LAW OF THE SEA

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Introduction

The law of the sea is a body of public international law governing the geographic jurisdictions of coastal States and the rights and duties among States in the use and conservation of the ocean environment and its natural resources. The law of the sea is commonly associated with an international treaty, the Convention on the Law of the Sea (UNCLOS), negotiated under the auspices of the United Nations, which was signed in 1982 by 117 States and entered into force in 1994. At present 133 States have signed and ratified UNCLOS; Canada, Israel, Turkey, USA, and Venezuela are the most prominent among those that have not ratified. This treaty both codified customary international law and established new law and institutions for the ocean. UNCLOS is best understood as a framework providing a basic foundation for the international law of the oceans intended to be extended and elaborated upon through more specific international agreements and the evolving customs of States. These extensions have begun to emerge already, making the law of the sea at once broader, more complex, and more detailed than UNCLOS *per se*.

The law of the sea can be distinguished from two closely related bodies of law: maritime and admiralty. Maritime law is the private law relating to ships and the commercial business of shipping. Admiralty law, often used synonymously with maritime law, applies to the private law of navigation and shipping, in inland waters as well as on the ocean. The latter may also refer more parochially to the legal jurisdiction of specialized Admiralty courts. There may be important overlaps between the public international law of the sea and private maritime law, as may occur through the application of rules for vessel passage through a jurisdiction or the enforcement of domestic law in the ocean.

The historical development of the law of the sea is sometimes traced back to a Papal Bull of 1493, which divided the world's oceans between Portugal and Spain, thereby solidifying Spain's claim to Columbus' discovery of the New World. In the early seventeenth century, an important 'debate' took place between the Dutch jurist Hugo Grotius, who, in 1608, argued on the basis of natural law for freedom of the seas, and the English academic, John Selden, who argued in 1635 for the establishment of sovereign rights over areas of the ocean. In modern times, both regimes persist, although scientific and technological advances have combined to reduce that portion of the seas that is not subject to the authority of coastal States, and international rules have been developed to regulate many types of activities that occur beyond the reach of national jurisdictions.

This article outlines the public international law of the sea, focusing mainly on UNCLOS. Important extensions of the UNCLOS framework are highlighted. The development of the law of the sea can be conceptualized as a tree with UNCLOS as its trunk. Its roots are historical customs, some centuries old, and agreements that emerged mostly after World War II. Its branches are customs, agreements, and soft law that is only now beginning to take shape. Six topical areas are covered: underlying principles, jurisdictions, fishery resources, mineral resources, marine science and technology, environmental protection, and dispute settlement.

Underlying Principles

UNCLOS and its related agreements articulate certain distinctive, but closely related, principles of international environmental law. One of these, concerning sovereignty over resources, can be considered a general principle of customary international law. Others, including precautionary action, the common heritage of mankind, the duty to conserve the environment, sustainable development, and international cooperation, are just now emerging. These latter are philosophical concepts helping to shape the law of the sea that may one day achieve the status of general principles.

Sovereignty over Resources

One of the most widely accepted norms of international environmental law is found in Principle 21 of the Stockholm Declaration of 1972. Its objective is to strike a balance between a State's sovereignty and its responsibility to ensure that its activities and the activities of its citizens do not cause environmental harm to other States or to areas beyond national jurisdiction. The UNCLOS rendering of Principle 21 reads:

> States have the sovereign right to exploit their natural resources pursuant to their environmental policies and in accordance with their duty to protect and preserve the marine environment.

Further,

> States shall take measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights …

This principle applies to the actions of the citizens of a State within its territorial sea and exclusive economic zone, as well as on ships flying its flag, wherever they may steam.

Precautionary Action

First applied to the marine environment in 1987 after the development of UNCLOS, the principle of precautionary action refines and strengthens Principle 21. During the last decade, it was incorporated increasingly into international agreements and soft law, such as the 1992 Rio Declaration and its accompanying Report on the United Nations Conference on Environment and Development (popularly known as Agenda 21). The articulation of the principle has been inconsistent, leading to varying interpretations in different contexts. In the context of marine pollution, a fair, but general, reading of the principle is that the release of substances thought to be potentially harmful should be regulated (or prohibited) prior to the establishment, according to scientific methods, of a causal link between the release and environmental damage. The principle implies a shift in the burden of proof from the pollutee or regulator, who previously had to prove that the release of a substance was harmful, to the polluter, who now must prove that it is not. The principle has an analogous interpretation in the fisheries context.

Common Heritage

Five principal elements characterize the common heritage of mankind: (1) common space areas are owned by no one but are managed by everyone; (2) universal popular interests have priority over national interests; (3) the economic benefits of natural resources exploited from the commons must be shared among all States; (4) the use of the commons must be limited to peaceful purposes; and (5) scientific research is permissible as long as there is no threat to the environment. The principle is stated in connection with the Area (see next section on Jurisdictions), which, along with its resources, is defined explicitly in UNCLOS as the common heritage of mankind. Some commentators have argued, however, that the exploitation of the resources of the Area is still a high seas freedom, not subject to the common heritage principle. This latter interpretation may be particularly relevant for States that have not ratified UNCLOS.

Environmental Conservation

UNCLOS specifies that:

> All States have the duty to take, or to cooperate with other States in taking, such measures for their respective nationals as may be necessary for the conservation of the living resources of the high seas.

