(Under)Mining the Seabed? Between the International Seabed Authority Mining Code and Sustainable Bioprospecting of Hydrothermal Vent Ecosystems in the Seabed Area: Taking Precaution Seriously

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(Under)Mining the Seabed? Between the International Seabed Authority Mining Code and Sustainable Bioprospecting of Hydrothermal Vent Ecosystems in the Seabed Area: Taking Precaution Seriously

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INTRODUCTION

Over the millennia, the diverse wealth of the oceans and the critical role of marine ecosystems in the biogeochemical processes of our planet have remained important components of and catalysts to human development. Although life in the oceans is dominated by physical factors such as tides, waves, salinity, temperature, et cetera, these in turn largely determine the nature and character of biological communities. On the economic scale, the relevance of the oceans of the world is simply too vast to detail. The ocean produces most of the oxygen we breathe and oceans dominate the biosphere. Put simply, we owe our existence to the oceans.

Whether in terms of transportation of goods and services, recreation, fishing, or as a source of energy, an econocentric conception of the oceans has dominated normative developments on the exploitation of both marine ecosystem resources and metallic resources lying at the abyssal plains of the oceans. Interestingly, international law on ocean governance has been fo-

*EDITORS' NOTE.—The author wishes to note that the research assistance of Ekaterina Lioubar in the preparation of this article is appreciated. The usual caveat on the author's responsibility holds. This article is dedicated to the author's friend and colleague, Dr. Obiora Chinedu Okafor.


cused on the regulation of ocean resources, especially fish and mineral resources. The latter has been the primary assignment of the International Seabed Authority (ISA) created by the United Nations Convention on the
Law of the Sea (UNCLOS). It was apparently expected that seabed minerals would make a significant contribution to the wealth of nations and the global economy. Recent developments in marine biotechnology, however, suggest that the international community may have missed the primary or at least immediate source of products, services, wealth, and scientific insights. In spite of the focus of the ISA on seabed minerals, bioprospecting of seabed ecosystems, especially, hyperthermophiles and thermophiles is increasingly becoming a profitable industry.

Generally speaking, there are still a lot of things about the oceans and deep seas that modern science is yet to uncover, study, and understand. The evolution of the deep seabed, the dynamics of fluid migration, and the variables where biosphere meets geosphere are some of the fascinating aspects of the deep seabed, which scientists are currently studying. Giant and complex ecosystems in the deep seabed, the role of microbial mediation in biomineralization and calcification in particular, are some of the particular phenomena of the deep seabed that still fascinate marine scientists. The actual and potential economic benefits of hydrothermal bioprospecting and seabed microbiological resources have catalyzed greater research into deep-sea life forms and ecosystems.

Almost 6,000 bioactive metabolites from such microorganisms have been described in recent literature. Hundreds of these bioactive metabolites have novel structures and properties of commercial and industrial interest. In most cases, “these structural and functional properties may provide paradigms for chemically synthesized materials” and biotechnological products. Given the difficulty in reproducing their natural growth conditions in the laboratory setting, bioprospecting of some these organisms remains the only way of collecting and exploiting their unusual chemical properties.

In addition to bioprospecting of hydrothermal bioresources, modern technological development is at the threshold of devising machines and systems for mining polymetallic nodules such as sulfide and manganese deposits.
found on the seabed beyond the territorial jurisdiction of states. These developments are a fulfillment of earlier predictions that supplies of metallic ores from the international seabed may replace or at least significantly augment the land-based supply of precious metals. However, the environmental impact of some of these seabed mineral mining tools remains an open question.

As modern developments in marine biotechnology and ocean mining make feasible the prospects of commercial exploitation of the resources and ecosystems of the international seabed, the question arises as to whether international law has risen to the complex challenges of developing and institutionalizing the framework for the sustainable development of the international seabed area so as to protect hydrothermal vent ecosystems. These questions arise because unlike in the past, the oceans, a "global life-support system often viewed as infinitely resilient, is in a state of serious decline." The environmental impact of seabed mining and bioprospecting is no longer a matter of mere academic speculation or paranoia on the part of environmentalists. There is conclusive evidence to support the dire warnings of marine environmentalists, especially in respect of the environmental impact of seabed polymetallic mining on hydrothermal vent systems.

For example, recent scientific surveys show that as polymetallic nodules are sucked up from the seabed and transported to the surface (during the mining process) sediment clouds are generated at the seabed, mid-water, and at the surface through unwanted sediment discharge. According to one commentator, the sediment activation is "extensive and continuous. For example, a German prototype mining system would mobilize 7,400 tons of sediment daily." Biological, as well as geophysicochemical systems may be affected. Similarly, there is abundant evidence that bioprospecting of plants and habitat destruction has driven some terrestrial plants to extinction. Unless adequate safeguards are in place, there is no reason why a

similar pattern may not occur in respect of hydrothermal life forms of the international seabed and associated habitat. It is hardly in doubt that given the considerable environmental impact of polymetallic and nodule prospecting in the seabed area, a workable regime limiting the environmental impact of polymetallic nodule mining on hydrothermal vent communities is imperative.15

Rapid developments in marine biotechnology and the prospect of seabed mining have exposed the inadequacy of legal frameworks to regulate the exploration, exploitation, and sharing of the benefits that arise from such marine endeavors. The fact of the matter is that despite the giant strides made in and the huge financial stakes involved in bioprospecting of hydrothermal vent ecosystems, legal issues raised by profitable biotechnology development through marine scientific research (MSR) are still at an infant and underdeveloped stage.16

This article evaluates the extent to which the present legal order for the mining of seabed polymetallic nodules with its tangential reference to hydrothermal vent ecosystems succeeds in incorporating precautionary principles. In addition, the article queries the continued wisdom in severing the regulation of seabed mining of polymetallic nodules from the nonregulation of bioprospecting of hydrothermal vent communities of the seabed. The omission of the latter from the regulatory framework of the ISA is perhaps a reflection of the limited jurisdiction conferred on the ISA by the relevant legal instruments governing the oceans. The unfortunate situation today is that there is no existing legal order, sketchy or otherwise, regulating bioprospecting of hydrothermal vent ecosystems. Lyle Glowka has articulated the lacuna in international law of the sea as follows:

[F]rom a practical standpoint, hydrothermal vents, their associated biological communities and the activities governing them fall into an inter-

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14. Although there are various definitions of “regime,” this article would adopt the definition that an international regime is a social institution comprising a set of principles, norms, rules, and decision-making procedures around which actors’ expectations converge in a given issue area in international relations. For a fuller analysis of the concept of regimes, see S. D. Krasner, ed., [Special Edition] International Organization 36, no. 2 (1982): 1-22. See also S. Meese, “The legal regime governing seafloor polymetallic sulfide deposits,” Ocean Development and International Law 17 (1986): 131-62.


national legal crack; neither UNCLOS (United Nations Convention on the Law of the Seas) nor the CBD (Convention on Biological Diversity) specifically reference them, and their application can only be inferred.  

Although international treaties such as UNCLOS and the Convention on Biological Diversity\(^\text{18}\) (CBD) may apply to hydrothermal vents, the scope of applicability of each treaty is largely dependent on the nature and location of the activity in question. Hydrothermal vent ecosystems located in the Exclusive Economic Zone of States are regulated by the relevant laws of the State (including the State's legal obligations under the CBD or any other pertinent treaty to which it is a party). Where, however, hydrothermal vents and their related ecosystems occur in areas outside national jurisdictions and thus part of the "common heritage of mankind," the right to exploit such resources rests with the international community. Strangely enough, the international community has not yet articulated a legal regime for the exploitation of such resources. International law of the sea is, however, in the process of designing a new regime for the exploitation of polymetallic sulfides, which in many respects have some organic links with hydrothermal vent ecosystems. The question that arises is whether the regulation of seabed mining of polymetallic sulfides without making similar rules for hydrothermal vent ecosystems does not compartmentalize an otherwise holistic phenomenon.

This article argues that unless the proposed ISA Mining Code on seabed sulfides makes adequate provisions for the protection of seabed hydrothermal vent ecosystems, the perpetuation of a practice of compartmentalizing the seabed raises significant issues for the health and diversity of hydrothermal vent ecosystems and the seabed as a whole. If a holistic regulation of seabed governance is to emerge, international law has something to do about the legal crack in which hydrothermal vents, their associated biological communities, and the activities governing them have fallen into.

Activities on the seabed that invariably affect hydrothermal vent ecosystems need to be regulated in such a manner as to take into consideration the fact that the overall health and resilience of the oceans cannot be promoted by compartmentalizing the processes and phenomena of the seabed. Although the discovery of hydrothermal vents is a relatively new event, it can hardly be denied that seabed mining and marine bioprospecting are activities that pose serious challenges to hydrothermal vent systems. According to Lyle Glowka, "threats include not only direct physical damage


and destruction, but indirectly the possibility of sedimentation and upsetting water circulation systems. In short, a major thrust of this article is that Article 145 of UNCLOS should be expansively and creatively interpreted by the ISA so that the protection of marine flora and fauna in the international area can be a reality. While it may be premature at this stage to speculate on the contents of the proposed code on seabed sulfide mining by the ISA, the provisions of the Mining Code on manganese nodules probably offers some clues on the direction of the proposed code on seabed sulfide mining. Within this context this article argues that if seabed hydrothermal vents are to be adequately protected, the ISA should seriously consider adopting a relatively liberal construction of Article 145 of UNCLOS.

Furthermore, this article suggests that the preoccupation with polymetallic nodules to the marginalization of hydrothermal vent ecosystems of the international seabed is a legacy of the founding instruments of Part XI of UNCLOS. Arguably, the drafters of the UNCLOS treaty probably did not contemplate the emergence of marine bioprospecting as a viable industry, probably yielding more immediate economic and scientific rewards than polymetallic nodules. Given recent shifts in modern technology, this narrow focus needs to be revisited. More importantly, the question has to be asked, how can exploration for seabed mineral deposits benefit extremophile bioprospecting, and vice versa? And, what, if any, procedural controls are appropriate at this early stage of development of the regimes for seabed mining and bioprospecting of hydrothermal vent communities of the international seabed?

