Into The Abyss: Rationalizing Commercial Deep Seabed Mining Through Pragmatism and International Law

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This Article discusses issues surrounding deep seabed mining, exploring in depth both arguments for and against it.[1] This Article then takes a step back to dissect the underlying assumptions behind these arguments, using pragmatism and international law. As 2018 approaches, marking the start of commercial deep seabed mining operations, it seems relevant to elevate the "yes or no" to deep seabed mining discourse to how to best incentivize states to delay deep seabed mining projects in order to improve state and deep seabed mining contractor accountability, to intensify consumer awareness of both the mineral supply problem and of the necessity of recycling, and finally, to ensure long-term supply of minerals, particularly those critical to emerging technology. By breaking down assumptions behind two extreme deep seabed mining positions, this Article aims to afford states, environmentalists, mining companies, and other affected individuals greater opportunity to address their respective concerns.

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1. An abridged version of this Article appeared in International Law Institute: Natural Resources and the Law of the Sea by Juris Publishing, Inc. 2016.

I. INTRODUCTION

Increase in demand and decrease in supply of terrestrial minerals advances commercial interest in deep seabed mining (DSM). In 2018, a joint consortium between Nautilus Minerals Niugini Limited (Nautilus)

and Papua New Guinea (PNG) will conduct the first commercial DSM, thirty-one miles away from PNG's Rabaul.[2] Meanwhile, the International Seabed Authority (ISA), a body created under the 1982 United Nations Convention on the Law of the Sea (UNCLOS) to regulate DSM in areas beyond national jurisdiction in a zone called "the Area," continues to develop a Mining Code.[3] ISA previously approved separate Regulations on Prospecting and Exploration of Cobalt-rich Ferromanganese Crusts, Polymetallic Sulphides and Polymetallic Nodules (collectively, "Prospecting and Exploration Regulations"), and now, waits for its Legal and Technical Commission (LTC) to finish drafting Regulations on Exploitation of Cobalt-rich Ferromanganese Crusts, Polymetallic Sulphides and Polymetallic Nodules (collectively, "Exploitation Regulations").[4] Thereafter, mining companies sponsored by their home states can begin applying for exploitation licenses. Mining companies expect DSM minerals to complement waning terrestrial supplies, while developing states believe DSM could help them transition to developed state status.[5] Companies and governments conclude that between terrestrial and DSM, the latter poses less environmental and social harm.[6]

Environmentalists disagree and reject commercial DSM both within the national jurisdiction and in the Area.[7] They submit that mankind does not know enough about its impact on the marine environment; it could

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2. NAUTILUS MINERALS, ENVIRONMENTAL IMPACT STATEMENT: SOLWARA 1 PROJECT 1-1 (Sept. 2008), http://www.nautilusminerals.com/irm/content/pdf/environment-reports/Environmental%20Impact%20Statement%20-%20Main%20Report.pdf [hereinafter NAUTILUS, EIS].

3. Tearinaki Tanielu, *Establishment of a National Regulatory Framework for the Exploration and Exploitation of Deep Sea Minerals: A Case Study for Kiribati*, U.N. OCEANS & L. SEA 25 (Dec. 2013), http://www.un.org/depts/los/nippon/unnff_programme_home/fellows_pages/fellows_papers/Tanielu_1314_Kir.pdf.

4. *Id.*

5. Rupert Neate, *Seabed Mining Could Earn Cook Islands 'Tens of Billions of Dollars,'* GUARDIAN (Aug. 5, 2013), http://www.theguardian.com/business/2013/aug/05/seabed-mining-cook-islands-billions; *Frequently Asked Questions*, SEABED MINERALS AUTH., http://www.seabedmineralsauthority.gov.ck/faqs (last visited Nov. 4, 2016); *see also* United Nations Convention on the Law of the Sea arts. 82, 150(d), Dec. 10, 1982, 1833 U.N.T.S. 3 [hereinafter UNCLOS]; *see also* UNCLOS Annex III art. 13(1)(a).

6. NAUTILUS, EIS, *supra* note 2, at 10-4, 10-5; DAVID BATKER & ROWAN SCHMIDT, EARTH ECONS., ENVIRONMENTAL AND SOCIAL BENCHMARKING ANALYSIS OF NAUTILUS MINERALS INC. SOLWARA 1 PROJECT xi, xii-iv, 39-40 (May 2015), http://www.nautilusminerals.com/irm/content/pdf/eartheconomics-reports/earth-economics-may-2015.pdf.

7. Pedro Re, *Deep-Sea Hydrothermal Vents 'Oases of the Abyss,' in* NEW TECHNOLOGIES AND LAW OF THE MARINE ENVIRONMENT 70 (Jean-Pierre Beurier et al. eds., 2000); SHAWNCEY WEBB, ENCYCLOPEDIA OF ENVIRONMENTAL ISSUES 1100 (Craig W. Allin ed., 2011).

destroy undiscovered biodiversity and devastate fish stocks by disrupting seamounts where they gather. DSM critics ask for a moratorium on DSM unless there are assurances that adequate environmental protection safeguards are in place.[8] In the case of PNG, conservationists additionally argue that there is zero accountability, as the exclusive economic zone (EEZ) falls outside ISA jurisdiction, and PNG has a financial motive to look the other way. Indigenous communities stress the effect of DSM on their traditions and explain that desecrating ancestral waters results in cultural genocide.

The polarity of both positions, the valid points made by each, and the increasing commercial and environmental stakes of DSM, underscore the need for a more exacting and balanced analysis. This Article's goal is to provide such analysis. To that end, the Article is divided into four Parts, in addition to this introductory chapter, Part I. Part II discusses DSM importance and advantages from the point of view of mining companies and governments, while Part III presents counterarguments. Part IV describes a way forward between the two extreme DSM views. It explores the supply level for rare metals, the comparability of terrestrial and deep seabed mining, profitability of DSM, implications of the precautionary principle, the legitimacy of goods other than indigenous peoples' and fishermen's rights, and the current international environmental legal system. In breaking down assumptions, this Article aims to increase DSM awareness and elevate discussions toward sustainable and accountable DSM. Part V concludes, and incorporates lessons from maritime disasters and other environmental initiatives. As applied to PNG, this Article recommends a temporary DSM moratorium, pending amendments to the Mining Act of 1992. As mineral scarcity pushes DSM popularity, it is imperative to bridge the differences and the interests of those for and against DSM.

II. DEEP SEABED MINING AS THE FUTURE OF THE EXTRACTIVE INDUSTRY AND OF DEVELOPING STATES

Long-term supply of minerals, if based solely on terrestrial reserves (a term used for known amounts of minerals on the ground exploitable with current technology and under current economic conditions), appears bleak. In 2012, world production of copper and iron (the two most

8. GREENPEACE, DEEP SEABED MINING: AN URGENT WAKE-UP CALL TO PROTECT OUR OCEANS 11, 17 (July 2013), http://www.greenpeace.org/international/Global/international/publications/oceans/2013/Deep-Seabed-Mining.pdf.

widely used metals in building construction), electric and electric products, transportation equipment, consumer and general products collectively, as well as production of industrial machinery and equipment, reached seventeen million tons and 2.930 billion tons, respectively.[9] In 2100, the 1.7 billion tons demand will far exceed the 1.6 billion tons of cumulative reserves of copper deposits.[10] However, starting in 2030, copper supply will be on a steady decline.[11] Dividing reserve base by annual consumption rate, economists project that antimony (used in nonmetal products—including ceramics, glass, and rubber products), flame retardants, and metal products, including antimonial lead and ammunition, will run out in fifteen years.[12] Silver, used for electronics, coins and medals, photography, jewelry and silverware, antimicrobial bandages and clothing, pharmaceuticals, plastics, batteries, bearings, brazing and soldering, catalytic converters in automobiles, electroplating, inks, mirrors, photovoltaic solar cells, water purification, and wood treatment, will be gone in ten years; and indium, used for liquid crystal displays, will be gone in five years.[13] In a 2007 examination of fifty-seven minerals, eleven had reached their peak and were in decline.[14] These figures bring constant pressure to mining companies, which, in order to stay in business, must constantly discover new sources or buy additional sources.[15]

While there may be undiscovered terrestrial resources that could complement reserves, the demand for minerals highest in the supply risk index also continues to grow. Cross-referencing the 2015 British Geological Survey's Risk List (for minerals which are of economic value) with the 2016 United States Geological Survey Mineral Commodity Summaries (which describes minerals essential to emerging and next generation technologies), shows the need to expand current

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9. JOSEPH M. KIRSADA, U.S. GEOLOGICAL SURVEY [USGS], 2012 MINERAL YEARBOOK STATISTICAL SUMMARY (ADVANCE RELEASE) 2.32 (July 2015), http://minerals.usgs.gov/ minerals/ pubs/commodity/statistical_summary/myb1-2012-stati.pdf; *see also* USGS, MINERAL COMMODITY SUMMARIES 2016 54 (Jan. 28, 2016), http://minerals.usgs.gov/minerals/pubs/mcs/2016/mcs2016. pdf [hereinafter USGS, 2016 MINERAL SUMMARIES].

10. BRITISH GEO. SURV., RISK LIST 2015 23 (2015), https://www.bgs.ac.uk/downloads/ start.cfm?id=3075.

11. BATKER & SCHMIDT, *supra* note 6, at 13.

12. USGS, 2016 MINERAL SUMMARIES, *supra* note 9, at 24; *see also* BRITISH GEO. SURV., *supra* note 10, at 24.

13. USGS, 2016 MINERAL SUMMARIES, *supra* note 9, at 80, 152; *see also* BRITISH GEO. SURV., *supra* note 10, at 24.

14. BRITISH GEO. SURV., *supra* note 10, at 25.

15. HOWARD L. HARTMAN & JAN M. MUTMANSKY, INTRODUCTORY MINING ENGINEERING 18 (2d ed. 2002).

resources to accommodate expected increase in mineral use for technological purposes alone.[16] Based on seven risk criteria,[17] the British Geological Survey created a supply risk scale of one to ten, one for very low risk and ten for very high risk.[18] The rare earth elements of bismuth, germanium, gallium, tungsten, cobalt, indium, platinum group elements, silver, tantalum, niobium, titanium, copper (currently used for steel, superalloys, steel superalloys (e.g., jet engines), metallurgical additives, fusible alloys, pharmaceuticals, chemicals, electric products, catalytic converters, liquid crystal displays, jewelry, and petroleum refining,[19] are at risk, at levels as high as 9.5.[20] Supply risk could further increase considering the role of the aforementioned elements in the development of emerging and next-generation technologies.[21] Juxtaposing 2006 demand with projected 2030 demand from emerging technology shows a 2.67% to 22.06% increase,[22] lending further support to supply risk assumptions.

Metal supply-demand dynamics present a case for DSM. DSM not only addresses the global supply problem, but also avoids overreliance on states that enjoy a monopoly of certain minerals. Developing states see DSM as a route to economic progress. Meanwhile, mining companies like Nautilus present DSM as the less harmful choice, and the next phase of marine mining. These arguments are discussed *in seriatim*.

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16. BUREAU DE RECHERCHES GÉOLOGIQUES ET MINIÈRES, CRITICAL MINERALS FOR THE EU ECONOMY: FORESIGHT TO 2030 6 (2013), http://www2.warwick.ac.uk/fac/soc/pais/research/researchcentres/csgr/green/foresight/economy/2013_ec_critical_minerals_for_the_eu_economy_-_foresight_to_2030.pdf [hereinafter BGRM, CRITICAL MINERALS]; USGS, 2016 MINERAL SUMMARIES, *supra* note 9, at 7.

17. These include production concentration, reserve distribution, recycling rate, companion metal fraction, substitutability governance for top producing nation, and governance for top reserve-hosting nations.

18. BGRM, CRITICAL MINERALS, *supra* note 16, at 4.

19. *Id.*

20. BRITISH GEO. SURV., *supra* note 10, at 1.

21. BGRM, CRITICAL MINERALS, *supra* note 16, at 6; *see also* USGS, 2016 MINERAL SUMMARIES, *supra* note 9, at 54, 115, 134, 150, 152, 166, 169, 176, 188 (listing as examples photovoltaic solar cells, computer chips, thermal cooling devices, hybrid and electric car batteries, storage of solar energy, magnetic recording media, high-temperature superalloys and superconductors, supermagnets, cellphones, liquid lead-bismuth coolant for nuclear reactors, bismuth-metal polymer bullets, negative thermal expansion devices, X-ray photo imaging, new-generation capacitors, superconducting resonators, hydrogen fuel cells, chemical sensors, and cancer drugs).

22. James R. Hein et al., *Seamount Mineral Deposits: A Source of Rare Metals for High-Technology Industries*, 23 OCEANOGRAPHY 184, 188 (2010).

A. An Answer to Supply Constraints

Deep-sea minerals increase mineral supply pool, particularly for those ranked "risky" by the British Geological Survey. Four main classes of deep-sea minerals exist within the inner continental margin: hydrocarbons, construction aggregates and sand, minerals in placer deposits (e.g., diamonds, gold, and ilmenite), and industrial chemicals (e.g., sulphur and phosphate). In the outer continental margin, there are phosphorites, evaporate deposits, gas hydrates, polymetallic nodules (manganese nodules), polymetallic sulphides (seafloor massive sulphides), and cobalt-rich ferromanganese nodules, (cobalt-rich crusts).[23] In the next few years, many expect commercial DSM of the last three—manganese nodules, seafloor massive sulphides, and cobalt-rich crusts—to significantly improve mineral reserves.

Manganese nodules, seafloor massive sulphides, and cobalt-rich crusts contain strategic and valuable minerals with metal grades superior to their terrestrial counterparts.[24] Manganese nodules, located 4500 to 6500 meters in depth, hold valuable concentrations of iron and manganese, as well as traces of copper, nickel, and cobalt.[25] Nodule density varies according to area, and can go as high as 75 kg/m^2 of seabed, but more commonly averages less than 15 kg/m^2 as in the Clarion Clipperton Zone in the north-central Pacific Ocean, Peru Basin in the southeast Pacific Ocean, and the center of the North Indian Ocean.[26] In the Pacific Islands region, manganese nodules abound in the Cook Islands, Kiribati, Tuvalu, and Niue.[27] Seafloor massive sulphides,

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23. EDWIN EGEDE, AFRICA AND THE DEEP SEABED REGIME: POLITICS AND INTERNATIONAL LAW OF THE COMMON HERITAGE OF MANKIND 184 (2011).

24. *Id.* at 187-88; SECRETARIAT OF THE PAC. CMTY., PACIFIC-ACP STATES REGIONAL LEGISLATIVE AND REGULATORY FRAMEWORK FOR DEEP SEA MINERALS EXPLORATION AND EXPLOITATION 3 (2012), https://www.smenet.org/docs/public/FinalDeepSeaMineralsProject Report.pdf [hereinafter SPC, REGIONAL LEGISLATIVE FRAMEWORK].

25. U.N. DIV. FOR OCEAN AFFAIRS & LAW OF THE SEA OFFICE OF LEGAL AFFAIRS, MARINE MINERAL RESOURCES: SCIENTIFIC ADVANCES AND ECONOMIC PERSPECTIVES 62 (2004), https://www.isa.org.jm/files/documents/EN/Pubs/ISA-Daolos.pdf [hereinafter DOALOS]; *see also* Stephen A. Macko, Professor of Environmental Sciences, Univ. of Virginia, Presentation at the 2014 Yeosu Academy of the Law of the Sea: Continental Shelf Science and Resources 79 (Oct. 23, 2014) (on file with author); *see also* Becky Oskin, *Vast Bed of Metal Balls Found in Deep Sea*, LIVE SCI. (Feb. 17, 2015, 08:26 AM), http://www.livescience.com/49820-manganese-nodules-atlantic-ocean.html. Manganese nodules, located 4500 to 6500 meters in depth, hold valuable concentrations of iron and manganese, as well as traces of copper, nickel, and cobalt.

26. SECRETARIAT OF PAC. CMTY., DEEP SEA MINERALS: MANGANESE NODULES, A PHYSICAL, BIOLOGICAL, AND TECHNICAL REVIEW 11 (Elaine Baker & Yannick Beaudoin eds., vol. 1B 2011) [hereinafter SPC, DEEP SEA].

27. *Id.*

predominantly found in water depths ranging from 1000 to 5000 meters, usually contain rich concentrations of copper, gold, silver, and zinc, with trace concentrations of bismuth, cadmium, gallium, germanium, antimony, tellurium, thallium, and indium.[28] Thus far, more than 300 sites have been found, mostly in mid-ocean ridges and back-arc basins, ten of which may have sufficient size and grade for future mining.[29] These sites include: Canada, Saudi Arabia, Sudan, Ecuador, New Zealand, Tonga, Japan, Fiji, and PNG, as well as the Pacific and Atlantic Oceans.[30] Cobalt-rich crusts, located on the flanks of submerged volcanic islands and submarine ridges, around 400 to 4000 meters, contain rich concentrations of iron and manganese, and essential metals for emerging technologies (e.g., cobalt, nickel, rare earth elements, copper, molybdenum, yttrium, tellurium, niobium, and possibly platinum).[31] Mining these metals poses difficulties due to crust attachment to rock substrates.[32] Based on grade, tonnage, and ocean conditions, however, mining in the central equatorial Pacific Ocean and the EEZs of the United States (Johnston Island), Marshall Islands, Kiribati, Federated States of Micronesia, French Polynesia, Tuvalu, Samoa, and Niue has potential.[33] Tapping into these deep marine minerals ensures long-term viability of current mineral uses and of emerging technologies.

DSM could also temper effects of restrictions monopolies may impose on minerals. From 2010 to 2015, China, which produces 95% of the rare earth elements, imposed strict export limits.[34] China reportedly used these limits as an economic weapon, cutting off Japan's access to

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28. *Id.* at 13; *see also* SPC, REGIONAL LEGISLATIVE FRAMEWORK, *supra* note 24, at 14.