Thus, a State whose nationals fish on the high seas is obliged to adopt conservation laws for its own citizens. The principle of obligatory environmental conservation under UNCLOS has influenced subsequent environmental agreements, including the 1985 ASEAN agreement through which its parties contracted to take measures to safeguard ecological processes, and soft law, including Chapter 17 (concerning the Oceans) of Agenda 21.

Sustainable Development

Sustainable development is another principle that emerged after the development of UNCLOS. It was articulated most clearly in the Rio Declaration, and it appears (referred to as sustainable use) in the 1992 Convention on Biological Diversity. As a general guiding principle, it implies economic or resource development in a way and at a rate such that the needs of both present and future generations can be met. Early conceptions of this principle appeared in UNCLOS, particularly with respect to the sustainable yield in fisheries, and it can be seen as closely related to the principles of environmental conservation and precautionary action.

International Cooperation

In addition to the general obligation of members of the United Nations to cooperate in good faith with the organization and among themselves, UNCLOS expresses a particular need to cooperate to conserve the seas. The convention calls for international cooperation in the conservation and management of living and nonliving resources, the use of scientific study for the benefit of mankind, the peaceful settlement of all sea-related disputes, regulation of pollution, technology transfer to developing nations, and enforcement of all the provisions of the Convention.

International cooperation is facilitated by international organizations, thus the Convention provides mechanisms to aid dialogue among member States. Some examples include: the International Sea Bed Authority, the International Tribunal on the Law of the Sea, and the Commission on the Limits of the Continental Shelf.

Jurisdictions

The world's oceans are divided into six basic zones in which the types and degrees of State jurisdiction vary. These zones are: the territorial sea, the contiguous zone, the exclusive economic zone (EEZ), the continental shelf, the high seas, and the Area. The seaward limits of the territorial sea, contiguous zone, and EEZ are defined in terms of distance from a baseline, which is essentially the waterline at low tide. The construction of baselines may follow any of several methods; in theory, the baseline might shift with changes in coastal geomorphology. The drawing of straight baselines is permitted across deeply indented coastlines or to connect islands along the coast of a State. (Islands, differentiated from mere rocks, must be capable of sustaining human habitation or an economic life of their own.) Baselines may not extend more than 24 nautical miles across the mouth of a bay.

Territorial Sea

The territorial sea extends to a limit of 12 nautical miles from the baseline of a coastal State. Within this zone, the coastal State exercises full sovereignty over the air space above the sea and over the seabed and subsoil. A coastal State may legislate on matters concerning the safety of navigation, the preservation of the environment, and the prevention, reduction, and control of pollution without any obligation to make these rules compliant with international standards. Resource use within the territorial sea is strictly reserved to the coastal State.

All States have the right of innocent passage through the territorial sea of another State, although there is no right of innocent air space passage. Innocent passage is considered moving through the territorial sea in a way that is not prejudicial to the security of the coastal State, including any stopping and anchoring necessary to ordinary navigation. Innocent passage implies two important limits to the power of coastal State jurisdiction in the territorial sea: (1) the obligation not to hamper, deny, or impair the right of innocent passage; and (2) the recognition of innocent passage even in the case of vessel-source pollution as long as the pollution is not willful and serious. With notice, innocent passage may be suspended in specified areas of the territorial sea for security reasons.

Even warships are to be accorded innocent passage (submarines must remain on the surface); however, in practice, many States require prior authorization for warships entering their territorial sea, and the law is unsettled here. Following the decision of the International Court of Justice in an infamous case in which Albania failed to notify Great Britain of the presence of underwater mines in the Corfu Channel, the coastal State must notify other States of its knowledge of navigational hazards. Regimes exist also for transit passage through international straits and archipelagic sea lanes passage in designated sea lanes through archipelagos, such as the Philippines.

Contiguous Zone

The contiguous zone is a region adjacent to the territorial sea in which the coastal State may exercise control to prevent and punish infringement of its customs, fiscal, immigration, or sanitary laws. It may not exceed a distance of 24 nautical miles from the baseline. The coastal State may take action only with respect to offenses committed within its territory or territorial sea – not to those occurring within the contiguous zone or beyond. Although not sanctioned by UNCLOS, States such as India, Pakistan, and Yemen have asserted security jurisdiction in their contiguous zones. Such practices are becoming more widely accepted as customary international law.

Exclusive Economic Zone (EEZ)

The EEZ is an area beyond and adjacent to a coastal State's territorial sea to a limit of 200 nautical miles from the baseline. Within this zone, the coastal State may exercise sovereign rights over exploration, exploitation, conservation, and management of natural resources and other economic activities, such as the production of wind or tidal power. All States, whether coastal or land-locked, enjoy the right of navigation and overflight and the laying of submarine cables and pipelines within any EEZ. The coastal State alone, however, has the right to construct and operate artificial islands and other structural installations with accompanying 500 meter safety zones. Within the EEZ, the coastal State is primarily responsible for the conservation of living resources. The coastal State has the right to regulate both marine scientific research and pollution in the EEZ. It also has legislative and enforcement competence within its EEZ to deal with the dumping of waste from vessels and pollution from seabed activities.

