

# Ocean Dumping and Fertilization in the Antarctic: Tangled Legal Currents, Sea of Challenges

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**ABSTRACT.** The law and policy framework governing potential ocean disposals in the Antarctic is surveyed using two nautical images. First, the “tangle of legal currents” is described with a focus on six global agreements relevant to ocean dumping and the 1991 Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol). The Madrid Protocol strictly controls the disposal of wastes generated in the Antarctic region through various removal obligations. Second, the “sea of challenges” surrounding effective control of ocean dumping is highlighted. Those challenges include ensuring full adoption and implementation of international agreements relevant to ocean dumping, getting an effective governance grip on ocean fertilization projects, and securing strong compliance with the two key global agreements targeting ocean dumping, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention) and the 1996 Protocol to the London Convention.

## INTRODUCTION

Two nautical images help capture the international governance of potential ocean dumping and ocean fertilization activities in the Antarctic. First is “tangled legal currents.” A complex mix of global and regional agreements may interact to control ocean disposals in the Southern Ocean. Second is a “sea of challenges.” Effective control of ocean dumping faces numerous constraints, including ensuring full adoption and implementation by states of key international agreements, getting a firm international grip on ocean fertilization projects, and securing compliance with ocean-dumping-related instruments.

A two-part “cruise” follows. The tangle of international agreements addressing ocean dumping is first surveyed, followed by a tour of three major challenges being faced in implementation practice. A particular focus is given to the law and policy challenges raised by proposed ocean fertilization experiments in the Southern Ocean. Does ocean fertilization constitute dumping? What international law and policy responses have occurred? What can be learned from a recent ocean fertilization experiment in the Atlantic sector of the Southern Ocean, the LOHAFEX experiment<sup>1</sup>, led by the Alfred Wegener Institute for Polar and Marine Research?

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## TANGLED LEGAL CURRENTS

The tangle of international legal currents relevant to potential ocean disposals in the Southern Ocean involves six global and two regional agreements. At the global level, the 1982 UN Law of the Sea Convention<sup>2</sup> might be viewed as a major foundational “undercurrent,” and two agreements, the 1972 London (Dumping) Convention<sup>3</sup> and the 1996 Protocol to the London Convention,<sup>4</sup> might be described as the “mainstreams” for ocean dumping control. Three other global agreements might be characterized as “side currents” as they more tangentially address potential ocean disposals. Those agreements are the Convention on Biological Diversity (1992),<sup>5</sup> the Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal (1989),<sup>6</sup> and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997).<sup>7</sup> Two “regional gyres” complete the regulatory current picture, namely, the Antarctic Treaty (1959)<sup>8</sup> and the Madrid Protocol on Environmental Protection to the Antarctic Treaty (1991).<sup>9</sup> A synopsis of these key global and regional agreements follows. This paper does not address the regulation of discharges from ships, such as sewage and garbage, covered by the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) (IMO, 2006).

### SIX KEY GLOBAL AGREEMENTS

#### *The Major “Undercurrent”*

The 1982 UN Law of the Sea Convention (LOSC) sets out various general marine environmental protection responsibilities of states, e.g., the obligation to protect and preserve the marine environment (Article 192) and the duty to minimize the release of toxic, harmful, or noxious substances into the marine environment (Article 194, paragraph 3(a)). The LOSC also provides environmental impact assessment (EIA) requirements such as undertaking EIAs for planned activities under the jurisdiction or control of states that may cause substantial pollution or significant and harmful changes to the marine environment (Article 206) and reporting of results (Article 205). The LOSC specifically targets ocean dumping (Article 210) by requiring states to adopt national ocean dumping laws no less effective than global standards, urging states to establish global and regional rules/standards for controlling pollution by dumping and mandating the express prior consent of the coastal state for any dumping within national zones of jurisdiction

A major potential limitation in the control of potential ocean dumping off the Antarctic continent is the lack of generally recognized coastal states with authority to legislate and enforce national laws against foreign vessels (Vigni, 2001) that might engage in ocean disposals. A sector of the Antarctic remains unclaimed (Watts, 1992). The historic territorial claims by seven states (Argentina, Australia, Chile, France, New Zealand, Norway, and the United Kingdom) remain “frozen” pursuant to Article 4 of the Antarctic Treaty (Gautier, 1992; Joyner, 1992, 1998), and thus, flag state not coastal state jurisdiction stands as the prime means of legal control (Zovko, 2007).

