GUARDING THE FINAL FRONTIER: THE FUTURE REGULATIONS OF THE INTERNATIONAL SEABED AUTHORITY

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I. INTRODUCTION

Beyond the reaches of the continental shelf,[1] the ocean floor drops and gives way to the deep sea. This dark expanse, which receives little to no sunlight, is home to some of the planet's most unique and otherworldly creatures and is one of the least known and least explored areas—truly the final frontier. Areas of the deep sea, particularly hydrothermal vents, are thought to be the nurseries of all life on earth.[2] The deep sea is home to a huge pool of rare and genetically diverse organisms with biological processes that could have significant applications within the health industry, industrial processes, and bioremediation.[3] Additionally, deep seabed ecosystems serve as a greenhouse gas buffer, as they play a key role in the carbon cycle.[4] However, these untouched regions could be exposed to a new threat—deep seabed mining.

Deep seabed mining has been considered a viable option since World War II.[5] Given the unique environment in which it is undertaken, deep seabed mining has faced considerable technological hurdles.[6] By the late 1970s and early 1980s, it was believed that technology and international price points were in place to make deep seabed mining a commercial reality.[7] At the same time, the idea of the

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1. Physically, the continental shelf is the extension of the continental landmass that is submerged in a shallow sea. RANDOM HOUSE UNABRIDGED DICTIONARY 439 (2d ed. 1987). This term has taken a legal definition that applies to the seabed and subsoil beyond the territorial sea but still subject to some level of national control. Peter Tobias Stoll, *Continental Shelf*, *in* MAX PLANCK ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW ¶ 1 (2008).

2. *See, e.g.*, William Martin, John Baross, Deborah Kelley & Michael J. Russell, *Hydrothermal Vents and the Origin of Life*, 6 NATURE REVIEWS MICROBIOLOGY 805 (2008) (explaining that hydrothermal vents harbor rich ecosystems that are chemically reactive environments suitable for sustained prebiotic syntheses).

3. Salvatore Arico & Charlotte Salpin, *Bioprospecting of Genetic Resources in the Deep Seabed: Scientific, Legal and Policy Aspects,* U.N. Univ.-Inst. of Advanced Studies 53 (2005).

4. *Id*.

5. Stoll, *supra* note 1.

6. *Id*.

7. *Id*.

"common heritage of mankind" developed in international law.[8] With this development came the U.N. Convention on the Law of the Sea (UNCLOS), which set out to codify and regulate international waters and, specifically, the deep seabed.[9] Under the Third UNCLOS, the International Seabed Authority ("the Authority") was created.[10] The Authority was a major sticking point at the time because deep seabed mining was thought to be a booming area.[11] The seabed mining boom never materialized as new sources of minerals were discovered on land, and the Authority largely shrunk back from the international spotlight.

The Authority emerged into existence with a roar in the mid-1990s,[12] but since then has barely made a whimper. That is all set to change, as the Authority looks poised to become relevant again.[13] Easily accessible sources for minerals have again become scarce, and a decade and a half has brought new developments in technology. The biggest sign of its return to relevancy is that the number of applications to the Authority for exploratory licenses has more than doubled in the past two years.[14]

The Authority has developed regulations to control prospecting and exploring deep sea mining in regards to polymetallic nodules and polymetallic sulphides.[15] It has yet to develop any regulations with regard to exploiting any of these minerals, which will be one of the Authority's primary goals in its next few sessions. This will not be an easy task, as seabed mining poses distinctive problems and concerns

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8. There is no universally agreed upon definition of the common heritage of mankind. Scott J. Shackelford, *The Tragedy of the Common Heritage of Mankind*, 28 STAN. ENVTL. L.J. 109, 110 (2009). The basic core principle is that some areas should not be subject to the sovereignty of individual states but should be held for the benefit of all mankind. *Id*.

9. Stoll, *supra* note 1, ¶ 3.

10. U.N. Convention on Law of the Sea, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397, 457 (entered into force Nov. 16, 1994) [hereinafter UNCLOS III].

11. *See* Elliot L. Richardson, *Treasure Beneath the Sea*, N.Y. TIMES (July 30, 1994) http://www.nytimes.com/1994/07/30/opinion/treasure-beneath-the-sea.html (discussing both the difficulties in ratifying the Authority and the potential of deep seabed mining).

12. *See, e.g.*, *About Us*, INT'L SEABED AUTH., http://www.isa.org.jm/en/about (last visited Nov. 14, 2011) (stating that the Authority was established on Nov. 16, 1994 in the facilities of the U.N. Kingston Office for the Law of the Sea in Kingston Jamaica).

13. *See* James Harrison, *Is Deep Sea Mining About to Take Off?? New Developments at the International Seabed Authority*, INTERNATIONAL LAW OBSERVER (July 8, 2011, 4:50 PM), http://internationallawobserver.eu/2011/07/08/is-deep-sea-mining-about-to-take-off-new-developments-at-the-international-seabed-authority/ (last visited July 8, 2011) (noting there has been a large increase in applications for deep seabed mining exploration permits, signaling that it may now be a commercially viable enterprise).

14. *See ISA Council Approves Five New Applications for Exploration*, INT'L SEABED AUTH. (July 24, 2012, 6:32 AM), http://www.isa.org.jm/en/node/770 (last visited Aug. 15, 2012) (discussing the nine approved applications for exploration in the past two years, bringing the total to seventeen).

15. *See, e.g.*, Harrison, *supra* note 13 (noting polymetallic sulphides and nodules cobalt-rich crusts have also been the subject of prospecting and exploration regulations, but polymetallic sulphides and nodules are the most promising of the three types of resources for mining in the near future).

for regulators.[16] Additionally, the Authority will have many different parties with many different interests pulling at it.[17] The Authority will have to address many issues to create an environmentally responsible set of regulations, but this Comment will focus on the inclusion of the precautionary principle and how it should be applied to the future Authority regulations on exploitation.

Part II will provide a brief overview of the development of the law of the sea, the formation and structure of the Authority, and the development of the precautionary principle in international law. Part III will address the potential forms of deep seabed mining. Part IV will then explore the environmental protections and guidance given in UNCLOS III. Part V will look at the environmental standards existing in the current regulations already developed by the Authority. Part VI will outline the environmental impacts of the different forms of mining and the levels of uncertainty accompanying them. Part VII will review the early plans the Authority is considering for environmental protection of the seabed. Finally, Part VIII will discuss what the regulations regarding exploitation will likely look like based on the Authority's past actions, and also what they should look like to govern the deep sea area responsibly.

II. BACKGROUND

A. Development of the Law of the Sea and the "Common Heritage of Mankind"

In 1608, the famous publicist Hugo Grotius was one of the first to expound on why the seas should be open to all for trade and exploration.[18] This idea gained traction, and by the nineteenth and early twentieth century, it was generally held that the seas were indeed open to everyone and subject to no one country's sovereignty.[19]

This idea began to encounter resistance in the middle of the twentieth century as an increase in technology made the high seas more accessible.[20] They were no longer foreboding and mysterious areas; they were instead sources of vast economic and strategic opportunities.[21] The seabed was one of the first maritime

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16. *See, e.g.*, *id.*

17. *See generally* Dionysia-Theodora Avgerinopoulou, Note, *The Lawmaking Process at the International Seabed Authority as a Limitation on Effective Environmental Management*, 3 COLUM. J. ENVTL. L. 565 (2005) (describing how the Authority is pulled in different directions by its developing member-states, developed member-states, scientists, environmentalists, and private mining corporations).

18. *See generally* HUGO GROTIUS & MARE LIBERUM, THE FREEDOM OF THE SEAS (James Brown Scott ed., Ralph Van Deman Magoffin, trans., Oxford University Press 1916) (1608) (responding to the Portuguese attempt to exclude the Dutch East India Company from the Indian waters).

19. *See* RAM PRAKASH ANAND, ORIGIN AND DEVELOPMENT OF THE LAW OF THE SEA: HISTORY OF INTERNATIONAL LAW REVISITED (1982).

20. *See* Shackelford, *supra* note 8, at 167.

21. *See id.* at 123.

zones beyond the territorial sea to be claimed by sovereign states.[22] In 1945, President Harry Truman issued a proclamation claiming that the United States controlled all of the resources on the seabed of the U.S. continental shelf.[23] This stance was followed by countries all around the world and gave birth to what would become customary international law regarding control of the seabed.[24] However, customary law would not be sufficient to govern the increasingly complicated and frequent interactions on and under the seas, and in 1958, the United Nations Convention on the Law of the Sea (UNCLOS I) was enacted.[25] The UNCLOS I was an important first step as it began a dialogue with parties at the negotiating table, but it lacked the holistic approach needed to address inter-related issues and failed to anticipate major issues like deep sea mining.[26]

Not long after the law of the sea first became codified in UNCLOS I, the concept of the common heritage of mankind begin to develop more fully, specifically with regard to the seabed. The idea behind the common heritage of mankind is that some things belong to the entire world and should be protected and held in trust for future generations.[27] In 1967, President Lyndon Johnson delivered an address declaring that international cooperation was important in the international seabed because "[w]e 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 bottom are, and remain, the legacy of all human beings."[28] This was followed by a famous speech from Arvid Pardo to the U.N. General Assembly in which he expressed his concerns that technological developments would allow advanced countries to appropriate the seabed and ocean floor, and bring them under national jurisdiction.[29] This would leave developing nations on the sidelines, unable to reap any benefit from the seabed and ocean floor—supposedly part of the common heritage of mankind. In order to truly preserve the rights of developing nations, and to protect the seabed itself, jurisdictional and regulatory issues would have to be codified.[30]

In 1970, the U.N. General Assembly declared the seabed beyond the

22. *See id.* at 114.

23. *See* Proclamation No. 2667, 10 Fed. Reg. 12,305 (Sept. 28, 1945).

24. Shackelford, *supra* note 8, at 124.

25. *Id.* The UNCLOS I is really a collection of four separate international treaties: the Convention on the Continental Shelf; Convention on the Territorial Sea and Contiguous Zone; Convention on the High Seas; and the Convention on Fishing and Conservation of Living Resources. They are collectively also known as the 1958 Geneva Conventions. *Id.* at 124 n.63.

26. *See* DAVID ANDERSON, MODERN LAW OF THE SEA 9–10 (2008).

