

Reprinted from

**natural
resources
journal**

**the university of new mexico
school of law**

PORTER HOAGLAND III*

The Conservation and Disposal of Ocean Hard Minerals: A Comparison of Ocean Mining Codes in the United States**

ABSTRACT

We compare and contrast existing and proposed ocean mining codes in the United States in the context of current efforts to establish disparate systems to dispose of ocean hard minerals. Broad public policy goals and specific "core" provisions relating to access, revenue generation, performance requirements, and information management are considered as they influence public ocean mineral disposal. To aid in understanding the relationship between "disposal" and "economic conservation," we separate uncertainty into legal and geologic components, distinguish managerial discretion from management flexibility, identify the potential for preferential treatment of ocean hard mineral development, and describe the advantages of a uniform method for public mineral disposal. For ocean hard minerals, attempts to achieve specified policy goals through their disposal could supplant a goal of economic conservation.

INTRODUCTION

In 1983, an Office of Strategic and International Minerals was created within the Minerals Management Service (MMS) of the U.S. Department of the Interior.¹ The mission of this new office has been to encourage the exploration and development of ocean hard mineral resources² on the

*Research Associate, Marine Policy Center, Woods Hole Oceanographic Institution. B.S. 1977, Hobart College; M.M.P. 1982, College of Marine Studies, Univ. of Delaware.

**Research supported by the Pew Charitable Trusts, the Marine Policy Center of the Woods Hole Oceanographic Institution (WHOI), and with funds from the Department of Commerce, NOAA, National Sea Grant College Program under grant Nos. NA84-AA-D-00033 and NA86-AA-D-SG090 (WHOI project Nos. R/G-9 and R/S-9). The author gratefully acknowledges the careful readings and encouragement provided by Jim Broadus and the comments and suggestions received on earlier drafts from Scott Farrow and Andy Solow. The views expressed here are those of the author and do not necessarily represent the positions of either WHOI or the sponsoring organizations. The author accepts full responsibility for any shortcomings. WHOI Contribution No. 6714.

1. John B. Smith, Buford R. Holt, and Robert G. Paul, Current Status of Leasing Proposals for the U.S. Exclusive Economic Zone, 17 Offsh. Tech. Conf. 9 (1985).

2. We use the term "ocean hard minerals" here to mean "minerals other than oil, gas and sulphur" as defined in the Outer Continental Shelf Lands Act (OCSLA), 43 U.S.C. § 1337(k) (1982). The U.S. Department of the Interior has estimated that about 88 types of ocean hard minerals may be

United States outer Continental Shelf (OCS)³ and to develop a program for leasing these minerals within the ambit of the Outer Continental Shelf Lands Act (OCSLA),⁴ an ocean mining code.⁵ As preliminary steps toward accomplishing this mission, MMS already has released three environmental impact statements (EISs), one final⁶ and two draft,⁷ that consider the environmental effects of the leasing of OCS lands for these minerals. Using the advice of an interagency task force, MMS has begun to construct regulations to carry out the provisions of the relatively nonspecific paragraph in OCSLA referring to ocean hard minerals.⁸ These regulations will sculpt a competitive leasing system, possibly modified by inventive provisions to reduce the perceived size of "upfront" payments.⁹

Irrespective of their economic potential,¹⁰ interest in the public policy

of commercial interest. U.S. Department of the Interior, Geological Survey, A National Program for the Assessment and Development of the Mineral Resources of the U.S. Exclusive Economic Zone 269 (1983) "USGS Symposium". The 88 minerals are essentially those commodities that are recovered from onshore deposits worldwide and that are analyzed annually by the U.S. Bureau of Mines in its Mineral Commodity Summaries series. Careful analysis suggests that near term ocean hard mineral prospects may be limited to only a few of these 88. See note 10.

3. Smith, Holt & Paul, 17 Offsh. Tech. Conf. at 9 (cited in note 1).

4. OCSLA, 43 U.S.C. §§ 1331-1356 (1982).

5. For a definition of the term "ocean mining code," see notes 37-49 and accompanying text.

6. U.S. Dept. of the Interior, Minerals Management Service, Final Environmental Impact Statement Proposed Arctic Sand and Gravel Lease Sale (1983) ("Sand and Gravel FEIS").

7. U.S. Dept. of the Interior, Minerals Management Service, Draft Environmental Impact Statement Proposed Polymetallic Sulfide Minerals Lease Offering, Gorda Ridge Area, Offshore Oregon and Northern California (1983) ("Gorda Ridge DEIS"). U.S. Dept. of the Interior, Minerals Management Service, Draft Environmental Impact Statement Proposed Marine Mineral Lease Sale in the Hawaiian Archipelago and Johnston Island Exclusive Economic Zones (1987) ("Cobalt Crust DEIS").

8. OCSLA, 43 U.S.C. § 1337(k) (1982). The interagency task force is chaired by an official from the Minerals Management Service's (MMS) Office of Strategic and International Minerals (OSIM) and has included participation from several other offices within MMS, as well as representatives from the U.S. Geological Survey, the U.S. Bureau of Land Management, the U.S. Bureau of Mines, the Interior Solicitor's Office, the National Oceanic and Atmospheric Administration's (NOAA) Office of Ocean Minerals and Energy (OME), and the U.S. Army Corps of Engineers. U.S. Dept. of the Interior, Minerals Management Service, Briefing Book: OCS Marine Mining (1987).

9. Reid T. Stone and Timothy J. MacGillvray, Economic Assessment and Review of the U.S. Exclusive Economic Zone, 4 Circum-Pacific Energy and Min. Conf. (Aug. 1986) (forthcoming). "Upfront payments" are defined here as payments, such as bonuses, made by private firms to obtain rights to explore for and potentially to exploit hard minerals. These payments are made in advance of production and may be made in advance of detailed knowledge concerning the commercial feasibility of a mineral deposit. See notes 164-185 and accompanying text.

10. In the United States, actual experience in the mining of ocean hard minerals has been limited. Within the jurisdiction of coastal states, either internal waters or the territorial sea (43 U.S.C. § 1301(a)(2) (1982); 43 U.S.C. § 1312 (1982)), small dredging operations for construction aggregate, such as sand and gravel or shell, occur locally. S.J. DeGroot, Marine Sand and Gravel Extraction in the North Atlantic and Its Potential Environmental Impact, with Emphasis on the North Sea, 10 Ocean Mgmt. 21 (1986). More exotic minerals, like lode barite and gold placers, have been recovered off the coast of Alaska. Raymond M. Thompson and Kenneth G. Smith, Undersea Lode Mining in Alaska, 2 Proc. Offsh. Tech. Conf. (1970) (barite mining) and Ken Wells, On Ship Off Alaska, All that Glitters is Gold from Sea Floor, Wall Street Journal 1 (Sept. 18, 1987) (gold mining). See also

issues that pertain to ocean hard minerals has swelled recently, as evidenced by the commissioning of federal-level studies¹¹ and the holding of congressional hearings by two subcommittees in the U.S. House of Representatives.¹² In 1986, the Marine Policy Center of the Woods Hole Oceanographic Institution organized and moderated a series of discussions concerning the design of an appropriate management system for ocean

U.S. Dept. of the Interior, Geological Survey, Program Feasibility Document: OCS Hard Mineral Leasing 22 (1979) and H.R. 5464 Hearings (cited in note 12) (prepared statement of William Bettenberg, Director, Minerals Management Service). Precious coral (a gemstone derived from marine fauna) is recovered off Hawaii. (Because of its biogenesis, precious coral, a form of calcium carbonate, is considered a renewable resource, and its production is considered a "fishery.") See generally Richard W. Grigg, Economics and Future Development of the Precious Coral Fishery in the Pacific (Chennat Gopalakrishnan, ed.), *The Emerging Marine Economy of the Pacific* (1984). By permission of the Interior Department, some prospecting efforts for ferromanganese nodules and encrustations, titaniferous sands, phosphorites, and carbonate sands have been mounted off both the Atlantic and Pacific coasts on the federal OCS. See note 112 for a list of permits. Additionally, several U.S. companies have been involved in prospecting, exploration, and research and development (R&D) activities concerning deep seabed manganese nodules. James M. Broadus, *Asian Pacific Marine Minerals and Industry Structure*, 3 *J. Mar. Res. Econ.* 63 (1986). To date, however, no large scale commercial recovery of hard minerals by U.S. citizens has occurred from the OCS or the deep seabed. Broadus reviews the markets and development activities surrounding some "seabed materials" including: crude oil; natural gas; sand and gravel; calcium carbonate and shell; phosphorites; heavy mineral placers, such as gold, platinum, titanium sands and associated minerals such as monazite (source of thorium, yttrium, and rare earths), zirconium and hafnium; massive sulfides containing zinc and copper; and ferromanganese deposits such as nodules and crusts, containing nickel, cobalt, copper, and manganese. James M. Broadus, *Seabed Materials*, 235 *Sci.* 853 (1987).

11. These ongoing and completed studies include: U.S. Dept. of the Interior, Bureau of Mines, *An Economic Reconnaissance of Selected Heavy Mineral Placer Deposits in the U.S. Exclusive Economic Zone* (1987) and U.S. Dept. of the Interior, Bureau of Mines, *An Economic Reconnaissance of Selected Sand and Gravel Deposits in the U.S. Exclusive Economic Zone* (1987) conducted at the request of the Director of the Minerals Management Service; U.S. Congress, Office of Technology Assessment (OTA), *Marine Mining: Exploring Our Nation's Ocean Frontier* (1987), conducted at the request of the House Committees on Merchant Marine and Fisheries and Science and Technology; National Research Council, Marine Board, Committee on Technology Requirements for the Exclusive Economic Zone (EEZ) Utilization, (1986-87), established at the request of the Geological Survey (the results of this study were not published but were incorporated into a Marine Board study of broader scope concerning Seabed Utilization in the Exclusive Economic Zone (1987 to present) ("EEZ Utilization Draft"); U.S. National Strategic Materials and Minerals Program Advisory Committee (Mott Committee), examination of EEZ minerals as a subset of its responsibilities as requested by the Secretary of the Interior; U.S. National Advisory Committee on Oceans and Atmosphere (NACOA), *Marine Minerals: An Alternative Mineral Supply* (1983) and *The Need for a National Plan of Scientific Exploration for the Exclusive Economic Zone* (1986). An additional NACOA report, which was to be directed at issues arising from the superimposition of the EEZ on existing jurisdictions, was not completed due to the disbanding of NACOA in the autumn of 1986.

12. *The Ocean and the Future*, Serial No. 99-18, Hearings Before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, 99th Cong., 1st Sess. (1986) ("The Ocean and the Future"); Exclusive Economic Zone Hearing: (unpublished hearings before the Subcomm. on Panama Canal and Outer Continental Shelf of the House Comm. on Merchant Marine and Fisheries), 99th Cong., 2d sess. (1986) ("EEZ Hearings"); H.R. 5464—The National Seabed Hard Minerals Act (unpublished Hearings Before the Subcomm. on Panama Canal and Outer Continental Shelf of the House Comm. on Merchant Marine and Fisheries), 99th Cong., 2d sess. (1986) ("H.R. 5464 Hearings").

hard minerals found in the U.S. Exclusive Economic Zone (EEZ).¹³ Held in Washington, D.C., the discussions brought together a diverse group of participants including industrial interests, environmental and public interest organizations, and representatives of coastal states.¹⁴ Invited presentations by high-level administrative officials were included in the discussions and congressional staff aides attended as observers.¹⁵ Apart from the Marine Policy Center, which acted as a disinterested facilitator of the discussions, the other participants agreed that the existing framework for the conservation and disposal of ocean hard minerals in the EEZ was inappropriate.¹⁶

A consensus was reached by these participants on ten "concepts"¹⁷ that resemble provisions later incorporated into a bill, the National Seabed Hard Minerals Act (NSHMA), introduced during the second session of the 99th Congress.¹⁸ Beyond preliminary hearings, no legislative action was taken, but the bill was reintroduced, unchanged, during the first session of the 100th Congress.¹⁹ Because the proposed bill, if enacted, would repeal any applicability of OCSLA to ocean hard minerals,²⁰ Congress has under consideration a change in the method of "disposal" of these minerals.²¹

The U.S. Congress has devised disposal methods for public minerals²²

13. Woods Hole Oceanographic Institution (WHOI), "WHOI Moderates Second Meeting of EEZ Hard Minerals Working Group," Press Release (1986). The Exclusive Economic Zone is defined in Proclamation No. 5030, 48 Fed. Reg. 10,605 (1983) ("EEZ Proclamation"). The U.S. Exclusive Economic Zone, which extends 200 nautical miles from the baseline from which the U.S. territorial sea is determined, except in cases where it might infringe upon the jurisdiction of another nation, will hereinafter be referred to generically as the ("EEZ"). Lands ceded to the U.S. coastal states under the Submerged Lands Act, 43 U.S.C. § 1312 (1982), generally the three nautical mile territorial sea, are excluded from federal minerals management.

14. *Id.* A list of participants is available from the author.

15. *Id.* A list of administrative officials and observers is available from the author.

16. *Id.*

17. *Id.* A list of the ten concepts is available from the author.

18. National Seabed Hard Minerals Act, H.R. 5464, 99th Cong., 2d sess. (1986).

19. National Seabed Hard Minerals Act (NSHMA), H.R. 1260, 100th Cong., 1st sess. (1987). On 5 August 1987, this bill was marked-up (amended) by the Subcommittee on Oceanography and reported to the full Merchant Marine and Fisheries Committee for further deliberation. Technically, this version will be considered by the full committee. However, since August 5, the marked-up version has undergone further modification in order to increase the likelihood of its passage. Although review is planned by the full committee in 1988, we examine the bill in its most recent modified status. Amendment in the Nature of a Substitute for H.R. 1260 Offered by Mr. Lowry of Washington (Feb. 1, 1988). We refer to this amended version as "NSHMA (1988)." A copy of this version is available from the Subcommittee on Oceanography. In the House of Representatives, the Subcommittee on Mining and Natural Resources of the Committee on Interior and Insular Affairs shares jurisdiction over the bill with the Oceanography Subcommittee.

