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Richard B. Lillich & John Norton Moore (editors)

OIL AND GAS IN THE OCEANS

Herman T. Franssen

Introduction. Petroleum consumption in the world has doubled during the 1960's and is likely to double again in the period from 1970-1980. To meet these projected demands, nations will increasingly turn toward the last largely untapped reservoirs of oil and gas, the oceans. In the United States—the major oil producer among the large non-Communist industrial countries—new additions to proved onshore reserves are no longer the result of newly discovered fields but are instead caused by improved recovery techniques for already producing wells. Aside from continuing improvements in recovery techniques, new fields with vast petroleum potential are likely to be found in Alaska and beneath the continental margins around the United States.

The two other major industrial giants in the Western World, Western Europe and Japan, are in a far less enviable position than the United States. Neither has large reserves or even substantial potential petroleum resources on land and consequently are largely dependent on the Middle East. These Persian Gulf States contain more than one-half of the world's proved oil reserves, but because of monopolistic practices and political instability have been unable to guarantee supplies at a relatively stable price. Japan and Europe may succeed in partially diversifying their sources of oil and gas supplies through offshore development because liquid hydrocarbons in the oceans are known to be widely distributed around the world. Marine geologists believe that the ultimate recoverable yield of petroleum from the oceans is at least equal to, and probably larger than reserves and resources on land. Hence, offshore

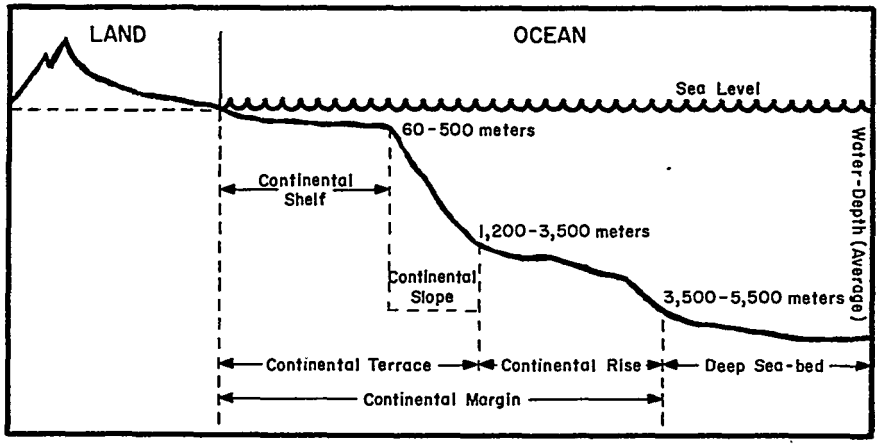
production, which increased sixfold between 1960-69 and contributes approximately 18 percent of the current world production of oil, is expected to continue to grow faster than onshore exploitation and should contribute about 35 percent of total oil production by 1980. While recent rapid increases of the posted prices of crude oil and natural gas will speed up exploratory activities, uncertainty about ownership of parts of the seabed, investment guarantees, and environmental legislation are bound to have a retarding effect until such problems have been solved.

Formation of Oil and Gas. Oil is formed from the remains of marine plants and animals that rest in fine-grained mineral particles such as clay or carbonate muds deposited on the sea-floor. Whenever coarse-grained sediments like sand are present, the organic substance—under high pressure and over a period of millions of years—will migrate into the pervious sand bodies (reservoir beds), where the change of environment may turn the substance into a thick coherent mass of concrete oil particles.

This process by itself is not sufficient to form oilfields. In order to concentrate liquid hydrocarbons in commercially attractive quantities from broad areas of the reservoir bed into smaller areas where it can be tapped, certain geological structures caused by movements in the earth's crust must have been formed to trap oil and gas and prevent further migration into pervious sediments. Traps occur in the form of folds caused by lateral compression of sediments, by local bending caused by penetration of salt pillars (salt domes, diapirs) in the overlying sediments, and by regional compaction of thick sediments over buried hills.[1]

Few areas of the seabed meet all these conditions for the formation and accumulation of oil and gas. For example, one expert maintains that the North Sea, an area of about 200,000 square nautical miles, probably contains only a few hundred square miles with petroleum potential.[2]

Location of Oil and Gas. The seabed is divided into four distinct areas: the Continental Shelf, Continental Slope, Continental Rise, and the Abyssal Plain or deep-seabed. The shelf, slope, and rise, although deeply submerged, are part of the continental mass.



Of the different parts of the seabed, the Continental Shelves, which contain about one-half of the sedimentary strata under the continental margins, are expected to have the best potential for oil and gas accumulation. Not all countries are equally blessed with extensive shelves. There are great variations in width and thickness of sedimentation and in stratigraphic and structural features which trap the migrating oil and gas. Generally, sedimentation is deposited off flat coasts, and the shelves off most mountainous coasts appear to be largely erosional in origin because they are shallowly underlain by bedrock.[3] The Continental Slopes are still largely a mystery, and except for the upper slopes, cannot be considered very favorable prospects for petroleum accumulation. This is because there are fewer layers that are coarse-grained enough to be satisfactory reservoir beds for the migration of oil.[4] There is considerable disagreement among marine geologists about the potential for oil and gas beneath the Continental Rise. Those arguing against a high petroleum potential on the rise point out that sediments tend to be low in organic matter due to oxidation in the very slowly deposited sediments. Others, however, believe that the rise may contain substantial oil deposits and that rich source beds may have been redeposited from the upper slope by turbidity currents, gravity slides, submarine slumps, and bottom currents.[5] Proponents of this theory also point at the presence of favorable structures on the Continental Rise necessary to trap oil and gas.