The practice of claiming an EEZ is one example of how UNCLOS has given rise to customary international law. The United States, for example, is not a party to UNCLOS but claims an EEZ that extends up to 200 nautical miles from its baseline. Canada has even adapted UNCLOS provisions to meet its needs for an exclusive fishing zone.

Continental Shelf

The continental shelf is geologically defined as the submerged prolongation of the land mass of the coastal State, consisting of the seabed and subsoil of the shelf, slope, and rise. It does not include the deep ocean floor. The significance of the continental shelf is that it may contain valuable minerals and shellfish. UNCLOS addresses the issue of jurisdiction over these resources by allocating sovereign rights to the coastal State for exploration and exploitation.

The shelf has been defined as extending either to the edge of the continental margin or to 200 nautical miles from the baseline, whichever is further. Unlike the case of an EEZ, coastal States do not have to proclaim a continental shelf, but they must define its limits. Where the physical limits of the continental shelf extend beyond 200 nautical miles, the coastal State must delineate it, according to one of several formulas, using straight lines that do not exceed 60 nautical miles in length. A Commission on the Limits of the Continental Shelf makes recommendations to coastal States on matters related to the establishment of outer limits of the continental shelf where they extend beyond 200 nautical miles.

High Seas

UNCLOS defines the high seas to be:

> All parts of the sea that are not included in the EEZ, the territorial sea, the internal waters of a State, or in the archipelagic waters of an archipelagic State.

On the high seas, all States enjoy freedoms of navigation, overflight, fishing, scientific research, the laying of submarine cables and pipelines, and the construction of artificial islands and installations. Because the high seas are open to all States, no State may attempt to subject any part of them to its sovereignty.

Jurisdiction over ships on the high seas is reserved for the flag State. There must be a genuine link between the State and the ship that flies its flag, and States must fix their own conditions for granting nationality to ships and for registration. Warships and government vessels are accorded complete immunity from the jurisdiction of any State other than their flag State. High seas fishing States have a duty to take conservation measures for their own nationals either alone or in cooperation with other nations. In instances of piracy, unauthorized broadcasting, slave trading, illicit drug trafficking, or statelessness, nonflag States may exercise enforcement jurisdiction.

The Area

The Area is defined as 'the sea-bed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction'. The Area has significance because of the occurrence of mineral resources, such as polymetallic nodules. Like the rest of the high seas, the Area and its resources are considered to be the common heritage of mankind. Each State must ensure that the activities of its own nationals are controlled, with the understanding that damage to the Area may entail State liability.

An International Seabed Authority, established in Jamaica, regulates all activities in the Area, from marine scientific research to resource exploration and development. The Authority also has the right to conduct scientific research and to enter into research contracts. Finally, it enjoys the right to make rules and regulations preventing pollution to the marine environment and protecting natural resources. All installations are subject to these rules and regulations.

Boundary Determinations

Several territorial and continental shelf boundaries were decided prior to the signing of UNCLOS, but there are many international boundaries that still must be drawn. In 1984, in the Gulf of Maine Case, the International Court of Justice decided the first combined EEZ and continental shelf boundary, between the United States and Canada. There appear to be no hard and fast rules for boundary determinations. Rationales for claims have ranged from historic uses to economic significance, leading the Court to decide most cases on the basis of equitable principles and relevant circumstances.

Fishery Resources

The last half-century bore witness to significant growth in worldwide yields of marine fish stocks, starting at around 20 million metric tons in 1950 and peaking at 93 million metric tons in 1997. Although each fishery has its own unique characteristics, fisheries scientists now believe that, at the global level, aggregate yields have approached a natural limit. There are well-known examples of fisheries that have been exploited at inefficiently

high rates, leading in some cases to severe stock depletion (e.g., north–west Atlantic cod). Evidence continues to mount of a shift from the exploitation of species at high trophic levels to those at lower levels, revealing a natural constraint to further expansion of wild harvests. Any increases in the production of seafood from the ocean and its value are likely to require both the implementation of more effective management measures that seek to optimize economic yields and the continuing development of husbandry (aquaculture).

In the face of production trends and constraints in wild harvest fisheries, there is a critical need for the implementation of management measures that lead to sustainable yields. Although this need has been recognized for decades, it has rarely been achieved because of the difficulties of allocating shares of harvests across different groups in the face of limits to understanding the dynamics of intertwined ecological and environmental systems. As a practical matter, the international law of the sea relating to fisheries conservation provides only a crude framework within which to work. Domestic and regional institutions implement specific management measures within the broader context of this framework.

Regional Fishery Management

Regional institutions were established as early as a century ago primarily for the purposes of conducting scientific research on fisheries and ecosystems that would lead, it was hoped, to recommendations for management (namely, the International Council for Exploration of the Seas in 1902). In the period since the end of World War II, these regional institutions proliferated. Today, more than 30 regional fishery bodies exist worldwide, most of which now strive to couple fisheries science to the active management of stocks that straddle the fisheries jurisdictions of multiple States or stocks that are located in part beyond any national jurisdiction (the so-called high-seas and highly migratory stocks). Where stocks are actively managed, national quotas tend to be the instrument of choice, although enforcement problems are rife. Even with this institutional presence, at any time, dozens of fisheries conflicts are occurring between the nationals of different States. In the extreme, fishery conflicts have been known to escalate to the level of military intervention.

