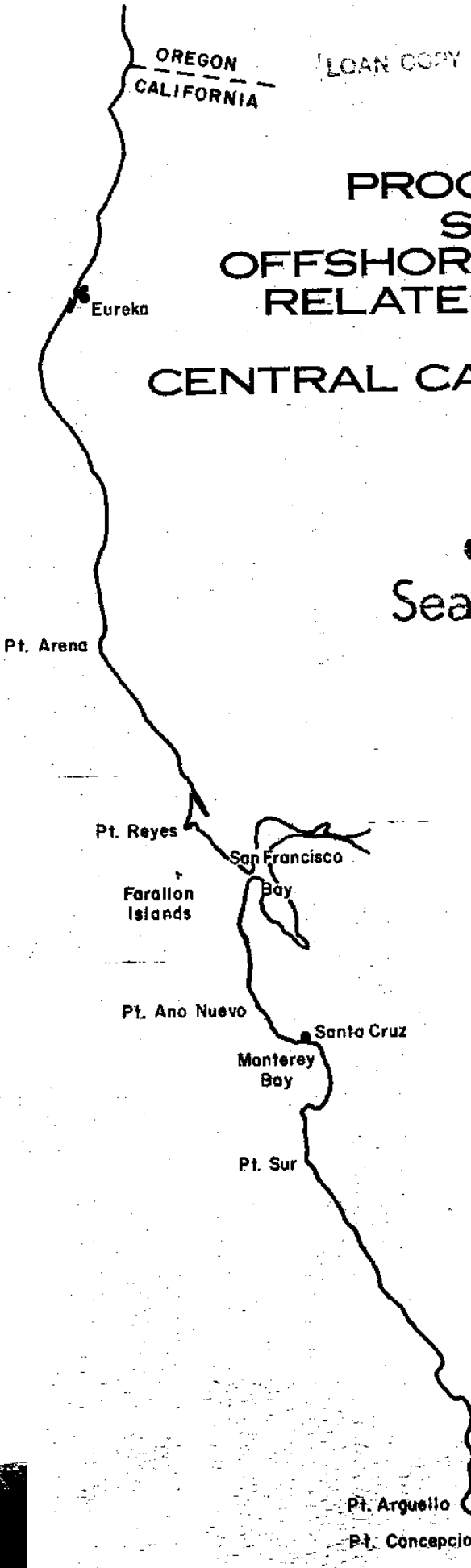

PROCEEDINGS OF THE SYMPOSIUM ON OFFSHORE OIL POTENTIAL AND RELATED LAND USE IMPACTS IN THE CENTRAL CALIFORNIA COASTAL ZONE

CO-SPONSORED BY:

ASSOCIATION OF MONTEREY BAY AREA GOVERNMENTS AND
COASTAL MARINE LABORATORY
UNIVERSITY OF CALIFORNIA,
SANTA CRUZ CAMPUS

JUNE 8, 1975

PROCEEDINGS

OFFSHORE OIL POTENTIAL AND LAND USE IMPACTS IN THE CENTRAL CALIFORNIA COASTAL ZONE

William T. Doyle, Editor

Special Publication Number 3

Coastal Marine Studies
University of California
Santa Cruz, California 95064

The Proceedings includes presentations and question and answer remarks from a symposium held on June 8, 1975, in Thimann Lecture Hall 3, on the Santa Cruz campus of the University of California. The symposium was open to the general public.

The symposium was co-sponsored by:

(1) The Association of Monterey Bay Area Governments (AMBAG)

(2) The Coastal Marine Studies Committee, Santa Cruz campus of the University of California.

Additional copies of these Proceedings may be obtained from:

Director
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University of California
Santa Cruz, California 95064

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WELCOMING REMARKS

Bert Muhly, President
Association of Monterey Bay Area Governments

I would like to welcome you all to this Symposium on Offshore Oil Potential and Related Land Use in The Central California Coastal Zone. The Association of Monterey Bay Area Governments is really pleased to be able to co-sponsor this with the Coastal Marine Studies program here at the Santa Cruz Campus of the University of California.

In the way of setting the stage for what is to transpire today, I would like to offer a few remarks that will review certain historical events that have a bearing on the current efforts to focus public attention on the exploration for and extraction of oil and minerals in the outer continental shelf area. Just prior to leaving office, former President Nixon issued a directive enabling the leasing of 10,000,000 acres of offshore lands for oil exploration and eventual extraction. To implement more fully the purposes and objectives of the Outer Continental Shelf Lands Act the oil and gas industry and the general public were invited to submit information to the Bureau of Land Management (BLM) concerning areas of interest for offshore oil and gas leasing and to identify problem areas. Seventeen specific regions were defined in the invitation--three of these involve outer continental shelf lands off California: (1) southern California borderlands, (2) Santa Barbara area, and (3) north and central California. It is this latter region, the north and central California region, which is the focus of this

meeting today. This region includes all outer continental shelf lands north of San Luis Obispo County's south boundary to the Oregon border. Of course, AMBAG has particular concern about that portion or that segment of the region which is offshore of Monterey Bay and its adjacent coastal waters.

From the responses that BLM received from the oil companies who were invited to nominate areas with respect to their desirability for leasing, the central and northern California continental shelf area was ranked 16 out of 17. Not all of the responding companies ranked the areas and some did not rank all 17 areas. At least 11 of the oil companies expressed interest in this area and 2 had particular interest in specific locations within this region. For comparison, it can be noted that the southern California borderland was ranked fourth and the Santa Barbara area was ranked tenth. I think that it is very interesting that Santa Barbara, which was ranked tenth by this particular procedure, was the scene, and still remains the scene, of a lot of public controversy in regard to the program and the processes that govern the continued leasing and oil exploration and drilling operations in the state tidelands region. Moreover, it was in this area that in the winter of 1969 there was an oil blowout on outer continental shelf lands.

In 1968, about six weeks or so prior to the Santa Barbara oil spill, State Senator Donald Grunsky, with vigorous support from AMBAG, introduced Senate Bill 57. This bill proposed to establish an oil-free sanctuary in the State tidelands region (extending from the coastline to three miles offshore) along the California coast from the northern San Luis Obispo County line north to the southern San Mateo County line. All of Monterey Bay was included in the proposed sanctuary. It is of interest to note that Senate Bill 57 was introduced before the

Santa Barbara oil spill; it was not a response to it. The oil spill was of great concern to AMBAG because the affected area of some 800 square miles is about 3 to 4 times the size of Monterey Bay. Moreover, there was no definitive information on the current patterns within Monterey Bay or water turnover time. We did know that Monterey Bay was an exceptionally attractive and valuable environment and that great care must be taken to protect this potential for diverse and compatible uses of this resource -- from recreation to fisheries.

In spite of the fact that Senate Bill 57 was approved without a dissenting vote by both Houses of the State Legislature, there was great concern that the Governor might veto the bill. The record will show that the bill had virtually unanimous support of the Monterey Bay communities, planning commissions, and county Boards of Supervisors. In the face of this vigorous and crucial support, the Governor was persuaded to sign the bill, even though there was strong opposition to it from within his cabinet. For example, the head of the Department of Finance recommended against signing the bill and suggested the possibility of oil and gas under approximately 196,000 of the 227,000 acres that would be included in the extended sanctuary.

Passage of Senate Bill 57 focussed attention on the oil potential of this area and on what might be done in the outer continental shelf area, which is under federal jurisdiction. At the local level, there was considerable interest in extending the sanctuary to include the adjacent outer continental shelf area. Correspondence with Congressman Talcott and Senator Cranston, among others, resulted in the introduction of several bills at the federal level. To date these efforts have not resulted in definitive action.

During this time period, very little was being done at the federal or state level, or by the oil industry, to pinpoint the specific outer continental shelf areas that might have oil potential. This information is absolutely essential at the regional and local planning level in order that the appropriate agencies can assess the implications of oil exploration and extraction on adjacent onshore land use. The siting and size of the onshore support facilities as well as the location of the offshore drilling platforms themselves, need to be assessed in terms of potential conflicts in land-use, impacts on recreation, fisheries or unique biological resources such as marine mammal rookeries, and visual aesthetic impacts in these areas.

AMBAG, with unanimous support of the fifteen member cities and two member counties, organized and hosted a public forum to discuss this issue. On February 6 we assembled, in my opinion, an exceptionally fine group of scientists and representatives of the private and public sectors to discuss the implications of leasing for oil exploration and extraction ten million acres of the outer continental shelf lands of this country. (A copy of the agenda of this forum is appended to this chapter.) As a result of that forum, the Board of Directors of AMBAG agreed to support the position of the City of Los Angeles, a position which was also endorsed by California Senators Cranston and Tunney. This position included a request to the federal government that it not lease outer continental shelf lands off the coast of California until completion and approval of the State Coastal Plan. The development of the State Coastal Plan was mandated by the people of California in the November 1972 election. The development of this plan is in progress and premature letting of oil leases by the federal government would subvert the intent of the

initiative. The position of the City of Los Angeles now is also the position of the Governor of the State of California.

The Federal Coastal Zone Management Act of 1972 requires that the federal government deal with regional Coastal Plans that were developed and encouraged by grants obtained through this act. The State of California, for development of its Coastal Plan, has received such a grant. At issue, apparently, is whether offshore oil leasing should wait until completion of the Coastal Plan. The State of California argues that leasing should wait until the plan has been completed and approved, until policy has been established, and until the people of the state can assess the trade-offs inherent in utilization of nonrenewable resources and possible land-use conflicts. That is really where we are today; there has been no resolution of this request.

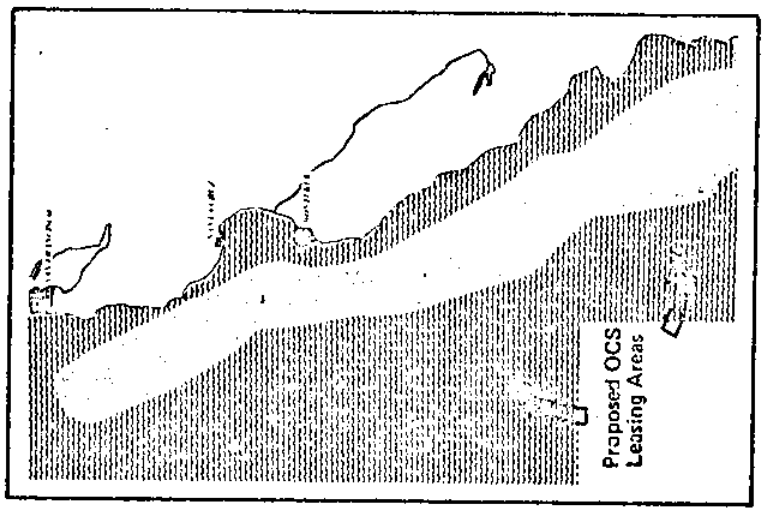
The Association of Monterey Bay Area Governments has taken two additional actions. There is the possibility that a marine sanctuary could be established on the outer continental shelf area similar to that which exists covering the state tidelands in the Monterey Bay area. In a conversation with Mr. Knecht, Assistant Head of the National Oceanographic and Atmospheric Agency (NOAA) in Washington, D.C. (the agency which administers the Federal Coastal Zone Management Act), we learned that there has been no activity in response to our request that any offshore area be studied as a possible sanctuary. Further, AMBAG requested that the central and northern California area be dropped from the list of nominations for oil leasing because of the low priority of this region in the eyes of the oil companies themselves, and the high priority that much of this area has for a multitude of other purposes and the possibility of a marine sanctuary

designation for part of this area. The request was made several months ago. As yet we have received no response from the Department of Interior.

I am speaking here as an elected representative (Santa Cruz City Council) who has also been elected by the Board of Directors of AMBAG as its President, and in no other capacity. Today's conference is a follow-up to our first forum which was held in February. With the array of talented people which we have assembled today we hope that we can focus on specifics of the geology of this coastal area, basin location, conditions which favor oil accumulation, and places of potential oil accumulation. These discussions will be followed by an assessment of where land-use conflicts might occur in the Monterey Bay area, how one identifies and anticipates potential conflicts, and the methodology required to resolve conflicts when they do arise. We are not here today to solve problems, but to identify where problems might occur and the procedures that should be followed in order to resolve these problems. This conference, then, will serve (1) to give to local and regional planning agencies some perspective of the magnitude of the oil potential and consequent possible land-use conflicts in the central and northern California region, with specific concern in the Monterey Bay area, and to assist in determining where local, regional, or legislative action might be necessary; and (2) to provide information so that the public (a) can make an informed judgement as to what trade-offs might be necessary if outer continental shelf oil exploration were to be permitted and (b) can be out in front of things for a change rather than waiting until developments begin and then having to go through the traumatic and emotional experience of

operating and making decisions with insufficient time and which are based on insufficient information.

If we are able to take a step in this direction this afternoon, then this symposium will be well worthwhile.



OUTER CONTINENTAL SHELF
OIL AND GAS LEASING
AND THE MONTEREY BAY AREA

An AMBAG Forum

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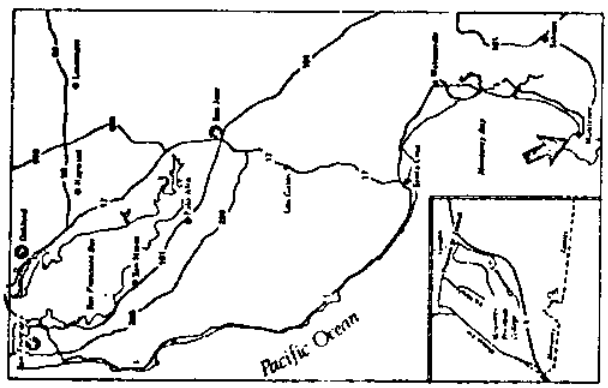

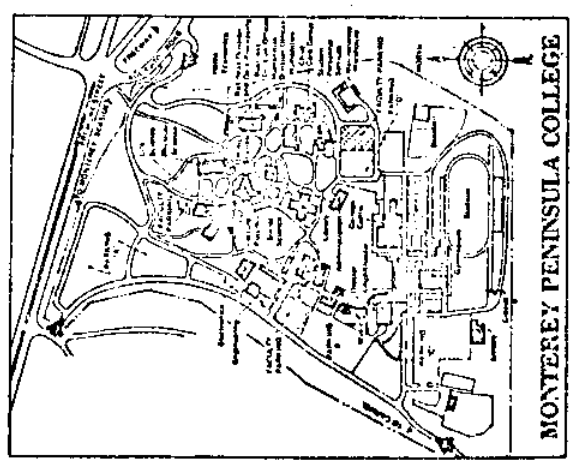

How to get there:

OUTER CONTINENTAL SHELF OIL AND GAS LEASING AND THE MONTEREY BAY AREA

AMBAG is hosting this workshop to focus local concerns over the federal government's proposed program to increase the acreage offered for oil and gas leasing on the Outer Continental Shelf. Under this program federal lands three miles off the central California coastline are scheduled for leasing in 1977-78. The U.S. Bureau of Land Management has issued an Environmental Impact Statement discussing the general impacts of such a program, but the specific implications of possible leases in this region were not dealt with in depth.