#### *“Mainstreams”*

The 1972 London Convention represents a permissive approach to ocean dumping (VanderZwaag and Daniel, 2009). Almost anything can be dumped at sea if a permit is granted by a state party. General permits for most types of waste are covered in Annex III of the convention, which sets out various factors decision makers must carefully consider before issuing a permit, such as characteristics of the waste (e.g., toxicity, persistence, oxygen demand, and nutrients) and characteristics of the dumping site and method of deposit (e.g., distance from the coast and resource exploitation areas, dispersal potentialities, and existing pollutant loads). General considerations include possible effects on marine living resources, possible effects on other uses of the sea (such as fishing, shipping, and marine conservation areas), and practical availability of alternative land-based methods of disposal or treatment. Special permits may be granted for Annex II–listed wastes (the “grey list”) which include, for example, wastes containing arsenic, chromium, copper, lead, nickel, zinc, cyanides, and fluorides, but particular care in disposal must be taken. Only a limited prohibited list of wastes are listed in Annex I where ocean dumping is generally not allowed: organohalogen compounds, mercury and mercury compounds, cadmium and cadmium compounds, persistent plastics, crude oil and its wastes, radioactive wastes, biological and chemical warfare materials, industrial waste, and incineration at sea of industrial waste and sewage sludge.

The 1996 Protocol to the London Convention shifts toward a precautionary approach (VanderZwaag and Daniel, 2009). The protocol explicitly recognizes the need for a precautionary approach in Article 3, paragraph 1: “In implementing this Protocol, Contracting Parties shall apply a precautionary approach to environmental protection from dumping of wastes or other matter whereby appropriate preventative measures are taken when there is

reason to believe that wastes or other matter introduced into the marine environment are likely to cause harm even where there is no conclusive evidence to prove a causal relation between impacts and their effects.”

The protocol also adopts a “reverse listing” approach where listing favours the environment and is precautionary. Nothing can be dumped unless it is listed on a “safe list,” i.e., dredged material; sewage sludge; fish wastes; vessels and platforms or other man-made structures; inert, inorganic geological material; organic materials of natural origin; and bulky items primarily comprising iron, steel, concrete, and similarly unharmed materials for which concern is physical impact (limited to where wastes are generated at locations having no practicable access to disposal options other than dumping). Sequestration of carbon dioxide under the seabed has also been added to the “safe list” through an amendment adopted 2 November 2006 and in force 10 February 2007.

Even for wastes on the safe list, Annex 2 of the protocol further encourages a precautionary approach through the permitting process (de La Fayette, 1998). The permitting authority is encouraged to require ocean dumping applicants to undertake waste prevention audits, i.e., whether waste reduction or prevention at source is feasible, for example, through product reformulation or clean production technologies. If so, applicants should be required to formulate a waste prevention strategy, and waste reduction and prevention requirements should be included as permit conditions. The permitting authority is obligated to refuse issuing a permit if appropriate opportunities exist to reuse, recycle, or treat the waste without undue risks to human health or the environment or disproportionate costs. The permitting authority is also urged to deny an ocean dumping permit if an environmental assessment does not include adequate information to determine the likely effects of the proposed disposal.

