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POOR ORIGINAL

DRL MEETING ON SAN ONOFRE 2 & 3
LOS ANGELES, CALIFORNIA
JULY 28-29, 1970

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Summary

On July 28 and 29, 1970, Regulatory representatives and their consultants from USGS and USC&GS, Dr. Page representing the ACRS, the writer, plus the applicant and his consultants toured the site area and met in the Los Angeles offices of the Southern California Edison Company. Special attention was given to the exposed features of the Christianitos Fault which runs within 3/4 mile of San Onofre Unit 1 and even closer to Units 2 & 3 (and 4 & 5).

Examination of the overlaying terrace deposits at locations along the fault about 16 miles north and one mile south of the site indicate that the fault probably has not moved since the terraces were deposited. These deposits are at least 32,600 years old, according to carbon dating techniques.

Attempts by the applicant to map the offshore extension of Christianitos and to relate other offshore faults with the active (capable) Newport-Inglewood and the inactive (incapable) Pelican Hills faults to the north were relatively unsuccessful.

The applicant was requested to:

1. Provide more information to support his conclusion that Christianitos had not moved more than once in the past 500,000 years.

2. Provide more justification that the carbon dating samples are truly representative in age of the deposits overlaying Christianitos.

3. Provide underwater sounding data, including some proprietary oil company data, for the review of Regulatory and USGS, to assist in evaluating the underwater fault extensions.

4. Determine and justify the plant accelerations to be expected at the site in the event of Magnitude 8.0 quake on nearby underwater Fault "A", which may be an extension of the Newport-Inglewood Fault.

5. Justify the adequacy of the proposed tsunami protection.

6. Submit a step-by-step summary of how he meets the proposed seismic siting criteria (March, 1969).

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Visit to Site and Surrounding Areas, July 28, 1970

The group making the site tour included representatives of DRL (Birkel and Cardone), DRS (Minogue), Dames & Moore (Fisher, et al), USGS (Beltz and Yerkes), USC&GS (Murphy), Marine Advisors, San Diego Gas & Electric, Southern Calif. Edison (Ortega, et al), and ACRS (Page and Hard).

At Plano Trabuco

An exposure was created using bulldozers on a hillside about 16 miles north of the site. The Christianitos Fault and overlying sediments were exposed at this location. Dating of the terrace was through the use of wood fragments taken about 20' above the base rock-terrace interface. Dr. Page noted some gravel in the faulted zone which was not easily explained. He also questioned whether this fault was actually the Christianitos. The applicant expressed confidence that they were able to follow it from the ocean to this exposure.

At the Seashore

The Christianitos Fault intersects the coastline about a mile south of the San Onofre site. At this point the applicant had excavated for a length of 680' along the coastline to expose the contact between faulted base rock and overlying terraces. Though slides had occurred which covered some of the exposure, the terraces here, as at Plano Trabuco, appeared undisturbed and continuous. In the faulted zone, it was apparent that the rock on the east side had slipped upward relative to the west side. In fact, the San Mateo sandstone on the west side was not in evidance on the east side and apparently has been completely eroded away leaving only the lower level Capistrano formation exposed. (Note: Photos of this area were taken by the USGS attendees and will be available to the ACRS.)

The group also visited and was shown the location from which marine samples (shells) were taken for carbon dating the terrace deposits. This area is about 4½ miles down coast from the site.

Meeting in SCE Offices, Los Angeles, Calif., July 29, 1970

The attendance was much the same as the previous day's plus Dr. G. Housner, a consultant to SCE.

In response to DRL's previous questions on the geology-seismology of the San Onofre site, SCE provided the handout, Attachment #1, to this report.

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The contents of the attachment are:

I. A review of the Christianitos Fault study including length, displacement and age dating.

II. A review of Fault A and its relationship to other nearby faults.

III. San Onofre Fault study as related to AEC Geologic and Seismic Criteria of March 1969.

IV. Comparison of the San Onofre investigation to the Bolsa Island study.

V. Potential for onshore and offshore landslides which could affect the site.

VI. Offshore oil leases and potential subsidence.

Discussion on Part I

Dr. Page questioned the basis for concluding that the fault had not moved more than once in the last 500,000 years. The applicant stated that there is no positive evidence that multiple movements have occurred. The 900' vertical displacement in the PSAR should have been 90' according to J. Smith of Converse-Davis. The San Mateo formation on the west side of the fault is thought to extend 10' below the sand level at that point. This gives a 60' thick layer of San Mateo. From this they assumed that the vertical displacement could not have been more than 90'.

In summary, the amount of displacement is thought to be no more than 100 - 200' and is not of the order of thousands of feet. Dr. Page agreed with the probable displacement but pointed out that much larger displacements could have occurred. The answer to this question is not easily nor obviously attainable since the amount of past faulting erosion of the Capistrano is not known. Mr. Yerkes, USGS, asked for more detailed information on the specific location of the C^{14} marine samples. All agreed that an additional bore hole to determine better the thickness of the San Mateo would give a better fix on the minimum amount of displacement experienced, although this would not help in evaluating the maximum displacement. If the displacement is 500' or more, maybe one would have to assume more than one movement in 500,000 years, according to Yerkes. Minogue observed that OGC's feeling is that lack of evidence for multiple movements is not evidence that multiple faulting has occurred.