20. NSHMA, § 504 (1988).

21. See notes 50-56 and accompanying text for a definition of the term "disposal."

22. For the purposes of this article, the term "public minerals" will be defined broadly to include minerals found on the U.S. public lands (Federal Land Policy and Management Act, 43 U.S.C. § 1702 (1982)) or otherwise subject to disposal under authorization of the U.S. government. Here, public minerals will include minerals located on the U.S. outer Continental Shelf or within the U.S. Exclusive Economic Zone. Deep seabed minerals will also be considered public minerals for the

several times in its history.²³ Currently in the United States, two statutes govern the disposal of ocean hard minerals: OCSLA and the Deep Seabed Hard Mineral Resources Act (DSHMRA).²⁴ Two federal agencies, MMS in the Interior Department and the National Oceanic and Atmospheric Administration (NOAA) in the Commerce Department, have primary regulatory responsibility under OCSLA and DSHMRA respectively, and both are in the process of promulgating regulations to carry out these responsibilities.²⁵ Except for some marginal, yet cloudy, jurisdictional overlaps between the two statutes,²⁶ they apply to different resources, for different purposes, in different areas.²⁷ In particular, these laws provide

purposes of comparing and contrasting disposal methods. Of course, deep seabed minerals are not owned or otherwise under the jurisdiction or control of the United States. They can be considered public resources in the more general sense that they may be defined in international law as the "common heritage of mankind." United Nations Convention on the Law of the Sea of 1982, Part XI, § 2, art. 136 ("LOS Convention"); Declaration of Principles Governing the Seabed and the Ocean Floor and the Subsoil Thereof Beyond the Limits of National Jurisdiction, Dec. 17, 1970, G.A. Res. 2749, 25 U.N. GAOR Supp. (No. 28) at 24, UN Doc A/8097 (1977). See notes 154-158 and accompanying text. For an excellent treatment of the definition of minerals in the United States see George E. Reeves, *The Meaning of the Word "Minerals"*, 54 N. Dak. L. Rev. 419 (1978).

23. For good overviews of the U.S. federal "mining codes," see George Cameron Coggins & Charles F. Wilkinson, *Federal Public Land and Resources Law* (2d ed. 1987); Ronald W. Tank, *Legal Aspects of Geology* (1983).

24. OCSLA, 43 U.S.C. § 1337(k) (1982); Deep Seabed Hard Mineral Resources Act of 1980 (DSHMRA), 30 U.S.C. §§ 1401-1473 (1982).

25. For ocean hard minerals, the Minerals Management Service is considering the promulgation of three sets of rules: (1) exploration [Minerals Management Service, *Exploration for Nonenergy Minerals on the Outer Continental Shelf*, 49 Fed. Reg. 47,871 (1984) (advanced notice of proposed rulemaking)]; (2) leasing [Minerals Management Service, *Call for Information to Delineate Areas of Interest for Further Evaluation for Potential Leasing of Strategic and Nonenergy Minerals Found in the Exclusive Economic Zone and Outer Continental Shelf*, 50 Fed. Reg. 2264 (1985) (call for information) and Minerals Management Service, *Leasing of Nonenergy Minerals in the Outer Continental Shelf*, 50 Fed. Reg. 15,590 (1985) (advanced notice of proposed rulemaking)]; and (3) postlease operations [Minerals Management Service, *Postlease Operations for Minerals Other than Oil, Gas, and Sulphur in the Outer Continental Shelf*, 51 Fed. Reg. 12,163 (1986) (advanced notice of proposed rulemaking)]. Rules governing "prelease prospecting" have been proposed Minerals Management Service, *Prelease Prospecting for Marine Mining Minerals Other than Oil and Gas*, 52 Fed. Reg. 9758 (proposed rule to be codified at 30 C.F.R. 280), but draft rules governing leasing or postlease operations have not been published in the Federal Register or released widely and still are undergoing departmental review. The National Oceanic and Atmospheric Administration (NOAA) has promulgated rules for deep seabed exploration [15 C.F.R. 970 (1988)] and has proposed final rules for deep seabed commercial recovery National Oceanic and Atmospheric Administration, *Deep Seabed Mining: Proposed Regulations for Commercial Recovery and Revision of Regulations for Exploration*, 51 Fed. Reg. 26,794 (1986) (proposed rule to be codified at 15 C.F.R. 970 and 971).

26. James M. Broadus & Porter Hoagland III, *Rivalry and Coordination in Marine Hard Minerals Regulation*, Proc. Oceans '84 at 415 (1984). This does not imply that such overlaps are uninteresting. Interior has felt the need to establish its regulatory jurisdiction for outer Continental Shelf hard minerals management at least to the limit of the EEZ. See Authority to Issue Outer Continental Shelf Mineral Leases in the Gorda Ridge Area, 92 Interior Dec. 459 (1985).

27. OCSLA 8(k) pertains to "any mineral other than oil, gas, and sulfur." 43 U.S.C. § 1337(k) (1982). DSHMRA pertains to "hard mineral resource[s]" or "any deposit or accretion on, or just below, the surface of the deep seabed of nodules which include one or more minerals, at least one of which contains manganese, nickel, cobalt, or copper." DSHMRA, 30 U.S.C. § 1403(6) (1982). The purposes of OCSLA and DSHMRA are explained at notes 57-78 and in the accompanying text. OCSLA applies to the submerged lands of the outer Continental Shelf of the United States. OCSLA,

markedly distinct methods for private access to public minerals: OCSLA grants access through a competitive leasing system and DSHMRA authorizes access through a license-permit system.²⁸ In many ways, the proposed NSHMA has been constructed along the lines of DSHMRA, itself a descendent of the location-patent system, one of the disposal methods for hard minerals on the U.S. public lands onshore. On a general level, however, the two statutes and the proposed bill contain similar mechanisms for public management of ocean hard minerals. A look at differing policy goals in the context of variable levels of geologic understanding can help to explain the rationale for each mining code.²⁹

All modern mining codes have been derived from earlier codes, and it is useful therefore to investigate previous law and policy whenever new legislation is considered.³⁰ Because of the present (and contemporaneous) efforts of the U.S. federal executive and legislative branches to establish

43 U.S.C. § 1331(a) (1982). In practice, Interior concentrates its management efforts within 200 nautical miles of the baseline from which the territorial sea is measured, essentially the EEZ. Minerals Management Service, Outer Continental Shelf; Notice of Jurisdiction of the Department of the Interior Relating to Minerals Other Than Oil, Gas, and Sulphur; Clarification, 48 Fed. Reg. 2450 (1983) (notice). See also note 24. DSHMRA applies to the deep seabed, defined as that area beyond the Continental Shelf of any nation. DSHMRA, 30 U.S.C. § 1403(4) (1982).

28. The definitions of these two methods of access, and their derivations are explained in notes 102-24 and in the accompanying text. A good comparison of different access system methods, with some attention to the ocean hard minerals case, is Walter J. Mead, Pricing and Buyer Selection Alternatives (William A. Vogeley, ed.), 3 Econ. Min. Indus. 648 (1976).

29. Uncertainty faced by private developers is separated here into both legal and geologic components. Each kind of uncertainty has the identical effect of raising the private costs of public mineral development. But the costs of legal uncertainty can be reduced directly through the design of a mining code. Geologic uncertainty can be reduced only through costly exploration efforts.

30. Retrospective comparisons of mining statutes, particularly international comparisons, often have been published as guides to private investment options or public international relations policies. For such a comparison in the case of U.S. coastal states, see U.S. Office of Technology Assessment, Marine Mining at 281 (cited in note 11) and J. Leslie Goodier, U.S. Federal and Seacoastal State Offshore Mining Laws (1972). For a comparison of mining codes governing the U.S. public lands onshore, see Deborah Fleischer and Ursula Guerrieri, Mineral Leasing on Federal Lands: A Comparison of Key Leasing Elements (American Petroleum Institute Discussion Paper No. 042) (June 1985). Comparative studies have been made of domestic and international mining laws that govern the mining of the deep seabed for manganese nodules: Richard Todd Louma, A Comparative Study of National Legislation Concerning the Deep Seabed Mining of Manganese Nodules, 14 J. Mar. L. and Comm. 243 (1983); E.D. Brown, Deep-Sea Mining: The Consequences of Failure to Agree at UNCLOS III, 7 Nat. Res. Forum 55 (1983); Jeffrey D. Wilson, Mining the Deep Seabed: Domestic Regulation, International Law, and UNCLOS III, 18 Tulsa L.J. 207 (1982); and F.M. Auburn, National Deep Seabed Mining Regimes and Reciprocity, 4 Oil & Gas L. and Tax'n Rev. 125 (1982). Also see United Nations, Economic Commission for Asia and the Far East, Proc. Seminar on Petroleum Legislation with Particular Reference to Offshore Operations (Mineral Resources Development Series No. 40) (1973).

An obvious benefit from such a comparison is the revelation of differences among laws and policies that could result, *ceteris paribus*, in differential encouragement or restriction of development activity and the hindrance of efficient resource allocation. See, e.g. Thomas J. Tiesberg, Federal Management of Energy and Mineral Resources on the Public Lands, 11 Bell J. of Econ. 448 (1980) for an analysis of the financial terms across mineral access systems to determine optimal timing of exploration and development in the absence of "ideal" efficiency conditions. For an analysis of the effects of "locational" variables, especially tax structures, on the attractiveness of capital investment and

disparate systems to dispose of ocean hard minerals,³¹ it makes sense at this stage to examine past knowledge, understanding, and practice relating to these and other "public" minerals.³² Here we compare and contrast the existing and proposed ocean mining codes in the United States: OCSLA and its potential regulations, DSHMRA, and NSHMA. First, the public policy goals incorporated into these laws and initiatives are introduced.³³ Second, some historical perspective and background on the appearance of these laws and initiatives and their relationship to ocean hard minerals is presented.³⁴ Third, four "core provisions" that deserve thoughtful consideration, method of access, generation of revenues, requirements for performance, and handling of resource information, are discussed.³⁵ Fourth, an apparent dilemma in mining codes between legal certainty and management flexibility is analyzed.³⁶ Finally, we summarize some general points that appear to be useful in considering the disposal of ocean hard minerals. In the latter context, we note that the advantages of a unified system of disposal for public minerals, particularly in removing variations between mining codes that favor the development of one mineral over another because of locational, geological, or jurisdictional differences, are not usually considered in the design of a mining code.

OCEAN MINING CODES

Mining Code Definition

The specific collection of rules commonly grouped together into a "mining code" govern entitlements and activities relating to the devel-

economic development in Canadian onshore hard minerals, see Brian W. MacKenzie, Dallas W. Davis & Michel L. Bilodeau, *Effects of Location on the Competitive Position of Mineral Exploration and Development in Canada* (1986). Brooks discusses the problems inherent in establishing different policies for the same resource in different areas. David B. Brooks, *Deep Sea Manganese Nodules: From Scientific Phenomenon to World Resource*, 8 *Nat. Res. J.* 401 (1968). See also U.S. Public Land Law Review Commission, *One Third of the Nation's Land* 121 (1970).

31. These efforts may, in a sense, be rivalrous. The introduction of NSHMA may have occurred, in part, to push the Minerals Management Service to reconsider its attempts at promulgating regulations for ocean hard mineral activities under OCSLA, 43 U.S.C. § 1337(k) (1982).

32. Especially in the case of the public policies concerning public minerals, lessons can be learned through examination of a rich and detailed history. This article will not attempt to duplicate the several excellent historical treatments of the public policy of public minerals. The interested reader is referred to John D. Leshy, *The Mining Law: A Study in Perpetual Motion* (1986); Carl J. Mayer & George A. Riley, *Public Domain, Private Dominion* (1985); Robert H. Nelson, *The Making of Federal Coal Policy* (1983); Tank, *Legal Aspects of Geology* (cited in note 23); Robert W. Swenson, *Legal Aspects of Mineral Resources Exploitation* (Paul W. Gates, ed.), *History of Public Land Law Development* (1968) and other references contained in those works.

33. See notes 37-78 and accompanying text.

34. See notes 79-101 and accompanying text.

35. See 102-318 and accompanying text.

36. See notes 319-38 and accompanying text. In particular, it is stressed that, after consideration of the likelihood of contributions from ocean hard minerals to general mineral supply, there is plenty of time for thoughtful consideration of public policy goals and issues. *The Ocean and the Future* at 130 (cited in note 12) (prepared statement of James M. Broadus, Director, Marine Policy Center, Woods Hole Oceanographic Institution).

opment of mineral resources. Mining codes have been employed at least since the medieval period to reduce the private risks associated with mineral development activity.³⁷ In the Americas, the first mining code was introduced by Spanish Conquistadors in 1550, and it contained some rudiments of successive codes.³⁸ Modern mining codes can be imagined to encompass the universe of restrictions or incentives relating to mineral entitlements found explicitly and implicitly in international treaties, domestic legislation, regulations, contracts, and common law precedent. In this analysis, however, we employ a narrower definition of mining code, restricted to the policies expressed in U.S. federal statutes and their associated regulations pertaining to ocean hard minerals. Moreover, statutory provisions relating to environmental protection and federalism, among others, are given minimal attention here.³⁹ Even within this narrow definition, a great deal of variation exists among the public goals and mechanics of federal mining codes.

The paramount purpose of a federal mining code is to offer limited rights in a mineral property so that the minerals can be employed in the public's "interest."⁴⁰ In the United States, the federal government acts on the public's behalf⁴¹ to manage public minerals so as to maximize the total return on their disposal.⁴² It is possible to consider this return as assuming many public benefit forms other than just a financial return.