Another collateral issue pertinently articulated by Brewer is the question of the recognition to be accorded to intellectual values and skills, especially those relating to the technology relevant to the exploitation of hydrothermal vent organisms in the Area. In this context, it is important to note that the sharing of technology is not inconsistent with appropriate recognition of the rights of ownership of technology and the benefits accruing to the owners. However, further analysis of the issue of intellectual property rights arising from biotechnology products derived from hydrothermal vent communities is premature and thus beyond the scope of this article.

In summary, this article broadly examines the adequacy or lack thereof of the recent Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area, otherwise known as the ISA Mining Code. These is-

20. The fact that some microorganisms may be found only in physically and/or chemically extreme environments makes them highly useful for the production of novel products.
22. Decision of the Assembly of the International Seabed Authority Relating to the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area. ISBA/6A/18. (Kingston, Jamaica) 13 July 2000. (Hereafter called the Mining Code.)
sues are examined within the context of the evolving norms on sustainable development of marine ecosystems and the obligation of applying the principle or approach of precaution to activities that have the potential of impacting negatively on the marine environment, especially hydrothermal ecosystems. In the course of the analysis, attention is drawn to the fact that UNCLOS and other relevant instruments deriving their authority therefrom gives the ISA power to elaborate and adopt rules, regulations, and procedures to facilitate and govern the exploration and exploitation of seabed minerals.

Without doubt, the most significant body of rules on marine nodule mining and related activities is the Mining Code. The importance of this new regulation, its symbolism as the first mining code on the seabed, and indeed, what it omits to regulate, justifies its central place in the course of subsequent analysis in this article. Three themes run the course of analysis in this article. The first is the limited scientific knowledge of the role of fragile marine environments in the regulation or ordering of global biogeochemical processes. This reality makes a compelling case for precaution. Second, the international community should revisit the inattention to matters regarding hydrothermal vent communities. It is difficult to create a regulatory regime on the marine environment, particularly, the international seabed, and in the same breath, postpone action on regulating hydrothermal vents of the seabed.

Third, in designing the regime for sustainable utilization of the resources of the seabed and bioprospecting of hydrothermal marine ecosystems, there is a great need for flexibility and appreciation of the complexity and differences between various types of nodule deposits and hydrothermal ecosystems. These themes derive from the inherent interrelations and tensions between economic development and the integrity of the marine environment. The fundamental idea in this article is that given the unity of the oceans, serious activities in "one" ocean or part of an ocean would reverberate in other oceans and marine ecosystems.

Towards articulating these multiple but convergent ends, I have divided this article into three parts. The first part deals with the nature and characteristics of marine polymetallic nodules and extremophile ecosystems. This part also evaluates the differences between various polymetallic nodules and thermophilic ecosystems of the international seabed. In addition, issues related to the complexity and immense potential economic benefits of seabed nodules and life forms occurring in the hydrothermal vents of the seabed are addressed. Given the economics of marine resources and ecosystems, this part also examines, albeit briefly, the political economics influencing the development of a regime for deep seabed mining.

The second part examines the evolution of a regulatory regime for the international seabed. The dominant feature here is the process leading towards the emergence of the concept of common heritage of mankind as
the juridical anchor for international seabed governance. This part thus evaluates the various legal doctrines competing for acceptance as the jurisprudential basis for control and regulation of activities relating to the international seabed and associated ecosystems. In this context, the ascendancy of the concept of common heritage of mankind in the development of a regime for regulating access to and exploitation of the seabed is explained on the basis of the numerical weight of third world States at the United Nations. In sum, the second part deals with the foundations, character, and scope of the jurisdiction of the ISA.

The third part extends the scope of the analysis by examining the provisions of international law on sustainable exploration, exploitation, and conservation of the international seabed. It argues that while the Mining Code contains bold and imaginative procedures on dealing with seabed nodule mining, it ignores the potential and actual harmful effects of manganese nodule mining on fragile seabed ecosystems, such as hydrothermal vents. This part evaluates the probable environmental impact of seabed mining and extremophile bioprospecting vis-à-vis on hydrothermal vent ecosystems. Obvious environmental impacts of manganese nodule mining and hydrothermal bioprospecting include marine biodiversity loss, pollution from mining activities, and the possible loss of habitat for hydrothermal life forms.

It seems that the regulations in the Mining Code have sufficient flexibility to adequately reflect the complexity of polymetallic nodules on the international seabed. The more difficult question, rather, disappointment with the Mining Code, is that despite its extensive and stringent nature, it makes little provision for dealing with the impact of manganese nodule mining on hydrothermal ecosystems. However, considering that seabed sulfides have closer organic relationships with hydrothermal vents, this omission may be intentional on the part of the ISA. It is hoped that the proposed Mining Code on seabed sulfide will address the question of protecting hydrothermal vent systems from the environmental impact of seabed sulfide mining. The article concludes with the suggestion that Article 145 of the Convention affords the ISA the legal authority to make provisions for the protection of seabed hydrothermal vents.

POLYMETALLIC NODULES AND HYDROTHERMAL ECOSYSTEMS

Seabed minerals include deposits of copper, sulfur, cobalt, nickel, gold, manganese, and other minerals. There are differences between the origins

23. See Article 156, UNCLOS (n. 3 above).

of manganese nodules and sulfide deposits. Sulfide deposits are usually derived from hydrothermal vents, hence the close relationship between sulfide deposits and manganese nodules. Sulfide deposits are thus usually found at or near areas of active hydrothermal venting, "where hot-water mineral springs flow from the earth and deposit their mineral contents" on the seabed. Hydrothermal vents open where the earth's crust is unstable and as these cracks form, seawater seeps "down into the hot rock and is then expelled again as the temperatures inside the vent causes it to boil. The temperature around such a crack can be as high as 420°C. Small particles and hot water enriched with minerals from the rock spew out the vent." These volcanogenic polymetallic sulfides, as they are called, occupy about 1 percent of the ocean floor.

25. These seabed minerals often accumulate in the abyssal plains of the seabed. In some cases, nodules lie exposed on the seabed. The depth of oceans where polymetallic nodules are located falls between 15,000 and 20,000 feet and distribution of the nodules across the oceans vary. These nodules contain a staggering amount of mineral deposits. Estimates of the volume of manganese nodules in the Pacific Ocean range from 1,700 billion tons to one trillion tons. A United Nations study shows that seabed nodules may contain 16.4 billion tons of nickel, 8 billions tons of copper, and 8.8 billion tons of cobalt. Although nodules occur almost everywhere on the ocean floor, the most promising finds occur in a narrow band stretching from Baja California to about 1000 miles south of Hawaii, a region called the Clarion and Clipperton Fracture Zones. Generally speaking, seabed minerals vary widely in their origins, chemical constitution, physical shapes, and appearance. The nodules are usually spherical, cannon-ball sized concentrations of metallic substance. The abyssal plains of the seabed where the nodules often occur includes mountain ranges, deep trenches, and other unexplored parts of the ocean bed formed as a result of marine geological activities spanning millions of years and extending to present-day geological activities. See H. U. Oebius, "Parameterisation and evaluation of marine environmental impacts produced by deep-sea manganese nodule mining," *Deep-Sea Research* 48, Part 2 (2001): 3453–67; J. Mero, *The Finding and Processing of Deep-Sea Manganese Nodules* (Berkeley: The University of California Press, 1959); J. Mero, *The Mineral Resources of The Sea* (Amsterdam: Elsevier Pub. Co., 1964). Although all oceans have deposits of manganese nodules, available data show that most such nodules occur in the Pacific Ocean; The Report of the U.N. Secretary General. *Marine Mineral Resources*. E/CM.20DD5. 13 January 1971. Manganese is used in the refining of steel and for scrubbing sulfur from stack gas, usually from coal burning plants. Manganese may also be used to refine copper and cobalt. The United States is the world's largest consumer of manganese.


28. These are deposits of sulfur-containing minerals formed by hydrothermal activity, that is, by an upwelling of hot volcanic magma and super-heated seawater from beneath the ocean floor. They are found along an active submerged volcanic mountain range that extends through all the world's ocean basins, as well as around volcanic island chains such as along the western edge of the central Pacific. See *Seabed Authority Begins Work on Scheme to Regulate Polymetallic Sulfides and Cobalt-Rich Crusts*, ISA Press Release, SEA/1764, 15/08/2002. In contrast, cobalt crusts are ox-
Heat-loving life forms are often found in the ecosystems of such hydrothermal vents. Polymetallic sulfides have a link with hydrothermal vents and related ecosystems but their exploitation is a challenge for modern technology. From the juridical perspective it would seem that the development of a legal regime for the exploitation of seabed sulfides has been contingent on their relatively lower economic value. With particular reference to manganese nodules, many states have sought to encourage mining of seabed polymetallic manganese nodules through sponsored scientific researches, tax incentives, and direct government investment. However, while engineering advances in seabed mining have largely focused on manganese nodules, it would seem that immediate economic benefits are flowing from bioprospecting of hydrothermal vent ecosystems. This is largely a result of the fact that seabed mining is not yet commercially viable. The mining of different types of seabed minerals, especially sulfides, when it becomes commercially and technologically viable, however, raises the question of the impact of such activities on hydrothermal vent ecosystems. Given the ecological and environmental inter-relationship between polymetallic sulfide deposits and hydrothermal vent ecosystems, it is pertinent to briefly examine the nature of these ecosystems before evaluating the adequacy, or lack thereof, of the new regime on mining of polymetallic manganese nodules. The nature of these ecosystems raises interesting policy questions for ocean governance.