Dr. Page asked if there was any consistent location of the Christianitos fault with local topographic features (always at the base of hills, e.g.). Apparently the fault passes under varying topographic features and is very hard to trace.

<u>Discussion on Part II</u>

SCE has in its possession confidential Mobil Oil and Standard Oil data which cannot be made part of the public record but which are available for inspection.

Though the applicant has assumed that the Newport-Inglewood fault connects with the Fault "A" shown in the PSAR and in Attachment #1, there is no clear-cut evidence that this connection exists. In fact, if the Newport-Inglewood is extended linearly, it goes farther to sea than Fault "A". Attempts to follow the extension using a 30,000 joule sparker unit were unsuccessful. If Fault "A" connects with the Pelican Hill fault, Fault "A" has not been active for hundreds of thousands of years. But, this relationship cannot be shown either.

As a design basis, the applicant has assumed that the largest experienced quake on Newport-Inglewood fault (Mag. 6.3) is raised to 7.3 and is moved to a point on Fault "A" opposite the plant. This gives 40%g at the site. The applicant assumes 30%g for the DBE. However, per Ortega, the San Onofre 2 & 3 project manager, they cannot assume that Fault "A" and Newport-Inglewood are connected, though for design purposes, the assumptions above are made.

<u>Discussion on Part III</u>

DRL and their consultants pressed for more documentation on the age of terraces and the sample locations, and on the investigations and studies made to look for multiple movements along Christianitos in the last 500,000 years. Apparently many studies were made which don't show in the record. The applicant agreed to provide this information.

<u>Review of Underwater Data</u>

There was a presentation and discussion of the data which was accumulated and submitted in Appendix 2B of the PSAR. It was not clear to some of the Regulatory attendees, such as Dr. Page, that the interpretation of this data would be the same with a different interpreter (Dr. Page recommended privately that the USGS, who has experts in the field, look closely at some of the traces).

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Following a post-lunch caucus, the applicant stated that their position on Fault "A" is that if it does run north to the shoreline, it connects with the Pelican Hills Fault which is inactive.

These underwater tests employed "sparkers" and "boomers". The former uses an electrical discharge which creates an 80 - 100 cps sound wave which bounces off the ocean bottom and off interfaces of materials with different densities under the ocean bottom. The "boomer" actuates an aluminum plate electromagnetically which generates a higher frequency sound (500 - 800 cps) which gives better resolution but lower penetration.

In summary, Fault "A" cannot be traced any farther north than four miles south of Dana Pt. (Dana Pt. is ~ 9 miles from the site).

<u>Comparison with Bolsa Criteria</u>

The applicant pointed out the differences between San Onofre and Bolsa; island vs non-island site, and metropolitan vs non-metro site. The main similarity is that they are both nuclear plants. So, the applicant concludes that Bolsa criteria do not necessarily apply at San Onofre.

<u>Accelerations</u>

Murphy questioned the applicant's statement that a Magnitude 8.0 quake at 5 miles from the site would give 50%g at the site (this statement apparently was made only orally). Murphy felt that the 50%g is a low number for this assumption. Fisher noted that even Magnitude 8 quakes don't knock down buildings as evidenced by the San Francisco buildings left standing after the 1906 catastrophe. Murphy suggested more justification for the FSAR values.

<u>Tsunami Protection</u>

SCE's conclusions here are the same as with Unit 1; the plant is protected to +28' MLW. Murphy cautioned that there may not be agreement on this point at this time. Though the 28' MLW may be acceptable, Murphy stated that this has not been justified.

<u>Comparison of Seismic Siting Criteria (March 1969) with San Onofre 2 & 3 Criteria</u>

The applicant is to submit a summary on this subject. The summary is to expand on the researches done to justify their conclusions.

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Regulatory Caucus

Mr. Birkel asked for comments from the attendees on the following questions:

1. The Christianitos fault is not capable - Dr. Page agreed. Saltz needed more information, possibly on the underwater data to assure that Christianitos does not connect with Newport-Inglewood and including confirmation of the ancient age of the fault.

2. Is Fault "D" a continuation of the Christianitos Fault? A consensus was that the raw sparker data should be evaluated by experts in that line.

3. Is Fault "A" an extension of Newport-Inglewood? Dr. Page felt that there is no evidence at hand that it connects with either Newport-Inglewood or Pelican Hills faults.

4. Is Pelican Hill Fault inactive? Yerkes agreed as did Saltz.

Final Discussion with Applicant

Mr. Birkel listed the areas in which more information should be provided.

* * *

Attachment:
Summary of Suggested Items for Discussion
w/Brief Abstract re: Scope of Investigation
and Reasons for Conclusions

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Attach. #1

SAN ONOFRE NUCLEAR GENERATING STATION
UNITS 2 AND 3

In the July 15, 1970 meeting at Bethesda, questions were asked which require more detailed answers than provided in the PSAR. Following is a summary of suggested items for discussion with a brief abstract concerning the scope of the investigation and reasons for our conclusions.