27. *See* Shackelford, *supra* note 8, at 110–11 (holding that although there is no commonly held definition of the common heritage of mankind, there are five agreed on points within the various definitions).

28. Harold M. Schmeck Jr., *Johnson Asks Joint Exploitation of Sea Resources*, N.Y. TIMES, July 14, 1966, at 10; s*ee also* Martin A. Harry, Note, *The Deep Seabed: The Common Heritage of Mankind or Arena for Unilateral Exploitation*, 40 NAVAL L. REV. 207, 209 (1992).

29. G.A. Res. A/6695, ¶ 5, U.N. GAOR, 22nd Sess., U.N. Doc. A/C.1/952 (Nov. 1, 1967).

30. *See* Ian Bezpalko, Note, *The Deep Seabed: Customary Law Codified*, 44 NAT. RESOURCES J. 867, 870–71 (2004) (holding it was necessary to resolve jurisdictional issues regarding access in order for the high seas to truly belong to all mankind).

continental shelf as part of the common heritage of mankind.[31] As stated above, this principle, which deals solely with the commons, originated in the late 1960s specifically in reference to the seabed.[32] Its basic elements regarding the seabed are: (1) no state may claim sovereignty over the common heritage; (2) it must be open for use by all; (3) countries must cooperate in its use; (4) an obligation exists to share the benefits; (5) it must be used for peaceful purposes; and (6) an inter-temporal obligation exists to preserve the area and its resources for future generations.[33] The inter-temporal aspect of the final element points toward the idea that sustainable development is an affirmative obligation.[34] The common heritage of mankind principle has been extended to the Antarctic and to the moon, with slightly different elements playing a role in each.[35]

The 1970 U.N. declaration helped lead to the UNCLOS III—a nine-year conference running from 1973 to 1982.[36] With participation by 160 countries, the conference filled in many of the gaps left by previous agreements.[37] UNCLOS III covered many areas and reached a consensus on issues such as maritime zones (i.e., territorial seas, contiguous zone, exclusive economic zone, the continental shelf, high sea, and the international seabed);[38] provisions for passage of ships;[39] protection of the marine environment;[40] and freedom of scientific research.[41] UNCLOS III was finalized and opened for signature in 1982, but did not receive enough ratifications to come into force until 1994.[42] This twelve-year delay was, in large part, due to what had become the most controversial provision of the

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31. "The seabed here referred to is that which is beyond national jurisdiction of coastal states, identified as the 'common heritage of mankind.'" Declaration of Principles Governing the Seabed and the Ocean Floor, and Subsoil Thereof, Beyond the Limits of National Jurisdiction, G.A. Res. 2749, U.N. GAOR Supp. (No. 28) at 24, U.N. Doc. A/8028 (1970), *reprinted in* 10 I.L.M. 220 (1971).

32. Michael Wood, *International Seabed Authority*, *in* MAX PLANCK ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW ¶ 1 (2008).

33. *See* Rüdiger Wolfrum, *Common Heritage of Mankind*, *in* MAX PLANCK ENCYCLOPEDIA OF PUBLIC INTERNATIONAL LAW ¶¶ 4–26 (2009).

34. *See* KEMAL BASLAR, THE CONCEPT OF THE COMMON HERITAGE OF MANKIND IN INTERNATIONAL LAW 103 (1999) (affirming that sustainable development is a major element of the common heritage of mankind).

35. *See* Wolfrum, *supra* note 33, ¶¶ 5–8 (discussing the inclusion of the common heritage of mankind principle in treaties concerning the Antarctic and the moon).

36. *See* Oceans & Law of the Sea United Nations, *The United Nations Convention on the Law of the Sea: A Historical Perspective* (1998), http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm.

37. *See id.*

38. *See* UNCLOS III, *supra* note 10.

39. *Id.*

40. *Id.*

41. *Id.*

42. *Id.* The United States has yet to ratify the UNCLOS III. *See Treaties in Force,* U.S. DEP'T OF STATE, Jan. 1, 2011, http://www.state.gov/documents/organization/169274.pdf (last visited Feb. 27, 2012) (not including UNCLOS III in listing of all treaties to which the United States is a party).

agreement—the creation of the Authority.[43]

The Authority was so controversial precisely because it addressed Pardo's worry that only the developed nations would be able to reap the reward of mining the deep seabed in international waters. Part XI of UNCLOS III outlined not only the Authority, but also the system of governance for the deep seabed.[44] First, UNCLOS established a zone that lies beyond the limits of national jurisdiction and consists of "the ocean floor and subsoil thereof," which is to be called "the Area."[45] The Area's resources belong to the common heritage of mankind, while the rights to these resources are vested to the Authority on behalf of all mankind.[46] The Authority was given specific rights to control and regulate the extraction of the Area's mineral resources.[47]

This Section also stipulates much of the structure for the Authority and requires that the Authority facilitate technology transfers to developing states so they can participate in deep sea mining.[48] Additionally, the Authority was given the ability to engage in deep sea mining itself, through an organ called "the Enterprise," funded in part by contractors who mine in the Area.[49] This ability, coupled with the technology sharing, would allow developing nations to reap the Area's rewards. Developed nations resisted the Authority, as originally outlined in UNCLOS III, because they worried that the Authority would be expensive and inefficient, and would impede rather than promote deep seabed mining.[50] The developed nations also had deep concerns about the technology-sharing scheme.[51]

Developed nations' concerns about commercial rights and technology, combined with the United Nations' desire for universal ratification of UNCLOS III, ultimately led to the 1994 "Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982" (Agreement).[52] The Agreement modified Part XI of UNCLOS III to make it more palatable to developed nations, ensuring that the Authority would be cost-effective, make decisions in a manner to protect the interests of developed nations, and regulate the exploitation of the Area's resources in a commercially viable way.[53] The Agreement altered the voting rules so that developed nations in the Council[54] would have an effective veto to any vote, and by removing the mandatory technology transfer so that neither the Enterprise nor developing states are

43. *See* R.R. CHURCHILL & A.V. LOVE, THE LAW OF THE SEA (1999) (describing how some developed nations had concerns due to the fact that the UNCLOS were primarily about the Authority and its effect on deep sea mining).

44. UNCLOS III, *supra* note 10, at 445–77.

45. *Id.* at 399.

46. *Id.* at 445–77.

47. *Id.*

48. *Id.* at 449.

49. *Id.* at 471.

50. CHURCHILL & LOVE, *supra* note 43, at 20.

51. *Id.*

52. UNCLOS III, *supra* note 10, at 528–47.

53. CHURCHILL & LOVE, *supra* note 43, at 20.

54. *See infra* note 58 and accompanying text.

guaranteed access to the needed mining technology.[55] In a bigger blow to developing nations, the Agreement also made clear that contractors looking to mine in the Area no longer had to help finance similar mining operations taken up by the Enterprise.[56]

The Agreement ensured more participation in UNCLOS III.[57] It also tipped the scales in the Authority away from developing countries sharing in the Area's full benefits to developed nations having more control over and access to the Area's economic benefits.[58]

B. Structure of the International Seabed Authority

The Authority is its own autonomous organization, and it is technically not part of the U.N. system.[59] However, the Authority was born from the United Nations and still closely aligns with the U.N. system.[60] The Authority is broken up into multiple organs: the Assembly, the Council, the Secretariat, and the Enterprise.[61] The Assembly is the multi-faceted supreme body of the Authority that is composed of all the Authority's members and serves to: approve the budget; decide individual member's contributions; elect the Council; elect the Secretary-General; approve the rules, regulations, and procedures adopted by the Council; and examine the annual report made by the Secretariat. [62] All Assembly decisions are made by consensus and thus far this has been achieved on all but two occasions.[63] Arguably, the most important task the Assembly engages in is the election of the Council.

The Council serves as the Authority's executive organ and is comprised of thirty-six members elected by the Assembly.[64] The Council election is done

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55. *See* Philip A. Burr, *The International Seabed Authority*, 29 SUFFOLK TRANSNAT'L L. REV. 271, 279–80 (2006) (reviewing the changes from the 1982 UNCLOS language to the rules under the 1994 agreement).

56. *Id*. at 280.

57. CHURCHILL & LOVE, *supra* note 43, at 21. The United States has yet to ratify the UNCLOS despite the fact that ratification has been endorsed by Presidents and Senate committees.

58. *See* Burr, *supra* note 55, at 281–82 (comparing the philosophies in the preamble of the UNCLOS to the preamble in the Agreement to show that a fundamental shift in philosophy away from the common heritage of mankind took place).

59. Wood, *supra* note 32, ¶ 12.

60. *Id.*

61. UNCLOS III, *supra* note 10, art.158, at 458.

62. *Members*, INT'L SEABED AUTH., http://www.isa.org.jm/en/about/members (last visited Nov. 11, 2011). The membership of the Authority is all the parties of the UNCLOS III. *Id.* As of May 15, 2011, the membership consists of 161 countries and the European Community. *Id.*

63. Wood, *supra* note 32, ¶ 15. If all measures to reach a consensus have been exhausted, then a simple majority is required for procedural matters, and a two-thirds vote for substantive matters. *Id.*

64. *The Council*, INT'L SEABED AUTH., http://www.isa.org.jm/en/about/members/council (last visited Nov. 11, 2011).

according to a complex formula[65] that attempts to maintain specific representation[66] as well as maintaining diversity of interests.[67] As the executive organ, the Council is charged with developing policies for the Authority that conform both to UNCLOS III and to the wishes of the Assembly.[68] This includes: controlling all of the Area's operations; developing specific regulations for prospecting, exploring, and exploiting the Area; approving licenses and contracts for potential miners; and issuing emergency orders to prevent environmental harm by miners in the Area.[69] As with the Assembly, voting in the Council is meant to be done by consensus.[70] The Council also controls two smaller commissions: the Economic Planning Commission and the Legal and Technical Commission.[71] The Legal and Technical Commission fulfills many of the tasks that the Council performs, including promulgation of recommendations to the Council on seabed mining applications and environmental protections.[72] This makes it one of the most important arms of the Authority.