The existence of unusual life forms at great depths, pressures, and toxicity is not a recent discovery. These life forms found around oceanic hydrodized deposits of cobalt-rich and manganese layers formed by the precipitation of minerals from cold seawater onto hard seabed surfaces. They cover the submerged flanks of inactive underwater volcanoes throughout the oceans, on ridges and other seafloor elevations where currents sweep the rock floor clear of sediments. In addition to the cobalt found in both types of deposit, ferromanganese sulfides also contain manganese, iron, other metals and rare earth elements, while crusts include copper, lead, nickel, zinc, gold, and silver. See, ISA Press Release 1764.


Prior to the discovery of these ecosystems, many scientists held the view that the deep seabed was devoid of biodiversity. The reverse is indeed the case. Thriving communities of many species have been found, some that are unknown elsewhere. These unusual life forms thrive in toxic and extreme environments. The base of the food web for hydrothermal vent communities is populated by a group of bacteria-like microbes, named Archaea, which are genetically distinct from other species on earth. Scientists are of the view that Archaea may have preceded all other life forms on Earth. These Archaea and other biota found at hydrothermal vent sites (collectively termed "extremophiles") have demonstrated incredible abilities to "conduct the basic processes of life at high temperatures and pressures and in the presence of generally toxic chemicals." Over 300 species of hydrothermal organisms have been documented and studied.

The ability of these organisms to survive and thrive in such extreme environments make them prime candidates for synthesizing or developing chemical reactor systems and pollution control organisms where high temperatures, pressures, and chemical activities are necessary for efficient reactions. In this age of biotechnology, these strange life forms have yielded useful medicines, enzymes, nutritional additives, and improved chemical, energy, and agricultural products. For example, two thermophile species *Thermus aquaticus* and *Thermococcus litoralis* are used as sources of the enzyme DNA polymerase for the polymerase chain reaction in DNA fingerprinting. The enzymes from these microorganisms are stable at relatively high temperatures, which is necessary for the polymerase chain reaction process. This product has a current market of about US$ 100 million and forms the basis of much of today's DNA technology industry. According to Montserrat Gorina-Yserrn, "the potential market revenue for these industrial uses has

34. Hydrothermal vents occur when water seeping through cracks on the ocean floor (mid-ocean ridges where the Earth's tectonic plates meet) touch the core of the Earth's magma and are then spewed out at temperatures nearing 350°C. It has been estimated that 30 of these individual vents generate the equivalent energy of the largest nuclear power stations.

35. These organisms have the ability to create their energy without the aid of sunlight or photosynthetic processes. Instead, they use sulfide, which is plentiful in the vents, to create food, in a process called chemosynthesis. There are no plants in the deep ocean, because sunlight cannot reach them.


37. Ibid.

conservatively been assessed at US$ 3 billion per year. Another estimate puts worldwide sales of marine biotechnology related products at $100 billion in the year 2008. Another thermophile, Bacillus stearothermophilus, which survives temperature of 75°C, “has been grown commercially to obtain the enzymes used in ‘biological’ washing powders.” The multibillion dollar market for bio-based products (potentially estimated at $13–$22 billion) is increasingly boosted by recent scientific developments in the area of new deep-diving submersibles and other modern tools. These developments and emerging potentials of the economic and industrial utility of the hydrothermal ecosystems may justify recent hopes that hydrothermal vent ecosystems would become a subocean pharmacy of the world.

It is increasingly becoming apparent in many circles that contemporary international law of the sea has no adequate provisions for sustainable bioprospecting of hydrothermal vent ecosystems. This situation is probably a result of the recent nature of marine biotechnology and more importantly the narrow focus on seabed nodules by the negotiators and drafters of UNCLOS. Thus, although the conduct of marine scientific research (MSR) is regulated in Part XIII of UNCLOS and other international treaties such as the CBD (especially where such activities occur within the territorial boundaries of states), neither UNCLOS nor any other treaty deals in detail with the measures to be taken to regulate bioprospecting of hydrothermal vent communities.

In effect, the impact of treaties such as UNCLOS and CBD are greater in respect of hydrothermal vent ecosystems occurring within national jurisdiction than in areas of the international seabed. Moreover, considering that some technologically advanced States at the forefront of marine bioprospecting, such as the United States, are not party to either UNCLOS or the CBD, the prospecting of hydrothermal vent ecosystems remains a sort of no-man’s land where the rule of ability, rather than of law seems to be the state of affairs. It is within these contexts that the next section examines the im-

pact of the negotiating history of UNCLOS on the contemporary lacuna in governance of hydrothermal vent ecosystems of the seabed area.

THE DEVELOPMENT OF A SEABED NODULE MINING REGIME AND THE MARGINALIZATION OF HYDROTHERMAL VENT ECOSYSTEMS

The complexity of the legal nature of access to and property rights over seabed resources, especially hydrothermal vent ecosystems in the international seabed area, is an enduring challenge for seabed governance. The debate is often an oceanic version of the terrestrial global divide and controversy on equitable access to and equitable sharing of the resources of the planet. In a nutshell, the debate on access to the deep seabed revolves around the vexed issues of ownership, mining, production, distribution, pricing and equitable sharing of the profits from seabed resources. However, these complex problems directly implicate not only the juridical character of the ocean floor, but also governance of the fragile ecosystems of the seabed.

In a juridical sense, the heart of the matter is how best to devise an equitable and sustainable regime governing access to the seabed and its ecosystems, especially, hydrothermal vent communities. While some states, scholars, and various stakeholders in the resources and ecosystems of the seabed have sought to answer this question by positing that the international seabed is res communis (common property), others have argued that the concept of res publica (public property) should be the operating concept. These various concepts import different legal and juridical implications.42

Ostensibly deriving support from the writings of Hugo Grotius, some scholars43 and few industrialized states argued that the ocean seabed be-


43. See for example, D. Larson, “Foreword,” *Ocean Development and International Law* 11, no. 1 and 2 (1982): 1–8; D. Larson, “The United States position on the deep seabed,” *Suffolk Transnational Law Journal* 3 (1979): 1–45. It is doubtful whether Grotius meant what modern scholars attribute to him in respect to the seabed. Grotius argued, at least by inference, that title to a produce of the high seas vests in whoever was first to reduce such produce to private possession. This is quite different from the assertion of exclusive right to harvest the seabed being advanced by some scholars and a few industrialized States. While the doctrine of the freedom of the seas justifies the former, it hardly protects the latter. The latter is clearly a claim of right to the resource in situ or indeed a private claim of territorial sovereignty of the seabed itself. For a detailed analysis of this issue, see G. Biggs, “Deep seabed mining and unilateral legislation,” *Ocean Development and International Law* 8, no. 3 (1980): 223–58.
longed to no one and thus its exploitation should be free to everyone and merely restrained by ability, technology, and financial strength. In other words, ocean floor minerals and ecosystems should be subject to a free-access regime (FAR). In practical terms, what this position translates into is that the resources of the high seas belong to those who have the means and the will to exploit it. Needless to say, in a world divided on the lines of technological abilities or lack thereof, seabed resources would practically belong to the industrialized States.

Scholarly support for the FAR doctrine was anchored on scant authorities such as Article 2 of the 1958 Geneva Convention. However, as Van Dyke and Yuen have clearly demonstrated, neither the text of the 1958 Geneva Convention nor the associated ambiguous commentaries affords any defensible basis for the theory that the international seabed was part of the freedom of the high seas under customary international law. Not surprisingly, few States and scholars shared the opinion that the seabed should be subject to a FAR doctrine.

Although the vocal champions of the common heritage concept as applied to the seabed were mainly drawn from the industrializing world, it would be incorrect to argue that all industrialized States had always believed the international seabed to be subject to the principle of the high seas, belonging to no one or res communis. In fact, some of the earliest proponents of the common heritage concept as applied to the international seabed were

44. Marvasti (n. 29 above), p. 274.
45. According to Charles Brewer, Acting Legal Adviser, United States Department of State “at the present time, under international law and the High Seas Convention, it is open to anyone who has the capacity to engage in mining of the seabed.” Hearing Before the House Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, 93rd Congress, 1st Session, 50 (1974).
48. See generally, Van Dyke and Yuen (n. 31 above).
49. There are inherent inconsistencies and inefficiencies in the res nullius argument for the seabed. For example, if the res nullius doctrine is applied to the seabed, the first occupier of a defined part of the seabed would appropriate it as private space. This would of course conflict with the high seas doctrine itself. For a res nullius argument on the seabed, see L. F. E. Goldie, “A general international law doctrine for seabed regimes,” International Law 1 (1973): 796-825.
Presidents Lyndon Johnson and President Richard Nixon of the United States of America. As Van Dyke and Yuen have correctly noted, "the United States gave significant support to the common heritage idea during the Nixon administration."

Ultimately, the political economics of the ocean floor and the struggle for control and regulation of its resources is a reflection of terrestrial self-interest of States and thus it is not surprising that the industrialized States disagreed with the industrializing States on the characterization of the seabed as a common heritage of mankind. As Marvasti notes, "the developing countries support a tightly controlled state ownership regime under the United Nations." The developed countries favor a market system solution administered through a licensing agency or a registry where prices will be the rationing criteria. For a long time, these ideological controversies plagued the development of an acceptable regime for seabed governance.

There are some reasons why the FAR doctrine was not convincing and which made it yield to a regime of common control of the international seabed. First, the industrializing States had the preponderance of votes and were generally opposed to the "winner takes all" principle implicit in the FAR doctrine. Besides the advantage of numbers possessed by the industrializing States under the United Nations framework, the FAR regime originally proposed by some of the industrialized States presupposed that unregulated access to the seabed, even by the industrialized States alone, would not result in congestion and over-use by those possessed of the technological ability. This supposition is far from the reality. A regime of FAR would have had enormous potential for mischief, perhaps anarchy, on access to the seabed. Furthermore, the common heritage concept was proposed at a time when the doomed movement by the industrializing States for a new international economic order was gaining intellectual and emotional ascendancy. Thus, the argument for regulated access to the international seabed was not only anchored on the common heritage concept, but on the economics of effi-

50. In 1966, President Johnson had warned, "under no circumstances, we believe, must we ever allow the prospects of rich harvest and mineral wealth to create a new form of colonial competition among the maritime nations. We must be careful to avoid a race to grab and hold the lands under the high seas. We must ensure that the deep seas and the ocean bottoms, are, and remain, the legacy of all human beings." As cited to in Van Dyke and Yuen (n. 31 above), p. 527.