I. A review of the Cristianitos Fault study including length, displacement and age dating.

A. Age Dating of Terrace Deposits

Studies by Southwick, 1928, indicate the earliest movement on the fault occurred in post early Pliocene time with the major movement occurring middle to late Pliocene or early Pleistocene, depending upon the age of the San Mateo Formation. The most recent movement occurred prior to deposition of the Marine Terraces which are considered at least 70,000-130,000 years old, based upon the approximate terrace shoreline angle elevation of 75 feet. Oral communication with Dr. B. J. Szabo of the U.S.G.S. in Denver confirmed that the terraces in the area of San Onofre are 70,000-130,000 years old, based upon Thorium-Protactinium Disequilibrium determinations on samples collected by J. G. Vedder of the U.S.G.S.

Shell samples obtained from the Marine Terrace section about 4.5 miles south of the plant site indicated an age greater than 33,000 years, based upon Carbon -14 Radiometric dating.

B. Displacement of the Cristianitos Fault

The Cristianitos Fault exhibits no evidence of two or more movements at the ground surface in the last 500,000 years. The only data suggesting the possibility of two or more movements in the last 500,000 years on the Cristianitos Fault is the fact that 900 feet of Plio-Pleistocene San Mateo Formation exists at the plant site west of the Fault, but there is no San Mateo Formation immediately east of the Fault at the coast. This could suggest at least 900 feet of vertical displacement on the Cristianitos during Pleistocene time, assuming that the base of the San Mateo Formation is nearly horizontal or dipping eastward.

Although data are incomplete and the stratigraphic relationships are complicated by at least two unconformities, the following observations argue against the large displacement suggested above, and support an estimate of about 90 feet of vertical displacement on the Cristianitos Fault at the coast:

1. The base of the San Mateo Formation is not horizontal, but is, rather, an irregular sloping surface representing an unconformity between the San Mateo and the Capistrano Formations.

2. This surface generally slopes downward from the vicinity of the Cristianitos Fault toward the southwest and the plant site.

3. Maximum observed vertical separation of the upper surface of the San Onofre Formation (the oldest rocks on both sides of the Fault—Middle Miocene) is about 400 feet. (This surface is also an unconformity and is a highly irregular surface. Although the actual separation may be somewhat more or less than 400 feet, it exists at least 2-1/2 miles inland.)

4. Maximum observed vertical separation of the unconformity between the San Mateo and Capistrano Formations (a Pliocene surface) is 250 feet. (This separation does not extend completely across the Cristianitos Fault, and the total separation may be more than 250 feet, but not much more because of the inclination of the unconformity. This separation exists at least 3 miles inland.)

5. The thickness of terrace deposits, the height of the cliff and the slope stability conditions at the coastal exposure of the cristianitos Fault could have resulted from a total vertical displacement on the Fault at that point of only about 90 feet.

6. Offshore geophysical exploration did not disclose a seaward projection of the Cristianitos Fault longer than a few miles, suggesting that the Fault, and the displacement thereon, dies out seaward.

7. The offshore seismic profiling data suggest a seaward-sloping unconformity between Capistrano and San Mateo Formations at shallow depth, a short distance offshore, indicating a thinning of the San Mateo Formation in the direction of the Cristianitos Fault.

8. A water well log in the San Onofre Creek basin about 1 mile inland and 2400 feet west of the Cristianitos Fault indicates the unconformity between the Capistrano and San Mateo Formations was encountered at approximately 115 feet below sea level, further indicating thinning of the San Mateo Formation toward the Cristianitos Fault.

C. Length of the Cristianitos Fault

The Cristianitos Fault is approximately 25 miles long on land. It has not been traced farther north than about Aliso Canyon by the California Division of Mines and Geology and the United States Geological Survey. The seaward extension of the Cristianitos Fault dies out within the area of investigation. The total length of the fault is approximately 28 miles.

D. Orientation of the Offshore Extension of the Cristianitos Fault

Seismic profiles south of San Onofre reveal that the Cristianitos Fault does not project offshore with its terrestrial NNW-SSE strike. Boomer lines B-4 through B-7 and Sparker profiles S-9, 14, 20, 22, 25, and 26 (Appendix 2-B, Figure 1) crossing the projected submarine extension of the Fault did not reveal any structural breaks that could be interpreted as the Cristianitos.

However, southwest of the seal-cliff exposure of the Cristianitos Fault, a distinct change in acoustic appearance and an increase in effective depth of seismic penetration from about 700 feet to about 1400 feet on Sparker profiles, S-21 and S-26 (Appendix 2-B, Figures 1 and 10) indicate a significant change in sediment lithology that trends nearly parallel to the coast. Such a change in terrestrial lithology occurs at the Cristianitos Fault where the San Mateo and Capistrano Formations are juxtaposed by normal faulting (Converse, Davis and Associates, 1970), and this offshore change is probably the Cristianitos Fault.