#### “Side Currents”

The 1992 Convention on Biological Diversity (CBD), although not dealing directly with ocean dumping, might be described as “side venue” on various counts. The convention may be relevant to EIA of proposed ocean disposal activities as the convention requires parties to ensure their EIA procedures address project impacts on biological diversity with a view to avoiding or minimizing significant adverse effects (Article 14, paragraph 1(a)). Voluntary guidelines on biodiversity-inclusive impact assessment have been developed (CBD, 2006), and further guidance for the implementation of EIA for activities that may have

significant impacts on marine biological diversity beyond national jurisdiction was provided through an Expert Workshop on Scientific and Technical Aspects Relevant to EIA in Areas Beyond National Jurisdiction held in November 2009 (CBD, 2009). The convention has also become a forum discussing the scientific and governance challenges posed by ocean fertilization projects. A *Scientific Synthesis of the Impacts of Ocean Fertilization on Marine Biodiversity* was published in 2009 (Secretariat of the Convention on Biological Diversity, 2009), and the Conference of the Parties has advocated a precautionary approach be taken toward proposed ocean fertilization activities, as discussed further below.

The 1989 Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal prohibits the export of hazardous wastes for disposal within the area south of 60°S latitude (Article 4, paragraph 6). The convention leaves implementation of the prohibition to each party through national legislation.

The 1997 Joint Convention on the Safety of Spent Nuclear Fuel Management and on the Safety of Radioactive Waste Management represents a parallel current to the Basel Convention, but with a focus on preventing the disposal of radioactive wastes in the Antarctic. Article 27, paragraph 2, of the convention requires contracting parties not to licence the shipment of spent fuel or radioactive waste to a destination south of latitude 60°S for storage or disposal.

#### REGIONAL GYRES

The 1959 Antarctic Treaty, which mainly encourages scientific cooperation, is relevant to potential ocean dumping in two main ways. Article V prohibits radioactive waste disposal in the area south of 60°S latitude. Article VII, paragraph 5, requires each contracting party to give notice to other contracting parties of all proposed expeditions to and within Antarctica on the part of ships or nationals. This provision could cover future proposed ocean disposal activities, such as ocean fertilization, a topic further discussed below.

The 1991 Madrid Protocol on Environmental Protection to the Antarctic Treaty contains three main “legal eddies” relevant to ocean disposal. First, Annex III specifically addresses wastes generated in the Antarctic in four main ways (minimization, removal, disposal, and planning requirements). The protocol urges minimizing the amount of wastes produced in the Antarctic as far as practicable (Article 1, paragraph 2). Article 2, paragraph 1, requires the removal of many generated wastes.

Generators of many wastes produced after entry into force of the annex must remove them from the Antarctic Treaty area, e.g., radioactive materials; electrical batteries; fuels; wastes with harmful levels of heavy metals or acutely toxic compounds; various products that could produce harmful emissions if incinerated such as rubber, lubricating oils, treated timbers, and polyvinyl chloride materials; plastic wastes; and fuel drums and other solid, noncombustible wastes (unless greater adverse environmental impacts would result than leaving them in their existing locations). Article 3, paragraph 1, imposes disposal obligations by incineration for combustible wastes, other than those wastes listed in Article 2, paragraph 1 (such as plastics, batteries, rubber, and treated timbers), not removed from the Antarctic. Solid residues of incineration also must be removed from the treaty area. Sea disposal of sewage and domestic liquid wastes is allowed subject to various conditions (Article 5): taking into account the assimilative capacity of the receiving environment, locating discharge areas where rapid dispersal occurs, and treating large quantities of waste (generated in stations having an average weekly occupancy over the austral summer of approximately 30 individuals or more) at least by maceration. The protocol further mandates parties carrying out activities in the Antarctic Treaty area to prepare waste management plans (Article 8) to be annually reviewed and updated and shared with other parties and sent to the Committee for Environmental Protection, which may review and offer comments (Article 9).

