

Future of Deep-Sea Mineral Resources: Environmental Issues

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NB: The views expressed are those of the author, who is writing in her personal capacity.

Abstract

Early in the second phase of the UN Secretary-General's informal consultations on outstanding issues relating to the deep seabed mining provisions of the UN Convention on the Law of the Sea (LOSC) culminating in the Agreement relating to the Implementation of Part XI of the LOSC, "environmental considerations" were removed from the original list of "nine issues representing areas of difficulty," because "it was no longer considered to be a controversial issue in the context of deep seabed mining." (UN Doc A/48/950, 9 June 1994.) This paper examines the reasons given for this conclusion 25 years ago, contrasts them with the environmental issues now facing the International Seabed Authority (ISA) from the perspective of 25 years later, as it develops exploitation regulations, and addresses “area of difficulty (b) transfer of technology” in the environmental context. It concludes with suggestions for the ISA’s environmental work in the next 25 years.

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1. Introduction

When it became clear that the United Nations Convention on the Law of the Sea (LOSC or the Convention)¹ was likely to enter into force with 59 developing States and one developed State as the required sixty parties, the then Secretary-General of the United Nations, His Excellency Javier Pérez de Cuéllar, decided to hold informal consultations to identify issues of concern with regard to LOSC Part XI and look for solutions, with a view to achieving universal participation in the LOSC after its entry into force.

The informal consultations were held between 1990 and 1994, in two phases of two years each (1990-1992) and (1992-1994). No official records were kept during the informal consultations and no official documents were issued until nearly the end, when drafts of the 1994 Implementing Agreement and the accompanying Resolution were issued. Informal "Information Notes," "Background Papers", and "Summaries" were issued from time to time by the Special Representative of the Secretary-General for the Law of the Sea, but none had a document number, all were only in English, and were not part of the official UN documentation for the Implementing Agreement. There are no formal "*travaux*." A detailed history of the informal consultations is available in Nandan *et al.* (2002),² and in International Seabed Authority (2002).³

"The first phase was devoted to the identification of issues of concern to some States, the approach to be taken in examining them and the search for solutions. During the second phase more precision was given to the results reached so far; additional points were raised for consideration and participants directed their attention to an examination of consolidated texts embodying these solutions and on the procedure whereby they might be adopted."

At the beginning of the first phase, 1990-1992, nine issues "representing areas of difficulty" were identified. These nine issues are listed below in their original order.

- (a) the Enterprise
- (b) transfer of technology
- (c) cost to States Parties
- (d) production limitation
- (e) compensation fund
- (f) financial terms for commercial operations
- (g) decision-making

¹ United Nations Convention on the Law of the Sea (Montego Bay, 10 December 1982, in force 16 November 1994) 1833 *U.N.T.S.* 397.

² S. Nandan, M.W. Lodge, S. Rosenne (2002) *The Development of the Regime for Deep Seabed Mining*. Kluwer Law International, The Hague, the Netherlands and Center for Oceans Law and Policy, University of Virginia, Charlottesville, VA.

³ All the UN documents cited in this paper are available in: International Seabed Authority (2002) *Secretary-General's Informal Consultations on Outstanding Issues Relating to the Deep Seabed Mining Provisions of the United Nations Convention on the Law of the Sea: Collected Documents*. International Seabed Authority, Kingston, Jamaica. Unless specified otherwise, the quotations in this paper are taken from this publication. A brief overview of the Informal Consultations by the UN Division for Ocean Affairs and Law of the Sea is available at: https://www.un.org/Depts/los/convention_agreements/convention_overview_part_xi.htm; last accessed 31 March 2020.

- (h) environmental considerations and
- (i) the Review Conference.

Early in the second phase (1992-1994) of the informal consultations (now led by the next Secretary-General of the United Nations, His Excellency Boutros Boutros-Ghali), the area of difficulty (h) "environmental considerations" was removed from the original list of "nine issues representing areas of difficulty," because "it was no longer considered to be a controversial issue in the context of deep seabed mining."

This paper examines the reasons given for this conclusion 25 years ago, contrasts them with the environmental issues now facing the International Seabed Authority (ISA) from the perspective of 25 years later, as it develops exploitation regulations, and addresses "area of difficulty (b) transfer of technology in the environmental context. It concludes with suggestions for the ISA's environmental work in the next 25 years.