The Sparker profiles, S-21 and S-26, parallel the coast. They are believed to have been run within a disturbed zone of a fault, labeled "D." (No Sparker traverses crossed normal to Fault "D," so the width of the disturbed zone or the exact location of the axis of the fault was not determined. Shallow water depth (less than 40 feet) hampered data acquisition across the fault and subsequent analysis of the seismic profiles.) The disturbed zone, labeled Fault "D," is interpreted to be the seaward extension of the Cristianitos Fault. Thus, the submarine continuation of the Cristianitos turns to the southeast and trends subparallel to the coast. The lack of evidence of faulting on Sparker records crossing the NNW-SSE offshore projection of the Cristianitos confirms that it does not strike diagonally across the continental shelf. The Fault trace must bend to the southeast or terminate just seaward of the sea-cliff exposure. The attached cross-section indicates the generalized geological interpretation of the offshore sparker data.

A brief review of confidential Sparker data provided by an oil company supports this interpretation. Sparker profiles south of the plant site which cross the submarine fault projection reveal no evidence of faulting that can be correlated to the Cristianitos Fault. These profiles were recorded to within one-half mile of the beach. Therefore, any seaward extension of the Cristianitos must curve to the southeast and die out within a short distance.

E. Distance between the Cristianitos Fault and Units 2 and 3

The scale on the PSAR geology drawing 2.9-2 at 1" = 400' is incorrect for the reduced drawing. Unit 3 is approximately 2,600 feet and Unit 2 is approximately 2,900 feet from the nearest trace of the Cristianitos Fault.

II. A Review of Fault A and Its Relationship to other Nearby Faults

A. Possible Northerly Extension of Fault A

The study of offshore Fault A centered around its possible northerly extension onshore at Dana Point or Laguna Beach or an 18-mile projection to a possible seaward extension of the Newport-Inglewood Fault in the vicinity of Newport Beach or other faults such as the Pelican Hill Fault or the Laguna Canyon Fault.

Because of the poor Sparker data between Dana Point and Newport Beach, it is impossible to determine with any certainty the structural relationship of Fault "A" with either the Newport-Inglewood Fault or other faults along this portion of the coast.

Between Dana Point and Newport Beach, points of possible faulting at the edge of the shelf were noted on the Sparker records. However, record quality in this region does not permit much confidence in either the determination of the existence and location of a fault of the correlation of the feature to adjacent Sparker traverses. The possible fault crossings are indicated by the dots on Figure 9 (Appendix 2B); the questionable correlation of the fault trace is shown by the "dashed-question-marked line." This interpretation was unavoidably biased by the proximity of the fault crossings to the shelf edge and by the locations of the Newport to the north and Fault "A" to the south.

A brief review of supplementary, confidentail Sparker data from other sources also revealed very poor record quality between Newport Beach and Dana Point. The additional data provided little assistance in resolving the relationship of the faults in question. However, zones of possible faulting were noted at the shelf edge and on the continental slope. The oil company data is available for review by AEC staff but cannot be submitted for public record because of its proprietary nature.

In summary, the relationship of Fault "A" with the Newport-Inglewood Fault could not be resolved because of poor record quality due to the geology of the area. A possible connection or intersection of the two faults is undeterminable with data used for this shelf structure investigation. Additional geophysical studies would probably be unproductive.

Another fault that is a more likely correlative with Fault "A," an interpretation permitted by the offshore Sparker data, is the Pelican Hill Fault. The Pelican Hill Fault has the following characteristics.

1. It is a northwest trending fault lying between the San Onofre Nuclear Generating Station site and the Newport-Inglewood Fault;

2. It juxtaposes rocks of Middle to Upper Miocene age;

3. It is overlain by nonmarine terrace deposits at Emerald Bay, and by marine terrace deposits at elevation 600 feet (probably several hundreds of thousands of years old) at Pelican Hill;

4. It originated during Middle Miocene time and does not displace strata of early Pliocene Age.

If Fault "A" is correlated with the Pelican Hill Fault, which is likely since it lies east of the Newport-Inglewood Fault, then based on the above characteristics, Fault "A" has not displaced the ground surface in hundreds of thousands of years.

B. Possible Southerly Extension of Fault A

The linear, continuous trace of Fault "A," its disturbed zone, and its northwest-southeast strike suggest that "A" is a structural feature which could extend to the southeast of San Onofre. Fault "A" was traced approximately 10 miles south of San Onofre to the southern limit of the area investigated.

A brief inspection of confidential oil company Sparker data indicated possible faulting at the edge of the continental shelf south of the study area. Sparker profiles beyond the southern limit of the survey area from Oceanside to Cardiff revealed zones of possible faulting at the shelf edge, similar to the location of Fault "A" off San Onofre. However, the examined profiles had a line spacing of two miles and greater. Such fault evidence at the shelf edge off Oceanside and further south may be attributable to a southerly extension of Fault "A," another unmapped fault at the shelf edge, or a series of short faults, perhaps en echelon with northwest strikes.