The impetus for extending national territories that led to the basic jurisdictional zones codified in UNCLOS was driven by the perceived value of marine resources adjacent to coastal States. For fishery resources in the developed world, this value increased as demand expanded and technological innovations reduced costs. In 1958, an international Convention on Fishing and Conservation of the Living Resources of the High Seas was signed, providing the basic framework that remains little changed to this day: local management coupled with the encouragement to cooperate internationally where nationals from different States prosecute the same fishery. According to the 1958 Convention, States were permitted to implement conservation and management measures for their own nationals fishing 'high seas' stocks adjacent to their coasts and were urged to cooperate with other States fishing there.

Fishery Conservation Zones

One shortcoming of the 1958 Convention was that the geographic boundary defining the high seas was left undefined. This problem was rectified by UNCLOS, which permitted States to claim an EEZ within which they could exercise 'sovereign rights' over the exploitation of their natural resources, including fisheries. Several conditions were placed on this exercise of sovereign rights, but, in practice, these conditions are not seen as limiting. For example, States may determine the total allowable catch and are to manage EEZ fisheries at levels that can produce a maximum sustainable yield. However, management for maximum sustainable yield may be qualified at the State's discretion by economic, environmental, ecological, or distributional reasons. These qualifications could be used as arguments for setting allowable catch, and thereby fishing effort, at levels either above or below those that might maximize sustainable yield. If a coastal State does not have the capacity, as measured by itself, to harvest its allowable catch, then, by agreement, it shall give other States, including landlocked and geographically disadvantaged States, access to any surplus. (This provision does not apply to sedentary shellfish stocks anywhere on the continental shelf.) In practice, the discretion accorded a State in determining fishing capacity and allowable catch implies that any surplus could be defined away easily. However, some States, notably Pacific Island States, have used these provisions to rent out their EEZ fisheries to the fleets of major distant water fishing nations, such as Japan.

Coastal States within whose internal waters and EEZs anadromous fish (e.g., salmons) originate or catadromous fish (e.g., eels) spend the greater part of their life cycle are responsible for management of these species. Unless otherwise agreed to on a regional or an international basis, such species are to be fished inside the EEZ. Highly migratory species (e.g., tunas, billfishes, sharks, cetaceans) are to

be managed through regional or international organizations to ensure conservation and to promote optimum utilization. Importantly, marine mammal conservation may be regulated more strictly within a coastal State's EEZ than provided for by international rules.

Straddling and High Seas Stocks

UNCLOS also provides a framework for straddling and high seas stocks. This framework has been elaborated further in a 1995 international Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks. Problems remain, however, including the specification of multiple and potentially mutually exclusive management objectives (e.g., maximize yield and minimize by-catch). Again, regional bodies are asked to undertake the tough job of operational management. States are encouraged to join existing or to establish new regional management institutions. However, where such bodies already exist, the basis for incorporating new entrants into decision making and for allocating to them a limited quota remain unclear.

Mineral Resources

Ocean mineral resources, particularly offshore oil and natural gas, contribute significantly to worldwide supply. Offshore deposits now provide almost 10% of oil and 20% of natural gas production worldwide. Hard mineral deposits are much less important, although in some areas their production is meaningful to local economies. Tin has been produced for decades by dredging high-grade deposits located in the nearshore waters of Thailand and Indonesia. Diamonds are now profitably recovered off the coast of Namibia. Sulfur and salt are mined in conjunction with offshore oil production. Sand and gravel and calcium carbonate for use as a construction aggregate and to forestall beach erosion are dredged in many parts of the world. Other minerals on the continental shelves include phosphorite deposits and heavy mineral sands. Interest in the exploration of these latter occurrences continues, but these resources cannot yet be classified as economic reserves.

Certain types of deep ocean mineral deposits are plentiful, including polymetallic nodules, ferromanganese crusts, and polymetallic sulfides. Much political effort was expended to establish in UNCLOS an international legal regime governing the exploitation of these classes of minerals. Although deep ocean resources are thought to be vast, the cost of recovery and processing, including the major risks of operating on the high seas, cannot now or in the foreseeable future justify their commercial exploitation.

Continental Shelf Minerals

Because of the costs of operating in the offshore environment, much of the production of ocean minerals takes place in shallow, near-shore waters. Deep-water facilities, which at present are operational only for oil and natural gas, such as those in the North Sea, require very large or high-grade deposits to generate viable scale economies. Where production takes place within the territorial sea, the legal regime is well developed, differing little from domestic rules onshore. Consequently, the most significant legal provisions in the international law of the sea relating to mineral resources concern the establishment of a regime for the continental shelf.

Production from seabed pools of oil and natural gas began at the turn of the century off the coast of California and in the Gulf of Mexico. But it was not until after World War II that an international legal regime governing the disposition of the resources of the continental shelf began to take shape. In 1945, US President Harry Truman issued a Proclamation asserting US jurisdiction and control over the Continental Shelf seabed and the natural resources of the subsoil. No seaward limit to the shelf was specified, although it was suggested that the shelf could be considered to extend to a depth of 100 fathoms ($\cong$183 meters). The Truman Proclamation (and its companion proclamation concerning fishery resources) helped set off a series of jurisdictional claims of varying geographic and legal coverages in Latin America, the Middle East, and elsewhere. In 1958, a Convention on the Continental Shelf entered into force, defining the continental shelf as an area adjacent to a State's coast – but beyond its territorial sea – to a depth of 200 m. The adjacent coastal State could exercise sovereign rights over the exploration and exploitation of the natural resources of its continental shelf. Importantly, this jurisdiction could be extended 'to where the depth of the superjacent waters admits of the exploitation' of the natural resources. In this sense, jurisdiction could be expected to 'creep' with technological advance and changes in market conditions.