51. Van Dyke and Yuen (n. 31 above), p. 225.


54. The concept of common heritage of mankind entered the lexicon of international law a few decades ago. While some scholars attribute the origins of this concept to Ambassador Arvid Pardo in 1967, others point to Aldo Cocca's statement some months earlier at the deliberations on peaceful uses of the outer space. It seems, however, that Arvid Pardo was the first to articulate the concept of common
ciency of demarcated property rights and the prevailing temper of the
times. The combination of these and other factors help to explain the rela-
tive triumph of the industrializing States during the process of fashioning
a regime on seabed governance.

The Common Heritage Concept and the International Seabed Area

While the industrializing States had argued, at least, since the late 1960s
that the ocean seabed should be characterized as a common heritage of
mankind, normative steps were simultaneously taken to entrench this
viewpoint. First, a United Nations resolution, the “Moratorium Resolution,”
declared as unlawful any seabed mining activity undertaken without the
authorization of an international body. Second, the position of the indus-
trializing States soon gained ground as the now defunct Soviet
Union, China, Poland, Norway, Finland, the Netherlands, New Zealand, and
Australia all voiced support for the common heritage concept.

Historically, the characterization of the seabed as a common heritage
of mankind may be traced to Ambassador Arvid Pardo’s famous address to
the United Nations General Assembly in 1967. The address, also contained
in the note verbale submitted by the Maltese delegation to the General As-
sembly of the United Nations in 1967, probably owes a measure of debt to
John Mero’s landmark publication of The Mineral Resources of the Sea describ-
ing vast seabed resources. Prior to John Mero’s publication, there was little
heritage as a potential principle on which the proposed seabed governance would
have to be anchored. For an examination of the confused thinking on the concept
of common heritage concept see S. Gorove, “The concept of common heritage of
mankind: A political, moral or legal innovation,” San Diego Law Review 9 (1972):
390-403.

55. I. G. Bulkeley, “Property rights and the efficient development of minerals

56. An attempt by the industrializing states to characterize technology as part
of the common heritage concept failed. See “The draft international code of con-
duct on the transfer of technology,” 6 May 1980, International Legal Materials 17

57. Evriviades (n. 52 above).

58. R. Wolfrun, “The principle of the common heritage of mankind,” Heidelberg


109, p. 30.

61. For a treatise on the common heritage concept, see K. Baslar, The Concept
of the Common Heritage of Mankind in International Law (The Hague: Martinus Nijhoff,
1998).

62. J. L. Mero, The Mineral Resources of the Sea (Amsterdam: Elsevier Science,
1965).
public knowledge of the immense mineral wealth of the seabed. The seabed was an ignored part of the planet.

In the note verbale, the Maltese Delegation posited that the seabed and ocean floor that constitutes five-sevenths of the world's area should be declared a "common heritage of mankind." Riding on those forces that I have briefly elucidated on, and supported by near global unanimity, the Maltese position gained momentum as an emerging norm of international law and was adopted by the United Nations General Assembly Resolution 2749 on 17 December 1970. Although this resolution is notoriously ambiguous, Article 1 thereof clearly states, "the seabed and ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction (hereinafter referred to as the Area), as well as the resources of the Area, are the common heritage of mankind." The characterization of the seabed as a common heritage of mankind has been further entrenched in subsequent norm-bearing instruments hammered out at various international fora. For example, the Charter of Economic Rights and Duties of States adopted by the UN General Assembly on 12th December 1974 recognizes the international seabed as a common heritage of mankind. Article 29 thereof provides, inter alia, that "the seabed and ocean floor and the subsoil thereof, beyond national jurisdiction, as well as the resources of the Area, are the common heritage of mankind." Given the large number and repeated acceptance of the common heritage concept in various international treaties and conventions, it is hardly debatable that the common heritage concept as applied to the seabed has become an entrenched principle of modern international law. However, its scope of application and defining elements or characteristics remain undetermined and sometimes controversial.

The designation of the international seabed as a common heritage of mankind imports some legal obligations on parties to such treaties and conventions. First, it delegitimizes and makes unlawful, national appropriation of the seabed by State parties or entities deriving their juridical status from

63. Note Verbale dated 17 August 1967 from the Permanent Mission of Malta to the United Nations, U.N.G.A./A/6695. The resolution was passed unanimously, by a vote of 108-0 with only 14 states from Eastern Europe abstaining. However, since the mid-1970s, Eastern European states have embraced the concept of common heritage of mankind as applied to the seabed.

64. Declaration of Principles Governing the Seabed and the Ocean Floor, and the Subsoil Thereof, Beyond the Limits of National Jurisdiction, 17th December 1970, 1933rd plenary meeting, UNGA 25th Session.


67. Ibid.
the domestic legal framework of those State parties. Second, it forbids the militarization of the ocean floor through the establishment of fixed military installations. Third, within the context of equity and the Sisyphean attempt to redress chronic global economic apartheid, the common heritage concept abhors the exploitation and depletion "of resources of immense potential benefit to the world, for the national advantage of technologically developed countries." More importantly, notwithstanding some controversies surrounding its elements and scope, the common heritage of mankind concept as applied to the international seabed imposes other legal duties on State parties to the relevant treaties and conventions.

These legal incidents include the removal of the seabed from the sphere of spaces open to national appropriation. In addition, the exploration and exploitation of the seabed would have to be done in a manner consistent with the Principles and Purposes of the Charter of the United Nations. Further, the use of the seabed and its economic exploitation would have to be undertaken with the "aim of safeguarding the interests of mankind. The net financial benefits derived from the use and exploitation of the sea-bed and the ocean floor shall be used primarily to promote the development of poor countries." Furthermore, the seabed is reserved exclusively for peaceful purposes in perpetuity. And finally, the common heritage concept would entail the creation of an international agency to act as a trustee for all countries over the seabed and ocean floor. As the present writer has argued elsewhere, these laudable objectives and normative changes have not completely resolved considerable disagreements over the meanings of the elements of the common heritage concept and the scope of its applicability to the global commons.

68. Note Verbale (n. 63 above).
69. Ibid.
70. On the basis of this principle, the use of the ocean floor as a testing ground for weapons of mass destruction was outlawed under international law. See "Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and on the Ocean Floor and In the Subsoil Thereof," International Legal Materials 10 (1971): 145–77. Similar prohibitions or control on the use of the ocean floor have been made in respect to maritime warfare, laying of submarine cables, marine pollution, etc.
71. Strong United States' objection to these radical proposals that ultimately found their way to the UNCLOS Convention led to its nonratification by the United States. See R. Hildreth, "Legal regimes for seabed hard mineral mining: Evolution at the federal and state levels," Ocean Development and International Law 20, no. 2 (1989): 141–56. Other states that joined the United States in this approach are the United Kingdom and Germany.
This situation may well be a result of the difficult journey towards a global regime on seabed mining that was characterized by protracted negotiations, disappointments, and compromises by various states and blocs, particularly, the notorious North-South divide. From 1973 and 1982, the Third United Nations Conference on the Law of the Sea (UNCLOS III) had produced a comprehensive convention on the seas and oceans of the world. Of the 9 parts of UNCLOS, perhaps the most important is Part XI, which establishes the ISA. The fundamental area of disagreement between the United States and the industrializing States was whether the Assembly or the Council created by UNCLOS should have authority over the proposed ISA. In apparent protest against the ideological and procedural leanings of the emergent ISA and the inordinate delay in fashioning a regime acceptable to its domestic interests, the United States and some other industrialized States such as Germany enacted domestic laws authorizing private entities to exploit and explore the “resources” of the ocean seabed.

Two leading theories have been proposed in explanation for the unilateralist measure of the United States (followed by Germany and Italy) in respect of seabed mining. The first is that the United States wanted to break the deadlock in negotiations concerning the decision-making procedures of the proposed ISA. The second was the fear by the Reagan administration that the American seabed mining industry might abandon the development of seabed mining technology. Some scholars have interpreted the rejection of UNCLOS by the Reagan administration as a triumph of ideology. As Ted McDorman argued, “the United States, in particular, has been unhappy with

74. UNCLOS (n. 3 above) is made up of 15 parts, 320 Articles and 9 annexes.
75. The 1982 LOS Convention which was opened for signature on 10 December 1982, entered into force on 16 November 1994, having received, according to its terms, the necessary number of ratifications or accessions.
76. Part XI of the Convention has been ratified by almost all the industrialized states except the United States.
80. It is significant that in the definition of the term “resources” of the seabed, only polymetallic nodules are captured by the definition. In effect, hydrothermal vent ecosystems and their allied components are not considered “resources” by the UNCLOS Treaty.
81. For a fuller analysis of this phenomenon, see Biggs (n. 43 above).
82. It is significant that of all the industrialized states of the world, only the United States has refused to ratify both UNCLOS and Part XI thereof which establishes the International Seabed Authority.
the deep sea-bed regime of the LOS Convention siding against the regime in the early 1980s primarily for ideological reasons. Although these types of law were designed to be superseded by the UNCLOS treaty, it is now generally agreed by scholars that unilateral legislation on deep-sea mining by individual States is arguably contrary to international law.

Interestingly, unilateral legislation on seabed mining, especially the U.S. version, purport to perform at least two critical functions that may conflict with the international legal regime on deep seabed ocean governance. First, such unilateral legislation created temporary legal frameworks regulating seabed mining by citizens of the States enacting them at the period before the passage of the enactment itself and before the ratification of UNCLOS. Second, it was intended that in the event negotiations failed to produce a treaty acceptable to those States, the temporary regulatory framework created by those unilateral enactments would then become permanent.

