	Siltstone becoming less fractured.				
582			70	90%	
583	SILTSTONE, bedding dip changes drastically from 50° to horizontal in 2' of core, at 584', bluish gray claystone beds are pinched out and slightly offset, siltstone becomes well indurated below 584', highly jointed, slickensides common. ML				
584					
585					
586					

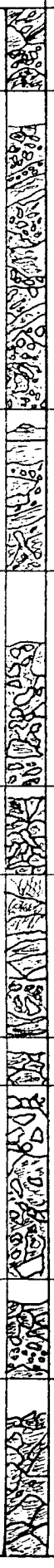
DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
587	SILTSTONE (Monterey Formation), olive black, 5YR2/1, interbedded with bluish gray claystone and sandstone, beds range from 1/16" to 1" thick, dips range from horizontal to 18°, no weathering, some jointing (vertical), occasional thin lenses of sand (ash?) at 590', layer of very well indurated sandstone, fish-scales seen at 594', highly polished bedding plane surfaces. ML		71	88%	
588					
589					
590					
591	Very well indurated sanstone at 589.6' to 590.4'				
592					
593					
594	SILTSTONE, beds dipping mostly 35°, with clay-filled joints. ML		72	100%	
595					
596					
597					
598					
599	Highly contorted bedding, bluish gray claystone prevalent in this zone, highly fractured, clay-filled joints.				
600					
601			73	98%	
602					
603					
604					
605					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
606	SILTSTONE (Monterey Formation), olive gray, 5YR4/1, interbedded with some fine sandstone and bluish gray claystone. Bedding from 1" to 7" thick with the interbeds less than 1" thick, dips are 35° to 40° with joints mostly parallel to bedding, some are vertical, occasional slickensides surfaces, well indurated with very little weathering. ML		73	98%	
612	SILTSTONE, slightly fissile, bedding from 1" to 8" with a few thin clayey interbeds and fine sand beds, slightly fractured area from 616.5' to 617', with slickenside surfaces, dips at 40°, most fractures display slick surfaces. ML		74	90%	
617	SILTSTONE, slightly higher percentage of fine sand, slickenside surfaces on fractures, dips average 25°.		75	100%	
623	SILTSTONE, light olive gray, 5YR5/2, some fine grained sand, silicified, moderately fractured with minor offset bedding, some visible forams, dips approximately 25°.				
624					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
625	SILTSTONE, light olive gray, 5YR5/2, some fine sand, very hard, silicified, moderately fractured, visible forams, dips 25°. ML		76	95%	
626	SILTSTONE (Monterey Formation), light olive gray, 5YR5/2, interbedded with a few bluish gray clay lenses, highly fractured and contorted zone at 626' to 627', dips 20° above fractured zone and 35° below it, general fracture trend parallel to bedding with some slickenside surfaces, some joints near vertical, occasional pods or thin lenses of fine sand, well indurated, slightly weathered. ML				
627					
628					
629					
630			77	No Recovery	
631					
632					
633					
634					
635			78		
636	SILTSTONE, olive gray-olive black, 5YR1/2, appears brecciated through the entire run, containing mostly angular fragments of siltstone in silty matrix, dip of fractures is 55° to 60°, one 2.5" to 3" zone of shearing @ 638.5', also a very light gray, N8, fine sandy layer, 1" or less thick @ 640.6'. ML		79	99%	
637					
638					
639	Numerous small pieces of siltstone at 639.8'.				
640	Numerous polished surfaces, mostly not well indurated.				
641					
642					
643					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
644	SILTSTONE (Monterey Formation), olive gray-olive black, 5YR2/2, less brecciated, cemented layer @ 645.6', fractures with 55° to 60° dip. ML		80	86%	
645					
646					
647					
648					
649					
650	Intrusive with possible baked upper contact				
651					
652	SILTSTONE, olive black, 5YR2/1, becomes more dense and cemented, fractures are sub-horizontal, 65°, and vertical, lithologic changes at 653.4', 653.7', 654.2', 654.4', and 658.2', upper ones are light gray, N7, sandy beds, one at bottom is light bluish gray, 5B6/1, brecciated siltstone. ML		81	83%	
653					
654	Sample taken at 654' yields age of Louisian (Middle Miocene).				
655					
656					
657					
658					
659	Monterey Formation, basal unit consisting of glaucophane schist (low grade), dusky blue, 5PB3/2, sandy matrix with rounded quartz grains.		82	10%	
660					
661					
662					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
663	BRECCIA, dark bluish gray, 5B4/1, low grade blue schist, very weathered/reworked.		83	77%	
664					
665					
666	BRECCIA, dark bluish gray, 5B4/1, core is less broken-more intact, pronounced brecciation, hard layer on top, material is possibly reworked.		84	72%	
667					
668					
669					
670					
671					
672	BRECCIA, (San Onofre Breccia), medium bluish gray, 5B5/1, core contains many angular clasts from sand size to clasts larger than the core diameter (2 1/2"), material is in a fine grained bluish gray chloritic matrix which is highly weathered, much difficulty in keeping core intact, clasts are mainly glaucoplane shist, with some muscovite, lepedolite, plagioclase, quartz, garnet, and pyrite, well developed schistosity in most fragments.		85	58%	
673					
674					
675					
676					
677			87	68%	
678					
679			88	84%	
680					
681					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
682	BRECCIA (San Onofre Breccia), medium bluish gray, 5B5/1, many angular clasts ranging from sand-sized to 4" to 5" (larger than 2 1/2" core diameter) in a blue gray, fine grained chloritic matrix, generally moderately to highly weathered, most clasts display a well developed schistosity and contain glaucophane, muscovite, garnet, plagioclase, and pyrite.		89	86%	
683					
684					
685					
686			90	80%	
687					
688			91	62%	
689					
690					
691			92	91%	
692			93	100%	
693	Clay matrix with clasts to 3".				
694			94	57%	
695	Cores fracture easily. Most pieces less than 2" long.		95	96%	
696					
697			96	83%	
698					
699			97	80%	
700					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
			98		
701	BRECCIA (San Onofre Breccia), medium bluish gray, 5B5/1, schistose clasts are contained in a light bluish gray cholorite matrix in various degrees of weathering clasts vary in size from sand size (medium grained) to larger than core size, clasts are mostly chlorite and glaucophane schist, 55° fracture surface dip.		99	76%	
702					
703					
704					
705			101	64%	
706					
707			104	25%	
708					
709	Minerals embedded in matrix include quartz, biotite, garnets, amphibole, and glaucophane schist clasts.		105	67%	
710					
711					
712			106	76%	
713					
714					
715			108	27%	
716					
717			109		
718			110	12%	
719					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
720	Only clasts recovered, no matrix. Clasts are angular, blue schists with garnet, biotite, pyrite, quartz, porphyroblasts, from pebble size to 3". Clasts are fairly fresh.		110	12%	
721					
722					
723	One fresh blue schist clast recovered.		111	5%	
724	BRECCIA (San Onofre Breccia), medium bluish gray, 5B5/1, matrix supporting angular to rounded, generally metamorphic clasts from sand size to clasts longer than 2 1/2", poorly to moderately cemented matrix, matrix and clasts fresh, no orientation, sorting, or stratification to clasts within matrix, matrix is fine grained chlorite material.		112	96%	30%
725					
726					
727					
728	BRECCIA, highly fractured to massive, well indurated clasts to 5" or more in length.		113	90%	48%
729					
730					
731					
732					
733	BRECCIA, bluish gray matrix with rounded to angular clasts. Friable to well indurated, moderately fractured.		114	100%	66%
734					
735					
736					
737					
738					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	RQD
739	BRECCIA (San Onofre Breccia), medium bluish gray, 5B5/1, chloritic clay matrix contains more sand than before, moderate to well cemented with clasts ranging in size from sand size to larger than core barrel size, clasts are angular to subangular, larger clasts are mostly chlorite and glaucophane schist, smaller clasts of quartzite, and amphibole, some lenses of poorly indurated medium grained sandstone, joints at 35°, moderately weathered in zones, well indurated at 740.5' to 743'.		115	100%	71%
740					
741					
742					
743					
744					
745	Clast is faulted and displaced 1/2".		116	75%	0%
746					
747			117	100%	
748					
749					
750	Bottom of Boring at 749.5 ft.				