With respect to ocean mineral development, the activity surrounding the legal regime for the deep seabed arguably has drawn attention away from a more important part of UNCLOS: the royalty provisions concerning the development of the continental shelf. UNCLOS provides that nonliving resource production occurring on that portion of the continental shelf extending beyond 200 nautical

miles is subject to financial payments or contributions in kind to the International Seabed Authority, which is to share them equitably among the parties to UNCLOS. Payments begin at 1% of the value or volume of production in the sixth year of production. The payment increases at 1% a year until it reaches 7% in the 12th year, where it remains fixed.

Deep Seabed Minerals

As the Continental Shelf Convention was being finalized, economic geologists and mining engineers began to examine more closely the potential for exploiting the vast deposits of polymetallic nodules occurring on the deep seabed. Polymetallic nodules are composed of a number of metals, including iron, manganese, nickel, copper, and cobalt. Recent economic analyses focus on nodules mainly as a nickel ore, with cobalt, copper, and, in some scenarios, manganese to be produced as by-products. Early analyses, conducted in the late 1950s and early 1960s, suggested that the nodule resource was commercially exploitable, while noting that there was no legal mechanism for allocating rights to areas thought to be so far offshore as to be beyond national jurisdiction.

In 1967, the Maltese Ambassador to the United Nations, Arvid Pardo, called for an international agreement to prevent the national appropriation of the deep seabed, to establish the seabed and its resources as a common heritage of mankind, and to employ any resource rents for the development of poor nations. Although these basic principles were eventually incorporated into UNCLOS, their acceptance by the international community, especially by the developed West and the Soviet bloc, was not immediate. By 1970, however, the administration of US President Richard Nixon proposed a common heritage mining regime for an International Seabed Area, located beyond the 200 m isobath, that laid the basis for the UNCLOS negotiations.

When UNCLOS was ready for signature in 1982, the deep seabed regime had become so extraordinarily complex and restrictive as to be unpalatable to some of the western market-oriented States. The common heritage principle was to be the centerpiece of the postcolonial new international economic order, through which the development of the world's poorer States would be boosted by mandatory technology transfer and the promise of financial payments flowing from mineral royalties. This conception was made to appear realistic in light of predictions of world resource limits, such as those made by groups like the Club of Rome, and short-term upward trends in metal commodity prices. Those States concerned about the effects on their own mineral sectors from seabed mine production were appeased in part with the promise of production limits. The final treaty provided for a parallel system of mining. Each pioneer investor (either a State or an industrial consortium sponsored by a State) would stake a mining claim and offer an additional claim of equivalent expected value to the International Seabed Authority's Enterprise. The Enterprise would mine the parallel claims using technology transferred to it by the industry.

Although the parallel system was a US proposal, in 1982 the incoming administration of US President Ronald Reagan would have nothing to do with the deep seabed mining provisions. The United States, Germany, and Great Britain, all with industrial interests in deep seabed mining, refused to sign the Convention, arguing that the nonseabed provisions reflected customary international law. Other developed States with seabed mining interests, including Japan, France, Canada, The Netherlands, Australia, and the Soviet Union, signed the Convention but delayed ratification. In lieu of the UNCLOS regime, a reciprocating States regime was organized by the West, permitting claims to the deep seabed to be staked and recognized among the participants to that agreement. The combination of the alternative regime, a steep decline in commodity prices in the 1980s, and delayed ratifications resulted in an agreement in 1994 to modify the deep seabed mining regime. Among other provisions, the revised UNCLOS deep seabed mining regime eliminated production controls and mandatory technology transfers, reduced license fees, and put the claims of miners registered under the reciprocating States regime on an equal footing with pioneer investors registered under the Convention.

Marine Science and Technology

UNCLOS was the first international agreement to establish a regime for the conduct of marine scientific research in the ocean. The regime recognizes the right of a coastal State to control access to ocean areas under its authority for the study of the physical characteristics of the ocean and its natural resources. Although the regime has been characterized by some in the scientific community as unnecessarily burdensome and too discretionary, and although problems in obtaining permission for scientific research commonly arise, the regime has proven to be workable. Seeking permission to conduct marine scientific research in the EEZ or on the continental shelf of another coastal State requires careful

advance planning and, frequently, close cooperation with the scientific community in the coastal State.

The Convention recognizes that any State or competent international organization has the legal right to conduct marine scientific research. This right is conditioned only on the rights and duties of other States. Marine scientific research must be conducted for peaceful purposes, using appropriate scientific methods, and in such a way so as not to interfere unjustifiably with other legitimate uses of the ocean.