Since the early nineteenth century, Congress has employed constitutional authority⁴³ to dispose of public mineral property in a number of

37. Anthony Scott, *Does the Government Create Real Property Rights? Private Interests in Natural Resources* 17 (Feb. 15, 1984) (unpublished manuscript). Also see Thomas T. Tapping, *The Rhymed Chronicle of Edward Manlove* (1851) a reprint of an original edition dated 1653 that concerns "the liberties and customs of the lead mines within the Wapentake of Wirksworth, Derbyshire," with a glossary of principal mining terms and a list of litigations relative to the Derbyshire lead mines.

38. Aiton has claimed that this code, introduced in Mexico, barely resembles present-day mining codes and that any resemblance may, in fact, be accidental. Aiton, *The First American Mining Code*, 23 Mich. L. Rev. 105 (1924).

39. This does not subtract from the importance of these issues. As exemplified by the NSHMA proposal, and by the coalition that formed to draft principles that became embodied in NSHMA (see note 12 above), these other provisions are very much a part of modern mining codes.

40. The congressional declaration of policy to OCSLA states: "the outer Continental Shelf is a national resource reserve held by the federal government for the public, which should be made available for expeditious and orderly development" [emphasis added]. OCSLA, 43 U.S.C. § 1332(3) (1982). The public interest could include preservation or nondevelopment. See generally Anthony C. Fisher & John V. Krutilla, *Resource Conservation, Environmental Preservation, and the Rate of Discount*, 89 Q. J. Econ. 358 (1975).

41. See generally Mortimer Adler, *We Hold These Truths* 18 (1987). C.f. Joseph L. Sax, *The Public Trust Doctrine in Natural Resources Law: Effective Judicial Intervention*, 68 Mich. L. Rev. 471, 545 (1970).

42. Nelson postulates that public managers believe that they adhere to a concept of scientific resource management in the true "conservationist" tradition, but, in fact, resource management may be shaped by bargaining among interest groups. Nelson, *The Making of Federal Coal Policy at 177* (cited in note 26).

43. U.S. Const. art. IV, § 3.

ways, in order to achieve several policy goals: revenue generation,⁴⁴ national security,⁴⁵ territorial expansion,⁴⁶ restructuring of markets,⁴⁷ the settlement of unsettled lands,⁴⁸ and technological development.⁴⁹ The core provisions of a mining code, such as the system of access, revenue generating measures, performance requirements, and the handling of resource information, are designed to serve these broader policy purposes. Both the broader purposes and the core provisions are considered here because both may influence the management of public minerals in the public's interest.

Conservation and Disposal

As used in the field of minerals management, the terms "conservation" and "disposal" are related conceptually. In economics, conservation implies a socially-optimal resource allocation such that mineral resources are developed at the appropriate moment and rate.⁵⁰ Conservation might

44. For example, OCSLA states that "leasing activities shall be conducted to assure receipt of fair market value for the lands leased and rights conveyed by the Federal Government." OCSLA, 43 U.S.C. § 1344(a)(4) (1982).

45. The early attempts at leasing lead in the Indiana and Missouri Territories had the twofold purpose of generating revenue for the young republic and to secure a supply of lead for military applications. Swenson, *Legal Aspects of Mineral Resources Exploitation* at 702 (cited in note 32).

46. In 1856, through enactment of the Guano Islands Act, Congress stated "[w]henever any citizen of the United States discovers a deposit of guano on any island, rock, or key, not within the lawful jurisdiction of any other government, and not occupied by the citizens of any other government, and takes peaceable possession thereof, and occupies the same, such island, rock, or key may, at the discretion of the President, be considered as *appertaining to the United States*" [emphasis added]. The Act allowed occupation by U.S. citizens for the purposes of recovering and selling biogenic phosphorites to U.S. citizens. Guano Islands Act, 48 U.S.C. §§ 1411-1419 (1982).

47. The Mineral Leasing Act of 1920 (MLA), 30 U.S.C. §§ 181-287 (1982), was enacted primarily to prevent a perceived problem of overproduction of oil in California. The Act instituted a leasing system for hydrocarbon and certain solid minerals on onshore public lands. Public managers believed that oil production would be more efficient if accomplished by a few large producers. (This conservationist belief was abetted by major California oil producers.) Increased efficiency was thought possible only by restricting access through the "discretionary" nature of a leasing system, as opposed to the open access system in existence at that time. The concept of "leasing" arose out of a study of coal leasing in Australia, conducted by the U.S. Geological Survey in 1907. Mayer & Riley, *Public Domain, Private Dominion* at 155-208 (cited in note 32).

48. Through the grant of patent monopolies, the Mining Law of 1872, 30 U.S.C. §§ 21-54 (1982), was intended to encourage both mineral development and the settlement of western lands. Mayer and Riley, *Public Domain, Private Dominion* at 44 (cited in note 32).

49. In 1980 Congress found that "*development of technology* required for the exploration and recovery of hard mineral resources of the deep seabed will require substantial investment for many years before commercial production can occur, and *must proceed at this time* if deep seabed minerals are to be available when needed" [emphasis added]. DSHMRA, 30 U.S.C. § 1401(a)(11) (1982). Moreover, Congress declared that one of the purposes of the Act was "to encourage the continued development of technology necessary to recover the hard mineral resources of the deep seabed." DSHMRA, 30 U.S.C. § 1401(b)(5) (1982).

50. For two good general overviews of mineral resource conservation, see Anthony Scott, *Natural Resources: The Economics of Conservation* 26-38 (1955) and Orris C. Herfindahl, *Three Studies in Minerals Economics* 1-12 (1961).

be achieved by private mineral developers who respond to market signals. In the presence of market distortions resulting from environmental side-effects, imperfectly competitive industrial behavior, and superimposed tax structures, such an ideal situation is difficult to obtain.⁵¹

In mineral law, disposal implies the transfer of mineral entitlements.⁵² For public minerals, disposal connotes the transfer of entitlements with the expected result that public minerals will be recovered according to a schedule. In this manner, modern public mineral disposal involves a conservation meted by resource managers.⁵³ Thus, under public regulation, the timing and rate of mineral resource exploration, development, and production can differ from that expected under solely private management.

In the United States at the turn of the 20th century, public mineral "conservation" was invoked to correct actual or perceived market distortions.⁵⁴ In addition to remedial provisions for these distortions, modern mining codes⁵⁵ contain other disposal provisions that affect the economic conservation of public minerals.⁵⁶ In this article, we use the term disposal in the sense of managing the development of public mineral stocks in the interest of serving not only conservation but other public goals as well.

Policy Goals and Return to the Public

Figure 1 compares some of the broad policy goals for ocean mining that have been expressly stated or recommended by statute or executive proclamation. These goals span a wide range including: receiving fair market value for the resource; encouraging marine technology development; encouraging the development of additional sources of supply for certain designated strategic minerals; and distinguishing the development

51. Talbot Page, *Conservation and Economic Efficiency: An Approach to Materials Policy* 4-7 (1977).

52. Tank, *Legal Aspects of Geology* at 307 (cited in note 23).

53. See generally Nelson, *The Making of Federal Coal Policy* (cited in note 32). Ocean mining codes refer to "conservation" in a slightly different sense than that used here. Generally, in these codes, the term is used not in the sense of controlling the timing and rate of production, but rather in the (related) sense of ensuring that submarginal resources are not disturbed (or "wasted") in such a way as to preclude potential future production. OCSLA, 43 U.S.C. § 1334(a), 1861 (1982); DSHMRA, 30 U.S.C. § 1420 (1982).

54. See generally Mayer & Riley, *Public Domain, Private Dominion* (cited in note 32).

55. See notes 37-49 and accompanying text.

56. Detailed analysis of these provisions is beyond the scope of this article, but they include environmental protection, antitrust review, as well as other public management provisions such as national security "first-buyer" authority. In addition to the requirements of the National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4370 (1982), among other environmental laws, environmental protection and safety provisions have been incorporated into OCSLA, 43 U.S.C. §§ 1346, 1347, 1348, 1351 (1982) and DSHMRA, 30 U.S.C. § 1419 (1982). Antitrust review of the disposal of public ocean minerals is provided for in OCSLA, 43 U.S.C. §§ 1337(c), 1344(d) (1982) and in DSHMRA, 30 U.S.C. § 1413 (1982). Depletion allowances, similar to onshore minerals, may be available for many ocean hard minerals to deduct from general corporate taxes.

FIGURE 1
Stated or Proposed U.S. Ocean Mining Policy Goals¹

	1953/ 1978 OCSLA (43 USC)	1970 ² Mining and Minerals Policy Act (30 USC)	1980 ² Materials & Minerals Policy R&D Act (30 USC)	1980 DSHMRA (30 USC)	1983 EEZ Proclamation (48 Fed. Reg.)	1984 ² National Critical Materials Act (P.L. 98-373)	1988 ³ Proposed NSHMA (H.R. 1260)
<i>Policy Goal</i>							
Receive Fair Market Value	1344(a)(4)						308(a)(2)(B) "fair and equitable return" ⁴
Strategic Resource Needs	1341(b),(c),(e) 1344(a) 1353(f)	21a	1602	1401(a)(1-6)	10605	202(a)(1)	
Encourage Technology Development		21a	1602	1401(a)(11) 1401(b)(5)		202(b)(3)	102(b)(3)
Distinguish Development of Ocean Hard Minerals from Other Resources	1337(k)			1403(6)			102(b)(1)

1. This list of policy goals is not exhaustive.
2. These three general statutes have been included because their policy goals may apply to both onshore and ocean hard mineral activity.
3. Amendment in the Nature of a Substitute for H.R. 1260 Offered by Mr. Lowry of Washington (1 Feb. 1988).
4. (This provision may be deleted from subsequent versions of the bill.)

of hard minerals from the development of other mineral types, like hydrocarbons.⁵⁷ Additional policy goals, such as environmental protection, antitrust review, and the collection of resource information for management, among others, are important but are not discussed here. The management of resource information is considered below.

Notably, among these statutory goals, only OCSLA attempts to collect fair market value for the disposal of public ocean minerals.⁵⁸ Specific revenue generating mechanisms, such as bonuses, rentals, and royalties are employed to accomplish this goal.⁵⁹ Revenue generating mechanisms attempt to garner a portion of economic rent, the difference between private development costs and gross revenues,⁶⁰ in the form of a financial return. For OCS minerals, this revenue is placed in the U.S. Treasury's general account, without any earmarks, except for minor contributions to two conservancy funds.⁶¹ This revenue then is spent for various public purposes.

Interestingly, it is possible to consider rent in nonpecuniary terms. Financial rents may be foregone by the U.S. public in order to achieve specified policy goals other than the receipt of fair market value.⁶² Viewed in this fashion, foregone rents go uncollected and do not reach the treasury. Thus, foregone rents truly are "earmarked" to pay for public policy purposes like encouraging private firms to recover certain designated

57. OCSLA, 43 U.S.C. § 1332(3) (1982). Compare the goals of OCSLA with DSHMRA and the proposed NSHMA in Figure 1. The latter two have the common goal of encouraging technology development. In addition, one of DSHMRA's stated goals is to encourage the development of manganese nodules because of the perceived strategic importance of this resource and its contained metals.

58. OCSLA, 43 U.S.C. § 1344(a)(4) (1982). But see NSHMA § 308(a)(2) (1988) (cited in note 19).

59. See notes 167-185 and accompanying text.

60. For a general discussion of economic rent associated with mineral entitlements see Stephen L. McDonald, *The Leasing of Federal Lands for Fossil Fuel Production* (1979).

61. OCSLA, 43 U.S.C. § 1338 (1982). The National Historic Preservation Act 16 U.S.C. § 470h and the Land and Water Conservation Fund Act 16 U.S.C. § 4601-5(c)(2) provide specifically for the transfer of OCS revenues to funds organized by those acts. The annual amounts transferred to each fund are \$150 million for the National Historic Preservation Fund and approximately \$850 million for the Land and Water Conservation Fund. Revenues are transferred annually whether or not they are used, but Congress must authorize the appropriation of amounts from these funds. Because Congress is unlikely to authorize an appropriation equal to the entire amount of the holdings of these funds (the holdings of the Land and Water Conservation fund are approximately \$3 billion), the contribution from OCS revenues can be viewed, in large part, as only a "paper" transfer. In 1984, OCS mineral revenues totalled \$8.04 billion. U.S. Dept. of the Interior, Minerals Management Service, *Federal Offshore Statistics: 1984* at 49 (1986). Although OCS oil and gas revenues often are cited as the second largest contributor to the federal government's general account, in 1982 the contribution was only approximately one percent of annual federal revenues, compared with the roughly 60% attributed to personal income and corporate taxes. U.S. Dept. of Commerce, Bureau of Census, *Statistical Abstract* 261 (1985).

62. Viewed from this perspective, foregone rent represents an opportunity cost to the resource "owner," the public.

strategic resources or to develop ocean technology. DSHMRA, for example, seeks to achieve these latter purposes and gives little attention to the collection of financial rents.⁶³

Other implications arise from attempts to achieve some of the purposes of ocean mining codes. One goal found in the proposed NSHMA,⁶⁴ DSHMRA,⁶⁵ and the 1983 draft EIS for the Gorda Ridge⁶⁶ expresses a national need for the development of technology to explore, recover, and process ocean hard minerals. This goal is superimposed upon a broader public policy that encourages technological development more generally, such as tax incentives for research⁶⁷ and the patent system for inventions.⁶⁸ To the extent that extra encouragements, like potential rents, are provided in an ocean mining code to induce technological development, the activity of ocean mining may be given preferential treatment in U.S. public policy.