APPENDIX 1-B

GEOPHYSICAL LOGS

welenco

WELL ENGINEERING SURVEYS

ELECTRIC LOG

COMPANY WOODWARD-CLYDE

WELL SONGS 2 & 3 PROJECT 412991 B-2

FIELD SAN ONOFRE

STATE CALIFORNIA COUNTY SAN DIEGO

LOCATION

OTHER SERVICES GR/N

SEC ____ TWP ____ RGE ____

Permanent Datum: GROUND LEVEL Elev. ____

Log Measured From GROUND LEVEL ____ Ft. Above Perm. Datum

Drilling Measured From GROUND LEVEL

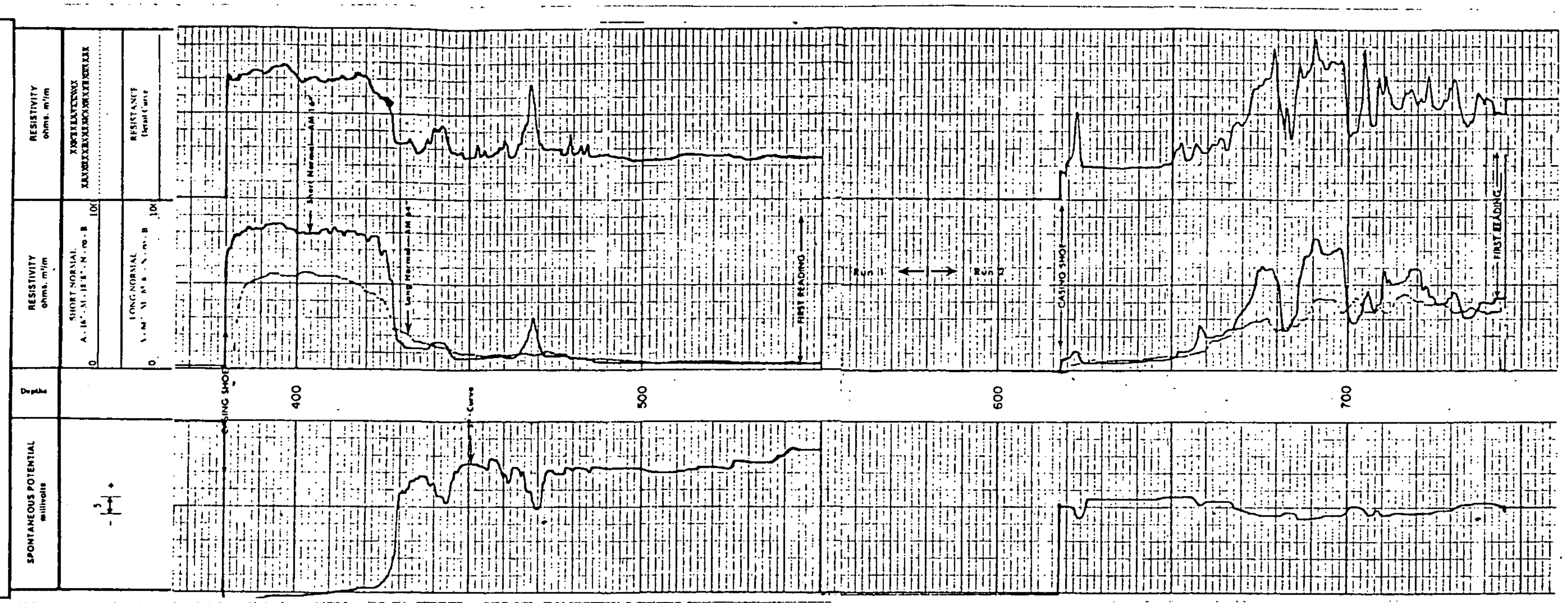
Elev.: K.B. ____ D.F. ____ G.L. ____

Date	6-17-30	6-18-80		
Run No	ONE	TWO		
Depth—Driller	742.5'	749.5'		
Depth—Logger	543'	744'		
Btm. Log Inter.	544'	743'		
Top Log Inter.	350'	618'		
Casing—Driller	4" @ 380'	3" @ 610'	@	@
Casing—Logger	380'	618'		
Bit Size	4"	4"		
Type Fluid in Hole	GEL	GEL		
	-	-		
Dens. | Visc.	-	- |	|	|
pH | Fluid Loss	- | ml	- | ml	| ml	| ml
Source of Sample	CIRC.	CIRC.		
R_m @ Meas. Temp.	6.25 @ 74 °F	6.40 @ 74 °F	@ °F	@ °F
R_{mf} @ Meas. Temp.	6.43 @ 74 °F	- @ °F	@ °F	@ °F
R_{mc} @ Meas. Temp.	- @ °F	- @ °F	@ °F	@ °F
Source: R_{mf} R_{mc}	M |	M |	|	|
R_m @ BHT	- @ °F	- @ °F	@ °F	@ °F
Time Since Circ.	15 HOURS	1 HOUR		
Max. Rec. Temp.	N.A. °F	N.A. °F	°F	°F
Equip. | Location	FV | BAK	FV | BAK	|	|
Recorded By	SPOON	SPOON		
Witnessed By	MR. NOGITA	MR. NOGITA		