We urge your participation, and hope the forum will broaden local awareness and understanding of this issue and provide a basis for well-informed decisions by all involved.

Saturday, February 15, 1975
9:00 am - 4:30 pm

Lecture Forum No. 103
Monterey Peninsula College
Monterey, California

Free of charge and open to the public.

9-9:05 am — **Welcoming remarks**
Bert Muhly, Mayor of Santa Cruz
President of AMBAG

9:05-9:30 am — **Remarks**
Hon. Paul N. McCloskey, M.C.,
12th Congressional District,
San Mateo Ranking Republican Member,
House Merchant Marine Subcommittee

9:30-10:00 am — **Remarks**
Hon. Burt L. Talcott, M.C.,
16th Congressional District,
Salinas

10:00 am — **Coffee Break**

10:10-10:30 am — **Background on Leasing Program**
William Grant,
Manager of Bureau of Land Management,
Los Angeles

10:30 am-noon — **Panel Discussion:**
RELATIONSHIPS BETWEEN OCS LEASING AND FEDERAL AND STATE ENERGY POLICIES

William Arnzt; Regional Administrator,
Federal Energy Administration, Region IX,
San Francisco

William Grant; Manager,
Bureau of Land Management,
Los Angeles

Ruth Andresen; Member,
State Coastal Commission

Robert Solomon; Special Consultant,
State Energy Commission

Roger W. Poyner; Supervisor,
Monterey County
(Moderator)

noon-1:00 pm — Lunch
Monterey Peninsula College Cafeteria

1:00-2:30 pm — **Panel Discussion:**
DISCUSSION OF DRILLING OPERATIONS, INCLUDING INDUSTRY ENVIRONMENTAL SAFEGUARDS, AND POTENTIAL ENVIRONMENTAL RISKS TO MONTEREY BAY

Edward W. Mertens, Senior Research Associate, Chevron Research Co., Richmond and Chairman of American Petroleum Institute Committee: "Fate & Effects of Oil on the Environment"

Thomas A. Hudson, Senior Staff Engineer, Standard Oil Co., San Francisco

Capt. F. W. Folger; Chief, Marine Safety Division, 12th Coast Guard District, U.S. Coast Guard

Patrick Kinney, Ph.D.; physical oceanographer, Santa Cruz

John Pearse, Ph.D.; marine biologist, University of California, Santa Cruz

John F. Mathews, Jr.; Chief,
State Division of Oil and Gas, Sacramento
(Moderator)

2:30 pm — **Coffee Break**

2:40-4:00 pm — **Panel Discussion:**
SUMMARY OF GOVERNMENTAL ACTIONS IN RESPONSE TO THE PROPOSED LEASING OF OCS

Hon. Terry Goggin; Assemblyman,
San Bernardino

Robert Lutz; Director,
Institute of Coastal Law and Management,
USC

James W. Rote, Ph.D.; Consultant,
Assembly Office of Research

Norman Emerson; Assistant to the
Mayor of Los Angeles

Dale Dawson; Supervisor,
Santa Cruz County
(Moderator)

4:00-4:30 pm — Wrap-Up
President Bert Muhly

SPECIALLY SCHEDULED MEETING OF AMBAG BOARD OF DIRECTORS

WEDNESDAY, FEB. 19, 1975
7:30 pm

BOARD OF SUPERVISORS CHAMBERS
MONTEREY COUNTY COURTHOUSE
Church and West Alisal Streets
Salinas, CA

The AMBAG Board will meet to receive the information generated at the February 15 Forum and to consider adopting a policy statement relative to the leasing program to submit to the Bureau of Land Management. The meeting is open and the public is invited.

MEMBER AGENCIES OF THE

ASSOCIATION OF MONTEREY BAY AREA GOVERNMENTS

Capitola	Salinas
Carmel	Sand City
Del Rey Oaks	Santa Cruz
Gonzales	Scotts Valley
Greenfield	Seaside
King City	Soledad
Monterey	Watsonville
Pacific Grove	Monterey County
	Santa Cruz County

AMBAG was established January 8, 1968, to form an organization composed of local governments in the Counties of Monterey and Santa Cruz to explore problems having a direct effect on the health, welfare and economy of Monterey Bay and its retention as a natural asset.

TECTONIC AND BASIN DEVELOPMENT OF THE CENTRAL CALIFORNIA COASTAL AREA

Eli Silver
Associate Professor of Earth Sciences
and Marine Studies Committee
University of California
Santa Cruz, California 95064

When we talk about the problem of where oil ought to be offshore, or where oil ought to be anywhere, we need to think in terms of just a few basic ideas.

The first requirement of a potential supply of oil is some kind of a source. A source of hydrocarbons may be found in coastal upwelling regions along eastern boundaries of oceans, such as off California, or Western South America. Secondly, the hydrocarbons need to be stored in sediments in an environment where they will accumulate in large enough volume so that they can be extracted. And, thirdly, the hydrocarbons need to be buried or heated so that they become chemically altered into some type of oil that can be pumped from this reservoir rock.

There are other conditions that need to be met in order to have potential oil-bearing strata and perhaps one of the other speakers will go into these in detail. For example, the reservoir rock must be permeable so that the accumulated oil can be extracted at a rate fast enough to make it economically worthwhile. A cap rock must cover this reservoir so that the oil will not seep out prior to extraction. Also important is the correct structural geometry such as a nice pot-sized basin which facilitates oil accumulation, concentration and extraction. In addition, there

should be enough fluid pressure so that the oil will come out by itself once the cap rock has been drilled through and the viscosity of the oil should be relatively low so that the oil will flow without being heated.

In my talk I will attempt to identify environments in the central and northern California continental margin region in which there may be accumulations of organic-rich sediments. Organic-rich sediments accumulate in sedimentary basins and most basins need some kind of tectonic activity for their formation. I needn't review all of the possible kinds of tectonic activity, but I will refer to some of the kinds of activity that might be important in the formation of basins off the California coast.

Location of Major Offshore Sedimentary Basins

I assume that everyone knows that California is a tectonically active area. The state has numerous major and minor faults, of which the San Andreas fault is the most conspicuous and best known. The San Andreas fault, however, is a lateral fault. That is, the displacement is lateral along the fault, rather than vertical, and this movement does not result in the formation of sedimentary basins. Fault activity, to result in basin formation, must have sufficient vertical subsidence of an area to form a trough in which marine sediments can accumulate.

One can look on land and see where marine sediments have accumulated in basins, which now are uplifted on land. The central valley, for example, is a big marine basin which just very recently has become non-marine. There is (or was) lots of oil in specific regions of this basin.

What about the offshore area? I have analyzed offshore marine seismic reflection data which outlines the dominant structure of the continental margin. The California continental margin is characterized by the development of several large sedimentary basins. Most of these basins are bounded on one or both sides by large fault zones which are still tectonically active. All of the basins are bounded at least on the seaward side, by a marginal ridge or marginal uplift.

The large basins off California, from north to south, are: Eel River Basin off Eureka; Point Arena Basin north of Point Arena; Bodega Basin, offshore between Pt. Año Nuevo and Point Arena, bounded on the west by the Farallon ridge; Outer Santa Cruz Basin off the coast of Santa Cruz to Half Moon Bay, located west of the Farallon ridge and bounded on the west by the Santa Cruz high; Sur Basin, southwest of Point Sur; and Santa Maria Basin, south of Sur basin to Point Arguello. The Santa Maria Basin, bounded by the Hosgri and Santa Lucia Bank faults, extends onshore in the southern part. Bodega Basin extends onshore in the Santa Cruz mountains and Pt. Reyes region, and Eel River Basin comes onshore in the Eureka area. Minor oil extraction has been done in all of these basins onshore, of which the Santa Maria is most significant.

Geophysical Techniques Used to Detect and Study Offshore Basins

Earlier I made mention of seismic reflection data analysis and use of this data in identifying basin location and size. For this work a ship is used which tows a sound source. The sound can be created by a spark source, sudden release of air high pressure, or some other explosive source. The sound waves move through the water column. When they reach the sediment layer, some of the sound energy bounces off the sediments and these reflections are picked up by a string of hydrophones on

shipboard; much of the energy penetrates the sediments. At each sediment interface and between the sediment and bedrock interface, additional sound energy is reflected back and is detected and recorded on board ship. The sound waves can penetrate to great depths, depending on the size of the energy source. A small source doesn't give much penetration.

I won't go into more complicated techniques, but the oil companies have, for a long time, used sophisticated processing techniques with which they can greatly enhance their seismic signal returns. In some cases they can even "see" pools of oil and gas in the sediments.

With the seismic reflection tool we can determine the depth of the water column, the sea floor, and the depth of the sediments that overlie the basement material. Very little energy penetration occurs through basement material or older, deformed sediments. An active fault that extends through a basin can be detected as well as a domal uplift of basement type rock. It is an extremely useful technique.

Using the seismic technique the geologic profile of the Bodega Basin off of Point Reyes can be visualized. Here is a sequence of sediments over two kilometers thick. In this study a fairly low-energy sound source was used and we did not penetrate the sedimentary sequence down to the basement material. The sedimentary sequence here is relatively thick. This basin is bounded on the east side by a big fault and a smaller fault (with a granitic uplift) on the west side.

Moving farther south, I'll discuss two profiles across the Outer Santa Cruz Basin. This is the Santa Cruz High in the vicinity of the Farallon Ridge, which is underlain by granitic rock. In

this study, the sound source had more energy than that used in the Bodega Basin study. The sediments here are not quite two kilometers thick. Here and in the Bodega Basin we find sediment of sufficient thickness to be accumulating hydrocarbons and heating them up sufficiently to convert them into oil.

Another profile of the Santa Cruz Basin indicates a sediment thickness of almost three kilometers. I'm not convinced that this is really basement material here so that there may be even more sediment. Jim Taylor may have more to say about this during his talk.

The next seismic profile to be discussed will be across the Sur Basin in the area just south of Point Sur. In the outer ridge area the basement material is overlain by young, organic-rich sediments. Here the basement is about three kilometers in depth and it keeps getting deeper as we go closer to the coast. It is one of the thickest marine basins of sediment I have seen off the central California coast. It just thickens as you go towards shore, but none of these sediments occur onshore. On the coast one finds just metamorphic basement rock, the Franciscan formation of California. Close to shore is a fault with a very large offset.

In moving farther south of the Point Sur area, the sediment accumulation thins. There is little over a kilometer of sediment, but not much more. Continuing farther south, we find areas where the sediment accumulation locally thickens because of down faulting. In places there is a thin sliver of thick sediment accumulation; in another place there is a rather wider accumulation of perhaps from five to ten kilometers in width. Those are the only things we really look at as important for offshore oil. These sediments are in much too deep water to now drill for petroleum.

Moving still farther south in the vicinity of Santa Maria we find rather folded, contorted, and faulted sediments. Again, we find local moderately thick accumulations. In some places are small basins with extra thick accumulations.

The use of gravity, measuring the force of gravity over the entire continental margin, is another method, but less accurate than the seismic method, to measure sediment thickness and therefore to determine sedimentary basin location and size. Sediments have low density and basement rocks have high density. In looking for thick accumulations of sediment, one looks for regions where the pull of gravity is less than other places. Over the Sur Basin, for example, is a negative low measurement of gravity, a low gravity anomaly, which can be followed to the south over the Santa Maria Basin, where it is less intense. High gravity anomalies occur in the Point Arena area and offshore in the Santa Cruz High; between those gravity highs are areas of low gravity which are the basins that accumulate sediments. The use of gravity anomalies, therefore, is another way to locate sedimentary basins and to estimate sediment thickness.

Origin of California Offshore Basins

We now come to the last aspect of my talk, the age and timing of basin formation off the California coast. This subject might not be as interesting to you in terms of just the location of oil accumulation, but in terms of how and why basins form, this information is really critical.

The usual way to date the timing of basin formation is to drill cores into the sediment and date them by the use of fossils. Sediment cores are taken back to the laboratory where the plant and animal fossils are separated from the sediments. The fossils are then identified. Accurate identi-

fication is important because each species lives for a relatively restricted time period. The age of the basins that the Shell Oil Company has determined as a result of drilling in each of these basins along the California continental margin is in the order of ten or twelve million years old. That is, all of these basins started forming, or at least their western margins started uplifting, as discrete, mappable basins about ten or twelve million years ago.

A related question is: what happened during that time to initiate basin formation? What may have happened during that time period really is unknown with certainty and is difficult to reconstruct with absolute certainty. The tectonic history of California is so complex that it often is difficult to separate events in time without taking a broader look at the tectonic events of the whole world. In this case, it is easier to understand what is going on locally along the California coast when one studies and understands world-wide tectonic processes.

The concept of plate tectonics is now central to our thinking. There is a growing body of evidence that most of the tectonic movements everywhere around the world take place along very narrow boundaries of rigid units called plates. The plates are regions in which there is a relatively low level of tectonic activity, practically no faulting or earthquakes. The places of intense activity or movement occur along these plate boundaries. California is along one of these boundaries between two plates, the North American and the Pacific plates.