Public concerns about the strategic importance of ocean hard minerals appear in a statement that accompanies the EEZ Proclamation,⁶⁹ as well as in several publications authored by government officials concerning the proposed OCSLA regulations.⁷⁰ The availability of EEZ minerals as a supplemental source of military-strategic metal commodities has been a marine policy goal of particular importance to the Reagan Administration. When he proclaimed an EEZ in the United States, President Reagan

63. Note that the deep seabed is beyond the national jurisdiction of the United States. See note 22. Because the U.S. public does not "own" the resources there, it may not deserve a return on their disposal. How potential rents are "spent" on policy goals is determined beforehand by Congress, as guided by the legislative process. Once a federal mining code is enacted, this spending decision appears fixed and without the flexibility to respond to economic changes. Should the "value" of policy goals exceed true economic rent, Congress might consider subsidizing the ocean mining industry. But assigning values to public policy goals would be difficult. Moreover, without incorporating some mechanism into a mining code for fine-tuning, it would be difficult to remove built-in subsidies. (The National Academy of Sciences has under consideration recommendations to establish a joint government-industry effort to explore and exploit ocean hard minerals in the EEZ and to provide incentives and market assurances for marine mining there. See Marine Board, *EEZ Utilization Draft* (cited in note 11).) If resource managers are given the ability to fine-tune a disposal authority, an important question concerns the degree to which this kind of management flexibility raises the level of legal uncertainty and thereby deters private investment in public mineral development. See notes 319-38 and accompanying text.

64. NSHMA, 102(b)(3), (b)(3) (1988) (cited in note 19).

65. DSHMRA, 30 U.S.C. § 1401(a)(11), (b)(5) (1982).

66. Minerals Management Service, *Gorda Ridge DEIS* at 395 (cited in note 7).

67. 26 U.S.C. § 174(a)(1982) (research and experimental expenses).

68. See generally U.S. Dept. of Commerce, *Patent and Trademark Office, Patent Laws* (1986).

69. *United States Ocean Policy*, statement by the President, 19 Weekly Compilation of Presidential Documents 383 (Mar. 10, 1983).

70. Stone and MacGillivray, 4 *Circum-Pacific Energy and Min. Conf.* (cited in note 9); John B. Smith, *Managing Nonenergy Mineral Development—Genesis of a Program*, Proc. Oceans '85 at 339 (1985); Smith, Holt, and Paul, 17 *Offsh. Tech. Conf.* at 9 (cited in note 1). To the extent that OCSLA encourages the development of domestic oil and gas sources to guard against the possibility of economic disruptions from supply cutoffs from other sources, offshore hydrocarbons also are treated as a kind of strategic mineral.

said that "[r]ecently discovered deposits there [in the EEZ] could be an important future source of strategic minerals."⁷¹ Steps taken to achieve such a policy goal might encourage the disposal of ocean minerals at a rate that gives little consideration to economic conservation.

Several government studies and statutes⁷² distinguish or recommend the need to distinguish the development of hard minerals from the development of hydrocarbon minerals. It is clear that all minerals have geologic and end-use characteristics that are distinguishing features. It is not clear that such characteristics are important in justifying mining code differences, however. To the extent that some minerals are more difficult to discover, prove-out, and work, then private forecasts of commercial returns for these minerals will be uncertain. The degree and nature of uncertainty, not necessarily geologic differences, are important as justifications for differences in mining codes.⁷³

One potential policy goal, which during this century has never been considered seriously at the national level in the United States, is the establishment of a unified system for the disposal of public minerals in the United States.⁷⁴ At least one commentator has described the potential inefficiencies of differential systems of disposal that provide incentives for the development of lower quality minerals before the depletion of those of higher quality.⁷⁵ Differential systems might also encourage the development of one type of mineral before or instead of another. Because of the plethora of mining codes in the United States, including those on U.S. public lands onshore,⁷⁶ state public lands onshore and in the territorial sea,⁷⁷ and OCSLA and DSHMRA, a unified system appears infeasible. The enactment of OCSLA in 1953, however, might be regarded as one of the first attempts at such a goal, if only for public ocean minerals, because it applied one mining code to all types of minerals on the outer Continental Shelf.⁷⁸

71. United States Ocean Policy 383 (cited in note 69).

72. U.S. Commission on Marine Science, Engineering and Resources (Stratton Commission), *Marine Resources and Legal-Political Arrangements for their Development*, Panel Reports, Vol. 3 at VII-116 (1969); National Academy of Sciences, Marine Board, Panel on Operational Safety in Marine Mining, *Mining in the Outer Continental Shelf and in the Deep Ocean* at 55 (1975) ("NAS Panel"); Geological Survey, USGS Symposium at 271 (cited in note 2); NSHMA, § 102(b)(1) (1988); OCSLA, 43 U.S.C. § 1337(k) (1982).

73. EEZ Hearings (cited in note 12). Prepared Statement of James M. Broadus, Director, Marine Policy Center, Woods Hole Oceanographic Institution.

74. The Mining Law of 1872 was perhaps the closest the United States got to a uniform system for the disposal of public minerals. Coal, however, was not included under that law. See generally Leshy, *The Mining Law* (cited in note 32).

75. Brooks at 419 (cited in note 30).

76. See generally Coggins & Wilkinson, *Federal Public Land and Resources Law* (cited in note 23); Tank, *Legal Aspects of Geology* (cited in note 23).

77. OTA, *Marine Mining* at 281 (cited in note 11); Goodier, *U.S. Federal and Seacoastal State Offshore Mining Laws* (cited in note 30).

78. OCSLA, 43 U.S.C. § 1331(q) (1982). But because OCSLA does not include either location-patent or preference right lease systems, this uniformity is confined to the OCS.

Ocean Mining Code Development

Since the mid-1970s, the Department of the Interior has made several attempts to institute a regulatory framework for ocean hard minerals under the broad direction of section 8(k) of OCSLA. In 1961, phosphorites were leased off the California coast, but these leases soon were relinquished.⁷⁹ In 1974, the Bureau of Land Management (BLM) published a draft EIS with details of a mining code for phosphorites and sand and gravel resources.⁸⁰ Reaction to the draft was mixed, but mainly negative, and BLM postponed its effort.⁸¹ In 1979, the Interior Department moved again to examine the ocean hard mineral case. In that year, the U.S. Geological Survey published a Program Feasibility Document which recommended a prototype or test lease sale.⁸² The recommendation went unheeded until another Administration came into office. In 1982, a new Secretary of Interior, James Watt, approved departmental efforts to develop and implement an ocean hard mineral leasing system.⁸³ In 1983, MMS moved to sell access to sand and gravel resources off Alaska⁸⁴ and marine polymetallic sulfide (MPS) resources on the Gorda Ridge off Washington and Oregon.⁸⁵ Both a "Notice of Tentative Terms and Conditions" for the sand and gravel sale⁸⁶ and the draft EIS for the MPS sale⁸⁷ contained proposed mining code provisions. Partly due to a slumping oil market, Arctic oil and gas industry interest in sand and gravel waned, and the disposal of these materials was cancelled.⁸⁸ The draft EIS for the Gorda Ridge received negative comments, particularly concerning the lack of resource and environmental information on the proposed and alternative actions, and a special federal-state task force was organized

79. U.S. Dept. of the Interior, Bureau of Land Management and Collier Carbon and Chemical Corporation, Phosphate Lease Under the Outer Continental Shelf Lands Act (Feb. 1, 1962) [copy on file with Pacific OCS Region, Minerals Management Service, Los Angeles, Calif.; entire file including the lease ("Phosphate Lease File")].

80. U.S. Dept. of the Interior, Bureau of Land Management (BLM), Draft Environmental Impact Statement, Proposed Outer Continental Shelf Hard Mineral Mining, Operating and Leasing Regulations (1974) ("1974 Proposed Regulations DEIS").

81. Geological Survey, Program Feasibility Document: OCS Hard Mineral Leasing at 6 (cited in note 10).

82. *Id.* at 62 (cited in note 10).

83. Minerals Management Service, Proposed Mineral Materials Lease Form and Request for Comments, 48 Fed. Reg. 34,143 (1983) (notice).

84. Minerals Management Service, Notice of Tentative Terms and Conditions for an Arctic Sand and Gravel Sale, 48 Fed. Reg. 15,541 (1983); Minerals Management Service, Request for Supplemental Information; Sand and Gravel Leasing Offshore Alaska, 49 Fed. Reg. 12,761 (1984).

85. Minerals Management Service, Outer Continental Shelf; Proposed Lease Sale of Polymetallic Sulfide Minerals in the Gorda Ridge; Intent to Prepare an Environmental Impact Statement, 48 Fed. Reg. 12,840 (1983) (notice).

86. Minerals Management Service, 48 Fed. Reg. 15,541 (1983) (cited in note 84).

87. Minerals Management Service, Gorda Ridge DEIS at 391-410 (cited in note 7).

88. Telephone communication with Yvonne Morehouse, Minerals Management Service, Washington, D.C. (Dec. 1986). Arctic sand and gravel would have been used as construction material in building OCS oil and gas production facilities in the Beaufort Sea.

to help remedy these problems.⁸⁹ In 1984, a similar task force was formed with the participation of the state of Hawaii to draft an EIS and initiate steps toward the potential leasing of "cobalt-rich" ferromanganese encrustations.⁹⁰

Concurrent with the Interior Department's attempts to initiate an ocean hard mineral program under OCSLA, Congress examined the enactment of a statute that would govern the exploration and commercial recovery of deep seabed manganese nodules. Pressed primarily by the American Mining Congress and other deep seabed mining interests, Congress considered several draft bills from the late 1960s through their culmination in the enactment of DSHMRA in 1980.⁹¹ None of the proposals involved OCSLA-type competitive bonus bid access methods.⁹² Instead, a first-come, first-serve method of access to exploration areas, with a preference right to commercial recovery in the same area, was promoted and enacted. DSHMRA was seen as an interim, and possibly alternative, mining code pending the completion of negotiations over an international code for the deepsea nodule resource at the United Nations Convention on the Law of the Sea.⁹³ The entitlements created by DSHMRA established a basis for U.S. companies to invest in deep seabed prospecting and R&D. For these companies, DSHMRA reduced legal uncertainty through an institutional framework that precluded claim-jumping by other U.S. firms or foreign firms whose governments agreed to "reciprocate" with the United States in this area.⁹⁴

In 1981 and 1982, NOAA promulgated rules governing the granting of deep seabed exploration licenses.⁹⁵ Because several licenses were is-

89. Minerals Management Service, U.S. Dept. of the Interior, Oregon and Department of the Interior Create Working Group on Gorda Ridge Ocean Mining Assessment, News Release (Feb. 28, 1984).

90. Minerals Management Service, Call for Information to Delineate Areas of Interest for Preparation of an Environmental Impact Statement on the Exploration for and Possible Recovery of Cobalt-Rich Manganese Crusts in the Hawaiian Exclusive Economic Zone, 49 Fed. Reg. 34,099 (1984) (call for information). Similar task forces have been organized by Minerals Management Service with the states of North Carolina [Minerals Management Service, U.S. Dept. of the Interior, North Carolina and Interior Department Announce Joint Task Force to Study Nonfuel Minerals Offshore, News Release (Mar. 12, 1986), Georgia Minerals Management Service, U.S. Dept. of the Interior, Georgia and Interior Department Initiate Cooperative Investigation of Offshore Nonfuel Minerals, News Release (Oct. 16, 1986)], and the Gulf Coast, involving the states of Texas, Louisiana, Mississippi, and Alabama [Interview with John B. Smith, Office of Strategic and International Minerals, Minerals Management Service, Long Beach, Calif. (Dec. 17, 1986)].

91. A legislative history through 1975 can be found in James E. Mielke, Ocean Manganese Nodules, Congressional Research Service for Committee on Interior and Insular Affairs, 94th Cong., 1st sess. 59 (1975).

92. A 1970 working paper drafted by the Nixon Administration for use by the United Nations Seabed Committee did include revenue generating mechanisms such as bonuses, rentals, and royalties. These mechanisms were immediately opposed by the American Mining Congress, a driving force behind the early DSHMRA proposals. *Id.* at 61.

93. DSHMRA, 30 U.S.C. § 1401 (b)(3) (1982).

94. DSHMRA, 30 U.S.C. § 1428 (1982).

95. 15 C.F.R. § 970 (1988).

sued simultaneously, those firms seeking licenses in the United States and in other countries met on several occasions to resolve overlapping claims through the trading of areas and resource information.⁹⁶ In 1984, four licenses (to six areas) were granted to deep seabed mining consortia in the United States.⁹⁷ In 1986, NOAA proposed regulations governing the grant of permits for commercial recovery.⁹⁸

From 1985 to 1987, Congress once more took up consideration of the need to legislate the disposal of ocean hard minerals, this time on a proposed "national seabed" of the United States.⁹⁹ Again, pressed primarily by ocean mining interests, but with the assistance of environmental groups and coastal states,¹⁰⁰ Congress has under consideration the "National Seabed Hard Mineral Resources Act."¹⁰¹

COMPARISON OF CORE PROVISIONS

Access: Lease Versus License

The Mining Law of 1872 provided for the disposal of proven mineral discoveries on public lands onshore such that perfect ownership could be transferred from the public to an individual or private firm. Individuals were allowed free access to the U.S. public lands and, in the event a valuable mineral deposit was located, they could stake a claim to the deposit and produce the mineral or patent the claim.¹⁰² The location-patent system is still the basis for the disposal of most hard minerals on the U.S. public lands. Mining codes enacted by Congress subsequent to this "location-patent" system did not allow the permanent transfer of property rights but instead allowed: (1) transfers of property and devel-

96. James M. Broadus & Porter Hoagland III, *Conflict Resolution in the Assignment of Area Entitlements for Seabed Mining*, 21 *San Diego L. Rev.* 541 (1984).