Consent Regime

Within its territorial sea, each coastal State has the right to regulate, authorize, or conduct marine scientific research, as a specific exercise of its sovereignty there. The conduct of marine scientific research in the territorial sea of a coastal State requires its express consent. Within its EEZ and on its continental shelf, each coastal State has the right to regulate, authorize, or conduct marine scientific research, as a specific exercise of its jurisdiction there. The conduct of marine scientific research in the EEZ or on the continental shelf of a coastal State requires its consent. A coastal State may not exercise its discretion to withold consent for research on the continental shelf beyond 200 nautical miles unless such research is proposed in areas that have been specifically designated by the coastal State for exploration or exploitation. All States have the right to conduct marine scientific research in the water column beyond a coastal State's EEZ and in the Area.

States seeking consent to conduct marine scientific research must provide detailed information about a proposed research project at least six months in advance. Although it is free to do so, a coastal State is under no obligation to grant its consent for scientific research in its territorial sea. Conversely, under normal circumstances, a coastal State is to grant consent for EEZ or continental shelf research, and it must establish rules so that requests for research are not delayed or denied unreasonably. However, coastal States are given considerable discretion to withhold their consent for EEZ and Continental Shelf research. Notably, consent may be withheld if a scientific research project is of significance for resource exploration or exploitation, involves drilling or the use of explosives or harmful substances, involves the construction, operation, or use of artificial islands; if the request for consent contains inaccurate information about the nature and objectives of the project, or if the requesting State has outstanding obligations from a prior research project. If consent is granted, the coastal State has the right to participate or to be represented in the research project and must be given access to all data and samples, assessments of data, and preliminary and final project results. Unless the coastal State acts to withhold consent within four months of the request or requires supplementary information, or unless outstanding obligations on the part of the requesting State exist, the consent of the coastal State is deemed to have been implied, and the research project may proceed without an affirmative grant of consent.

Technology Transfer

As an element of the new international economic order, language encouraging marine technology transfer was incorporated into UNCLOS to accelerate the social and economic development of the developing States. However, the technology transfer provisions are mainly hortatory, promoting international cooperation and suggesting options for program development. Importantly, there is no obligation to transfer technology other than on fair and reasonable terms and conditions, respecting the rights and duties of holders, suppliers, and recipients of marine technologies.

Environmental Protection

UNCLOS was designed, in part, to serve as the unifying framework for international law on marine environmental protection, which it does primarily by clarifying the rights and duties of States in this regard. It provides general goals and a few recommendations for combating all forms of marine pollution and environmental degradation but no specific pollution-control standards or required actions. To the extent that specific standards and requirements exist, they are set forth in other multilateral agreements that address either a particular form or source of pollution or a particular area of ocean space.

In addition to creating new legal instruments elaborating rules pursuant to the general goals of UNCLOS, States are called upon to cooperate in notifying other countries of imminent threats of pollution, eliminating the effects of such pollution and minimizing the damage, developing contingency response plans, undertaking research programs, exchanging data, establishing appropriate scientific criteria for pollution-control rules and standards, and implementing and further developing international law relating to responsibility and liability for damage assessment and compensation.

Although UNCLOS requires States to take measures against pollution from any source, it places particular emphasis on certain categories of

pollutant substances and sources. States must take measures designed to minimize to the fullest extent possible: (1) releases of toxic, harmful, or noxious substances, especially those that are persistent, from land-based sources, from or through the atmosphere, or by dumping; (2) pollution from vessels; (3) pollution from installations and devices used in exploration or exploitation of the natural resources of the seabed and subsoil; and (4) pollution from other installations and devices operating in the marine environment. Among the pollutant sources enumerated in UNCLOS, only vessel discharges and dumping by ships and aircraft are currently subject to detailed standards and regulations at the global level.

Vessel Discharges

The main instrument addressing operational discharges by vessels is the 1973 International Convention for the Prevention of Pollution from Ships, as modified by the 1978 Protocol thereto. Known as MARPOL 73/78, this treaty system includes five annexes containing regulations for the prevention of pollution by oil, by noxious liquid substances in bulk, by harmful substances carried at sea in packaged forms or in freight containers, portable tanks, or road and rail wagons, by sewage from ships, and by garbage from ships. The annexes covering oil and noxious liquid substances in bulk are mandatory for all contracting parties, but the others are optional.

Ocean Dumping

Pollution by dumping includes the deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms, or other artificial structures, as well as the deliberate disposal of the vessels, aircraft, or structures themselves. Dumping is regulated at the global level under the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, also known as the London Convention. The Convention prohibits the dumping of certain hazardous materials and limits the dumping of other wastes or matter by requiring prior permits, including special permits for some materials according to criteria relating to the nature of the material, the characteristics of the dumping site, and the method of disposal. An important category of wastes not covered by the London Convention are those derived from the exploration and exploitation of seabed mineral resources.

Under UNCLOS, such wastes remain subject to regulation by individual States for activities conducted in areas under their jurisdiction, while wastes resulting from activities in the Area beyond national jurisdiction are subject to regulation by the International Seabed Authority. UNCLOS also mitigates a more general shortcoming of the London Convention – the fact that it has only 78 Contracting Parties representing just 68% of world merchant-marine tonnage. The main benefits of UNCLOS in this regard are that it clarifies the rights of coastal States to prohibit dumping in waters under their jurisdiction and requires all of its Contracting Parties to enact domestic measures that are at least as stringent as the London Convention requirements.