This Heading and Log Conform To API RP 31

Fold Here

REMARKS



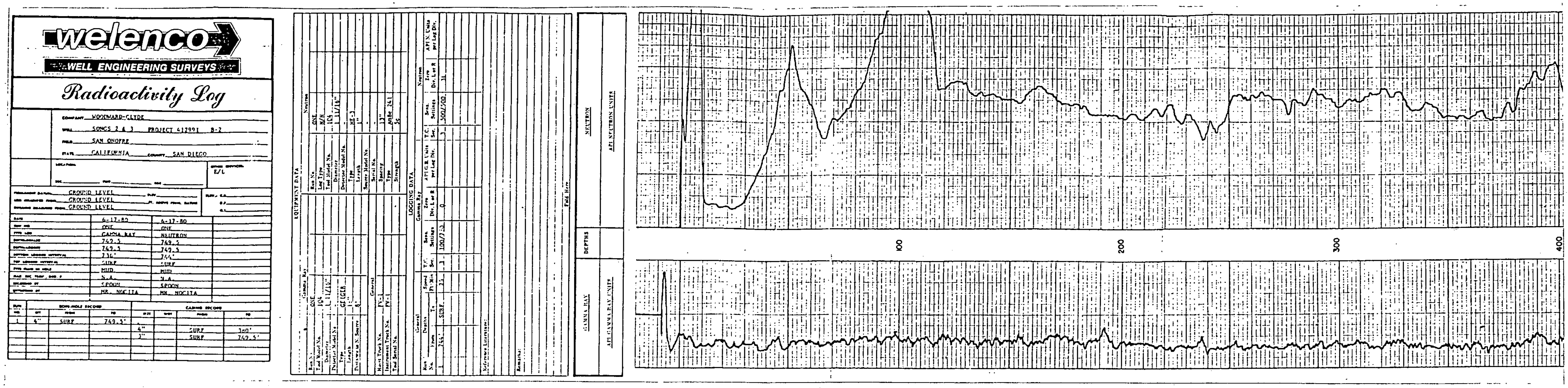
WOODWARD-CLYDE CONSULTANTS

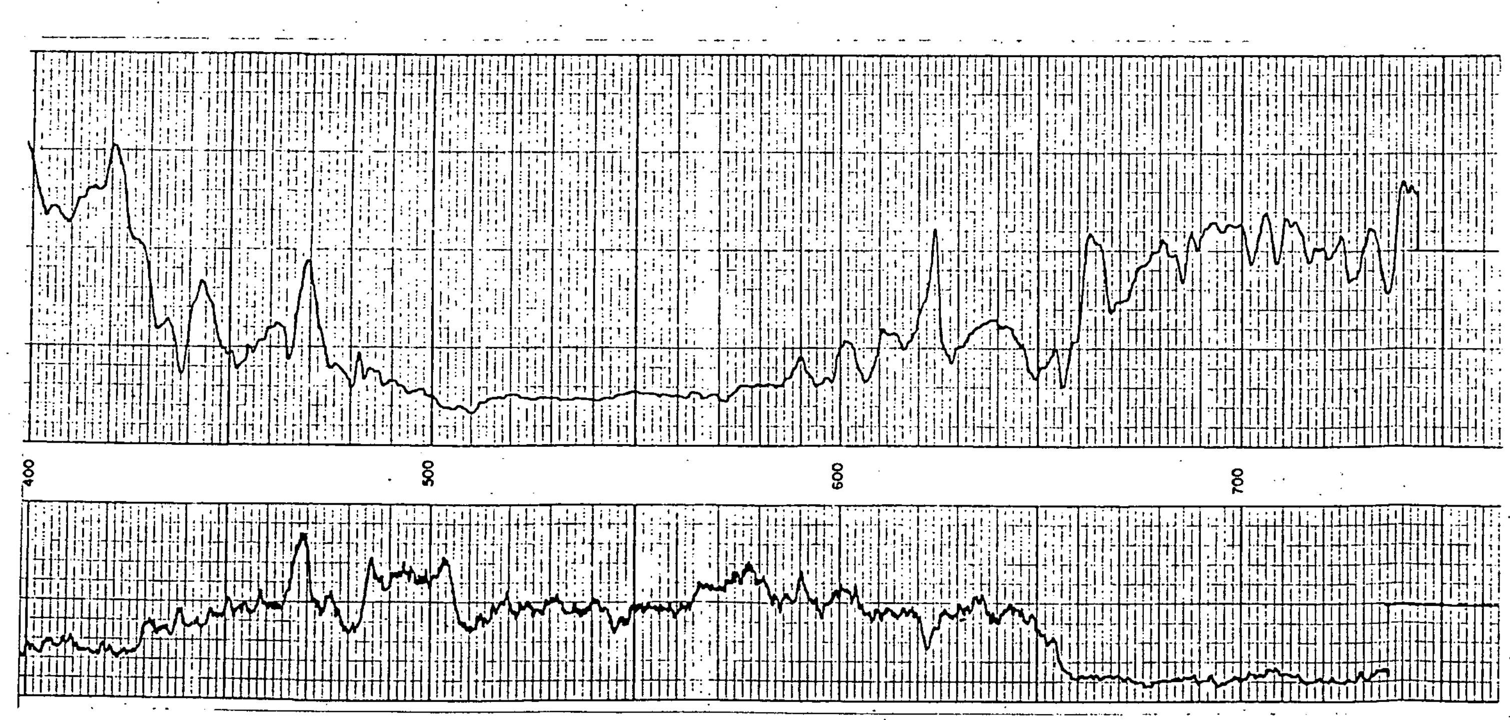
ELECTRIC LOG

Project No. 412991

SONGS 2 & 3

Fig. 1-B-1





WOODWARD-CLYDE CONSULTANTS

RADIOACTIVITY LOG

Project No. 412991 SONGS 2 & 3	Fig. 1-B-2

APPENDIX 1-C

MICROFOSSIL AGE DATES

ANDERSON, WARREN & ASSOCIATES, INC.
CONSULTING MICROPALEONTOLOGY
11526 Sorrento Valley Road Suite G
San Diego, California 92121
(714) 755-1524
TWX: 9103221735 MICROPALEO SDG

July 3, 1980

TO: Southern California Edison Co.

RE: So. Cal. Edison
Core B-1, Samples 1 to 5
San Onofre Area
Orange County, California

NANNOFOSSIL REPORT

Introduction

Four (4) samples were examined for calcareous and siliceous nannofossils and siliceous microfossils. These samples represent scattered depth intervals from near 485 feet to about 654 feet cored in this test hole and provide the basis for the age determinations of this report.