The Secretariat is the Authority's administrative organ and is in charge of the Authority's day-to-day administration, including researching, monitoring, and information gathering and disseminating.[73] Currently, the Secretariat also controls the functions of the Enterprise. The Enterprise is another arm of the Authority specifically created under UNCLOS III.[74] This distinct entity is charged with "the transporting, processing and marketing of minerals recovered from the Area"[75] to ultimately help finance the Authority and providing developing nations the benefits of the common heritage of mankind.[76] To date, the Enterprise has yet to undertake any mining operations. The Secretariat is responsible for the functions of the

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65. *See id.* (describing the five special interest voting groups that each member of the Council must be voted into).

66. *See* Wood, *supra* note 32, ¶ 20 (explaining how decision making in the Council is designed to favor the groups that represent the major consumers/importers of the commodities mined in the Area, the largest investors in seabed mining, and the largest land based producers of the commodities mined in the Area).

67. *The Council*, *supra* note 64.

68. *Id.*

69. *Id.*

70. Wood, *supra* note 32, ¶ 20. The rules if a consensus is not reached require a majority for procedural issues and a two-third majority for substantive issues, provided that no majority in any one of the five special interest groups votes against it. *Id.* So far all decisions have been made in the Council by consensus. *Id.*

71. UNCLOS III, *supra* note 10, at 466.

72. *Id.* at 468–69.

73. Wood, *supra* note 32, ¶¶ 27–29; s*ee also The International Seabed Authority: Structure and Functioning*, INT'L SEABED AUTH., http://www.isa.org.jm/files/documents/EN/Brochures/ENG2.pdf (last visited October 25, 2012) (explaining the Secretariat's role of carrying out day-to-day assignments of the Authority).

74. UNCLOS III, *supra* note 10, at 471.

75. *Id.*

76. It was originally envisioned that once mining starts that the Enterprise will work initially in tandem with private miners and then move to its own sites for mining. Wood, *supra* note 32, ¶ 29. This would create a tandem or parallel system where the Authority can cover its own costs and also supply profits to developing nations. *Id.*

Enterprise until mining commences, whereupon the Enterprise would gain independence from both the Secretariat and the Council.[77]

In the eighteen years the Authority has existed, it has made only limited headway in developing regulations. In 2000, the Authority adopted and issued regulations regarding prospecting[78] and exploring[79] polymetallic nodules.[80] Ten years later the Authority passed similar regulations regarding the search for polymetallic sulphides,[81] and in 2011 they did the same for cobalt rich crusts.[82] In addition to the development of these regulations, the Authority has granted seventeen contracts for the exploring and prospecting of minerals, with nine of those contracts in 2011 and 2012.[83] With this increased activity, the Authority has now begun developing its regulations regarding the exploitation of minerals, and will be faced with difficult decisions as to what extent environmental principles, particularly the precautionary principle, will play in these new regulations.[84]

C. The Precautionary Principle

The precautionary principle played a prominent role in international environmental law, including in the current regulations the Authority has drafted. This principle sprang out of the realization that reactionary environmental policies that focused on repairing environmental damages would no longer effectively respond to increasingly wide-ranging and long-term environmental problems.[85] Additional proactive policies were established,[86] but these were also problematic

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77. *Id.*

78. Prospecting is defined as "the search for [minerals] in the Area, including estimation of the composition, sizes and distributions of polymetallic nodule deposits and their economic values, without any exclusive rights." Int'l Seabed Auth., *Regulations on Prospecting and Exploration of Polymetallic Nodules in the Area*, regulation 1.3(e) (July 13, 2000).

79. Exploration is defined as "searching for deposits of [minerals] 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." *Id.* at regulation 1.3(b).

80. *Mining Code*, INT'L SEABED AUTH., http://www.isa.org.jm/en/mcode (last visited Feb. 26, 2012).

81. *Id.*

82. *Seabed Assembly Ends Productive 18th Session Of The Authority*, INT'L SEABED AUTH., (July 29, 2012), http://www.isa.org.jm/en/node/778.

83. *Tonga Becomes Second Developing State to Sign Contract with ISA*, INT'L SEABED AUTH., http://www.isa.org.jm/en/node/714 (last visited Feb. 26, 2012); INT'L SEABED AUTH., *supra* note 14.

84. *See International Seabed Authority Enters New Stage in the Development of Marine Minerals*, INT'L SEABED AUTH., (Nov. 29, 2011), http://www.isa.org.jm/en/node/707 (discussing how the Authority must now tackle the environmental issues associated with exploitation).

85. SUMUDU A. ATAPATTU, EMERGING PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW 203 (2006).

86. *See* SONJA BOEHMER-CHRISTIANSEN, THE PRECAUTIONARY PRINCIPLE IN GERMANY: ENABLING GOVERNMENT IN INTERPRETING THE PRECAUTIONARY PRINCIPLE 34–37 (1994) (discussing the evolution of precautionary policies in Germany).

where scientific evidence was lacking with regard to exact causes of environmental harm.[87] The precautionary principle focuses on environmental action at an early stage and requires measures to protect the environment "even in situations where there is potential hazard but scientific uncertainty as to the impact of the potentially hazardous activity."[88] The most famous declaration of the precautionary principle is contained in Principle 15 of the Rio Declaration on the Environment and Development.[89] Principle 15 states that "[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[90]

The precautionary principle did not burst onto the international scene until the mid-1980s, when German proposals at international conferences began carrying the language.[91] Since then, it has rapidly risen in popularity, with numerous international treaties and individual countries adopting it into national laws and regulations.[92] Because the principle was not as developed by 1982, the UNCLOS does not contain any precautionary language per se.[93] The influence of the precautionary principle has increased to the point that "[i]t has become a guiding principle of modern international law and, increasingly, of national instruments . . . relating to protection of the environment."[94] Regardless of its legal distinction, the precautionary principle has become increasingly popular because science still has trouble developing prediction models for the complex natural systems affected by environmental hazards.[95] In addition to helping prevent present day environmental harm, it also helps provide inter-generational equity as long-term environmental

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87. *See* ATAPATTU, *supra* note 85, at 203–04 (presenting the problem of global warming as the perfect situation in which the precautionary principle would come into play).

88. Meinhard Schroder, *Precautionary Approach/Principle*, *in* MAX PLANCK ENCYCLOPEDIA OF INTERNATIONAL LAW, ¶ 2 (2009).

89. *Id.*

90. United Nations Conference on Environment and Development, Rio de Janiero, Braz., June 3–14, 1992, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26 (Vol. I), Annex I, (1992) [hereinafter Rio Declaration], *available at* http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm.

91. Schroder, *supra* note 88, ¶ 7.

92. *Id.* ¶ 14. The list of international treaties that include the precautionary principle includes amongst others: Ozone Layer Protocol; Second & Third North Sea Declarations; Nordic Council's Conference; Bamako Convention on Transboundary Hazardous Waste into Africa; and the Maastricht Treaty on the European Union. *See, e.g.*, JOEL TICKNER & CAROLYN RAFFENSPERGER, SCIENCE AND ENVIRONMENTAL HEALTH NETWORK, PRECAUTIONARY PRINCIPLE IN ACTION: A HANDBOOK 20–23 (1998) (listing a non-exhaustive collection of international agreements using the precautionary approach).

93. The minor exception to this is the "Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks" signed in 1995, which does mention the precautionary principle as being an important policy measure. *Id.*

94. Schroder, *supra* note 88, ¶ 1.

95. SIMON MARR, THE PRECAUTIONARY PRINCIPLE IN THE LAW OF THE SEA: MODERN DECISION MAKING IN INTERNATIONAL LAW 6 (2003).

harm is often prevented under this approach.[96]

The precautionary principle is not met with universal praise. There is considerable potential for over-regulation with extreme scientific uncertainty that could hamper development.[97] This can be particularly contentious when diametrically opposed scientific views are involved, with one view signaling that regulation is necessary and the other showing no need.[98] The impacts of over-regulation include stymied economic and technological growth. Additionally, the precautionary principle is not always as straightforward as it may seem. It has a number of different formulations that can dictate action when there is: "an absence of adequate scientific information"; "no scientific proof"; "no conclusive evidence"; or "lack of full scientific certainty."[99] Different situations in different sectors may call for different formulations of the principle,[100] which can lead to confusion.

The precautionary principle is a tool to provide guidance to regulators making decisions in the face of environmental uncertainty. Because the principle is used in different ways in different places, it is helpful to distill it into smaller sections for easier analysis in regulatory settings for decision-makers. The precautionary principle can be broken down into the following sections: (1) the reaction to scientific uncertainty; (2) the types of uncertainty; (3) placement of the burden of proof for harm; and (4) the triggers for the precautionary principle.

The first section addresses the issue of whether there is scientific uncertainty as to an environmental impact. This question can be dealt with in two different approaches: the action-guiding and deliberation-guiding approaches.[101] The action-guiding approach requires regulation when there is scientific uncertainty about whether or not an act is environmentally hazardous.[102] The deliberation-guiding approach does not require action, but does not allow a lack of certainty in scientific evidence to justify a delay in regulation of a potentially hazardous act.[103]

An example could be the use of a new type of fishing net. There may be scientific uncertainty as to how this net would affect the environment. The action-guiding approach would require regulators to take action to limit the use of the net preemptively to protect the environment. In the same situation, the use of the deliberation-guiding approach would not require specific action. It would require

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96. ATAPATTU, *supra* note 85, at 204.

97. *Id.* at 205; s*ee also* Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1004–09 (urging that the use of the precautionary principle creates harms on all side of the equation, including environmental harm).

98. MARR, *supra* note 95, at 6–7; s*ee also* Southern Bluefin Tuna Cases (Nos. 3 & 4) (N.Z. v. Japan; Austl. v. Japan) Order of Aug. 27, 1999 (ordering that all sides negotiate an agreement for the protection of the bluefin tuna despite the fact that scientific evidence of the harm to the tuna was uncertain).

99. MARR, *supra* note 95, at 9.

100. Schroder, *supra* note 88, ¶ 22.

101. MARR, *supra* note 95, at 11.

102. *Id.*

103. *Id.*

that, in the debate about any potential regulations, scientific uncertainty about the environmental effects of the new type of net not be used to push for no regulation. Since the deliberation-guiding approach does not require immediate action, it is less stringent than the action-guiding approach.[104] This still leaves open questions on uncertainty, but it provides guidance as to when to take action.