97. U.S. Department of Commerce, National Oceanic and Atmospheric Admin. (NOAA), *Deep Seabed Mining Report to Congress* 9 (1985). These licenses are available for public review at NOAA headquarters, Washington, D.C.

98. National Oceanic and Atmospheric Administration, 51 *Fed. Reg.* 26,794 (1986) (cited in note 25).

99. See Congressional hearings referenced in note 12 above. NSHMA would define a "seabed" beyond the territorial sea and otherwise coincident with the EEZ except in cases where the outer edge of the continental shelf extends beyond the EEZ. NSHMA § 103(15) (1988). The use of the term "national seabed" instead of "outer Continental Shelf" is indicative of the concerns of the supporters of the bill that a framework governing the disposal of ocean hard minerals be kept distinct from the framework governing the disposal of oil and gas minerals (i.e., OCSLA). At the same time, private firms involved in offshore oil and gas activity are displeased with the notion that OCSLA might be opened once again for amendment. The enactment of NSHMA would appear to solve both problems by creating a new large-scale ocean enclosure with a unique mineral disposal mechanism, thereby circumventing the need to amend OCSLA. But see note 339.

100. H.R. 5464 Hearings (cited in note 12) (Testimony of Art Rocque, Chairman Emeritus, Coastal States Organization).

101. See note 19.

102. Mining Law of 1872, 30 U.S.C. §§ 21-54 (1982). Patenting is not necessarily a prerequisite for mineral production.

opment rights through a lease,¹⁰³ (2) the allocation of development rights by license or permit,¹⁰⁴ or (3) the sale of surface materials in place.¹⁰⁵ Figure 2 compares methods of access found in OCSLA, DSHMRA, and the proposed NSHMA.

FIGURE 2
Access to Ocean Hard Mineral Entitlements
 (all activities above the dotted line are nonexclusive;
 all activities below the line are exclusive)

	OCSLA	DSHMRA	NSHMA
<i>Activity</i>			
Oceanography	<i>permit</i> ^a or <i>notice</i>	open	open
Prospecting	<i>permit</i> ^b	open	open ^d
.....			
Exploration	competitive auction for <i>lease</i> ; exploration plan approval required before end of exploration term	first-entrant <i>license</i> ; ^c exploration plan approval required before grant of license	first-entrant <i>license</i> ; exploration plan approval required before grant of license
Other "Permits"	water quality air quality waste disposal drilling construction navigation pipelines coral protection	water quality waste disposal	unspecified: possibly similar to OCSLA
Development/ Production	<i>lease</i> (same as above); development/ production plan approval required before production start	<i>permit</i> ; commercial recovery plan approval required before production start	<i>permit</i> ; commercial recovery plan approval required before production start
Assignment or Transfer	approval of public manager required	approval of public manager required	approval of public manager required

^aGeological or Geophysical Scientific Research Involving Drilling or Explosives.

^bGeological or Geophysical Exploration Activities Not Under a Lease.

^cResolution of concurrently-staked overlapping claims possible.

^dThe activities of "mapping" and the "random taking of bottom samplings" are specifically exempt from requiring authorization from the resource manager.

103. See generally Tank, *Legal Aspects of Geology* at 297-98 (cited in note 23).

104. DSHMRA § 102, 30 U.S.C. § 1412 (1982).

105. Surface Materials Act of 1947, 30 U.S.C. §§ 601-604 (1976). The purpose of this Act, also known as the "Common Varieties Act," was to provide for a method of disposal of materials such as sand, gravel, and stone without disposing of the land on which these minerals were situated. *U.S. v. Coleman* 390 U.S. 599, 604 (1968) (denial of application to patent, under the Mining Law

Legal Differences. From a traditional legal standpoint, a difference exists between methods of access that employ either leasing or licensing. Generally, in law, a lease conveys a real property right to the lessee, whereas a license (or permit) carries only the permission of the licensor to conduct some predetermined business activity in the licensed area.¹⁰⁶ Following this tradition, in mining law, the lease implies the right to exclude all others from the use of the leased area.¹⁰⁷ Thus a lease consists of a stronger bundle of rights than a license. Moreover, a license might be more easily revoked than a lease,¹⁰⁸ thereby enhancing the "discretion" of a licensor relative to that of a lessor.¹⁰⁹

From a more modern and pragmatic perspective, the property right distinction between leasing and licensing has become blurred. Under

of 1872, a mineral discovery of quartzite stone for use as a building material). The Act was designed to curb the practice of claiming land patents under the 1872 Mining Law on the basis of the location of common variety minerals. The policy goal here was to reserve the patent system incentive for the harder-to-find lode and placer minerals. The Act established competitive access for common varieties, except in special cases as determined by the Secretary of Interior, such as the grant of surface materials to states, territories, municipalities, or nonprofit corporations.

106. "A lease is a contract for the possession and profit of land by the lessee, and a recompense of rent or increase to the lessor, and is a grant of the estate in the land. . . . A license is an authority to do some act or series of acts on the land of another, for the benefit of the licensee, without passing any estate in the land; and when the license is to mine upon the land of another the right of property in the minerals, when they are severed from the soil, vests in the licensee." *Christensen v. Pacific Coast Borax Co.* 38 P. 127, 128 (Oregon 1894).

107. "Mere nomenclature is unimportant. 'The test to determine whether an agreement for the use of real estate is a license or a lease is whether the contract gives exclusive possession of the premises as against all the world, including the owner, in which case it is a lease'." *Herigstad v. Hardrock Oil Co.* 52 P.2d 171, 174 (Montana 1935). In the same case, concerning the rights of assignees under federal oil and gas prospecting permits on the public lands, Matthews, J., found that ". . . it is generally held that such a 'lease' does not vest in the lessee an estate in the land or in the oil and gas therein, but simply the right to prospect for oil and gas, 'a sort of subterranean *ferae naturae*,' to which no title vests until reduced to possession by extraction from the earth; an incorporeal hereditament." *Id.* See notes 118-121 and accompanying text. Swenson has noted that ". . . one of the most troublesome problems in mining leases today is the extent to which either traditional property or contract principles should govern the rights of the lessor and the lessee or their transferees." Swenson, *Development Covenants in Solid Mineral Leases*, 1 Nat. Res. J. 271 (1961). He has suggested also that mining leases (mining agreements involving solid or hard minerals) may be related to (and therefore derived from) traditional oil and gas leases. *Id.* at 272.

108. "A mere license, while it remains executory, is revocable at the pleasure of the licensor, is indivisible and nonassignable." *Stinson v. Hardy* 41 P. 116, 118 (1895) (an exclusive, irrevocable license for possession of a mining claim, under which possession may be maintained against the world, found to be a lease). "'License' unlike 'lease' conveys no estate in affected property, and is generally revocable at will without notice." *Strandholm v. Barbey* 26 P.2d 46 (Washington 1933) (U.S. Dept. of the Army lease of tidelands and shorelands in the Columbia River for fish seining operations found not to be a lease but a license).

109. An increase in the ability of the licensee to exercise its discretion to revoke or otherwise modify the terms and conditions of a license will, *ceteris paribus*, increase uncertainty and, as a result, the perceived private costs of development. This may be an important consideration in the case of ocean mineral entitlements. The Ocean and the Future at 195 (cited in note 18) (prepared statement of Richard J. Greenwald, Secretary and General Counsel, Deepsea Ventures, Inc. and Ocean Mining Associates).

either form of access, private firms are able to produce or recover minerals and to profit from their sale.¹¹⁰ In modern mining codes, both leases and licenses can be made to exclude other prospective claimants.¹¹¹ (Interestingly, a nonexclusive *permit* is required under OCSLA for *prelease* exploration activity,¹¹² and permits from other federal or state agencies

110. Under OCSLA, "[A]n oil and gas lease issued pursuant to this section shall . . . entitle the lessee to explore, develop, and *produce* the oil and gas contained within the lease area (emphasis added). . . ." OCSLA, 43 U.S.C. § 1337(b)(4) (1982). Production under OCSLA is defined as "those activities which take place after the successful completion of any means for the removal of minerals, including such removal, field operations, transfer of minerals to shore, operation monitoring, maintenance, and work-over drilling . . ." OCSLA, 43 U.S.C. § 1331(m) (1982). Note that the definition of production does not specifically include the actual ownership, sale or other use of minerals, and these activities are not specifically authorized elsewhere in the Act. Royalty provisions, however, do apply to amounts or values of production "saved, removed, or sold." OCSLA, 43 U.S.C. § 1337(a)(1)(A) (1982). Under DSHMRA, a permit for commercial recovery ". . . recognizes the right of the holder to recover hard mineral resources and to *own*, transport, *use*, and *sell* hard mineral resources recovered (emphasis added)." DSHMRA, 30 U.S.C. § 1412(b)(3) (1982). Under the proposed NSHMA, "[e]ach license or permit issued under this Act shall have attached to it terms, conditions, and restrictions that—(A) authorize the holder of such license or permit to process at sea, transport, *use*, and, in the case of a permit, *sell* the hard mineral resources recovered; . . . (emphasis added)." NSHMA, § 308(a)(1)(A) (1988). The lack of specific authority to own, sell, or otherwise use minerals produced on OCS leases should not be interpreted as a weaker bundle of rights than those granted under other ocean mining codes. Such activities are implicit in an OCS "lease" and thus go unmentioned in the Act. The inclusion of such activities specifically in the language of DSHMRA and NSHMA may help to reduce legal uncertainty associated with "licenses" or "permits." N.b. the absence of the term "own" in the NSHMA proposal.

111. See OCSLA, 43 U.S.C. § (1982); DSHMRA, 30 U.S.C. § 1412(b)(2) (1982). Laitos & Westfall consider both federal leases and federal licenses and permits to be in the same class of "non-vested protectible property rights." Jan G. Laitos & Richard A. Westfall, *Government Interference with Private Interests in Public Resources*, 11 *Harv. Envtl. L. Rev.* 1, 8 (1987).

112. To date, only 17 permits have been issued for prelease exploration of ocean hard minerals on the outer Continental Shelf. The following table summarizes information about the permits:

<i>Year</i>	<i>No.</i>	<i>Permittee</i>	<i>Mineral Prospect</i>	<i>Approximate Location</i>
1966	1	Marine Exploration	Gold Placers	Norton Sound, Alaska
1966	1	Ocean Science & Eng.	Gold Placers	Norton Sound, Alaska
1966	1	Newport News Shipbldg.	Phosphorites	North Carolina
1967	2	Ocean Resources	Phosphorites	Southern California
1967	1	Bear Creek Mining	Phosphorites	Southern California
1969	1	Global Marine	Sand, Hvy. Mins.	New Jersey
1969	1	Ocean International	Heavy Minerals	Mid-Atlantic
1970	1	Deepsea Ventures	Mn Nodules	Blake Plateau
1975	1	Radcliff Minerals	Sand	West Cameron, La.
1986	2	DuPont	Heavy Minerals	Georgia
1986	2	Associated Minerals	Heavy Minerals	Georgia
1986	1	Tech. Univ. of Clausthal	Cobalt Crusts	Hawaii
1987	1	Inspiration Gold	Gold Placers	Norton Sound, Alaska
1987	1	Geomarex	Carbonate Sands	Florida Keys

Source: Personal compilation from conversations with various regional offices of Minerals Management Service.

This list does not include 32 permits issued from 1982-1987 to seven companies in the Alaska OCS Region for high-resolution geophysics or shallow geological investigations. These latter permits were directed, in part, toward sand and gravel resources that might be used for the construction of gravel islands or other support structures for offshore oil production facilities.

may be required for postlease activities such as waste disposal and construction.¹¹³) It is unclear whether the legal status of the use of either a lease or a license affects the flow of financial capital to the miner.¹¹⁴

What may be of overriding interest to private firms, disregarding any traditional differences, is the extent to which a method of access involves iterations at which resource managers may exert discretionary power to revoke or in some manner derogate the nature of the entitlement. Under OCSLA the Secretary of Interior maintains a significant amount of discretion with regard to the modification or revocation of mineral leases.¹¹⁵ A recent case before the U.S. Supreme Court¹¹⁶ concerning the scope of intergovernmental relations in OCS oil and gas activities¹¹⁷ highlights this discretionary authority. In *Secretary of the Interior v. California*, Justice O'Connor, by extricating the act of federal OCS lease sales from the purview of coastal state consistency review,¹¹⁸ declared that "by purchasing a lease, lessees acquire no right to do anything more. Under the plain language of OCSLA, the purchase of a lease entails no right to proceed with full exploration, development, or production that might trigger CZMA [Coastal Zone Management Act] section 307(c)(3)(B); the lessee acquires only a priority in submitting plans to conduct those activities. If these plans, when ultimately submitted, are disapproved, no further exploration or development is permitted."¹¹⁹

The association of "leasing" with access to hydrocarbon minerals on-

113. The final EIS for the Arctic Sand and Gravel Lease Sale details potential permit requirements including: rights of way for common carrier pipelines on the OCS, coral protection, offshore construction, dredging and filling of navigable waters, offshore structures, and those issued under the National Pollutant Discharge Elimination System. Minerals Management Service, Sand and Gravel FEIS at C-1 (cited in note 6).

114. Concerning hard minerals on the onshore public lands, Hansen has suggested that a leasing system "could affect the industry's ability to attract capital for large investments needed to develop low grade deposits." Clinton J. Hansen, *Why a Location System for Hard Minerals? Frontier Doctrine Confronts the Computerized Society*, 13 Rocky Mtn. Min. L. Inst. 1, 16 (1967).

115. OCS activities are separated into prelease exploration, exploration, and development and production. Iterations at which discretion can be exerted include requirements for a prelease exploration permit [30 C.F.R. § 251 (1986)]; competitive bidding for a lease OCSLA, 43 U.S.C. § 1337 (1982); exploration plan submittal and approval [OCSLA, 43 U.S.C. § 1340 (1982)]; a drilling permit [OCSLA, 43 U.S.C. § 1340(d) (1982)]; and development and production plan submittal and approval [OCSLA, 43 U.S.C. § 1351 (1982)].