2. The Original Environmental Considerations

The March 1991 Information Note summarized the "environmental considerations" raised in the October 1990 informal consultations as follows:

"While it is accepted that it is inevitable that there will always be some impact on the marine environment as a consequence of any activity on the seabed, the concern is in respect of any effect from such activities on the living or non-living components of the marine environment and associated ecosystems beyond that which is negligible or which has been assessed and judged to be acceptable in accordance with relevant rules and regulations for this purpose."

It is important to recall that the meetings of the Preparatory Commission (Prep Com), which began in 1983, were also going on during this time; environmental considerations were also being discussed in that forum. Indeed, the Information Note of March 1991 continues:

"Note: The Preparatory Commission has been considering a comprehensive set of rules which inter alia require that activities in deep seabed area can only take place if they do not cause harm to the marine environment beyond a prescribed acceptable level, established on the basis of data and information gathered at each stage of the activities. Under this monitoring scheme, such activities can only take place if the technology and procedures used are safe, if there is the capacity to monitor the environment parameters and ecosystem components so as to identify any adverse effect and if there is the capacity to respond effectively to accidents, particularly those which might cause serious harm to the marine environment. No plan of work for exploration would be approved under these rules unless an environmental report is submitted by the applicant based on data collected during the prospecting stage, together with a programme for oceanographic and baseline environmental studies of a general as well as site-specific nature. In the case of exploitation, no approval will be given unless an environmental impact-statement of a site-specific nature is submitted and evaluated and found to be consistent with the requirements of the rules. A special preservation reference zone within a mine site is to be set aside in which no mining is to 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. The

rules would also provide for the responsibility of the sponsoring State and the liability of the operator for any serious harm to the marine environment."

At the end of Prep Com's 9th session in August 1991, the first reading of Part VIII of the draft nodule regulations relating to the protection and preservation of the marine environment from activities in the Area was complete.

The Information Note to prepare the delegations for the December 1991 informal consultations set out the environmental considerations, which had evolved substantially, as follows:

"D. ENVIRONMENTAL CONSIDERATIONS

26. The Convention on the Law of the Sea imposes upon all States the obligation to protect and preserve the marine environment from all sources of pollution. In addition, the Authority has a specific mandate to adopt appropriate rules, regulations and procedures to prevent, reduce and control pollution of the marine environment arising from the exploration and exploitation of the resources of the international deep seabed area. It is inevitable that there will be some impact on the marine environment as a consequence of activities in the deep seabed. The concern is over the effect of such activities on the living and non-living components of the marine environment and the associated ecosystems beyond that which is negligible or which has been assessed or judged to be acceptable in accordance with the standards to be established. The rules, regulations and standards that are to be established by the Authority, must ensure that there is a fair balance between the need to preserve and protect the marine environment and the development of the resources of the international seabed area for the benefit of all mankind.

27. The Preparatory Commission has been considering a comprehensive set of rules which, inter alia, require that activities in the deep seabed area can only take place if they do not cause unacceptable changes to the marine environment beyond the acceptability level to be established on the basis of data and information gathered at each stage of such activities. The rules would provide that such activities can only take place if the technology and procedure used are safe, if there is capacity to monitor environmental parameters and ecosystem components so as to identify any adverse effect. Further, there should also be the capacity to respond effectively to accidents, particularly those which might cause unacceptable changes to the marine environment. Accordingly, no plan of work for exploration would be approved under the proposed rules, unless an environmental report is submitted by the applicant based on the data collected during the prospecting stage, together with a programme for oceanographic and baseline environmental studies of a general and site-specific nature. Such studies are to be submitted to the Authority as the project develops. In the case of exploitation, no approval will be given unless an environmental impact statement of a site-specific nature is submitted and evaluated and found to be consistent with the rules and regulations of the Authority.

28. The rules will require the setting aside of a special reference zone within a mining area in which no mining is to occur to ensure a representative and stable biota of the seabed in order to assess any changes in the flora and fauna of the marine environment. The rules would also provide for the responsibility of the sponsoring State and the liability of the operator for unacceptable changes to the marine environment. These matters assume great relevance in the case of deep seabed mining where environmental harm may occur in an area which lies beyond

national jurisdiction and where harm is likely to occur to the marine environment itself rather than to a person or property. The rules contemplate establishing an upper limit on the liability of an operator and also the possibility of establishing a fund in order to ensure that liabilities which are not discharged by the operators are met.