Given that new global regulatory machinery has now been instituted, albeit, without the formal participation of the United States, this leaves the question of the juridical and practical import of some of those regulatory frameworks created vis-à-vis the UNCLOS regime. Perhaps, the better question is what is the present legal status of those unilateral legislation on seabed mining? This is a question that may be resolved by reference to accepted principles of international law, particularly, whether a treaty may bind non-parties. Some delegates foresaw this problem during negotiations over the wording of the Declaration of Principles and UNCLOS itself. To avoid this conundrum, both the United States and United Kingdom's representatives had strongly argued that the emergent regime on seabed governance must derive its authority from a great majority of States traversing the various ideological, geopolitical, and economic divides.

86. For a fuller argument, see Willsey (n. 32 above), p. 510.
This position is certainly a reflection of the well-known rule in international law that treaties generally bind only States that ratify them. However, there are treaties that have a universal constitutive effect, for example the UN Charter, binding on all nations, parties or not. A prime example of such a treaty would be one that brings into existence some new global entity. This is particularly the case where the constitutive entity is a product of a treaty generally agreed upon by a preponderance of States across the globe. However, treaties such as UNCLOS that enjoy support from most major political, economic, and geographical groups of the world but lack the universal character of say, for example, the United Nations, are not binding on nonparties. However, the realpolitik of international law may dictate that the structures created by unilateral legislations on seabed mining may not be given practical effect by States that created them, in political deference to the sensibilities of other States or groups of states with mutual interests in the biotic resources of hydrothermal vent communities. Be that as it may, the unenviable situation now is that the regulation of seabed hydrothermal bioprospecting falls into a vacuum that may only be filled by the self-restraint of States and entities. In effect, the consensus of States or entities interested in hydrothermal vent bioprospecting is the crucial lynchpin for the sustainable use of resources of hydrothermal vent ecosystems.

The Jurisdiction of the ISA and Sustainable Exploitation of Seabed Hydrothermal Vent Organisms: Does Article 145 Really Matter?

Apparently taking a cue from the focus of the negotiations at UNCLOS III, the main focus of the ISA has been the regulation of the exploration for and exploitation of manganese nodules. The mandate of the ISA is thus limited, at least for the present, to the Area's mineral resources. However, there is a potential expansion of the ISA's jurisdiction, especially, where seabed mining impacts on hydrothermal vents and in cases where marine scientific research takes place in the seabed area. The potential jurisdiction of the ISA thus involves an intricate web of factors. As Lyle Glowka points out,

[I]t only addresses marine scientific research and the Area's biological communities when seabed mining is involved. Therefore, without (1) direct measures taken by researching States to regulate the conduct of their marine scientific researchers in the Area, (2) a new international treaty or (3) voluntary oversight by the scientific community itself, there is very little that international law can directly offer at present to mini-

mize the potential use conflicts and the threats marine scientific research may pose to a hydrothermal system.89

Hence, to the exclusion of hydrothermal vents and other aspects of the seabed, modalities for the implementation of the rules and procedures concerning the exploitation of the seabed have largely been focused on manganese nodules, and lately, polymetallic sulfides.90 Yet, mining of polymetallic sulfides, when it becomes technologically and commercially viable, would inevitably impact on hydrothermal vent communities. To appreciate the character of ISA’s limited jurisdiction and how this limitation may be remedied or modified to deal with the realities of hydrothermal vent bioprospecting in the Area, it is perhaps necessary to examine the development of the ISA jurisdiction.

The emergence of an acceptable scientific regime for the sustainable exploitation of seabed nodules (to the exclusion of hydrothermal vent resources) may be traced to August 1993 when representatives of several industrialized and industrializing states circulated a paper among the delegates. By 1994, the final rounds of consultations focused on the paper of August 1993 had congregated around five issues, namely,

- Decision-making in the Council,
- The Enterprise, that is, the proposed ISA,
- Provisional application of the Agreement and provisional membership in the Authority,
- The treatment of pioneer investors, and
- Representation of the Eastern European Group in the Council.

At the last meeting of these consultations (31 May–3 June 1994) the draft agreement on the implementation of Part XI of the LOS Convention was


adopted. Given that this Agreement substantively changed certain provisions in Part XI of the LOS Convention, and laid the legal framework for the Mining Code, it has the legal character of a protocol of amendment to the substantive treaty. Moreover, the Agreement and Part XI have to be interpreted and applied as a single instrument and following the lex posterior principle in the interpretation of statutes or legal agreements, in the event of any inconsistency between Part XI and the Agreement, the latter will prevail. In effect, there is no dual regime on the exploitation of the seabed; rather, the terms of the Agreement would have to be reconciled with the UNCLOS treaty. However, a rider is apposite here. No state or entity may establish its consent to be bound by the Agreement unless it has established or establishes its consent to be bound by the Convention itself.

Although the ISA is undoubtedly a unique international organization representing interests covering nearly three-fourths of the Earth’s surface, the problematic question is whether the ISA would be willing to interpret its jurisdiction in such a manner as to enable it to regulate mining activities that negatively affect seabed hydrothermal vent ecosystems. This question arises because a careful reading of the pertinent provisions of UNCLOS and the texts of the Agreement and other instruments of the ISA, particularly the Mining Code, leaves the impression that the ISA jurisdiction is limited to seabed mining. In effect, notwithstanding the clear and direct potential harm that may befall hydrothermal vent ecosystems in the event of seabed sulfide mining activities, hydrothermal ecosystems are left at the mercy of the restraint, if any, that may be shown by entities engaged in seabed mining.

Beyond the potential environmental impact of seabed sulfide mining, regulating access to hydrothermal vent ecosystems of the seabed Area has not really featured in the emerging regime on seabed governance. Thus, marine scientific research or other activities directed at bioprospecting (of seabed hydrothermal ecosystems) would seem to be, prima facie at least, “an exercise of the freedom of the high seas under Article 87 of the UNCLOS


92. For example, provisions on review conference, transfer of technology, production policy, and financial terms of contracts.

93. Article 2 of the Agreement (n. 91 above).

94. For a fuller examination of these issues, see Brewer (n. 21 above).

95. Article 4, par. 2 of the Agreement. This mechanism protects the interests of States who had agreed to be bound by UNCLOS.

Convention." The consequence of this state of affairs is that hydrothermal vents and their communities on the seabed are free for exploitation by whoever has the means or technology to exploit them. Certainly, given the fragile nature of hydrothermal vent systems, it is doubtful whether a regime of neglect of hydrothermal vent systems is consistent with sustainable use of seabed resources. What is interesting here is that the ISA has limited its jurisdiction by circumscribing its regulatory ambit to exploration and exploitation of manganese polymetallic nodules leaving only a tangential responsibility in cases where such mining activities impact negatively on hydrothermal vent ecosystems. This cautious construction of its jurisdiction by the ISA is perhaps best exemplified in the Mining Code. For example, Regulation 1 of the Mining Code provides the following:

[F]or purposes of these regulations. . .

"exploration" means searching for deposits of polymetallic nodules in the area with exclusive rights, the analysis of such deposits, the testing of collecting systems and equipment, processing facilities and transportation systems, and the carrying out of studies of the environmental, technical, economic, commercial and other appropriate factors that must be taken into account in exploitation.

Similarly, seabed prospecting is limited to or defined as the search for polymetallic nodules. Again, Regulation 1 of the Mining Code defines prospecting as "the search for deposits of polymetallic nodules in the area, including estimation of the composition, sizes and distributions of polymetallic nodule deposits and their economic values, without any exclusive rights." Bioprospecting of hydrothermal vent ecosystems is clearly excluded. Clearly, the Mining Code on polymetallic nodules denies and rejects a jurisdiction over hydrothermal vents and its ecosystems. Consequently, the legal position seems to be that bioprospecting activities (not necessarily marine scientific research) in the seabed area and with particular reference to hydrothermal vent systems may proceed unsupervised and unregulated by the ISA or any other international agency.

Although the stance of the ISA on this issue is apparently justified by international law and the enabling convention granting the ISA its powers, such a conservative approach to the exercise of its jurisdiction operates on the questionable assumption that the seabed could be segmented and thus

98. Saigal (n. 42 above).
99. Mining Code (n. 22 above).
100. Ibid. (Emphasis added).
regulated by piecemeal mechanisms. Unless, of course, hydrothermal vent bioprospectors show some restraint of their own volition, it would appear that no legal regulation obliges them to explore or exploit hydrothermal vent organisms in a sustainable or environmentally friendly manner. This would seem to be the legal position, notwithstanding that Article 143(1) of UNCLOS maintains the platitude that marine scientific research in the Area "shall be carried out for the benefit of mankind as a whole." Interestingly, neither UNCLOS nor the Agreement defines the meaning of the phrase "benefit of mankind as a whole." Leaving aside the possible regulation of marine scientific research in the seabed area, would the commercialization of the benefits of marine bioprospecting be construed as a "benefit of mankind as a whole"?

In short, while there is something to be said for voluntary restraint, it would seem that the ISA would be on a good footing if it construed the provisions of Article 145 of UNCLOS in such a manner as to enable it to regulate any activity in the Area that causes or has the potential to pollute or harm hydrothermal vent ecosystems, bioprospecting included. In making this liberal interpretation of Article 145, a few points of argument may be proposed in support. First, Article 87 of UNCLOS is not an absolute provision. The rights granted by Article 87 are to be exercised under the conditions laid down by UNCLOS itself and by other manifestations or evidences of international law on the issue. In addition, the legitimate interests of the other States qualify Article 87.