In operation, the biggest questions in the precautionary approach deal with uncertainty. Before looking at the tools to handle uncertainty in the precautionary principle, it is important to understand the different types of uncertainty, because different tools may be more or less useful depending on the type of uncertainty. The three types of uncertainty are risk, unquantifiable risk, and ignorance.[105] Risk is best thought of in the traditional situation where all the potential outcomes are known and each outcome has a known probability of happening.[106] Here a regulator knows the risks and probabilities and can then make a decision using traditional risk assessment measures.[107]

Unquantifiable risks are risks that are known but the probability of each risk happening is unknown, thus leaving the decision-maker in a more precarious position with few objective tools and more subjective choices.[108] The final type of uncertainty is ignorance, which is when an outcome or set of outcomes is not even considered or known during the decision making process.[109] Because it can be difficult to know what level of uncertainty one is dealing with, it is important for a regulator to stay cognizant of the limits of available knowledge and to keep open alternative approaches and appraisals.[110] Only when there is an understanding of the type of uncertainty to be dealt with can the best tool to handle the uncertainty be chosen.[111]

To deal with uncertainty in the precautionary principle there are two main tools policy makers can use. The first tool is often standard under the precautionary principle—the shifting of the burden of proof.[112] The idea is to shift the burden of proving harmlessness to the party who seeks to undertake the potentially harmful activity.[113] This is a departure from the traditional tort-oriented approach requiring proof of damage before an action is labeled as harmful.[114] This placement of the burden reaffirms the central idea of the precautionary principle that pollution

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104. *Id.*

105. Poul Harremoës et al., *Twelve Late Lessons*, *in* THE PRECAUTIONARY PRINCIPLE IN THE 20TH CENTURY: LATE LESSONS FROM EARLY WARNINGS 185, 188 (Poul Harremoës et al. eds., 2002).

106. *Id.*

107. *Id.*

108. *Id.*

109. *Id.*

110. *Id.*

111. Harremoës, *supra* note 105, at 188.

112. MARR, *supra* note 95, at 15.

113. Bernard A. Weintraub, *Science, International Environmental Regulation, and the Precautionary Principle: Setting Standards and Defining Terms*, 1 N.Y.U. ENVTL. L.J. 173, 204 (1992).

114. *Id.*

prevention is more desirable than ex-post assignments of responsibility.[115] Additionally, shifting of the burden of proof may be more efficient as a potential regulator may not have the capability or the means to do an environmental impact assessment to evaluate potential harm.[116] This technique can do well in situations where the uncertainty is limited to risk, but when unquantifiable risk and ignorance are at play an environmental assessment will only go so far.[117] This is most dangerous in situations where long-term harm can come from small actions.[118]

The second tool regulators can use to tackle uncertainty is to adjust the minimum level of uncertainty of environmental risk that will trigger precautionary measures. The precautionary principle has no set level of uncertainty that is required in order for it to be invoked; rather, different uses have taken different levels.[119] Some examples of the different levels used are "scientific suspicion of risk"; "reasonable grounds for concern"; "the balance of evidence"; and "beyond reasonable doubt."[120] The level chosen should reflect the uncertainty and seriousness of the harm. For example, if an action has a low likelihood of having a negative effect and a small effect even if it does happen, then a higher threshold like "beyond reasonable doubt" might be appropriate. On the other hand, if a proposed action has a small likelihood of having a negative effect, but that effect could be quite large, then a lower threshold such as "scientific suspicion of risk" would be more appropriate. The tools used to regulate deep sea mining will be particularly important because the mining techniques will be new and the deep sea environment is unique and fragile.

III. MINING TECHNIQUES

A. Polymetallic Nodules: Mining Techniques

Some of the most promising resources to be mined from the deep seabed are polymetallic nodules. "[A]lso called manganese nodules, [they] are rock concretions formed of concentric layers of iron and manganese hydroxides around a core."[121] The nodules can vary in size from nearly microscopic to the size of a bowling ball.[122] The average size for a nodule ranges from slightly larger than a

115. James E. Hickey, Jr. & Vern R. Walker, *Refining the Precautionary Principle in International Environmental Law*, 14 VA. ENVTL. L.J. 423, 436 (1995).

116. Weintraub, *supra* note 113, at 205.

117. *See* MARR, *supra* note 95, at 17.

118. *See id.* (citing the example of genetically modified food as a situation where an impact assessment might not work).

119. The lack of continuity in the precautionary principle likely stems from the fact that each environmental problem has its own complex combination of relevant factors that require balancing in different ways creating a situation where no "one size fits all" solution is applicable. Harremoës, *supra* note 105, at 208.

120. *Id.*

121. *Polymetallic Nodules*, INT'L SEABED AUTH., http://www.isa.org.jm/files/documents/EN/Brochures/ENG7.pdf (last visited Oct. 7, 2011).

122. *Id.*

golf ball to the size of a baseball.[123] There are several theories as to how polymetallic nodules form.[124] Growth rates of nodules are slow even by geological standards with approximately a centimeter over several million years.[125] The majority of nodules in the Pacific Ocean are two to three million years old.[126]

Polymetallic nodules were first discovered in 1868 in the Kara Sea off the arctic coast of Russia.[127] Since that time they have been found in all of the earth's oceans and even some lakes and can be found at nearly any depth, but the highest concentrations are between 4,000 and 6,000 meters.[128] Polymetallic nodules lie half buried on the sea bottom sediment, are easy to pick up, and can cover 70% of the bottom.[129] For an area to be economically viable for polymetallic nodule mining there must be a concentration of ten kilograms per square meter with an average of fifteen kilograms per square meter over a few tenths of a kilometer squared.[130] Only nodules that contain at least 27% manganese, 1.25% nickel, 1% copper, and 0.2% cobalt are of economic interest.[131] Only a few areas have been discovered that have a high enough concentration of nodules that are of economic interest: the center of the north central Pacific Ocean between Hawaii and Central America, the Peru Basin in the southeast Pacific Ocean, and the northern Indian Ocean.[132]

The minerals on the deep seabed floor are quite difficult to harvest.[133] The best analogy to polymetallic nodule mining is that it is like "standing on top of a skyscraper on a windy day and trying to suck marbles off the street with a vacuum cleaner hose."[134] Several different techniques have been tested over the years, but the most promising is a hydraulic mining system, which involves a floating mining platform that sits on the ocean surface.[135] Beneath this, a rigid pipe with hydraulic pumps along it runs nearly all the way to the seabed.[136] At this point a transfer box links to a flexible hose that links to a self-propelled collector vehicle with a crusher.[137] This vehicle crawls along the seabed collecting nodules, crushing them,

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123. *Id.*

124. The two main theories are a hydrogenous process, in which the nodules are formed from a slow precipitation of metallic components in seawater, and a diagenetic process, in which manganese is picked up as it precipitates at the sediment/water interface. *Id.*

125. *Id.*

126. *Id.*

127. *Polymetallic Nodules*, *supra* note 121.

128. *Id.*

129. *Id.*

130. *Id.*

131. *Id.*

132. *Id.*

133. *Seabed Technology*, INT'L SEABED AUTH., http://www.isa.org.jm/files/documents/EN/Brochures/ENG10.pdf (last visited on Oct. 8, 2011).

134. Jason C. Nelson, *The Contemporary Seabed Mining Regime: A Critical Analysis of the Mining Regulations Promulgated by the International Seabed Authority*, 16 COLO. J. INT'L ENVTL. L. & POL'Y 27, 40 (2005).

135. *Polymetallic Nodules, supra* note 121.

136. *Id.*

137. *Id.*

and then the attached hose sucks the crushed up nodules to the mining platform.[138] Ore carriers can then dock with the platform and take the nodule ore to a processing facility on land.[139] Currently, no commercial seabed mining has been done at depths of more than 200 meters, but testing of the hydraulic system described above has been done at depths beyond 5,000 meters, demonstrating that it should be a viable method for deep seabed mining.[140]

B. Polymetallic Sulphides: Mining Techniques

Some other mineral resources that have shown promise are polymetallic sulphides. A newcomer to the field of undersea mining, it was not until 1979 that a group of scientists doing undersea exploration came across a "chimney-like" rock formation on top of a large sulfide deposit gushing hot water.[141] These formations became known as black smokers and it was discovered that they played host to a plethora of organisms seen nowhere else on earth.[142] Most importantly for mining purposes, these chimneys sat on top of huge sulfide deposits that contained large quantities of valuable minerals.[143]

Since 1979, more exploration has been done and black smokers have been found predominantly in the Pacific Ocean, and to a lesser extent in the Atlantic and Indian Oceans.[144] Black smokers are traditionally found on the summits of underwater mountains and ridges.[145] They are the product of tectonic plate movement.[146] When plates separate from each other, hydrothermal fluids sink deep into "subterranean chambers where they are heated by the molten rock . . . beneath the [earth's] crust . . . ."[147] These superheated and pressurized fluids are then pushed back up to the seafloor where black smokers discharge them at extraordinary temperatures, including 400 degrees Celsius.[148] These formations are typically found at depths up to 3,700 meters where the seawater is very cold.[149]

When the frigid water mixes with the superheated hydrothermal fluid, sulphides and other minerals are discharged out onto the chimneys and surrounding seabed.[150] Over millions and millions of years, this slow process can produce a substantial amount of sulphides. Discovered deposits range from several

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138. *Id.*
139. *Id.*
140. *Seabed Technology*, *supra* note 133.
141. *Polymetallic Sulphides*, INT'L SEABED AUTH., http://www.isa.org.jm/files/documents/EN/Brochures/ENG8.pdf (last visited Oct. 9, 2011).
142. *Id.*
143. *Id.*
144. *Id.*
145. *Id.*
146. *Id.*
147. *Polymetallic Sulphides*, *supra* note 141.
148. *Id.*
149. *Id.*
150. *Id.*

thousand tons of polymetallic sulphide to 100 million tons.[151] Miners' interests are typically copper, zinc, and lead.[152] However, increasing exploration has discovered some locations with high quantities of silver and gold.[153] The number of sites which host sulfide deposits is expected to increase since only 5% of oceanic ridges have been explored.[154] This potential mining would bring increased activity to the deep seabed and the possibility of serious environmental harm if not properly regulated.

IV. ENVIRONMENTAL MANDATES IN THE LAW OF THE SEA CONVENTION

Part XI of UNCLOS III outlines not only the basic structure of the Authority, but also provides specific environmental obligations for the Authority in the Area. Part XI reaffirms the dedication to the common heritage of mankind principle when it states that "[t]he Area and its resources are the common heritage of mankind."[155] This statement does not necessarily translate to a clear call for environmental protection because it can be argued that environmental protection has nothing to do with the common heritage of mankind principle in UNCLOS III.