116. *Secretary of the Interior v. California*, 464 U.S. 312 (1984) (Interior Department not required to prepare "consistency determination" document before selling offshore oil and gas leases). See Laitos & Westfall, 11 Harv. Envtl. L. Rev. 34 (cited in note 111).

117. For a good overview of issues associated generally with federalism in ocean management and specifically with the "federal consistency" provisions of the Coastal Zone Management Act (CZMA), see Timothy J. Eichenberg & Jack Archer, *The Federal Consistency Doctrine: Coastal Zone Management and "New Federalism"*, 14 Ecol. L. Q. 9 (1987).

118. Coastal Zone Management Act, 16 U.S.C. § 1456(c) (1982).

119. 464 U.S. 339. In a dissenting opinion, Justice Stevens questioned the practical extent of this discretionary authority: "Approval for exploration and development by the lessee is obviously the expected and intended result of leasing; if it were not, the Secretary would not bother to lease and the lessees would not bother to bid." 464 U.S. 372-373.

shore and offshore and of "licensing" with access to deep seabed minerals (as shown in Figure 2), probably is an important, though seemingly semantic, distinction. Under OCSLA, private firms bid competitively for leases to mineral exploration, development, and production rights (Figure 2).¹²⁰ Those miners with winning bids spend "front-end bonus" monies after prelease exploration but before exploration, development, and production of a deposit. Under both DSHMRA and the proposed NSHMA, licenses, which include the right to a subsequent recovery permit, are allocated to miners on a first-come, first-serve basis.¹²¹ The government charges a fee, but receives no bonus, for the administrative costs incurred in processing the license application.¹²² Therefore, licenses, implying lower private costs of access, are preferred by the ocean hard mineral interests over leases. In the case of DSHMRA, however, several "pre-enactment explorers" have received licenses concurrently, so that a system of conflict resolution of overlapping claims based on prespecified equity factors was established.¹²³ For deep seabed licenses, preenactment investments were important in determining the allocation of exploration areas on the deep seabed. No similar conflict resolution provision has been included in the proposed NSHMA.¹²⁴

Sand and Gravel: A Special Case? Ocean sand and gravel deposits, which in certain locations undoubtedly are first in line as an ocean hard mineral commodity,¹²⁵ potentially represent an exception to the OCSLA method of competitive access. As one part of its 1983 proposed Arctic sand and gravel lease sale, MMS suggested the grant of easements to existing OCS oil and gas lease holders for the use of sand and gravel resources on their lease tracts.¹²⁶ The lease sale was not held, and the easements were never granted. Alternatively, the State of Louisiana has

120. OCSLA, 43 U.S.C. § 1337 (1982).

121. DSHMRA, 30 U.S.C. § 1413(b) (1982); NSHMA, § 302(a) (1988).

122. DSHMRA, 30 U.S.C. § 1414 (1982); NSHMA, § 305(d) (1988).

123. 15 C.F.R. § 970.302 (1986). Broadus & Hoagland, 21 San Diego L. Rev. 552 (cited in note 96).

124. NSHMA, § 302(a) (1988).

125. Bureau of Mines, *An Economic Reconnaissance of Selected Sand and Gravel Deposits* (cited in note 11).

126. Notice of Tentative Terms and Conditions for an Arctic Sand and Gravel Lease Sale, 48 Fed. Reg. 15,541 (1983). It is unclear whether Minerals Management Service possessed the authority to grant easements under OCSLA. In 1959, a decision of the Interior Solicitor concluded that OCS sulfur lessees were not entitled to the free use of salt (to be employed in the production of sulfur) on their OCS leases. Application for Free Use of Salt Deposits for Sulphur Mining Operations on "Section 6" Outer Continental Shelf Leases, M-36548 (Jan. 19, 1959) (unpublished solicitor's opinion). For an interesting historical analog with a contrary result, see W.T. Morris, 51 Interior Dec. 416 (1926) (individual permittee is an agent of the United States under the Mineral leasing Act of 1920 and, as such, entitled to the free use of coal resources to be used as fuel in drilling a deep test well for oil and gas on the U.S. public lands).

requested a grant of OCS sand for use in counteracting the effects of coastal land subsidence on its coast.¹²⁷ Onshore, access to sand and gravel resources on the U.S. public lands typically is authorized through a competitive or noncompetitive contract sale of the resource in place.¹²⁸ Yet under the Surface Materials Act¹²⁹ states, territories, local governments, or nonprofit corporations may receive grants of these materials for noncommercial uses such as public works projects.¹³⁰ No such provision exists in OCSLA for the federal OCS, and Louisiana's request may not be satisfiable there.

Conservation Issues. It is useful to consider the implications for conservation of the methods of access found in existing and proposed ocean mining codes. Invoking a number of simplifying assumptions,¹³¹ a mining code with the goal of conservation should work to maximize the net present value of a mineral resource to society.¹³² Interestingly, such a condition can be realized when the mineral resource owner (here the federal government) captures the true economic rent, or the difference between private development costs, including uncertainty and the opportunity costs of investment, and gross revenue from the sale of the produced mineral.¹³³ One method of access, which attempts to capture a financial rent and which is consistent with a goal of economic conservation, is to sell the mineral property to the highest bidder at an auction.¹³⁴ In cases where, legally, an actual "land" sale cannot transpire, the government still might sell "access" to the property to the highest bidder. Out of the numerous methods by which some form of entitlement can be sold,¹³⁵ the most efficient method for practical application cannot be de-

127. Telephone interview with Buford R. Holt, Ofc. of Strategic and Int'l Minerals, Minerals Management Service (April 1986). See also EEZ Hearings (cited in note 12) (prepared statement of J. Steven Griles, Asst. Sect., Land and Minerals Management, U.S. Dept. of the Interior at 21).

128. 30 U.S.C. § 602 (1982).

129. 30 U.S.C. § 601-604 (1982).

130. *Id.*

131. The most important assumptions concern market failures, such as pollution externalities, imperfectly competitive behavior, tax structure distortions, and freight subsidies. See Page, *Conservation and Economic Efficiency* at 5 (cited in note 51).

132. This is equivalent to an economic definition of the term "conservation," which will be employed here. Russell O. Jones, Walter J. Mead, & Philip E. Sorenson, *The Outer Continental Shelf Lands Act Amendments of 1978*, 19 *Nat. Res. J.* 885, 893 (1979). Scott, *Natural Resources: The Economics of Conservation* at 26 (cited in note 50), discusses the definitional problems associated with the term "conservation." It should be noted that the definition used here does not necessarily account for fundamental distributional questions of existing income distribution or intergenerational equity.

133. McDonald, *The Leasing of Federal Lands for Fossil Fuel Production* 24 (cited in note 60).

134. Nelson, *The Making of Federal Coal Policy* 231 (cited in note 32).

135. Alternative selling methods include bonus bidding, royalty bidding, profit share bidding, work commitment bidding and variations or combinations of these. In addition, there are different methods of staging an auction. Mead, 3 *Econ. Min. Indus.* 664 (cited in note 28).

terminated on the basis of theory alone.¹³⁶ Notwithstanding this problem, important empirical work has suggested that, for OCS oil and gas minerals, a competitive bonus bid system is an efficient access method for a goal of resource conservation.¹³⁷

Since at least 1920, several types of minerals have been leased competitively in the United States.¹³⁸ The minerals industries traditionally have opposed competitive bid access systems, primarily because of the front-end payment requirements.¹³⁹ For example, members of the oil and gas industry opposed the competitive bidding systems that were incorporated into the Minerals Leasing Act in 1920 and OCSLA in 1953.¹⁴⁰ Assertions from mineral interests to the contrary,¹⁴¹ there is little evidence to suggest that such a system is inappropriate in cases where the mineral resource is well-understood and rents can be captured with some certainty.¹⁴²

136. Stephen L. McDonald, "Foreword," in Walter J. Mead, Asbjorn Moseidjord, Dennis D. Muraoka & Philip E. Sorenson, *Offshore Lands: Oil and Gas Leasing and Conservation on the Outer Continental Shelf* xxii (1985) ("Offshore Lands").

137. *Id.* at 45-84. In "Offshore Lands" the authors state that the most prominent problem with competitive bonus bidding is the possibility that smaller firms might not be able to muster the resources to make competitive bids and thus could be excluded. *Id.* at 45-84. This problem, if it exists in reality, assumes imperfections in financial capital markets.

138. Perhaps the earliest leasing concerned the lead resources of the Indiana and Missouri territories. Swenson, in *History of Public Land Law Development* at 702 (cited in note 32); Mayer & Riley, *Public Domain, Private Dominion* at 20-42 (cited in note 32); Tank, *Legal Aspects of Geology* at 451 (cited in note 23).

139. EEZ Hearings (cited in note 12) (prepared Statement of Richard J. Greenwald, President-Elect of Ocean Mining Associates and Deepsea Ventures Inc.).

140. For the Minerals Leasing Act of 1920, see C. Winter, *Four Hundred Million Acres* 101 (1932). For the case of OCSLA, see H.R. Rep. No. 1778, 80th Cong., 2d Sess., repr. in 1953 U.S. Code Cong. & Ad. News 1415, 1437.

141. See Greenwald, *Prepared Statement* (cited in note 139). Generally, ocean hard minerals interests base their arguments against leasing as a method of access on the following: there exist geologic, technological, and planning horizon differences compared with the leased hydrocarbon minerals, and traditionally the access method onshore has been a location-patent system. The mineral differences can be better understood as based upon uncertainty, which will affect practice under any mining code. The latter argument, based upon "tradition," may be the stonger of the two. It is possible that administrative costs of a leasing system may have been too great to institute one for public minerals during the second half of the nineteenth century. Swenson, in *History of Public Land Law Development* at 719 (cited in note 32), postulates that it is unclear that a leasing system would have been unworkable, because the question "had never really been studied by Congress."

142. Several researchers have outlined the rationale for a competitive bidding system for ocean hard minerals. Broadus, *Prepared Statement* (cited in note 73); Mead, 3 *Econ. Min. Indus.* at 671 (cited in note 28); Ross D. Eckert, *Exploitation of Deep Ocean Minerals: Regulatory Mechanisms and United States Policy*, 17 *J. L. Econ.* 143 (1974); R.H. Coase, *United States Policy Regarding the Law of the Seas, Mineral Resources of the Deep Seabed*, Hearings on Amendment No. 946 to S. 1134 before the Subcommittee on Minerals, Materials and Fuels of the Senate Committee on Interior and Insular Affairs, 93rd Cong., 2d sess. 1159, 1171 (1974); Orris C. Herfindahl, *Some Problems in the Exploitation of Manganese Nodules*, 7 *L. Sea Inst. Proc.* 28 (1972); Francis T. Christy, *Minerals of the Deep Sea*, 3 *L. Sea Inst. Proc.* 331 (1969); Brooks, 8 *Nat. Res. J.* 421 (cited in note 30). Contrary to the case of offshore oil and gas, little empirical work has been accomplished to demonstrate economic theory in the case of hard minerals. Examination of onshore

Under either a location-patent or a license-permit system, some or all of the economic rent, if it exists, accrues to the licensee. Thus these systems contain encouragements for the miner that act to counterbalance geologic or legal uncertainties.¹⁴³ The main conservation issue arising from these methods of allocating mineral rights is that licenses are not necessarily distributed to the most efficient producer but, instead, to the earliest entrant.¹⁴⁴ If licenses can be assigned by one firm to another, then this poses little problem on efficiency grounds, except for additional negotiation costs.¹⁴⁵ When this happens, the most efficient miners are willing to bid up to the true economic rent to obtain the license from the first licensee. Conservation is served, although the public does not receive the rent. The license-permit systems found in both DSHMRA and the proposed NSHMA have been formulated by the mining industry and clearly are offspring of the location-patent system.¹⁴⁶ OCSLA and DSHMRA permit the reassigning of licenses with government oversight, and NSHMA provides for reassignment by the resource manager.¹⁴⁷

The Effect of Legal Uncertainty. Deep seabed mining is a case where, legally, the federal government cannot sell the mineral property, the deep seabed, because it has no ownership or legal control of the resources there.¹⁴⁸ According to the Law of the Sea Convention, the resources of the deep seabed are considered the "common heritage of mankind."¹⁴⁹ Although the United States has not signed this convention,¹⁵⁰ it still is

experience with the leasing of solid minerals, like phosphates, or fossil fuel minerals, like coal, could prove useful. Compare the above sources with Harris, however, who advocates a noncompetitive leasing system for onshore hard minerals. Deverle P. Harris, "Some Issues and Principles for the Design of Alternatives to the Location/Patent System for 'Locatable Minerals' on Public Lands," 4 *Materials and Society* 67 (1980).

143. Robert H. Nelson, "The Public Lands," (Paul Portney and Ruth Haas, eds.), *Current Issues in Nat. Res. Pol'y* 37 (1982). Alternative procedures that collect rents would reduce the level of encouragement.

144. Mead, 3 *Econ. Min. Indus.* 650 (cited in note 28).

145. Eckert, 17 *J. L. Econ.* 170 (cited in note 142).

146. *Ocean Manganese Nodules* at 62 (cited in note 91). NSHMA provisions have been modeled closely after DSHMRA. Greenwald, *Prepared Statement* (cited in note 139).

147. OCSLA, 43 U.S.C. § 1337(e) (1982); DSHMRA, 30 U.S.C. § 1425(b) (1982); NSHMA § 312(b) (1988) (cited in note 19). Provision for reassignment of licenses or permits was left out of earlier drafts of the NSHMA bill possibly in order to preclude government oversight of transfer or assignment, which might be considered a hindrance to sale or transfer of entitlements. See Swenson, 1 *Nat. Res. J.* 274, n. 22 (cited in note 107).