29. *See* SPC, DEEP SEA, *supra* note 26, at 14; *see also* Macko, *supra* note 25, at 76; *see also* MICHELLE ALLSOP ET. AL., GREENPEACE, REVIEW OF THE CURRENT STATE OF DEVELOPMENT AND THE POTENTIAL FOR ENVIRONMENTAL IMPACTS OF SEABED MINING OPERATIONS 10 (2013), https://www.oceanfdn.org/sites/default/files/seabed-mining-tech-review-2013.pdf; *see also* Richard Steiner, *Deep Sea Mining a New Ocean Threat*, HUFFINGTON POST: BLOG (Oct. 20, 2015, 04:08 PM), http://www.huffingtonpost.com/richard-steiner/deep-sea-mining-new-threa_b_8334428.html.

30. *See* ALLSOP ET AL., *supra* note 29, at 10.

31. SECRETARIAT OF THE PAC. CMTY., DEEP SEA MINERALS: COBALT-RICH FERROMANGANESE CRUSTS, A PHYSICAL, BIOLOGICAL, AND TECHNICAL REVIEW 16 (Elaine Baker & Yannick Beaudoin eds., 2011), http://dsm.gsd.spc.int/public/files/meetings/TrainingWorkshop4/UNEP_vol1C.pdf [hereinafter SPC, COBALT-RICH CRUSTS]; *see also* SPC, REGIONAL LEGISLATIVE FRAMEWORK, *supra* note 24, at 4; *see also* DOALOS, *supra* note 25, at 63.

32. SPC, COBALT-RICH CRUSTS, *supra* note 31, at 5; ALLSOP ET AL., *supra* note 29, at 10.

33. ALLSOP ET AL., *supra* note 29, at 9-10.

34. Jim Hein, *Prospects for Rare Earth Elements from Marine Minerals*, INT'L SEABED AUTH. (May 2012), https://www.isa.org.jm/sites/default/files/files/documents/bp2.pdf; *see* Panel Report, *China–Measures Related to the Exportation of Rare Earths, Tungsten, and Molybdenum*, WTO Doc. WT/DS431/R (adopted Mar. 26, 2014).

these rare earth supplies in September 2010, as part of a long-standing territorial dispute over the Senkaku Islands.[35] However, many argue that China holds a false monopoly, and that other States have rare earth metal reserves and resources, but simply cannot compete with China's low prices as a result of China's measly labor and environmental compliance costs.[36] As DSM of rare earth metals (in cobalt-rich crusts) becomes more feasible, DSM could additionally serve as an effective anti-monopolistic measure.

B. A Developmental Right

States have the sovereign right to pursue developmental policies like mining. Developing states benefit tremendously from economic rents in terrestrial mining in their national territory. In low-to-middle income economies, mining contributes 60% to 90% of foreign direct investment, 30% to 60% of exports, 3% to 20% of government revenues, 3% to 10% of national income, and 1% to 2% of employment.[37] Government revenues include royalties, taxes, fees, and compensation payments. States see DSM as complementary to land-based mining earnings.

States stand to earn considerable amounts from DSM within their national jurisdiction. States have the sovereign right to exploit mineral resources found in their seabed, an area that spans at least 200 nautical miles, and may extend up to 350 nautical miles from the baseline or 100 nautical miles from the 2500 meter isobaths.[38] As applied to PNG, DSM benefits include: 2% in royalties, 30% in taxes, a 0.25% production levy, a 10% value added tax, a $162,500 (PKG 500,000) annual fuel excise tax, a community development fund, and other fees, such as a $3,618.99 exploration license (PGK 11,000), and the $15,791.96 mining license

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35. Keith Bradsher, *Amid Tension, China Blocks Vital Exports to Japan*, N.Y. TIMES (Sept. 22, 2010), http://www.nytimes.com/2010/09/23/business/global/23rare.html; *see also* Sheila A. Smith, *Japan and the East China Sea Dispute*, COUNCIL ON FOREIGN REL. (2012), http://www.cfr.org/japan/japan-east-china-sea-dispute/p28795.

36. Chris Lo, *The False Monopoly: China and the Rare Earths Trade*, MINING-TECHNOLOGY.COM (Aug. 20, 2015), http://www.mining-technology.com/features/featurethe-false-monopoly-china-and-the-rare-earths-trade-4646712/; *see also* Sophia Yan, *China Is About To Tighten Its Grip on Rare Earth Minerals*, CNN MONEY (June 5, 2015, 10:21 AM), http://money.cnn.com/2015/06/05/investing/molycorp-china-rare-earth-minerals/.

37. Cecilia Jamasmie, *CHARTS: This Is How Much Gold Miners Really Put into Their Host Countries*, MINING.COM (Oct. 27, 2014, 6:05 PM), http://www.mining.com/this-is-how-much-gold-miners-really-put-in-their-host-countries-38891/.

38. UNCLOS, *supra* note 5, arts. 76-77; North Sea Continental Shelf (Fed. Rep. of Ger./Den. v. Fed. Rep. of Ger./Neth.), Judgment, 1969 I.C.J. 4, 22 ¶¶ 22, 19 (Feb. 20); Continental Shelf (Libya v. Malta), Judgment, 1985 I.C.J. 13 ¶¶ 34-35, 36-39 (June 3).

(PGK 48,000).[39] PNG also owns 30% interest in the project.[40] Nautilus projects $142 million total direct benefits to PNG over its twenty year license on Solwara 1 alone.[41] Multiplied by forty-seven, the number of existing exploration licenses of Nautilus in PNG, DSM alone would generate at least half of 2014's gross domestic product.[42] As the government of the Cook Islands succinctly pointed out, DSM, which the government envisions will commence in its waters by the end of this decade, could elevate a "developing state" to "developed state" status.[43] Even industrialized states stand to benefit from DSM. The United Kingdom expects to earn a £40 billion contribution to its economy over a thirty year period.[44] Combining these direct economic benefits with other benefits highlights DSM's significant contribution, particularly to developing states.

The same rhetoric of economic and social development applies to DSM in the Area. States characterized the Area as common heritage of mankind—property of the people, to be administered by the people and for the people—and have made a commitment to bridge financial gaps and promote universal peace and well-being through DSM.[45] In fact, States share in ISA proceeds for DSM beyond the designated national 200 nautical miles.[46]

C. The Environmental Choice

Nautilus, poised to commence DSM in PNG by the first quarter of 2018, presents DSM as a better option for both the environment and

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39. Press Release, Nautilus Mins., Nautilus Minerals Awarded Favorable Arbitration Decision (Oct. 3, 2013) (on file with author), http://www.nautilusminerals.com/IRM/PDF/1136/NautilusMineralsAwardedFavourableArbitrationDecision; *Nautilus Minerals Investor Update*, NAUTILUS MINS. 3, 9 (Aug. 13, 2015), http://www.nautilusminerals.com/IRM/PDF/1648/ConferenceCallPresentation [hereinafter NAUTILUS, *Investor Update*]; NAUTILUS, EIS, *supra* note 2, at 10-4, 10-5; GOLDER ASSOCS., MINERAL RESOURCE ESTIMATE SOLWARA PROJECT, BISMARCK SEA, PNG 12-5 (2012), http://www.nautilusminerals.com/irm/content/pdf/SL01-NSG-DEV-RPT-7020-001_Rev_1_Golder_Resource_Report.pdf.

40. *See* NAUTILUS, *Investor Update*, *supra* note 39, at 3, 9; NAUTILUS, EIS, *supra* note 2, at 2-1; GOLDER ASSOCS., *supra* note 39, at 19.

41. *See* NAUTILUS, EIS, *supra* note 2, at 10-5.

42. ASIAN DEV. BANK, PAPUA NEW GUINEA (2015), http://www.adb.org/sites/default/files/publication/175162/png.pdf.

43. Neate, *supra* note 5; *see also Frequently Asked Questions*, *supra* note 5.

44. *See* Neate, *supra* note 5.

45. RAM PRAKASH ANAND, LEGAL REGIME OF THE SEA-BED AND THE DEVELOPING COUNTRIES 247-48 (1976).

46. UNCLOS, *supra* note 5, art. 82, 150(d); *see also* UNCLOS, *supra* note 5, Annex III, art. 13(1)(a).

society. Since 1997, Nautilus has maintained several exploration licenses in the Bismarck Sea that allow the company to learn more about the extent and nature of the seabed and minerals in proposed mining sites, particularly from the first site, Solwara 1. Between 2006 and 2011, Nautilus completed four drilling programs, and submitted an Environmental Impact Statement (EIS) regarding Solwara 1.[47] This EIS presented mitigation efforts to counter environmental disturbances, and pointed out that, as compared to land-based mining, DSM area is smaller and has a lower water discharge.[48] PNG gave credence to Nautilus' EIS; it issued a final environmental plan in 2009, and a twenty year mining lease for the 59 km^2 Solwara 1 project two years thereafter.[49] To assuage fears of DSM, Nautilus commissioned Earth Economics, a United States non-governmental organization (NGO), to conduct an Environmental and Social Benchmarking Analysis in Solwara 1. After five months, Earth Economics published a comprehensive report comparing the Solwara 1 project with three terrestrial mines: Prominent Hill (Australia), Bingham Canyon (United States), and Intag (proposed mine in Ecuador).[50] Earth Economics concluded that, assuming sufficient biodiversity conservation sites would be created, mining in the deep seabed "has fewer identified, quantified, and monetized impacts than terrestrial mining."[51]

Earth Economics used the landmark Millennium Ecosystem Approach to compare environmental and societal impacts of land-based mining with those of DSM. This approach, formed by an international coalition of over 1360 scientists and experts from the United Nations Environmental Program, the World Bank, and the World Resources Institute, focuses on four categories: provisioning goods and services, regulating services, supporting services, and cultural services.[52] "Provisioning services" refer to what the affected ecosystem could otherwise provide, which in the case of mining, entails: food, medicinal resources, ornamental resources, energy, raw materials, and water

47. GOLDER ASSOCS., *supra* note 39, at 37.

48. NAUTILUS, EIS, *supra* note 2, at 5-5, 7-16.

49. Tina Hunter & Madeline Taylor, *Deep Sea Bed Mining in the South Pacific: A Background Paper*, U. QUEENSL. CTR. FOR INT'L MINS. & ENERGY L. 5 (2013), https://intranet.law.uq.edu.au/old-site/law.uq.edu.au/documents/cimel/Deep-Sea-Bed-Mining-in-the-South-Pacific.pdf; GOLDER ASSOCS., *supra* note 39, at 11.

50. BATKER & SCHMIDT, *supra* note 6, at 44.

51. *Id.* at xiv.

52. *Id.* at 39-40.

supply.[53] "Regulating services" pertain to the benefits of natural control of ecosystem processes, as when climate is stable, wetlands are protected, extreme events are moderated, erosion is controlled, waste treated, pollution minimized, and water use regulated.[54] "Supporting services" deal with what the affected ecosystem supports, which, as applied to mining, includes habitat and nursery, nutrient cycling, and genetic resources.[55] Finally, "cultural services" refer to the rationale of human interaction with nature, for the sake of natural beauty, cultural and artistic information, recreation and tourism, science and education, and spiritual growth.[56]

The four-category approach favored Solwara 1. According to Earth Economics, DSM bore less impact on: raw materials, biological control, climate stability, air quality, waste treatment, habitat and nursery, nutrient cycling, genetic resource values, habitat and nursery, nutrient cycling, genetic resource values, and science and education values; had smaller risk to downstream ecosystems; and had lower magnitude of monetized annual damages ($25,000 per year versus $1.2 to $22.2 million per year).[57] Furthermore, Solwara 1 did not displace people; did not create downslope risk to human communities; and did not impact food production, fresh water supply, disaster risk reduction, pollination, soil formation, erosion, freshwater regulation, recreation, historic, or cultural values.[58] Across all four categories, Solwara 1 ranked better than, if not equal to, the three mining sites. This supports Nautilus' stance that DSM may be a better alternative to terrestrial mining.

While the above findings have yet to be tested, higher mineral concentration of deep-sea minerals appears uncontested. Current U.S. Geological Survey data confirms that significantly higher grades of copper, cobalt, nickel, and gold are found in the deep seabed.[59] For copper, terrestrial grade stands at 0.49% and deep seabed grade at 7.7%.[60] Significantly high mineralization, in itself, would lead to numerous efficiencies.[61] Land-based mining costs increase as grade and depth

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53. *Id.* at 39.
54. *Id.* at 40.
55. *Id.* at 40.
56. *Id.* at 40.
57. *Id.* at xi, xiii-iv.
58. *Id.* at xi, xiii-iv.
59. Charles Roche, *Industrial Mining the Deep Sea: Social and Environmental Considerations*, MINERAL POL'Y INST. 7 (May 14, 2015), http://www.mpi.org.au/wp-content/uploads/2015/05/May-2015-Duke-Uni-Webinar-Mining-the-sea-MPI-web-version.pdf.
60. *See id.* at 7; BATKER & SCHMIDT, *supra* note 6, at xvi.
61. *See* BATKER & SCHMIDT, *supra* note 6, at xvi.

decline.[62] Reserves located deeper in the earth cost higher in monetary and environmental terms.[63] Proponents present DSM as the less environmentally and socially harmful method of harvesting minerals.

D. The Next Phase of Marine Mining

DSM can also be seen as the next phase of marine mining. The commercial recovery of minerals at the surface of or below the seabed, or in the intertidal zone, has intensified in terms of depth of water, quantity and type of minerals, and tool complexity,[64] in comparison to when marine mining began in the 1900s.[65] The 1990s saw a massive expansion of offshore mining activities. In 1991, after fifteen years of exploration,[66] De Beers, a company known around the world for diamond engagement rings, started commercial diamond mining in southern Namibia and northwestern South Africa. From a 29,000 carat annual offshore production in 1990, De Beers's production multiplied twelvefold in two years, and doubled again in four years.[67] In 1997, De Beers modernized its equipment, incorporating a remote-operated vehicle with rubber crawler tracks and an integrated ripping/suction head into its mother ship, and equipped it with underwater cameras and scanning sonar.[68] De Beers has not stopped innovating; it now has six vessels and the latest can mine up to 140 meters below sea level.[69] In the early 1990s, Indonesian corporation Tambang Timah shifted its tin operations offshore.[70] As of 2009, annual tin production has reached 58,000 tons. Significantly, a

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62. HARTMAN & MUTMANSKY, *supra* note 15, at 18.

63. *Id.*

64. Peter A. Rona, *The Changing Vision of Marine Minerals*, 33 ORE GEO. REV. 618, 625-26 (2007); Lloyd Jones, Nautilus Managing Director, Presentation at Mining the Territory 2012: The Future of Offshore Exploration and Mining slide 7 (Sept. 19, 2012), http://vantaz.com/the-future-of-offshore-exploration-and-mining/.

65. N. TERRITORY ENVTL. PROT. AGENCY, INTERIM REPORT: SEABED MINING IN THE NORTHERN TERRITORY 112 (2012), https://ntepa.nt.gov.au/__data/assets/pdf_file/0006/284910/Seabed-Mining-Report.pdf; *see also* Michael J. Hilton, *Applying the Principle of Sustainability to Coastal Sand Mining: The Case of Pakiri-Mangawhai Beach, New Zealand*, 18 ENVTL. MGMT. 815, 817 (1994).

66. Des Clifford, *Marine Diamond Mining Comes of Age*, 1 MINING MAG. 337, 337-339 (Dec. 1997), https://www.highbeam.com/doc/1G1-55762014.html.

67. *Id.*

68. *Id.*

69. George H. Read, *Diamonds: Exploration, Mines and Marketing*, 112 LITHOS 1, 4 (2009), http://www.sciencedirect.com/science/article/pii/S002449370900098X; *Applause as N$2.3 Billion SS Nujoma Enters Water Ahead of Schedule*, DE BEERS (Jan. 14, 2016), https://www.debeersgroup.com/en/building-forever/our-stories/applause-as-n2-3-billion-ss-nujoma-is-launched.html.

70. THE TERRITORIES OF INDONESIA 256 (Iem Brown ed., 2009).

year prior to PNG's 2011 license for Nautilus, the Saudi-Sudanese Red Sea Commission had already issued an exploitation license for seafloor massive sulphides in the Atlantis Basin II in the Red Sea.[71] Whether Russia has begun exploiting its manganese nodules in the Gulf of Finland remains uncertain.[72] These developments in shallow seabed mining and DSM licensing promote DSM optimism.

The 1994 organization of the International Seabed Authority (ISA) (the governing body for DSM beyond national jurisdiction) effectively lifted UN General Assembly Resolution 2574D (XXIV), imposing a moratorium to DSM, pending the creation of an international regime.[73] Administration of DSM in areas within national jurisdiction remains separate from the administration of the Area. Coastal states, however, may not infringe upon or unjustifiably interfere with navigation or any other of the high sea freedoms.[74] They should enact laws and regulations on pollution from seabed activities, other activities in the Area, and dumping, at least as effectively as international rules, standards, and recommended practices and procedures.[75] This means that carefully crafted prospecting and exploration regulations, which passed through the twenty-four manned LTC before consideration of the thirty-six member Council and the Assembly, could equally apply to DSM within national jurisdiction, at least as a benchmark for local laws.[76] The same is true for separate Exploitation Regulations of deep-sea minerals, currently being drafted by the LTC. It could be argued that dual regulation of DSM within national jurisdiction could in fact result in greater regulation than that of other prevalent offshore activities that likely fall exclusively within national jurisdiction. Heightened regulation lends support to DSM's emergence as the next phase of marine mining.

Mining companies make a strong case for DSM. DSM not only ensures steady mineral supply; it also contributes significant capitalization that developing states particularly need. DSM could also

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71. ALLSOP ET AL., *supra* note 29, at 27-28; *Atlantis II Red Sea Deeps*, DIAMOND FIELDS INT'L LIMITED, http://www.diamondfields.com/s/AtlantisII.asp (last visited Nov. 4, 2016).

72. Jones, *supra* note 64, at slide 7.

73. UNITED NATIONS CONVENTION ON THE LAW OF THE SEA: A COMMENTARY 104 (Satya N. Nandan et al. eds., vol. VI 2002) [hereinafter UNCLOS COMMENTARY vol. VI].