A second eddy is stirred by Article 3 of the protocol, which sets out principles to be followed for proposed activities in the Antarctic (which could include ocean disposals). Activities should avoid significant adverse effects on air or water quality, avoid further jeopardy to endangered or threatened species, and be based on sufficient information for prior environmental impact assessment.

The third eddy is the establishment of three levels of EIA for activities in the treaty area (Article 8 and Annex I). Those levels are preliminary assessment (if an activity is determined to have less than a minor or transitory impact it may proceed), initial environmental evaluation (IEE; if an activity is determined as likely to have a minor or transitory impact), and comprehensive environmental evaluation (CEE; if an IEE indicates the potential for more than a minor or transitory impact or that determination is otherwise made). The draft CEE is subject to review/comment through the Committee for Environmental Protection and Antarctic Treaty Consultative Meeting (ATCM). The final CEE must address comments received.

## SEA OF CHALLENGES

An array of challenges surrounds the governance of ocean dumping. Three major challenges are highlighted below: ensuring full adaption of key international agreements relevant to ocean dumping, getting a firm legal grip on ocean fertilization projects, and securing compliance with ocean dumping related treaty obligations. Other constraints beyond the scope of this paper but discussed elsewhere (VanderZwaag and Daniel, 2009) include keeping up with the numerous guidelines surrounding ocean dumping, sorting out the boundaries of the London Convention/Protocol with other international agreements, such as MARPOL 73/78, providing adequate financial and technical assistance, addressing liability and compensation, and ensuring adequate enforcement.

### ENSURING FULL ADOPTION OF KEY INTERNATIONAL AGREEMENTS

An ongoing concern in relation to potential ocean disposals in the Southern Ocean is the limited adoption by states of the key global and regional agreements aimed at preventing and controlling ocean dumping activities. As of 31 October 2009 there were only 86 parties to the 1972 London Convention, comprising 67.09% of world tonnage, and only 37 parties to the 1996 Protocol to the London Convention (hereafter referred to as the 1996 Protocol), comprising 32.22% of world tonnage.<sup>10</sup> There are limited parties (47) to the Antarctic Treaty (28 consultative and 19 nonconsultative), and only 34 parties to the Madrid Protocol.<sup>11</sup>

Thus, the window remains open for vessels not flagged by state parties to the relevant conventions to sidestep the various legal obligations. The effectiveness of the Antarctic Treaty System in light of vessels flagged to nonparties has been especially worrisome in relation to tourist vessels (New Zealand, 2007), but the range of concerns is much broader than tourism activities and could extend to ocean dumping.

### GETTING A FIRM INTERNATIONAL LEGAL GRIP ON OCEAN FERTILIZATION PROJECTS

The international control of proposed ocean fertilization projects, exemplified by adding iron to increase phytoplankton blooms and the fixation of CO<sub>2</sub> from the atmosphere, might be described as slippery. Controversy has arisen over application of the ocean dumping regime

to ocean fertilization projects with considerable fragmentation and uncertainties in international responses to date (Sagarin et al., 2007; Freestone and Rayfuse, 2008; Rayfuse et al., 2008). The limited international “grip” is exemplified by the 2009 LOHAFEX ocean fertilization experiment in the Atlantic sector of the Southern Ocean.

A first slippery aspect is how proposed ocean fertilization activities relate to the two global ocean dumping agreements. Differing views have emerged over whether ocean fertilization projects constitute ocean dumping as defined in the 1972 London Convention and 1996 Protocol as “any deliberate disposal at [into the] sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea.” “Yes” views argue iron does constitute dumping as the “iron matter” is deposited deliberately and is abandoned, whereas “no” views posit that deliberate iron deposits are not undertaken for disposal purposes but for constructive purposes such as marine scientific research (IMO, 2008a, 2008b).