29. In the light of the general agreement that there must be environmental rules to cover every stage of activities in the deep seabed, the question that needs to be addressed is: whether an agreement can be reached on a set of principles which would constitute the basis on which the Authority will adopt appropriate rules, regulations and procedures to prevent, reduce and control pollution of the marine environment arising from the exploration and exploitation of the resources of the deep seabed.

A possible approach

30. The principles which may be considered are as follows:

- (a) the Authority shall establish a comprehensive set of rules and regulations which, inter alia, will ensure that exploration and exploitation of the resources in the deep seabed area can only take place if they do not cause harm beyond that which has been assessed as acceptable in accordance with the standards established by the Authority. Such rules, regulations and standards shall ensure that there is a fair balance between the need to protect and preserve the marine environment and the development of the resources of the deep seabed for the benefit of all mankind;*
- (b) the rules, regulations and environmental standards established by the Authority shall be reviewed and updated on a continuing basis in order to incorporate the latest results of research in the deep seabed and the experience derived from deep seabed mining when that takes place;*
- (c) each operator shall be required to submit at every stage of activity in the deep seabed an environmental report and a programme for oceanographic and baseline environmental studies and, before proceeding to exploitation, an environmental impact statement in accordance with the requirements of the Authority;*
- (d) the rules and regulations shall contain provisions on the responsibility and liability of operators for causing unacceptable changes to the marine environment;*
- (e) all rules and regulations relating to environmental matters shall apply to all operators, including the Enterprise;*
- (f) any disputes concerning the interpretation or application of the above principles shall be subject to the dispute settlement procedures under the Convention."*

In the January 1992 summary of the 1990-1991 Informal Consultations, the Secretary-General enumerated the many circumstances that had changed since the Convention was negotiated. Relevant to the present discussion on environmental considerations are the following comments:

"(e) as the work of the Preparatory Commission has progressed, there has been greater understanding of the practical aspects of deep seabed mining, as more information on these has become available."

"4. With the changed circumstances, many of the issues of concern are more widely shared today, and the approaches towards resolving them are also more broadly accepted than was the case when the Convention was being negotiated. In addition, greater knowledge of deep seabed mining activities has given States more confidence in addressing these issues."

"In the process of examining the areas of difficulties, a solid foundation has been laid for resolving them which should be built upon. It is apparent that some of the issues need to be dealt with in detail at this stage. Others, however, can be resolved by way of agreement on certain fundamental principles on the basis of which detailed rules and regulations may be established when commercial production of minerals from the deep seabed becomes feasible."

"IX. ENVIRONMENTAL CONSIDERATIONS

45. It was noted that the Convention imposes upon all States the obligation to protect and preserve the marine environment from all sources of pollution. In addition, the Authority has a specific mandate to adopt appropriate rules, regulations and procedures to prevent, reduce and control pollution of the marine environment arising from the exploration and exploitation of the resources of the international deep seabed.

"Environmental aspects of deep seabed mining require continuous study at every stage of the activities and the submission of environmental impact statements before production of seabed minerals is undertaken.

46. It was agreed that this was not a controversial issue and was therefore qualitatively different from the other eight issues under consideration. It was noted that the Preparatory Commission has been considering a comprehensive set of rules concerning the environment, and that there has been no insurmountable obstacle in the progress being made there."

All work on the draft nodule regulations, including on the marine environment, was complete at the end of Prep Com's 10th session in August 1992.

2.1. Discussion of the Original Environmental Considerations

In my view, the successful conclusion of the Prep Com's work on the draft nodule regulations, including on the marine environment, explains the formal withdrawal of environmental considerations from the list of nine issues of concern in the December 1992 Information Note to prepare the delegations for the January 1993 Informal Consultations. Herein the United Nations Secretary-General:

"made it clear that the purpose of these consultations was not to renegotiate Part XI of the Convention but to find a practical way out of the difficulties which have inhibited the industrialized countries from ratifying or acceding to the Convention.