More importantly, the argument that bioprospecting of the seabed is a freedom of the seas must not be pursued in a manner that seems oblivious to the mutual vulnerabilities of various segments of the oceans. Hydrothermal vents are often linked to polymetallic sulfides. Accordingly, while it might be somewhat expansive for the ISA to make rules pertaining to hydrothermal vent ecosystems in the context of the Mining Code on polymetallic manganese nodules (which have a different origin and relationship with hydrothermal vents), the same cannot be said for hydrothermal seabed sulfides. The overlap between hydrothermal vent ecosystems and polymetallic sulfides makes it reasonable for the ISA, when the time comes, to craft a regulatory framework for the protection of hydrothermal vent ecosystems within the larger framework of the proposed regime or code on mining polymetallic sulfides.

The overlap and shared commonalities between hydrothermal vent systems and seabed sulfide deposits justify any holistic regulatory regime that deals with both types of resources as if they were intertwined and largely inseparable. As the Secretary-General of the ISA recently observed,

101. UNCLOS (n. 3 above).
The essential problem for the Authority is that the hydrothermal vent sites that are being targeted by scientific researchers and bioprospectors are also of considerable interest to prospective seabed miners. There is therefore considerable overlap, as well as potential for conflict, between the Authority’s responsibilities in respect of the marine environment and activities directed at bioprospecting.\textsuperscript{103}

Furthermore, an argument may be made that where hydrothermal vents occur at the seabed the provisions of Article 1 of Part XI of UNCLOS may be read or construed in such a manner that in conjunction with Article 145, UNCLOS empowers the ISA to regulate activities that may be harmful to the integrity and sustainability of seabed hydrothermal vent ecosystems. The territorial jurisdiction of the ISA is limited by UNCLOS to “the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction.”\textsuperscript{104} However, it has to be conceded that beyond the issue of territorial jurisdiction, the pertinent activities that the ISA may regulate in the Area are “all activities of exploration for, and exploitation of, resources of the Area.”\textsuperscript{105} Given that the term “resources” is further delimited or circumscribed to mineral resources, hydrothermal vent organisms are excluded. Furthermore, according to Article 133 of UNCLOS, “for the purposes of this part, (a) ‘resources’ means all solid, liquid or gaseous mineral resources in situ in the Area or beneath the seabed, including polymetallic nodules; (b) resources, when recovered from the Area, are referred to as ‘minerals’.” In effect, where activities in the Area pertain to hydrothermal vents, it would seem that on a strict interpretation of UNCLOS, the ISA lacks the jurisdiction, prima facie, to regulate activities in the seabed area that pertain to bioprospecting of hydrothermal vent organisms.

However, beyond the narrow question of territory and what constitutes “resources” under UNCLOS, the larger question is whether a holistic reading of UNCLOS clearly debars the ISA from regulating activities in the Area if such activities endanger the integrity and sustainability of seabed ecosystems, even if such activities do not directly pertain to seabed polymetallic mining (whether manganese or sulfide)? The answer to this question would probably depend on how narrowly or widely one wants to construe Article 145 of UNCLOS. It would seem that the ISA has a broader regulatory role with respect to the protection and preservation of the marine environment. This jurisdiction would conceivably extend to seabed prospecting of biodiversity as well as to the regulation of marine scientific research in the Area generally.

\textsuperscript{103} Secretary General’s Report (n. 97 above), p. 12.
\textsuperscript{104} Article 1, Part XI, UNCLOS (n. 3 above). (Emphasis added).
\textsuperscript{105} Ibid.
\textsuperscript{106} Article 133, Part XI, UNCLOS (n. 3 above).
This expansive construction of the ISA jurisdiction may be justified on the grounds that aside from mining activities, exploration activities for and bioprospecting of hydrothermal vent communities have huge impacts on the marine environment of the seabed. As Lyle Glowka has pointed out, it is an irony that “perhaps the most immediate threat to hydrothermal vent systems and their associated biological communities may be marine scientific research itself.” Mullineaux and other commentators have noted that disturbance “by researchers can have a substantial impact on vent systems” and that “anthropogenic changes in distribution and occurrence of vent fluid flows and of associated vent communities have been well documented at vents along the East Pacific Rise, on the Juan de Fuca Ridge and the TAG field on the Mid-Atlantic Ridge.” In addition, depending on the circumstances, sampling of marine invertebrates occurring at hydrothermal vents may compromise the biological communities of hydrothermal vents. This may be the case in situations where alien or nonindigenous species are introduced. Furthermore, where a microorganism is not readily culturable or synthesizable, excessive collection or harvesting of such microorganisms may endanger the sustainability of such microorganisms in the pertinent hydrothermal vent community. These concerns make it imperative to rethink how Article 145 of UNCLOS is applied to hydrothermal vent communities. As provided by Article 145,

Necessary measures shall be taken in accordance with this Convention with respect to activities in the Area to ensure effective protection for the marine environment from harmful effects which may arise from such activities. To this end the Authority shall adopt appropriate rules, regulations and procedures for inter alia:

(a) the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging, excavation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to such activities;
(b) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment.

107. Glowka (n. 17 above).
108. Mullineaux et al. (n. 89 above).
109. Article 145, Part XI, UNCLOS (n. 3 above).
Clearly, paragraph (b) of Article 145 is a potential source of legal authority for the regulation by the ISA of any activity capable of damaging life forms of hydrothermal vents. This power can best be exercised in a very nuanced and sophisticated manner. It must however be conceded that the jurisdictional ambit of the ISA that extends to marine scientific research, regulation of seabed mining, accommodation of activities in the Area and in the marine environment, protection of archaeological and historical objects lying at the seabed, et cetera, has not yet been construed to include hydrothermal vent communities of the seabed. This lacuna may be filled by the ISA carefully crafting a mining code on sulfide deposits that takes into full account the relationship between hydrothermal vent systems and sulfide deposits.

THE ISA MINING CODE ON POLYMETALLIC NODULES: PRECAUTIONARY TALES AND THE PROSPECTIVE CODE ON SEABED SULFIDES

The vastness of the oceans may yield the mistaken impression that they are immune from human despoliation. However, there is a consensus of opinion that mining activities in or affecting the ocean floor have various deleterious effects on the entire ocean ecosystem. For example, in addition to direct physical damage and destruction of the seabed, there is the possibility of sedimentation and upsetting of water circulation systems. Living marine resources, their habitats and nonliving marine resources are in a constant state of interaction that may be adversely affected if adequate precautionary measures are not taken in the course of seabed mining. This makes it reasonable to adopt an ecosystem approach in the exploration and exploitation of marine resources.

Conscious of the harmful effects that may result from seabed mining and related activities, Article 145 of UNCLOS recognizes the need for protection of the marine environment. As already noted, Article 145 provides that “necessary measures shall be taken in accordance with this Convention with respect to activities in the Area to ensure effective protection for the marine environment from harmful effects which may arise from such activities.” In addition to authorizing the ISA to deal with pollution and/or environmental damage arising from seabed mining or related activities, Arti-

111. See Preamble to Part XI of UNCLOS, par. 3, (n. 3 above).
113. Article 145, Part XI, of UNCLOS (n. 3 above).
cle 145 makes the protection and conservation of the flora and fauna of the Area a cardinal responsibility of the ISA.\textsuperscript{114}

In this regard, activities in the Area are to be conducted in a policy that will achieve an "orderly, safe and rational management of the resources of the Area ... in accordance with sound principles of conservation."\textsuperscript{115} Furthermore, Article 147 provides that "activities in the Area shall be carried out with reasonable regard for other activities in the marine environment."\textsuperscript{116} Under Article 165 of Part XI of UNCLOS, the Legal and Technical Commission of the ISA has the power to "prepare assessments of the environmental implications of activities in the Area."\textsuperscript{117} In addition, a close reading of Article 165 and other pertinent provisions makes it clear that the Legal and Technical Commission has the power to make regulations governing mining and related activities in the Area. Clearly, these are immense responsibilities requiring interdisciplinary cooperation, flexibility, and expertise.\textsuperscript{118} More importantly, these provisions offer a juridical basis for an ecosystem approach in the articulation of a framework for regulating mining of polymetallic sulfides and the impact of such activities on hydrothermal vents.

Under the relevant procedures of the ISA, mining of the seabed may be undertaken if the following requirements are guaranteed: (a) the economic viability of the mining site; (b) the availability of the mining and metallurgical processing technology; (c) the existence of safe legal grounds with security of investment and assurance of access to mining sites; and (d) the availability of adequate financing. Remarkably, however, none of these criteria have a direct bearing on the issue of hydrothermal vent bioprospecting. Under the ISA guidelines, access to the minerals of the area may be gained when the prospective miner submits a workplan to the Authority's Legal and Technical Commission. The workplan submitted to the Commission should be in the form of a contract and contain not only a declaration of sponsorship by the appropriate state, but also an assurance that the applicant will comply with the provisions on the transfer of technology to the Authority and will accept that the rules and regulations of the ISA, including the Mining Code, are enforceable.