Perspectives have also differed on whether ocean fertilization projects might fall under a major exception found in both 1972 London Convention and the 1996 Protocol as “‘dumping’ does not include . . . placement of matter for a [the] purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of this convention [protocol].” Disagreements exist over whether ocean fertilizations are placements (with a possible restricted meaning of placing with the ability to retrieve), and a lack of clarity surrounds what placements would be contrary to the aims of the convention (IMO, 2008a, 2008b).

Even if ocean fertilization is deemed subject to the ocean dumping regime, questions of prohibition or permitting requirements arise. Under the 1972 London Convention, could iron be an industrial waste listed on Annex 1 and thus be prohibited from disposal at sea? Or would the special or general permitting requirement apply? Under the 1996 Protocol, is iron an inert, inorganic, geological material that is allowed to be dumped? The fact that adding iron to marine waters is meant to catalyze growth of phytoplankton supports a conclusion against inertness (IMO, 2008c).<sup>12</sup>

A second slippery aspect is the considerable fragmentation and uncertainties in international responses to ocean fertilization proposals to date. A fragmented array of international bodies/institutions have offered statements/decisions regarding ocean fertilization, e.g., the Conference of the Parties to the CBD at their ninth meeting, scientific groups and meetings of the parties to the

London Convention and 1996 Protocol, the International Oceanographic Commission ad hoc Consultative Group on Ocean Fertilization, and the Intergovernmental Panel on Climate Change (IMO, 2008e).

Considerable uncertainties remain in the wake of two of the most important international pronouncements/processes. In 2008 the Ninth Conference of the Parties to the CBD adopted Decision IX/16 on biodiversity and climate change, which urged parties and other governments to adopt a precautionary approach to ocean fertilization. The text called upon parties and other governments:

[I]n accordance with the precautionary approach, to ensure that ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, including assessing associated risks, and a global, transparent and effective control and regulatory mechanism is in place for these activities; with the exception of *small scale scientific research studies within coastal waters*. Such studies should only be authorized if justified by the need to gather specific scientific data, and should also be subject to a thorough prior assessment of the potential impacts of the research studies on the marine environment, and be strictly controlled, and not be used for generating and selling carbon offsets or any other commercial purposes. (emphasis added)<sup>13</sup>

The text left major questions outstanding regarding what ocean fertilization projects were allowable. What are small-scale scientific studies? What are coastal waters?

Key uncertainties also surround the numerous efforts to address ocean fertilization under the London Convention and 1996 Protocol. In June 2007, the Scientific Groups to the London Convention and Protocol issued a statement of concern regarding iron fertilization to sequester CO<sub>2</sub> and took the view that knowledge about the effectiveness and potential environmental impacts of ocean fertilization currently was insufficient to justify large-scale operations (IMO, 2007a). The statement of concern, subsequently endorsed by the governing bodies at their meeting in November 2007 (IMO, 2007b), was not clear regarding what would constitute “large-scale operations.”

In October 2008, the governing bodies issued Resolution LC-LP.1 on the “Regulation of Ocean Fertilization,” which also raised various uncertainties. The parties agreed that in order to provide for legitimate scientific research, such research should be regarded as placement of matter for a purpose other than mere disposal thereof; scientific research proposals should be assessed on a case-by-case basis using an assessment framework to be developed by

the scientific groups; until specific assessment guidance is available, parties should be urged to use utmost caution and the best available guidance to evaluate scientific research proposals to ensure marine environmental protection consistent with the convention/protocol; and given the present state of knowledge, ocean fertilization activities other than legitimate scientific research should not be allowed and such other activities should be considered as contrary to the aims of the convention/protocol (IMO, 2008d).

What precisely constitutes legitimate scientific research remained hazy. This was especially the case since the “assessment framework for scientific research involving ocean fertilization” had yet to be finalized.