Beyond the Continental Rise very little is known. Deep-sea sedimentation is generally very thin and thus not likely to contain much oil. An exception may be made for semienclosed seas, where geologists have on several occasions located structures suggestive of potential oil and gas accumulation beneath the Abyssal Plain (Gulf of Mexico and the Mediterranean). At one point a research ship did find a trace of oil in a core drilled in water of 11,720 feet in the Gulf of Mexico.[6]

Reserves and Resources. Petroleum resources can be divided into three basic groups: proved reserves, supplementary reserves, and undiscovered potential resources. Proved reserves are those which geologic and engineering data demonstrate with reasonable certainty to be recoverable from known reservoirs under existing economic and operating conditions. In the United States this is usually no more than one-third to one-fourth of the oil in place. Of the remaining estimated petroleum in known reservoirs, the part that may be recovered with the use of improved secondary and tertiary techniques is called supplementary reserves. Additions from supplementary to proved reserves are subject to technological developments and, even more on the margin between prices and costs. Estimates of potential resources are based on the premise that a given volume or area of sediments in a basin which is favorable for hydrocarbon generation and entrapment should ultimately yield a predictable volume of hydrocarbons. These estimates also consider the geological history and characteristics of the basin and industrial experience in similar but more extensively explored basins.[7] Geologists know that their assessments of undiscovered potential resources are at best educated guesses, useful only in providing information on worthwhile exploration areas. The very size of the ultimate potential recoverable oil and gas, recently estimated at 2,272 billion barrels oil equivalent (in contrast to proved offshore reserves of 100 billion barrels of oil and 131 billion cubic feet of natural gas), may be confusing.[8] It is not the quantity of oil and gas beneath the seabed but the economic value of these resources that is important. At $10 per barrel, the

potential oil resources would represent a value of $20 trillion. However, even if technology were available to exploit all those resources, the production costs of a substantial part of the 2,272 billion barrels might far outweigh the revenues that could be realized by production.

But, there is still sufficient cause to be generally optimistic about new offshore discoveries because more than half of the seabed area in 1,000 feet of water or less is underlain by young sediments of a tertiary age which are known to have a relatively high potential for petroleum. As much of the large onshore oil and gasfields have already been discovered, it is likely that the present ratio of onshore to offshore reserves of 6 to 1 will change considerably in favor of new undersea reserves. Even prior to recent price hikes of crude oil, United Nations sources indicated that new offshore fields with reserves totaling as much as 140 billion barrels of recoverable oil would be added to existing offshore reserves within this decade.[9]

Geographical Distribution of High Potential Areas. North America in general, and the United States in particular, has been the most active in terms of offshore oil and gas exploitation. During the 1950's and 1960's, more than 15,300 wells were drilled off U.S. coasts, producing over 4.5 billion barrels of oil worth $8.8 billion.[10] In contrast to onshore areas where new large reserves have become very scarce, new vast reserves were discovered in offshore Louisiana, California, and Alaska. Lewis Weeks estimated total recoverable petroleum resources of North America up to a depth of 1,000 feet at approximately 20 percent of the world's potential resources.[11] On the basis of his 1965 study, the North American seabed up to a depth of 1,000 feet should contain about 140 billion barrels, plus 60 billion barrels for petroleum liquids exploitable by secondary recovery techniques. Estimates made in 1947 by M. King Hubbert for the U.S. Continental Shelf were 175 billion barrels, and the Weeks study puts U.S. petroleum resources beneath the continental margins at 270 billion barrels.[12] A recent study by the National Petroleum Council (NPC) projects potentially recoverable oil and gas in the United States at respectively 385 billion barrels and 1,178 trillion cubic feet, of which about one-half is said to be in Alaska and in offshore areas.[13]

Although the U.S. Continental Shelf is probably the best known in the world, vast areas remain largely unexplored. For example, the northern part of the Gulf of Mexico off Louisiana and east Texas, where most of the American offshore oil is produced, is quite familiar, but much of the southern shelf of Texas and the entire Floridian shelf still remain untested. Geologists also expect to find petroleum resources on the Continental Slope and Rise as well as on the Abyssal Plain of the northern gulf. Southern California was the major offshore producing area in the United States prior to the 1950's when the Gulf States took over the lead. The area, and in particular the Santa Barbara Channel, will continue to be among the more promising offshore prospects in the country. Discovery of a supergiant field on the north slope of Alaska, a field which is estimated to contain as much as 12.5 billion barrels of oil and 10 trillion cubic feet of natural gas, has drawn attention to the as yet undiscovered petroleum resources in the Gulf of Alaska and in the Beaufort, Chukchi, and Bering Seas.[14] Geological and geophysical surveys off the Atlantic coast have singled out Georges Bank, Blake Plateau, and the Baltimore Canyon basin as the areas with potential oil and gas resources. These, as well as the Alaskan prospects, have shown sedimentation and folding favorable for the accumulation of oil and gas, but none of the prospective areas have been put to the test of the drill.

Favorable conditions continue on the

Canadian side of the border. Already one discovery of natural gas was made on Sable Island, about 100 miles east of Nova Scotia, and Canada's Arctic Circle may be among the most promising prospects in North America. One authoritative source indicates that Canada's Arctic islands may constitute one of the largest offshore petroleum provinces in the world.[15] During the decade of the seventies, Canada may add as much as 56 billion barrels of oil and 336 trillion cubic feet of gas to its reserves.[16]

Outside the United States and Canada, Venezuela is the only major oil producer in the Western Hemisphere. Most of its current production is from Lake Maracaibo, which produces almost 3 million barrels per day. It appears that production from those fields is leveling off, and exports from Venezuela have subsequently declined. The northeastern shelf may offer good prospects for the future. Except for Venezuela, Peru, Trinidad, and Mexico, other offshore ventures in Latin America have proven disappointing, and uncertainty about the role of foreign investment is likely to have a retarding effect on further exploration.

Elsewhere one of the most actively explored areas in recent years has been the North Sea. Since the beginning of exploratory activities in 1967, a total of five giant oilfields have been discovered, and additional large findings can be expected, particularly in the northern part of the sea. A recent estimate puts potential yield of the North Sea at approximately 42 billion barrels of oil and 110 billion cubic feet of gas, enough to turn Norway into a net petroleum exporter and to make the United Kingdom independent from outside supplies by the early 1980's.[17] While no other major discoveries have been made outside the North Sea, the Mediterranean, the Black Sea, Celtic Sea, and a few areas off the Atlantic coast are known to have potentially petroliferous sedimentary formations.