C. Data on Nearby Faults

Fault	Length (Miles)	Nearest Approach (Miles)	Maximum Historic Magnitude on Fault	Principal Sense of Movement	Displacement
San Andreas	500+	60	8.0 (1857)	Right Lateral	25 miles in Tertiary Time
San Jacinto	195	45	7.1 (1934)	Right Lateral	15 miles total
Elsinore	120	23	6.0	Reverse	1000 feet horizontal (right lateral) 5000 ft. min. vertical
Newport-Inglewood	48 (on shore)	30	6.3 (1933)	Right Lateral	3000 - 5000 feet horizontal, 4000 ft. vertical vert. separation 200 ft. Plio-Pleistocene contact
"A"	17	5	Unknown	Unknown	Unknown
Cristianitos	25 (on shore)		Unknown	Vertical Normal	5000 ft. max. at midpoint 90 ft. at shoreline. No movement in at least 70,000-130,000 years

No attempt was made to determine the maximum potential earthquake magnitude for any fault since there is no factual basis for such predictions.

These data show, as indicated in Appendix 2A of the PSAR, that maximum recorded magnitudes and total displacement generally decrease on northwesterly trending faults in relationship to distance away from the San Andreas Fault.

D. Magnitude of Earthquakes which Could be Associated with Fault A

On the basis of our geological investigation and experience, it is our opinion that Fault A is connected with the Pelican Hill Fault. We consider that the Pelican Hill Fault is not a "capable" fault. However, we do not have definitive data on the northward extension of Fault A. We have assumed, for a structure of the significance of a nuclear station, that Fault A has an earthquake potential equivalent to that of the Newport-Inglewood Fault.

If this postulation were correct, we must assume an earthquake as large as, or somewhat larger than the 1933 Long Beach (Magnitude 6.3) earthquake might occur anywhere along the Newport-Inglewood or Fault A. In California, our experience has been that the occurrences of earthquakes along any particular geologic structure follows a normal distribution of magnitude and time. For example, there are no instances of Magnitude 7 earthquakes occurring unless Magnitudes 5 and 6 shocks have previously occurred. Thus, we have conservatively assumed that an earthquake of one magnitude higher than has previously occurred along the Newport-Inglewood Fault could occur at the closest approach of Fault A to the site.

Another indication of the conservatism of the assumption of a Magnitude 7.3 is the historical record which has no indication of great shocks occurring to the West of the San Andreas Fault zone. From our evaluation of the geology and seismology of the area, we believe that this assumption is reasonable and conservative for design purposes for the planned nuclear units. The postulated occurrence of a Magnitude 7.3 earthquake along Fault A results in Intensity IX Levels and ground accelerations of less than 40% of gravity at the site.

The final design of the structures in accord with the recommended design spectra presented in the PSAR would accommodate an earthquake larger than any recorded in the region, including the unlikely event of a maximum hypothetical Magnitude 8 earthquake postulated on the Newport-Inglewood Fault.

III. San Onofre Fault Study as Related to AEC Geologic and Seismic Criteria of March 1969

A. Capability of the Cristianitos Fault

The Cristianitos Fault has been demonstrated to have not displaced the ground surface in the last 70,000-130,000 years. The Fault does not exhibit evidence of one or more displacements in the last 500,000 years, and the small amount of total displacement on the Fault in the vicinity of the San Onofre Nuclear Generating Station site suggests that it occurred during Pliocene—early Pleistocene time—its inferred period of major activity. It is not associated with any instrumentally well-determined seismicity.

During its early history, the Cristianitos Fault was connected with and genetically related to the Whittier-Elsinore Fault, a "capable" Fault by proposed AEC criteria. However, subsequent activity on the Whittier-Elsinore Fault has produced a dense pattern of diverse faults that intercede between it and the Cristianitos Fault for a distance of about 15 miles. The evidence of greatly different ages of last displacement on the Cristianitos and Whittier-Elsinore Faults, testifies to the apparent lack of coupling between the two Faults, and, thus, they are no longer related in a manner such that the Cristianitos Fault may be considered "capable."

The Cristianitos Fault is not connected to the Newport-Inglewood Fault, and no evidence is exhibited of a genetic relationship between the two faults.

Therefore, the Cristianitos is not a "capable" Fault.

B. Capability of Fault A

Fault A also exhibits no evidence for recent vertical displacement, at least since the offshore slope was truncated by wave erosion during rising sea levels which have occurred since the last glacial epoch. This fault also lacks macro-seismicity.

If Fault A is assumed to be connected with the Pelican Hill Fault, then Fault A is not a "capable" fault for the reasons demonstrated by the characteristics enumerated in Section II.A above.

If Fault "A" is assumed to be connected with the Newport-Inglewood Fault, Fault "A" might be considered a "capable" Fault. If so, its "control width" is approximately 3-1/2 miles, based on the distance between Fault A and the south end of Fault C. In this case, the San Onofre site is outside the hypothetical "control width" of Fault A.