It would be very difficult to answer the kinds of questions that I am asking by looking only at California, although we should be able to do that in time. An easier way is to go around the world and determine how the continents have been moving over differ-

ent periods of time. We can do that by looking at boundaries between plates which have been pulling apart, where new crust is being created. This procedure gives us an easily readable record of how each of these plates has moved during any time period over the last 40 or 50 million years. So, if we want to know what the history of movement has been in California, between the North American and Pacific plates, we can go around the world and look at the history of opening between the Pacific and Antarctic plates, between the Antarctic and Indian plates, between the Indian and African plates, and between the African and North American plates. When these movements are summed the movements between the Pacific and North American plates become apparent.

The results of such an exercise, focusing on the last 20 million years of California history, indicates the following: (1) a change in rate of tectonic movements in California and, (2) a change in direction of the movements between the Pacific and North American date around 10 million years ago. The dates cannot be precise because of the procedures used.

(1) Atwater and Molnar compared the plot of plate displacement versus age in the California region obtained on a world-wide scale. They found considerable displacement over the last ten million years, a fairly short period of time in a geologic sense. During the last ten million years tectonic movements have been fairly rapid. The rate of activity was a lot slower from about 10 to 25 million years ago.

Researchers at Stanford and UC Berkeley, in painstaking work, looked at offsets along the San Andreas Fault over time. They found essentially no offset along the San Andreas Fault prior to 20 million years ago. From 20 to 10 million years ago, the offsets were at a slow rate. The rate of offsets have ac-

celerated considerably during the last ten million years. Thus, the speed of offset for both the San Andreas Fault and the plate boundaries has been accelerating. The two curves of plate boundary displacement and of San Andreas Fault offset are not the same, however, because the plate curve represents total displacement between someplace in the middle of the Pacific and the middle of North America over that time period; whereas, the fault offset curve represents movements along only the San Andreas Fault. The San Andreas offsets take up a little more than half the total movement of the plate boundaries if these curves are correct.

(2) There has been a change in direction along the plate boundaries in the last ten million years. I went through the exercise of summarizing world-wide data for this time interval. I found that prior to ten million years ago the dominant direction of movement between the Pacific and North American plates was more northerly than it is today, sort of along the direction of the San Gregorio Fault and the Santa Lucia Bank Fault. From about ten million years ago to the present, the direction of tectonic movement changed and is now essentially parallel to that of the San Andreas Fault in central California. Movement directions changed from more northerly to more northeasterly. My hypothesis is that if the data is correct, at about ten million years there was a time when all of these major faults underwent a component of extension--and here's where I go out on a limb. The plates which were moving laterally past one another then began to move in another direction, which gave a component of opening. This component of opening could have split the crust and popped all these basins--pop-pop-pop-pop--all at once, resulting in the development of the sedimentary offshore basins about ten to twelve million years ago.

QUESTIONS

Question. Does the pressure of water overlying the sediments play an important role in increasing the fluid pressure of the oil in the ground?

Response. Yes, that is a good point. To date most drilling has been in fairly shallow water and I don't think that the pressure effect is that much different. In these waters and on land, pressures develop by sufficient burial of the oil-bearing strata and the capping off of the reservoir so that petroleum cannot escape. The more sediments deposited on top, the more pressure builds up. In deeper water, the weight of the water column is an additional factor.

Question. Where does the organic material come from? Are rivers important here?

Response. Organic material comes from many sources--from rivers, plankton falling out of the water column, setting out of muds and sediments. A basin structure is needed for accumulation.

Question. Do seismic surveys result in fish kills by the explosives?

Response. I wouldn't like to be right at the spark. The bigger organisms--you set the spark off every four seconds--certainly hear it coming and I don't think it does much damage to them. I have never seen fish kills behind one of our seismic operations. However, I have been told that a fish kill wouldn't be seen anyway because dead fish sink to the bottom. I don't think it really has much effect on the bigger fish because the discharge is so frequent that they are warned and get away. To plankton, and things of that sort, it could be locally disastrous.

Question. How deep can you see with seismic methods?

Response. It would just depend upon the amount of energy you used. In the Amchitka nuclear device explosion the explosion was heard all the way around the world. The depth that can be seen is totally dependent upon how much energy is used.

ESTIMATING POTENTIAL OIL RESOURCES

IN THE CENTRAL CALIFORNIA COASTAL ZONE

James C. Taylor
U.S. Geological Survey
Menlo Park, California

Before beginning the main part of my talk I would like to draw your attention to the number 6. Six what? Six giga-B's. Now you may not know what a giga-B is for it is not in my dictionary either. But a giga is a billion, "B's" stands for barrels, and six giga-B's or 6 billion barrels is an important figure because this is our yearly consumption of oil in the U.S. Six giga-barrels a year, which is roughly 16 1/2 million barrels a day.

In my presentation, I plan to outline some of the major factors that control oil accumulation in basins. Some of these factors we understand fairly well. Others, we don't know as much about. I will quickly go through these and then relate them to the offshore basins in central and northern California. I will then present some petroleum production statistics for California and the U.S. At the end of the talk we will get back to "6 giga-B's."

Oil Accumulation in Basins

The central and northern California offshore area, from Point Conception to the Oregon border, consists of about 25,000 square miles (Fig. 1) extending to the base of the continental slope. Note the narrow area that extends from the coastline

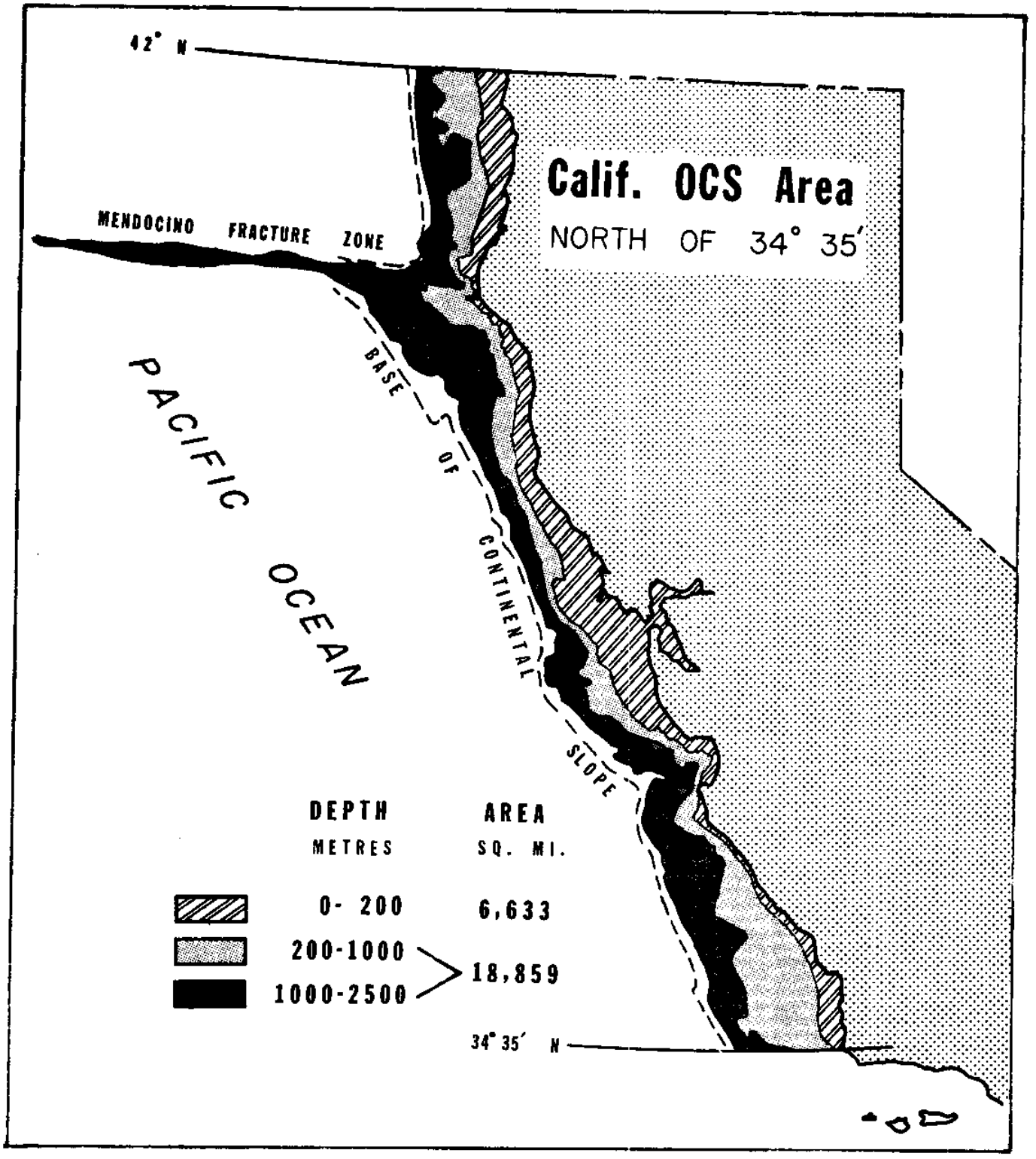

FIGURE I. THE OUTER CONTINENTAL SHELF AREA OF NORTHERN AND CENTRAL CALIFORNIA NORTH OF 34° 35' WITH AREAS TO 200 AND 2500 METRES IN SQUARE MILES.

to the 200-metre depth (660 feet). This 200 metre depth is greater than any of the oil-producing platforms that are now in existence in any of the seas throughout the world. Exxon is currently building a platform for the Santa Barbara Channel to be placed in 850 feet of water, which will be the tallest offshore platform by several hundred feet of any that now exists. The area out to the 200 metre depth is closer to the shoreline in some areas than in others, and it will be in these areas where exploration and development will first take place. The deeper the water, the more expensive and technically difficult are exploration and development.

From north to south there are a number of sedimentary basins, including the Eel River Basin, the Point Arena Basin, the Bodega Basin, the Outer Santa Cruz Basin, and the Santa Maria Basin (Fig. 2). In southern California there is the Santa Barbara Channel and borderland. In evaluating the petroleum potential in frontier areas we first look at the size of each basin. Those in the central and northern California coastal area total about 13,700 square miles, or a little over half of the 25,000 square mile total OCS area out to the base of the continental slope.

Several major factors control oil accumulation. Each of these, in turn, can be subdivided into categories, such as (1) the thickness and volume of sediments; (2) the type of sediments and their potential as source and reservoir rocks; (3) the tectonic history during and after sedimentation and; (4) the presence of traps. Many of these parameters are fairly well understood onshore where we have more information. But let's look at these factors in these offshore basins.

First, the thickness of the basin sediments must be

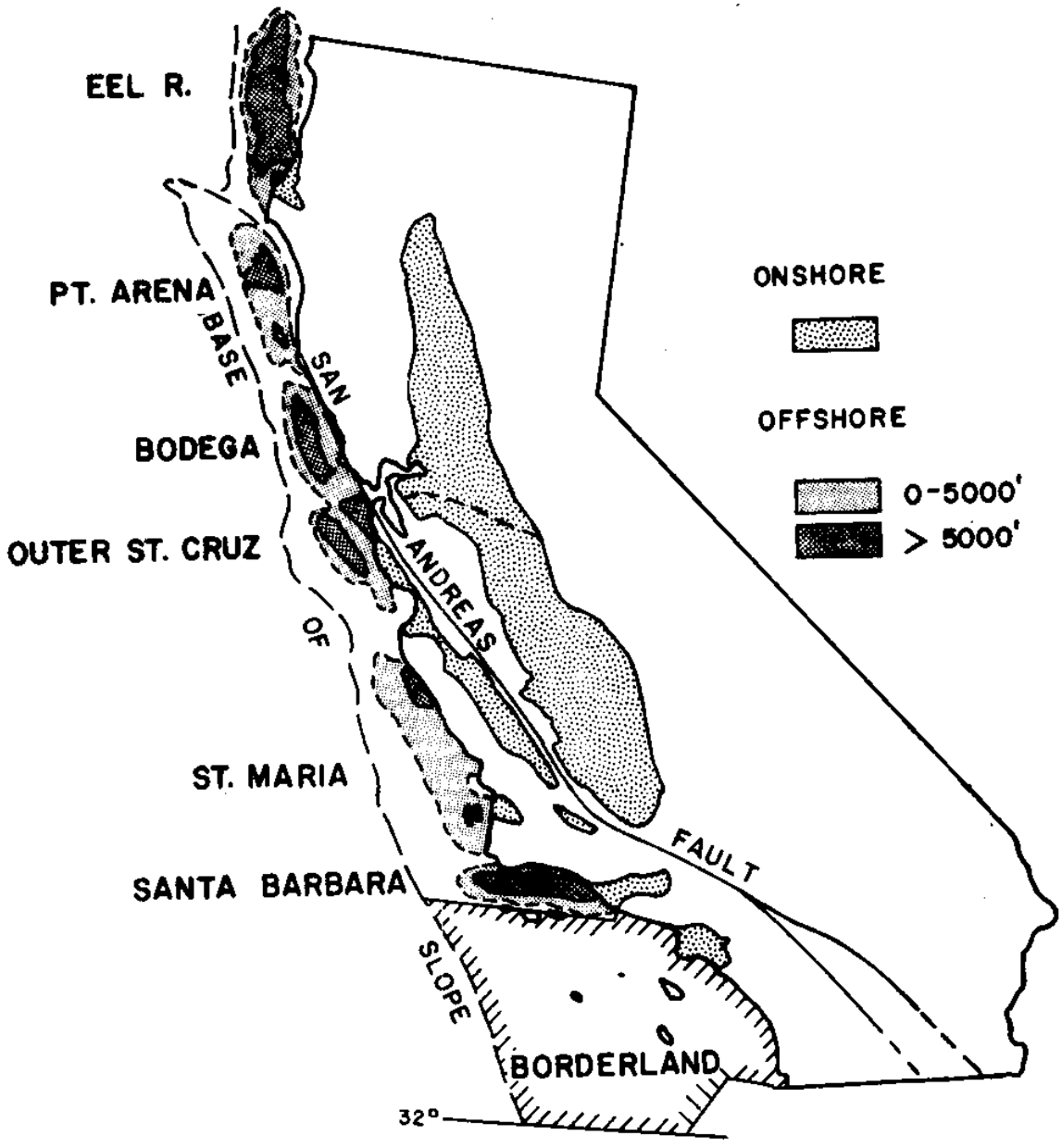

Figure 2.—Upper Tertiary onshore and offshore basins of California.

determined. This is important because the volume of the sediments within an offshore basin can then be compared to onshore basins, especially those with oil reserves. This is arrived at by geophysical means (as described by Eli Silver, in this symposium) and is confirmed by exploratory wells that penetrate the sedimentary section. Only a few small pockets in each of these offshore basins contain late Tertiary deposits thicker than 5,000 feet. This is an important factor when compared to the more than 20,000 feet in the three major onshore producing basins.