148. *Convention on the High Seas*, Apr. 29, 1958, arts. 1, 2; 13 U.S.T. 2312; T.I.A.S. 5200; 450 U.N.T.S. 82.

149. *United Nations Convention on the Law of the Sea of 1982*, Part XI, § 2, art. 136; U.N. Doc A/Conf. 6/122 of Oct. 7, 1982; 21 *ILM* 1261, 1293.

150. As of Dec. 31, 1986, 159 nations had signed the convention, and, of these signatories, 35 have ratified it. United Nations, Office of Ocean Affairs and Law of the Sea, *Status of the United Nations Convention on the Law of the Sea*, 10 *Law of the Sea Bulletin*, at 6 (Nov. 1987).

unable to claim ownership of deep seabed mineral occurrences. Instead, the United States considers development of the minerals of the deep seabed to be a "high seas freedom."¹⁵¹ As a result, a system of licenses and permits, which provide exploration and commercial recovery rights to U.S. licensees but do not involve property right transfers, has been established to provide access for private firms to these high seas resources.¹⁵²

There is no reason why a competitive bidding access method could not have been employed for deep seabed licenses.¹⁵³ However, legal uncertainty is inevitable under any type of access system set up by the United States for an area that is not owned or controlled by the United States. In this case, the encouragement inherent in the DSHMRA license-permit system (potential rents) can be viewed as a counterbalance to legal as well as existing geologic uncertainty.

Ocean hard mineral mining on the "national seabed" is related to the case of deep seabed mining. The outer Continental Shelf lands are not true "public lands" owned by the federal government and thus are not subject to the traditional constitutionally-authorized disposal.¹⁵⁴ Congress, however, in enacting OCSLA, declared that outer Continental Shelf lands "appertain" to the United States and are subject to its "jurisdiction, control, and *power of disposition*" (emphasis added).¹⁵⁵ Under OCSLA,

151. In enacting DSHMRA, Congress found "that exploration for and commercial recovery of hard mineral resources of the deep seabed are freedoms of the high seas. . . ." DSHMRA, 30 U.S.C. § 1401(a)(12) (1982). See, Theodore K. Kronmiller, Legal Regimes for Mining Hard Rock Minerals Within 200 Miles, Proceedings Oceans '82 at 1209 (1982). Congress also found that the United States had supported a United Nations General Assembly Resolution declaring the minerals of the deep seabed as the common heritage of mankind *but* "with the expectation that this principle would be legally defined under the terms of a comprehensive international Law of the Sea Treaty yet to be agreed upon." DSHMRA, 30 U.S.C. § 1401(a)(7) (1982). The definition of common heritage now included in the LOS Convention, with its attendant mining code, apparently does not prevent the United States from maintaining that deep seabed mining is a high seas freedom, irregardless of the findings of Congress written into DSHMRA.

152. Goldie argues that deep seabed mining entitlements under DSHMRA are analogies to usufructs (the right to enjoy the "fruits" belonging to another) and are not territorial in nature. L.F.E. Goldie, Title and Use (and Usufruct)—An Ancient Distinction Too Oft Forgotten, 79 Am. J. Int'l. L. 689 (1985).

153. Unless miners consider the legal status of licenses to be inferior to that of leases, causing increased uncertainty and associated costs and reducing true economic rent. See also, note 114.

154. The term "public lands" means any land and interest in land owned by the United States within the several States and administered by the Secretary of the Interior through the Bureau of Land Management, without regard to how the United States acquired ownership, except—(1) lands located on the Outer Continental Shelf; and (2) lands held for the benefit of Indians, Aleuts, and Eskimos." FLPMA, 43 U.S.C. § 1702(e) (1982). This point recently has appeared in a debate between committees in the House of Representatives concerning legislative jurisdiction over OCSLA. The House Merchant Marine and Fisheries Committee, in arguing for its jurisdiction over OCSLA, claimed that the responsibility of the Committee on Interior and Insular Affairs over "public lands" provided no basis for its interest in offshore lands because the OCS does not constitute "public land." The Omnibus Budget Reconciliation Act of 1985, H. Rep. No. 300, 99th Cong., 1st Sess. 586, 591 (1985).

155. OCSLA, 43 U.S.C. § 1332(1) (1982).

then, the federal government can dispose of OCS minerals, through leases, to private firms.¹⁵⁶

According to an early version of the NSHMA proposal, the "seabed of the United States is subject only to the jurisdiction and control of the United States."¹⁵⁷ Absent a stated congressional power of disposition, it would be impossible under the NSHMA proposal to transfer property rights by lease to ocean hard mineral properties on the national seabed. Like the deep seabed, however, it appears that mining activities could be licensed on the national seabed. This implies the somewhat unexpected and possibly objectionable result of increased legal uncertainty associated with a new national seabed jurisdiction, that is, a weaker national claim than the OCS jurisdiction and control that includes the power of disposition. On a more mundane level, the absence of a congressionally-authorized disposition power in NSHMA works to the advantage of the hard minerals concerns who prefer licenses to leases.¹⁵⁸

There is no reason why licenses for national seabed hard minerals could not be issued competitively, so that access is allocated to the most efficient producer.¹⁵⁹ However, due to the relatively high level of geologic uncertainty and the current low level of industrial interest and activity in ocean mining, expected economic rents could be low or even nonexistent. To compensate for the lack of rents, methods other than bonus bidding that allocate access competitively, such as profit share bidding,¹⁶⁰ and work commitment bidding,¹⁶¹ among others, have been suggested.¹⁶² In general, these methods of access impose enforcement and other administrative costs that are not encountered in a license-permit system. Moreover, there may not be enough commercial interest to hold a competition for enti-

156. See note 120 and accompanying text.

157. NSHMA, § 102(a)(5) (1987). In the amended version of the bill (NSHMA (1988)), references to "jurisdiction and control" were deleted and emphasis was placed on the "sovereign rights and jurisdiction of the United States within the Exclusive Economic Zone, to the extent permitted by international law without prejudice to the policies of the United States concerning the outer Continental Shelf. . . ." NSHMA § 102(A)(1) (1988) (cited in note 19).

158. NSHMA could be redrafted to include disposal authority, but the existing distinction favors those interests that seek a license-permit system.

159. Unless Congress determines that inducements (potential rents) should be provided for ocean hard mineral development within the EEZ. Although mineral properties, under NSHMA legally may not be "subject to disposition" in the EEZ, one might postulate that, with respect to citizens of other countries, the legal uncertainty of entitlements there would be less than on the deep seabed.

160. Brooks, 8 Nat. Res. J. 421 (cited in note 30); Mead, 3 Econ. Min. Indus. 671 (cited in note 28).

161. NAS Panel at 57 (cited in note 72). Using the case of oil shale as an example, Rooney suggests the use of "competitive research expenditure bidding" (a type of work commitment bidding) in situations where "considerable research, or exploration in virgin territory, is expected to be necessary before a known mineral deposit will be economic, or the presence of mineral deposits will be proven." Robert F. Rooney, Competitive Bidding for Mineral Leases, 8 Nat. Res. J. 650 (1968).

162. A detailed analysis of the benefits and costs of these access methods is beyond the scope of this article. See Mead, 3 Econ. Min. Indus. 671 (cited in note 28).

tlements. Whether or not the potential administrative costs of these alternative methods exceed the "earliest entrant" potential inefficiency of the license-permit method remains a question for further research.¹⁶³

Revenue-Generating Measures

Rarely are public minerals allocated solely on the basis of outright sale.¹⁶⁴ Instead, a variety of alternative revenue-generating measures have been employed to capture a portion of a financial rent for the public.¹⁶⁵ There is little available evidence to indicate the basis for the rates or sizes of revenue generators such as royalties and rentals. Tradition certainly plays an important role, and there is some evidence that royalties for leased minerals on the U.S. public lands may be based on the going private rate at the time they are incorporated into legislation.¹⁶⁶ Figure 3 describes revenue generating measures for existing and proposed ocean mining codes.

OCSLA

Under OCSLA, the Secretary of Interior has the authority to determine the most appropriate revenue-generating measures for hard minerals on the outer Continental Shelf.¹⁶⁷ For OCS hydrocarbon, sulfur, and salt minerals, bonuses are collected from competitive lease sales and royalties are collected upon production.¹⁶⁸ The bonuses are the highest of those bid on any particular lease area or tract, if they are above a minimum

163. At a low level of activity, the social costs of nonconservation may be small. Broadus, Prepared Statement (cited in note 73). It is interesting to speculate that incentives could exist for public managers to prefer access methods that incur higher administrative costs, because these methods might increase their levels of responsibility and program budgets. See generally William A. Niskanen, *Competition Among Government Bureaus* (Carol H. Weiss & Allen H. Barton, eds.), *Making Bureaucracies Work* (1980). Alternatively, Nelson, *The Making of Federal Coal Policy at 229* (cited in note 32), mentions that public mineral management may have an "existence value" for progressivists.

164. Common varieties of public minerals like sand and gravel on the U.S. public lands are sold in place. 30 U.S.C. §§ 601-615 (1982).

165. Discussions of alternative revenue generating mechanisms can be found in U.S. General Accounting Office (GAO), *Congress Should Extend Mandate to Experiment with Alternative Bidding Systems in Leasing Offshore Lands 92-98* (1983) and Mead, Moseidjord, Muraoka and Sorenson, *Offshore Lands* (cited in note 136).

166. Interview with Thomas Walker, Director, Solid Mineral Leasing Division, Bureau of Land Management, U.S. Dept. of the Interior (September 1986). See also Nelson, *The Making of Federal Coal Policy at 26* (cited in note 32); U.S. General Accounting Office (GAO), *Interior Should Continue Use of Higher Royalty Rates for Offshore Oil and Gas Leases 9* (1982).

167. OCSLA, 43 U.S.C. § 1337(k) (1982).

168. Detailed statistical information on revenues that have been generated from ocean mineral entitlements can be found in: Minerals Management Service, *Federal Offshore Statistics* (1984) (cited in note 61).

FIGURE 3
Revenue Generators for Ocean Mineral Entitlements

	<i>OCSLA Hydrocarbon Minerals</i>	<i>1986 Proposed OCSLA Hydrocarbon Minerals</i>	<i>1954-1969 OCSLA Sulfur and Salt</i>	<i>1974 Proposed OCSLA Phosphorites Sand/Gravel</i>	<i>1983 Proposed OCSLA Arctic Sand/Gravel</i>	<i>1983 Proposed OCSLA Gorda Ridge MPS</i>	<i>DSHMRA Manganese Nodules</i>	<i>1986 Proposed NSHMA Hard Minerals</i>
Bonus	yes	yes	yes	yes	yes	yes	no	no
Minimum Bid per Acre	\$150	\$25	1954: \$15 1965: \$25 1969: None	unknown	\$25	unknown	no	no
Bonus Credit	none	none	none	none	none	50-90% of bonus ^a	none	none
Bonus Deferral	none	80% over 5 year period	80% over 5 year period	none	unknown	deferral ^b unspecified	none	none
Rental or Minimum Royalty per Acre	\$3	sliding scale or contingent	1954: \$2 1965: \$3 1969: \$3	\$0.10 Expl. \$0.25 Devlp. \$1.00 Prdct.	\$1	escalating: \$0.10-1.00	none	none
Minimum Royalty Credit	on royalty	on royalty	on royalty	on royalty	on royalty	possible up to minimal acceptable level of work	none	none
Royalty	floor: 12.5%; up to 33.3%	floor: 12.5%	1954: 7.5% 1965: 10.0% 1969: 15.0%	2.0% of Gross Value of Production	none specified	3-5% of gross product	see: "Tax"	ceiling: 12.5% of recovered resource value
Royalty Renegotiation	public manager's discretion	public manager's discretion	unknown	unknown	unknown	possible after 10-20 years	none	unknown
Royalty Credit	none	none	none	none	none	up to 50% for unusual depth or distance	none	unknown
Tax	none	none	none	none	none	none	0.75% of "fair market value"	none
Fee	none	none	none	none	none	none	Lic.: \$100,000 Pmt: \$100,000	reasonable fee for license and permit

^aCredits against bonuses proposed for prespecified work commitments by lessee. Possible credits against pre- and post-lease exploration and development expenditures.
^bPossible "split" bonus payments divided equally over ten year exploration period or deferral of all or portion of bonus.

bid for the tract, as predetermined by the government.¹⁶⁹ The royalty levels vary: oil and gas royalties cannot be less than 12.5 percent "in amount and value of production saved, removed, or sold" and, depending upon the operating environment, usually are 16.7 percent.¹⁷⁰ In a few limited instances, royalties on large, nearshore deposits have been as high as 33.3 percent.¹⁷¹ The deeper water and "frontier" tracts may carry a lower royalty rate.¹⁷² Sulfur and salt lease royalties are not less than five percent, as determined by the Secretary.¹⁷³ Rentals of three dollars per acre leased also are collected under OCSLA.¹⁷⁴ Subsequent to discovery of a commercial mineral deposit, minimum (or "advance") royalties may be charged. Similar to rentals, minimum royalties are a set charge per acre-year, usually specified in a lease.¹⁷⁵ Rentals and minimum royalties are types of performance requirements, as well as revenue generators, and these two revenue measures will be discussed in greater depth in the next section.