Asia has the biggest known offshore petroleum reserves, and the continental margins from India to Korea are among the most promising areas in the world. Even now, the shallow waters of the Persian Gulf produce oil at a rate of more than 2.6 million barrels per day. Moreover, reservoirs beneath the gulf contain about 75 percent of the world's proved offshore reserves.[18] Indonesia is the second biggest producing and oil exporting region in Asia, and recent wildcat successes off the coast of Kalimantan and Sumatra have spurred further activities on the vast, yet mainly unexplored, Continental Shelves. Exploratory drilling off South Vietnam, Malaysia, and Thailand has discovered little, but vast areas of the subcontinent remain unexplored due to custody disputes and internal political reasons.

Economics of Offshore Oil and Gas Development. The knowledge that more than half of the offshore area in 1,000 feet of water or less is underlain by young sediments of a tertiary age which have a record of greater average yield per well and per discovery than the older sediments[19] must be tempered by some knowledge of the economics of production. In order to be profitable, the expected greater yield per well must offset the usually higher costs of exploration, production, and transportation, which vary considerably with water depth, distance from land, and ocean environment. For example, the operating costs of exploratory drilling under prevailing weather conditions in the North Sea may be twice as high as the cost of drilling at similar depth in areas with generally favorable weather conditions such as in Indonesian waters. In the Arctic Circle, on the other hand, exploring and producing offshore oil and gas may again be several times higher than drilling in the North Sea.[20] A United Nations study undertaken in 1970 estimated the average cost of

exploratory drilling between $350,000 and $2 million per well and for wells currently being drilled in the North Sea as much as $5 million.[21] Production and completion costs also rise sharply with water depth, at least up to 1,500 feet, and are subject to environmental constraints. Hence, production costs may rise from $1.5 million in shallow waters of 100 feet, to $4 million in 350 feet and $12 million in 600 feet.[22] Platforms costing between $1 million and $2 million in the Gulf of Mexico would cost between 8 and 15 million at similar depth at Cook Inlet, Alaska. Transportation and storage costs are also related to water depth and oceanic conditions. Thus, an underwater pipeline of only 8-inch in Alaska is 1.5 times more expensive than an average 30-inch pipeline in the Gulf of Mexico.[23]

A recent study on cost variations of offshore petroleum development came up with the estimates shown in the table below.[24] Cost differences, associated with variations in ocean environment, are due to the need for specially designed equipment, capable of withstanding weather conditions varying from areas with year-round calm weather to stormy winter conditions in the North Sea and the icy waters of the Arctic. Moreover, in some areas bottom currents are very strong and platforms need to be cemented deep into the ocean floor, while in other areas there are hardly any bottom currents and platforms can rest on the seafloor. Costs also increase with water depth and distance from land and markets because of increased expense for drilling, production, servicing, storage, and transportation facilities. The high cost of offshore development has an important bearing on the size of fields that can be economically exploited. Reservoirs that might be considered rich in recoverable oil or gas on land are not necessarily profitable in the oceans; but again there are considerable regional differences. While relatively small offshore fields may be profitably exploited in calm waters where production costs are rather low, in the Arctic only fields of giant size are commercially attractive. It should be noted that 81 percent of the world's current offshore production is a product of giant fields, i.e., fields containing 500 million barrels or more.[25]

Offshore petroleum exploitation is particularly subject to technological changes which can eventually bring about substantial cost-savings. For example, the ability to drill up to 60 wells from one single platform employing directional drilling techniques is a considerable improvement over earlier practices when only one or a few wells could be drilled from one platform. Progress in subsea completion, production, and servicing will also result in large cost-savings in moderately deep and deep waters and under adverse weather conditions in areas where currently fixed platforms are used.

In addition to high development costs, offshore leases have continued to rise throughout the decades of the fifties and sixties. In the Gulf of Mexico, sales of federal wildcat leases went up from an average of $294 per acre in 1954 to $3,187 per acre in December 1972.[26] The costs of offshore leases are

Cost Components	Cost Multiplying Factor (land = 1)		
	100 feet	600 feet	1,000 feet
Exploratory drilling	2	2.5-4.0	4.0
Development drilling	2	4.0-5.0	5.0-8.0
Production facilities	2	2.0-3.0	6.0-16.0
Pipelines	2	2.0-4.0	4.0-6.0

expected to climb even higher when the remaining areas with oil potential are divided up into concessions, the ratio between reserves and production declines, and profit expectations increase. In the United States there is no alternate to competitive bidding, even if it means that large amounts of capital must be committed for leases many years before any return on investment can be realized and with no guarantee of success.[27]

Some have speculated that the combination of regulated domestic prices and high offshore exploration and development costs have kept profits considerably below those of similar investments on land.[28] While exploration and development costs were higher offshore than on land, reserve additions per foot drilled were 2 to 2½ times higher offshore.[29] Exploration, development, and production costs were estimated at $2.34 per barrel for offshore Louisiana crude, which even at 1970 U.S. prices was profitable, and at the current price of more than $5 per barrel for oil produced from old wells and over $10 for oil from new wells, this is very profitable indeed!

A major factor slowing down worldwide petroleum development efforts for many years was the readily available low-cost Middle Eastern crude. There was little incentive to engage in costly deep-water activities, and consequently, only large fields in shallow waters of less than 300 feet were exploited. Even those ventures were barely profitable at pre-1973 prices. Indeed, as late as January 1972, there was some consensus among oil company executives that with the exception of the Santa Barbara Channel, expansion into water deeper than 600 feet would lag because of economic considerations. Many expressed doubt that fields of 200-300 million barrels (a typical good field in the Gulf of Mexico) would prove economical in deep water, considering the present state of the art.[30] This situation has markedly changed. While the production cost of Middle Eastern oil is expected to continue to be less than 20 cents per barrel until the 1980's, the posted price (the artificial price on which taxes and royalties are calculated) rose more than 400 percent between late 1972 and December 1973 to $11.65 per barrel for light Arabian crude. Hence, earlier studies predicting that oil from other than giant or supergiant fields in shallow waters would not be able to compete favorably with alternative sources of supply warrant complete revision. Several companies expecting higher future return on investment from developments in deeper waters have leased tracts off West Africa in water depth up to 3,000 meters, and many countries around the world have sold leases for areas beyond 200 meters.