We need to determine the extent and types of tectonic movements that occurred during and after sedimentation. Within these basins environments are needed that will allow the deposition of organically rich source rocks and reservoir rocks to hold the oil. A favorable history and stratigraphic relation are needed between the source rocks and the reservoir rocks. We would like to see a moderate rate of sedimentation, not too rapid and not too slow. Tectonic activity often results in unconformities, and these should be geologically timely and must be favorably located within the particular basin. One factor, which is not a problem with our California basins, but is in other parts of the world, is that we don't want to see basins being flushed with fresh water. Lastly, we would like to see the basin sediments protected in part (preferably the entire basin) from later uplift and erosion or intense tectonic activity which may destroy any oil accumulations that have occurred.

An adequate supply of organic material in the sediments is essential to petroleum development. Organic material has

to be deposited and buried in a nondestructive environment. It must not be an oxidizing environment or an environment in which bacteria destroys the organic material before it gets buried as a potential source rock. The oil industry has developed criteria for identifying what might be potential source rocks. Those with less than 0.4% organic carbon content are not considered rich enough to be potential source rocks, but those with greater than 5% organic content are excellent potential source rocks. This organic material needs to be transformed into hydrocarbons. Two major controlling factors in the generation of petroleum are temperature and time. Since temperatures increase with depth in the earth's crust, source rocks need sufficient burial before becoming petroleum. The degree of this maturity of organic material can be evaluated by various methods. Geochemists can remove the extractable hydrocarbons, measure the amount and examine its characteristics. Palynologists, looking at pollen grains, can determine the degree of maturity by the darkness of the pollen grains. During transformation, pollen grains change from nearly colorless to pale yellow, orange, and finally to black when the matter has has been completely carbonized. Another method is vitronite reflectance, a technique first used in coal research. Organic material is extracted from shales, compacted, polished, and then the amount of light reflected from this polished surface is measured. This indicates the degree of transformation (maturity) of that particular organic material. Pyrolysis of the organic matter in the rock is another technique. All of the standard methods help to determine whether the organic matter is mature enough to have generated oil or gas.

Petroleum, once generated, tends to migrate and often gets trapped in a reservoir. The reservoir rock of course must be porous. A good reservoir sand, for example, will have

a porosity of about 20 percent. We would like to know from what kind of terrane these sands were derived. Rocks derived from a volcanic terrain generally make poor reservoir rocks. Their mineralogic components are of such a nature that once they are buried, they are subjected to alterations which destroy their porosity. Good reservoir sediments come from granitic terrane or a mature terrane high in quartz or quartzose material. Another favorable factor is large fairly thick lenses of sand. We have to know something about the geologic history of a basin to see whether such things do exist and, of course, we eventually have to drill to define some of these particular parameters.

The spatial relation of reservoir rocks to source rocks must be determined. The source beds should be either laterally equivalent to or below the reservoir rocks. It is important that sediment deposition occur in an environment which has a high enough energy to separate the muds from the sands, resulting in clean sands and porous reservoirs.

Traps and impermeable seals must be developed above the reservoir rock so that the oil or gas does not escape. In California these are shales and shaley siltstones. Traps are of three types, the anticline trap, the fault trap, and the stratigraphic trap. Particularly in our California basins, and also on a worldwide scale, the anticlinal trap holds the vast majority of the oil. It is also the easiest for the geologist or geophysicist to find.

Timing of this oil generation and its migration in relation to basin history is important. Were the structural traps present before the oil was generated and migrated? Favorable

traps that contain no oil often are known to have formed after the oil had already migrated.

These are some of the major factors that must be determined in order to estimate potential oil resources in the offshore, or in any new frontier basins. We are only beginning to understand some of these factors in the central and northern California offshore basins.

Basin Oil Potential

Because of our gaps in understanding basin structure and history, we cannot yet predict which offshore basins of central and northern California do or do not have oil in commercial quantities. As we expand our knowledge in these frontier areas we can compare them to well-known, well-explored, and well-developed onshore basins. The more we know about each offshore basin, the easier it will be to pick the right onshore analog for comparison, and more accurately estimate its petroleum potential.

In this regard it is certainly important to look at the oil production in California's basins. The total cumulative production in California has been almost 21 giga-B's of oil (Fig. 3). Most of this, in turn, has come from two major basins, the Los Angeles Basin (about 7.7 giga-B's) and the San Joaquin Basin (about 8 giga-B's). Production from the other basins is much lower: the Ventura Basin with 2.6; the Sacramento Basin, which has no oil, but the gas has a 0.9 giga-B's energy equivalent. The Santa Maria Basin, of about 0.7 giga-B's, which does have an offshore equivalent in central California. There are also smaller basins of less significance.

Many dissimilarities exist between the Sacramento-San

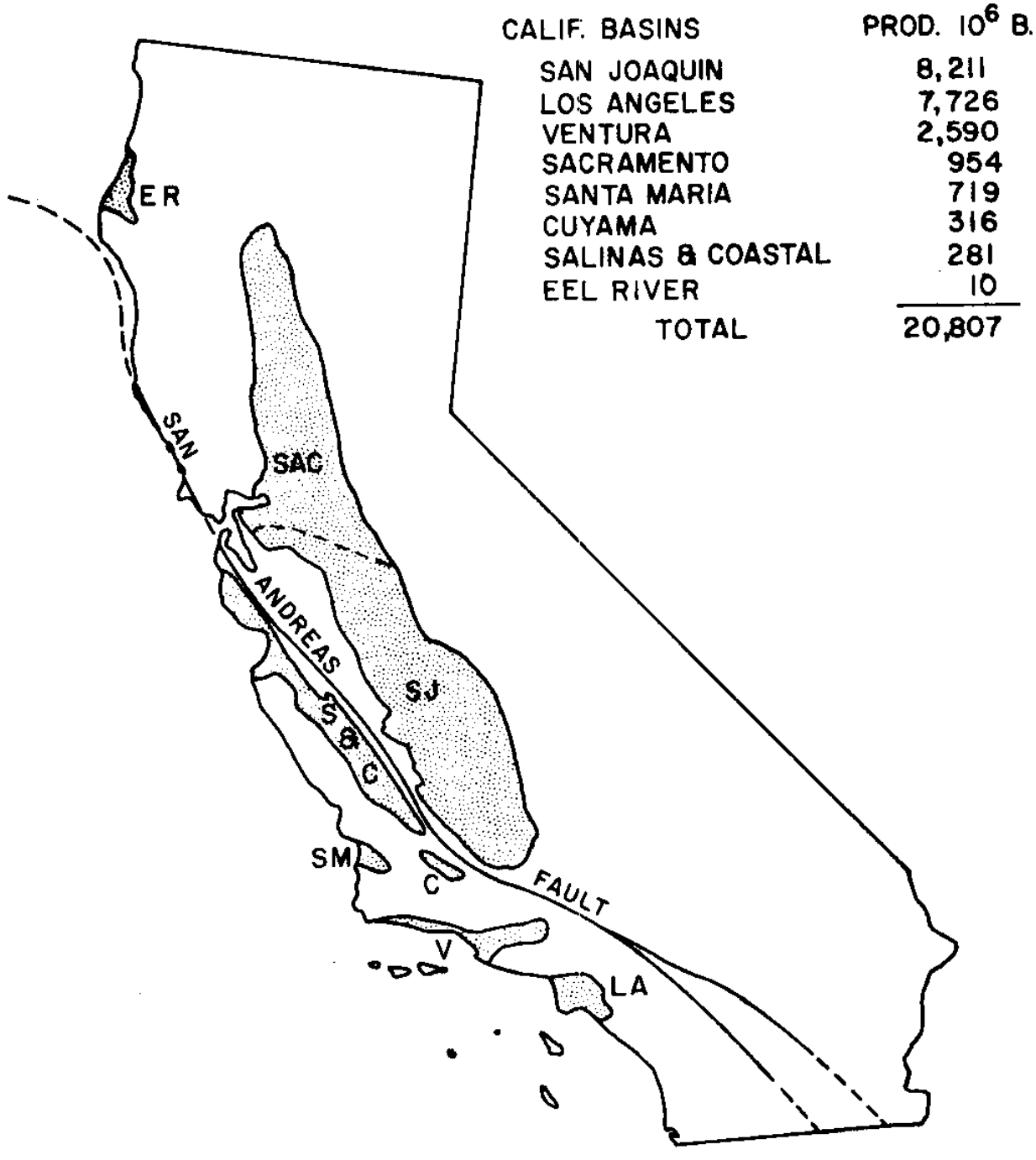

Figure 3.— Cumulative production of oil and gas in California basins

Gas converted to oil as BOE (Barrels Oil Equivalent on approximate BTU energy equivalent of 6,000 cu ft equal to one barrel of oil).

Joaquin basin and offshore ones. We should, therefore, compare our offshore basins to those coastal basins which are west of the San Andreas fault. These include, from south to north, Los Angeles, Ventura, Santa Maria, Salinas Valley and a few other small coastal basins.

Eighty-five percent of the oil production in these onshore coastal basins has come from middle Miocene or younger sediments. There is a direct correlation between the amount of petroleum reserves in these basins and the richness of the organic matter in the source rocks. From work done in offshore southern California by the U.S. Geological Survey we find that these same middle Miocene and late Miocene Sediments contain about 5 percent by weight of organic carbon. These are classified as potentially excellent source rocks. This same organic richness is found in the producing basins onshore. The U.S. Geological Survey does not have such data for the offshore of central and northern California. We have ongoing research in this region and hope to obtain these data in order to evaluate this parameter. It is also important to learn whether the early Tertiary sediments, in southern California and here in northern and central California, are as organically rich as Miocene sediments.

The oil industry has carried on studies in the offshore coastal basins in central and northern California over the past 15 to 20 years. Much seismic work was done during the late 1950's and early 1960's preceding a 1963 government lease sale by the Bureau of Land Management in central and northern California. A large amount of the offshore was offered for leasing and for exploratory drilling. Subsequently, between 1963 and 1965, 19 deep exploratory wells were drilled some of which reached basement rock. Although few interpretations and conclusions

have been released by industry, well histories and logs and a few publications are now available. One paper in particular is pertinent. This is an article by Hoskins and Griffith in the American Association of Petroleum Geologists Memoir 15, published in 1971. It gives a very good account of the drilling activity in these particular basins.

Four wells were drilled in the Eel River Basin. The area available for leasing was north of the town of Eureka. The government did not lease the area directly west of Eureka because of concern about shipping even though this area was known to contain some good structures. Most of the leasing was in the central and northern part of the Eel River Basin and in less than 200 metres of water.

The next basin to the south is the Point Arena Basin where three wells were drilled fairly close to shore. There are some very minor oil or tar sands on or near Point Arena. The results indicate that this basin is fairly shallow and geologically young.

The Bodega Basin, a basin that industry thought had excellent prospects, had nine wells drilled on major structures. There were only a few oil shows.

The next major basin is the Outer Santa Cruz Basin where two wells were drilled. This basin trends southeasterly towards Monterey Bay but is separated from it by the San Gregorio fault. The basin east of the San Gregorio fault is considerably shallower than the offshore basin to the west.

The most southerly basin is the offshore equivalent of

the Santa Maria Basin. Only one well was drilled in this basin. Again, the area which might be of most interest directly offshore from the onshore basin, was not put up for leasing, mainly because of the proximity of the Vandenberg Missile Base. There was no drilling in the northern half of this basin (the part that Eli Silver referred to as the Sur Basin).

What do we now know about the petroleum potential of these basins? Are there any oil seeps? There are abundant oil seeps in Santa Barbara Channel and Santa Monica Bay. On the other hand I know of no offshore oil seeps in central and northern California. We know quite a bit about the areal extent of these basins. We now know something about their stratigraphic sequence, not only from seismic profile studies, but also from these 19 wells. We know that the sediments in the basins are generally thin, although there are some areas where thicknesses locally exceed 5,000 feet and occasionally 10,000 feet. We find that there are only a few good reservoir-quality rocks in the wells that were drilled.

In evaluating the data it is important to realize that the 19 wells were all drilled by industry on the most favorable structures that they had identified. This is an important point to be kept in mind during discussions of oil potential. Let me emphasize this point by the following example: in the Los Angeles Basin the seven largest fields account for 75 percent of the oil production for the entire basin (Table 1). There are something like 60 fields in the basin, but these seven have accounted for 75 percent of the oil. In these offshore basins, industry is interested in finding large accumulations and will explore the most favorable areas first. The economics of offshore exploration and development are such that large accumulations are essential to make it economically worthwhile.