IV. Comparison of the San Onofre Investigation to the Bolsa Island Study

There are no obvious differences between the results of offshore sparker studies conducted for Bolsa Island and San Onofre. The equipment was the same in several cases. The major difference was that off San Onofre no good reflector horizons were indicated which are comparable to the "A" and "B" horizons encountered at Bolsa. Also, at San Onofre the shallow reflectors are in part masked by a thin layer of sand and cobbles. Bolsa Island consisted of about 150 miles of sparker survey in a small area while San Onofre offshore surveys included approximately 200 miles of sparker, boomer, and side scan sonar surveys over a 33-mile section of coastline. For the San Onofre study, data was reviewed on an additional 400 miles, which confirmed the fact that the data for San Onofre was the best obtainable using equipment available at this time. The Bolsa Island study of the Newport-Inglewood Fault supports the location of the possible seaward extension of the Fault in the vicinity of Newport Beach as shown in Appendix 2B.

Much of the detailed study for Bolsa Island utilized equipment with greater resolution and lesser penetration than that used offshore of San Onofre. The sub-bottom profiling characteristics of the equipment utilized at San Onofre are summarized below:

	Sparker	Boomer
Source frequency	80-120 Hz	500-800 Hz
Power level of source (electrical energy)	2000-3000 joules	500-1000 joules
Usual penetration below sea bottom	800 ft.	70 ft.
Depth of shallowest detectable geologic data below sea bottom	70 ft.	10 ft.
Resolution (thickness reflecting layer for detection)	10 ft.	2 ft.
Minimum throw of fault for detection	10 ft.	2 ft.

V. Potential for Onshore and Offshore Landslides which Could Affect the Site

A. Offshore Landslides

The attached profile shows the ocean bottom profile off San Onofre out to the base of the continental slope. The drawing illustrates the gentle bottom slopes of less than 1° out to a depth of about 100 meters. Beyond this point out to depth of about 800 meters the slope is about 5°. The flat slopes and consolidated nature of the offshore sediments preclude the possibility of offshore landslides which could affect the plant.

B. Onshore Landslides

Landslides are indicated on the geologic map Drawing 1, Appendix 2A. One large landslide area occurs along the sea cliffs, 3400 feet down coast from Unit 3 where Capistrano Formation has been uplifted on the east side of the Fault. This landslide is active but does not relate in any way to the plant which is founded in dense San Mateo sand.

VI. Offshore Oil Leases and Potential Subsidence

There are no oil leases offshore of San Onofre. Further, it is our understanding that new legislation by the State of California will prohibit offshore drilling in this area.

It is generally believed that the oil provinces die out to the south and that their is little evidence to suggest that oil production might be expected in the future south of the City of San Clemente.