A major constraint on offshore development is the shortage of skilled personnel and drilling equipment. Since July 1973, when the Federal Government allowed prices for newly discovered oil to fluctuate, the demand for rigs, drilling equipment, and oil pipe rapidly expanded. Unfortunately this happened at a time when world demand for drilling equipment was also at an all-time high, and steel was in short supply. Delivery delays ran as long as 18 months. Even though the drill industry will increase output, it will take a few years before the new rigs will be on the market. Experts also agree that there is a serious shortage of skilled manpower[31] caused in part by the fact that a great deal of the work involves experience, and additional training schools will not solve the short-term problem. One industry observer claimed that shortage of equipment and manpower will trim expansion down to about one-half of earlier estimates.[32]

Ownership of Seabed Resources and Security of Investments. To date, at least 107 nations have confirmed that the coastal state has jurisdiction over

minerals in submerged areas adjacent to its coast. This confirmation has taken the form of domestic legislation, unilateral declarations, regional treaties, offshore concessions, or ratification of the 1958 Convention on the Continental Shelf.

Under the terms of the 1958 convention signed and ratified by 39 coastal states, the Continental Shelf is defined as:[33]

> . . . the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea to a depth of 200 meters or beyond that limit to where the depth of the superjacent waters admits of the exploitation of the natural resources of the said areas . . ..

Hence, by the convention, ownership of seabed resources is subject to two qualifications: that the area is "adjacent" and that the depth of the superjacent waters admits of the exploitation. During the preparatory stages of the 1958 Law of the Sea Conference, several states proposed definite limits to the Continental Shelf, but none of these could win the majority needed for adoption. After 6 years the International Law Commission that had been charged with the preparatory work of the conference in 1950 was still debating the merits of either a depth limit at the 200-meter isobath or a limit defined by exploitability.

While a specific depth limit at the 200-meter isobath would have been definitive, it would have discriminated against countries with narrow Continental Shelves. Most states on the west coast of South America, for example, have generally narrow shelves (in some areas even as little as 1 mile or less), while other nations such as Argentina, Australia, and the entire northern Arctic region have wide shelves, often extending hundreds of miles out to sea.

Latin American countries, meeting in Ciudad Trujillo from 15 to 28 March 1956, submitted a compromise formula which would give the coastal state exclusive jurisdiction over the resources of submarine areas outside the territorial sea to a depth of 200 meters or, beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of the seabed and subsoil.[34] At its eighth session in 1956, the International Law Commission adopted the Latin American formula, and, in the interest of compromise, the Geneva Conference endorsed the Commission's definition of the Continental Shelf.[35]

International lawyers greatly differ over the interpretation of the definition. It could be interpreted that as technology improves, the state will be able to claim that there is no actual limit to the Continental Shelf. Shigoru Oda, for example, argued that under this convention it could be inferred that: ". . . all the submarine areas of the world have been theoretically divided among the coastal state at the deepest trenches. This is the logical conclusion to be drawn from the provisions approved at the Geneva Convention."[36]

On the other hand, the adjacency clause in the definition could be interpreted as to imply that even if technology were available, national jurisdiction cannot be extended unless the area is situated adjacent to the coastal state. A significant number of states voiced support for the concept of a finite Continental Shelf by express provisions in their national declarations, and the International Law Commission (ILC) which prepared the 1958 Geneva Conference, clearly did not intend the exploitability criterion to be a blank check for any ocean depth.[37] Judge Fitzmaurice, for example, pointed out that the concept of the Continental Shelf and the submarine areas did not allow any interpretation which would be "tantamount to appropriation of a part of the high seas," and Garcia-Amador, the chairman of the ILC, said

that "the adjacent areas ended at the point where the slope down to the ocean began, which was not much more than 25 miles from the coast."[38] The adoption of the 1967 United Nations General Assembly Resolution 2340, establishing an ad hoc committee to study the peaceful uses of the seabed and the ocean floor *beyond* the limits of national jurisdiction, indicates that a majority of states recognize that the area of the seabed over which nations can exercise sovereignty is limited.

As to the limits of national jurisdiction over seabed resources, Professor Louis Henkin of Columbia University argues that, although national sovereignty is not limited to the 200-meter isobath, the area is closely limited by the very use of the term "Continental Shelf," . . . which is itself a geological term and does not include the Continental Slope, the Continental Rise, or the Continental Terrace. It is clear the framers were not intending to limit themselves strictly to the Continental Shelf as geologically conceived, but it is also clear that they were trying not to get too far away from it either.[39]

The National Petroleum Council (NPC), an advisory body of the Department of the Interior of the United States, has taken the position that under the 1958 definition of the Continental Shelf, states are entitled to claim submarine areas encompassing the continental margins.[40] The NPC's position is based upon the language of the Convention on the Continental Shelf, the records of the International Law Commission and the conference which negotiated and signed it, the practice of a large number of states in leasing seabed areas in water depth considerably beyond 200 meters, the records of the U.S. executive branch and the Senate during the ratification process, opinions of the International Court of Justice in the North Sea Channel Continental Shelf case, the conclusion of a majority of professional and scholarly bodies that have studied the question, and, the views and recommendations of geology experts concerning the profound differentiation between the submerged continental mass and the deep ocean basin.[41]

In the Continental Shelf cases between the Federal Republic of Germany and the Kingdoms of Denmark and the Netherlands, the International Court of Justice decided on 20 February 1969, that:

> . . . the rights of the coastal state in respect of the area of Continental Shelf that constitutes a natural prolongation of its land territory into and under the sea exist *IPSO FACTO* and *AB INITIO*, by virtue of its sovereignty over the land, and as an extension of it in an exercise of sovereign rights for the purpose of exploring the seabed and exploiting its natural resources. In short, there is here an inherent right . . .[42]