7 LARGEST FIELDS, LOS ANGELES BASIN

	Cum. oil + BOE (1-1-74) 10^6 bbls.	Cum. % of total basin	Structure Trap
Wilmington	1,776	23.5	A
Long Beach	1,057	37.5	A
Huntington Beach	1,034	51.1	A
Santa Fe Springs	740	60.9	A
Brea-Olinda	409	66.3	Flt. H.
Inglewood	332	70.7	A
Dominquez	320	75	A
Others (53)	1,893	25	
Total (60)	7,563	100	

13 LARGEST FIELDS, SAN JOAQUIN VALLEY

	Cum. oil + BOE (1-1-74)	Cum. % of total basin	Structure Trap
Midway-Sunset	1,278	15.8	Reg. H, w/ A, U. fr. sh.
Kettleman	922	27.2	A
Buena Vista	760	36.6	A, Perm., fr. sh.
Coalinga	664	44.8	A, S, tar
Kern River	608	52.3	H
Coalinga, East	514	58.7	A, Perm.
Elk Hills	325	62.7	A
McKittrick	225	65.5	Flt. A, H
Belridge, South	190	67.8	A
Coles Levee, North	180	70.0	A
Mt. Poso	166	72.1	Flt. H
Belridge, North	156	74.0	A
Cymric	146	75.8	Flt. A
Others (104)		24.2	
Total (117)	8,088	100	

9 LARGEST FIELDS, VENTURA BASIN

	Cum. oil + BOE 1-1-74 10^6 bbls.	Cum. % of total basin	Structure Trap
Ventura-San Miguelito	1,194	46.1	A
Rincon	150	51.9	A
So. Mountain	124	56.7	A
Elwood	118	61.3	A
Dos Cuadros	95	65.	A
Newhall Potrero	83	68.2	A
Saticoy	75	71.1	H, strat.
Aliso Canyon	67	73.7	A
Carpinteria	47	75.5	A
Others (104)	635	24.5	
Total (113)	2,588	100	

7 LARGEST FIELDS, SANTA MARIA BASIN

	Cum. oil + BOE (1-1-74) 10^6 bbls.	Cum. % of total basin	Structure Trap
Santa Maria Valley	191	26.6	H, fr. sh.
Orcutt	171	50.4	A, fr. sh.
Cat Canyon, West	151	71.3	A, fr. sh.
Lompoc	47	77.8	A, fr. sh.
Gato Ridge	39	83.2	A, fr. sh.
Cat Canyon, East	34	88.0	A, fr. sh.
Casmalia	33	92.6	A, fr. sh.
Others (12)	53	7.4	
Total (19)	719	100	

TABLE 1. LARGEST FIELDS IN 4 MAJOR OIL PRODUCING BASINS IN CALIFORNIA, WITH CUMULATIVE PRODUCTION IN MILLIONS OF BARRELS OIL PLUS GAS* TO 1-1-74 AND TYPE OF TRAP

*Gas as BOE, barrels oil equivalent, converted on approximate BTU energy equivalent, 6,000 cu ft gas to 1 barrel oil.

A = Anticline; H = Homocline; Flt. = Faulted; U = Unconformity; Reg. = Regional; S = Stratigraphic; fr. sh. = fractured shale; Perm. = Permeability

What kinds of traps do we find in these productive fields in onshore basins? In the Los Angeles Basin all but one is an anticline. The exception is a faulted homocline. These particular types of traps would be fairly easy to identify offshore using present seismic techniques. In the Ventura Basin nine of the largest fields make up 75 percent of the total production (Table 1). Again, all but one of the structural traps are anticlines. In the San Joaquin Valley, although this area is not a good analog for these offshore basins, 13 of the 117 fields account for 75 percent of the oil. Here the traps are a little more complicated. Most of them are anticlines, but there are also some homocline and permeability traps. The Santa Maria Basin is a fairly small producing basin. Here four fields account for 77 percent of the oil that has been extracted. Most of these fields have faulted and fractured reservoirs and are anticlinal traps. About 60 to 70 percent of the production from the Santa Maria Basin has not come from sand (which is the typical reservoir in California) but from fractured shale. Fractured shales are very abundant onshore, but there are a lot of production problems in extracting the oil. Although the cumulative oil produced has been fairly high (some fields have produced 100 or more millions of barrels of oil), it would be difficult and perhaps uneconomical to produce some of these fractured shale fields if they were found in the offshore.

As a general prediction we might say that the prospects for large oil reserves in these offshore basins in central and northern California are fairly poor. This is reflected in the low (16 out of 17) ranking of this area in the Government's list for leasing. There are some people who then say: "Well, why even bother?" I think the answer to this lies in the fact that we are really in a very precarious national energy situation. This situation should not be underestimated. Here is

where we come back to the 6 giga B's. Within California, up to January 1, 1974, we have produced approximately 16 1/2 giga-B's. The proven reserves are 3 1/2 giga-B's. Note that the proven reserves represent just a little over half of the nation's annual consumption. We are going to have to do something about energy in the next 10 or 20 years for our nation to survive. For that reason, if there is any oil out there and someone is willing to take the risk to find and extract it, we should let them go ahead and do it.

In closing I would like to mention that the U.S. Geological Survey has recently completed a nationwide study of the remaining oil reserves in the onshore and offshore United States. This has been a careful, well-documented review that covers more than 100 provinces. There were over 70 experts involved in this study; in the review process they applied several types of resource appraisal techniques. They then followed this with a group appraisal in which objective probability procedures were applied. The results published in U.S. Geological Survey Circular 725 indicate that the proven reserves amounts to 62 billion barrels. The potential recoverable but as yet undiscovered reserves are estimated to be about 82 billion barrels. If we continue at our present consumption of 6 billion barrels (giga-B's) a year, this amount won't last long.

OFFSHORE PETROLEUM EXTRACTION

AND ONSHORE FACILITIES

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I would like to describe the technology and operating procedures used to explore, drill and produce offshore oil and gas and the siting of an onshore support facility. Then I'll open the floor to questions, and we can talk about the situation from an oil company's viewpoint.

Petroleum Extraction

Offshore oil and gas drilling and producing activities are widespread and well developed. Exxon has been operating offshore since at least World War II. Numerous offshore wells have been drilled--about 18,000 worldwide. The offshore area presently accounts for some 20%, more or less, of both the free world and the United States' oil production.

In the United States about 10 million out of some 275 million prospective offshore acres have been leased. Offshore production totals about 1.6 million barrels of oil and some 7.1 billion cubic feet of gas per day. Worldwide there are some 300 rigs currently active offshore. About 90 of these are in American waters.

Most of the offshore domestic activities I have cited are off Louisiana, where about 25% of the continental margin

has been leased. Production is being undertaken as far as 125 miles from shore and in water depths in excess of 375 feet.

There are some 600 platforms off Louisiana. Fourteen or fifteen thousand wells have been drilled, and they account for a large portion of the United States' offshore production.

In California, most of the offshore activity has been in the Santa Barbara Channel area. There are some 14 platforms in the Santa Barbara Channel. Most of these are in state waters close to shore, but there are 6 or 7 in federal waters towards the northeast corner of the channel. In 1968, most of the channel was opened for leasing. The industry took several hundred million dollars worth of leases. Exxon, for example, paid the federal government $219 million in bonus for the rights to explore.

In typical offshore operations, prior to leasing, geophysical activity such as was described by previous speakers, usually is undertaken. Leases, blocks normally nine square miles in area, three miles on a side, are offered by the Department of Interior. These are leased to the highest bidder with the government reserving a one-sixth production royalty. Leases on particular tracts in a few instances have run as high as a hundred million dollars. This is a very competitive business with high stakes. Exxon, as previously mentioned, spent $219 million for Santa Barbara Channel leases in 1968; to date, we have had no production to pay off any of this investment. In the meantime, we have spent about 100 million additional dollars in drilling exploratory wells.

In shallow water--out to 300 feet--jack-up rigs are often used for exploratory drilling. These are mobile drilling rigs

that float to location. The legs are lowered onto the ocean floor and elevate the rig out of the water. Once in the elevated position, the rig proceeds to drill the well. Upon the completion of drilling, even if we find something, the well drilled with the mobile rig is either temporarily or permanently abandoned, and the rig moves off to another location. These rigs, thus, are used only to find new deposits or define the extent of deposits.

In deeper water, mobile floating drilling rigs are used for exploratory drilling. One type is known as a semi-submersible. It floats on location, and the buoyancy chambers are placed below wave action so that the vessel doesn't move very much in high waves. It has good motion characteristics and provides a stable work platform.

We also use floating drill ships. In the Santa Barbara Channel, Exxon has drilled some 44 wells from floating vessels on the acreage that was acquired in 1968. We have drilled numerous wells in water depths over 500 feet and some in water out to 1,500 feet.

Protection of the environment is provided on floating rigs by a sub-sea blowout preventer. This equipment is set on the ocean floor. It is 40 or 50 feet tall. When a problem occurs in the well, the blowout preventer squeezes around the drill pipe and closes the well off to maintain control of the well and prevent spillage. To my knowledge, in drilling several thousand wells from mobile rigs, there has never been a significant pollution problem of any kind.

Once a petroleum deposit is discovered and confirmed to be big enough to be of commercial value, a platform is

utilized for development of the field. A drilling rig is placed on the platform with which a number of producing wells may then be drilled. These are directional wells that go out at an angle, allowing a large area of perhaps a mile or a mile and a half radius to be developed from one platform. There may be one or two platforms with 30 or 40 wells on them, although ten, twelve, eighteen or twenty-four wells per platform is more common.

In the Santa Barbara Channel, Exxon presently is building a platform to be located in 850 feet of water. The underwater part is almost equivalent in height to the Empire State Building. Platforms are attached to the ocean floor by large diameter pilings. For the Santa Barbara platform there will be twenty 54-inch piles driven 300 feet or so in the ocean floor.

Shallow-water platforms are fabricated at an onshore construction yard, placed on a barge and towed to location. At location, the platform is launched from the barge into the water. Then it is up-ended and installed using derrick barges. Platforms of this type have been installed in the Gulf of Mexico in water depths up to 375 feet and in the North Sea in depths up to about 550 feet. As mentioned earlier, the one we have planned for the Santa Barbara Channel, and are now building, will go in 850 feet of water. Current platform technology is good to water depths of at least 1,000 and perhaps 1,200 feet--just larger structures need to be constructed.

Our Santa Barbara Channel platform will be fabricated in one piece and then cut in two for transportation to the site. It will be placed in the water, joined together, up-ended and then piles will be driven. Once the platform is installed and the wells are drilled, we are ready to commence production.

A large number of safety devices on the platform and in the well are used to minimize the possibility of any spill incident. For example, probably the key safety device is the subsurface safety valve, installed in the well down below the mud line. In the event of a problem of any kind, it will be automatically closed from the surface to prevent any fluid or gas from coming out of the well. There is a similar device on the wellhead. All of the vessels and storage tanks have what we call drip pans under them to collect oil from any minor leakages. We are equipped with fire protection and prevention systems. The pipelines going to shore have automatic shut-off valves.

The subsurface safety valve may be a ball-type valve. It is held open by hydraulic pressure from the surface. Automatically--or manually, if the operator so desires--a decrease in hydraulic pressure closes the valve and shuts in the well. The surface safety valve operates in a similar manner in that there are sensing loops tied to high and low pressure sensors on all the tanks, to high levels in the tanks, and to high pressures in the flow lines. Any time a control condition gets out of range, the well is automatically shut in at the wellhead.

Once production is established, the petroleum may need to be processed. By processed, I mean that the oil and the natural gas which comes along with it may need to be separated. The oil may have water in it. This water needs to be removed. The natural gas may have impurities which need to be removed and this requires processing. Processing often results in the need for an onshore facility.

Siting of Onshore Support Facilities

The technology of petroleum processing is such that

usually there is no need to develop processing facilities in environmentally sensitive areas, such as along scenic highways. An excellent case in point is the recent referendum vote in Santa Barbara County which involved a change in zoning to permit Exxon to develop a petroleum processing facility on land that the company owns. We did have an alternative to this onshore facility. Our platform will be in federal waters beyond the 3-mile limit. If we had been unable to come to shore, we could have utilized a floating vessel that would have separators and other equipment on it. The vessel would also serve to store the oil. If we had had to use this procedure, the vessel would have been permanently moored outside the 3-mile limit and periodically a coastal tanker would have come up alongside to take the oil to refineries either in San Francisco or in Los Angeles.

The alternative we proposed was to bring oil and gas production to shore and do the processing there. We own a 1,500-acre site which extends from ridge-line to ridge-line in a canyon and from the coast to about 1.5 miles inland. The main canyon that opens to U.S. Highway 101 is Corral Canyon.

The specific area for facility development is a fifteen-acre site near the top of the property. This site is 1.3 miles inland from the highway in Las Flores Canyon, a dry tributary of Corral Canyon. Here water will be separated from the oil, and impurities would be removed from the natural gas. The ability to supply natural gas, I believe, was one of the key features that led the county to vote in favor of the zoning. Natural gas is in short supply locally. We would not have been able to make the natural gas available to market without pipelines coming ashore.

The other approximately 1,485 acres of our tract will serve

as a buffer zone to help ensure that no problem is created off the property. We will have ambient air monitoring at the property line. We will monitor for odors and several other conditions. If we violate any of some 73 ordinance conditions that were imposed on us by the county, the county has the right to shut us down. The 15-acre facility site cannot be seen from the highway, and it will not cause any kind of offsite problem.

New Technological Developments

I might take just a second and talk about some of the new technology that is coming on.

As I mentioned, current platform design is good perhaps to 1,000 or 1,2000 feet of water. To go beyond that, new technology is needed. One type of structure that we are testing is a guyed tower that has 20 or 30 large diameter cables attached to it to help withstand the wave action, etc. This might be good to 1,800 feet or so. In water deeper than this we will need a subsea system.

Exxon is presently testing a system in the Gulf of Mexico that we anticipate will have applications. This system has the wellheads, valving, and pumps on a subsea unit that is on the ocean floor. The wells are drilled through this unit from a floating vessel. The production is routed to a nearby platform, to shore, or perhaps to a buoy to which tankers could tie up in order to take on the crude oil. The facility would be operated electronically by remote control. If a valve or a piece of equipment were to go bad, we would replace it using a manipulator that can be lowered on a cable from a small boat. This type of system would be good to depths of at least 3,000 feet. We started installation of a three-well test system about the first of the

year. We have now drilled the wells and within the next month or six weeks we will initiate production.

QUESTIONS

Question. Is drilling in deep water more risky than in shallow water due to the high pressure formations being closer to the surface?

Response. Not really. Someone earlier raised the question about pressure gradients. Normally, and it varies somewhat, the gradient, going subsurface, is about .456 pounds per foot of depth, which is about a sea water gradient. Even in deep water this is the pressure gradient we usually encounter. For example, at 10,000 feet the bottom hole pressure might be 4,600 pounds. While there are exceptions, we usually run into about the same pressure in shallow water as in deep water.