Movement of Hazardous Wastes

Another global agreement, of relevance to both vessel-source pollution and dumping, is the 1989 Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention). Under the Basel Convention, transboundary movements of hazardous or other wastes can take place only upon prior written notification by the exporting State to the States of import and transit, and each shipment of waste must be accompanied by a detailed movement document.

Land-Based Marine Pollution

Land-based marine pollution (LBMP), although it accounts for an estimated 80% of all contaminants entering the sea, is regulated only at the national level throughout most of the world, with the exception of six regional seas where multilateral agreements are in force. Adoption of a global treaty on LBMP was the object of intensive diplomatic effort from the mid-1980s until 1995, when 109 States adopted instead the nonbinding Global Programme of Action for the Protection of the Marine Environment Against Land-Based Activities. Among the main factors discouraging adoption of a binding global convention have been the largely disappointing results of the regional agreements and the fact that the causes and effects of LBMP operate primarily at regional or smaller geographic scales. The main arguments in favor of a global convention have centered on the pervasiveness and seriousness of the problem in virtually all regions of the world and the inability of developing countries and regions to address it effectively in the absence of a legal mechanism that provides for the transfer of relevant technologies and other forms of assistance from the developed world.

Airborne Marine Pollutants

No multilateral agreements are in force whose primary purpose is the regulation of airborne marine pollutants, but such pollutants are included within

the general scope of several regional agreements that address a broad range of marine pollution sources. Of these, only the agreements covering the Baltic, North-East Atlantic, and Mediterranean include any specific regulatory measures. In addition, the 1979 Geneva Convention on Long Range Transboundary Air Pollution provides for detailed regulation of emissions of numerous airborne pollutants by participating Northern Hemisphere countries. Although it does not target marine pollution directly, the Geneva Convention presumably provides indirect benefits to the marine environment.

Persistent Organic Pollutants

Potentially among the most significant international instruments for controlling marine pollutants that are both land-based and airborne is a draft global convention slated for adoption in late 2000. Commonly known as the POPs Treaty, the agreement will regulate the production, sale, and use of initially one dozen persistent organic pollutants (POPs), most of them pesticides, whose characteristics include the tendencies to bioaccumulate in the marine food chain and to undergo long-range oceanic and atmospheric transport.

Habitat and Ecosystem Protection

UNCLOS calls for States' pollution-control measures to include measures to protect habitats and ecosystems, but it does not make an explicit call for cooperation in this regard or for ecosystem-based management of marine resources. UNCLOS thus leaves large marine ecosystems, which typically straddle two or more jurisdictional zones, subject to potentially conflicting management approaches and enforcement standards. Protection of marine *habitats* is provided under two major international treaties – the 1975 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) and the 1992 Convention on Biological Diversity – and under several Regional Seas protocols and other regional agreements. Protection of marine ecosystems is far less well developed in international law, no doubt in large part because ecosystem science and management are themselves comparatively new and undeveloped fields. This circumstance may also account for what some legal scholars consider to be an incoherent approach to ecosystem protection in UNCLOS.

The lack of clarity as to the locus of authority to enforce ecosystem protections is uncharacteristic of UNCLOS, which otherwise exhibits an overriding concern with jurisdictional clarity in the balance it strikes between the competing interests of international navigation and the environmental protection concerns of coastal States. In general, UNCLOS limits the authority of States to enforce national and international environmental regulations where such authority conflicts with other principles established under the various legal regimes relating to different categories of ocean space. For example, coastal State authority to enforce national laws is subordinated to the right of innocent passage in the territorial sea; and on the high seas, only the flag State of an offending vessel has authority to enforce international environmental regulations, in deference to the principle of freedom of navigation. Because of such provisions, in the view of some environmentalists, UNCLOS does not provide the basis for full and effective protection of the marine environment, even if its entire agenda of elaborating agreements is eventually completed.

Dispute Settlement

Following the UN Charter, which requires that all States settle their international disputes by peaceful means and without endangering international security, UNCLOS provides a binding framework for the peaceful settlement of sea-related disputes. The Convention stipulates that if States cannot resolve their disagreements peacefully on their own, they are to submit them to one of the following international bodies of their choice: (1) the International Tribunal of the Law of the Sea; (2) an arbitral tribunal constituted in accordance with Annex VII of the Convention; (3) a tribunal set up in accordance with Annex VIII; or (4) the International Court of Justice.

International Tribunal of the Law of the Sea

The Tribunal applies the provisions of UNCLOS and other rules of international law in deciding disputes. Its decisions are final and must be complied with by parties to the dispute. The decisions have binding force only among the parties and with respect to their particular dispute.

The jurisdiction of the Tribunal comprises all disputes between parties to the Convention and the agreement relating to the implementation of the deep seabed mining provisions. The Tribunal is called upon to settle three types of claims: (1) claims that application of the International Seabed Authority's rules and procedures are in conflict with obligations of the parties; (2) claims concerning excess jurisdiction or misuse of power; and (3) claims for damages to be paid for failure to comply with conventional or contractual obligations. The Tribunal

also has jurisdiction over disputes concerning the Area through a special Seabed Disputes Chamber and can conduct judicial reviews of the International Seabed Authority. It cannot, however, substitute its own decision or measure for that of the Authority or annul any underlying rule, regulation, or procedure established by it.