The NPC maintains that the Court's judgment supports the position that coastal states have exclusive rights over the natural resources of all the submerged areas which form the underwater prolongation of such nation's land territory. According to the National Petroleum Council, geological evidence proves the Continental Slope and at least the landward portion of the Continental Rise to constitute a part of the prolongation of the land territory of the continent.[43]

As is so often the case, the solution to one problem has created others. Coastal states can now extend national jurisdiction for the purpose of seabed resources exploration and exploitation out to at least a water depth of 200 meters, but now an effort must be made to determine Continental Shelf boundaries between opposite and adjacent states in areas of shallow waters. Delimitation of the Continental Shelf is regulated under article 6 of the 1958

Convention on the Continental Shelf, which states that:

> Where the same continental shelf is adjacent to the territories of two or more states whose coasts are opposite each other, the boundary of the continental shelf appertaining to such states shall be determined by agreement between them. In the absence of agreement, and unless another boundary line is justified by special circumstances, the boundary is the median line, every point of which is equidistant from the nearest points of the baselines from which the breadth of the territorial sea of each state is measured. Where the same continental shelf is adjacent to the territories of two adjacent states, the boundary of the continental shelf shall be determined by agreement between them. In the absence of agreement, and unless another boundary shall be determined by application of the principle of equidistance from the nearest points of the baselines from which the breadth of the territorial sea of each state is measured.[44]

In the North Sea Continental Shelf cases, the International Court of Justice rejected the German claim that delimitation of the shelf should be governed by the principle that each state is entitled to a just and equitable share, but it also dismissed a submission by Denmark and the Netherlands that delimitation should follow a principle of equidistance in the absence of agreement or unless another boundary is justified by special circumstances.[45] The Court found that no one single method of delimitation was likely to prove satisfactory in all circumstances, that delimitation should be carried out by agreement or by reference to arbitration, and that it should be effected on equitable principles.[46]

Additional complications in the process of determining Continental Shelf boundaries arise from the existence of special circumstances such as trenches in shallow seas, offshore islands used as basepoints, and islands midway between two states in narrow shallow seas. Several bilateral agreements involving special circumstances have been successfully negotiated between North Sea countries and between states in the Persian Gulf area.[47] In the East and South China Seas, however, opposing claims over islets, straight baselines, and trenches in potentially oil-rich areas, have at least in one instance evolved into an ongoing, military clash between China and South Vietnam.

In the years following the 1958 Conference on the Law of the Sea, science and technology advanced to the degree that the seabed beyond a water depth of 200 meters became accessible for mineral exploration, and the actual mining of seabed and subsoil resources was expected to follow soon. Clearly the present chaotic legal void left by the first Law of the Sea Conference needed to be filled, and according to a report issued by the Secretary General of the United Nations:

> . . . The relevant principles of international law do not provide detailed guidance and regulations as regards the exploration and exploitation of mineral resources of the area of the seabed and ocean floor beyond the limits of national jurisdiction, nor has precise legal status of that area been decided or its exact boundaries set . . .[48]

When more knowledge about seabed resources became available, a growing number of nations began to extend national jurisdiction unilaterally, in several cases up to 200 nautical miles from the coast.

Following a speech on the wealth of the seabed by Ambassador Arvid Pardo in the United Nations, the General

Assembly established an ad hoc committee to study the peaceful uses of the seabed and the ocean floor beyond the limits of national jurisdiction. On the basis of an ad hoc committee report issued the following year, a permanent committee was formed, and on 15 December 1969, it, in turn, adopted a resolution requesting the Secretary General to review the opinions of member states on convening a new Law of the Sea Conference to determine the future regime for the oceans.

By Resolution 2750C, the General Assembly decided to convene in 1973 such a conference which—among others—would deal with the establishment of precise and uniform limits of national jurisdiction over the resources of the seabed and subsoil.[49] A machinery was set up to determine the agenda, date, location, and duration of the conference, and since 1971 six preparatory sessions have been held in Geneva and New York. The Committee on the Peaceful Uses of the Seabed and the Ocean Floor Beyond the Limits of National Jurisdiction, usually called the Seabed Committee, formed three subcommittees, each charged with specific responsibilities. Of the three, Subcommittee II is responsible to prepare a comprehensive list of subjects and issues concerning the Continental Shelf, the territorial sea and the contiguous zone, fishing and conservation of the living resources of the high seas, and to prepare draft treaty articles thereon.[50]

The basic problem is to accommodate the needs and interests of the coastal states who demand an extension of resource jurisdiction with the interests of other states and the world community at large.

For the developing countries involved in the dispute, extension of exclusive jurisdiction over resources beyond the territorial sea is the single most important issue. Spearheaded by a small group of Latin American countries claiming a 200-mile maritime zone, the demand for protection of resources beyond a narrow territorial sea gained momentum during the 1960's and has found widespread acceptance in Africa and Asia in recent years.

The first in a series of developments suggesting a trend toward acceptance of a 200-mile limit was the Declaration of Montevideo of August 1970, whereby nine Latin American States specifically recognized the right of coastal states to extend national jurisdiction to a distance of 200 nautical miles, measured from the baseline of the territorial limits.[51] A few months later a larger number of Latin American States meeting in Lima, Peru, confirmed the right of coastal states to establish the limits of maritime jurisdiction "in accordance with reasonable criteria, having regard to its geographical, geological and biological characteristics, and the need to make rational use of its resources."[52] Following the Montevideo and Lima declarations, the Caribbean countries met in Santo Domingo in July 1972 and agreed on what could become a universal formula to reconcile nations demanding narrow territorial limits and those claiming jurisdiction out to 200 nautical miles. The Caribbean nations introduced a new concept, the "patrimonial sea" of 200 miles, in which states would have sovereign rights over all ocean resources. Territorial limits would be restricted to 12 miles.[53] At a seminar of high-level government officials in Yaoundé (Ivory Coast) in June of the same year, participants recommended to African States to extend their jurisdiction over all the resources of the high seas area adjacent to their territorial sea within an economic zone to be established.[54] A year later, in May 1973, the Council of Ministers of the Organization of African Unity recognized the right of coastal states to establish an exclusive economic zone not exceeding 200 nautical miles.[55] China, Canada, Australia, and a growing number of others, particularly de-

veloping countries, appear ready to endorse the concept.