The Intersessional Legal and Related Issues Working Group on Ocean Fertilization, established in 2008, developed at its meeting in February 2009 eight decision options for further addressing ocean fertilization (IMO, 2009a). Options ran from nonbinding (e.g., a further statement concern or resolution) to binding (e.g., a stand-alone article on ocean fertilization or an amendment of Annex I to the 1996 Protocol). Australia and New Zealand considered the simplest and most effective way of regulating legitimate scientific research involving ocean fertilization would be to add a new paragraph to Annex I (the global safe list): “material or substances for which the principal intention is ocean fertilization for legitimate scientific research” (IMO, 2009b). At the time of writing, there was no consensus yet on the best option, and the Intersessional Working Group on Ocean Fertilization was tasked with continuing the discussions with a meeting proposed for March 2010 (IMO, 2009c).

The limited “international grip” reality is exemplified by the 2009 LOHAFEX experiment, the joint iron fertilization experiment carried out in January–March 2009 by the Alfred Wegener Institute for Polar and Marine Research (AWI) and the National Institute of Oceanography (India). Approximately 6 tonnes of dissolved iron were applied to a 300 km<sup>2</sup> area outside the Antarctic Treaty area in an eddy around 48°S, 16°W (AWI, 2009a). Considerable criticisms emanated from environmental nongovernmental organizations as an alleged violation of the CBD’s moratorium (only small-scale scientific research studies in coastal waters allowed). No international EIA process was applicable. The project fell outside the Madrid Protocol’s EIA provisions since it took place outside the Antarctic Treaty area. A scientific risk assessment was conducted by AWI and the National Institute of Oceanography (AWI, 2009b), and on behalf of the Federal Ministry of Education and Science (Germany) further reviews of the risk

assessment were solicited from various institutions (including from the British Antarctic Survey, University of Heidelberg, and University of Kiel).<sup>14</sup> The risk assessment interpreted the CBD criteria broadly. The project was a spatial small-scale experiment covering just 300 km<sup>2</sup> compared to the 50 million km<sup>2</sup> covered by the Antarctic Circumpolar Current and involved coastal waters as coastal plankton species inhabit the offshore fertilized waters (AWI, 2009b).

#### SECURING COMPLIANCE

One of the greatest compliance challenges is the failure by many parties to the London Convention and the 1996 Protocol to report on the nature and quantity of wastes permitted to be dumped at sea (as required by Article VI, paragraph 4, of the convention and Article 9, paragraph 4, of the protocol). For 2007 (latest year for which annual reporting was available) only 35 contracting parties provided a national report, and 53 contracting parties did not report (IMO, 2009d). Thirty-three contracting parties had not submitted reports in the last five years (IMO, 2009e)!

It remains to be seen how effectively a Compliance Group, established in 2007, will facilitate compliance with reporting requirements. The Compliance Group’s questionnaire asking parties to explain reasons for not reporting received only 18 protocol parties’ responses, and only two convention parties answered (IMO, 2009f). The Compliance Group, at its second meeting in October 2009, recommended as a first step establishing or reestablishing contact with parties not reporting and suggested as a second step developing a comprehensive database on parties having national implementing legislation in order to ascertain whether national permitting requirements exist for which reporting would be mandatory (IMO, 2009f). The Compliance Group has authority to address noncompliance by individual parties, but the noncompliance procedure has not been invoked yet.

#### CONCLUSION

Ocean dumping in the Southern Ocean from outside the region is not reportedly occurring.<sup>15</sup> This is likely for two main reasons: preference by disposers to dispose of wastes in areas within national 200 nautical mile zones because of cost savings and hazardous and radioactive waste export prohibitions to the Antarctic Treaty area pursuant to the Basel Convention and Joint Convention

on Spent Nuclear Fuel and Radioactive Waste Management, respectively.