Question. Why haven't you used ocean floor systems to eliminate unsightly rigs from view?

Response. There are two or three reasons. One, the technology is just now emerging fully. There have been a number of individual wells utilized, but technology for multi-well systems is just coming on. Two, subsea systems really aren't the final answer to aesthetics in that the wells in this system will have to be drilled with floating vessels or rigs, which may be moored there for several years to do the drilling. Also, even after the wells are drilled, service vessels, etc., will be in position over the subsea system a large portion of the time. So the subsea system necessarily does not completely eliminate visibility. Platforms will also be needed to serve as a base for operations. Equipment visibility may be reduced in later life when as much drilling isn't being

done but subsea systems don't solve the visibility problem and they are quite a bit more expensive by a factor of 2 or 3 to 1.

Question. Do you use divers, offshore? How much in deep water?

Response. Yes, we utilize divers somewhat. Divers are very expensive on large, complex jobs. They can effectively do specialty work. In the 44 wells that we have drilled in the Santa Barbara Channel, we have not utilized a diver. We do use divers quite often to install pipelines and that sort of thing. Further, as a matter of economics, diving capability exists to at least 850 to 1,000 feet of water, but to accomplish an hour's work at these depths might cost several hundred thousand dollars in support equipment, decompression time, etc. In shallow water, say 50 feet, where a diver can quickly bounce down and do his work and come back up without too much decompression time, we use divers quite often.

Question. Aren't offshore wells really risky in terms of oil spills and pollution?

Response. I don't think that this is a problem. Industry has drilled some 18,000 offshore wells and, depending on what you want to call a problem, 3 or 4 may have been a problem at one time or the other. In only one instance has the industry ever had a major spill that got significant quantities of oil to the beach. Unfortunately this was the spill at Santa Barbara in 1969. It did raise much environmental concern in the public, in government, and in the industry. A lot has been done since 1969, both by industry and by the regulatory agencies, to strengthen the regulations and improve the procedures. While industry experience shows one major beach-polluting spill in 18,000 wells, I think that many of the things subsequently

accomplished, including many of the safety devices that I have shown here, have made the odds even much better.

Question. Do you design your facilities to withstand earthquakes? How severe?

Response. Yes. For example, the platform that we are installing in 850 feet of water is designed for seismic loading. Professor Jennings at Cal Tech spent several months establishing criteria for such that the structure would not fall down in the very worst earthquake, the platform is designed not to suffer any damage. Our criteria exceeds the California building code on tall buildings or hospitals, and in the event of a major earthquake our platform would likely be the safest structure in Santa Barbara County. It is just a matter of design.

Question. What Richter number do you design for?

Response. Design is accomplished on the basis of acceleration rather than a Richter scale number. The highest acceleration that has been measured that we know of was over 1.06 in the San Fernando earthquake of 1971. Through computer models, we have tested our structure with the wave spectrum of the San Fernando earthquake. That earthquake wouldn't have damaged our platform.

Question. How do you know your platform is not directly over a major earthquake area?

Response. We made extensive underwater surveys over 80,000 acres, which is 130 square miles, around our structure to define the active faults. We are not within several miles of any active faults.

Question. Was the federal government first to lease for drilling in the Santa Barbara Channel?

Response. No. The first leasing in the Santa Barbara Channel was by the state. Most of the state water bottom from Ventura to Point Conception was leased by the state back in the 1950's and 60's. This acreage is from the shoreline to the 3-mile limit, mineral exploitation is controlled by the federal government. In the Santa Barbara Channel there was some offset leasing in about 1966 or 1967 and the big lease sale was in 1968.

Question. I understand you would transport your oil out of Santa Barbara by tanker. Am I correct?

Response. That's right. By tanker. We would bring it into the processing plant and store it. There are no long-distance pipelines along the south coast of Santa Barbara. A tanker would pull into the marine terminal about 3,700 feet offshore.

Question. Didn't your slide show an existing marine terminal?

Response. Our facility is adjacent to an old oil field, which is one reason we selected the site. Existing storage tanks and a marine terminal serve the existing oil field, which has been there since 1929. As a matter of fact, one of the conditions of our zoning ordinance requires that we take a couple of those tanks out and that we landscape around the rest of them to reduce visibility. We will modernize the existing marine terminal and move it out beyond the kelp.

Question. How many producing fields are there in federal water off California?

Response. Right now there are three federal leases producing.

Question. How much new exploration is going on?

Response. There is one rig operating right now looking for new oil.

Question. Why not consolidate leases to minimize the number of platforms and facilities?

Response. The federal government, after we made our discovery, formed an 80,000 acre unit, which includes leases of ours, leases of Standard of California's and leases of Shell's. They put them in one unit called the Santa Ynez Unit. We are the operator of that unit. Our one site will serve the full 80,000 acres, which basically is all of the federal leases west of Santa Barbara.

Question. Why put your facility up a canyon?

Response. To remove it from sight and to have the buffer zone around it.

Question. Aren't pipelines the real pollution problem?

Response. There have been some pipeline leaks in the Gulf of Mexico, but really a pipeline monitored using today's technology and properly maintained should never create a problem. There should be no problem with spills from pipelines. There are several pipelines in the Santa Barbara Channel and there has never been a problem of a pipeline leak. The Carpinteria Beach has four pipelines crossing it and there has never been a prob-

lem there.

Question. For future offshore leases, will pipelines bring the oil ashore or will tankers be used?

Response. I think a mixture of the two, depending on the location and the water depths you have to cross to get to shore and what is on the adjacent shore.

Question. Don't tanker operations involve spills and leaks?

Response. There have been spills from tankers but the exposure is so big--there are thousands of tankers that ply the ocean. For Exxon's operation at Santa Barbara, we have selected a tanker and we are putting all sorts of special features on it that would minimize this sort of thing. I don't know if you could do that with every tanker that plies the ocean, but in this instance it can be done.

Question. Will you bring a supertanker into your terminal?

Response. We are talking in terms of 28,000 DWT tanker which is a coastal tanker. This is not a supertanker. We have been accused of setting up a supertanker port and that is not right. It is the kind of tanker that plies between Los Angeles and San Francisco.

Question. Why don't you use sources of fuel other than offshore oil?

Response. In looking at long-term energy requirements, we see that 20 years from now things like shale oil, coal gasification,

tar sands from Alberta, or wherever--things of this type--can come in long-term. For the intermediate term, the next ten years, our best shot at fulfilling energy requirements is the offshore oil and gas and hopefully, they will fill the need during that period of time.

Question. Would an offshore oil field last only 10 or 20 years?

Response. Yes, typically. It might last longer than that, but at a declining rate--it would be at peak rates for maybe ten years.

Question. Was gas availability significant in the Santa Barbara referendum?

Response. Yes. If we had not been able to come ashore, we would have had to re-inject our gas back into the producing reservoir and it would have not been available for market. By having the shore site, we can sell this gas to local pipelines. At peak rates this will amount to some 77 million cubic feet per day, which would be enough to supply 250,000 homes.

Question. Will it be less expensive for you to bring your oil ashore?

Response. It would cost us more to operate offshore, probably in the range of a million and a half dollars per year. In addition, we would not have been able to sell the natural gas.

Question. Would this be enough less profit to cause your project not to pay out?

Response. No, it was not determinative in the economics.

Question. Will all your production go to Benicia?

Response. At peak rates we are talking about 60 to 80 thousand barrels per day, and of that only a portion will likely go to Benicia. Other portions could go to other refineries.

Question. How do you justify the high profits you will make from Santa Barbara?

Response. Let me say that the economics are attractive or obviously we wouldn't do it. However, considering that we have 200 million dollars tied up in leases, another hundred million dollars in wells drilled so far, plus another $150 million to $200 million to get on production, the return on that investment is relatively nominal--a little better than you would get out of a bank on your money, but not much.

Question. Have floating offshore terminals been used elsewhere? Are they better than subsea tanks?

Response. There are a few used in the Gulf of Mexico. There are one or two relatively large ones used in the North Sea. It can be done. It is a matter of economics. In the case of our facilities in Santa Barbara, the alternative of a floating vessel was economically and environmentally preferred.

POTENTIAL LAND USE CONFLICTS RESULTING FROM OFFSHORE OIL PRODUCTION IN THE CENTRAL CALIFORNIA COASTAL AREA

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In listening to the previous speakers I am led to believe that the probability of offshore oil extraction in the Central California Coastal area is quite remote, and even if extraction were to take place, the adverse impact would be small indeed. Since I was asked to speak on potential land use conflicts resulting from offshore drilling and production, my remarks may now seem moot, or at best hypothetical. Nonetheless, since the prediction of the future is not noted for rigor or reliability, it may still be useful to explore the nature of potential land-use issues surrounding offshore extraction and identify processes for their resolution. This is not intended to cast doubt on the conclusions reached by previous speakers, but merely to suggest that we are always captives of our present realities in terms of knowledge, technologies, and values. Given the uncertainty of the global energy picture, one might be wise to prepare, but not necessarily plan, for the worst.

By way of introduction, I should first modify the title of these remarks by substituting the term resource for land, since the potential impact of offshore oil development clearly affects a broader range of uses or values than those directly

tied to the land. Second, my remarks reflect a public policy perspective, and are directed to those issues confronting persons in planning and decision-making positions. Finally, the subject does not easily lend itself to disciplinary boundaries. Consequently, my observations will be considerably more general and impressionistic, necessarily lacking the degree of resolution contained in those talks presented earlier today.

My remarks are organized around four general questions:

1. What is a resource-use conflict?

2. What types of resource-use conflicts might result from offshore development?

3. What consideration should be included in determining resource-use priorities?

4. What are the bases for actually setting these priorities?

How do we know when a resource-use conflict exists? Let me suggest three approaches or methods commonly used for making such determination: 1) intuition or emotion, 2) tradition or convention, and 3) rational analysis.

Conflict-identification based on intuition or emotion must necessarily rely heavily on 'good-guy bad-guy images', suspecting governmental and/or private motives, feelings that conclude that oil development and ecological health are mutually exclusive possibilities, etc. Tradition or convention-based identification favors the status quo; that is, existing agencies charged with

offshore leasing would continue their allocation process identifying conflicts from their particular perspectives. And the identification of conflict through independent rational analysis would attempt to reduce areas of ignorance by bringing all parties and information into the identification, clarification, and subsequent resolution of (potential) issues. This third approach was endorsed by AMBAG Chairman Muhly in his opening remarks today and is also the approach I advocate. However, information needs to go far beyond questions of scientific fact or evidence, and must necessarily include a wide spectrum of human values. Thus, the initial task in conflict-identification is to explicate information in order to make fact and value clear and unambiguous.

In a public policy, planning, or decision-making context, formal conflict explication (particularly with respect to which parties and their respective values are framing an issue) becomes very difficult due to the variety of means for value determination available to elected and/or appointed public officials. At least four such means exist, and each could lead to the definition of significantly different resource-use issues or conflicts given a single proposed action (in the immediate case, offshore oil production). The four most common means for value (hence conflict) determination are: 1) what the majority of constituents feel, 2) what important interest groups feel, 3) the conscience or individually held values of the public official or officials involved, and 4) an interpretation of existing public policy.

I favor the latter means since it provides the greatest clarity in establishing a framework and rules for social conduct. This is not to deny the importance of these other means, but the first three are implicit and integral to our electoral political system, and therefore, are contained within the declaration of public policy.

But developing explicit, operable public policy is not a particularly simple task. When there are many competing sub-publics, identifying the 'public interest' becomes a formidable task indeed. The single question of meeting national energy needs poses very difficult problems in determining national versus regional and local public interests. However, one thing is clear; such issues are profoundly complex, and without some form of rational analysis and explicit public policy the prospect for the adequate and continuing resolution is very dim.

Let us now turn to the second question; namely, what type of resource-use conflicts might occur from offshore oil development in the Central California Coastal zone. In pursuing a rational analysis strategy, two approaches seem appropriate. Use-type compatibility is the first approach. The range of potential uses and resources within the area under consideration (for offshore production) would first be identified, followed by a determination of the compatibility or incompatibility of these uses. For example, shipping, industrial use, and agriculture might be quite compatible with an offshore oil production operation, while some forms of recreation and housing might be deemed wholly incompatible.

Moreover, the cumulative and indirect effects must be considered in addition to the more obvious direct effects. For example, low level organic waste disposal might not have an initial adverse effect on fisheries or water contact sports, but could lead to a major effect and thus a conflict through its cumulative affects. Such determinations are very difficult to make as the state-of-the-art is woefully inadequate in determining cumulative and indirect effects of such environmental changes.

In order to determine how offshore oil development would specifically affect other coastal uses, the following information would be extremely useful, and in some cases virtually required:

1. An inventory of existing land and water uses.

2. An analysis of existing general land use plans.

3. An analysis of single purpose plans (i.e., highways, water supply, energy systems, etc.).

4. An analysis of special purpose plans (e.g., the California Coastal Zone Conservation Commission plan).

5. A use-compatibility/suitability analysis (i.e., the determination of the geographical intensity of potential use conflicts through identification of environmental or social-economic attributes which attract or constrain particular coastal uses).

6. The proximity to ancillary facilities (that is, port facilities, refineries, pipelines, etc.).

7. The availability of potential sites for ancillary facilities (e.g., favorable slope, soil, the absence of geologic hazards, etc.).

Resource impact is a second approach to use-resource conflict identification. This approach involves the determination of environmental changes which adversely affect valued ecological

or environmental factors which are not use-specific. Obvious examples of this approach are air and water pollution, although all common property resources should be evaluated, including resource-use conflicts resulting from the intrinsic uniqueness of a particular area (such as Año Nuevo and Big Sur). Other examples might include undisturbed natural areas which are rare and representative of biological communities, areas of unique geologic or topographic significance, and areas of high natural productivity such as estuarine systems (which are vital links in energy flows and food chains for coastal fisheries) that need to be protected in order to maintain other coastal resources.

Identifying criteria for determining resource-use priorities is our third area of inquiry. The following list of criteria serves to illustrate the types of consideration which should be made in setting use priorities.