74. UNCLOS, *supra* note 5, art. 78.

75. *Id.* arts. 208-10.

76. *Id.* arts. 159(1), 163(1)(2); *see* Int'l Seabed Auth. [ISBA], *Decision of the Council Relating to the Election of Members of the Legal and Technical Commission*, ISBA Doc. ISBA/7/C/6 (July 2-13, 2001), https://www.isa.org.jm/sites/default/files/files/documents/isba_7c_6.pdf (increasing the number of members of the Legal and Technical Commission to allow performance of functions supposedly by the Economic Planning Commission).

pose significantly less harm than land-based mining. While the extent of environmental harm remains uncertain, the fact alone that DSM offers fifteen times higher mineral concentration at six times lower cost with ten or fifteen times lesser area necessary for operation poses an opportunity worth considering.[77] Examining past marine activities can additionally confirm industry readiness for DSM.

III. DEEP SEABED MINING AS A DANGEROUS SHORTSIGHTED MOVE

NGOs and citizen groups voice strong objections to DSM. Greenpeace and Deep-Sea Mining Campaign—an association of NGOs (e.g., Mining Watch Canada, Oxfam Australia, Earthworks, and PNG Groups Against Seabed Experimental Mining), and citizens from the Pacific Islands, Australia, and Canada, call for a DSM moratorium unless and until the full range of marine habitats, biodiversity, and ecosystem functions are adequately protected.[78] Deep-Sea Mining Campaign specially advocates for a moratorium to observe and understand the dynamics of proposed mining sites, at least for ten years, to conduct more extensive scientific research on species identification, community ecology, distribution, genetics, life histories, resettlement patterns, and resilience to disturbance.[79] It also believes that local communities should take part in the decision-making process and should have a right to veto, and that states, before granting mining licenses, should require independently verified research that neither communities nor ecosystem would suffer long-term.[80] The Center for Biological Diversity, a nonprofit corporation dedicated to preserve, protect, and restore biodiversity and ecosystems, also opposes deep-sea mining, for its risk of irreparable harm and lax environmental standards.[81] NGOs basically ask for more time to study species in the deep-sea and assure minimal environmental impacts, for participative discussions with affected parties, and for greater transparency and regulation. The discussion below exhausts issues against DSM, regardless of whether or not actually raised by opponents.

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77. *See* Roche, *supra* note 59, at slide 7; *see also* Stephen Eisenhammer, *The Robot Is Ready—So When Will Deep Sea Mining Start?*, REUTERS (Apr. 18, 2014), http://www.reuters.com/article/us-mining-deepsea-idUSBREA3H06T20140418.

78. GREENPEACE, *supra* note 8, at 11.

79. Steiner, *supra* note 29.

80. *About the Deep Sea Mining Campaign*, DEEP SEA MINING CAMPAIGN, http://www.deepseaminingoutofourdepth.org/about/ (last visited Nov. 4, 2016).

81. Complaint for Declaratory and Other Relief at 5, 16, Center for Biological Diversity v. Pritzker, No. 15-723, 2015 WL 3489849 (D.D.C. May 13, 2015).

A. A Bill of Attainder to the Deep-Sea

Critics underscore a lack of information and misinformation about the environmental risks DSM poses.[82] Challengers raise the potential threat to species and ecosystems across various depths—from the surface mixed layer (the water surface up to a 200 meter depth), the mesopelagic zone (between 200 to 1000 meter depth), and the deep-sea (beyond 1000 meters).[83] They also question if comparison of DSM with land-based mining instead of with other maritime development activities is proper.[84] To ensure that DSM is the most environmentally conscious choice, critics ask for better baselines before operations commence.

1. A Source of Pollution

DSM can generate different kinds of wastes and increase spillage risks. DSM opponents question the lack of studies on various forms of mine-derived pollution. They stress the importance of examining pollution risks at every mining stage: from mining, sifting, and collecting ore, dewatering, and transporting ore to onshore processing center, not just the risks that arise during the actual process of mining ore.[85]

Foremost, mining, regardless of type, creates wastes known as tailings. Tailings, non-minerals separated from the minerals and dumped back to the oceans at varying depths, alter water composition.[86] In the case of Solwara 1, tailings could reach as high as 130 kilotons of unconsolidated cement (equivalent to six meters deep) and 115 kilotons of waste rock.[87] Combined and disposed down the slope, discharged wastes containing 10,000 kilotons of contaminated effluents can smother benthic communities.[88] Simultaneous large-scale DSM could, in the future, lead to unimaginable amounts of waste.

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82. WEBB, *supra* note7, at 1100.

83. Hunter & Taylor, *supra* note 49, at 6.

84. HELEN ROSENBAUM & FRANCIS GREY, DEEP SEA MINING CAMPAIGN, ACCOUNTABILITY ZERO: A CRITIQUE OF THE NAUTILUS MINERALS ENVIRONMENTAL AND SOCIAL BENCHMARKING ANALYSIS OF THE SOLWARA 1 PROJECT 8 (2015), http://www.deepseamining outofourdepth.org/wp-content/uploads/accountabilityZERO_web.pdf.

85. Macko, *supra* note 25, at 77.

86. WEBB, *supra* note 7, at 1100-01.

87. RICHARD STEINER, BISMARCK-SOLOMON SEAS INDIGENOUS PEOPLES COUNCIL, INDEPENDENT REVIEW OF THE ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED NAUTILUS MINERALS SOLWARA 1 SEABED MINING PROJECT, PAPUA NEW GUINEA, 3 (Jan. 10, 2009), http://www.deepseaminingoutofourdepth.org/wp-content/uploads/Steiner-Independent-review-DSM1.pdf [hereinafter STEINER, REVIEW].

88. *Id.* at 5.

DSM vessels will also likely discharge ballast water and brine. In transporting mined ore back to shore, shipping operators will have to dispose ballast water, initially pumped to provide stability and maneuverability to an empty vessel. Based on projected vessel size, Nautilus will dump around 1.4 million tons worth of ballast water.[89] Shipping operators will also have to perform reverse osmosis of seawater to meet potable water requirements. Desalination could produce up to eighty-two kiloliters per day of brine, double the typical salinity of seawater, which will then be dumped back to the sea.[90]

Finally, DSM increases spillage risk. Oil spills can occur at any mining stage.[91] There could be seafloor equipment malfunctions, riser or pipes leakage, upwelling, fuel transfer spillage, and lost tow spillage.[92] Nautilus fails to account for the resulting exponential increase in barge trips due to DSM, the tidal strength of the Bismarck Sea, and Solwara 1's proximity to the coast.[93] Fuel transfer procedure and equipment, weather restrictions, spill prevention, and response-specific measures could significantly reduce these threats, yet are notably unavailable.[94]

Early signs show that pollution could be a huge problem with Solwara 1. Citizens of New Ireland, a province in PNG, have already reported cloudy water and dead tuna washing ashore, negatively affecting the diving and fishing industry.[95] Critics insist the relevance of discussing water pollution mitigating efforts in greater detail.

2. A Roadblock to Evolution Knowledge

Scientists fear mankind will lose the opportunity to learn more about how the world began if mining companies disturb, or worse, destroy, the deep-sea ecosystem, which covers 70% of the Earth, and harbors at least ten million species.[96] DSM is much more complex than shallow seabed mining; deep-sea species have not been studied

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89. *Id.*

90. Hunter & Taylor, *supra* note 49, at 9.

91. WEBB, *supra* note 7, at 1101.

92. Hunter & Taylor, *supra* note 49, at 9; *see also* STEINER, REVIEW, *supra* note 87, at 2; *see also* JOHN L. LUICK, DEEP SEA MINING CAMPAIGN, PHYSICAL OCEANOGRAPHIC ASSESSMENT OF THE NAUTILUS EIS FOR THE SOLWARA 1 PROJECT 11-2 (Nov. 2012), http://www.deepseaminingoutofourdepth.org/wp-content/uploads/EIS-Review-FINAL-low-res.pdf.

93. STEINER, REVIEW, *supra* note 87, at 2, 5, 17.

94. *Id.* at 9.

95. Gemina Harvey, *The Deep Sea Resources Rush*, DIPLOMAT (Aug. 30, 2013), http://thediplomat.com/2013/08/the-deep-sea-resources-rush/2/.

96. Lyle Glowka, *The Deepest of Ironies: Genetic Resources, Marine Scientific Research, and the Area*, 12 OCEAN Y.B. 154, 156 (1996); ALLSOP ET AL., *supra* note 29, at 6.

thoroughly, and the deep-sea is incomparable with shallow waters (or any of the present environment for that matter)[97] in terms of temperature, pressure, pH levels, and toxic levels.[98] Deep-sea vents replicate early earth conditions, in that the Area, microbes associated with the vents, likely descended from the earliest life forms on Earth.[99] DSM can obliterate the opportunity to answer questions on hydrothermal vents—particularly, whether life originated thereat, if its activities control El Niño events, if it exists in other planets of the solar system, and if it engineered photosynthesis—all of which remain unanswered despite decades of research.[100] Nautilus' statement on the temporality of any loss and the possibility for rehabilitation[101] does not guarantee preservation of the deep-sea environment.

3. A Danger to Species

DSM not only results in pollution and habitat loss, it also introduces alien species and creates unwanted light and sound. These effects, separate or combined, could result in behavioral changes and death in marine species.

a. Causing Imbalance

Studies show that scraping and ballast water discharge introduce alien species to the marine environment. DSM buries living creatures in hydrothermal vents. Different species reappear after some time, although noticeably hardier and less desirable.[102] Ballast waters taken and released in different areas transport species from the point of origin to the point of disposal. In the case of PNG, accompanying exotic invasive species from the 1440 kilotons of ballast water from bulk ore carriers may inhabit New Britain's near shore waters.[103] Whether these alien species survive or how they interact with the original species remains unknown.

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97. WEBB, *supra* note 7, at 1100.
98. *Id.* at 1100; Glowka, *supra* note 96, at 159.
99. Glowka, *supra* note 96, at 157.
100. Re, *supra* note 7; *see also* Jason Om, *Concerns Over Impact Deep Sea Mining for Copper, Gold Off Papua New Guinea Will Have on Sea Life*, ABC NEWS (Aug. 25, 2014, 10:08 AM), http://www.abc.net.au/news/2014-08-25/concerns-for-sea-life-near-png-deep-sea-mining-project/5695644.
101. NAUTILUS, EIS, *supra* note 2, at 9-26.
102. WEBB, *supra* note 7, at 1101.
103. STEINER, REVIEW, *supra* note 87, at 5.

b. Inducing Behavioral Changes

Scientists also warn about behavioral changes caused by light and noise on various species. Artificial lighting disrupts seabirds, whales, dolphins, and sea turtles, which in the case of seabirds, could lead to exhaustion, and even death.[104] Underwater noise from the cutter head and removal of waste rock, which remains audible even 600 kilometers away from the mining site, can trigger signal-masking effects that also alter species movement.[105] Nautilus fails to account for these behavioral changes.

c. Threatening Species Survival

Heavy metals in sediments and elevated temperature of dewatered effluents can poison marine species. Metals, once ingested, move up the food chain and across different waters through predators and migratory fish stocks like tuna.[106] Lower metal concentrations may lead to cell damage or reproductive failure, while high metal poisoning can lead to death.[107] Concentrations tend to accumulate, exposing organisms higher up the food chain to greater harm.[108] Higher temperatures of discharged dewatered effluents may also cause poisoning. Effects of ocean hydrodynamics change on marine species remain uncertain.[109] No concrete studies exist on the "effects of high pressure on the toxicity of chemicals in organisms."[110] Critics nevertheless require Nautilus to look at Solwara 1's projected effluent temperature of 5.8° C to 11.4° C and the resulting impact to species in the discharge area.[111] These poisoning risks heighten DSM anxiety considering potential vulnerability of humans.[112]

DSM also endangers rare endemic species. Hydrothermal communities vary according to geographic location.[113] Giant tubeworms, for instance, dominate the East Pacific Rise, while shrimps abound the Mid-Atlantic Ridge.[114] In the case of PNG, a 2007 partial study revealed

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104. Complaint for Declaratory and Other Relief, *supra* note 81, at 18.
105. STEINER, REVIEW, *supra* note 87, at 18-19; Hunter & Taylor, *supra* note 49, at 9.
106. Hunter & Taylor, *supra* note 49, at 7; Complaint for Declaratory and Other Relief, *supra* note 81, at 2-3.
107. Complaint for Declaratory and Other Relief, *supra* note 81, at 8.
108. *Id.* at 17.
109. STEINER, REVIEW, *supra* note 87, at 10; LUICK, *supra* note 92, at 20.
110. Hunter & Taylor, *supra* note 49, at 8.
111. STEINER, REVIEW, *supra* note 87, at 10; LUICK, *supra* note 92, at 20.
112. Complaint for Declaratory and Other Relief, *supra* note 81, at 17.
113. Re, *supra* note 7, at 70.
114. *Id.*

at least twenty new species in the Solwara 1 site. DSM, in effect, puts discovery of species in the same area in peril.[115] While vent organisms may be transferred, doubt of their survival remains. Assuming they do survive, this does not guarantee compatibility with existing species in the Area.[116] DSM can potentially lead to irreparable loss of unique species.

These environmental concerns lead economists, scientists, and civil society groups to seriously question Earth Economics' Economic and Social Benchmarking Analysis for Solwara 1. Professor Rick Steiner, in a critique entitled *Accountability Zero,* dismisses the "apple to oranges" comparison between terrestrial mining and DSM. He recommends use, instead of data, relating to gas and oil drilling, as well as other maritime development activities, such as military use, bridge construction, dredging, and deep-sea trawling.[117] Absent proper baselines, critics fear environmental mismanagement and destruction.

B. A Threat to Tradition, Livelihood, and Health

DSM faces opposition not only from environmentalists, but also from indigenous peoples and fishermen, who question the lack of studies and consultations on the full scope of the social, cultural, and economic effects of DSM.[118] The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) requires indigenous peoples' consent before approval of any project affecting their resources.[119] It empowers indigenous peoples to maintain and strengthen their spiritual relationship with traditionally owned or otherwise occupied and used land, territories, waters, coastal seas, and other rights.[120] In the case of PNG, the Bismarck Solomon Sea Indigenous Peoples Council bemoans the lack of consultation to adequately address the social, cultural, and economic values of their oceans. They fear loss of their shark-calling tradition, and disrespect of dead spirits and mythical creatures.[121] Vanuatu similarly has issued 145 exploration licenses in the past five years without any

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115. STEINER, REVIEW, *supra* note 87, at 2.

116. *Id.* at 10, 19-20.

117. ROSENBAUM & GREY, *supra* note 84, at 6, 8.

118. *Id.* at 9; *see* Harvey, *supra* note 95; *see also* John Ahni Schertow, *Indigenous Communities Oppose Deep Sea Mining*, IC MAG. (July 10, 2008), https://intercontinentalcry.org/indigenous-communities-oppose-deep-sea-mining/.

119. G.A. Res. 61/295, United Nations Declaration on the Rights of Indigenous People art. 36 (Sept. 12, 2007) [hereinafter UNDRIP].

120. *Id.* art. 25.

121. STEINER, REVIEW, *supra* note 87, at 8-9 (The Bismarck council denies Nautilus' claim that it conducted a number of well-attended meetings in Bagabag Island, Madang province).

community consultation.[122] DSM also affects basic human rights of fishermen who rely on stable and uncontaminated fish stocks for survival.[123] Indigenous peoples and fishermen, backed by non-profit groups, jointly criticize governments for ignoring community concerns.[124]

C. A Short-term Economic Solution

Literature on economic performance of mining states over a twenty year period rebuts economic development. Most resource-intensive economies generally perform below expectations.[125] In many cases, mining dependence results in underdevelopment of long-term industries, and corruption and mismanagement of mining rents.[126] A United Nations Conference on Trade and Development study associates rising poverty incidence in several African countries, i.e., the Central African Republic, the Democratic Republic of Congo, Guinea, Liberia, Niger, and Sierra Leone, to mineral production because it creates dependency on a short-term industry instead of developing competitiveness on long-term industries like agriculture and manufacturing.[127] Empirical studies of 123 states also suggest that mineral-dependent states are more corrupt than non-mineral dependent ones.[128] Even if not corrupt, government officials of mining-dependent states can be incompetent and poor managers,[129] relying on taxation proceeds alone, without adding value downstream or upstream, like supplies, employment, and smelting.[130] Mineral resource wealth, unfortunately, has not necessarily translated into economic development.

PNG's experience reflects the resources-development gap. Consistently a top gold producer,[131] PNG nonetheless remains a low-to-middle income economy and continues to slide down the United Nations Development Program Human Development Index (now 145

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122. Harvey, *supra* note 95.

123. Complaint for Declaratory and Other Relief, *supra* note 81, at 8.

124. *About the Deep Sea Mining Campaign*, *supra* note 80.

125. Graham A. Davis & John E. Tilton, Should Developing Countries Renounce Mining? A Perspective on the Debate 28 (Dec. 12, 2002) (working paper) (on file with Colorado School of Mines), http://inside.mines.edu/~gdavis/Papers/Davis_and_Tilton_2002.pdf.

126. *Id.* at 1-2.

127. *Id.* at 13.

128. *Id.* at 41.

129. *Id.* at 12.

130. *Id.* at 11-2, 20.

131. Syble Michelle Pennington, Deep-Sea Mining in Papua New Guinea: Policy Frontier 13 (May 2009) (unpublished MEM dissertation, Duke University) (on file with the Duke University Libraries).

out of 177).[132] Indo-Pacific Public Policy and Economics Director, Paul Flanagan, suggests focusing on the agricultural sector, instead of the resource sector, considering that 80% of the population relies on subsistence agriculture.[133] Furthermore, while mining companies reportedly comply with their monetary obligations, lack of transparency in national and local governments results in a failure to account for where the monies actually go.[134] In 2009, one mining site alone injected PKG 56 million ($17,947,908.72) in royalties, compensations, and dividends, equivalent to PKG 1597 ($512) higher than the 2009 per capita income.[135] Thomas Webster, Director of PNG's National Research Institute, confirms that government institutions do not perform their job.[136] Worse, PNG's environment absorbs the externalities, and its mines are among the worst polluting mines worldwide.[137] Five PNG mines have dumped at least 33,160 million tons of tailings annually into PNG's rivers and other marine bodies, devastating the waters, fish stocks, and other marine species.[138] These records put into question the long-term role of mining in the economic growth of PNG.