The Madrid Protocol has substantially curtailed the ocean disposal of wastes generated within the Antarctic region with the exception of sewage and domestic liquid wastes. Although the protocol requires cleanups of waste sites located on land (Article 1, paragraph 5), the protocol does not impose a parallel requirement to address past dumping of wastes in the ocean. Thus, the need to clean up historical offshore dumping sites could become a future issue.<sup>16</sup>

The greatest challenge on the law and policy horizon relating to ocean dumping appears to be possible future ocean fertilization experiments in the Antarctic region. Six iron enrichment experiments have already occurred in the Southern Ocean (Strong et al., 2009), and potential negative effects of large-scale fertilizations, such as creating anoxic regions, altering marine food webs, and increasing ocean acidity, remain a concern (Cullen and Boyd, 2008; Denman, 2008) as does the potential for substantial nitrous oxide production (Law, 2008). Although considerable uncertainty surrounds the future scale and numbers of ocean fertilization initiatives, in light of experiments like LOHAFEX, where carbon sequestration was smaller than expected, and because of the serious difficulty in verifying net greenhouse gas reduction (Strong et al., 2009), one thing is certain. Getting a firm international governance grip on ocean fertilization proposals remains an “unfinished voyage.”

## NOTES

1. “LOHA” is the Hindi word for iron, and “FEX” refers to fertilization experiment.
2. “United Nations Convention on the Law of the Sea,” 10 December 1982, 21 *International Legal Materials* (ILM) 1261.
3. “Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter,” 29 December 1972, 11 ILM 1291.
4. “Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter,” 7 November 1996, 36 ILM 1 (1997).
5. “Convention on Biological Diversity,” 5 June 1992, 31 ILM 818.
6. “Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal,” 22 March 1989, <http://www.basel.int/text/documents.html> (accessed 27 November 2009).
7. “Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management,” 29 September 1997, International Atomic Energy Agency INFCIRC/546 (24 December 1997).
8. “Antarctic Treaty,” 1 December 1959, 402 *United Nations Treaty Series* 71.
9. “Protocol on Environmental Protection to the Antarctic Treaty,” 4 October 1991, 30 ILM 1455.

10. IMO, “Summary of Status of Conventions,” [http://www.imo.org/Conventions/mainframe.asp?topic\\_id=247](http://www.imo.org/Conventions/mainframe.asp?topic_id=247) (accessed 20 November 2009).

11. Secretariat of the Antarctic Treaty, “Parties,” [http://www.ats.aq/devAS/ats\\_parties.aspx?lang=e](http://www.ats.aq/devAS/ats_parties.aspx?lang=e) (accessed 8 November 2009).

12. “Revised Specific Guidelines for the Assessment of Inert, Inorganic Geological Material,” adopted in 2008, further clarify that the term “inert” is intended to ensure that the only impacts of concern following dumping are restricted to physical effects (IMO, 2008d: Annex 4).

13. Convention on Biological Diversity, “COP 9 Decisions,” Decision IX/16, Section c(4), <http://www.cbd.int/decisions/cop/?m=cop-09> (accessed 27 November 2009).

14. The reviews are on the AWI Web site, [http://www.awi.de/en/news/selected\\_news/2009/lohafex/experiment](http://www.awi.de/en/news/selected_news/2009/lohafex/experiment) (accessed 27 November 2009).

15. For example, ocean dumping activities reported by contracting parties for the year 2006 overwhelmingly constituted dredged materials, which were disposed of in coastal waters, and no dumping permits were reported as issued for the Southern Ocean. See IMO, Final draft summary report on dumping permits issued in 2006, Report LC 31/INF.3 London: IMO, 2009.

16. An example of a marine area being subject to at least limited past ocean disposals and contamination by heavy metals from a land-based disposal site is provided by Brown Bay near Australia’s Casey Station. See “Initial Environmental Evaluation for Clean-up of Thala Valley Waste Disposal Site at Casey Station, Antarctica (2003),” [http://www.ats.aq/documents/EIA/7041enThala%20Valley%20IEE\(2003\).pdf](http://www.ats.aq/documents/EIA/7041enThala%20Valley%20IEE(2003).pdf) (accessed 27 November 2009).

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