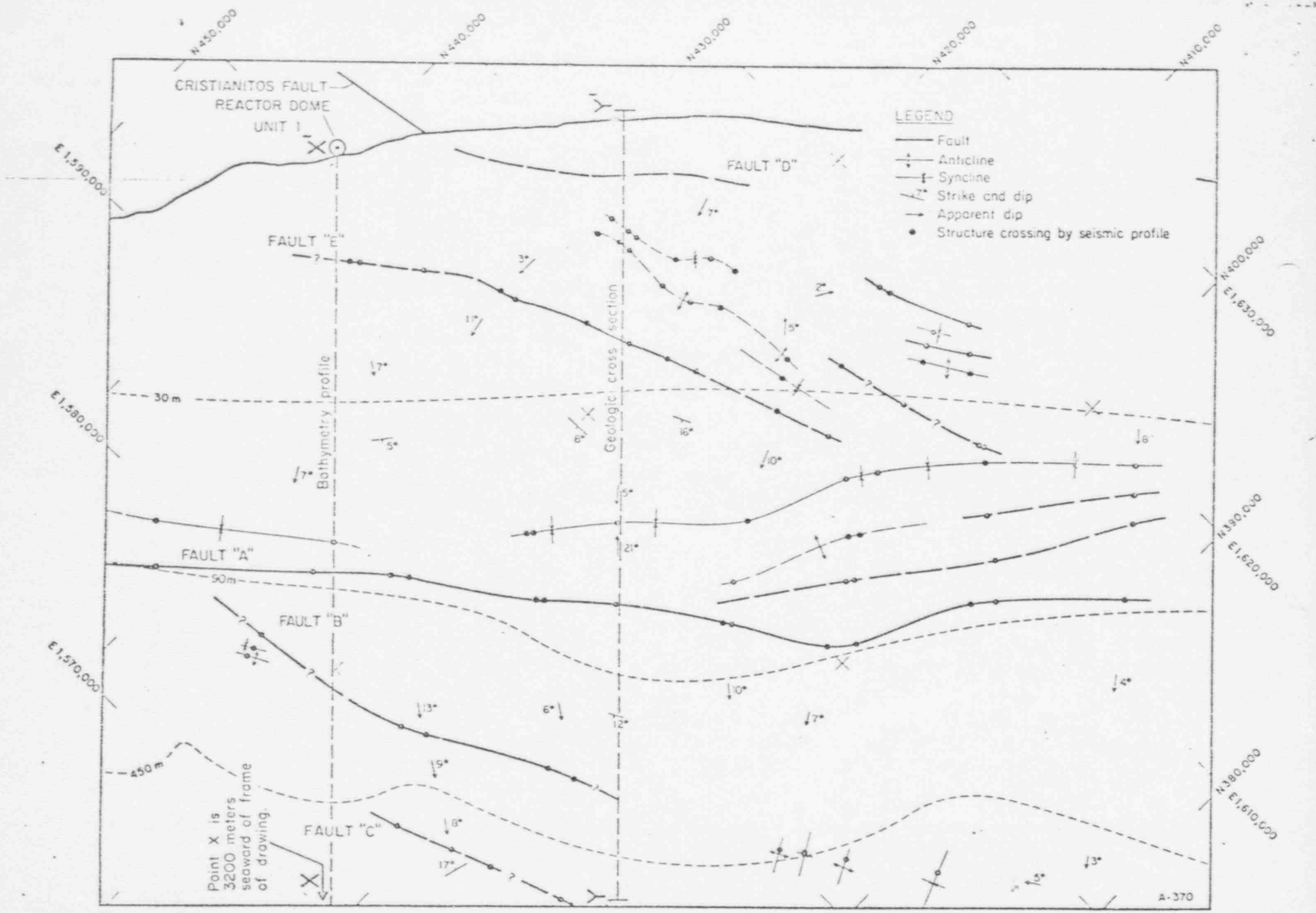


Figure C.
Location of bathymetry profile and geologic cross section.

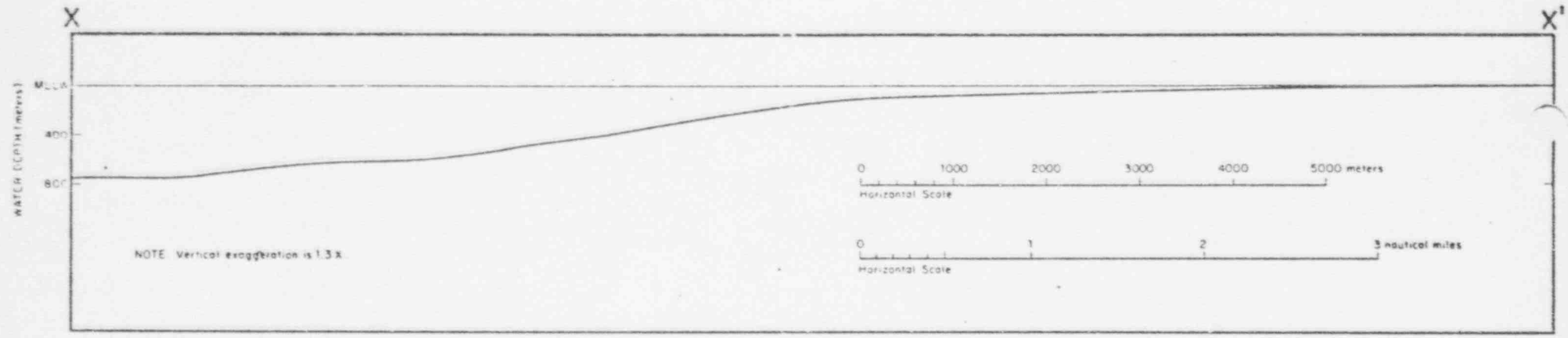


Figure A.

Bathymetry profile of continental margin, San Onofre. (See Figure C for location.)