4. During the consultations, it was decided to remove the issue entitled "Environmental considerations" from the list of issues to be dealt with, since it was not considered any more to be a hard-core issue in the context of deep seabed mining."

In August 1993 an informal and anonymous paper appeared as a “*contribution to the process of consultations.*” This paper, which became known as the “Boat Paper,” “*did not necessarily reflect the position of any of the delegations involved, but was intended to provide a useful basis for negotiation.*” With regard to the marine environment, its suggested provisions and those of the revised November “Boat Paper” are remarkably similar to what became the final text of the Agreement relating to the implementation of LOSC Part XI (IA).⁴

It is evident from the discussion - all quoted in full above - on the environmental considerations set out in the informal consultation documents, that:

- a) the environment was not considered to be an issue preventing the so-called industrialized countries from adopting the Convention,
- b) these considerations were addressed in the Prep Com's draft regulations sufficiently adequately, based on the existing Part XI and Part XII of the Convention, such that the environmental provisions set out in Part XI did not require further work.

It is also relevant that exploration - on which Prep Com's draft Regulations were focused - was then expected to be the principal activity in the Area for the foreseeable future and that exploitation was not expected to take place until well into the 21st century.

Taken together, these are, in my view, the primary reasons why environmental considerations were removed from the list of issues of concern to be addressed in the development of the Implementing Agreement.

3. Selected Current Environmental Considerations

3.1 Environmental Requirements under the Convention

Before turning to a selection of environmental issues now facing the International Seabed Authority (ISA) from the perspective of 25 years later, as it develops exploitation regulations, I summarize below the LOSC's requirements on the protection and preservation of the marine environment with regard to activities in the Area.

In Part XI: Article 145 - Protection of the marine environment

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,*

⁴ Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (New York, 28 July 1994, in force 28 July 1996) 1836 *UNTS* 3.

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.

The importance of the marine environment in the Convention is demonstrated by its presence in the very first Article of the Convention, where it is only preceded by three clauses about the Area. This Article defines pollution of the marine environment as follows:

Article 1 I. (4) "pollution of the marine environment" means the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities;

Note that "hazards" are a separate category of harm to the marine environment - they are different from pollution - and are undefined. They appear again in *Article 195 (Duty not to transfer damage or hazards or transform one type of pollution into another)* of Part XII, the chapter devoted to protection of the marine environment, with which activities in the Area must also comply.

3.2 Greenhouse Gas Emissions: A Conundrum

It is instructive to consider the status of CO₂ and other greenhouse gases (GHG) in the context of the unqualified requirements in the LOSC for their prevention, reduction and control (cf. Verlaan, 2009)⁵ and reflect on why these requirements have so far, to the best of my knowledge, still not been formally invoked as providing the legal basis for mandatory global action accordingly in the ongoing climate change negotiations (cf. Verlaan, 2020).⁶

With regard to activities in the Area specifically, the continued absence of mandatory and enforceable international action on climate change in general, and on GHG emissions in particular, presents an ironic conundrum for the ISA as it develops the environmental part of the exploitation regulations. This is because under the LOSC, the ISA too must take appropriate action insofar as activities in the Area may exacerbate, for example, GHG emissions. The irony resides in all the members of the ISA also being parties to the LOSC, which - so far in vain - requires them to take action on GHG emissions globally, not just from activities in the Area.

3.3 Missing Environmental Considerations

Absent from the records of the Informal Consultations leading to the Implementing Agreement, the Prep Com discussions on the draft Nodule Regulations, the subsequent

⁵ P. A. Verlaan (2009) "Geo-engineering, the Law of the Sea, and Climate Change." *Carbon and Climate Law Review* 4:446-458.

⁶ P. A. Verlaan (2020) "The Interface of Science and Law: A Challenge to the Privileging of 'Marine Biodiversity' over 'Marine Environment'," in: R. A. Barnes and R. Long (Eds.) *Frontiers in International Environmental Law: Oceans and Climate Challenges*, Brill, Leiden, *in press*.

discussions prior to their formal adoption by the ISA, and the current discussions by the ISA on the marine environmental protection provisions of the draft exploitation regulations is any mention of the following set of environmental elements required to be addressed under Article 145 of the LOSC with regard to activities in the Area.