At the preparatory conferences for the law of the sea, which have been held in Geneva and New York since 1970, some countries have proposed a uniform limit of 200 miles within which coastal states will have exclusive jurisdiction over all resources, pollution, and scientific research. Others, with broad continental margins, want to extend exclusive jurisdiction to the outer edge of the margins beyond 200 miles, and a number of landlocked and shelf-locked states prefer a limit of 200 meters or 40 miles, with an additional intermediate zone of 40 miles within which the coastal state would have preferential and veto rights over exploitation. If accepted, the latter proposal would reserve some two-fifths of the world's estimated recoverable offshore oil and gas resources for the international community. The Soviet Union, with its extensive, shallow Arctic Sea, has proposed to limit coastal state jurisdiction to a depth of 500 meters or 100 miles, whichever is further from shore, and the United States propounds a Coastal Seabed Economic Area within which the coastal state could exercise exclusive jurisdiction (subject to certain provisions) out to 200 miles or to the edge of the continental margins. The new U.S. proposal would leave the international community little of any valuable oil and gas resources.

Agreements on the limits of national jurisdiction over seabed resources are compounded by considerable differences of opinion over fisheries. While proponents of a simple 200-mile economic or resource zone tend to stress coastal state rights in the area, they are usually silent on coastal states duties. They also overlook the management problems arising from the adoption of a 200-mile economic zone. Maritime states that have traditionally fished in distant waters (U.S.S.R., Japan, and others) are opposed to granting coastal states exclusive jurisdiction over living resources out to 200 miles. Japan and the Soviet Union recognize the special interest of coastal states beyond territorial limits but maintain that regulatory measures should be established in agreement with other states engaged in fishing in the area. The positions of most coastal developing nations and nations possessing long-range fleets are still far apart on the degree of management responsibilities and catch allocation rights of coastal states in the areas adjacent to a 12-mile territorial sea. The United States, with mixed coastal and distant interests, does not favor any specific limit to exclusive fishing rights, but its proposals provide for coastal state jurisdiction over coastal and anadromous species to the full extent of their migratory range.[56]

As the final outcome is expected to be a package deal, the resources issue cannot be debated in complete isolation from other problems. These include questions of transit through straits used by international traffic, the limits of the territorial sea, the nature and management of the international regime beyond the economic zone, et cetera. Many proponents of extensive coastal state jurisdiction are primarily interested in resources and are willing to give in to maritime nations' demand for narrow territorial limits, provided that their resource interests will be protected. The United States and other maritime powers, in turn, are prepared to accept extension of territorial limits to 12 miles and coastal state jurisdiction over resources beyond the territorial sea, provided there is agreement on free transit through straits used for international navigation and that the interests of both the states and the international community are recognized in the economic zone. Provided that general agreement on all major issues will be reached, acceptance of a 200-mile economic zone appears likely, with some compensation to states with wide

continental margins.

Recent increases in the price of crude oil will have a negative effect on the economies of many developing countries, and this, in turn, may serve as an additional incentive to claim the resources of the entire potentially oil-rich continental margins. In light of this fact, the United States insists on safeguards for its oil drilling industry, in the form of a security of investment clause and on compulsory dispute settlement. Initial capital outlays for development of oilfields beneath the seabed are very high, and it takes years before the first revenue can be expected. Such vast investments can only be made if they are protected by international agreement and if, in case of serious disagreements, disputes will be subject to compulsory claims settlement. Security of investment is in the interests of both the investors and the coastal states with offshore resources. Most developing coastal states rely on foreign capital for the exploration and exploitation of their offshore petroleum resources, and the willingness of these international investors to meet capital demands will be significantly enhanced by the degree of security provided to the companies developing the offshore resources.

The new Law of the Sea Conference is scheduled to commence in Caracas, Venezuela, in August 1974 and will last until draft treaties are completed and agreed upon. Acceptance of exclusive national jurisdiction for the exploration and exploitation of seabed resources extending out to 200 miles from the coast, or even over the entire continental margins, is likely to result in optimum resources exploitation, provided that articles related to security of investment and compulsory claims settlement are included.

Ocean Oil and the Energy Crisis. Although one may expect that offshore petroleum production will grow at a faster rate than predicted prior to the recent price hikes, it is not likely to solve our worldwide energy problems. These are the result of not only limited resources but of Government interference with the market system and, more recently, the creation of an artificial shortage by the major petroleum exporting nations.

Before the Arab embargo, oil needs in the United States were calculated to increase by 25 percent between 1972 and 1976,[57] but in view of higher prices and conservation measures, the actual increase may be somewhat lower. As domestic onshore production reached its peak in 1970 and no North Slope oil is expected to reach the market until the late 1970's, additional supplies have to be imported.

Recent Government policy to allow the price of old and new domestic crude to rise considerably will certainly lead to a renewed search for additional reserves. Moreover, higher prices will make it economical to increase output from existing wells onshore and offshore with secondary and tertiary recovery techniques. However, while potential offshore resources are known to be substantial, it takes between 4½ and 9½ years between the time when funds are committed for exploration and actual full production. On average, it takes from 1 to 3 years of geophysical work to locate a commercially attractive oilfield and another 2 years of exploratory drilling before oil is found. Once petroleum is located, it takes about 6 to 18 months to build production platforms and to set them in place and another 2 to 3 years to bring a platform to full production.