Skepticism over extractive industry contribution includes DSM. DSM will likely not provide PNG nationals valuable employment. Solwara 1 will employ approximately 140 employees, most of whom will be expatriates.[139] Although Nautilus plans to build a concentrator onshore PNG, smelting will reportedly occur in China.[140] In contrast, Debmarine, owned by De Beers and Namibia in equal shares, employs 80%

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132. *Papua New Guinea*, WORLD HEALTH ORG. [WHO], http://www.wpro.who.int/countries/png/en/ (last visited Nov. 4, 2016); *see also Papua New Guinea*, WORLD BANK GROUP [WBG], http://data.worldbank.org/country/papua-new-guinea (last visited Nov. 4, 2016).

133. Paul Flanagan, *From Economic Boom to Crisis Management in PNG*, E. ASIA F. (Jan. 2, 2016), http://www.eastasiaforum.org/2016/01/02/from-economic-boom-to-crisis-management-in-png/.

134. Margaret Callan, *Mining in Papua New Guinea—Where Do the Benefits Go?*, DEV. POL'Y CTR.: DEVPOLICY BLOG (Sept. 10, 2012), http://devpolicy.org/benefits-from-mining-in-papua-new-guinea-where-do-they-go/.

135. *Id.*

136. *Id.*

137. EARTHWORKS & MINING WATCH CAN., TROUBLED WATERS: HOW MINE WASTE DUMPING IS POISONING OUR OCEANS, RIVERS, AND LAKES 2, 8 (Feb. 2012), https://www.earthworksaction.org/files/publications/Troubled-Waters_FINAL.pdf.

138. *Id.* at 8, 14-15, 17-18, 20.

139. STEINER, REVIEW, *supra* note 87, at 4.

140. *Id.*

Namibians, including skilled workers.[141] It appears that PNG's gain will again be limited to rents.

D. An Incomplete, Unenforceable Legal Regime

DSM within national jurisdiction, unlike DSM in the Area, may legally commence now, subject to compliance with local legislations. DSM in the Area, on the other hand, requires prior approval of mining regulations and licenses. The ISA's LTC must finish drafting separate Exploitation Regulations, which the ISA's Council must then deliberate and recommend to the ISA's Assembly.[142] Once the regulations are in place, a public or private mining contractor duly sponsored by an UNCLOS state party may apply for a mining license. Regardless of the location of DSM, within national jurisdiction or in the Area, legal and implementation gaps presumably aggravate fears.

1. Inexistent and Inadequate Legal Regimes

DSM within national jurisdiction remains largely unregulated. A majority of coastal states, including pioneering state PNG, have not adopted legislations on DSM within the full extent of their national jurisdiction, i.e., the twelve nautical mile territorial sea, 200 nautical mile EEZ, continental shelf, and if applicable, the extended continental shelf. To date, PNG has not revised its Mining Act of 1992, which regulates offshore mining within its territorial sea.[143] Even with PNG's new mining policy,[144] however, many DSM issues remain unclear. These include: benefit-sharing of local communities and governments in the rents, the role of customary law, the process for closing mines, and remediating, waste management, rights of communities, and royalty payments.[145] Meanwhile, the few existing laws on DSM within national jurisdiction

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141. Edgar Brandt, *Production Record of 1.16 Million Carats in 2013 for Debmarine*, NEW ERA (Apr. 8, 2014) (Namib.), https://www.newera.com.na/2014/04/08/production-record-1-16-million-carats-2013-debmarine/.

142. UNCLOS, *supra* note 5, arts. 160(2)(f)(ii), 162(2)(o)(ii), 165(2)(f).

143. *Mining Act 1992* § 2 (Papua N.G.); *see also* ECORYS RES. & CONSULTING, DG MAR. AFFAIRS & FISHERIES, STUDY TO INVESTIGATE STATE OF KNOWLEDGE OF DEEP SEA MINING 55 (Aug. 28, 2014), https://webgate.ec.europa.eu/maritimeforum/sites/maritimeforum/files/Annex%202%20Legal%20analysis.pdf.

144. *See* PAPUA N.G., A GREEN PAPER ON OFFSHORE MINING POLICY (Revised 1999), http://actnowpng.org/sites/default/files/6.%20Master%20final%20Green%20paper1999%20version_20Oct08.pdf; PAPUA N.G., THE PAPUA NEW GUINEA MINING POLICY (2012), http://www.mra.gov.pg/Portals/2/docs/Mineral%20Policy%202012.pdf.

145. ECORYS RES. & CONSULTING, *supra* note 143, at 55.

appear sparse and problematic. For states that are a part of the European Union (EU), as the EU itself is an UNCLOS signatory, each must comply with its own laws and with EU law regarding DSM on the continental shelf.[146] Apart from absence of EU law on DSM, the offshore mining legislations of some EU states are incomplete, inapplicable, or even unconstitutional.[147] Laws of others states equally suffer from impracticality and vagueness, in part because they were enacted pre-UNCLOS, at least two decades ago,[148] or are mere extensions of terrestrial mining laws.[149] Recently enacted DSM national legislation remains soft on fiscal provisions, still not requiring insurance or strict liability payments,[150] or if requiring them at all, only with low ceilings.[151] The legal framework for DSM within national jurisdiction, even in PNG, unfortunately remains underdeveloped.

States, likewise, fail to completely regulate DSM in the Area, which indirectly affects DSM within national jurisdiction. Several UNCLOS states parties that have sponsored corporations or state entities in the Area have no laws, regulations, or administrative measures on DSM in

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146. *Id.* at 46.

147. *Id.* at 48-50; EDWARD DUCAN BROWN, SEA-BED ENERGY & MINERALS: THE INTERNATIONAL LEGAL REGIME 187-88 (Vol. 2 2001). The laws of Greece (Decree No. 142 of 13 March 1969 as amended in 1973 by Article 191 of Decree 210/1975) and Italy (Law No. 613 of July 21, 1967) do not include deep-sea minerals. Germany's legislation (Law for the Implementation of the UN Convention and the Implementation Agreement of June 6, 1995) fails to account for the inherent seabed limitation of the Baltic and North Seas, neither of which extending below 200m. France's revised Mining Code (Ordinance No. 2011-91 of Jan. 20, 2011) does not include the regulatory part of the Mining Code (Law No.68-1181 of Dec. 30, 1968). Spain's Law (Mining Law No. 22/1973, of July 21, 1973) applies to all forms of mining irrespective of original and physical state. The special legal regime adopted by Azores (Regional Legislative Decree 21/2012/A of May 9, 2012), an autonomous region of Portugal, was held unconstitutional.

148. *See* 43 U.S.C. §§ 1331 *et seq.* (1953); Decree by the President of the Russian Federation on the activities of Russian natural and juridical persons in the exploration and exploitation of the mineral resources of the seabed beyond the limits of the continental shelf (Russ.), *translated in* 28 LOS Bull. 28; Law on Interim Measures for Deep Seabed Mining (July 20, 1982), 22 I.L.M. 102 (1983) (Japan).

149. *See Mining Act 2010* vol. II no. 85, para 2 (Fiji).

150. *See Offshore Areas Mineral (Development and Regulation) Act*, No. 17 of 2003, INDIA CODE, ¶¶ 20-21, 23-24, 28; *Tuvalu Seabed Minerals Act 2014* paras 24-26, 43, 78 (Tuvalu).

151. *See Seabed Minerals Act 2009*, s 47 (Cook Islands); *Seabed Minerals Act 2009* s 109 (Tonga); *China Passes Seafloor Mining Law*, MARITIME EXEC. (Feb. 27, 2016), http://www.maritime-executive.com/article/china-passes-seafloor-mining-law; *see also China Adopts First Law on Deep Seafloor Exploration*, ENGLISH.NEWS.CN (Feb. 26, 2016), http://news.xinhuanet.com/english/2016-02/26/c_135135110.htm.

the Area,[152] as required by the ISA.[153] Furthermore, no international rules, regulations, or procedures exist to prevent, reduce, and control pollution from DSM within national jurisdiction. States decided to exclude regulation of wastes from mineral exploitation and seabed mining activities in the London Convention.[154] While intended to avoid redundancy, because UNCLOS already requires regulation of seabed pollution,[155] this exclusion extends to DSM within national jurisdiction, which thus remains unregulated.[156] While PNG and others covered by the Noumea Convention are nevertheless regulated, this framework is geographically limited.[157] To properly regulate DSM in the Area, which affects DSM within national jurisdiction, passage of Exploitation Regulations is not enough. Patent legal gaps only support calls for a DSM moratorium.

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152. *See* Letter from Jung-Keuk Kang, President, Korea Institute of Ocean Science & Technology, to Int'l Seabed Auth. on Status of Legislation Related to the Deep Seabed Activity by the Government of the Republic of Korea (Mar. 25, 2013) (on file with Int'l Seabed Auth.), http://www.isa.org.jm/files/documents/EN/NatLeg/ROK.pdf (that Korea is holding consultations); Report of the Secretary-General, *Laws, Regulations and Administrative Measures Adopted by Sponsoring States and Other Members of the International Seabed Authority with Respect to Activities in the Area*, ¶¶ 19-20, ISBA/18/C/8 (July 16-27, 2012), https://www.isa.org.jm/sites/default/files/files/documents/isba-18c-8_0.pdf (showing Nauru has commenced the process of implementing a comprehensive legal framework); Letter from the Embassy of France in Jamaica to the Int'l Seabed Auth. (Mar. 22, 2013) (on file with Int'l Seabed Auth.), http://www.isa.org.jm/files/documents/EN/NatLeg/FR-en.pdf (stating France commits to legislating on the issue); *Tuvalu and Kiribati Join Countries Progressing Responsible Management of Deep Seabed Minerals*, SPC-EU DEEP SEA MINS. PROJECT (Feb. 17, 2015), http://gsd.spc.int/dsm/index.php/news/54-tuvalu-and-kiribati-join-countries-progressing-responsible-management-of-deep-seabed-minerals (disclosing that Kiribati is currently undertaking public consultation).

153. Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Case No. 17, Advisory Opinion of Feb. 1, 2011, 2011 ITLOS Rep. 10, 73 ¶ 238-39 [hereinafter 2011 ITLOS Advisory Opinion]; UNCLOS, *supra* note 5, annex III, art. 4(4).

154. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter art. III(1)(c), Dec. 29, 1972, 1046 U.N.T.S. 120 (1975); Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter arts. 1, 4(1)(3), Nov. 8 1972, 36 I.L.M. 1, 7 (1997).

155. UNCLOS, *supra* note 5, art. 209; Global Ocean Comm'n, Strengthening Deep Seabed Mining Regulation 7 (Policy Paper No. 5) (Nov. 2013), https://www.oceanfdn.org/sites/default/files/GOC%20-%20Strengthening%20deep%20seabed%20mining%20regulation.pdf.

156. *See* Global Ocean Comm'n, *supra* note 155, at 7.

157. Convention for the Protection and Development of the Natural Resources and Environment of the South Pacific Region art. 1, Nov. 25, 1986, 26 I.L.M. 38 (1987) [hereinafter Noumea Convention].

2. Regulator-Benefactor Conflict of Interest

Coastal states' interest in DSM rents raises the issue of whether they can effectively regulate the activity. PNG, for instance, has a notoriously bad mining record.[158] Its mining dependence[159] may have triggered its decision not only to allow Herculean tailings discharge to its rivers (reportedly as high as seventy million tons of waste rock and tailings annually for Ok Tedi),[160] but also to enact legislation to bar foreign suits related to compensation and claims from mining and petroleum projects[161] and limit financial compensation.[162] Early signs, likewise, show the tendency of the PNG government to favor Nautilus. Apart from failing to amend its Mining Act of 1992 before issuing Nautilus a mining license for Solwara 1, the PNG government accepted Nautilus' EIS despite vacancies in its Environment Council, the body responsible for issuing permits and performing environmental audits and investigations.[163] These events indubitably create an impression of laxness, if not bias.

There may also be a conflict of interest in the ISA-Enterprise relationship. The Enterprise, itself a seabed mining corporation,[164] remains interlocked with other ISA-bodies. Election of its officers rests on ISA's Assembly,[165] while approval and/or exclusion of its project depends on ISA's Council.[166] In the meantime, until commencement of the Enterprise's operations,[167] the ISA's Secretariat performs its administrative functions.[168] This web of relationships poses questions for the independence of the Enterprise, and more importantly, the possibility of self-dealing by the ISA.

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158. ASIAN DEV. BANK, *supra* note 42.

159. EARTHWORKS & MINING WATCH CAN., *supra* note 137, at 8, 14-15, 17-18, 20.

160. WORLD RES. INST., WORLD RESOURCES 2002-2004 188 (2003) (ebook), http://pdf.wri.org/wr2002_case_oktedi_papua.pdf.

161. *Compensation (Prohibition of Foreign Legal Proceedings) Act 1995* § 4 (Papua N.G.).

162. *The Mining Ok Tedi (Restated Eight Supplemental Agreement) Act 1995* § 2, 5 (Papua N.G.).

163. Pennington, *supra* note 131, at 16-17.

164. UNCLOS, *supra* note 5, art. 170.

165. *Id.* art. 160(1), (2).

166. *Id.* art. 162(2).

167. *Id.* arts. 158(1), 166.

168. *Id.* art. 170(2), annex IV, art. 13(2).

3. Dubious Enforcement Mechanism

ISA governance will be tested by its ability to, among other things, disallow DSM in the Area by states not party to UNCLOS, and to effectively determine the state of nationality for purposes of sponsorship relevant for environmental liability allocation. The ISA's power over UNCLOS state parties is weakened by inability to prevent non-party states from conducting DSM in the Area. UNCLOS' history shows the tenuousness of provisions in the Area.

Industrialized states, like the United States, the United Kingdom, and Germany, declined to sign the UNCLOS in 1982 because of what they perceived as disincentives to innovation, in particular the preferential treatment of the Enterprise, highlighted by the transfer of technology requirement, protection of land-based mining, revenue-sharing obligations on contractors, and burdensome seabed regulations.[169] 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 ("1994 Implementing Agreement") addressed these objections, in part, by eliminating mandatory transfer and formulaic production charge and share of net proceeds, requiring a market-based approach in obtaining DSM technology, and incorporating the General Agreement on Tariffs and Trade-World Trade Organization (GATT-WTO) prohibition of subsidies and discrimination.[170] These changes led to greater UNCLOS acceptance, notably Germany's acceptance in 1994, and the United Kingdom's in 1997. DSM, by entities from non-party states like the United States, without ISA imprimatur, could encourage other state parties to accept. This can incentivize breakaway from ISA governance, if not UNCLOS altogether. Implementing ISA regulations can be burdensome, and enacting legislation alone is costly.[171] Disengagement from ISA frees regulation of DSM in the Area, leaving it entirely to states, and creating the likelihood of a race to the bottom.

Unfortunately, there are telltale signs of a potential United States challenge to ISA governance. The United States signed agreements with powerful states that recognize its seabed mining rights and its recently approved extension of exploration licenses over the Clarion-Clipperton Zone situated within the Area. Pre-UNCLOS, the United States entered

169. UNCLOS COMMENTARY vol. VI, *supra* note 73, at 48-49, 58, 176-77.

170. *Id.* at 189, 279-80.

171. Responsibilities and Obligations of States with Respect to Activities in the Area, Case No. 17, Statement of Nauru of Aug. 5, 2010, at 5 ¶ 26, https://www.itlos.org/fileadmin/itlos/documents/cases/case_no_17/Statement_Nauru.pdf [hereinafter Statement of Nauru].

into agreements with France, Germany, Italy, Japan, and the United Kingdom, committing to recognize each other's claims to seabed mining sites and to enact legislation with other states in the Area.[172] Two separate memoranda of understanding in 1991, with China (including Belgium and the Netherlands), and with Russia, bolster these agreements.[173] Except for Italy, the abovementioned state parties have ISA-issued exploration licenses in the Area. Consistent with the above Memorandum of Understanding, the United States recognizes deep-sea licenses in the Area in exchange for recognition of its own. It is worth noting that in June 2012, the United States' National Oceanic and Atmospheric Administration issued five year extensions to explorations by Lockheed Martin Corporation[174] in USA-1 and USA-4 located in the Clarion-Clipperton Zone. It will be interesting to see whether the ISA issues its own exploration licenses over those areas allotted to Lockheed. ISA only leased USA-3 to G-Tec Sea Mineral Resources, with Belgium as the sponsoring state, in 2013, more than twenty years after a U.S. consortium relinquished its license over the same. It remains to be seen whether the United States will persist in challenging ISA governance, and if so, how ISA will respond.

The ISA will also face challenges in implementing its effective nationality requirement. This is relevant in determining states that are liable for sponsoring state responsibilities, which, among others, include legislating on guarantees and damages, and applying the precautionary principle and best environmental practices.[175] Enforcing the ISA requirement of dual, or even multiple sponsorship, by UNCLOS state parties for DSM in the Area in cases where the state of incorporation differs from the state of control, and cases where the partnership or consortium involves many states,[176] may prove difficult considering the

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172. Provisional Understanding Regarding Deep Seabed Matters, Aug. 3, 1984, 1409 U.N.T.S. 463.

173. Steven Groves, *The U.S. Can Mine the Deep Seabed Without Joining the U.N. Convention on the Law of the Sea*, HERITAGE FOUND. BACKGROUNDER NO. 2746 6 (Dec. 4, 2012), http://thf_media.s3.amazonaws.com/2012/pdf/bg2746.pdf.

174. Complaint for Declaratory and Other Relief, *supra* note 81, at 7, 14. While Ocean Minerals Company (OMCO) originally owned the license for USA-1, it only succeeded to USA-4 after Kennecott Consortium (KCON) surrendered its license. All OMCO partners subsequently withdrew their interests in the company, except for Lockheed Martin Corporation.