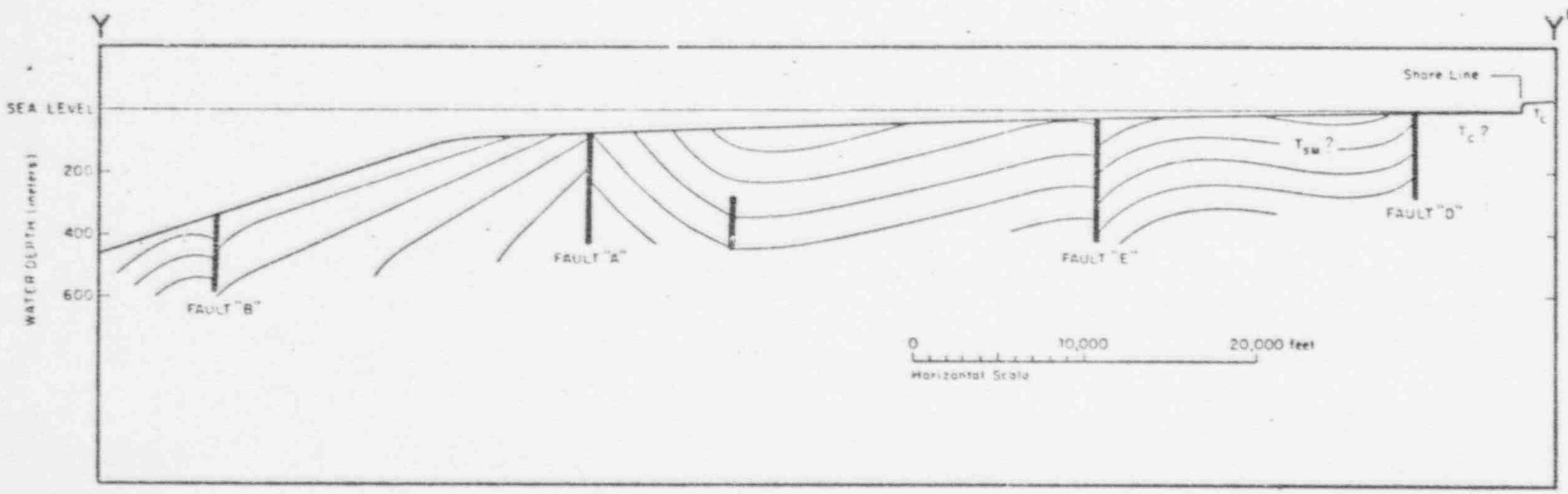
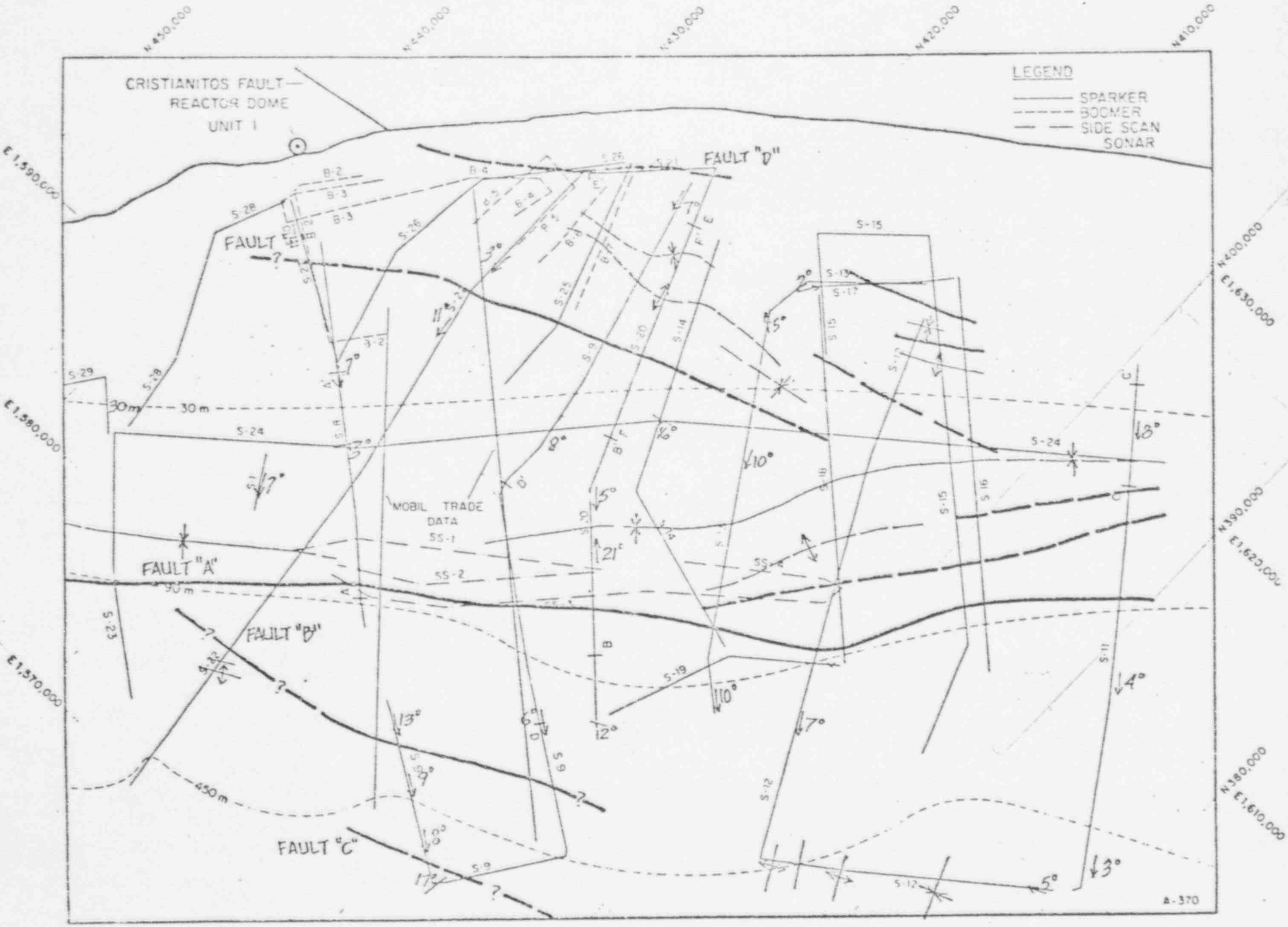


Figure B.

Geologic cross section of continental shelf, San Onofre. (See Figure C for location)


CRISTIANITOS FAULT—
REACTOR DOME
UNIT 1
LEGEND
SPARKER
BOOMER
SIDE SCAN
SONAR
FAULT "D"
FAULT "E"
FAULT "A"
FAULT "B"
FAULT "C"
MOBIL TRADE
DATA
SS-1
SS-2
S-24
S-15
S-13
S-17
S-16
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30m
30 m
90 m
450m
N450,000
N440,000
N430,000
N420,000
N410,000
N400,000
N390,000
N380,000
E1,590,000
E1,580,000
E1,570,000
E1,630,000
E1,620,000
E1,610,000
A-370

Figure 1.