President Nixon's recent energy policy has improved our long-term energy outlook, but, even under the most optimistic conditions, the National Petroleum Council has estimated that we will still be dependent for 11 percent of total energy needs from foreign sources of supply by 1985.[58] The question is, from where? Currently we

import most of our foreign oil from Canada and Venezuela, but Western Hemisphere sources have almost reached their limits, and consequently most of the additional imports will have to be supplied by such areas as the Middle East and North Africa. Aside from the danger of reliance on vital energy supplies from politically unstable sources, the Assistant Secretary for Energy and Minerals of the Department of the Interior, Stephen A. Wakefield, said that "... considering the effect of recent oil increases on the economies of the eastern hemisphere producing nations, their production rates would in all probability not be expanded enough to meet the combined 1980 projected demands of Europe, Japan and the U.S. at any price ..."[59]

Hence, additional world demand must be met from other sources of supply to meet even a downward adjusted demand for petroleum and to prevent potential serious conflict between the United States and its allies over Middle East imports. The continental margins of the world offer a unique solution to our medium-term energy problems. In contrast to onshore petroleum resources, offshore prospects are more evenly divided among the nations of the five continents. Diversification of exploratory and development activities is a good guarantee against future supply interruptions for political or economic reasons. However, it will take several years and vast amounts of capital to search for and produce from new offshore fields. In the meantime, growing dependence on the Middle East cannot be avoided, regardless of successes in our search for new sources of supply. The economic, political, and military consequences are obvious, and it will take superior leadership to bridge the temporary domestic and worldwide energy shortage while avoiding an economic recession at home and a dangerous scramble for limited supplies between the countries of the Western alliance.

NOTES

1. K.O. Emergy, "The Continental Shelves," *Oceanus,* Spring 1973, p. 12.

2. T.F. Gaskell, "Oil and Natural Gas: Evaluation, Exploration and Exploitation of Deep Water Petroleum," Jerzy Stucky, ed., *Symposium on the International Regime of the Seabed* (Rome: Academia Nazionale dei Lincei, 1970), p. 76.

3. K.O. Emery, "Geological Aspects of Sea-Floor Sovereignty," Lewis M. Alexander, ed., *The Law of the Sea* (Columbus: Ohio State University Press, 1967), p. 148.

4. K.O. Emery, "Continental Rises and Oil Potential," *Oil and Gas Journal,* vol. 67, No. 19, p. 231.

5. National Petroleum Council, *Petroleum Resources under the Ocean Floor* (Washington, D.C.: March 1969), p. 25.

6. *Ibid.,* p. 23.

7. United Nations, General Assembly, Doc. A/AC/38/87 (New York: June 1973).

8. An earlier study by Wallace E. Pratt estimated that the Continental Shelves of the world contain more than 1,000 billion barrels of oil, and Lewis Weeks estimated ultimate recoverable offshore oil up to a depth of 1,000 feet at approximately 700 billion barrels and added another 300 billion barrels for petroleum liquids exploitable by secondary recovery techniques. Estimates on the existence of major oil resources on the rise are disputed. Weeks' estimates of oil beneath the Continental Rise (about one-fifth of the resources of the slope) contrast sharply with Emery's findings. Emery believes that Weeks' estimates of oil potential on the slope are too high and that, instead, potential hydrocarbon resources beneath the rise are considerably higher. See: Wallace E. Pratt, "Petroleum on the Continental Shelves," *Bulletin of the American Association of Petroleum Geologists,* April 1947, p. 669; and United Nations, General Assembly, Doc. A/AC/38/87 (New York: 4 June 1973), p. 4.

9. United Nations, ECOSOC, Doc. E/4973 (New York: 26 April 1971), p. 12.

10. *Ibid.,* p. 12.

11. Lewis G. Weeks, "World Offshore Petroleum Resources," *The American Association of Petroleum Geologists Bulletin,* October 1968, p. 1687.

12. Annibal R. Martinez, "Estimates of Petroleum Resources," *The American Association of Petroleum Geologists Bulletin,* September 1966, p. 20001.

13. National Petroleum Council, *U.S. Energy Outlook: a Summary Report of the National Petroleum Council* (Washington: 1972), p. 35.

14. United Nations, ECOSOC, Doc. E/4973, p. 13. Between 1970 and 1980, some 30-40 billion barrels of oil may have been added to proved resources in Alaska. Sam H. Schurr, *Middle East Oil in the Next Decade* (Washington: Resources for the Future, 1970), p. 112.

15. *World Oil,* May 1972.

16. United Nations, ECOSOC, Doc. E/4973, p. 13.

17. *World Oil,* July 1973, p. 76; *World Oil,* 15 August 1973, p. 92. North Sea fields could approach a production of 1.5 million barrels by 1975 and 203 million barrels per day by 1980.

18. John P. Albers, et al., *Summary of Petroleum and Selected Statistics for 120 Countries, Including Offshore Areas* (Washington: 1973), p. 143.

19. Alving Kaufman and Maribeth Handsman, "Ocean Mining: Today and Tomorrow," *The Decade Ahead, 1970-1980* (Washington: Marine Technology Society, 1969), p. 483.

20. For differences in daily costs of operations under varying conditions, see *World Oil,* July 1973, pp. 85-86.

21. United Nations, *Mineral Resources of the Sea,* p. 31; and *Ocean Industry,* September 1973. The average cost of the 1,191 offshore wells drilled off the United States in 1969 was $559,309. See United Nations, ECOSOC, Doc. E/4973, p. 52.

22. United Nations, ECOSOC, E/4973, p. 53. Large platforms in the same area at depth of 430,700 and 1,000 feet were estimated at respectively $6 million, $15 million, and $25 million.

23. *Ocean Industry,* February 1972, p. 41.

24. *World Oil,* July 1973, p. 93. Costs are expected to increase further as operations extend into deeper waters and into remote areas where environmental conditions are severe.

25. See P. Sreenivasa Rao, "Development and the Sea," *Oceanus* Summer 1973, p. 12.

26. Don E. Kash, et al., *Energy Under the Oceans,* (Norman: University of Oklahoma Press, 1974), p. 82.

27. High bonus payments paid for offshore leases do not necessarily mean that offshore activities off the coasts of other states are more profitable since similar (or much higher) amounts of economic rent are extracted by other states in the form of taxes, royalties, pegged prices, et cetera. See Francis C. Christy, "Economic Resources and Prospects for Exploitation of Resources of the Seabed and Subsoil," Paper Delivered at the Council of Europe, Strassbourg, 3-5 December 1970, p. 14.