175. 2011 ITLOS Advisory Opinion, *supra* note 153, at 71.

176. UNCLOS, *supra* note 5, art. 139; Int'l Seabed Auth., *Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area*, Reg. 11, ISA/19/C/17 (July 22, 2013), https://www.isa.org.jm/sites/default/files/files/documents/isba-19c-17_0.pdf [hereinafter ISA Nodules Regulation]; Int'l Seabed Auth., *Regulations on Prospecting and Exploration for Polymetallic Sulphides in the Area*, Reg. 11, ISA/15/A/11 (Nov. 15, 2010), https://www.isa.org.jm/sites/

complexity of corporate structures. The long line of civil procedure cases in determining the "principal place of business"[177] gives a semblance of the difficulty of apportioning control. It will also be interesting to see how the ISA would treat an application by a consortium that includes just one non-party state. The four U.S.-licensed DSM consortia approved in 1985 was comprised of, to a certain degree, foreign corporations from UNCLOS state parties—Belgium, Canada, Germany, Italy, Japan, and the United Kingdom.[178] ISA's treatment of a similar application for exploitation in the Area can further affect perception of its authority.

Again, ISA actions are foreboding. ISA has issued exploration licenses under the sponsorship of another state even if it could be argued that a corporation under the jurisdiction of another state effectively controls the sponsored corporation. The ISA granted a Tonga-sponsored corporation an exploration contract despite that the Tonga Corporation is wholly-owned by a Canadian company.[179] Similarly, the Council approved U.K. sponsorship of a U.K. company owned by a U.S. corporation. Corporations can easily form various webs to escape home state sponsorship, and, as ISA may have already experienced, it can be very cumbersome to untangle these webs.

DSM critics call for caution in the face of mounting environmental, human rights, economic, and accountability controversies. They seek assurances regarding environmental conservation and management, indigenous peoples' and fishermen's livelihood protection, economic sustainability, and corporate and government accountability before conduct of DSM within and beyond national jurisdictions, and present recycling as a better alternative to meet supply constraints. They insist on a moratorium unless and until states address DSM issues to their

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default/files/files/documents/isba-16a-12rev1_0.pdf [hereinafter ISA Sulphides Regulation]; Int'l Seabed Auth., *Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts in the Area*, Reg. 11, ISA/18/A/11 (Oct. 22, 2012), https://www.isa.org.jm/sites/default/files/files/documents/isba-18a-11_0.pdf [hereinafter ISA Crusts Regulation].

177. *See* Daimler AG v. Bauman, 134 S. Ct. 746, 760 (2014); Goodyear Dunlop Tires Operations, S.A., et al. v. Brown, 131 S. Ct. 2846, 2856 (2011); Hertz Corp. v. Friend, 130 S.Ct. 1181, 1186, 1192-93 (2010).

178. Groves, *supra* note 173, at 4-5, 14.

179. SRK CONSULTING (AUSTRALASIA) PTY LTD., NI 43-101 TECHNICAL REPORT 2011 PNG, TONGA, FIJI, SOLOMON ISLANDS, NEW ZEALAND, VANUATU AND THE ISA ii (March 2012), http://www.nautilusminerals.com/IRM/Company/ShowPage.aspx/PDFs/1054-44329846/NautilusMineralsTechnicalReport2011 (Tonga Offshore Mining limited is a wholly owned subsidiary of Nautilus Corporation).

opponents' satisfaction. The length of time that the moratorium will hold, however, remains an open question.

IV. RATIONALIZING DEEP SEABED MINING ASSUMPTIONS

Dissecting basic assumptions of companies and governments currently supporting DSM, on the one hand, and of DSM critics on the other, may pave the way for better, more constructive discourse. Mining companies assume critical supply levels of mineral reserves, comparability of land-based mining with DSM, and financial astuteness of DSM. Critics, on the other hand, assume precaution stands for indefinite moratorium unless and until achievement of certainty on minimal environmental harm, the illegitimacy of other goods, and an ability to hold companies and governments accountable for DSM environmental harm. Exploring these assumptions may allow both sides to arrive at less contentious positions.

A. Assumption 1: Critical Supply Level for Rare Metals

The assumption that mineral reserves will run out between one hundred and five hundred years supports DSM today as it ensures continuous development of high-tech industries at minimal cost. Common metals such as aluminum, copper, iron, lead, and zinc, contain trace concentrations of rare metals, which are used in technological devices.[180] Since rare metals are only byproducts, dwindling supplies of the source metal particularly puts the technology industry at high risk. While mineral supplies can be secured elsewhere, in land and possibly in outer space, prices will be more expensive. Production costs in terrestrial mining increase as the depth increases,[181] and asteroid mining remains financially impractical.[182] Between the years 2000 and 2010, prices of many non-energy minerals have annually increased by around 15%.[183]

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180. Thomas E. Graedel et al., *Metal Resources, Use, and Criticality*, *in* CRITICAL METALS HANDBOOK 8 (Gus Gunn ed., 2014).

181. HARTMAN & MUTMANSKY, *supra* note 15, at 18.

182. Rob Davies, *Asteroid Mining Could Be Space's New Frontier: The Problem Is Doing It Legally*, GUARDIAN (Feb. 6, 2016), http://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues. *Cf. Planetary Resources' First Spacecraft Successfully Deployed, Testing Asteroid Prospecting Technology on Orbit*, PLANETARY RES. (July 16, 2015), http://www.planetaryresources.com/2015/07/planetary-resources-first-spacecraft-deployed/.

183. U.N. ENV'T PROGRAMME [UNEP], WEALTH IN THE OCEANS: DEEP SEA MINING ON THE HORIZON? 3 (May 2014), http://na.unep.net/geas/archive/pdfs/GEAS_May2014_DeepSeaMining.pdf.

Failure to develop DSM now, which Nautilus claims as economically feasible, could result in exorbitant prices later on, affecting not just future technologies, but also current ones. Addressing supply instability now safeguards technological progress at reasonable prices.

The imprecision of the "peak concept," however, weakens the assumption. A 2011 study by University of Dundee's Professor Philip Crowson, Honorary Professor and Member of Centre for Energy, Petroleum, and Mineral Law and Policy (CEPMLP) Global Academic Team, reveals that reserve levels have increased over time despite increasing production.[184] New discoveries, including better mining and processing technology and greater access to deposits, lead to constant replenishment of perceived diminishing reserves.[185] Mineral economics also play a large role—reserves include lower-graded minerals when prices are high, and includes higher-graded minerals when prices are low, while high prices stimulate mineral substitution and recycling.[186] Relatedly, when China imposed export quotas on rare earth elements resulting in high prices, mines in the United States and Australia opened to fill the supply gap.[187] Hence, it may be imprudent to perform DSM now, when supply level is not yet critically low, and could be replenished by additional sources. A sudden deluge of deep-sea minerals will only disrupt current market stability. Oversupply will drive prices down, minimizing what could be higher rental revenue for developing states in the future. Although it is true that minerals are depleting assets, relying on the amount of recorded terrestrial reserves to justify DSM today seems insufficient.

B. Assumption 2: Comparability of Terrestrial and Deep Seabed Mining

Nautilus used substitutability of terrestrial and deep-sea minerals as the basis to compare land-based mining and DSM processes. Studies on a related industry, oil and gas, may have influenced the comparison. Indonesia deliberated over whether to build a facility for oil and gas

184. Graedel et al., *supra* note 180, at 7.

185. *Id.*; *see* U.S. GEOLOGICAL SURVEY, MINERAL COMMODITY SUMMARIES: COPPER (Jan. 2010), http://minerals.usgs.gov/minerals/pubs/commodity/copper/mcs-2010-coppe.pdf; *see also* U.S. GEOLOGICAL SURVEY, MINERAL COMMODITY SUMMARIES: COPPER (Jan. 2011), http://minerals.usgs.gov/minerals/pubs/commodity/copper/mcs-2011-coppe.pdf (which shows that the reserves have actually been increasing).

186. Graedel et al., *supra* note 180, at 7.

187. Lo, *supra* note 36.

refinery at sea, near the source, or on land, near communities.[188] Critics of the Nord Stream project, the longest gas transmission pipeline on the seabed, argued for consideration of the land-based alternative.[189] By comparing land and sea projects, governments may be better able to decide which activity to promote. Juxtaposing terrestrial mining and DSM based on environmental standards can eventually lead to competitive efficiencies in both processes as it increases environmental consciousness.

Practical differences between land-based mining and DSM, however, affect comparability. First, while mineral products are perfect substitutes, the processes are not. PNG, for instance, can grant a DSM license and a terrestrial mining license. At least for now, those are not mutually exclusive choices. In fact, Earth Economics did not use any of PNG's infamous mining sites as a basis for comparison.[190] Second, informational asymmetry still exists between the two processes. While there are several independent and peer-reviewed studies on the impact on deep-sea benthic communities,[191] the precise number of marine species remains largely unknown, and deep-sea industries (e.g., bioprospecting, methane hydrate extraction[192]) remain underdeveloped, such that any comparison between the two processes may be biased, if not premature. Third, unlike terrestrial mining, DSM does not require drilling for certain minerals. Potato-shaped manganese nodules, for instance, are scattered in the seabed, only partially covered by sediments.[193] Finally,

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188. Fabian Januarius Kuwado, *Presiden Putuskan Blok Masela Dibangun di Darat*, NASIONAL (Mar. 23, 2016) (Indon.), http://nasional.kompas.com/read/2016/03/23/13501001/Presiden.Putuskan.Blok.Masela.Dibangun.di.Darat.

189. Alexander Lott, *Marine Environmental Protection and Transboundary Pipeline Projects: A Case Study of the Nord Stream Pipeline*, 27 UTRECHT J. INT'L & EUR. L. 55, 67 (2011).

190. The report expressly uses Prominent Hill (Australia), Bingham Canyon (U.S.) and Intag (proposed mine in Ecuador) as bases for comparison. BATKER & SCHMIDT, *supra* note 6.

191. *Id.* at 28 ("There are over 30 independently published research articles relating to Solwara 1, in addition to the internal studies completed by Nautilus. These articles are publicly available and independently peer reviewed.").

192. *See Japan Becomes First Nation To Extract 'Frozen Gas' From Seabed*, GUARDIAN (Mar. 12, 2013), http://www.theguardian.com/environment/2013/mar/12/japan-extract-frozen-gas-seabed; Swaminathan S. Anklesaria Aiyar, *Tapping Massive Deposits of 'Fire Ice' Methane Hydrate Can Change India's Energy Landscape*, ECON. TIMES (Mar. 17, 2013, 12:58 PM), http://articles.economictimes.indiatimes.com/2013-03-17/news/37787191_1_hydrate-reserves-methane-hydrate-japan-oil-gas; *The International Community's Responsibility*, WORLD OCEAN REV., http://worldoceanreview.com/en/wor-3-overview/environment-and-law/international-commitments/ (last visited Nov. 4, 2016).

193. Satya Nandan, *Administering the Mineral Resources in the Deep Seabed*, *in* THE LAW OF THE SEA: PROGRESS AND PROSPECTS 89 (David Freeston et al. eds., 2006).

developmental models of the two processes vary. Terrestrial mining invests in building a community, from infrastructure, education, and health, to employment. This does not necessarily apply to DSM; in the case of Solwara 1, barges immediately take dewatered ore from PNG waters for processing in China. These basic environmental and financial differences limit acceptability of comparison between the two types of mining.

C. Assumption 3: Financial Astuteness of Deep Seabed Mining

Historical data debunks the assumption of a direct relationship between extractive industry growth and economic development. While it cannot be denied that mining, including DSM, brings in staggering revenues to cash-strapped economies, factors such as corruption, mismanagement, a lack of economic diversification, and environmental catastrophes can easily counteract these gains. Addressing these issues requires significant effort and time, but can definitely assist in producing sustainable growth.

Economic diversification, in particular, tempers overreliance on DSM. An objective inventory of marine resources could produce optimum exploitation strategies that benefit developing states both in the short and long-term.[194] Developing target income for marine activities and allocating that income among different marine activities can result in increased efficiencies.[195] Oceans host many income-generating species apart from minerals; coral reefs, mangroves, and seagrasses significantly contribute to tourism and recreation, medicine, fisheries, biodiversity, and coastal protection.[196] A 2012 study by the U.S. National Oceanic and Atmospheric Administration pegged the total annual economic value of coral reefs to select territories and two states within the United States alone to $2.379 billion.[197] Although marine bioprospecting, searching for potential new pharmaceuticals, remains underdeveloped, this will

194. *Id.* at 138.

195. *See* MAURICE MANDALE ET AL., THE ECONOMIC VALUE OF MARINE-RELATED RESOURCES IN NEW BRUNSWICK 46 (May 2000), http://www.dfo-mpo.gc.ca/Library/245997e.pdf.

196. *See The Importance of Coral Reefs*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., http://oceanservice.noaa.gov/education/tutorial_corals/coral07_importance.html (last visited Nov. 4, 2016).

197. LUKE BRANDER & PIETER VAN BEUKERING, NAT'L OCEANIC & ATMOSPHERIC ADMIN. [NOAA], U.S. DEPT. OF COMM., THE TOTAL ECONOMIC VALUE OF U.S. CORAL REEFS 5 (Feb. 2013), http://data.nodc.noaa.gov/coris/library/NOAA/CRCP/other/other_crcp_publications/TEV_US_Coral_Reefs_Literature_Review_2013.pdf (based on studies on Florida, Hawaii, American-Samoa, CNMI-Saipan, Guam, Puerto Rico, U.S. Virgin Islands).

improve in the coming years.[198] The biotechnology industry estimates a $600 million to $3 billion annual revenue for deep-sea hyperthermophiles alone.[199] Factoring in these industries, which DSM may jeopardize, could change developing states' perception of DSM's benefits.

D. Assumption 4: Precaution Means Indefinite Moratorium

Critics assume that the precautionary principle requires an indefinite moratorium on DSM. The principle, to them, does not stand for learning by doing, but rather, for meeting the burden of proof that DSM causes negligible or reversible impacts.[200] Critics ask for pause, just as governments and tribunals have, when an Australian court quashed the license for habitat relocation,[201] when the Northern Territory of Australia held a three-year moratorium on seabed mining in its territorial waters,[202] and when the International Tribunal for the Law of the Sea (ITLOS) imposed provisional measures on experimental fishing.[203] In the face of uncertainty, environmentalists level "prudence and caution" with stoppage.

The principle of preventive action similarly prohibits activity that causes or may cause environmental damage in derogation of international standards.[204] This principle, endorsed by many international environmental treaties,[205] seeks to prevent effects environmentalists fear DSM would cause, in particular, extinction of species of flora and fauna, pollution of any form, hostile environmental modification, non-migration of species, environmental degradation, transboundary impact, loss of fisheries and other biodiversity, and damage to health and the

198. *What Does Coral Have To Do with Medicine?*, NOAA, http://oceanservice.noaa.gov/facts/coral_medicine.html (last visited Nov. 4, 2016).

199. Glowka, *supra* note 96, at 79.

200. Elizabeth Mitchell, *Legal Opinion on the Application of the Precautionary Principle to Deep Seabed Mining in the Pacific Region*, ENVTL. L. ALL. WORLDWIDE 6-8 (Aug. 2012), http://pang.org.fj/wp-content/uploads/2013/03/ELAW_dsm_opinion.pdf.

201. *Id.* at 5; *see Leatch v. Director-General National Parks & Wildlife Service* [1993] NSWLEC 191 (Austl.).

202. Mitchell, *supra* note 200, at 6; *see* DEP'T OF MINES & ENERGY, MORATORIUM ON EXPLORATION AND MINING IN COASTAL WATERS OF THE NORTHERN TERRITORY UNTIL 2015 ¶ 3(b) (Mar. 6, 2012) (N. Terr.), https://minerals.nt.gov.au/__data/assets/pdf_file/0007/256714/Seabed_Mining_Policy.pdf.

203. Mitchell, *supra* note 200, at 7; *see* Southern Bluefin Tuna (New Zealand v. Japan; Australia v. Japan), Case Nos. 3 & 4, Order of Aug. 27, 1999, 3 ITLOS Rep. 280.

204. PHILIPPE SANDS ET. AL., PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW 247 (3rd ed. 2012).

205. *Id.* (citations omitted).

environment from chemicals and pollutants.[206] The breadth of international agreements, although not distinctly for DSM per se, shows overwhelming support for the preventive principle.

A strict interpretation of the precautionary and preventive principles, however, remains unpersuasive. UNCLOS does not seem to call for a ban or an indefinite moratorium in times of uncertainty. After all, adopting such a strong interpretation can prohibit all activities at sea, and actually lead to greater harm. UNCLOS, instead, seems to put emphasis on cooperation to prevent environmental damage, and on the establishment of "seriousness" of environmental harm.

UNCLOS, through the ISA, retains a temperate version of the precautionary principle. The formulation and interpretation of the principle has evolved throughout the years; some now require provisional regulations on the basis of available pertinent information;[207] and bar activities from taking place if the worst-case scenario is serious enough.[208] The ISA requirement nevertheless requires UNCLOS state parties to observe the original formulation under the Rio Declaration, that lack of full scientific certainty shall not be used as a reason to postpone cost-effective measures to prevent environmental degradation where there are threats of serious or irreversible damage,[209] and to adopt best environmental practices.[210] This essentially requires precautionary action once there is prima facie evidence of a possible crisis.[211] The degree of precaution necessarily varies according to the project and its impact.

The International Tribunal for the Law of the Sea (ITLOS), thus far, does not always support a total ban. In the *MOX Plant* case, instead of suspending the commissioning of the plant and prohibiting transportation

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206. *Id.* at 248-49 (citations omitted); *see also* Re, *supra* note 7, at 70 (discussing the extinction of species of flora and fauna and hostile environmental modification); WEBB, *supra* note 7, at 1101 (discussing the harmful effects of pollution and hostile environmental modification); STEINER, REVIEW, *supra* note 87, at 3, 5, 10 (discussing pollution and hostile environmental modification); LUICK, *supra* note 92, at 20 (discussing harmful effects in general).