The initial preparations of the four samples were void of calcareous nannofossils but did contain fragments and parts of siliceous microfossils (siliceous spicules, spines and radiolarian parts). The samples were then treated and prepared specifically for siliceous microfossils and on examination, were found to contain reasonably diverse assemblages of siliceous microfossils. Though the majority of diatom species present are benthonic forms, the assemblages do contain some pelagic species along with silicoflagellates, which allow the placement of these samples into their representative biostratigraphic zones. The high ratio of benthonic to planktonic forms suggest the marine environment

RE: Southern Calif. Edison - Core B-1, San Onofre Area

during the deposition of these materials was moderately shallow, probably neritic or a continental shelf setting.

The provincial ages of each of these samples are given in the following stratigraphic summary and are based on the included siliceous microfossils or siliceous nannofossils. The age and zonation framework used is based on the data and definitions provided by Barron (1975, a-b) and Koizumi (1975, 1977) for the diatoms and from Bukry (1975) and Ling (1977) for the silicoflagellates. A limited list of species of the total number identified from each of the samples is included as support for the age determinations. This suite of species given as representative of each sample include the age diagnostic forms and the more common species observed in each sample. The frequency or abundance of each species is also noted by letter symbols. The key to these symbols are as follows: V = very rare, R = rare, S = sparse, F = frequent.

Stratigraphic Summary

485' 4-8" (sample 3)

AGE:	Late Miocene, near the top of the lower Mohnian
DIATOM ZONE:	Denticula hustedtii/D. lauta, uppermost part
SILICOFLAGELLATE ZONE:	Distephanus longispinus, uppermost part

RE: Southern Calif. Edison - Core B-1, San Onofre Area

485' 4-8" (sample 3) (con't.)

DISCUSSION: Selected species occurring in this sample include Actinocyclus ingens (V), Actinoptychus gruendleri (V), Coscinodiscus gigas diorama (V), C. marginatus (F), C. robustus (V), Cyclotella kelloggi (V), Denticula hustedtii (R, including narrow ended form), D. lauta (V), Distephanus longispinus (V, with angled basal ring), Lithodesmium minusculum (V), Opephora schwartzii (S), Endictya japonica (V), Rhabdonema japonicum var. sparcicostatum (V), Stephanopyxis schenckii (S).

491' 24-37" (sample 1)

AGE:	Late Miocene, lower Mohnian
DIATOM ZONE:	Denticula hustedtii/D. lauta
SILICOFLAGELLATE ZONE:	Distephanus longispinus, lower part or "Mesocena hexagona subzone"

DISCUSSION: Some of the species present here include Actinocyclus ingens (S), A. tsugaruensis (S), Actinoptychus gruendleri (V), Arachnoidiscus decoratus (F), Bruniopsis mirabilis (V), Coscinodiscus marginatus (S), C. robustus (R), C. vestustissimus (V), Cyclotella kelloggi (R), Denticula hustedtii (S), D. lauta (V), Distephanus longispinus (R, with rounded basal ring), Endictya japonica (R), Melosira sulcata (F), Mesocena hexagona (R), M. septenaria (R), Stephanopyxis schenckii (V).

RE: Southern Calif. Edison - Core B-1, San Onofre Area

491' 50-55" (sample 2)

AGE:	Late Miocene, lower Mohnian
DIATOM ZONE:	Denticula hustedtii/D. lauta
SILICOFLAGELLATE ZONE:	Distephanus longispinus, lower part or "Mesocena hexagona subzone"

DISCUSSION: Distinctive or more common species here include Actinocyclus ingens (R), A. tsugaruensis (R), Actinoptychus gruendleri (V), Arachnoidiscus decoratus (R), Cannopilus schulzii var. longispinus (V), Coscinodiscus gigas diorama (V), C. marginatus (S), C. robustus (R), Cyclotella kelloggi (V), Denticula hustedtii (V), D. lauta (V), Distephanus longispinus (V), D. parva (V), Endictya japonica (V), Melosira sulcata (F), Mesocena hexagona (V), M. septenaria (V), Stephanopyxis schenckii (R).

650.3' 43-46" (sample 5)

AGE:	Middle Miocene, Luisian
DIATOM ZONE:	Denticula lauta
SILICOFLAGELLATE ZONE:	Corbisema triacantha

DISCUSSION: Miocene radiolarians were noted in this sample in addition to the diatoms and silicoflagellates. Selected representative species of all the siliceous forms include Actinocyclus ingens (F), A. i. var nodus (F), A. tsugaruensis (S), Actinoptychus gruendleri (V), Cannopilus boliviensis major (R), C. hemisphaericus (V),

RE: Southern Calif. Edison - Core B-1, San Onofre Area

650.3' 43-46" (sample 5)(con't.)

DISCUSSION (con't.):

Clathrocyclas sp. (V), Corbisema cf. triacantha (R), Coscinodiscus endoi (V), C. marginatus (F), C. robustus (R), Denticula lauta (R), Dictyocha epiodon (V), Diploneis crabro (S), Distephanus parva (F), Dorcadospyris sp. aff. pannosa (R), Endictya japonica (S), Hemiaulis polymorphus (V), Isthmia nervosa (F), Lamprocyrtis hannai (R), Larnacantha polyacantha (R), Liriospyris reticulata (V), Phorticium regulare (V), Spongodiscus spp. (F), Stephanogonia hanzawae (V), S. polyacantha (V), Stephanopyxis turris s.l. (V), Stylacontarium cf. bispiculum (R), Synedra jouseana (V), Xanthopyxis lacera (R).

Interpreted by:

E. Dean Milow

E. Dean Milow

ANDERSON, WARREN & ASSOCIATES, INC.

A. D. Warren

A. D. Warren

RE: Southern Calif. Edison - Core B-1, San Onofre Area

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July 3, 1980

TO: Southern California Edison Co.

RE: So. Calif. Edison
Corehole B-1 Cores
San Onofre Area
Orange County, California

FORAMINIFERAL REPORT

This report is based on processing and analysis of 5 core samples received June 18, 1980 on a rush priority basis.

Results of this study are detailed as follows:

Sample #1 (491'+24-26", +29-31", +35-37")

Barren of Foraminifera. Fish debris (C), spicules (R). Processed residue consists of few shale particles in the coarse fraction and very fine-grained, clear, angular quartz sand abundant in the fine fraction.

AGE: Possibly provincial Late Miocene (based on lithology and organic remains)

ENVIRONMENT: Marine undifferentiated

Sample #2 (491'+50-55")

Barren of Foraminifera. Fish debris CA, spicules RF, statocysts F. Lithology of processed residue same as sample #1.

AGE: Possibly provincial Late Miocene (based on lithology and organic remains)

ENVIRONMENT: Marine undifferentiated

RE: Southern Calif. Edison - Core B-1, San Onofre Area

Sample #3 (485'+4-8")

Barren of Foraminifera. Diatoms F. Tan dolomitic limestone with few diatoms locked in the matrix.