- a) the specific extension of the Convention's concept of the marine environment to "*the coastline*" with regard to the effects of activities in the Area - i.e., well beyond the definition of the Area set out in Article 1 of the Convention:⁷
- b) "*the ecological balance of the marine environment*"
- c) "*interference*" with the aforesaid "*ecological balance*"
- d) "*the natural resources of the Area*"
- e) "*protection and conservation*⁸ of the" aforesaid "*natural resources*"
- f) "*the flora and fauna of the marine environment*"
- g) "*prevention of damage to the*" aforesaid "*flora and fauna*".

So far I have been unable to find any attempt by the ISA to define, reduce to regulatory form and implement the protection and/or achievement of the above environmental elements set out in Article 145. These required elements are undeniably difficult to address in a regulatory context. The ISA is not alone in finding this difficult. Central to the difficulty is the scientifically wholly accurate, but administratively fiendishly complex, human-boundary-free nature of the Convention's concept of the marine environment, which is undefined in the LOSC, but all of which must be preserved and protected,⁹ without exceptions or qualifications.

As already pointed out above (this section), the 168 (as of 31 March 2020) members of the Authority are also parties to the LOSC as a whole, not just to Part XI. Therefore, all the marine environmental requirements of the Convention apply to them equally in their capacity as parties to the Convention as well as members of the Authority, such that in both legal capacities - as LOSC parties and ISA members - they must comply with the marine environmental requirements of the Convention. Last, but perhaps most important, Article 145 reinforces the Convention's concept of the marine environment as an integrated physical whole throughout.

One might have thought that, consequently, since the coming into force of the Convention, protection of the marine environment would be undertaken by the 168 states parties on a comprehensive, consistent, and above all integrated basis, reflecting the fundamental connectedness of the marine environment. One might have also thought that this would be an ideal project for the States Parties to the Law of the Sea Convention (SPLOS), because "*the problems of ocean space are closely interrelated and need to be considered as a whole.*"¹⁰ The participants in the Informal Consultations were fully aware of the requirement to treat the marine environment as a whole, referring in the March 1991 Note (see Section 2 above: The Original

⁷ " 1. For the purposes of this Convention:

(1) "*Area*" means the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction;"

⁸ Note the use of "*conservation*" with regard to natural resources in the LOSC, not "*preservation.*" The LOSC reserves the latter for the marine environment and the former for (natural) resources in the LOSC. The two words have different meanings and entail different legal obligations. This important distinction, despite being maintained throughout the LOSC, is frequently overlooked.

⁹ LOSC Article 192.

¹⁰ LOSC, Preamble, third paragraph.

Environmental Considerations) to the effects of activities in the Area on “*the living or non-living components of the marine environment and associated ecosystems.*”

One would, alas, be misguided on both counts. Consider, for example, the proliferation in the last 25 years of parts or aspects of the marine environment that are considered to merit some form of special protection (in alphabetical order), e.g.: ecologically or biologically sensitive areas (EBSAs), marine biodiversity in areas beyond national jurisdiction (MB/ABNJ); large marine ecosystems (LMEs), marine protected areas (MPAs), particularly sensitive sea areas (PSSAs), vulnerable marine ecosystems (VMEs). Each one of these areas is set up according to different and not necessarily compatible criteria and none is actually capable of protecting even its own area from, for example, acidification, deoxygenation, eutrophication, inappropriate light levels, invasive species, noise, ocean warming, polluting substances, etc. The intentions are unquestionably noble, but the results so far - at least in terms of observable positive effects on the marine environment - are unconvincing.

The MB/ABNJ even - bafflingly - seems to need an entirely new treaty, although the Convention's own - and far more rigorous - marine environmental protection requirements (see, e.g., Article 194(5)) to “*protect and preserve rare or fragile ecosystems as well as the habitats of depleted, threatened or endangered species and other forms of marine life,*” in the marine environment as a whole, and certainly not only in ABNJ, have so far not been addressed.¹¹

Yet these same 168 states parties, as ISA members, must tackle these issues in the Area because Part XI specifically requires the Authority to develop regulations that do so for activities in the Area. Article 145 takes on the whole marine environment and sets specific criteria and parameters for its protection. The ISA is the only formal intergovernmental body set up by the Convention with, among its many other duties,¹² a specific set of environmental mandates for the administration of a part of the ocean over which it has extensive legal control and which it must reduce to regulatory form. The ISA has a clear, legally mandated obligation to confront and implement its responsibility for the marine environment as a whole, even though its responsibility is limited to the adverse effects on the marine environment of activities in the Area. The major environmental issues associated with activities in the Area are briefly addressed below.