1. Identification of areas of particular or critical concern.

2. Identification of prior commitments of resource use.

3. Degree of control exercised over surrounding use areas (e.g., if an area is designated as a wildlife preserve, this priority must consider whether adjacent or surrounding uses can be controlled or maintained in a fashion compatible with the wildlife preserve).

4. Identification of impacts of use on surrounding areas (e.g., designating an area for a state park could produce traffic impacts on surrounding areas, or, impacts resulting from offshore oil development could seriously impact scenic values along Big Sur or wildlife values at Año Nuevo).

5. Determination of scarcity or uniqueness (e.g., areas which are scarce or rare, such as Año Nuevo, are likely to have fewer options for alternative uses than areas which have less unusual attributes).

6. Resource and/or use diversity. (This criteria is essentially directed to the maintenance of future options; rather than 'homogenizing' the coast, this criteria favors maintaining diversity in both natural and social system characteristics.)

7. Irreversibility of commitment (e.g., consumption of oil, commitments of sand and gravel, land fill, harbor dredging, etc.).

8. Degree of coastal dependency (i.e., to what extent does the use need to be located on the coast; how dependent is the use on the coastal resources for existence. Offshore oil development is clearly coastal dependent with respect to extraction, however, processing and storage is quite another matter. Furthermore, since not all energy resources are coastal dependent, the larger issue of energy production provides a more appropriate context for evaluation of this criterion).

9. Economic efficiency (i.e., will a designation of use priorities increase the economic efficiency of the uses in any given area; what are the effects of priority designations on production and consumer costs; what are the costs of oil or other energy sources on inland versus coastal sites. In addition, is there a locational economic advantage for the priority designation; are there economies of scale or external economies in designating the use priority, and in the case of offshore oil development in the Central California

Coast, where would ancillary facilities such as transport and processing facilities be located in order to permit operation of offshore oil development at an efficient economic level? The data presented in Dr. Taylor's remarks indicate that the criterion of economic efficiency in offshore oil development in this area is likely to be low indeed).

10. Regional benefits versus national interests. (As previously noted, this is probably the most difficult area for establishing criteria. Assigning benefits and costs at the national level, interstate level, and intrastate regional levels requires extraordinary skill and care.)

11. Accepting the fair share of social responsibility. (This criterion is directed at the "not in my neighborhood" caveat. During last year's gasoline shortage, bumper stickers appeared in the Gulf Coast states reading "Let the Bastards Freeze in the Dark," implying that Northern states, and non-oil producing states in general, were not carrying their fair share of social responsibility in the production of energy resources. This criterion is naturally very difficult to establish.)

12. Public preference. (This criterion utilizes public review as a means in establishing priorities.)

The final question seeks to identify the bases for actually setting resource-use priorities. As discussed in my introductory remarks, I consider public policy to be the most useful form of value expression in resolving conflicts. I like-

wise consider that sound public policy can provide the most appropriate basis for actually setting these priorities. A number of policies in the recently published California Coastal Zone Conservation Commission (CCZCC) Preliminary Plan could serve to guide the setting of use priorities with respect to offshore oil development in the Central California Coast. The following examples from the CCZCC Preliminary Plan illustrate the types of policies and policy areas which would be useful in setting resource-use priorities. In some cases the complete or partial text of a policy has been included; however, in most instances only the policy number and descriptive title are enumerated.

1. Protect and Restore Marine Resources. It should be public policy at all levels of government to maintain, enhance, and, where necessary, restore marine resources. While the entire ecosystem must be protected, special protection shall be given to areas and species of special biologic or economic importance. Uses of the marine environment--for commerce, food supply, mineral extraction, and recreation--shall be carried out in a manner that does not diminish the productivity of coastal waters or threaten the existence of native species.

10. Strictly Regulate Release of Oil and Other Toxic Substances. Specifically:

a. Prevent Petroleum Spills from Affecting Sensitive Areas. Petroleum facilities (e.g., tanker terminals, refineries, and drilling operations) shall be permitted only where it can be demonstrated that: (1) under Coastal Plan energy policies the facility is necessary and there is no alternative location that would result in less environmental damage;

(2) accidental spills will not adversely affect sensitive biological or aesthetic areas; and (3) the best available technology and mitigation measures have been incorporated to prevent oil leaks and spills.

26. Preserve Significant Natural Areas and Rare Species. Ecologically significant areas of all coastal natural living communities shall be preserved by public ownership or other appropriate means. Rare or endangered plants, animals, and communities shall be protected from destruction or further degradation, and restoration efforts shall be aggressively pursued, Activities shall be restricted and public access shall be carefully managed to prevent any disruption of the habitat values.

27. Restrict Use of Fragile Habitat Areas.

28. Control Adjacent Development.

a. Priority for Complementary Uses.

b. Restrict Disburbance of Shoreline Habitats.

c. Maintain Buffers to Protect Habitat Areas.

34. Regulate Development and Land Division Near Agricultural Areas.

43. New Developments Shall Protect Coastal Air Quality. Specifically:

a. Major Pollution Sources. Major pollution-generating developments, including refineries, oil storage and separation

facilities . . . shall meet all applicable Federal, State, and local air quality standards and all criteria specified in other Coastal Plan policies. Such developments shall not be built in areas of the coastal zone designated by the Air Resources Board as critical air areas or in areas where coastal resources (such as resort or agricultural areas) would be adversely affected unless the coastal agency determines there is no alternative inland or coastal location where siting would result in less environmental degradation.

47. Evaluate Development to Protect Coastal Viewshed. The entire California "coastal viewshed" shall be considered a public resource. Within this area the designs for all development proposals shall be evaluated so that the viewshed quality can be preserved where existing natural or manmade areas are scenic, enhanced by the addition of attractive improvements, and restored by the removal of undesirable visual elements. The viewshed shall be defined to include all land and water areas that can be seen from the sea, from the water's edge, from principal coastal access roads, trails, and railroads, from major lateral transportation corridors leading to the coast, as well as other areas specified by the coastal agency as being of statewide importance based on subsequent viewshed studies.

48. Development to Be Compatible with Highly Scenic Areas.

75. Consider Public Recreational Potential Before Allowing Other Uses.

136. Need for Offshore Development Should Be Clearly Determined.

New offshore oil and gas development of State or Federal lands shall be permitted only after: (1) development of the Outer Continental Shelf (OCS) off California has been clearly identified as an integral and priority part of a comprehensive, balanced national energy conservation and development program that gives consideration to full-scale energy conservation programs and to short-term and long-term resource availability; or (2) a comprehensive analysis has determined the need for California offshore production in light of the anticipated inflow to California and PAD V of oil and other forms of energy from all other sources . . . ; and (3) the coastal agency determines that the impacts on onshore resources and possible impacts on the coastal zone marine resources as a result of OCS development are acceptable according to the standards set forth in the Coastal Plan.

Regional Amplification

Central Coast: The current prohibition of oil exploration and drilling in the State tidelands of the Central Coast Region should be retained unless overriding national need is demonstrated.

137. Require Full Evaluation of Offshore Drilling Proposals.

138. Allow Offshore Drilling Only Where Safe. Offshore drilling and production shall be permitted only where it can be demonstrated that: (1) the most advanced state-of-the-art drilling and production technology is utilized; (2) the geologic characteristics of the area have been adequately investigated and are consistent with safe drilling and production; and (3) the proposed well sites

are the least environmentally hazardous and aesthetically disruptive sites feasible.

139. Consolidate Drilling, Production, and Processing Sites.

142. Minimize Impact of Onshore Facilities. All onshore drilling, production, and onshore support facilities for offshore operations, including separation plants, pipelines, terminals and storage facilities, shall be designed and located to minimize their environmental impacts consistent with recovery of the resource.

145. Protection Against Any Adverse Impact of Federal OCS Development. The Coastal Commission or the coastal agency, the California Legislature, the California congressional delegation, the State Lands Commission, the Division of Oil and Gas, and all other concerned agencies should seek agreement from the Department of Interior and other Federal authorities that Federal Outer Continental Shelf (OCS) leases will be approved by the Department of Interior only if the following conditions are met:

a.

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j. Designate Sanctuaries in Certain Areas. Sites and tracts should be designated as sanctuaries (1) if they are unusually subject to the risk of oil spills due to geological seismic disturbance; or (2) if they offer unusual coastal aesthetic assets or the local economy is particularly dependent upon the protection of coastal

aesthetic assets. Portions of the Santa Barbara Channel, Monterey Bay, and Santa Monica Bay would appear to be candidates for sanctuary status. (Emphasis added.)

147. Minimize Refinery Construction Along the Coast. New refineries or expansions of existing refineries shall be permitted in the coastal zone only when it can be demonstrated that: (1) there is a public need for such facilities, . . . (2) the refined products will significantly assist in reducing air pollution by users of the product; (3) there is no less environmentally damaging site available; (4) the project is designed and located to minimize any adverse environmental effects, including provision of a sufficient buffer zone to minimize impacts on surrounding property; and (5) the proposed project is consistent with all other policies of the Coastal Plan. In no event shall a new oil refinery be permitted in a highly scenic area,... or in or near special marine and land habitat areas. (Emphasis added.)

In addition to these policies, two excerpts from the CCZCC Preliminary Plan section on Regional Summaries of Resources, Issues, and Plan Proposals are useful in examining use-resource priorities. This section of the plan summarizes "critical resources; major plans, development pressures, and environmental problems; and major Plan proposals recommended by the staffs of the Regional Commissions." The excerpts are from the discussion of the Central Coast Region, and were selected for their relationship to the potential offshore production areas identified by Dr. Silver.

Subregion 3: Tunitas Beach to Majors Creek.

The rural coastline from Half Moon Bay to the northern fringe of Santa Cruz at Majors Creek contains a scenic stretch of Highway 1, gently rolling grazing lands, productive agricultural benchlands, commercial timber resources, several well-used beaches, and a major wetland at Pescadero. The Settlements of Davenport and Pescadero are small but historic, and are designated as special coastal communities by the Plan. [Año Nuevo Island, at roughly the center of the subregion, is a valuable wildlife habitat and forms a small part of the vast Big Basin-Año Nuevo State Park.]

The maintenance of open space and commercial agriculture and provision of additional recreational beach access compatible with natural habitats are important Coastal Plan policies for this subregion.

Subregion 7: Malpaso Creek to San Luis Obispo County Line.

The scenic Big Sur area is world-famous for its rugged beauty. Highway 1 from Carmel to San Simeon is a recreational area of national significance, with an estimated annual visitation of over a million persons. Existing conventional and wilderness camping facilities are used to capacity, and thousands of visitors are turned away every year.

Grazing remains an important land use, and is a primary factor in the maintenance of vast scenic landscapes. Access to the shoreline is limited to a very few locations; there is no publicly owned access north of the Big Sur River. Thus, the most popular attraction is the recreational motoring experience, enhanced by brief stops at scenic vistas, restaurants, and craft galleries along the highway.

It is clear that the impacts of offshore oil development in the Central California Coastal zone would result in significant resource-use conflicts under the current policy of the California Coastal Zone Plan. It is also highly likely that regional and local value conflicts would result. But one would hope that some systematic form of clear, explicit, rational analysis might be engaged in resolving these potential use conflicts, rather than resorting to the rhetorical types of conflict resolution so common in contemporary American politics. As Chairman Muhly mentioned in his introduction, problem identification and discussion should precede offshore oil extraction decisions so that public officials can be ahead of, rather than reacting to resource-use conflicts.

LEGAL ISSUES OF REGULATING

THE COAST

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A major problem in general discussions such as the one today is drawing a clear line between the two kinds of issues with which we are concerned: legal issues and political issues. Only in the United States do these two issues get confused. We are talking about, on the political side, "should" questions; on the legal side, "can" questions. The reason for this is that lawyers are trained to answer the question "what can government do". But they know very little about questions asking "what should government do". Despite this fact lawyers are regularly asked to render opinions on matters of public policy. This distinction between legal mechanics and political policy is terribly important to understanding the way natural resources are controlled through the legal process.

There are, just to pick an arbitrary number, five ways of controlling resource use. One is social pressure; elevate social pressure for achieving a given objective to the level of consensus and all your problems are solved. That is clearly a political process. Another political process is to regulate administrative procedure. By this I mean intergovernmental cooperation, coordination, and all those mystical words that I have never understood that have to do with transferring

pieces of paper and asking for a governmental agency to write their comments on the back and send it back in the next perforated envelope. The environmental impact report is a familiar example. The remaining three techniques are all legal devices. They are regulation, contract, and acquisition. These are the three principle legal techniques for controlling resource use. Of these, the first--that is regulation-- is by far the most important. I'll say something about the other two so that you will have some kind of context for what I have to say about regulation.

Acquisition is a way of getting control of the resource directly, either through purchase, condemnation, mandatory dedication, or by long term public use. The public can, through each of these devices either acquire total ownership of property or they can acquire rights to use of property in a way that they have already done for a certain period of time.

Contracts are widely used in everyday life to regulate the use of land. The contract is not, however, widely-used by government in regulating resources, although it is fairly widespread in California through programs such as the Williamson Act. At its root, a contract is merely a legally enforceable promise and there are very few restrictions on the kinds of promises that can be made. Contracts could, therefore, be used far more extensively than they now are to regulate natural resource use.

In the context of offshore petroleum extraction and related onshore land use impacts, the most important control technique is public regulation. Regulation includes a wide

range of programs including such things as zoning and permit procedures such as those administered by the Coastal Commission. Regardless of its form each regulatory mechanism is an expression of state sovereignty. In our system this power stems from the tenth amendment to the U.S. Constitution which limits the federal government to specifically enumerated powers such as commerce, defense etc. There is, however, a problem with that simplistic statement. It is that when we are talking about oil development on the coast, we are talking about something which is far more complex than city planning. One source of this complexity is the crazy quilt of conflicting jurisdictions which occur in the coastal zone. We have Federal government, state government, local government, and a variety of regional agencies. Each of these agencies operates at a different level and under different delegated responsibilities. It is very difficult to say where the jurisdiction of one agency begins and where another leaves off. We can, however, generalize about the legal requirements which the regulatory programs of any agency must meet in order to be upheld in court.