AGE: Indeterminate

ENVIRONMENT: Marine undifferentiated

Sample #4 (470'+26-30")

Bolivina marginata var. F, B. vaughani F, B. sp. FC, Buliminа uvigerinaformis F, Buliminella brevior R, Eponides rosaformis R, Pulvinulinella subperuviana FC, Uvigerina angelina R. Diatoms F, fish debris F, radiolaria F, spicules F. Silty, micaceous shale.

AGE: Provincial Late Miocene, Early Mohnian Stage

ENVIRONMENT: Outer Neritic to Upper Bathyal

Sample #5 (650.3'+43-46")

Bolivina advena(?) molds F, Dentalina obliqua(?) molds R, Pullenia miocenica(?) molds F, Siphogenerina(?) sp. molds R, Uvigerinid molds R, Valvulineria californica(?) molds C. Diatoms F. Brown to tan dolomitic limestone full of foraminiferal molds with test material very badly leached. Some molds are of possible Middle Miocene Foraminifera.

AGE: Probably provincial Middle Miocene, Middle Luisian Stage or older

ENVIRONMENT: Outer Neritic to Upper Bathyal or deeper

ANDERSON, WARREN & ASSOCIATES, INC.

A. D. Warren

APPENDIX 2-A

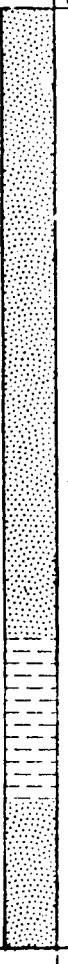
LOGS OF VIBRATORY CORES

Project No. 41299I Field Log of Boring No. 1-1 Sheet 1 of 2

BORING LOCATION SONGS OFFSHORE - E-1,597,186; N-427,655		ELEVATION AND DATUM Water Depth 72'	
DRILLING AGENCY WCC	DRILLER Iverson	DATE STARTED 6-7-80	DATE FINISHED 6-8-80
DRILLING EQUIPMENT		COMPLETION DEPTH 25.5'	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Plastic		NO OF SAMPLES: DIST.	UNDIST. / CORE
DRILLING METHOD VIBRATORY CORE		WATER ELEV. FIRST	COMPL. / 24 HRS.
CORE BARREL / LENGTH / BIT		LOGGED BY:	CHECKED BY:

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
1	Sand, dark greenish gray, 5GY4/1, very fine grained, well sorted, micaceous, organic odor, random shell fragments and some complete shells (sample 1 taken at 2.2'). SP		1		1
2					
3					
4					
5					
6					
7					
8					
9					
10			2		
11					
12					
13					
14					
15					
16					

Project No. 41299I Field Log of Boring No. 1-1 Sheet 2 of 2

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	RQD
	Age = 8,510 ± 265 yrs.		2		2
17	Sand, dark greenish gray, 5GY4/1, very fine grained, well sorted, micaceous, occasional pebbles. SP				
18	Abundant shells and shell fragments from 15.8' to 16.5'.				
19	Grades to medium grained sand at 17.8'.				
20	Grades to coarse grained sand at 19.0', light yellowish gray, 5Y6/2, subangular grains, moderately well sorted, occasional pebbles. SP				
21					
22	Grades to medium grained sand, medium gray, N5, well sorted Clay at 22.4', greenish black, 5G2/1, very plastic and sticky. CL				
23					
24	Sand at 24', dark greenish gray, 5GY4/1, fine grained, slightly clayey. SC				
25					
26	Bottom of Hole at 25.5'				
27					
28					
29					
30					
31					
32					
33					
34					
35					

Project No. 41299I Field Log of Boring No. 1-2 Sheet 1 of 3

BORING LOCATION SONGS OFFSHORE - E-1,595,807; N-426,123		ELEVATION AND DATUM Water Depth 100'	
DRILLING AGENCY WCC	DRILLER Iverson	DATE STARTED 6-8-80	DATE FINISHED 6-9-80
DRILLING EQUIPMENT		COMPLETION DEPTH 39.5'	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Plastic		NO OF SAMPLES: DIST.	UNDIST. CORE
DRILLING METHOD VIBRATORY CORE		WATER ELEV. FIRST	COMPL. 24 HRS.
CORE BARREL / LENGTH / BIT		LOGGED BY: JW/BN	CHECKED BY:

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
1	SAND, dark greenish gray, 5GY4/1, very fine grained, well sorted, micaceous, random shell fragments and some whole shells. SP		1		
9	Broken, nearly complete, pelecypod shell at 9.2'.				3
11	Complete gastropod at 11.4'.				4
14	Shells and shell fragments at 14.5'.				7

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
17	SAND, dark greenish gray, 5GY4/1, very fine grained, well sorted, micaceous, very slightly clayey. SP				
18					
19	Pebbles, shells, and shell fragments from 19.6' to 20.0'. Age = 9,095 ± 335 yrs.		1		6
20	Charcoal fragments and a pelecypod at 20.7'.				5
21					
22					
23					
24	Becomes fine grained at 23.7'. Large pebbles at 23.9'. Becomes fine to medium grained at 24'.				
25	Rounded pebbles at 25.4'. Becomes coarse grained at 25.5'.				
26	Becomes fine grained at 25.9'.				
27	Becomes medium grained at 27.1'. Becomes fine grained at 27.5'.		2		
28	Becomes fine to medium grained at 27.7'.				
29					
30	SAND, olive gray, 5YR4/2, fine to medium grained, sub-angular, well sorted, micaceous. SP				
31	SAND, olive gray, 5YR4/2, fine grained, well sorted, micaceous. SP				
32					
33	Grades to fine medium grained at 33.4'				
34	Grades to fine grained at 33.7'				
35					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
36	SAND, olive gray, 5YR4/2, fine grained, micaceous. SP				
	Grades to medium grained at 36.3'.				
37	Abrupt change to fine grained at 36.7'.				
	Rounded pebble (3/8") at 37.4'.				
38					
	No recovery from 38.5 to 39.5'.				
39					
40	End of hole. 1-2				

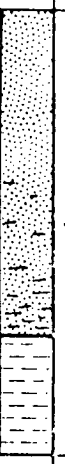
Project No. 41299I Field Log of Boring No. 1-3 Sheet 1 of 3

BORING LOCATION SONGS OFFSHORE - E-1,594,479; N-424,709		ELEVATION AND DATUM Water Depth 125'	
DRILLING AGENCY WCC	DRILLER Iverson	DATE STARTED 6-10-80	DATE FINISHED 6-10-80
DRILLING EQUIPMENT		COMPLETION DEPTH 39.5'	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Plastic		NO OF SAMPLES: DIST.	UNDIST. / CORE
DRILLING METHOD VIBRATORY CORE		WATER ELEV. FIRST	COMPL. / 24 HRS.
CORE BARREL / LENGTH / BIT		LOGGED BY: JW/BN	CHECKED BY:

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
1	SAND, silty, dark greenish gray, 5GY4/1, very fine grained, micaceous, random shell fragments. SM				
2					
3					
4	Abundant shells and shell fragments.				8
5					
6					
7					
8					
9	scattered shells				9
10					
11					
12					
13					
14					
15					
16					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
17	SAND, silty, dark greenish gray, 5GY4/1, very fine grained, micaceous, random shell fragments. SM				10
18					
18	organic matter		1		
19					11
19	organic matter, shells				
20					13
21	crab leg				
21					12
22			2		
23	Age = 9,400 ± 300 yrs.				
23					14
24					
24	no recovery at 24.0' to 25.0'.				
25					
25	gastropod, pelecypod				
26	Age = 5,065 ± 180 yrs.				15
26	becomes fine grained				
27					
28			3		
29					
30					
31	no recovery at 30.8' to 31.0'.				
32					
33					
33			4		
34					
35	SAND, dark gray N3, fine grained, well sorted, micaceous, small laminae of mica. SP				

Project No. 41299I Field Log of Boring No. 1-3 Sheet 3 of 3

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
36			4		
37					
38	Gradational change to clayey silt, grayish black, N2.				
39	Clayey silt, olive black, 5YR2/1, slightly micaceous. ML				
40	Bottom of hole. 1-3				

Woodward-Clyde Consultants

Project No. 41299I Field Log of Boring No. 1-4 Sheet 1 of 3

BORING LOCATION SONGS OFFSHORE - E-1,593,040; N-423,369		ELEVATION AND DATUM Water Depth 165'	
DRILLING AGENCY WCC	DRILLER Iverson	DATE STARTED 6-11-80	DATE FINISHED 6-12-80
DRILLING EQUIPMENT		COMPLETION DEPTH 39.5'	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Plastic		NO OF SAMPLES: DIST.	UNDIST. / CORE
DRILLING METHOD VIBRATORY CORE		WATER ELEV. FIRST	COMPL. / 24 HRS.
CORE BARREL / LENGTH / BIT		LOGGED BY:	CHECKED BY:

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
1	SAND, silty, olive black, 5Y2/1, very fine grained, micaceous, a few scattered shell fragments. SM				
2	Shells and shell fragments at 2.2' to 2.6'.				16
3	Shells from 3.9' to 4.4'.				
4					17
5					
6	Shells at 6.1'.				18
7	Gastropods at 7.1'.				19
8			1		
9	Shells at 9.2'.				20
10					
11					
12	Organic matter at 12.1'.				21
13					
14					
15					
16					

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
17	SAND, olive gray 5Y5/1, medium grained, subangular, moderately well sorted, scattered pebbles up to 1/4". SP		1		
18	SAND, olive gray 5Y4/1, fine to coarse grained, subangular, poorly sorted, slightly micaceous, SP, from 17.9 to 18.2.				
19	SAND, dark yellow gray 5Y7/1, medium to coarse grained, subangular, moderately sorted, occasional rounded pebbles to 3/4", SP, from 18.2' to 18.4'.				
20	SAND, olive gray, 5Y4/1, fine grained, moderately sorted, micaceous, some scattered pebbles. SP				
21	Organic matter at 21.1'. Age = 11, 355 ± 650 yrs.		2		22
22					
23					
24					23
25	Gastropod at 24.6'. Concentration of rounded pebbles up to 1" from 25.0' to 25.4'.				
26					
27			3		
28					
29					
30					
31					
32	SAND, medium light gray, N6, as above with small blebs and discontinuous lenses of sand which contain little mica.				
33	Slightly coarser grained, interval from 33.0' to 33.6'.		4		
34					
35					

Project No. 412991 Field Log of Boring No. 1-4 Sheet 3 of 3

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
36	SAND, olive gray, 5Y4/1, fine grained, subangular, well sorted, micaceous. SP				
	Small rounded pebbles at 36.3'.				
37	Scattered shell fragments at 37.3'.		4		
38					
39					
40	Bottom of Hole 1-4 at 39.5'.				

Project No. 41299I Field Log of Boring No. 1-5 Sheet 1 of 3

BORING LOCATION SONGS OFFSHORE - E-1,591,165; N-421,269		ELEVATION AND DATUM Water Depth 200'	
DRILLING AGENCY WCC	DRILLER Iverson	DATE STARTED 6-12-80	DATE FINISHED 6-12-80
DRILLING EQUIPMENT		COMPLETION DEPTH	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Plastic		NO OF SAMPLES: DIST.	UNDIST. CORE
DRILLING METHOD VIBRATORY CORE		WATER ELEV. FIRST	COMPL. 24 HRS.
CORE BARREL / LENGTH / BIT		LOGGED BY: JW/BN	CHECKED BY:

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
1	SAND, silty, olive gray, 5YR3/2, very fine grained, micaceous, scattered shell fragments. SM		1		
2					
3					
4					
5					
6					
7					
8	Organic debris at 7.9' Gradual color change to olive black, 5YR2/1, from 8.0' to 8.5'.				25
9					
10					
11					
12					
13					
14					
15					
16					

Project No. 41299I Field Log of Boring No. 1-5 Sheet 2 of 3

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
17	SAND, silty, olive black, 5YR2/1, very fine grained, micaceous, scattered shell fragments. SM		1		
18					
19					
20					
21	No recovery from 21.5' to 22.0'.				
22	Scattered organic debris from 22.0' to 27.0'.		2		
23					
24	Organic matter at 23.9'.				26
25					
26					
27					
28					
29	Organic matter at 29.7'.				
30					27
31	Organic matter at 30.6'. Age = 13,160 ± 550 yrs.				28
32					
33			3		
34	Organic matter at 33.8'.				29
35					

Project No. 41299I Field Log of Boring No. 1-5 Sheet 3 of 3

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	Sample No.
36	SAND, silty, olive black, 5YR2/1, very fine grained, micaceous, scattered shell fragments. SM		3		
37			4		
38	Organic matter in concretion at 38.4'.				
	Organic matter at 38.5'. Age = 12,270 ± 340 yrs.				32 31
39					
40	Bottom of hole 1-5 at 39.5'.				