207. Agreement on the Application of Sanitary and Phytosanitary Measures art. 5 ¶ 7, Apr. 15, 1994, 1867 U.N.T.S. 493.

208. *Final Declaration of the First European "Seas At Risk" Conference*, *in* NORTH SEA MONITOR: PROCEEDINGS OF THE FIRST EUROPEAN SEAS AT RISK CONFERENCE 60 (John Maggs ed., 1995).

209. Report of the United Nations Conference on the Human Environment, U.N. Doc. A/Conf.48/14/Rev.1, at 4, principle 15 (1972).

210. ISA Nodules Regulation, *supra* note 176, regs. 2(2), 5(1), 31(2); ISA Sulphides Regulation, *supra* note 176, regs. 2(2), 33(5); ISA Crusts Regulation, *supra* note 176, regs. 2(2), 33(5).

211. Rüdiger Wolfrum, *Precautionary Principle*, *in* NEW TECHNOLOGIES AND LAW OF THE MARINE ENVIRONMENT 212 (Jean-Pierre Beurier et al. eds., 2000).

of radioactive materials, as Ireland sought, the tribunal provisionally ordered the United Kingdom to cooperate and enter into consultations with Ireland.[212] In its final award, the tribunal clarified the importance of the "seriousness" of the harm when granting provisional measures, and concluded that Ireland's claims of environmental harm failed to reach this threshold.[213] Similarly, in the *Straits of Johor* case, the tribunal declined to suspend Singapore's land reclamations, as Malaysia had asked for, but instead required the two countries to exchange information and assess the risks or effects of land reclamation works.[214] Meanwhile, in the *Southern Bluefin Tuna* case, while ITLOS provisionally ordered the parties not to engage in experimental fishing, the tribunal, which was constituted under Annex VII of UNCLOS, eventually found itself without jurisdiction to hear the case.[215] While tribunals can ban an activity, the burden falls on applicants to show the significance of the potential harm.

Banning each activity that poses harm likewise raises practical concerns. Professor Cass Sunstein has written at length about the folly of the strongest and most distinctive form of the precautionary approach—shifting the burden of proof of no environmental impact to the proponent and banning activities unlikely to cause harm—because it leads to no direction at all.[216] Sunstein warns that an extreme interpretation creates a burden offended by regulation as well as non-regulation, as when a ban on nuclear power for health and safety issues could cause reliance in coal-power plants, increasing fossil fuel consumption, which in turn contributes to global warming.[217] He also raises the distributional effects of the principle, as in a global ban of genetically modified foods, as this would negatively impact some poor

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212. MOX Plant Case (No. 10) (Ir. v. U.K.), Case No. 10, Order of Dec. 3, 2001, ¶¶ 26, 81, 89, https://www.itlos.org/fileadmin/itlos/documents/cases/case_no_10/Order.03.12.01.E.pdf.

213. MOX Plant Case (Ir. v. U.K.), Order No. 3 of order June 24, 2003, at ¶ 55 (PCA Case Repository), https://www.pcacases.com/web/sendAttach/867.

214. Land Reclamation by Singapore in and Around the Straights of Johor (No. 12) (Malay. v. Singa.), Case No. 12, Order of Oct. 8, 2003, 2003 ITLOS Rep. 10, ¶¶ 22, 99, https://www.itlos.org/fileadmin/itlos/documents/cases/case_no_12/12_order_081003_en.pdf.

215. Southern Bluefin Tuna (Nos. 3 & 4) (Austl. v. Japan, N.Z. v. Japan), Case Nos. 3 & 4, Order of Aug, 27, 1999, 1999 ITLOS Rep. 280, ¶ 42-43; Southern Bluefin Tuna (Austl. v. Japan, N.Z. v. Japan), Award of Aug. 4, 2000, 23 R.I.A.A. 1, ¶ 52 (UNCLOS First Arb. Trib.).

216. Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PENN. L. REV. 1003, 1057-58 (2003) [hereinafter Sunstein, *Beyond*]; *see also* CASS R. SUNSTEIN, LAWS OF FEAR (2005); Jonathan Adler, *The Problems with Precaution: A Principle without Principle*, AM. ENTERPRISE INST. (May 25, 2011), https://www.aei.org/publication/the-problems-with-precaution-a-principle-without-principle/.

217. Sunstein, *Beyond*, *supra* note 216, at 1021-22, 1024.

countries where the agricultural insecticide, DDT, is the cheapest and most effective means to combat serious diseases.[218] As applied to DSM, imposing a ban or an indefinite moratorium might only push developing states to other extractive industries to secure more capital or could mean an imposition of a ban on all other similar offshore activities, increasing reliance on terrestrial resources. In any event, strict interpretation, rather than conserving the environment, may actually pose greater environmental risks and endanger developmental needs of developing states at the same time.

A selective ban or indefinite moratorium on DSM, applying Sunstein's explanation on activity transference, could increase reliance on other activities, which may cause similar, if not greater, harm. Mining of diamonds, sand, and tin, laying submarine cables and/or pipelines, and other activities critics insist should have been compared to DSM at Solwara 1 (namely gas and oil drilling, military use, bridge construction, dredging, and deep-sea bottom trawling),[219] also threaten the environment. Objections to DSM on benthic fauna and flora dispersal, noise disturbance, marine species mortality, and water pollution, equally apply to oil and gas drilling and its pipelines, as well as the various forms of shallow seabed mining.[220] Like DSM, uncertainties exist over the full impact of other marine activities. A study initiated by De Beers of the effects on benthic communities after twenty years of offshore diamond mining showed results similar to initial DSM findings[221]: difficulty in drawing firm conclusions on recovery, impossibility of active rehabilitation, indirect effects on adjacent areas, natural infilling of mined areas creating habitat for recolonization, and the existence of marine life with different community structure in previously mined areas.[222] It is also worth noting that Nautilus, unlike other entities, is transparent about its environmental impact assessments (EIA). China

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218. *Id.* at 1032.

219. ROSENBAUM & GREY, *supra* note 84, at 8.

220. *See* David Langlet, *Nord Stream, the Environment and the Law: Disentangling a Multijurisdictional Energy Project*, *in* ENVIRONMENTAL LAW 97 (Peter Wahlgren ed., 2014); Lott, *supra* note 189, at 64; UNEP GLOB. ENVTL. ALERT SERV, SAND, RARER THAN ONE THINKS 4 (Mar. 2014), http://na.unep.net/geas/archive/pdfs/GEAS_Mar2014_Sand_Mining.pdf; J. Rogers & X.C. Li, *Environmental Impact of Diamond Mining on Continental Shelf Sediments Off Southern Namibia*, 92 QUATERNARY INT'L. 101, 111-12 (2002).

221. Charles L. Morgan et al., *Synthesis of Environmental Impacts of Deep Seabed Mining*, 17 MARINE GEOSOURCES & GEOTECHNOLOGY 307, 347-48 (1999).

222. DE BEERS, LIVING UP TO DIAMONDS: 2010 REPORT TO SOCIETY 90 (2010), http://www.debeersgroup.com/content/dam/de-beers/corporate/documents/Archive%20Reports/RTS_10_Full.PDF.

does not appear to be carrying out EIA on its massive reclamation activities in contested features in the South China Sea.[223] Similarly, Nakheel, Dubai's contractor for its luxury islands, notwithstanding strict UAE and Dubai laws, did not submit an EIA to local authorities.[224] Available information suggests, however, that the EIA of the first island, Palm Jumeriah, covered only 1% of the twenty-five km^2 dredging area, and 0.33% of the zone of impact.[225] Furthermore, Solwara 1, unlike the Nord Stream 1 pipeline owned by a Russian and German consortium, is not located in an IMO-designated "particularly sensitive sea area."[226] By imposing a ban or indefinite moratorium on DSM as a whole, without looking into specifics, governments may be foregoing a better modeled project.

Moving further, consistent application of an extreme form of the precautionary principle calls for banning not only of DSM, but also of other marine activities as well. It can be argued that like in DSM, it is not possible to "credibly examine the potential risks and impacts"[227] of many of the abovementioned marine activities. Comparability, as with terrestrial mining, may be limited by differences, which include the type of minerals and the depth involved. Laying submarine cables and pipelines, gas and oil drilling, and deep-sea trawling may involve the deep-sea, but do not involve the same processes as mining. Meanwhile, mining activities have been limited to the shallow seafloor. Nevertheless, states' acceptance of all the aforementioned activities other than DSM raises questions as to the constant application of the precautionary principle. While precautions should certainly be made, activity-specific rejection should be avoided.[228]

E. Assumption 5: Illegitimacy of Other Goods

Focusing on indigenous peoples' right to their tradition and fishermen's right to their livelihood assumes illegitimacy of other goods. Professor David Kennedy's *The Dark Sides of Virtue* details several pragmatic flaws of international humanitarianism, including human

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223. Republic of the Philippines v. People's Republic of China, PCA Case No. 2013-19, PCA Case Repository (Mensah) 39 (Perm. Ct. Arb. 2015).

224. Bayyinah Salahuddin, The Marine Environmental Impacts of Artificial Island Construction 73-74 (2006) (unpublished MEM dissertation) (on file with Duke University Library).

225. *Id.* at 57.

226. Lott, *supra* note 189, at 64.

227. Mitchell, *supra* note 200, at 6.

228. SPC, REGIONAL LEGISLATIVE FRAMEWORK, *supra* note 24, at 46-47.

rights' occupation of other emancipatory strategies and the narrowing of other goods.[229] DSM, while affecting interests of indigenous peoples and fishermen, also provides a participating government an opportunity to improve its economy, and offers livelihood to those employed by the mining company. It also generates far less dislocation than land-based mining. These factors equally deserve consideration.

Opinions vary as to when indigenous peoples' right to free, prior, and informed consent exists. UNDRIP and the Committee on the Elimination of Racial Discrimination do not distinguish when the right applies,[230] while the Inter-American Court in *Saramaka People v. Suriname* and the Special Rapporteur's earlier statements make a qualification such that consent only becomes absolutely essential when potential for profound or major impact on the property rights of indigenous people exists, or physical or cultural survival is endangered.[231] Both positions have gained support through the years. Successive Special Rapporteurs from 2010 onward have reiterated the need for consent in extractive projects.[232] On the other hand, the 2009 *Poma Poma*

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229. David Kennedy, Manley O. Hudson Professor of Law, Harvard Law School, The Allen Hope Southey Memorial Lecture: Reassessing International Humanitarianism: The Dark Sides 9, 14 (June 8, 2004), http://www.law.harvard.edu/faculty/dkennedy/speeches/TheDarkSides.pdf.

230. UNDRIP, *supra* note 119, art. 32; Comm. on the Elimination of Racial Discrimination, *Rep. on the Rights of Indigenous People*, U.N. Doc. A/52/18, at 123, Annex III, General Recommendation 23 (Aug. 18, 1997).

231. CATHAL M. DOYLE, INDIGENOUS PEOPLES, TITLE TO TERRITORY, RIGHTS AND RESOURCES: THE TRANSFORMATIVE ROLE OF FREE PRIOR AND INFORMED CONSENT 146, 149-50 (2015); *see* Saramaka People v. Suriname, Preliminary Objections, Merits, Reprarations, and Costs, Judgment, Inter-Am. Ct. H.R. (ser. C) No. 172, ¶ 37 (Nov. 28, 2007); James Anaya (Special Rapporteur on the Situation of Human Rights and Fundamental Freedoms of Indigenous People), *Rep. on the Situation of Indigenous People in Nepal*, U.N. Doc. A/HRC/12/34, at Add.3, ¶ 47 (July 20, 2009); James Anaya (Special Rapporteur on the Rights of Indigenous Peoples), *The Situation of the Indigenous Peoples Affected by the El Diquís Hydroelectric Project in Costa Rica*, U.N. Doc. A/HRC/18/35, Add. 8, ¶ 15 (July 11, 2011).

232. DOYLE, *supra* note 231, at 152-53; *see* James Anaya, U.N. Special Rapporteur on the Human Rights and Fundamental Liberties of Indigenous People, *Declaración pública del Relator Especial sobre los derechos humanos y libertades fundamentales de los indigenas, sobre la "Ley del derecho a la consulta previa a los pueblos indigenas u originarios reconocido en el Convenio No. 169 de la Organización Internacional de Trabajo" aprobada por el Congreso de la Republica del Peru* [*Public Declaration of the Special Rapporteur on the Human Rights and Liberties of the Indigenous, Over the "Legislative Bill on the Indigenous Peoples' Right to Prior Consultation as Stipulated in ILO Convention 169" approved by the Peruvian Congress*], United Nations, Hum. Rts. Council (July 7, 2010), http://unsr.jamesanaya.org/docs/statements/2010_statement_unsr_peru_consultation_law_7_7_2010_sp.pdf; James Anaya, U.N. Human Rights Council, *Rep. of the Special Rapporteur on the Rights of Indigenous Peoples*, ¶ 80, U.N. Doc. A/HRC/18/35 (July 11, 2011); James Anaya (Special Rapporteur on the Rights of Indigenous Peoples), *Extractive Industries Operating Within or Near Indigenous Territories*, ¶ 65, U.N. Doc. A/HRC/18/35 (July 6,

v. Peru of the Human Rights Committee and the 2010 *Endorois v. Kenya* of the African Commission adopted the latter position.[233] In the case of PNG, it may be argued that the second interpretation applies. Like in the *Saramaka*, *Poma*, and *Endorois* cases, DSM does not threaten property rights or the survival of indigenous peoples, excusing Nautilus from securing prior consent of the Bismarck Solomon Sea Indigenous Peoples. Hence, even if critics decide to focus on DSM's implication on indigenous peoples' rights, it could be argued that PNG nevertheless remains compliant.

F. Assumption 6: Failed Environmental Legal System

States regulating DSM may be held liable for environmental damage under current rules. No single instrument details international rules on responsibility and liability for environmental harm.[234] Adoption of the Exploitation Regulations, which directly apply to sponsoring states in the Area, and indirectly to coastal states within their EEZ,[235] does not affect existing state liability under the Articles of State Responsibility and other applicable treaties or customary international law.[236] Developments in international environmental law with *actio popularis* standing, NGO participation as *amicus curiae*, and shared responsibility, create room for creative solutions to the state accountability gap in the form of countermeasures and trade-related responses. While historic data on environmental compensation validates pessimism to DSM accountability, recent trends indicate a contrary position.

2012); James Anaya (Special Rapporteur on the Rights of Indigenous Peoples), *Rep. on the Rights of Indigneous Peoples*, ¶ 28, U.N. Doc. A/HRC/24/41 (July 1, 2013).

233. DOYLE, *supra* note 231, at 153-54; *see* U.N. Hum. Rts. Comm'n, Communication No. 1457/2006, Angela Poma Poma v. Peru, ¶¶ 7.4, 7.6, U.N. Doc. CCPR/C/95/D/1457/2006 (Apr. 24, 2009); Centre for Minority Rights Development (Kenya) & Minority Rights Group (on behalf of Endorois Welfare Council) v. Kenya, African Court on Human and Peoples' Rights [Afr. Ct. H.P.R.], ¶¶ 226, 291 (Nov. 25, 2009), http://www.achpr.org/files/sessions/46th/comunications/276.03/achpr46_276_03_eng.pdf.

234. SANDS ET AL., *supra* note 204, at 875.

235. UNCLOS, *supra* note 5, art. 208.

236. *Id.* arts. 138, 139, 221, 235, 293; *see also* Bruno Simma & Dirk Pulkowski, *Leges Speciales and Self-Contained Regimes*, *in* THE LAW OF INTERNATIONAL RESPONSIBILITY 148 (James Crawford et al. eds., 2010).

1. Progressive Role of Environmental Activist States and Other Entities

Support for *actio popularis*, the exercise of legal protection on behalf of the international community, has been growing. From the implied recognition of the concept by a majority of judges in the *Barcelona Traction* case,[237] the 2001 Articles of State Responsibility explicitly recognize invocation of responsibility by a state other than an injured state.[238] Subsequently, the International Court of Justice in the *Belgium v. Senegal* case explicitly acknowledged Belgium's standing on the basis of the common interest to ensure torture prevention.[239] The International Tribunal for the Law of the Sea, in an advisory opinion, recognized the right of each state party to claim compensation relating to preservation of the environment of the high seas and in the Area.[240] More recently, in the *Whaling* case, the International Court of Justice granted Australia's objection to Japan's whaling program in the Antarctic.[241] It is worth noting that Australia hinged its standing on the collective interest of all states of ensuring compliance with the 1946 Whaling Convention, not on the fact that Japan's whaling activities took place in Australian waters.[242] Similarly, interested states, regardless of geographic location, can regulate erring DSM states.

Increasingly, international bodies recognize the role of entities other than states. The Permanent Court of Arbitration Optional Rules for the Arbitration of Disputes relating to Natural Resources and the Environment recognizes party autonomy, giving international organizations, NGOs, and private parties standing to arbitrate on a subject if it is agreed upon in writing.[243] Similarly, the Seabed Disputes

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237. Barcelona Traction, Light & Power Company Limited (Belg. v. Spain), Judgment, 1970 I.C.J Reports 4, ¶ 31 (Feb. 5).

238. G.A. Res. 56/83, Responsibility of States for International Wrongful Acts ¶¶ 46, 48 (Jan. 28, 2002).

239. Questions relating to the Obligation to Prosecute or Extradite (Belg. v. Sen.), Judgment, 2012 I.C.J Rep 422, at 424 (July 20).

240. 2011 ITLOS Advisory Opinion, *supra* note 153, ¶ 180.

241. Whaling in the Antarctic (Austl. v. Japan: N.Z. intervening), Judgment, 2014 I.C.J. 226 (March 31) (It should be mentioned, however, that Japan did not question standing and the Court did not discuss it either).

242. Whaling in the Antarctic (Austl. v. Japan: N.Z. intervening), Verbatim Record, ¶ 19 (July 9, 2013, 4:30 PM), http://www.icj-cij.org/docket/files/148/17450.pdf.