In 1999, a dispute between Saint Vincent and the Grenadines and Guinea was one of the first to be settled by the Tribunal. The M/V *Saiga*, a vessel flying the flag of Saint Vincent and the Grenadines, had been pursued and arrested by the Guinean Navy in international waters south of Guinea's EEZ because illegal bunkering was alleged to have taken place within Guinea's EEZ. The Tribunal was charged with making a judgment on whether Guinea could apply its customs laws in an area beyond its territorial sea. Although the ship's master was eventually found guilty on several counts, the Tribunal found that Guinea's application of customs laws in its EEZ was contrary to UNCLOS.

Annex VII Arbitration

When parties to a dispute do not select a specific type of arbitration under Article 287, an arbitral tribunal under Annex VII is automatically formed. Arbitral tribunals formed under Annex VII are five-member tribunals. Each party appoints one member and the remaining three must be approved by both parties and must be nationals of third-party States. Decisions are made by a majority vote of its members.

Annex VIII Arbitration

Arbitration under Annex VIII entails the establishment of four lists of experts from which arbitral tribunals may be constituted to hear special cases. Each party to the convention may nominate two experts in each of the fields. The lists are then established and maintained by four different international institutions: (1) the Food and Agriculture Organization for fisheries; (2) the UN Environment Programme for marine environmental protection; (3) the International Maritime Organization for navigation and ocean dumping; and (4) the Intergovernmental Oceanographic Commission for marine scientific research. Five-member tribunals are set up by these institutions to perform fact-finding and settle disputes.

International Court of Justice

The International Court of Justice (ICJ) is an independent forum for dispute settlement that was established under the UN Charter and whose authority is recognized by UNCLOS. Some disputes regarding the law of the sea have already been brought before the ICJ. An important difference of arbitration under the ICJ is that once States accept the court's jurisdiction, under the Statute of the International Court of Justice, acceptance of the final decision in any case cannot be withdrawn once proceedings are underway. Another difference is that parties cannot select the members of the court who will be hearing the case. Although arbitration before the ICJ depends on the willingness of both parties to agree to and to participate in the arbitration, the Court is powerful enough to exert influence over parties to a dispute who refuse arbitration. For example, in the 1974 Fisheries Jurisdiction case, although Iceland did not appear before the court, the fact that the case made it to the level of international arbitration put considerable pressure on Reykjavik to comply with applicable rules of international law.

Future Prospects

The law of the sea will continue to evolve as the rising worldwide population places greater pressures on the natural resources and ecological systems of the coastal ocean. Most of these pressures, without question, will be situated in the territorial seas and exclusive economic zones. For example, the continuing and growing releases of macronutrients, such as nitrogen, from agricultural operations in all States may have far-reaching and cumulative impacts on coastal environments. To the extent that marine science can unveil the complex physical and ecological links among national marine jurisdictions, the relevance and import of the international law of the sea will grow. Further, a consequence of the scientific portrayal of coupled ocean–atmosphere systems will draw the law of the sea more tightly into the fold of international environmental law, integrating the broader field, and thereby rendering the law of the sea less distinguishable as a selfstanding body of law.

See also

Fishery Management. International Organizations. Mariculture, Environmental, Economic and Social Impacts of. Maritime Archaeology. Manganese Nodules. Oil and Gas. Pollution in a Global Context.

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LEEUWIN CURRENT

See **INDONESIAN THROUGHFLOW AND LEEUWIN CURRENT**

LONG-TERM TRACER CHANGES

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Introduction

Ocean tracers that record long-term changes preserve certain water column information within the sediment. This information comprises (1) the tracers' fluxes in the past, such as erosional input from the continents, hydrothermal activity at mid-ocean ridges, input of extraterrestrial material, or carbonate recycling; (2) the distribution of water masses in the past and the state of the past global thermohaline circulation. Inorganic isotope tracers whose isotope ratios are modified by radioactive decay in their source materials are ideally suited for these studies. Their original water column values can be measured in materials such as biogenic carbonates, ferromanganese crusts and nodules, and the authigenic phase of deep-sea sediments.

Studies of tracer fluxes in the past are favored by those tracers whose residence time in the ocean (τ, defined below) is long relative to the turnover time of the thermohaline circulation (1500 y), such as Sr and Os. Tracers of which τ is of the order of, or shorter than the oceans turnover time (Nd, Hf, Pb, Be) offer the ability to label water masses isotopically. In this case, long-term isotope changes of these intermediate-τ tracers are potentially caused by variations of the thermohaline circulation. However, secular variations of these isotope tracers can also be caused by regional variations in these tracers' fluxes, mostly resulting from changes in weathering. It is not always straightforward to distinguish between these two causes of tracer variations.

Certainly the globally uniform seawater isotope evolution of Sr, Os, and potentially also Be, offer excellent tools for isotope stratigraphy on long (My) timescales.

Definitions and Concepts

Long-term tracers are those elements whose isotopic compositions provide information on the physical and chemical state of the oceans on timescales of several thousands of years to millions of years (My). For example, paleo-oceanographers aim to reconstruct past water mass distributions and the mode of the thermohaline circulation. For this purpose it would be desirable to reconstruct past oceanographic water mass characteristics such as salinity, temperature, silica, or phosphorus content from the sedimentary record. Similarly, the reconstruction of the past land–sea transfer of certain tracers is desirable in order to reconstruct changes in the weathering history of the continents. However, these