Definitions in the treaty limit the principle. For example, "resources" are narrowly defined in UNCLOS III as all "solid, liquid, or gaseous mineral resources *in situ* in the Area at or beneath the seabed, including polymetallic nodules."[156] This definition is important because it seems to limit the scope of this provision to mineral resources, as opposed to living resources, by seeking only equitable distribution and mining practices that do not destroy the next generation's opportunity to mine.[157] On the other hand, the Area[158] could include the living creatures residing in it. An interpretation that includes protection for the marine environment would be consistent with Arvid Pardo's intentions when creating the common heritage of mankind.[159] A key aspect of the common heritage of mankind

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151. *Id*. *But see* S. Peterson, M. Hannington, T. Monecke & G. Cherkashov, *Are Modern Seafloor Massive Sulfide Deposits a Possible Resource for Mankind: Lessons Learned from Shallow Drilling Operations*, OCEANS, Sept. 19–22, 2011, *available at* http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6106987 (last visited Feb. 27, 2012).

152. *Polymetallic Sulphides*, *supra* note 141.

153. *Id*.

154. *Id*.

155. UNCLOS III, *supra* note 10, at 446.

156. *Id.* at 445.

157. *See generally* Wood, *supra* note 32, ¶ 26 (stating that the basic aspects of the common heritage of mankind principle in regards to the seabed are: (1) that no state may claim sovereignty over the common heritage; (2) it must be open for use by all; (3) countries must cooperate in its use; (4) there exists an obligation to share the benefits; (5) it must be used for peaceful purposes; and (6) an inter temporal obligation to preserve the area and its resources for future generations).

158. UNCLOS III, *supra* note 10, at 399 (defining the Area as "the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction").

159. *See generally* Arvid Pardo, *Proceedings of the American Society of International Law at Its Annual Meeting (1921–1969): "Whose is the Bed of the Sea?"*, 62 AM. SOC'Y INT'L L. PROC. 216, 225–26 (1968) (stating that "the seabed and ocean floor and their subsoil have a special status of as a common heritage of mankind and as such should be reserved exclusively for peaceful purposes and administered by an international authority for the benefit of all peoples and

was the protection of the ocean from pollution.[160]

Other authors have opined further and claimed that the UNCLOS III has created a communal obligation, stemming from the common heritage of mankind, for all nations to protect the marine environment, including the ocean floor.[161] Regardless of whether that interpretation of a communal obligation is true or not, the common heritage of mankind has been applied to the mandate of the Authority. Therefore, to read the inter-temporal aspect as only requiring a sustainable use of resources for future generations would be a betrayal of the ecological principles of Arvid Pardo.

The environmental mandate, imposed on the Authority from Part XI, is less cryptic than the common heritage of mankind. The mandate is located in Article 145, and states:

> 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.[162]

The mandate creates a clear obligation for the Authority to protect aquatic life, but notably absent is any direction as to the principles or methods that should be utilized. The only guidance for environmental protection is located in the Implementation Agreement.[163] The Implementation Agreement requires any plan of work to be accompanied by "an assessment of the potential environmental impacts of the proposed activities and by a description of a [program] for oceanographic and baseline environmental studies."[164] The requirement for an environmental assessment prior to proposed activities appears to be an essential element of the action-guiding approach to the precautionary principle. However, this element alone is not dispositive of the precautionary principle. In the United States, the National Environmental Protection Act (NEPA) requires a similar environmental assessment, and scholarship on whether that is evidence of the

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of present and future generations.").

160. *Id*.

161. BASLAR, *supra* note 34, at 237.

162. UNCLOS III, *supra* note 10, at 449.

163. U.N. Convention on Law of the Sea, Annex, Agreement Relating to the Implementation of Part XI of the Convention Dec. 10, 1982, § 1, ¶ 7, 1994.

164. *Id.*

precautionary principle in U.S. law is divided.[165] While, the requirement for an environmental assessment may not be dispositive of the precautionary principle's use in Part XI, it certainly puts the Authority on notice that environmental concerns should play an important role in the governance of seabed mining.

V. CURRENT REGULATIONS AND THEIR IMPLICATIONS

The Authority has developed regulations for the prospecting (i.e., the search for minerals without any exclusive rights) and exploring (i.e., the search for minerals with exclusive rights) of polymetallic nodules and polymetallic sulphides.[166] Since mining methods are radically different with diverse concerns and issues, the Authority has decided to craft regulations for each type of mining.[167] This fragmentary regulatory scheme has benefits and disadvantages.

Drafting separate regulations for every type of mining is less efficient and limits the opportunities for regulatory improvement through information sharing across mining types.[168] On the other hand, this fragmentary approach allows for specialization and the ability to address the unique challenges and effects of the different types of mining.[169] Ultimately, the regulations must stay fragmentary because the types of mining are nuanced.[170]

In 2000, the Authority released the first set of regulations, entitled "Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area."[171] This set of regulations allowed for companies to apply for initial exploration and prospecting contracts.[172] The regulations for prospecting and exploring polymetallic sulphides were released in 2010.[173] These two regulations'

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165. JOAKIM ZANDER, THE APPLICATION OF THE PRECAUTIONARY PRINCIPLE IN PRACTICE 274 (2010) (discussing how some sources believe NEPA to be the precautionary principle in action while others think it lacks enough "teeth" to truly be the precautionary principle).

166. *Compare Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at regulation 1.3(e) (defining "prospecting" as "the search for [minerals] in the Area, including estimation of the composition, sizes, and distributions of polymetallic nodule deposits and their economic values, without any exclusive rights"), *and Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at regulation 1.3(b) (defining "Exploration" as "[the search] for deposits of [minerals] 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"), *with Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at regulation 1.3(a) (defining "Exploitation" as "the recovery for commercial purposes of [minerals] in the Area and the extraction of minerals therefrom, including the construction and operation of mining, processing and transportation systems, for the production and marketing of metals").

167. Nelson, *supra* note 134, at 70–71.

168. *Id.* at 71.

169. *Id.*

170. *Id*. at 72.

171. *Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78.

172. *Id.*

173. *Regulations Prospecting and Exploration for Polymetallic Sulphides in the Area*, INT'L SEABED AUTH., *available at*

preambles are virtually identical and state:

> In accordance with the United Nations Convention on the Law of the Sea ("the Convention"), the seabed and ocean floor and the subsoil thereof beyond the limits of national jurisdiction, as well as its resources, are the common heritage of mankind, the exploration and exploitation of which shall be carried out for the benefit of mankind as a whole, on whose behalf the International Seabed Authority acts.[174]

The preambles reaffirm the importance of the common heritage of mankind principle and tie the regulations to the principles of UNCLOS, including the precautionary principle.

A. Polymetallic Nodule Regulations

The precautionary principle has a prominent role in both the polymetallic nodules and the polymetallic sulphide regulations. The nodule regulations provide that "[i]n order to ensure effective protection for the marine environment from harmful effects 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, to such activities."[175] Principle 15 of the Rio Declaration states that "[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[176] One of the main points in this declaration is the limitation of action to "cost-effective measures."[177] This limitation could seemingly be overcome by a situation where the environmental costs of mining are larger than any gain in mining income.

Principle 15 of the Rio Declaration is a request for a deliberation-guiding approach since it requires only the scientific uncertainty not to be used against environmental precaution. However, that formulation is potentially at odds with another part of the nodule regulations: "Prospecting shall not be undertaken if substantial evidence indicates the risk of serious harm to the marine environment."[178] It is difficult to interpret this language to require a precautionary approach because it places the burden of proving harm on the environmentalist side, and it does not place the burden of proving harmlessness on the industry's side.[179] Furthermore, this language is vague because the threshold of "substantial

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http://www.isa.org.jm/files/documents/EN/Regs/PolymetallicSulphides.pdf.

174. *Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at pmbl. *See also Regulations Prospecting and Exploration for Polymetallic Sulphides in the Area*, *supra* note 173, at pmbl.

175. *Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at regulation 31.2.

176. Rio Declaration, *supra* note 90.

177. *Id.*

178. *Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at regulation 2.2.

179. Nelson, *supra* note 134, at 44 (discussing the possibility that this section uses the precautionary principle and saying that it is neither drafted in a way to support that assertion, and the regulations clearly knew how to draft the precautionary principle in if they wanted to).

evidence" is undefined. Some guidance to regulation 2, section 2 is given. "Serious harm" is defined as "a significant adverse change in the marine environment determined according to the rules, regulations and procedures adopted by the Authority on the basis of internationally recognized standards and practices."[180] Nevertheless, this definition allows many open questions such as the meaning of "significant adverse change" or which internationally recognized standards are to be followed? The regulations leave these questions to the Legal and Technical Commission to decide with no additional guidance.[181]

To further complicate matters, another part of the regulations states:

> Pursuant to article 145 of the Convention and paragraph 2 of this regulation, each contractor shall take necessary measures to prevent, reduce and control the pollution and other hazards to the marine environment arising from its activities in the Area as far as reasonably possible using the best technology available to it.[182]

This implies that some unspecified amount of harm to the environment is to be expected. Article 145 makes the same implication, but sheds little to no light on the issue. Moreover, the language requiring the best available technology standard does not help, because it only solves the question of how to regulate and not whether to regulate.

If this regulation is viewed as an indicator of the Authority's tolerance of pollution, then it seems to indicate that the Authority's tolerance is high. A technology standard is concerned with the economic effects on miners, along with the health of the aquatic ecosystem.[183] Furthermore, the phrase "as far as reasonably possible" indicates that the standard might be different for various potential miners from a wide range of countries depending on the miners' capabilities.[184] Once again, this regulation provides less than clear guidance and seems to point toward a tolerance of environmental change up to a significant level.

The nodule regulations do include a provision requiring that an environmental baseline study be completed prior to any prospecting or exploration in the area.[185] The purpose of this provision is to allow the Legal and Technical Commission the opportunity to evaluate the effect on the environment of any proposed activity.[186] While this provision does not place the full burden of creating an environmental assessment on the prospective miner, it is an example of an element of the deliberation-guiding approach to the precautionary principle.[187]

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180. *Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at regulation 1.3(f).

181. *Id.* at regulation 31.2.