28. See Miller B. Spangler, *New Technology and Marine Resources Development* (New York: Praeger, 1970), p. 152. Spangler also provides an interesting analysis of the reasons of the rapidly rising bidding for offshore leases in the Gulf of Mexico in spite of lower returns to investment.

29. Alvin Kaufman, "The Economics of Ocean Mining," *Marine Technology Society Journal* July/August 1970, p. 59.

30. *Ocean Industry,* January 1972, p. 21.

31. *Ocean Industry,* January 1974, p. 27.

32. *Ibid.,* p. 27.

33. United Nations, Legislative Series, Doc. St/LEG/SER.B/15 (New York, 1970), p. 767. The legal Continental Shelf defined here differs considerably from the earlier defined geological Continental Shelf.

34. Quoted from P. Sreenivasa Rao, "Offshore Natural Resources: An Evaluation of African Interests," *Indian Journal of International Law,* July 1972, p. 357.

35. *Ibid.,* p. 358. The compromise was facilitated by the fact that the participants at the 1958 Geneva Conference on the Law of the Sea believed that exploitation in water depth beyond 200 meters was indeed far away in the future. See William T. Burke, "Law and the New Technologies," Lewis M. Alexander, ed., *The Law of the Sea: Offshore Boundaries and Zones* (Columbus: Ohio State University Press, 1967), p. 205.

36. *Columbia Journal of Transnational Law,* 1-31, 1968, p. 9.

37. Francesco Durante, "The Present Regime of the Exploration and Exploitation of the Seabed Resources," Jerzy Stucky, ed., *Symposium on the International Regime of the Seabed* (Rome: Academia Nazionale dei Lincei, 1970), p. 283.

38. *Yearbook of the International Legal Commission,* vol. I, 1956, p. 139.

39. U.S. Congress, Senate, Committee on Commerce, *Special Study on United States Subocéanic Lands Policy,* 91st Congress, 1st sess. (Washington: U.S. Govt. Print. Off., 1970), p. 72. Another proponent of the narrow Continental Shelf definition is Professor Carl A. Auerbach of the University of Minnesota. See Carl A. Auerbach, "Tentative Recommendations of the Commission on Marine Science, Engineering and Resources," in Lewis M. Alexander, ed., *The*

Law of the Sea: International Rules and Organization for the Oceans (Kingston: University of Rhode Island Press, 1969), p. 6.

40. National Petroleum Council, *Petroleum Resources under the Ocean Floor* (Washington: 1969), p. 62. Similar opinions are held by R.Y. Jennings and by the Committee on Deep Sea Mineral Resources of the American Branch of the International Law Association. See P. Sreenivasa Rao, *Offshore Natural Resource Exploitation and World Public Order*, p. 116.

41. U.S. Congress, Senate, Committee on Commerce, pp. 79, 80, 93-95. See also National Petroleum Council, *Petroleum Resources under the Ocean Floor*, pp. 55-69.

42. Quoted from K.R. Simmonds, *The Resources of the Ocean Bed* (Oxford, England: Oxford University Press, 1969), pp. 11, 12.

43. National Petroleum Council, *Petroleum Resources under the Ocean Floor*, p. 62. The National Petroleum Council's position was shared by the Committee on Deep Sea Mineral Resources of the American Branch of the International Law Association and the House of Delegates of the American Bar Association. See Interim Report of the Committee on Deep Sea Mineral Resources of the American Branch of the International Law Association, 19 July 1968; and Resolution of the House of Delegates of the American Bar Association of July 1978 in Natural Resources Lawyer, January 1969.

44. Convention of the Continental Shelf, art. 6, para. 1 and 2. 1958.

45. Quoted from K.R. Simmonds, pp. 11, 12.

46. *Ibid.*, p. 12.

47. S. Houston Lay, et al., *New Directions in the Law of the Sea*, Documents (New York: Oceana, 1973), vol. I, p. 108. For Persian Gulf boundary agreements, see, for example, U.S. Dept. of State, Bureau of Intelligence and Research, Office of the Geographer, *Continental Shelf Boundary, Iran-Saudi Arabia*, No. 24, July 1970, p. 7.

48. United Nations, General Assembly, Doc. A/AC.138/12 (New York: 18 June 1969), p. 5.

49. For the complete text of the resolution see United Nations, General Assembly, Doc. A/RES. 2750 (XXV) (New York: 14 January 1971), pp. 5, 6.

50. United Nations, General Assembly, Doc. A/8421 (New York: 1971), p. 5.

51. United Nations, General Assembly, Doc. A/AC.138/L.10 (New York: 28 January 1972), p. 12. The Montevideo Conference was followed by the Lima Declaration of 15 Latin American States which did not specifically endorse a 200-mile limit but maintained the right of the coastal state to establish the limits of its maritime sovereignty on jurisdiction in accordance with reasonable criteria, having regard to its geographical, geological, and biological characteristics and the need to make rational use of its resources. United Nations, General Assembly, Doc. A/AC.138/28, 14 August 1970.

52. United Nations, General Assembly, Doc. A/AC.138/20 (New York: 14 August 1970).

53. For the text of the Santo Domingo Declaration see United Nations, General Assembly, Doc. A/AC.138/80 (New York: 26 July 1972).

54. For the text of the Yaoundé seminar see: United Nations, General Assembly, Doc. A/8721 (New York: 1972), pp. 73-76.

55. United Nations, General Assembly, Doc. A/AC.138/89 (New York: 21 July 1973).

56. Any international agreement which does not take into account migratory habits of fish is bound to render effective regulation and conservation almost impossible.

57. The Chase Manhattan Bank, *The Petroleum Situation*, 30 April 1973.

58. Under the most optimistic supply conditions, the National Petroleum Council estimates that by 1985 oil and gas would each provide 28 percent of total energy requirements; hydro and geothermal energy 4 percent; nuclear and coal 29 percent. Under the most pessimistic supply condition, these figures would be: 38 percent for imported oil and gas; 13 percent for domestic gas; 17 percent for domestic oil; 3 percent for hydro and geothermal energy; and 29 percent for coal and nuclear energy.

59. *Ocean Industry*, January 1974, p. 31.