3.4 Major Environmental Issues Associated with Activities in the Area

This section addresses the familiar list of major environmental issues potentially arising in the context of the future exploitation of ferro-manganese nodules, for which the environmental work at present is still more advanced than for polymetallic sulphides and Co-rich ferro-manganese crusts, in part because nodules were considered the most likely to be exploited first.¹³

Note that these environmental issues were already identified and targeted research underway in the context of possible exploitation of ferro-manganese nodules found in the

¹¹ For a detailed discussion of the scientific and legal aspects of this issue, see Verlaan (2020), *op. cit. supra* (n) 6.

¹² The complexity of the ISA's regulatory position and duties under the LOSC and other rules of international law not incompatible with the LOSC in the constellation of intergovernmental fora in general and for the marine environment in particular is discussed in an invited review by M.W. Lodge and P. A. Verlaan (2018) “Deep-sea mining: regulatory challenges and responses,” *Elements* 14(5):331-336.

¹³ For current (as of 31 March 2020) reviews of the sector as a whole, including all three resources listed here, see the suite of papers in R. Sharma (Ed.) (2017) *Deep-Sea Mining: Resource Potential, Technical and Environmental Considerations*, Springer Nature, Cham, Switzerland and in P.A.J. Lusty and B.J. Murton (Eds.) (2018) “Deep-Ocean Mineral Deposits,” *Elements* 14(5):298-336.

Clarion-Clipperton Zone (CCZ) of the North Pacific Ocean in tandem with the discussions in the United Nations General Assembly in 1967 that led in 1973 to the third United Nations Conference on the Law of the Sea (UNCLOS III), which culminated in the adoption of the LOSC in 1982.¹⁴ To date (31 March 2020), the largest number of contracts issued by the ISA for activities in the Area is still for ferro-manganese nodules in the CCZ.

Work on environmental issues related to deep-sea mining in the Area, especially of ferro-manganese nodules, continued well into the late 1990s;¹⁵ in other words, during and after the entire period of the Informal Consultations and that of the Prep Com.

The major environmental issues are:

- Permanent removal of solid (overall) and (probably) the particular solid substrate, e.g., nodules and crusts themselves, for which certain seabed sessile organisms and communities are probably specialized, and which is likely to result in slow regeneration of sessile biological communities in particular that are also likely to be different from those prevailing before removal of the substrate
- Changes in upper sediment layers (nodules) (e.g., removal, compaction, mixing)
- Sedimentation (bottom, surface, mid-water)
- Noise/Vibration
- Light (this can be either too much & too little)
- Operational and accidental (leaks, spills) discharges, effects of corrosion
- Vessel traffic between miner and coast
- Disturbance of surface and mid-water marine communities, including of migratory routes, especially if mining vessel remains on location for many months.

3.5 Discussion of Selected Current Environmental Issues

With regard to these issues, I highlight three points for purposes of the present paper.

First, they have been known for at least fifty years for nodules and are broadly similar for sulphides and crusts, with certain adjustments specific to each of the latter two resources.¹⁶

¹⁴ See, e.g., work since 1972 on potential environmental effects of ferro-manganese nodule mining sponsored by the US National Oceanic and Atmospheric Administration (NOAA), including the Deep Ocean Mining Environmental Studies (DOMES) project, conducted in the CCZ from 1975 through 1980, reviewed by R.E. Burns (1985) "DOMES revisited", in P.B. Humphrey (Ed.) *Marine Mining: A New Beginning, State of Hawai'i*, Dept. of Planning and Economic Development, Honolulu, HI, pp. 176-181; see also Vol 3, Nos. 1/2 of *Marine Mining* (1983), dedicated to the results of DOMES. See further NOAA's 1981 Programmatic Environmental Impact Statement (PEIS) on ferro-manganese nodule mining in the CCZ; available at https://www.gc.noaa.gov/documents/gcil_dsm_1981_report.pdf, last accessed 31.03.2020. Note that the PEIS launched the impact and preservation zones concepts. For the potential exploitation of Co-rich ferro-manganese crusts, still - to the best of this author's knowledge - the only formal EIS for crusts extant to date (31 March 2020) is the two-volume Final EIS (EIS/EA MMS 90-0029), jointly published in August 1990 by and available from the US Department of the Interior (Washington, DC) and the State of Hawai'i (Honolulu, HI), for the proposed marine mineral lease sale for the EEZ adjacent to Hawai'i and Johnston Island. Note this is not part of the Area.