182. *Id.* at regulation 31.3.

183. Nelson, *supra* note 134, at 59.

184. *Id.* at 55.

185. *Prospecting and Exploration of Polymetallic Nodules*, *supra* note 78, at regulation 31.4.

186. *Id.*

187. *Id.*

Due to the dichotomy between regulations and the ambiguity in the definitions of terms, the nodule regulations on prospecting and exploration leave much to be desired in clear governance guidance. Despite this, one can start to see the picture that the nodule standards seem to paint. It appears that the Authority has indeed adopted a deliberation-guiding approach to the precautionary principle, and this approach may have a high tolerance of harm to the environment before any mining operation would be prevented or stopped.

B. Polymetallic Sulphide Mining Regulations

The polymetallic sulphide regulations are similar to the nodule regulations in terms of environmental considerations, but have a few key changes. The Authority clearly identified whether the precautionary principle applies in sulfide regulations, but it did not offer additional guidance. The sulphide regulations state: "Prospectors and the Secretary-General shall apply a precautionary approach, as reflected in principle 15 of the Rio Declaration. Prospecting shall not be undertaken if substantial evidence indicates the risk of serious harm to the marine environment."[188] These two sentences in the regulation potentially contradict each other. Yet the drafters must not believe them to be contradictory because they are juxtaposed. Nevertheless, since the precautionary principle is clearly stated, it must be a guiding factor.

The next major change is the addition of a regulation to address the protection and preservation of the marine environment.[189] The regulation requires potential prospectors and explorers "to prevent, reduce and control pollution and other hazards to the marine environment arising from prospecting, as far as reasonably possible, applying a precautionary approach and best environmental practices."[190] This regulation encapsulates many of the issues from the nodule regulations. It is unclear what amount of pollution is tolerable, since the regulation calls for prevention, reduction, and control. Additionally, the phrase, "as far as reasonably possible" could, as in the nodule regulations, mean that different prospectors have different standards to meet based on their capabilities.

The sulfide regulations also require that each prospector shall "minimize" or "eliminate" "adverse environmental impacts of prospecting."[191] These terms have definitional problems, because one is unsure what threshold "adverse" should or will be. "Adverse environment impacts of prospecting" does seem to be a lower threshold than "substantial adverse effect," used in the definition of "serious environmental harm" in both the nodule and sulfide regulations.[192] Subsection B of regulation 5, section 1 provides the most tangible measurement regarding tolerable

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188. *Regulations Prospecting and Exploration for Polymetallic Sulphides in the Area*, *supra* note 173, at regulation 2.2.

189. *Id*. at regulation 5.

190. *Id*. at regulation 5.1.

191. *Id*.

192. THE NEW OXFORD AMERICAN DICTIONARY 23 (Elizabeth J. Jewell et al. eds., 2001) (defining "adverse" as "preventing success or development; harmful; unfavorable").

degrees of harm. This provision requires prospectors to "minimize" or "eliminate" "[a]ctual or potential conflicts or interference with existing or planned marine scientific research activities . . . ."[193] This requirement recognizes the importance of understanding deep sea ecosystems. However, it creates a situation where one place may be permitted to perform an act that in another place may be disallowed, depending on existing or planned scientific research activities. Despite the inconsistency, this regulation presents a stronger environmental stance than any language in the nodule regulations. More importantly, it prioritizes scientific research over mining. This recognition reaffirms the common heritage of mankind inter-temporal element requiring the Area to be governed in a way that benefits future generations.

The last major difference of the environmental measures in the sulphide regulations is the inclusion of regulation 33, section 4. This section states that the Authority must develop a method, using the best technology and information available, to determine:

> [W]hether proposed exploration activities in the Area would have serious harmful effects on vulnerable marine ecosystems, in particular hydrothermal vents, and ensure that, if it is determined that certain proposed exploration activities would have serious harmful effects on vulnerable marine ecosystems, those activities are managed to prevent such effects or not authorized to proceed.[194]

This regulation is the clearest sign of the Authority's recognition that hydrothermal vents are a special ecosystem that requires protection. If that protection comes at the price of mining, then the Authority is willing to pay that price. It should be noted that the threshold for regulation has reverted to an affirmative showing of "serious harmful effects," which is in clear opposition to the action-guiding approach to the precautionary principle, because it requires regulation only after the showing of environmental harm. Yet this language does not impede on the deliberation-guiding approach to the precautionary principle.

The polymetallic sulphide regulations paint a similar picture to that of the nodule regulations of a decade earlier. The prospecting and exploitation sulphide regulations still leave key terms and standards undefined, providing minimal guidance. The deliberation-guiding precautionary principle is once again clearly reaffirmed. In addition, the tolerance of environmental harm seems to be fairly high, since the "serious harmful effects" threshold has not changed. What is different is a broader recognition that the ecosystems in question are vulnerable. Indeed, there is a clear message that if mining will seriously affect these ecosystems, then it will not be tolerated. This is a stronger affirmation of the common heritage of mankind principle on which the Authority was founded.

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193. *Regulations Prospecting and Exploration for Polymetallic Sulphides in the Area*, *supra* note 173, at regulation 5.1.

194. *Id*. at regulation 33.4.

VI. ENVIRONMENTAL IMPACTS, INFORMATION GAPS, AND LEVELS OF UNCERTAINTY

A. Environmental Impacts and the Uncertainty of Nodule Mining

The deep seabed is an extremely fragile environment that has little to no sunlight and very few nutrients. The organisms at the deep seabed survive almost exclusively on detritus from above. As a result, even slight disturbances can have big impacts. As stated earlier, the most probable form of nodule mining involves a collector vehicle gathering small balls of minerals scattered across the seafloor and then grinding the minerals up to be sent to the surface through a long hose.[195] This type of mining has four known negative environmental impacts: collector vehicle crush, sediment plume, waste water discharge, and noise pollution.[196] This Section of the Comment evaluates each individual concern to see what type of uncertainty it entails—risk, unquantifiable risk, and/or ignorance—and the severity of the potential harm.

The collector vehicle process has the clearest impact. The collector vehicle crawls along the seabed floor, sucking up the top layer of sediment and nodules and crushing them to be sent to the surface.[197] This process is highly invasive and, due to the actual treads of the vehicle and the collection of nodules, the mortality rate of organisms in the direct path is 95% to 100%.[198] The extent of the harm would be limited, because only a small number of organisms would be harmed. Regulators favor this type because the harm is predictable, allowing the regulators to make informed decisions. Nothing about this predictable harm signals a need for the use of the action-guiding precautionary principle.

The collection vehicle also kicks up sediment from its propulsion, which can bury organisms in the immediate area outside the direct path and kill fauna.[199] The sediment plume created by the collector can also cause problems for organisms that live slightly above the seafloor, because the water in the surrounding area becomes choked with sediment.[200] Studies have shown that significant decreases in species abundance can be found at least nine months later.[201] This result is less predictable in scope than the vehicular crushing and may be an unquantifiable risk,

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195. *Polymetallic Nodules, supra* note 121.

196. Jan Magne Markussen, *Deep Seabed Mining and the Environment: Consequences, Perception, and Regulations*, *in* GREEN GLOBE YEARBOOK OF INTERNATIONAL CO-OPERATION ON ENVIRONMENT AND DEVELOPMENT 1994, 33 (Helge Ole Bergesen & Georg Parmann eds., 1994).

197. *Id.*

198. *Id.*

199. *Id*.

200. *Protection of the Seabed Environment*, INT'L SEABED AUTH., http://www.isa.org.jm/files/documents/EN/Brochures/ENG4.pdf (last visited on Oct. 9, 2011).

201. Dwight D. Trueblood & Erdogan Ozturgut, *The Benthic Impact Experiment: A Study of the Ecological Impacts of Deep Seabed Mining on Abyssal Benthic Communities*, Proceedings of the Seventh Int'l Offshore and Polar Engineering Conf., at 481 (1997).

since there are unknown factors about how large an area would be affected or how long the sediment would directly impact organisms.[202] The potential harm is greater in scope than the vehicular crushing, but it is still not directed at a massive area. Therefore, this harm is potentially very great, yet limited in scope. This type of mixed area is where a deliberation-guiding precautionary approach would be appropriate.

The lift system and the waste water discharge by the floating mining platform also pose significant short-term risks.[203] The larger contributor is the waste water discharged by the mining platform.[204] The mining platform receives the ground up nodules and sediment from the collector device and the valuable nodule pieces are separated.[205] The excess is dumped back into the ocean.[206] This process causes oxygen depletion, light depletion, water temperature, and density fluctuations that disrupt the water column and trace minerals release.[207] Any leak in the hydraulic pumping hose that brings material from the seabed to the surface can cause similar effects.[208] Of the nodule mining elements analyzed above, these processes have by far the most unquantifiable risks and potential for ignorance as the scope of the effects of a leakage are unknown. The potential for greater harm is also present because these processes could affect organisms at all levels of the sea. A regulator would be justified in using an action-guiding precautionary approach, because the stakes are high.

Underwater noise pollution is another concern that has been gaining significant traction in the past few decades.[209] According to this theory, human created noise from sources like boat engines, construction, sonar, and undersea mining disrupt aquatic life.[210] Noise pollution has a vast potential for harm as noise can travel great distances underwater.[211] This idea originally sprang up in the 1970s and 1980s with studies on the effect of human generated sound on marine mammals.[212] The effects on aquatic mammals can be immediate and can cause direct damage including hearing loss, hemorrhaging, and confusion leading to mass beachings, or long-term effects like behavioral modifications and habitat

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202. *Id*.

203. Markussen, *supra* note 196, at 35.

204. *Id*.

205. *Protection of the Seabed Environment*, *supra* note 200.

206. *Id.*

207. *Id.*

208. *Id*.

209. *See* Christopher Clark & Brandon Southall, *Turn Down the Volume in the Ocean*, CNN.COM (Jan. 19, 2012), http://www.cnn.com/2012/01/19/opinion/clark-southall-marine/index.html?hpt=hp_c2.

210. *See id.* (stating that noise from "energy exploration, offshore development and commercial shipping" is disrupting marine life).

211. *See id*. (discussing how under the right circumstances blue whale's songs can sometimes be heard 1,500 miles away).