114. Pursuant to this provision, the ISA hosted 10 experts on the deep seabed environment to help make recommendations for regulations on deep seabed mining. See Marine Scientific Research Geared to Provide Suitable Environmental Databases for the Implementation of Article 145 of the Convention and of the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area of the Mining Code. 11–13 March 2002, ISBA/7/LTC/1, ISBA/7/LTC/1/Rev.1 and ISBA/LTC/1/Rev.1/Corr.1.\textsuperscript{115}. Article 150 (b), Part XI, of UNCLOS (n. 3 above).\textsuperscript{116}. Article 147, Part XI, of UNCLOS (n. 3 above).\textsuperscript{117}. Article 165 (d), Part XI, of UNCLOS (n. 3 above). Originally envisaged as having 15 members, the Legal and Technical Commission now has 22 members.\textsuperscript{118}. J. Gamble, "Assessing the reality of the deep seabed regime," San Diego Law Review 22 (1985): 779–92.
Upon receipt and evaluation, the legal and technical committee makes a recommendation to the ISA whether to accept or reject the workplan. Until the Agreement and Mining Code were completed and adopted, some commentators opined that such workplans need not take into serious consideration the issue of marine environmental integrity. In fact, in 1992 when Secretary-General Boutros Boutros-Ghali continued the informal consultations that had been initiated by his predecessor, "the issue of environmental consideration was removed from the list of issues since it was no longer considered to be a controversial issue in the context of deep sea-bed mining."119 However, as already evident from the Agreement on implementation of Part XI of the LOS Convention, marine environmental protection ranks high on the concerns of the ISA. This development may not be unconnected with the development of precautionary approaches as an essential element in contemporary international environmental law.120

It is a necessary and welcome development in the ISA regime on marine integrity that the precautionary principle121 or approach in international environmental law is not only recognized but also embraced by the new Mining Code. Regulation 31 paragraph 2 of the Mining Code provides that "in order to ensure effective protection for the marine environment from harmful activities which may arise from activities in the Area, the Authority and sponsoring States shall apply a precautionary approach, as reflected in Principle 15 of the Rio Declaration,122 to such activities."123 This is a clear and explicit adoption of the emergent principle of precaution in international law.124

For good reasons, the norm of precaution125 (whether accepted as a principle or as an approach) has become one of the most powerful and

123. Mining Code (n. 22 above).
influential legal concepts in recent times for the regulation of activities that pose potential but unproven dangers to human health and the environment. It is neither an agenda for fear nor a mask for ignorance. Rather, in its pragmatic simplicity, it posits that activities that have a reasonable potential of danger to the environment should be prevented even when there is not full scientific certainty to prove that such activities are actually dangerous. It emphasizes avoidance and is preventative in approach. As long as there is reasonable basis or grounds for concern, the norm of precaution requires States to prevent the occurrence of such irreversible harm. The precautionary approach is the juridification and institutionalization of caution as a fundamental postulate of international environmental law and policy. While its principles are broad, it has the inbuilt advantage of permitting local flexibility and domestic discretion.

In the application of the precautionary principle to mining activities on the seabed, prior understanding of the potential consequences of such activities is a condition for any rational judgement of the potential and actual impacts of such activities. In addition, it makes the application of the precautionary principle credible machinery for marine environmental sustainability, rather than an engine of recklessness and technological hubris. The embrace of the precautionary approach by the Mining Code is not a function of fear and idle speculation on the dangers of seabed mining. Rather, it is a function of knowledge of the potential and actual impacts of mining activities on the marine environment, especially the hydrothermal vents.

Exploration and testing activities on the seabed have revealed the enormous potential for environmental damage and harm. For example, scientific reports show that “impacts from full-scale mining operations could create a plume visible from space. Mining impacts on water column chemistry and biology may be of sufficient magnitude to merit serious investigation.” According to a recent report by scientists commissioned by the ISA to examine some of these issues, “despite decades of study, we still cannot predict the impacts of re-sedimentation from mining plumes on abyssal seafloor communities. We cannot say, for example, whether rapid accumulation of 1 cm of sediment will wipe out the benthic macro fauna or have little effect.”

Given this mounting list of evidence, it is difficult to disagree with Thiel and Foell that “it would be reckless and possibly dangerous to initiate large-scale

130. Ibid.
mining disturbances in the sea-bed without having achieved a fuller understanding of the potential ramifications of such activities.\textsuperscript{131} Indeed, in instances when the consequences of such activities are not predictable, it follows, upon an application of the precautionary principle, priority should be accorded to conservation rather than reckless exploitation of poorly understood parts of the world’s oceans.\textsuperscript{132}

With respect to pollution of hydrothermal vents, the minimum threshold for precaution to be set in motion is the rather “imprecise pollution-tolerant limit encapsulated in the ocean’s assimilative capacity in reference to specific substance sources responsible for its deterioration.”\textsuperscript{133} Interestingly, the resilience and assimilative capacity of the oceans seems to have been exaggerated, or better still, taken for granted for too long.\textsuperscript{134} Given the emerging consensus among commentators that seabed mining is a potential source of ocean pollution, it is hardly deniable that the precautionary principle ought to be helpful in the formulation of any regime on seabed mining. Given the complex nature of oceans, the precautionary approach is not a plea for inaction; rather, it is a summons for interdisciplinary and intersectoral cooperation. To paraphrase Thiel and Foell, it is a task requiring the collaborative efforts of scientists, engineers, economists, and politicians. For example, while scientists would identify environmental risks, engineers would contribute their skills and knowledge towards developing environmentally safe technology. In addition, economists would consider the environment in cost accounting as politicians issue suitable environmental regulations.

From the foregoing, it is clear that the most pressing difficulty with devising a regulatory regime for seabed mining, including hydrothermal bioprospecting, is the absence of sufficient ecological knowledge necessary to adequately and quantitatively define impacts for purposes of risk assessments. The irony here is that the very knowledge and research needed to define the threshold of precaution may not be gathered or acquired without harming or endangering some hydrothermal vent ecosystems. In effect, the most immediate threat to hydrothermal vent systems and their associated biological communities is arguably, marine scientific research itself. As the Report of the ISA Secretary-General notes,


\textsuperscript{133} Ibid.

One specific issue which is becoming of increasing concern to the international community is the question of the management of threats to the biodiversity of hydrothermal vent fauna and in particular the legal regime to be applied to bio-prospecting (the harvesting for commercial purposes of genetic resources) in the Area. The international scientific community has concluded that deep sea hydrothermal vents are particularly sensitive because of their high percentage of endemic species and the unique nature of many of the species found there. Several such sites are already under potential threat either from intensive scientific exploration, including bioprospecting, or from future mining activities.\textsuperscript{13}

Consequently, some acceptable damage to hydrothermal vent communities would have to occur if scientists are to obtain and proffer a credible and empirical basis for precaution. As the report of the scientists commissioned by the ISA to examine this issue critically observes,

\begin{quote}
[T]he abyssal Pacific and Indian Ocean floors are thought to be major reservoirs of biodiversity, and yet the patterns and scales of this biodiversity are very poorly known. It will be extremely difficult to evaluate the threat of nodule mining to deep sea biodiversity (in particular, the likelihood of species extinctions) without knowledge of (1) the number of species residing within areas potentially perturbed by mining operations, and (2) the typical geographic ranges (and rates of gene flow) of species living within the targeted regions.\textsuperscript{136}
\end{quote}

However, these are not insurmountable problems. They represent challenges that could be dealt with by reevaluating the methods and scales of seabed research.\textsuperscript{137} Newer and less destructive research models would have to be devised. These challenges make a compelling case for international cooperation in deep seabed mining risk assessment. They also point the way for interdisciplinary collaboration, specifically between industry and science. This high-level and specialized cooperation would best be pursued at both national and global levels.\textsuperscript{138}

An extant juridical problem here is whether Article 256 of UNCLOS, which permits all states and competent international organizations to con-

\textsuperscript{135}Secretary-General’s Report (n. 97 above), par. 50, p. 12.

\textsuperscript{136}Report of the Authority’s Preparatory Meeting of Scientists Held at its Headquarters, 11–13 March 2002, p. 4.

\textsuperscript{137}Recently, a group of researchers at Scripps Institution of Oceanography at the University of California, San Diego, has shown that sediments in the deep sea ocean are a potential source of microbes that produce antibiotic molecules. See \textit{Scripps News}, 17 January 2003.

duct marine scientific research in the Area, is a blank cheque for scientific inquiries in the Area, even when such research has the potential of damaging marine ecosystems, especially, hydrothermal vent communities. It must be noted that Article 143, paragraph 2 of UNCLOS authorizes the ISA to coordinate the results of such research. However, Articles 143 and 256 of UNCLOS hardly resolve the question as to whether marine scientific research in the Area is subject to the jurisdiction of the ISA. In seeking to resolve this argument, the Report of the ISA Secretary-General delivered on 5–16 August 2002, notes the following:

[W]hile UNCLOS III was unable to reconcile conflicting views on the distinctions between “fundamental” and “applied” research in the various jurisdictional zones established in the Convention, it is clear that, under Article 143, marine scientific research in the Area is to be considered separate and apart from marine scientific research on the high seas and the results of such research are to be utilized for the benefit of mankind as a whole. Consequently, it will become necessary for the Authority to give more detailed consideration as to how best to realize the ideals set out in the Convention and the Agreement concerning the dissemination of the benefits of marine scientific research and technology transfer. One of the key practical questions that arise in this context is how to ensure the fair and equitable distribution of the benefits from such research without creating unreasonable obstacles to such activities as commercial biotechnological development and without limiting unreasonably commercial incentives, such as intellectual property rights, for work undertaken on the genetic resources of the Area.139

This article argues that the better way to resolve this impasse would be to encourage the ISA to extend its jurisdiction under Article 145 of UNCLOS to protect seabed flora and fauna from pollution. Until the ISA is permitted to exercise a jurisdiction over the seabed in a manner that recognizes the interrelatedness of seabed sulfide mining with potential pollution of seabed fauna and flora, including hydrothermal vent ecosystems, the ability of the ISA to apply the precautionary principle across the breath of the depths of the oceans, especially in respect of hydrothermal vent ecosystems, will be seriously hampered.

It may be arguable that Regulation 40 of the Mining Code extends the jurisdiction of the ISA to hydrothermal vents occurring at the seabed. Regulation 40 provides as follows:

139. Secretary-General’s Report (n. 97 above), p. 9.
tion of such resources shall be subject to the rules, regulations and procedures of the Authority relating to such resources in accordance with the Convention and the Agreement.\(^{140}\)

However, it is very doubtful whether this omnibus clause in a specialized code dealing with polymetallic manganese nodules refers to or deals with hydrothermal vent ecosystems of the seabed. If the legislator had so intended, it would have been clear from the tenor and overall text of the code. No such intention is manifest on the face of the code. Moreover, UNCLOS and the Agreement clearly define or delimit the word "resources" to mean mineral resources. Therefore, it would be tardy to read into Regulation 40 an intention on the part of the ISA to exercise jurisdiction and regulatory control over hydrothermal vent ecosystems and bioprospecting of thermophilic life forms.