243. PERMANENT COURT OF ARBITRATION, OPTIONAL RULES FOR ARBITRATION OF DISPUTES RELATING TO NATURAL RESOURCES AND/OR THE ENVIRONMENT introduction, art. 1(1), 185 (2001), https://pca-cpa.org/wp-content/uploads/sites/175/2016/01/Optional-Rules-for-Arbitration-of-Disputes-Relating-to-the-Environment-and_or-Natural-Resources.pdf.

Chamber accommodates cases filed by or against natural and juridical persons and the ISA, an international organization.[244] Organizations and tribunals have also expanded NGO participation as drafters of treaties and other international standards,[245] observers,[246] and *amici curiae*.[247] Greater participation in environmental governance can increase enforcement.

2. Broader Net of Respondents

Developments in the law of international responsibility increase likelihood of state liability by a non-party to UNCLOS. The International Court of Justice recognizes the possibility of shared responsibility of two or more states.[248] In *Certain Phosphate Lands in Nauru*, the Court upheld a claim against Australia even in the absence of other interested parties, namely United Kingdom and New Zealand.[249] Similarly, in the *Oil Platforms* case, Judge Brunno Simma opined that the tort law on joint and several liability rises to the level of a general

244. UNCLOS, *supra* note 5, arts. 188-89, annex VI art. 20(2).

245. SANDS ET AL., *supra* note 204, at 88 ("The International Union for the Conservation of Nature (IUCN), established in 1948, has developed policy initiatives and has prepared texts of draft instruments which have served as the basis for the negotiation of the 1971 Ramsar Convention, the 1973 CITES and the 1992 Biodiversity Convention. Together with UNEP and WWF, IUCN was also instrumental in drawing up the 1980 World Conservation Strategy and the 1990 World Conservation Strategy II. WWF, Greenpeace and Friends of the Earth are other international non-governmental organi[z]ations which have played an active role in developing treaty language and other international standards, and in acting as watchdogs in the implementation of treaty commitments, together with groups such as Oxfam and Action Aid.").

246. This includes the International Covenant for the Regulation of Whaling, Dec. 2, 1946, 161 U.N.T.S. 72, Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) art. 11, Sept. 22, 1992, 2354 U.N.T.S. 67 [hereinafter OSPAR]; Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters art. 10(5), June 25, 1998, 2161 U.N.T.S. 447.

247. Practice Direction XII, 6 I.C.J. Acts & Docs. 163; Appellate Body Report, *United States—Import Prohibition of Certain Shrimp and Shrimp Products*, ¶ 38, WTO Doc. WT/DS58/AB/R (adopted Nov. 21, 2001) [hereinafter *Shrimp/Turtle I*]; Appellate Body Communication, *European Communities—Measures Affecting Asbestos and Asbestos-Containing Products*, at 2, WTO Doc. WT/DS135/9 (adopted Nov. 8, 2000); Panel Report, *Contra European Communities—Measures Affecting the Approval and Marketing of Biotech Products*, ¶ 7.113-14, WTO Doc. WT/DS291-3/R (adopted Sept. 29, 2006) (where panel accepted briefs but ruled it was unnecessary to take into consideration); Appellate Body Report, *United States—Import Prohibition of Certain Shrimp and Shrimp Products—Recourse to Article 21.5 of the DSU by Malaysia*, ¶ 79, WTO Doc. WT/DS58/AB/RW (adopted Oct. 22, 2001) (where Appellate Body refused to consider brief received).

248. G.A. Res. 56/83, *supra* note 238, arts. 16, 47.

249. Certain Phosphate Lands in Nauru, (Nauru v. Austl.), Judgment, 1992 I.C.J. Rep. 240, ¶ 57 (June 26).

principle of law.[250] Affording an injured state (or a State that files an *actio popularis*) the option to choose against which state to file a case against,[251] and distinct examination of effective control in each instance,[252] accords environmental protection outside UNCLOS' dispute resolution framework.

States that are not a party to UNCLOS remain liable for DSM activities within or beyond its national jurisdiction. State responsibility attaches for breach, not only of treaties, but international customary law and general principles of law as well,[253] among which are the no-harm principle[254] and the abuse of rights principle.[255] The no-harm principle requires DSM states to continuously exercise due diligence to prevent foreseeable and significant damage to areas beyond the states' jurisdiction or control.[256] Foreseeability depends on present state of knowledge on the risks,[257] while significance relates to facts more than laws, on what is detectable, not necessarily the existence of serious or substantial harm.[258] Due diligence thus requires DSM states to legislate

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250. Oil Platforms (Iran v. U.S.), Judgment, 2003 I.C.J Rep. 161, 354-58 (Nov. 6) (separate opinion of Simma, J.); *see also* Corfu Channel (U.K. v. Alb.), Merits, 1949 I.C.J Rep. 4, 95, ¶ 24 (Apr. 9) (dissent of Azevedo, J.) (discussing that the conduct of the victim state can be taken into account in reducing the responsibility of the offending State).

251. Alexander Orakhelashvili, *Division of Reparation Between Responsible Entities*, *in* THE LAW OF INTERNATIONAL RESPONSIBILITY 657 (James Crawford et al. eds., 2010).

252. The Dutch Supreme Court affirmed the premise laid by its Court of Appeals—the general acceptance of the possibility that more than one party has effective control, and examination of effective control in one does not mean examination of the others. *See* HR 6 september 2013, RvdW 2013 (Neth./Mustafić-Mujić) (Neth.), http://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:HR:2013:BZ9228); *see also* HR 6 september 2013, RvdW 2013 (Neth./Nuhanović)(Neth.), https://www.rechtspraak.nl/Organisatie-en-contact/Organisatie/Hoge-Raad-der-Nederlanden/Supreme-court-of-the-Netherlands/Documents/12%2003324.pdf.

253. G.A. Res. 56/83, *supra* note 238, arts. 1, 2, 12, 13.

254. *See* Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. Rep. 226, ¶ 29 (July 8) [hereinafter Advisory Opinion on Nuclear Weapons].

255. Gabčíkovo-Nagymaros Project (Hung. v. Slovk.), Judgment, 1997 I.C.J. Rep. 7, 95 (Sept. 25) (separate opinion by Weeramantry, V.P.); *Shrimp/Turtle I*, *supra* note 247, at ¶ 158.

256. Trail Smelter (U.S. v. Can.), 3 R.I.A.A. 1905, 1965 (Train Smelter Arb. Trib. 1941); Corfu Channel Case (U.K. v. Alb.), Merits, 1949 I.C.J. Rep. 4, 22 (April 9); Advisory Opinion on Nuclear Weapons, *supra* note 254, ¶ 29; Case Concerning Pulp Mills on the River Uruguay (Arg. v. Uru.), 2010 I.C.J. Rep. 14, ¶ 101 (Apr. 20); 2011 ITLOS Advisory Opinion, *supra* note 153, at 35; Draft Articles on Prevention of Transboundary Harm from Hazardous Activities with Commentaries, Rep. of the Int'l Law Comm'n on the Work of Its Fifty-Third Session, 56 U.N. GAOR Supp. No. 10, at 151-52, U.N. Doc. A/56/10 (2001), *reprinted in* [2001] v.II pt. 2 Y.B. Int'l L. Comm'n 144 [hereinafter Draft Articles and Commentaries]; Report of the United Nations Conference on the Human Environment, U.N. Doc. A/Conf.48/14/Rev.1, at 5, principle 21 (1972).

257. PATRICIA BIRNIE ET AL., INTERNATIONAL LAW AND THE ENVIRONMENT 153 (3rd ed. 2009).

258. Draft Articles and Commentaries, *supra* note 256, art. 2 ¶ 4.

and enforce measures to prevent or minimize known significant risks of harm,[259] such as tailings, noise, and deep-sea species extinction. DSM states must not only require EIA, they also must ensure it reflects "the nature and magnitude of the proposed development and its likely adverse impact on the environment," and considers alternative mining locations.[260] DSM states must also directly notify affected states and the public about the activity,[261] and cooperate with them through consultation and good faith negotiations.[262] Meanwhile, DSM states violate the obligation not to abuse rights if they undertake DSM in a manner that impairs the capacity of other states to exercise their own basket of rights, and if the concomitant disadvantages exceed advantages received by the DSM states.[263] Viewing DSM as an ultra-hazardous activity, consequential harm may then trigger strict liability, regardless of fault.[264] International law obligations apply regardless of membership to UNCLOS. The principle of common-but-differentiated responsibility further augments developed states' obligations, as they must utilize all means at their disposal to ensure there is no significant damage.[265] Hence, developed states like the United States, though not party to UNCLOS, bear a heavier burden to disprove a breach, should DSM cause environmental harm, either within or beyond its national jurisdiction.

Difficulties in disentangling corporate structures do not detract from utilizing control as means to attribute breach to states not party to UNCLOS. A state can be liable for conduct of a corporation acting under the state's instructions, direction, or control.[266] In civil law traditions and international humanitarian law, control manifests in

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259. *Id.* art. 2 ¶ 10, 5; United States Diplomatic and Consular Staff in Tehran (U.S. v. Iran), Judgment, 1980 I.C.J. Rep. 3, ¶ 63 (May 24).

260. G.A. Res. 56/83, *supra* note 238, art. 4; *Pulp Mills*, 2010 I.C.J. Rep. 14, ¶¶ 204-05, 207-14.

261. G.A. Res. 56/83, *supra* note 238, arts. 8, 13, 13; *Pulp Mills*, 2010 I.C.J. Rep. 14, ¶ 110.

262. G.A. Res. 56/83, *supra* note 238, arts. 4, 9; MOX Plant Case (No. 10) (Ir. v. U.K.), Case No. 10, Order of Dec. 3, 2001, ¶ 82; Lake Lanoux Arb.(Fr. v. Sp.), 12 R.I.A.A. 281, 317 (1957); Application of the International Convention on Elimination of All Forms of Racial Discrimination (Geor. v. Russ.), 2011 I.C.J. Rep. 70, ¶ 158 (Apr. 1); *see also* North Sea Continental Shelf (Fed. Rep. of Ger./Den. v. Fed. Rep. of Ger./Neth.), Judgment, 1969 I.C.J. 4, 75 (Feb. 20); Gabčíkovo-Nagymaros Project (Hung. v. Slovk.), Judgment, 1997 I.C.J. Rep. 7, ¶ 141 (Sept. 25) (insistence on a position without contemplating any modification belies good faith).

263. LASSA OPPENHEIM, INTERNATIONAL LAW: A TREATISE 345 (H. Lauterpacht ed., vol. I, 8th ed. 1965).

264. SANDS ET AL., *supra* note 204, at 881.

265. Advisory Opinion on Nuclear Weapons, *supra* note 254, ¶ 29.

266. G.A. Res. 56/83, *supra* note 238, art. 8.

management—equipping, financing, coordinating, or helping in the general planning.[267] Similarly, environmental harm may be attributed to non-party states if they aid DSM corporations through provisions in equipment, finances, or logistics planning and preparation, regardless of place of incorporation.

Liability for DSM harm may be sought, not only against states, but against corporations as well. While international liability of individual persons, natural or juridical, remains largely undefined and unaccepted,[268] soft law developments expand regulatory possibilities. Voluntary sustainability initiatives commit corporations to good behavior. The Global Compact requires corporations to operate responsibly and submit reports on their social and environmental impact.[269] Similarly, the Guidelines of the Organization for Economic and Cooperative Development requires establishment of National Contact Points, which serve as forums for settling environmental issues, among others, between the business community and different stakeholders. A Chilean National Contact Point, for example, mediated between Marine Harvest, a Chilean subsidiary of multinational NUTRECO, and the NGOs Friends of the Earth (the Netherlands) and Ecoceanos (Chile), issuing recommendations, which for the most part, the parties implemented.[270] Environmental activists have, in *Kasky v. Nike*, used Nike's corporate sustainability efforts to sue Nike for misrepresentation, which resulted in a $1.5 million settlement, payable to an industry-dominated labor organization.[271] DSM critics can similarly look to environmental commitments of DSM corporations and consider filing analogous cases.

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267. *See* INT'L COMM. OF RED CROSS, THE MONTREAUX DOCUMENT 10 (Aug. 2009), https://www.icrc.org/eng/assets/files/other/icrc_002_0996.pdf; Prosecutor v. Tadic, Case No. IT-94-1-A, Judgment, ¶ 131 (Int'l Crim. Trib. for the Former Yugoslavia July 15, 1999); Military and Paramilitary Activities in and against Nicaragua (Nicar. v. U.S.), Judgment, 1986 I.C.J. Rep. 14, ¶ 131 (June 27); *see also* John Dugard, *Diplomatic Protection*, *in* THE LAW OF INTERNATIONAL RESPONSIBILITY 1051, 1067 (James Crawford et al. eds., 2010).

268. Christian Tomuschat et al., *The Responsibility of Other Entities: Private Individuals*, *in* THE LAW OF INTERNATIONAL RESPONSIBILITY 317 (James Crawford et al. eds., 2010).

269. *See Our Participants*, U.N. GLOB. COMPACT, https://www.unglobalcompact.org/what-is-gc/participants (last visited Nov. 4, 2016); Amanda Perry-Kessaris, *Corporate Liability for Environmental Harm*, *in* RESEARCH HANDBOOK ON INTERNATIONAL ENVIRONMENTAL LAW 367-68 (Malgosia Fitzmaurice et al. eds., 2010).

270. Perry-Kessaris, *supra* note 269, at 370; *see also* ORG. FOR ECON. CO-OPERATION, ANNUAL REPORT ON THE OECD GUIDELINES FOR MULTINATIONAL ENTERPRISES 2010—CORPORATE RESPONSIBILITY: REINFORCING A UNIQUE INSTRUMENT 34 (2010), http://www.estrategiafiscal.net/wp-content/uploads/2011/09/Annual-Report-on-the-OECD-Guidelines-for-Multinational-Enterprises-2010.pdf.

271. Perry-Kessaris, *supra* note 269, at 368-70.

3. Creative Solutions to Reparation

Claiming compensation admittedly poses difficulties. Sir Ian Brownlie conceded that physical manifestations of environmental impacts occur incrementally and in a complex manner.[272] The vastness and depth of the oceans, the number of activities thereat, and the interrelatedness of the species naturally give rise to problems of causal identification and multiple causation, and thereafter, quantification of damages.[273] States, by collectively imposing measures against erring DSM States, can sidestep these issues.

States can resort to countermeasures, non-violent actions in response to illegal state actions, as redress for environmental harm. If a state cannot directly challenge DSM state actions before a tribunal, it can do so indirectly through countermeasures, the legality of which will then be tested according to compliance with requisites established by customary international law.[274] Performed collectively, countermeasures can be a powerful tool to dispel irresponsible DSM states.

Countermeasures must meet requisites on both standing and purpose, and comply with certain conditions and limitations. Only an injured state or international organization can target[275] a responsible state or international organization[276] for what the former believes is a violation of the latter's international legal obligation,[277] and for the sole purpose of inducing compliance with such obligations, not as punishment.[278] Before this, an injured state or international organization must call for cessation and reparation, give notification of the decision to take countermeasures, and offer to negotiate.[279] Any retaliatory act by the injured party must then be temporary, reversible,[280] proportionate to the gravity of breach,[281]

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272. IAN BROWNLIE, PRINCIPLES OF PUBLIC INTERNATIONAL LAW 354 (7th ed. 2008).

273. James D. Fry, *Attribution of Liability*, *in* PRINCIPLES OF SHARED RESPONSIBILITY IN INTERNATIONAL LAW: AN APPRAISAL OF THE STATE OF THE ART 129 (Andre Nollkaemper et al. eds., 2014).

274. HJORTUR B. SVERRISSON, COUNTERMEASURES, THE INTERNATIONAL LEGAL SYSTEM AND ENVIRONMENTAL VIOLATIONS: WHEN TWO WRONGS MAKE A RIGHT FOR THE ENVIRONMENT 127 (2008).

275. G.A. Res. 56/83, *supra* note 238, art. 49(1); *see also* DANAE AZARIA, TREATIES ON TRANSIT OF ENERGY VIA PIPELINES AND COUNTERMEASURES 208-09 (2015).

276. G.A. Res. 56/83, *supra* note 238, art. 49(1).

277. Air Service Agreement (U.S. v. Fra.), 18 R.I.A.A. 417, 443 ¶ 81 (1978).

278. G.A. Res. 56/83, *supra* note 238, art. 49(1).

279. *Id.* art. 52(1); AZARIA, *supra* note 275, at 209.

280. G.A. Res. 56/83, *supra* note 238, art. 49(2)-(3).

281. *Id.* art. 51 (Least intrusive measure of available sufficiently effective measures proportional to the injury suffered and necessary to obtain the objective of the countermeasure).

compliant with fundamental rights that cannot be derogated,[282] and must immediately stop once the wrongful act ceases, or a dispute before a court or tribunal arises.[283] States notably fail to meet all these requisites.[284]

However, recent developments relax requisites for countermeasures. Expansion of *actio popularis*, discussed above, implies more states could take action against the erring state. It would also appear that tribunals have relaxed requirements on notification of the decision to take countermeasures, the offer to negotiate,[285] and the countermeasures' reversibility.[286] It may be argued that these improvements empower collective countermeasures,[287] which can target trade, tourism, and other economic relations as means of DSM enforcement.

States can specifically resort to trade-related measures against erring DSM states. The WTO disallows unilateral trade measures.[288] Developments in WTO jurisprudence on exceptions under Article XX GATT, however, show environmental activism paving way for collective trade restrictions,[289] such as the eco-labeling of mineral products, with a goal of preventing environmental degradation. Unlike the *Tuna* cases under GATT, where the panels denied and left unsettled the extraterritorial application of environmental exception,[290] the WTO

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282. *Id.* art. 50 (These exclude property rights.).

283. *Id.* art. 52(3)(b).