212. *See* ELENA MCCARTHY, INTERNATIONAL REGULATION OF UNDERWATER SOUND: ESTABLISHING RULES AND STANDARDS TO ADDRESS OCEAN NOISE POLLUTION 5 (2004) (discussing the early research into the effects of underwater acoustics on whales).

loss.[213] More recently, the harmful effects of man-made noise on fish have been studied.[214] These studies have shown potential disruption of fish distribution, reproduction, and predator evasion ability.[215] The effect of noise pollution could potentially be even higher in an environment where there is no light and sight is not a primary sense.

Hydraulic mining systems are far from silent as the collection vehicle, hydraulic pump system, and support vessels on the surface all make a tremendous amount of noise. Noise pollution poses the most potential for unquantifiable risk and ignorance because it is an area where there is still a very large knowledge gap. In addition, the potential harm is very high as sound can travel 1,500 miles or more underwater.[216] Because this element is marked by unquantifiable risk, ignorance, and the potential for significant harm to a large area, the action-guiding precautionary principle is the correct regulation tool to provide guidance.

Extensive studies on the potential effects of nodule mining are, as yet, impossible because large-scale commercial mining of this type has never been done. All of the information from various studies is based on small-scale test mining. This also assumes that hydraulic mining is the preferred method. Any new technique or procedure would bring new concerns and questions. At this point, it is important to understand the limitations of our knowledge of the effects and continue to take every opportunity available to further study the environmental impacts. The predicted impacts of nodule mining have been judged to be so large that a number of studies have recommended the abandonment of nodule mining efforts to avoid a large-scale and long-term risk to ocean ecosystems and fisheries.[217] Even after all of this, the uncertainty and risk in nodule mining pales in comparison to that of polymetallic sulphide mining.

B. Uncertainty in the Environmental Impacts of Polymetallic Sulfide Mining

The environmental concerns from polymetallic sulfide mining are difficult to assess for multiple reasons. Unlike polymetallic nodule mining, no single likely mining technique has emerged. The most promising method at this point would be a continuous recovery system that has rotating blades that chop the sulfide deposit into a slurry that is then sucked up to the surface.[218] In theory, this system would

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213. *Id*. at 21; *see also* Winter v. N.R.D.C., 555 U.S. 7, 25–26 (2008) (stating the seriousness of the harm to aquatic mammals from naval sonar).

214. *See* Matt Walker, *'Noise Pollution' Threatens Fish*, BBC.COM (Jun. 1, 2010), http://news.bbc.co.uk/earth/hi/ earth_news/newsid_8708000/8708318.stm (discussing scientists' reviews of impact of noise on fishes).

215. *Id*.

216. Clark & Southall, *supra* note 209 (discussing how under the right circumstances blue whale's songs can sometimes be heard 1,500 miles away).

217. Jochen Halfar and Rodney M. Fujita, *Danger of Deep-Sea Mining*, 316 SCIENCE 987 (2007) (citing TUSCH RESEARCH GROUP, *in* PROCEEDINGS INTERNATIONAL SYMPOSIUM KIEL INSTITUTE OF INTERNATIONAL LAW (R. Wolfrum ed., 1989)).

218. EDWIN EGEDE, AFRICA AND THE DEEP SEABED REGIME: POLITICS AND INTERNATIONAL LAW OF THE COMMON HERITAGE OF MANKIND 223 (2011).

be similar to that used for polymetallic nodule mining. As a result, this system would have many of the same environmental impacts and uncertainties as nodule mining, with huge disruptions of flora and fauna loss at the mining site as well as other disruptions, such as: oxygen depletion; light depletion; water temperature and density fluctuations that disrupt the water column; sound pollution; and a release of trace minerals.[219]

While the processes for mining are similar between polymetallic nodules and sulphides, the environments at risk are very different. The environments that surround hydrothermal vents are unique to each chimney and contain a plethora of organisms seen nowhere else on earth with biological processes that are likewise seen nowhere else.[220] The ecosystems surrounding hydrothermal vents in the deep sea are called chemosynthetic ecosystems.[221] They are special because unlike traditional earth ecosystems where the base of the food chain consists of life forms that produce energy from the sun through photosynthesis, these ecosystems are marked by a food chain base that produce energy from sulfur and methane through chemosynthesis.[222] In deep sea hydrothermal vents, the base of the food chain is populated by chemosynthetic bacteria that live off the sulfur and methane released there.[223] These unique ecosystems are an invaluable resource for scientific inquiry into metabolic,[224] biological, and genetic evolution. Each vent site serves as an island. It attracts life and this life develops in isolation creating a unique ecosystem.[225] The value of this genetic diversity cannot be overstated and has enormous potential for bio-prospecting for the health industry.[226]

Chemosynthetic ecosystems are not known for their stability.[227] Each organism has evolved to a very specific niche that exists at its individual vent.[228] This niche may only exist in a very small area and once this small area is disturbed by mining, there is nowhere for disrupted organisms to go. This means that even

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219. Nelson, *supra* note 134, at 70.

220. *See Polymetallic Sulphides*, *supra* note 141 (discussing the discovery of previously unknown animal species near vent areas).

221. *The Basics of a Chemosynthetic Ecosystem*, JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY, http://www.jamstec.go.jp/jamstec-e/kaiiki/shinkai2/kihon.html (last visited Feb., 26 2012).

222. *Id.*

223. *Id*.

224. *See Polymetallic Sulphides, supra* note 141 (detailing the discovery of two meter long worms with no digestive system that survive on chemosynthetic bacteria at deep sea vents).

225. *See Chemosynthetic Ecosystems*, HERMIONE, http://www.eu-hermione.net/science/chemosynthetic-ecosystems (last visited Feb. 26, 2012) (discussing the unique and isolated environment of chemosynthetic ecosystems).

226. Arico & Salpin, *supra* note 3. *See also* Lisa Drew, *The Promise and Perils of Seafloor Mining*, OCEANUS (Nov. 20, 2009), http://www.whoi.edu/oceanus/viewArticle.do?id=62986&sectionid=1000.

227. *See* NAUTILUS MINERALS NIUGINI LTD., ENVIRONMENTAL IMPACT STATEMENT: SOLWARA I PROJECT (2008) (describing the large mortality of snails at a vent site after small environmental changes), *available at* http://www.cares.nautilusminerals.com/assets/documents/main%20document%20text.pdf.

228. *Chemosynthetic Ecosystems*, *supra* note 225.

mining in a small area can bring an organism to extinction. Because each chimney is home to a unique and diverse set of organisms, the mining of a single site could lead to the extinction of a rare species.[229] Chemosynthetic ecosystems are still relatively new to science and the knowledge gap is quite large.[230] This type of mining has never been done before and its effects on the immediate ecosystem and surrounding vent sites have never been observed. Therefore, uncertainty as to the effects of sulfide mining at deep sea vents is marked by unquantifiable risk and a large potential for significant amounts of ignorance. In this situation, the action-guiding precautionary principle with a conservative threshold provides excellent guidance to regulators who want to avoid potential disastrous outcomes.

One suggestion has been made to limit mining to hydrothermal vent sites that are no longer active.[231] These inactive sites are believed to be inhabited by fewer organisms, but science knows less about these sites than it does active vent sites. This lack of knowledge calls for the action-guiding precautionary principle. The stakes are high and this will lead to very tough choices about where and when sulfide mining will be appropriate.[232]

The other area that is marked by a substantial knowledge gap is how individual vent sites are inter-connected. Scientists know that individual vent sites are connected to each other, but they are not sure how much connectivity exists.[233] Settlement of organisms at new vent sites happens, but how these organisms find these vent sites and how they get there is a mystery.[234] Also, there is some evidence that existing vent sites share genes to replenish the gene pool, but how this happens and the extent that it is required to support the ecosystems is again a mystery.[235] This sizable knowledge gap should leave potential regulators with a strong sense of humility as the repercussions from actions cannot be predicted. This ignorance combined with the potential for significant harm is once again a situation where the action-guiding precautionary principle would serve as an excellent tool for regulators.

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229. *Polymetallic Sulphides, supra* note 141.

230. *See generally* Cindy Lee Van Dover, *Tightening Regulations on Deep-Sea Mining*, NATURE, Feb. 3, 2011, at 31.

231. *Polymetallic Sulphides, supra* note 141.

232. *Id*.

233. INTERNATIONAL SEABED AUTHORITY, ISA TECHNICAL STUDY NO. 9, ENVIRONMENTAL MANAGEMENT OF DEEP-SEA CHEMOSYNTHETIC ECOSYSTEMS: JUSTIFICATION OF AND CONSIDERATIONS FOR A SPATIALLY-BASED APPROACH 52 (2011), http://www.isa.org.jm/files/documents/EN/Pubs/TS9/index.html.

234. *Id*.

235. *See id* (stating there is a lack of knowledge in gene flow).

VII. EARLY PLANS FOR PROTECTING DEEP SEA VENTS

The Authority typically takes years to develop regulations,[236] so with the increase in interest in mining in the Area, the Authority appears to be wasting no time and is already working on regulations regarding the exploitation of polymetallic sulphides and polymetallic nodules.[237] In particular, the Legal and Technical Commission released a report, Authority Technical Study No.9 (Study No. 9), outlining a potential plan for the environmental management of deep sea vent ecosystems—also known as deep sea chemosynthetic ecosystems.[238] This report addresses some of the major concerns and possible solutions, but comes up short because it does not account for the scientific ignorance of the way deep sea vent ecosystems work.

The conservation management system that is outlined in Study No. 9 is based on creating a network of chemosynthetic ecosystem reserves (CERs). These CERs would be carefully selected to represent an appropriate sampling of biological diversity; to facilitate connectivity between sites; and to be adequately sized to support the long-term survival of the ecosystems.[239] The CERs would range from completely protected sites to mixed-use sites that would support some mining or other human activity.[240] This would, in theory, allow a situation where some sites could be mined and ecosystems at that particular vent might crash, but similar ecosystems at nearby vents would remain intact to be representational of the lost ecosystem and further support the larger web of chemosynthetic ecosystems.

The report makes a reasonable effort to recognize what scientists know and do not know. It realizes that, to the extent that researchers have studied individual vents, they know about how these individual vent ecosystems function.[241] But a substantial knowledge gap remains in the area of connectivity between individual vent ecosystems; the resilience to disturbance; and the effectiveness of management strategies.[242] All of these areas are crucial and the report mentions that where these gaps exist, the precautionary principle should be used.[243] They define the precautionary principle as the deliberation-guiding approach used in Article 15 of the Rio Declaration.[244] But despite this definition, the report seems to hint that an action-guiding approach might be more appropriate in high-risk

236. The Authority began work on the polymetallic sulphide exploration regulations as early as 2003, and did not finish them until 2010.