Beyond the inattention to hydrothermal vents, there is another problem with the Mining Code, particularly, the ambiguous way in which some aspects of the precautionary approach are provided for. For example, Regulation 2 paragraph 2 of the Mining Code stipulates, "prospecting shall not be undertaken if substantial evidence indicates the risk of serious harm to the marine environment."\(^{141}\) While this provision generally resonates with contemporary understanding of the precautionary approach, neither the Mining Code nor any other instrument from the ISA defines what constitutes "substantial evidence" or "serious harm" to the marine environment. Given the general tenor of the code, it is difficult to speculate on the standard or threshold of "harm" that may trigger the precautionary principle into action. It is hoped that when the code on seabed sulfide mining is negotiated, the drafters of the code would revisit and clarify this issue.

In the search for an objective application of the precautionary principle in seabed mining activities, however, two interesting measures have been instituted by the Mining Code. The first relates to the well-known requirements of conducting environmental impact assessments of mining activities and the second deals with the principle of using the "best available technology" in such activities. This is a significant improvement on the application of the precautionary principle to seabed mining. Generally, the applicability of precautionary approaches is often tied to the ability of States to take measures necessary to prevent irreversible harm to the environment. Raising the bar to require the application of the "best available technology" by States or entities interested in seabed polymetallic mining is certainly an improvement on the prevailing minimum threshold.

The technology needed to exploit seabed minerals with minimal ecological damage must contend with and address issues related to removal

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\(^{140}\) Mining Code (n. 22 above).
\(^{141}\) Ibid.
of surface sediments, the relationship between the impact on the seafloor community and the amount of sediment dropped on it. Other challenging issues include marine biological and chemical disturbances, which will arise from seabed mining activities. These challenges compel the adoption of the principle of "best available technology." If this principle were reflected in the code on sulfide mining and hydrothermal vent bioprospecting, contractors would be obliged to use best experience and technology to deal with these sensitive and fragile marine ecosystems.

Another related issue is the question of environmental impact assessment. According to the provisions of paragraph 7, Section 1 of the Annex to the Agreement,

[A]n application for approval of a plan of work shall be accompanied by an assessment of the potential environmental impacts of the proposed activities and by a description of a programme for oceanographic and baseline environmental studies in accordance with the rules, regulations and procedures adopted by the Authority. 142

It seems that the idea in this provision was borrowed from the unilateral legislation on seabed mining enacted by the U.S. Congress in 1980. The United States legislation that predated the Agreement requires an environmental impact assessment prior to issuance of a license or permit. 143 Under such licenses, the activities of a seabed miner may be circumscribed by concerns for marine environmental integrity.

Perhaps the most laudable and objective method of achieving a credible environmental impact assessment of seabed mining activities is the environmental baseline concept and impact reference zones articulated in Regulation 31, paragraphs 4 and 7 of the Mining Code. On the former, paragraph 4 of Regulation 31 provides as follows:

Each contract shall require the contractor to gather environmental baseline data and to establish environmental baselines, taking into account any recommendations issued by the Legal and Technical Commission pursuant to Regulation 38, 144 against which to assess the likely effects of its programme of activities under the plan of work for exploration on the marine environment and a programme to monitor and report such effects. 145

142. Agreement (n. 91 above).
143. See s. 109(d) of the statute.
144. This regulation empowers the Legal and Technical Commission to periodically make rules on seabed mining.
145. Mining Code (n. 22 above).
Under this regulation, when a contractor applies for exploitation rights, baseline environmental data gathered by the contractor during the exploration contract should be sufficiently representative of the exploration area for the contractor to propose areas to be set aside for impact reference zones (IRZ). According to paragraph 7 of Regulation 31,

If the contractor applies for exploitation rights, it shall propose areas to be set aside and used exclusively as impact reference zones and preservation reference zones. “Impact reference zones” means areas to be used for assessing the effect of each contractor’s activities in the Area on the marine environment and which are representative of the environmental characteristics of the Area. “Preservation reference zones” means areas in which no mining shall occur to ensure representative and stable biota of the seabed in order to assess any changes in the flora and fauna of the marine environment.146

As evident from these texts, the preservation reference zones and impact reference zones are areas to be used to assess the effect of the contractor’s activities on the marine environment.147 According to Nollkaemper and Kimball, “these designations provide an innovative method to assess damage by establishing with a relatively high degree of certainty what the specific effects of mining activities on the environment have been.”148

The second innovative measure that makes practical sense in designing a code on seabed mining and related activities is the need for flexibility in both the rules and the rule-making process itself. This is particularly useful given the varieties of seabed nodules and their varied ecological demands. Considering the differences between polymetallic sulfides and cobalt-rich crusts,149 the need for different sets of rules for exploitation of the respective resources is imperative. This has been appreciated by the ISA. According to the ISA, there is a . . .

[N]eed for a flexible approach to the formulation of regulations for prospecting and exploration, particularly, in view of the lack of scientific knowledge relating to deep sea ecosystems. It was also clear that polymetallic sulphides and cobalt-rich crusts were different from polymetallic nodules as well as distinct from one another. Particular ecologi-

148. Ibid.
149. Nodules are scattered loosely over the sea floor. Crusts are fused to the underlying rock and sulfides occur around hydrothermal vents sprouting from volcanic areas of the seabed.
cal considerations arose with respect to polymetallic sulphides located at hydrothermal vents.\textsuperscript{150}

Indeed, prior to the adoption of the Mining Code, the ISA noted, “particular ecological considerations arose with respect to sulfides located at active hydrothermal vents from which superheated seawater containing minerals in solution wells up from hot magma beneath the sea floor.”\textsuperscript{151}

Given the differences between polymetallic sulfides and seabed polymetallic nodules, it is a significant contribution of Regulation 31 to the jurisprudence on environmental impact assessment of seabed mining activities that the dynamism and complexity of the seabed environment is recognized as crucial factors in the formulation of legal rules on harvesting the various resources and ecosystems of the seabed. Hence, Regulation 31 paragraph 1 provides for periodic review of environmental rules, regulations, and procedures to ensure a responsive regime of protection for seabed biota. All six contractors\textsuperscript{152} with contracts for exploration for deep seabed polymetallic nodules have agreed to these innovative guidelines.

CONCLUSION

In summary, the manganese nodule Mining Code is a welcome improvement and contribution to international environmental jurisprudence. Its evolution and development is a function of global economics and politics but in the final analysis, a measure of international consensus has developed around it. In the development of the Mining Code, the common heritage concept has played a significant role. Similarly, it would be naïve to ignore the realities of industrial and economic power and efficiency. These factors have combined to yield the Mining Code. The same embrace of realism ought to influence its approach to the growing significance of marine biotechnology to the global economy and how the oceans are perceived.

It is equally clear, at least from its embrace of the precautionary principle, that the emergent regime on exploration and exploitation of polymetallic nodules is comprehensive and stringent. Indeed, the emergent order has taken the regime of marine environmental protection one step further in its overall use of the precautionary approach. As Doug Richardson has

\textsuperscript{150} ISA Press Release, ISA/1764 (n. 28 above), p. 2.
\textsuperscript{151} Seabed Council Ends Session Devoted Mainly to Polymetallic Sulphides and Crusts, Press Release SEA/1762, 15/08/2002.
\textsuperscript{152} ISA Press Release SEA/1764 (n. 28 above). The contractors are from China, Japan, France, Korea, Poland, and Russia. All six contractors are exploring the Clarion-Clipperton fracture area. The Government of India is in the process of finalizing its contract with the ISA on the exploration of an area in the central Indian Ocean basin.
noted, this may have arisen "out of necessity, using strict guidelines to alleviate some of the potentially colossal impacts that may occur when dealing with projects of up to 150,000 square kilometers in size." The perils and promises of deep-sea mining are really enormous.

But more importantly, notwithstanding the apparent limitations on the jurisdiction of the ISA, particularly in respect of hydrothermal vent communities, one can hardly disagree with the Secretary-General of the ISA on the potentially wide scope of the regulatory ambit of the ISA on matters pertaining to the sustainable use of hydrothermal vent ecosystems. In the report to the 8th session of the International Seabed Authority, the Secretary-General articulated the ambit of the jurisdiction of the ISA in such aspects as follows:

[A]lthough the role of the Authority in the regulation of activities in the Area is directed primarily at exploration for and exploitation of mineral resources, the Authority also has a broader regulatory role with respect to the protection and preservation of the marine environment (including its biodiversity) as well as with respect to marine scientific research in the Area generally. This is made clear, inter alia, by (a) Article 145 of the Convention . . . and (b) other provisions within both the Convention and the Authority’s regulations that enable or require the adoption of rules, regulations and procedures for environmental protection. In addition, Article 165, paragraph 2, of the Convention requires the Legal and Technical Commission to, inter alia, make recommendations to the Council on the protection of the marine environment, take into account assessments of environmental implications when formulating the rules, regulations and procedures for exploration and exploitation referred to Article 162, paragraph 2 (o), of the Convention, and make recommendations to the Council regarding the establishment of a monitoring programme.154

Clearly, the mandate of the ISA as conferred by the United Nations Convention on the Law of the Sea is broad and ample. It extends to the regulation of activities that may be harmful to the integrity and sustainability of hydrothermal vents in the seabed area. It would therefore seem that the present focus on polymetallic nodules does not necessarily mean a denial of regulatory jurisdiction over seabed hydrothermal vents if mining activities endanger the health of or pollute hydrothermal vent communities.


In summary, the Secretary-General of the ISA seems to have made a powerful argument when his report of 2002 suggested the following:

[T]he solution to the problem of managing biodiversity in the Area is essentially one of better implementation of existing legal regimes and integration at the institutional level. While management of all the world’s hydrothermal vent sites is an unrealistic goal, the possibility of developing internationally agreed criteria for the identification of sites of critical importance and sensitivity may be considered.\textsuperscript{155}