¹⁵ For an overview of environmental work conducted before and during the Informal Consultations, see, e.g., C.L. Morgan, N.A. Odunton, A.T. Jones (1999) "Synthesis of environmental impacts of deep seabed mining." *Marine Georesources and Geotechnology* 17:307-356, which also reviews the main DOMES results; H. Thiel, M.V. Angel, E.J. Foell, A.L. Rice, G. Schriever (1998) *Environmental Risks from Large-Scale Ecological Research in the Deep Sea: A Desk Study*, Office for Official Publications of the European Communities, Luxembourg. States involved in the Pacific Ocean environmental work on nodule mining at the time included Germany, Japan, Russia, the US, and the six members of the InterOceanMetal (IOM) group.

Second, the ISA must apply LOSC Art. 145 to address them correctly, hence the importance of the ISA's tackling the definitions required to implement Art. 145 (see above, section 3.3, Missing Environmental Considerations).

Third, these environmental issues for deep-sea mining of nodules, sulphides and crusts are broadly similar to those associated with other commercial activities exploiting marine resources (including ocean space as such, an overlooked resource), e.g., oil and gas production, fishing, shipping, offshore renewable energy generation, sand and gravel extraction, dredging, wet diamond mining, tourism, cable and pipeline laying, etc. All these sectors are subject to, *inter alia*, the marine environmental provisions of the LOSC in Part XII; moreover, under certain circumstances¹⁷ they must also comply with the marine environmental provisions of LOSC Article 145 in Part XI.

Considerable scope exists for synergy in developing environmentally responsible approaches to activities conducted in all these sectors, including deep-sea mining, and for avoiding duplication of effort and reinvention of the wheel. Technology could and should play a major role here. Hence I now briefly address the last topic of this paper: environmental aspects of the “*area of difficulty (b) transfer of technology*”, with regard to activities in the Area; it is second on the list of the nine areas identified in the Informal Consultations and set out above in the Introduction (section 1).

4. The (Neglected?) Role of Technology

4.1 Requirements under the Convention

Technology is an essential driver in the LOSC, whose Part XIV (Development and transfer of marine technology) is wholly devoted to it. With regard to activities in the Area, the LOSC and the IA assign to the ISA and States Parties a variety of joint and several responsibilities for technology in, e.g., LOSC Part XIV Arts. 273 (Cooperation with international organizations and the Authority) and 274 (Objectives of the Authority), especially Art. 274 (b) and (d); Part XI Art. 144 (Transfer of technology), LOSC Annex III (Basic conditions of prospecting, exploration and exploitation) Art. 13 (1)(b) “*to attract ... technology to exploration and exploitation of the Area,*” Art. 13 (1)(d) “*to provide incentives ... for contractors ... to stimulate the transfer of technology*” [to] “*the Enterprise and developing States or their nationals*” and Art. 13 (14) on “*rules, regulations and procedures*” with regard to those

¹⁶ See, e.g., for all three resources listed here, the suite of papers in R. Sharma (Ed.) (2019) *Environmental Issues of Deep-Sea Mining: Impacts, Consequences and Policy Perspectives*. Springer Nature, Cham, Switzerland and D.O.B. Jones, D.J. Amon, A.S.A. Chapman (2018) “Mining deep-ocean mineral deposits: what are the ecological risks?” *Elements* 14(5):325-330.