Project No. 41299I Field Log of Boring No. 2-1 Sheet 1 of 3

BORING LOCATION SONGS OFFSHORE - E-1,597,740; N-418,851		ELEVATION AND DATUM Water Depth 165'	
DRILLING AGENCY WCC	DRILLER Iverson	DATE STARTED 6-13-80	DATE FINISHED 6-14-80
DRILLING EQUIPMENT		COMPLETION DEPTH 44.1'	ROCK DEPTH
SIZE AND TYPE OF CASING 4" Casing		NO OF SAMPLES: DIST.	UNDIST. / CORE
DRILLING METHOD VIBRATORY CORE		WATER ELEV. FIRST	COMPL. / 24 HRS.
CORE BARREL / LENGTH / BIT		LOGGED BY: JW/BN	CHECKED BY:

DEPTH (FEET)	DESCRIPTION	ROCK CORE: Sketch	Run No.	Recov. ft.	Sample No.
1	SAND, silty, olive gray, 5YR3/2, very fine to fine grained, subangular, micaceous, random shell fragments. SM		1		
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15	SAND, olive gray, 5YR4/2, medium to coarse grained, subangular, moderately sorted, slightly micaceous, shell fragments. SP				
16	SAND, olive gray, 5YR3/2, fine grained, subangular, poorly to moderately sorted, slightly silty, micaceous. SP				

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	Sample No.
17	Starting at 15.7' - SAND, olive gray, 5YR4/2, medium to coarse grained, subangular, moderately to poorly sorted, slightly micaceous, numerous shell fragments, numerous rounded pebbles. SP. SAND, olive gray at 17.1', 5YR4/1, fine grained, subangular, well sorted, micaceous. SP		1		
18					
19	no recovery at 18.0' to 19.5'.		No Recovery		
20					
21	SAND, olive gray, 5YR4/2, medium to coarse grained, subangular, moderately sorted, micaceous, numerous rounded pebbles to 1 1/2" in diameter. SP				
22					
23	SAND, olive gray, 5YR4/1, fine grained, subangular, well sorted, micaceous. SP				
24	SAND, olive gray, 5YR4/2, medium grained, subangular, well sorted, micaceous, occasional sub-rounded pebbles to 1/4" in diameter. SP				
25	SAND, olive gray at 24.3' to 24.5', 5YR4/1, fine grained, subangular, well sorted, micaceous. SP SAND, olive gray, at 24.5', 5YR4/2, medium grained, subangular, well sorted, micaceous. SP		2		
26	SAND at 25.2' becomes fine to medium grained.				
27	SAND, olive gray, 5YR4/1, fine grained, subangular, well sorted, micaceous. SP				
28					
29	From 28.7' to 29.3' vertical stringers of coarse grained sand.				
30					
31	Organic matter.				33
32			3		
33					
34	no recovery at 34.5' to 35.0'				
35					

DEPTH (FEET)	DESCRIPTION	ROCK CORE Sketch	Run No.	Recov. ft.	Sample No.
36	SAND, olive gray, 5YR4/1, fine grained, subangular, well sorted, micaceous. SP		4		
37	From 36.2' to 38.2' - blebs of whitish sand deficient in mica, up to 1/2" in diameter.				
38					
39	no recovery at 39.3' to 40.0'.				
40					
41			5		
42					
43					
44	Bottom of hole 2-1 at 44.1'.				

APPENDIX 2-B

AGE DATING RESULTS

APPENDIX 2-B

SUMMARY OF AGE DATING ANALYSES

The results of radiocarbon age determinations performed on selected samples of shell and organic material obtained in cores from vibratory drilling offshore of SONGS Units 2 and 3 are attached in this Appendix. Specifically, Table 2B-1 summarizes radiocarbon age date determinations on seven samples. This table is followed by the specific data sheets for each sample for the determinations made by Krueger Enterprises, Inc., Geochron Laboratories Division located in Cambridge, Massachusetts. It is noted that the results for Sample 15 of Core 1-3 appear anomalous when compared to the other results. Also, the quantity of sample was noted to be small enabling only limited pretreatment. Based on a discussion with Mr. Krueger, who made the determination, if this date were in error, it would be too young. For these reasons, it is suggested that the results of Sample 15 of Core 1-3 may be treated as anomalous and, therefore, disregarded in analysis.

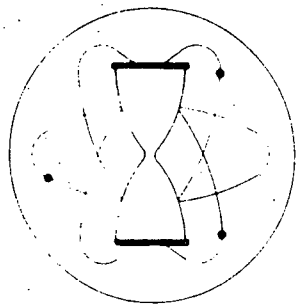
TABLE 2B-1

SUMMARY OF AGE DATING RESULTS

Core No.	Sample No.	Depth (ft)	Material Type	Age Date in Years Before Present*
1-1	2	16.4	Shells	8,510 ± 265
1-2	6	19.7	Shells	9,095 ± 335**
1-3	14	23.4	Organic	9,400 ± 300
1-3	15	25.7	Shells	5,065 ± 180**
1-4	22	21.1	Organic	11,355 ± 650
1-5	28	30.6	Organic	13,160 ± 550
1-5	31	38.5	Organic	12,270 ± 340

* These age dates are referenced to the year A.D. 1950.

** Thorough leaching not possible during pretreatment due to limited size of sample.



PRIORITY BASIS

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION

24 BLACKSTONE STREET • CAMBRIDGE, MA. 02139 • (617)-876-3691

RADIOCARBON AGE DETERMINATION — **REPORT OF ANALYTICAL WORK**

Our Sample No. GX-7327 **Date Received:** 27 June 1980

Your Reference: Project 41299I, Task 3160 **Date Reported:** 7/7/80

Submitted by: O. S. Ghuman
Woodward-Clyde Consultants
4000 W. Chapman St.
Orange, CALIF 92668

Sample Name: Sample #2. Offshore SONGS. Boring 1-1, run 2, section C, 15.8-16.5'. Shells.

AGE = 8510 +/- 265 C-14 years B.P. (c-13 corrected)

Description: Small sample of marine shells of various species.

Pretreatment: Shells and shell fragments were recovered after disaggregating the sample with ultrasonics. The shell material was further cleaned and rinsed briefly with very dilute HCl to remove altered surface material. The cleaned shell material was then hydrolyzed under vacuum to recover carbon dioxide for the analysis.

Comment:

δC^{13}_{PDB} = +1.1 $^{o}/_{oo}$.

Notes: This date is based upon the Libby half life (5570 years) for C^{14}. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

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PRIORITY BASIS

RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-7335 — **Date Received:** 30 June 1980

Your Reference: P.O. #41299I — **Date Reported:** 23 July 1980

Submitted by: O. S. Ghuman
Woodward-Clyde Consultants
4000 W. Chapman St.
Orange, Calif 92668

Project No. 41299I

Sample Name: Offshore SONGS. Sample #6.
Boring 1-2, run 1, sec. A, 19.8'. Shells

AGE = 9095 +/- 335 C-14 years B.P. (C-13 corrected)

Description: Mixed shell fragments in sand.

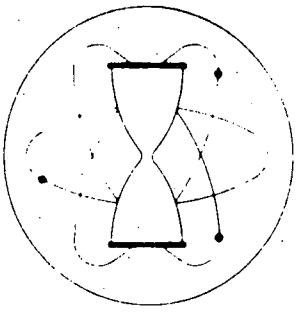
Pretreatment: The shells were cleaned thoroughly in an ultrasonic cleaner. A brief leaching with very dilute HCl was utilized to remove additional surficial material which may have been altered. Thorough leaching was not possible without severely reducing the size of the sample. The cleaned shells were then hydrolyzed with HCl, under vacuum, and the carbon dioxide recovered for the analysis.