What are the tests for a valid regulation? That is really what we have to know in order to know what government <u>can</u> do in regulating coastal resources. The first requirement of a valid regulation is that the regulation has to be designed to achieve a valid, legislative goal. What does that mean? It means that the court must agree that the regulation is needed to protect some important public objective. These valid goals vary over time. There was a time when regulation to achieve an aesthetic objective was not a valid legislative goal--the court said that beauty is in the eyes of the beholder and the courts aren't in the business of deciding whether someone should like Brahms, Bach, or somebody else. Furthermore, they held that aesthetics

were too tenuous a hook on which to hang a regulation. In an earlier presentation, Mr. Warner, from Exxon, told us that one of the 73 requirements of their zoning approval was that they landscape their tanks--not new tanks--tanks that have been there since 1929! I gather from that that aesthetics in Santa Barbara County is taken by Exxon Corporation, who has some high-priced legal talent, to be a valid legislative goal as it is in most California jurisdictions today. (I should point out parenthetically that this is not yet true everywhere in the United States).

The second requirement, after a valid legislative goal, is that the regulation must treat similarly situated persons being regulated in a similar way. That is, it can't discriminate unreasonably among people that are being regulated. What does that mean? That means that when a regulation is imposed and when some people are taken in under its net and others are left out there has to be a good reason for taking some in and leaving some out. And, the reasons have to be tied to what the people under the net are doing and what the people outside the net are not doing.

Drawing these lines well requires careful consideration of those things that Jim Pepper just told you about in the previous presentation: about knowing what your resources are, about knowing why society values them, and about knowing what you expect to do through this regulation.

The third test of a valid regulation is that it is not to be used in place of condemnation. There again, you've got a statement which, whether you recognize it or not, swallows up the whole problem. That is, the line we are looking for is

between a valid regulation and the taking over. The Constitution, as you know, prohibits taking property without just compensation. But, as Justice Holmes once said, "government can take some property without paying for it provided it doesn't take too much". The question is, "how far can government go in regulating property before it is taking too much". The answer is that a regulation must not be used to confer public rights in private property which the court hasn't yet recognized as being necessary in terms of public health, safety, etc. For example, the right of a private landowner to exclude the public has generally been regarded as basic. For this reason public agencies seeking public access to private property have usually been required to pay for it. Attempts to achieve this public access by regulation have often been struck down in court.

One of the tests of an unconstitutional "taking" of private property that is regularly suggested (and that is in fact used in a wide variety of jurisdictions in the United States) is this: "does the regulation unduly depress the market value of the land?". Courts have used several methods to determine what "unduly depress the market value" means. The most common of these is to balance the public benefit against the private cost. The California court ignores the effect of regulation on the value of property. Several important cases have involved regulations which have had a very severe impact on land value. One of these was Hadacheck V. Sebastion decided in 1915. Mr. Hadacheck had lived in the outskirts of Los Angeles for a number of years and had been quietly making bricks to build houses. People in Los Angeles, as they are wont to do, began to build houses out around his brick factory. And, when enough houses got built around the brick factory, people started to complain about all the smoke

that Mr. Hadacheck was putting out. They went to the City Council; the City Council passed an ordinance saying 'no more brick factories in town' and Mr. Hadacheck kept making his bricks, stubborn fellow that he was, until they put him in jail. Ultimately, it turned out that Mr. Hadacheck, in order to get out of jail, had to agree not to make bricks any more. The financial cost to him was tremendous.

I have tried to recite in a very brief version, the major devices available to public agencies for controlling resource use in the coastal zone. I think that the most efficient way of using the remaining time would be to respond to questions.

QUESTIONS

Question. If the development takes place in the city and has extra effects that are beyond the city but both the effects and the original cause are under the control and the jurisdiction of the Coastal Commission, can the Coastal Commission take care of those far-flung effects?

Response. It would depend on what the Coastal Commission had to do and what the Coastal Commission's powers were. One of the difficulties with ad-hoc bodies, like the Coastal Commission, is that they are creatures of delegated power. Unlike general purpose governments such as cities, counties and states, coastal commissions can only exercise the kinds of powers that they are given by law. As the Coastal Zone Act is now written the Coastal Commissions have very narrow powers. They can't set the kinds of criteria that might take care of your far-flung problem in a very easy way. It would be very difficult to do, and I would have to have a lot more facts, I suspect, in order to give you an informed answer to your question.

Question. I read recently about a case in Maine brought by an environmental group challenging a local land use control measure. Can you explain the possible grounds for such a suit and predict the outcome in court?

Response. The most common basis for a challenge of a local action is that the local action does not comply with some legal requirement such as failure to prepare an environmental impact report, etc. To the extent that the local agency, such as a city, is operating within its delegated authority then it is invulnerable to this sort of lawsuit because in Maine and in most states, cities have almost total land use control perogatives and their discretion is very broad. They can do just about anything that they choose. I don't see how, without more facts or information, a citizen group could prevail against a city unless they can show that the city failed to follow its own rules or those imposed upon it by the state.

Question. The basic question is "who has ultimate jurisdictional control over the area seaward of the mean high tide?". Is it totally federal, is it totally state up to three miles, or is it shared?

Response. There isn't a simple answer to that. Even when we talk about about the area within the 3-mile limit, there is a lot of jurisdictional overlap. The Federal Coastal Zone Management Act contains a series of provisions that create a jurisdictional overlap in that 3-mile area. At a recent NOAA conference at Asilomar (Pacific Grove, California) I asked that question pointedly of several people who were supposed to know more about that than I do. I didn't get a satisfactory answer, which leads me to the conclusion that that is a very good question. Does anybody have a real good answer?

Question. Is that jurisdictional ambiguity any clearer in the case of inland waterways?. Are any of those inland areas subject to multi-jurisdictional control?

Response. Yes, the San Francisco Bay, for example. Since much of it is navigable it is regulated by the Rivers and Harbors Act of 1899. It is also regulated by the State Land Commission; and as you know it is also regulated by the Bay Conservation and Development Commission. It is regulated by practically everybody.

Question. Who decides whether an oil company can run a pipeline from offshore to a refinery inland?

Response. It is resolved through that vague, mystical process that I described as administrative procedure; the business of administrative resolution, in which agencies involved ask one another "who is really most concerned?". Fish and Game, if this is a wildlife sanctuary, you seem to be really concerned --why don't you take it? Fish and Game says, "Well, the Corps of Engineers seems to be really concerned because they've got a dredging operation going down there, why don't they decide?". The Corps of Engineers says, "Well, the Coast Guard has been doing something there, maybe they ought to decide.", etc. And, finally, somebody decides. The best story that I know of on that, is the first chapter in Joe Sax's book, Defending the Environment.

PANEL SESSION

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Symposia which focus on controversial subjects and during which public participation is invited usually generate a multitude of questions. Some questions were answered at the end of each talk. Others were deferred until the end of the session. Except for Mr. Darrell Warner, who had to catch a plane back to Los Angeles, the symposium speakers agreed to serve as panel members to field questions from the audience. In addition, Drs. David Green and David McCulloch, each of whom have specific expertise resulting from their continuing work in the California coastal region, have agreed to serve as additional panel members.

Question. With oil drilling within three miles of shore, who has jurisdiction? Does the County have any jurisdiction over adjacent offshore land?

Response. The State has jurisdiction over this land; Counties have no jurisdiction in this area. This means that the State must approve not only exploration for and extraction of resources,

but structures such as pipelines that cross this State tidelands area.

Question. In the Salinas Valley there is a very thick sequence of sedimentary rock which, I believe, is of Miocene age. There is a small oil field in the upper part of the Salinas Valley, in the San Ardo area. Does this sequence of sedimentary rock continue offshore into Monterey Bay?

Response. (The original response made use of the blackboard; the following is a summary of that answer.)

When one looks at geological cross-sections of Monterey Bay, the relatively thin sediment sequence on top of the granitic basement rock is evident. The granites are quite high under the the Bay, except west of the Palo Colorado-San Gregorio Faults where sediment thicknesses may reach 800 to 1,000 meters. As one traces the sediments from the Salinas Valley into the Bay, there is rapid thinning of the sediments. Moreover, the sediments are relatively flat; there are no anticlines or other structural traps for oil entrapment if there were source rocks.

Several wells have been drilled around the Bay, from near Davenport to Monterey. They were all essentially dry wells. They are not producing and they never did. Most of these wells reached basement rock. They didn't reach basement rock in the Moss Landing area even though the well exceeded 7,000 feet. It was postulated that the well was drilled over the ancestral Monterey Canyon, which is quite a deep channel. Basement rock was hit in wells drilled on either side of this canyon. The oldest sediment found in all wells represent the Miocene Monterey Formation. I don't know whether there was any Eocene in the deep

well; it wasn't called that anyway.

Question. Would you care to hazard a guess, therefore, about the oil potential within Monterey Bay itself?

Response. (Three panel members participated in the response and the following is a summary of their comments.)

Within Monterey Bay I would say that it is very, very slight. In addition to the absence of structural traps in Monterey Bay and the relatively thin sediment sequence, the oldest sediments in most of the area is the Miocene Monterey Formation, which mostly consists of rhythmically bedded shales and very few sands. The reservoir potential is very slim. There is some overlying Purissima sandstone, of Pliocene age, which could serve as a reservoir. But the Monterey Formation and the Purissima sandstones lie flat on top of each other. There are no structural traps. Morecver, there have been no oil seeps in Monterey Bay.

The reservoir rock of the San Ardo oil field predominantly is a sandstone. Production has been about 250 million barrels up to now and it still has very large reserves. There is a problem of oil extraction in this field because of the low gravity of the oil. The field now is producing mainly because industry puts heat into the reservoir to increase the mobility of the low-gravity petroleum. There would be a big question whether or not we could technically or economically develop a similar low-gravity field, even if present, in Monterey Bay. From a geological point of view, therefore, the oil potential of Monterey Bay is very, very slim.

Question. All of what we have heard today seems to indicate that the central and northern California region has little potential for large amounts of offshore oil, whether from the state tidelands or outer continental shelf. Yet the southern California offshore basins are highly prized for their oil potential. It is still not clear to me why there should be this difference between the two areas. Is it mainly due to differences in the thickness of the sediments in basins of the two areas?

Response. (More than one panel member commented.)

No, I think that we can generalize a little bit more than that. The basins themselves, as we understand them at this time, generally are poor basins. We still have some big question marks in defining basin structure but in general they do not look very good.

There is, however, a great big difference in sediment thickness when thicker sections of offshore basins in central California are compared with those of southern California offshore basins. In the central and northern California basins, as was pointed out earlier, some sediment thicknesses greater than 5,000 feet are known and there are some places where they are greater than 10,000 feet. However, sediments of the same age equivalent in the Ventura Basin and Santa Barbara Channel, which is the offshore equivalent of the Ventura Basin, have depths of greater than 20,000 feet. Thus the sediments in the Ventura Basin, as well as in the onshore Los Angeles Basin, are about an order of magnitude greater than those in our California region.

Question. Exploratory drilling so far has been done in relatively shallow offshore water and the results do not look too promising. Might there be oil out where the water is deeper?

Response. That is a good question and is without a definitive answer. Sure, there might be. It depends on all the things that were talked about earlier, such as thickness of section, burial depth, presence of source rock, etc. Some places further offshore do have thicker sediment sections. A big question will be whether there are reservoir rocks out there. We really won't know until we drill.

Question. In the list of 17 areas, in which the central and northern California area was ranked 16, who sets the priorities of likelihood -- do the oil companies do that?

Response. There was a combination of industry and government agency input. A list went out to the oil companies and there was also an interagency committee in which the US Geological Survey participated. As a result, the offshore areas of the United States and Alaska were subdivided into these 17 areas. Subsequent to that, some of these 17 areas have been subdivided for purposes of upcoming lease sales. The Bureau of Land Management probably will manage closer to 25 lease sales in the next two and a half years, if all goes as expected at this time.

Question. What are the policy implications of that list? Does it mean that the priority rankings are the order in which these areas are bound for exploration or production? Or is the list simply an interest ranking by industry and as such is indicative only of the oil potential? Because of the list, is the government likely to encourage the exploration of one area versus

another? What does that list mean?

Response. An unranked list was developed originally because of ex-President Nixon's desire to lease ten million acres a year. The ranking only indicates industry's interest in each area. Oil companies were asked to rank all areas; not all of them ranked all areas. On a comparative basis, only one area generated less interest than did our central and northern California area. This does not mean to imply, however, that one or more oil companies might be greatly interested in our specific offshore area. It has a low ranking on a comparative basis.

To turn to your specific question, it was the intent of the government, I am quite certain, to put up first for lease the best prospective areas, those that could be developed quickly with present techniques and considering the various environmental problems that might occur in those areas. Subsequently the difficulty of leasing 10 million acres each year was realized. Perhaps four lease sales per year of smaller acreage seems more reasonable.

Question. Following the passage of the National Environmental Policy Act (NEPA), it has been my observation that the Federal government has the option of not evoking that act if something is required in the over-riding national interest. What generally is the means upon which the over-riding national interest is determined? Is there a procedure through the court system -- the Supreme Court -- or by Executive Order that would permit the Federal Government to essentially pay no attention, for example, to what the California Coastal Commission might recommend or adopt as policy?

Response. That is a juicy question and there are several answers -- some are longer than others. The short one is that matters of national security, such as landing Marines on certain beaches when they are learning how to land on beaches and things like that, do not require an Environmental Impact Assessment. The question of when something is a matter of national security and when it's not is a judicial question and the courts have to decide.

The other part of the question was how do certain Federal actions receive special dispensation from the Environmental Impact statement requirements of NEPA. The answer is that they get dispensation in a variety of ways, the most common of which is by special legislative variance. The Alaska pipeline was approved in this manner. Congress wrote in a section of the Bill itself saying in effect that NEPA does not apply to what we are passing now. There are also rare instances in which it is done administratively, but almost never. In other words, the short answer to your question when is an Environmental Impact Statement not required usually is (1) when the courts say that one is not required for one reason or another, the most common reason being national security, and (2) when Congress approves legislation saying that the National Environmental Policy Act does not apply to one of its programs.