237. *International Seabed Authority Enters New Stage in the Development of Marine Minerals*, *supra* note 84.

238. *See generally* INTERNATIONAL SEABED AUTHORITY, *supra* note 233.

239. *Id*. at 30.

240. *Id*.

241. *See id*. at 72.

242. *Id*. at 52.

243. INTERNATIONAL SEABED AUTHORITY, *supra* note 233, at 52.

244. *Id*. at 62.

situations involving CER placements.[245] The fact that the report finds only one possible situation where the risks are high enough is the shortcoming in the report. Insufficient analysis went into the type of uncertainty involved, and there is not enough healthy respect for the substantial knowledge gap that exists in how these ecosystems communicate, develop, and recover. Because this report does not address the ignorance and the associated potential risk, it fails to select the best regulatory tool—an action-guiding precautionary principle.

VIII. WHAT THE AUTHORITY IS LIKELY TO DO AND WHAT IT SHOULD DO

A. What the Exploitation Regulations May Contain

The Authority will not start from scratch in developing its final regulations. It must follow the regulations set out for it in UNCLOS III and it will build off of the existing regulations on exploration and prospecting. These provide a solid base from which it is able to extrapolate what future regulations will look like.

The mandates given to the Authority in Article XI are fairly general. The main idea is a general obligation to protect the Area from the harmful effects of any mining done in the Area.[246] But little guidance is provided as to how the Authority regulators should develop these governance strategies. The implementation agreement does require that baseline studies be done prior to any action by a potential miner.[247] The Authority has already stated that the new exploitation regulations will definitely include an official Environmental Assessment.[248] This is an excellent first step, but more may be required to protect the Area for future generations. The Area has been declared the common heritage of mankind, and along with that comes certain obligations for the Area's governance. One of these obligations is to preserve the Area and its resources for future generations.[249] This obligation has been explained as an obligation to sustainably develop the resource,[250] and this includes an obligation to protect and preserve both mineral and arguably non-mineral resources.

The existing regulations on nodule and sulfide exploration and prospecting will also serve as a good base. If the Authority follows the theme and language in those regulations, then it will produce a fairly predictable mining regulation. Both the nodule and sulfide regulations really focus on the idea that regulation should happen only after "serious harmful effects" can be shown. This is not an application of the precautionary principle, but is a more traditional regulatory

245. *See id*. at 38 (advising that, in circumstances where little is known and the risks of impacts are high, the situation is different and the precautionary principle should apply).

246. UNCLOS III, *supra* note 10, at 449.

247. Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, §1, ¶ 7, July 28, 1994, 1836 U.N.T.S. 42.

248. *International Seabed Authority Enters New Stage in the Development of Marine Minerals*, *supra* note 84.

249. *See* Wood, *supra* note 32, ¶ 1 (describing concerns and purposes of the Authority).

250. *See generally*, BASLAR, *supra* note 34.

method. This may have been appropriate for prospecting and exploration, as these activities are noninvasive and have little potential for serious irreversible widespread harm. Exploitation, on the other hand, poses more potential for serious, irreversible, and widespread harm.

Another factor that is located at various points in the regulations[251] is the call for the use of the precautionary principle as defined in Article 15 of the Rio Declaration. This is a double-edged sword as it calls for the deliberation-guiding approach but also references using only cost-effective measures to protect the environment. The use of the deliberation-guiding approach is an excellent step in preventing possible harm from uncertainties, but it only goes so far. This is particularly true when it is paired with the idea that regulation should happen only after "serious harmful effects" can be shown. The sulfide regulations showed increased concern for the unique components of chemosynthetic ecosystems, but still did not remove the "serious harmful effects" threshold. Additionally, the language in Article 15 of the Rio Declaration limiting regulation to cost-effective measures to protect the environment further restricts the possibility of strong environmental regulation. However, using traditional cost forecasting fails to take into account significant value not easily reduced to monetary terms. For example, it is impossible to quantify the value of a new organism that society has yet to discover. Focusing on costs leads to counter-intuitive policy making that focuses on short term monetary gain and has nothing to do with the mission of the common-heritage of mankind. At the end of the day, it comes down to how much society values the possibilities that bio-diversity and increased understanding bring.

Perhaps the best example of what future exploitation regulations might look like comes from Study No. 9. This report outlines a potential spatial management system that would create a network of CERs to maintain vent ecosystems. If this management system is used in the sulfide exploitation regulations, then it would occasion an expansion of the precautionary principle as used so far by the Authority. This spatial management system would be an affirmative action or regulation in the face of uncertainty. This shows that the Authority is at least considering an expansion of the precautionary principle when it comes to the exploitation regulations.

B. What the Authority Should Include in the Exploitation Regulations for Polymetallic Nodules and Sulphides

Large aspects of nodule mining and sulfide mining are marked by unquantifiable risk and have a large potential for unrecognized risks and negative outcomes. Additionally there are potentially severe adverse outcomes that could include the extinction of entire unique ecosystems. This ignorance toward the potential risks and potential for irreversible harm are telltale signs that an action-guiding approach to the precautionary principle is the proper tool for regulators to

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251. *See generally*, *Regulations on Prospecting and Exploration of Polymetallic Nodules in the Area*, *supra* note 78, at regulations 2.2, 31.2.

use to prevent serious environmental damage. The deliberation-guiding approach is a good first step but it only allows a lack of information to not be used against an argument for regulation. It gives regulators no constructive guidance as to how and when to regulate. The Authority has many different external pressures pulling on it, and without clear guidance on how to regulate, it may be pulled in directions that will not provide adequate environmental protections.[252] Because of this, it is even more imperative that the element of precaution is built in. As stated above, this would not be revolutionary in the Authority, since the deliberation-guiding approach to the precautionary principle is already in use. Suggestions by the Legal and Technical Commission to set up a spatial management scheme and to require environmental assessments are all elements of an action-guiding precautionary approach.

The appropriate use of the action-guiding approach to the precautionary principle in deep sea mining would put an affirmative obligation on miners to show "beyond a reasonable doubt" no "serious harmful effects"; otherwise they would be estopped from mining. This would be a flip of the current regulations for polymetallic sulphide exploration that require that mining not go forward if there is evidence of "serious harmful effects."[253] This places an added barrier in the way of potential miners, but these are large, rich, sophisticated, and state backed companies[254] that are better equipped than anyone else to fund and undertake the needed research into the effects of deep sea mining. Additionally, the Authority already requires baseline studies before an action can be undertaken in the Area,[255] and has said that it will require environmental assessments prior to any mining.[256] The costs would be similar, but it would be a higher burden for the miners to meet. The threshold for proof of no "serious harmful effects" could be adjusted to match the potential seriousness of the harm. Admittedly, the potential harm from nodule mining could be high, but the likelihood of irreversible harm is lower than it is for sulfide mining. Because of this, a showing of "more likely than not" that there would be no "serious harmful effects" could be used. Nodules are also found on

252. *See* Avgerinopoulou, *supra* note 17, at 606 (stating that there is uncertainty in the Authority's environment).

253. *Regulations on Prospecting and Exploration of Polymetallic Sulphides in the Area*, *supra* note 173, at regulation 33.4.

254. To date nineteen contracts have been handed out for prospecting and exploration, and the recipients include such sophisticated entities as: Yuzhmorgeologiya, a state enterprise of the Russian Federation; the Government of India; the Government of the Republic of Korea; Federal Institute for Geosciences and Natural Resources of the Federal Republic of Germany; Deep Ocean Resources Development Company of Japan; and China Ocean Mineral Resources Research and Development Association. *See Authority Brochure*, INT'L SEABED AUTH., http://www.isa.org.jm/files/documents/EN/Brochures/ENG1.pdf (last visited Feb. 27, 2012) (listing state owned enterprises, including China, Russia, Korea, and Germany, that have been awarded contracts for prospecting and exploration).

255. *Regulations on Prospecting and Exploration of Polymetallic Nodules in the Area*, *supra* note 173, at regulation 34.

256. *See International Seabed Authority Enters New Stage in the Development of Marine Minerals*, *supra* note 84 (stating that environmental assessment needs to be addressed).

abyssal plains and, by and large, the plains are fairly similar ecosystems from location to location.[257] Therefore, a thorough study at one site would pay more dividends to future mining.

Polymetallic sulphide mining is the more potentially dangerous of the two types of mining because it is marked by so much unquantifiable risk and ignorance. It also carries a significant chance of irreversible harm. Because of this, a more stringent threshold should be applied to an action-guiding precautionary approach. This would establish a ban on mining unless the miners could prove "beyond all reasonable doubt" that mining would not have "serious harmful effects" on the chemosynthetic ecosystem. This burden is high, but it would ensure the protection of some of the most unique organisms on earth and leave open the window for more research to gain a greater understanding of the Area.

Lastly, the common heritage of mankind principle that plays such a significant role in the Authority mandate requires that a protective stance be taken. The final element of the principle as applied to the Authority states that the Area must be preserved for future generations. This affirmative mandate seems to require that a sustainable approach to any action be in place. This would require that the future health of deep sea ecosystems be guaranteed. The best way to do this is through the implementation of the action-guiding precautionary principle. This way, the priceless knowledge that is contained in the genetic code of the deep sea organisms will be preserved for future generations to discover. The cost of the loss of this knowledge would easily outstrip any gains made from mining.

The deep sea is truly the final frontier. Like the American frontier, its resources are vast and diverse. While the American frontier was conquered slowly over generations, the modern world is rapidly developing the technology to quickly remove the mineral resources of the deep sea. These are ecosystems that are not necessarily resilient, and small actions could have a large ripple effect causing the loss of this unique and otherworldly ecological frontier. In order to keep the deep sea ecosystems from going the way of the buffalo, the action-guiding precautionary principle needs to be used.

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257. *See generally*, THE COLUMBIA ENCYCLOPEDIA, *Ocean* (5th ed. 1993) (describing that the abyssal plains are flat and "cover 30% of the Atlantic ocean floor and nearly 75% of the Pacific ocean floors.").