Comment:

$\delta C^{13}_{PDB} =$ +1.4 ‰

Notes: This date is based upon the Libby half life (5570 years) for C^{14}. The error stated is $\pm 1\,\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.



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P R I O R I T Y B A S I S

RADIOCARBON AGE DETERMINATION — **REPORT OF ANALYTICAL WORK**

Our Sample No. GX-7328 — **Date Received:** 27 June 1980

Your Reference: Project 41299I, Task 3160 — **Date Reported:** 2 July 1980

Submitted by: O. S. Ghuman
Woodward-Clyde Consultants
4000 W. Chapman St.
Orange, CALIF 92668

Sample Name: Sample # 14. Offshore SONGS. Boring 1-3, run 2, section A, 23.4 feet.

AGE = 9400 ± 300 C-14 years B.P.

Description: Small sample of organic matter in marine sediment.

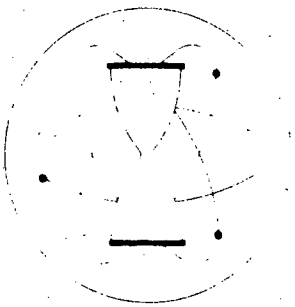
Pretreatment: The entire sample was dispersed in a large volume of water and the clays and organic matter were eluted away from any sand and silt by sedimentation and decantation. The clay/organic fraction was then treated with hot dilute HCl to remove any carbonates. It was then filtered, washed, dried, and roasted in oxygen to recover carbon dioxide from the organic matter for the analysis.

Comment:

δC^{13}_{PDB} = ‰.

Notes: This date is based upon the Libby half life (5570 years) for C^{14}. The error stated is ±1 σ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.



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PRIORITY BASIS

RADIOCARBON AGE DETERMINATION — **REPORT OF ANALYTICAL WORK**

Our Sample No. GX-7336 — **Date Received:** 30 June 1980

Your Reference: P.O. #41299I — **Date Reported:** 23 July 1980

Submitted by: O. S. Ghuman
Woodward-Clyde Consultants
4000 W. Chapman St.
Orange, Calif 92668

Project No. 41299I

Sample Name: Offshore SONGS. Sample #15.
Boring 1-3, run 3, sec. B. Shells.

AGE = 5065 +/- 180 C-14 years B.P. (C-13 corrected)

Description: Mixed shell fragments in sand.

Pretreatment: The shells were cleaned thoroughly in an ultrasonic cleaner. A brief leaching with very dilute HCl was utilized to remove additional surficial material which may have been altered. Thorough leaching was not possible without severely reducing the size of the sample. The cleaned shells were then hydrolyzed with HCl, under vacuum, and the carbon dioxide recovered for the analysis.

Comment:

δC^{13}_{PDB} = +0.9 ‰

Notes: This date is based upon the Libby half life (5570 years) for C^{14}. The error stated is ±1 σ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

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PRIORITY BASIS

RADIOCARBON AGE DETERMINATION — **REPORT OF ANALYTICAL WORK**

Our Sample No. GX-7329 **Date Received:** 27 June 1980

Your Reference: Project 41299I, Task 3160 **Date Reported:** 7/7/80

Submitted by: O. S. Ghuman
Woodward-Clyde Consultants
4000 W. Chapman St.
Orange, CALIF 92668

Sample Name: Sample # 22. Offshore SONGS. Boring 1-4, run 2, section A, 21.1'. Organic carbon.

AGE = 11,355 +/- 650 C-14 years B. P.

Description: Small sample of organic matter in marine sediment.

Pretreatment: The entire sample was dispersed in a large volume of water and the clays and organic matter were eluted away from any sand and silt by sedimentation and decantation. The clay/organic fraction was then treated with hot dilute HCl to remove any carbonates. It was then filtered, washed, dried, and roasted in oxygen to recover carbon dioxide from the organic matter for the analysis.

Comment: The sample was quite small, but was counted on each of two days with good concordance, average reported.

δC^{13}_{PDB} = ‰.

Notes: This date is based upon the Libby half life (5570 years) for C^{14}. The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.

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RADIOCARBON AGE DETERMINATION — **REPORT OF ANALYTICAL WORK**

Our Sample No. GX-7337 — **Date Received:** 30 June 1980

Your Reference: P.O. #41299I — **Date Reported:** @$ July 1980

Submitted by: O. S. Ghuman
Woodward-Clyde Consultants
4000 W. Chapman St.
Orange, Calif 92668

Sample Name: Offshore SONGS. Sample #28. Boring 1-5, run 2, sec A, 30.6'. Organic matter.

AGE = 13,160 +/- 550 C-14 years B.P.

Description: Organic matter from marine sediment.

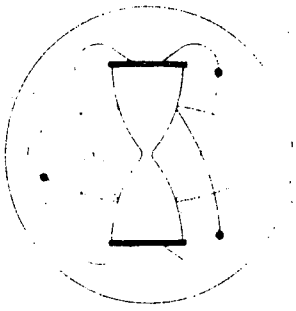
Pretreatment: The entire sample was dispersed in a large volume of water and the clays and organic matter were eluted away from any sand and silt by sedimentation and decantation. The clay/organic fraction was then treated with hot dilute HCl to remove any carbonates. It was then filtered, washed, dried, and roasted in oxygen to recover carbon dioxide from the organic matter for the analysis.

Comment:

δC^{13}_{PDB} = $^{o}/_{oo}$.

Notes: This date is based upon the Libby half life (5570 years) for C^{14}. The error stated is $\pm 1\ \sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.



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PRIORITY BASIS
RADIOCARBON AGE DETERMINATION — REPORT OF ANALYTICAL WORK

Our Sample No. GX-7338 **Date Received:** 30 June 1980

Your Reference: P.O. #41299I **Date Reported:** 24 July 1980

Submitted by: O. S. Ghuman
Woodward-Clyde Consultants
4000 W. Chapman St.
Orange, Calif 92668

Sample Name: Offshore SONGS. Sample #31. Boring 1-5, run 4, sec A, 38.5. Organic matter.

AGE = 12,270 +/- 340 C-14 years B.P.

Description: Organic matter from marine sediment.

Pretreatment: The entire sample was dispersed in a large volume of water and the clays and organic matter were eluted away from any sand and silt by sedimentation and decantation. The clay/organic fraction was then treated with hot dilute HCl to remove any carbonates. It was then filtered, washed, dried, and roasted in oxygen to recover carbon dioxide from the organic matter for the analysis.

Comment:

δC^{13}_{PDB} = ‰.

Notes: This date is based upon the Libby half life (5570 years) for C^{14}. The error stated is $\pm 1\,\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.

The age is referenced to the year A.D. 1950.