¹⁷ This important but so far largely unexplored environmental issue was adumbrated but not developed in my presentation due to time and scope constraints. Planning for it should form part of the ISA's environmental program for the next 25 years. The cable and pipeline sectors offer an instructive example. See, for cables, the Memorandum of understanding between the International Cable Protection Committee and the International Seabed Authority (2010), available at <https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/documents/EN/16Sess/Assembly/ISBA-16A-INF1.pdf>, last accessed 31.03.2020. See also, for a wider review of this sector in the context of the law of the sea, including the marine environment, the suite of papers by T. Davenport: (2018) “The high seas freedom to lay submarine cables and the protection of the marine environment: challenges for high seas governance,” *American Journal of International Law Unbound* 112:139-143; (2014) “Submarine power cables and international law,” *German Yearbook of International Law* (2014) 56:107-148; (2012) “Submarine communications cables and law of the sea: problems in law and practice,” *Ocean Development and International Law* 43:201-242.

incentives. Note that LOSC Annex III Art. 5 (Transfer of technology) is no longer applicable as per IA Section 5(2), but the topic is addressed by IA Section 5 (also entitled Transfer of technology).

Technology is fundamental to developing, conducting and monitoring environmentally responsible activities. With regard to “*technology for protection and preservation of the marine environment*” in relation to activities in the Area, the IA highlights this crucial link (Section 1(5)(i)) in its list of activities the Authority must “*concentrate on until the approval of the first plan of work for exploitation*” (IA Section 1(5)), i.e., “*monitoring of the development of marine technology relevant to activities in the Area, in particular technology relating to the protection and preservation of the marine environment.*” The Enterprise is similarly charged: among the “*functions*”¹⁸ it is currently¹⁹ tasked with is “*Assessment of technological developments relevant to activities in the Area, in particular technology relating to the protection and preservation of the marine environment.*” (IA Section 2 (1)(d).)

4.2 Discussion of the Role of Technology

The LOSC and IA offer ample scope for the interpretation that technology is to play a major role in meeting the ISA’s obligation under Art. 145 to [“*take necessary measures*”] ... to “*ensure effective protection for the marine environment from harmful effects that may result from such activities*” [“*in the Area*”]. Read together with the provisions set out in Annex III on incentives for contractors (section 4.1 Requirements under the Convention), the LOSC and the IA also can be read to support the interpretation that the measures required under Art. 145 include providing for those incentives. If this interpretation is correct, the draft regulations on exploitation will need to address this aspect in its environmental section. Note also that these incentives need not necessarily be only financial ones.

The ISA’s and the Enterprise’s obligations with regard to technology for marine environmental purposes, i.e., monitoring and assessment of this technology, respectively, are different but compatible and could provide the basis for a joint project developed together with the contractors.

I conclude this section by suggesting an initial focus for such a project. The LOSC requires that measures to protect and preserve the marine environment be aimed at “*prevention, reduction and control,*” in that order. The focus should therefore be to create a project to develop technology that a) prevents harmful effects of deep-sea mining, and b) facilitates the monitoring of the mining to assess whether the technology is achieving this prevention.

5. Conclusion

What should the Authority’s primary environmental objective be in the next 25 years? It should grasp the nettle of LOSC Article 145: define, reduce to regulatory form and implement the protection and/or achievement of the so far unaddressed environmental considerations set out there. As this will be done by the same 168 states that are also party to the Convention, and because the ISA must address the marine environment as a whole, the ISA’s work should also be undertaken with the additional objective to inform, engage with and assist the marine

¹⁸ IA Section 2.

¹⁹ The current status and operation of the Enterprise are complex: see, e.g., LOSC Art. 170, LOSC Annex IV, IA Section 2.

environmental protection efforts of these same states in other international and intergovernmental fora, and especially where the Convention's clear requirement to protect and preserve the *whole* marine environment has so far not been met.

Environmentally responsible deep sea mining is feasible, but requires carefully targeted research, technology, monitoring and adaptive management of the activities. The ISA should foster development and transfer of technology for prevention of harmful effects of activities in the Area.

Finally, the ISA should immediately release for public use all baseline environmental data submitted to the ISA by the contractors over the past 25 years, and ensure that henceforth new baseline environmental (including hydrographic and oceanographic) data collected by the contractors are made immediately available for public use at the same time that the accompanying annual report is submitted.

The ocean offers a cornucopia of opportunities to humankind, but these opportunities can only be realized if humankind's activities - ***NOT*** the ocean's activities - are managed appropriately. This is because working effectively and responsibly in the marine environment requires working with the marine environment.

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