284. In *Naulilaa*, an arbitral tribunal ruled in favor of Portugal and ruled that a single violent attack on three Germans apparently caused by language barrier does not justify six reprisal attacks. Naulilaa (Port. v. Ger.), 2 R.I.A.A. 1011, 1032-33 (1928). In the Fisheries Case, although the ICJ acknowledged the necessity of protecting fish stocks, it ruled that Iceland violated international law by unilaterally prohibiting the U.K. to fish within 50 M. The ICJ ordered the two to negotiate. Fisheries Jurisdiction Case (U.K. v. Ice.), Judgment, 1974 I.C.J. Rep. 3, ¶ 79 (July 25). In the Gabčíkovo-Nagymaros project case, the ICJ rejected Hungary's state of necessity defense to violation of its agreement with then Czechoslovakia. The ICJ nevertheless ruled that Slovakia's unilateral implementation of Variant C, which deprived Hungary of its right to an equitable and reasonable share of Danube, violated the proportionality requirement under international law. Gabčíkovo-Nagymaros Project (Hung. v. Slovk.), Judgment, 1997 I.C.J. Rep. 95, ¶¶ 48-59, 85 (Sept. 25).

285. SVERRISSON, *supra* note 274, at 191-93, 312-13.

286. G.A. Res. 56/83, *supra* note 238, art. 49(3).

287. *See* SVERRISSON, *supra* note 274, at 130-39.

288. General Agreement on Tariffs and Trade art. 23, Oct. 30, 1947, 55 U.N.T.S. 194 [hereinafter GATT].

289. SVERRISSON, *supra* note 274, at 310.

290. Panel Report, *United States—Restrictions on Import of Tuna*, ¶ 5.28, WTO Doc. DS21/R (Sept. 3, 1991) [hereinafter *Tuna I*]; Panel Report, *United States—Restrictions on Import of Tuna*, ¶¶ 3.38, 4.39, WTP Doc. DS29/R (June 16, 1994) [hereinafter *Tuna II*). In *Tuna I*, Article XX (g) did not have extraterritorial jurisdiction while in *Tuna II*, the panel did not come into a definite conclusion.

Appellate Body in the *Shrimp/Turtle I* case found a nexus between the conservation interest of the United States and the migratory sea turtles. The WTO Appellate Body accepted an environmental policy on unrelated values, recognizing regulation on shrimp harvesting which affects sea turtles.[291] The caveat that it has "not decided that sovereign states should act together bilaterally, plurilaterally or multilaterally, either within the WTO or other international fora, to protect endangered species or to otherwise protect the environment,"[292] nevertheless suggests acceptability of bilateral or multilateral trade restrictions "necessary to protect human, animal or plant life or health" or "relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption."[293] Collective trade-related measures can ensure states' accountability in DSM.

Coalescing creates a semblance of legitimacy, facilitating enforcement against erring DSM states. States could utilize collective countermeasures, in particular trade-related measures, as an immediate and convenient means to hold DSM states accountable for environmental harm within and beyond national jurisdiction. Pacific states could, for instance, violate their undertakings with PNG to compel the PNG to better regulate DSM. Australia can similarly suspend the Torres Strait Treaty, affecting PNG's seabed and fisheries jurisdiction. These defensive strategies, taken in conjunction with developments in standing—who can sue, and who to sue—show a robust environmental legal system.

DSM advocates and critics make assumptions, express or implied, in support of their position. Breaking down these assumptions creates room for states to weigh opportunity costs against possible sanctions; for environmentalists, indigenous peoples, and affected industries to examine the effectiveness and practicality of their objections; for mining corporations to improve project acceptability and feasibility; and for other stakeholders (e.g., corporations utilizing minerals in its production, consumers, insurers, and international organizations), to engage in the DSM debate. Juxtaposing supply and economic need-based assumptions with environmental, societal, and enforcement risk assumptions thus presents a path toward sustainable DSM.

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291. *See also Shrimp/Turtle I*, *supra* note 247, ¶¶ 144-45.
292. *Id.* ¶ 185.
293. GATT, *supra* note 288, art. XX (b), (g).

V. CONCLUSIONS AND RECOMMENDATIONS

Commercial DSM at this point remains unconvincing. Responsible DSM calls for balance in regulatory capacity, economic feasibility, environmental sustainability, and social acceptability,[294] a combination that DSM advocates have yet to demonstrate. In the case of the Solwara 1 Project, Nautilus presents independent studies suggesting that PNG stands to benefit 124 times the costs measured according to the four factors aforementioned.[295] Patent regulatory gaps nevertheless render Nautilus' accountability doubtful. Legislations and regulations pose disincentives to bad behavior. PNG, unfortunately, has no existing laws on DSM within its EEZ that would regulate, or even allow for the commencement of, the Solwara 1 project. Nautilus, in effect, enjoys environmental and societal impunity. Informational asymmetry could also delay any environmental activism from neighboring Australia, which possesses standing through an *actio popularis*, or as a state party to, among others, the Torres Strait Treaty, UNCLOS, and the Noumea Convention. As PNG maintains the sovereign right to undertake marine scientific research in the Bismarck Sea, Australia's state of knowledge of Solwara 1 post-DSM will rely, at least initially, on publicly issued reports, which if available at all, may not reach the level of "seriousness" under *Mox Plant* that would warrant provisional remedies. The international community's interest in securing future sources of minerals may additionally preclude collective interests to hold PNG accountable for environmental harm of its limited DSM. While a case for DSM exists, in particular against its indefinite moratorium, Nautilus' impending DSM project fails to fully convince.

Delaying DSM for a few years may boost Nautilus' position. Since DSM operations per the Solwara site would likely last only one to two years,[296] and Nautilus' mining license for Solwara 1 still has thirteen years to run, Nautilus can show good faith by giving the PNG government time to enact DSM-specific legislation beyond the territorial sea, conduct further consultations, and acquire the capacity to regulate DSM effectively. This would also accord scientists more time to understand

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294. *See* Christoper Avery, Seafloor Massive Sulphides: Assessment of Sustainable Mining Potential Through an Iterative Decision-making Framework 59 (Dec. 2011) (unpublished MAS dissertation) (on file with Queen's University).

295. *See* SECRETARIAT OF PAC. CMTY., AN ASSESSMENT OF THE COSTS AND BENEFITS OF MINING DEEP-SEA MINERALS IN THE PACIFIC ISLAND REGION: COST-BENEFIT ANALYSIS xvii (2016), http://dsm.gsd.spc.int/images/pdf_files/PIR_CBA_Report.pdf.

296. *Id.* at 2-7.

the dynamics of Solwara 1[297] to the satisfaction of critics. While precaution does not demand a moratorium, imposing one may lead to greater acceptability, not just of Nautilus' project, but also of DSM in general. In the meantime, DSM advocates and opponents, and stakeholders in general, may consider collaborative efforts to influence the culture of not only the mining industries and regulating states, but also of consumers and of mineral-dependent industries.

A. Develop a Culture of Sustainable Mineral Usage

Sustainable use, re-use, and recycling ensures stable mineral supply and prices without causing environmental harm. Unfortunately, only a few observe these measures. Mineral usage purpose stays unquestioned, as in the case of diamonds prized simply for their association with love,[298] and sands, dredged increasingly for territorial expansionism. For most metals, including those the British Geological Survey deems at risk, recycling remains very limited,[299] due to social, economic, and technological barriers. Many are unaware of the necessity of recycling; most manufactures do not design products for recycling, and governments lack the initiative, if not the technology, to implement possible recycling regulations.[300] Sustainable mineral usage culture leaves much to be desired.

DSM opponents can focus on increasing stakeholder participation in the aforementioned mineral conservation efforts. Consumers can positively affect the demand and supply equation, both directly through product usage and recycling, and indirectly, by creating pressure for more government action. Informational campaigns such as eco-labeling can increase awareness of dwindling mineral supply and, in turn, force manufacturers to devise products with complete, or at least partial, recyclability. Governments can then take a step further and increase recycling incentives such as tax deductions for manufacturers, and cash

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297. *About the Deep Sea Mining Campaign*, *supra* note 80.

298. *See* DE BEERS, THE 2014 DIAMOND INDUSTRY REPORT 16 (2014), http://insightreport.debeersgroup.com/_downloads/pdfs/de-beers-insight-report-2014.pdf (De Beers calls it the "diamond dream—that is, the allure that diamonds have for consumers, based on their association with romance and a sense of the eternal, and the fact that they are seen as a lasting source of value.").

299. UNEP, RECYCLING RATES OF METAL: A STATUS REPORT 19 (2011), http://www.unep.org/resourcepanel/Portals/24102/PDFs/Metals_Recycling_Rates_110412-1.pdf [hereinafter UNEP, RECYCLING RATES]; *see generally* BGRM, CRITICAL MINERALS, *supra* note 16; *see generally* USGS, 2016 MINERAL SUMMARIES, *supra* note 9.

300. *See* UNEP, RECYCLING RATES, *supra* note 299, at 22.

refunds for consumers. Rather than preparing for asteroid mining, environmentalists can focus on changing mineral usage culture.

B. Legislate and Enforce Effective Environmental Measures

1. Ensure Availability of Recourse to Compensation

States, as a legal[301] and practical requirement, must ensure availability of compensation for environmental harm. Apart from incorporating strict liability for regulatory violations and consequential environmental harm, states should create specialized funds and agencies.[302] States should establish a government fund, collected through higher taxes, royalties or fees, and penalties, and a Compensatory Restoration Board on Natural Resources that would assess damages.[303] States should additionally require contractors to procure sizeable insurance and form a trust fund for compensation to affected industries and individuals. States must remain cognizant of the values and implications of these funds. For instance, China's recent legislation setting a maximum strict liability cost for pollution at one million yuan ($154,293.21) seems too low, while BP's $20 billion trust fund in escrow as compensation for individuals and businesses affected by the Deepwater Horizon oil spill may appear too exorbitant for a developing state like PNG, whose gross domestic product is only twice that amount. States must complement punitive legislation and regulation with built-in mechanisms that ensure funding availability in the event of environmental harm.

2. Establish and Maintain Marine Spatial Planning

States should put in place sustainable marine spatial planning within their national jurisdiction. Marine spatial planning helps increase consciousness of the interconnectedness of the marine ecosystem and the diversity of marine industries, allowing states to optimize environmental and financial sustainability. As planning necessarily involves stakeholders, it also decreases future objections from certain interests

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301. 2011 ITLOS Advisory Opinion, *supra* note 153, ¶ 139.

302. *See* Michel Montjoie, *Nuclear Energy*, *in* THE LAW OF INTERNATIONAL RESPONSIBILITY 916 (James Crawford et al. eds., 2010).

303. NAT'L COMM'N ON BP DEEPWATER HORIZON OIL SPILL & OFFSHORE DRILLING, REPT. TO THE PRESIDENT, BP OIL SPILL COMMISSION, DEEP WATER: THE GULF OIL DISASTER AND THE FUTURE OF OFFSHORE DRILLING 79-80, 276-77 (2011), http://docs.lib.noaa.gov/noaa_documents/NOAA_related_docs/oil_spills/DWH_report-to-president.pdf [hereinafter DEEPWATER].

such as indigenous peoples and fishermen, and decreases regulatory issues with different government bureaus such as those involved with fisheries, environmental protection, mining, telecommunication, and oil and gas. It also facilitates creation of marine protected areas, those of high ecological importance or sensitivity, and elimination of area-wide leasing practices,[304] which impede economic diversification. Inasmuch as terrestrial mining planning engineers now plan to convert land mines into wildlife refuges, shopping malls, golf courses, airports, lakes, underground storage facilities, real estate developments, solid waste disposal areas, and other beneficial uses[305] after commercial mining; governments should also require rehabilitation efforts at sea with long-term non-mining use in mind.

3. Strengthen Regulatory Capacity

Ensuring effective laws and regulations comes at a price with which states may be unwilling and unable to comply. Forming an independent agency for DSM safety, for leasing and environmental science, and for resources revenue,[306] poses financial challenges. Even without a new agency, effective DSM regulation necessarily requires technical expertise and coordination among relevant agencies,[307] which in the case of PNG, includes the Mineral Resources Authority, Department of Commerce and Industry, Department of Mineral Policy and Geohazard Management, Conservation and Environment Protection Agency, National Fisheries Authority, and National Maritime Safety Authority. States need to devise ways to strengthen regulatory capacity without bearing the costs. They can require DSM participants to bear the costs of inspections, scientific studies, and regulation, and also to undertake joint research programs.[308] Contiguous states such as the Pacific Nations can band together to form economies of scale and scope. Together, they can appoint a regional regulator to oversee compliance[309] and an independent engineering consultant to review regulations for adequacy and "fit for purpose,"[310] and can form strategies for disaster response, planning, and capacity.[311] Similarly, states can utilize whistleblowers to increase indirect regulatory

304. *Id.* at 260.
305. HARTMAN & MUTMANSKY, *supra* note 15, at 14.
306. DEEPWATER, *supra* note 303, at 257-60.
307. *Id.* at 254-55.
308. *Id.* at 257, 264, 270.
309. SPC, REGIONAL LEGISLATIVE FRAMEWORK, *supra* note 24, at 47.
310. DEEPWATER, *supra* note 303, at 252.
311. *Id.* at 265.

oversight over DSM operators.[312] Using these cost-effective measures can improve state regulation of corporations, and at the same time, build a corporate culture of environmental consciousness.

4. Develop International Laws

ISA's adoption of Exploration Regulations is only the beginning of the long road to effective ocean governance. States must consider amending the London Protocol to include pollution from seabed activities and to ensure regulation within national jurisdiction, and putting high importance on the development of a convention on biodiversity beyond national jurisdiction, which would significantly increase the pie of activities in the Area. States must also add high seas marine protected areas to ensure sustainability of sites of natural and cultural importance.[313] Finally, states could consider building a joint trust fund similar to the International Oil Pollution Compensation Funds 1971 and 1992, which would compensate for damages to the marine environment, not otherwise compensable. Noting possible fragmentation of oceans governance, states must then ensure proper coordination of the different bodies responsible for these treaties and others.

C. Strengthen Corporate and State Accountability

DSM opponents can strengthen accountability through the help of interested parties. Apart from potential filing of a case similar to *Kasky*, based on contractors' public statements, interested parties should hold corporations accountable through the corporation's ties. They should encourage insurance companies, tasked to provide guarantees to governments for contractors' liability, and who have an interest in keeping payouts small, to band together and ensure tougher regulation of contractors. Similarly, interested states should use soft law initiatives, like the Regional Legislative and Regulatory Framework[314] and the

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312. *Id.* at 254.

313. *See* Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean pmbl., art. 2, June 10, 1995, 2102 U.N.T.S 181; OSPAR, *supra* note 246; Noumea Convention, *supra* note 157, Annex III; Protocol on Environmental Protection to the Antarctic Treaty, Oct. 4, 1991, 30 I.L.M. 1455.

314. SPC, REGIONAL LEGISLATIVE FRAMEWORK, *supra* note 24, at 9 (calls Pacific States to recognize the (1) non-renewable nature of deep-sea minerals resources and the importance of an economical and efficiently managed mining scheme; (2) importance of the sea to well-being and livelihood; (3) necessity to conserve and protect the marine and coastal environment; (4) public ownership of the resources; (5) importance of public participation in the planning, decision-

Madang Guidelines,[315] to remind DSM states of their obligations to the region and the international community. Coalescing interested parties will certainly help create an environment of corporate and state DSM accountability.

D. Incentivize Delay in Deep Seabed Mining

Developing states must also be reminded of possible incentives to delaying DSM. First, mining rents may significantly increase in the future, as demand for rare-metals increase and supply decreases. PNG's current 30% interest in Solwara 1 could significantly rise; it can increase bargaining power by being part of a regional organization.[316] Allowing DSM now could result in another lesson learned on extractive industry mismanagement—timing matters. Second, waiting may give developing States the opportunity and capability to mine the deep-sea themselves, which not only rings of nationalistic pride, but could lead to higher government profit. Finally, diversifying into other marine industries that are better studied and managed can provide developing states substantial income without risking long-term environmental and financial prospects. Waiting a few more years could better improve the developmental role of DSM.

Additional delays, however, lead to greater opportunity costs, which developing states may deem unacceptable. Studies on DSM have begun since the 1970s, and it may appear unreasonable to states to keep waiting when actual operations can improve the learning curve for when mineral supplies would have reached rock-bottom. To incentivize further delays, environmentalists may consider adopting creative market solutions such as those applied in Guyana, Sumatra, and Borneo as part of the United Nations Collaborative Programme on Reducing Emissions from

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making and conduct of DSM; and (6) potential through DSM to gather, analyze and disseminate scientific and technical data.).

315. OFFSHORE MIN. POL'Y WORKSHOP, REPORT, THE MADANG GUIDELINES: PRINCIPLES FOR THE DEVELOPMENT OF OFFSHORE MINERAL POLICIES (Dec. 1999), http://ict.sopac.org/VirLib/MR0362.pdf (The Madang Guidelines contain 19 recommendations to Pacific Island governments on how to govern offshore mineral developments. It underscores the importance of careful management of environmental impact and stakeholder interests.).

316. *Cf.* MANA SAEED AL OTAIBA, THE PETROLEUM CONCESSION AGREEMENTS OF THE UNITED ARAB EMIRATES 1939-81 (ABU DHABI) 144 (Vol. II, 1982) (For example, the Oil Concession Agreement Between the Government of Abu Dhabi and Amerada Hess Exploration Abu Dhabi Ltd, Occidental of Abu Dhabi Ltd., and Alpha Oil Corporation, Block B Concession.).

Deforestation and Forest Degradation in Developing Countries.[317] Creating investment funds to promote sustainable coastal industries can convince Pacific states to consider postponing DSM.

The inevitability of DSM in the future calls for elevation of the DSM discourse. Breaking down assumptions by DSM proponents and critics paves way for solutions to improving state and DSM contractor accountability, intensifying consumer awareness of the mineral supply problem, and ensuring long-term supply of minerals, particularly those critical to emerging technology. As marine mining moves into the abyss, environmentalists and other affected individuals could address their respective concerns better by working with, not against, DSM states and mining companies.

317. Rhett Butler, *As Rain Forests Disappear, A Market Solution Emerges*, YALE: ENVIR. 360 (Dec. 11, 2008), http://e360.yale.edu/feature/as_rain_forests_disappear_a_market_solution_emerges/2097/.