In only one case were leases issued for hard minerals (phosphorites) under OCSLA.¹⁷⁶ The leases involved bonuses of \$122,000 (1961) on six tracts totalling 30,240 acres; a royalty rate of five percent of gross value but not less than 30 cents per short-ton; escalating rentals of 50 cents per acre-year for the first two years and one dollar per acre-year thereafter; and minimum royalties of two dollars per acre-year.¹⁷⁷ The lease terms and lease form were based upon a standard OCS sulfur lease.¹⁷⁸

169. In 1982, minimum bids were raised from \$25 to \$150 per acre. The Minerals Management Service recently has analyzed the minimum bid policies. Minerals Management Service, Analysis of Outer Continental Shelf Minimum Bid Policies, 51 Fed. Reg. 5110 (1985) (request for comments). For a summary of the methods used by Minerals Management Service in determining fair market value for OCS leases, see U.S. General Accounting Office (GAO), Early Assessment of Interior's Area-Wide Program for Leasing Offshore Lands, 28-42 (1985).

170. The size of the royalty and the form in which it is paid are determined by the Secretary of the Interior. OCSLA, 43 U.S.C. § 1337(a)(1)(A) (1982). See also, U.S. Dept. of the Interior, Minerals Management Service, Oil & Gas Leasing/Production Program, Annual Report/FY 1986 (1987).

171. GAO, Interior Should Continue Use of Higher Royalty Rates for Offshore Oil and Gas Leases at 9 (cited in note 166).

172. U.S. Congress, Office of Technology Assessment (OTA), Oil and Gas Technologies for the Arctic and Deepwater 156 (1985).

173. 30 C.F.R. § 202.152 (1986).

174. Telephone communication with Sandy Seim, Sales Activities Bureau Chief, Minerals Management Service, Washington, D.C. (Oct. 1986).

175. 30 C.F.R. § 202.151 (1986).

176. On Dec. 15, 1961, sixteen phosphorite leases were offered off the coast of California on the federal OCS through OCSLA. Collier Carbon and Chemical Corporation, a subsidiary of Union Oil of California, obtained six leases. During exploration the firm discovered unexploded naval ordinance on its leases. Collier terminated its operations and succeeded in obtaining a reimbursement for the bonuses and rentals. Phosphate Lease File (cited in note 79).

177. *Id.* Expressed in 1987 dollars, these figures would be: bonuses of \$463,491 (an average of \$77,248 per tract); rentals on all six tracts totalling \$57,443 per year for the first two years (an average of \$9574 per tract) and totalling \$114,885 per year thereafter (an average of \$19,148 per tract); and minimum royalties of \$229,770 per year (an average of \$38,295 per tract).

178. *Id.* Memorandum from Thomas J. Cavanaugh, Associate Solicitor, Division of Public Lands, U.S. Dept. of the Interior to unnamed Assistant Director, Operating Services, BLM, U.S. Dept. of the Interior (Oct. 18, 1961) (discussing the form of the phosphate lease).

Subsequent proposals for hard mineral revenue generators have shown considerable variety.¹⁷⁹ In 1983, the Gorda Ridge draft EIS mentioned the possibility of employing "offsets" (credits) for bonuses or rentals that might be established under leases for marine polymetallic sulfide minerals.¹⁸⁰ For OCS oil and gas and sulfur leases, minimum royalties may be credited against true royalty payments once production is initiated.¹⁸¹ Since 1981, in developing its OCS hard minerals regulations, MMS did examine the possibility of allowing documented prospecting costs to be credited against bonuses.¹⁸² MMS decided to abandon the concept of incentives for prospecting¹⁸³ but still may consider the crediting of post-lease exploration costs against rentals or bonuses.¹⁸⁴ In addition, MMS has considered the deferral of bonus payments on a lease for up to a ten-year period.¹⁸⁵

DSHMRA and NSHMA

Under DSHMRA, no royalties are collected, but instead a tax on the imputed value of production is imposed.¹⁸⁶ The tax may be understood generally as a royalty, in the sense that it is exacted from production, although it may be treated differently for general corporate income tax purposes.¹⁸⁷ Viewed from this perspective, the U.S. seabed mining "royalty" is three-quarters of a percent of the value of production.¹⁸⁸ This tax revenue, when collected, is held in a trust fund account in the U.S. Treasury, pending the entry into force of the Law of the Sea Convention (LOS) for the United States. If this treaty is signed and ratified, the trust funds will be transferred to an International Seabed Authority.¹⁸⁹ Although the LOS "mining code" is not described in detail here, it is interesting to note that its "production charge" (royalty) is between 5 and 12 percent.¹⁹⁰ No other revenue generating mechanisms are employed by

179. BLM at 303-362 (cited in note 80); Minerals Management Service, Gorda Ridge DEIS at 391-140 (cited in note 7).

180. Minerals Management Service, Gorda Ridge DEIS at 400 (cited in note 7).

181. Seim, telephone communication (cited in note 174).

182. Stone & MacGillvray, 4 Circum-Pacific Energy and Min. Conf. (cited in note 9).

183. Minerals Management Service, 52 Fed. Reg. at 9761 (1987) (cited in note 25).

184. Stone & MacGillvray, 4 Circum-Pacific Energy and Min. Conf. (cited in note 9).

185. *Id.* Deferred bonus payments are possible for hydrocarbon leases as well. Deferred payment schedules are published in the notice of an OCS lease sale appearing in the Federal Register. 30 C.F.R. 260.110(a)(1)(iii)(1987).

186. Deep Seabed Hard Mineral Removal Tax Act of 1979 (DSHMRTA), 26 U.S.C. §§ 4995-4498 (1982).

187. Royalties generally are treated as a deductible cost for corporate income tax purposes. Terry S. Maley, Handbook of Mineral Law 669 (1983).

188. DSHMRTA, 26 U.S.C. §§ 4495(b), 4497(a) (1982) (cited in note 186) (The amount of the tax is 3.75% of the imputed value of the resource removed. "Imputed value" means "20 percent of the fair market value of the commercially recoverable metals and minerals." Thus the tax is equivalent to 0.75% of production).

189. DSHMRA, 30 U.S.C. § 1472(b),(d) (1982).

190. Under the LOS Convention, the seabed miner can choose between paying a production charge only or paying a combination of the production charge and a share of net proceeds (profit

DSHMRA, although fees are charged to cover the administrative costs of processing license and permit applications. NOAA charged a license fee of approximately \$100,000 for each of the four exploration licenses it issued in 1984.¹⁹¹

NSHMA proposes to generate revenues with a royalty upon recovery of hard mineral resources of 12.5 percent.¹⁹² The royalty would be based upon the "gross value of the hard mineral resource at the point of severance or extraction" and, presumably, determined on an individual permit basis.¹⁹³ In addition, the bill provides that the resource manager can increase the royalty rate "to achieve a fair and equitable return to the United States for the value of the rights and privileges received under the permit" or decrease the rate either to make economic recovery feasible or to enhance recovery for national security purposes.¹⁹⁴ No bonuses or rentals would be collected under NSHMA, but a "reasonable" administrative fee and a fee for certification would be charged for both exploration license and commercial recovery permit applications.¹⁹⁵

Bonanzas and Dry-Holes

If either bonus payments or outright sale of a mineral property appear an efficient means of both achieving conservation and generating revenues for the public, why are other forms of rent capture, such as royalties, employed? The answer can be found in the degree of geologic uncertainty associated with the disposal of minerals.¹⁹⁶ Both the government and the private developer face uncertainty. The government faces a kind of uncertainty that has been termed the "bonanza complex."¹⁹⁷ Under a pure bonus system, if the government receives a low-bonus payment for the sale of a mineral entitlement, and the private developer subsequently

share). Formulas for the determination of charges and shares are found at United Nations Convention on the Law of the Sea of 1982, U.N. Doc. A/Conf. 6/122 of Oct. 7, 1982; 21 ILM 1261, 1330. Annex III, art. 13(4), (5), (6). Other revenue generators include rentals of \$1 million per year, which can be credited against production charges or profit shares [Annex III, art. 13(3)] and administrative fees of \$500,000 for processing applications for plans of work [Annex III, art. 13(3)].

191. See 15 C.F.R. § 970.208 (1988).

192. NSHMA, § 308(a)(2)(A) (1988). The earlier version of the bill called for a 12.5% royalty "based upon the profitability of commercial recovery operations." This provision resembled a profit share arrangement. The administrative costs associated with a profit share royalty (namely the determination of profit) are potentially high. See, Jones, Mead & Sorenson, 19 Nat. Res. J. 900 (cited in note 132).

193. NSHMA, § 308(a)(2)(A) (1988).

194. NSHMA, § 308(a)(2)(B) and § 308(a)(2)(C) (1988). It is not clear whether or not the resource manager might have the ability to modify the royalty during the permit period.

195. NSHMA, § 305(b) and § 304(d) (1988).

196. McDonald, *The Leasing of Federal Lands for Fossil Fuel Production* at 38-39 (cited in note 60).

197. Herbert D. Drechsler, *The Value of Subsea Mineral Resources*, 6 L. Sea Inst. Proc. 115 (1971).

discovers a bonanza (a large or high-grade deposit), then the government may be unable to capture rent that exceeds the bonus.¹⁹⁸ Resource managers may then face political problems because of perceived "poor management" or "give-aways" of public mineral assets.¹⁹⁹ Thus royalties, which capture a portion of the rent over the full production period, are a mechanism that the government uses to hedge against the likelihood of the appearance of unanticipated rents.

The private firm, conversely, faces the possibility that it pays a bonus upfront but is unsuccessful in making a commercially-feasible discovery. To handle this uncertainty, private firms usually assign a premium to their predicted costs of mineral development.²⁰⁰ This uncertainty premium cuts into any economic rent and thereby reduces the size of a bonus. An access method that employs royalties provides the private firm with a hedge against a "dry-hole" event and thus reduces the size of the uncertainty premium (although the bonus may stay low as well).²⁰¹ Fixed royalty payments increase the average cost of production uniformly over time and act to cause premature abandonment of mineral deposits. Yet by reducing the costs associated with uncertainty, royalties might capture a larger portion of true economic rent than bonus payments employed alone.²⁰² The use of a sliding scale royalty, in which royalties gradually decrease over time and approach zero at the socially efficient point of abandonment, theoretically captures the entire rent, although administrative costs are potentially high.²⁰³

There may be an optimal combination of bonus payments and royalties for each entitlement.²⁰⁴ Resource managers might consider the combination of revenue generators that tend to capture the most rent and minimize uncertainties. This "flexibility" could be accomplished at several different scales: at the lease or permit level,²⁰⁵ for each lease sale,²⁰⁶ between areas where relative geologic understanding differs,²⁰⁷ or over

198. Drechsler makes the cogent point that "(t)he writers of the draft (LOS Convention) ignored the situation of no rent. The fact that there is now only small production of seabed derived mining products tends to give an intimation that the ore may be marginal with little available rent." *Id.*

199. One recent example of the bonanza complex concerns the sale of federal coal in the Powder River Basin, Montana. For a case history of this sale, which includes potential conspiracy as an added twist, see Commission on Fair Market Value Policy for Federal Coal Leasing, Report 374 (1984).

200. This premium may be incorporated into higher requirements for private return on investment. McDonald, *The Leasing of Federal Lands for Fossil Fuel Production* at 39 (cited in note 60).

201. *Id.* at 40.

202. *Id.*

203. *Id.* at 38.

204. *Id.* at 41. In fact, a "fair" market value may be hard to determine with any reasonable amount of precision. And the assignment of an appropriate royalty rate may be just as difficult.

205. See text accompanying note 321.

206. See text accompanying note 322.

207. See text accompanying notes 323-25.

time as learning takes place.²⁰⁸ For OCS oil and gas leasing, the Secretary of the Interior has experimented with the use of different royalty rates²⁰⁹ and has adjusted, from time to time, the minimum bid requirements of leases.²¹⁰

Exploration Offsets

For ocean hard minerals on the OCS, we expect no rents or only small rents because of the high costs involved in their discovery, exploration, and extraction relative to alternative sources of supply. OCSLA requires the leasing of ocean hard minerals by competitive bonus bid and gives the Secretary of the Interior discretion in the setting of a royalty.²¹¹ Although the Secretary might consider setting a zero royalty, we expect that the royalty will be nonzero because of the bonanza complex. However, with little or no expected rents and with the likelihood of a royalty structure in place designed to exact at least some rents, a competitive bonus bid lease sale might attract little bidding interest.

Consideration by MMS of offsets or credits for documented prospecting or exploration costs is an inventive solution to the problem of the disposal of minerals that are believed to be only marginally productive.²¹² Under the offset approach, private firms could include estimates of their exploration expenses in their bids and, in effect, bids would become the sum of estimated rents and exploration costs.²¹³ Nevertheless, this approach is not necessarily consistent with a goal of economic conservation because it cannot claim to select, in every case, the firm with the lowest combined costs of exploration, development and production.

As shown in Figure 4, assume that all bidders have identical development and production costs and that each bidder estimates the same gross discounted in-place value for an entitlement.²¹⁴ As is the case with

208. See text accompanying notes 326-27. See also Broadus, Prepared Statement (cited in note 73).

209. GAO, Interior Should Continue Use of Higher Royalty Rates for Offshore Oil and Gas Leases at 9 (cited in note 166).

210. Minerals Management Service, Analysis of Policies to Encourage Leasing, Exploration, and Production on the Outer Continental Shelf, 51 Fed. Reg. 39,810 (1986) (request for comments).

211. OCSLA, 43 U.S.C. § 1337(k) (1982).

212. Stone & MacGillvray, 4 Circum-Pacific Energy and Min. Conf. (cited in note 9). The concept of offsets or credits was suggested in Minerals Management Service, Gorda Ridge DEIS at 395 and 399-400 (cited in note 7). This concept currently is under study within the Interior Department and has not yet been proposed officially as a potential approach to the leasing of ocean hard minerals. Personal communication with Timothy J. MacGillvray, Minerals Economist, Ofc. of Strategic and International Minerals, Minerals Management Service, Long Beach, Calif. (Jan. 8, 1987). Prelease prospecting rules proposed by the Minerals Management Service in 1987 made no mention of offsets or credits. Minerals Management Service, 52 Fed. Reg. at 9761 (cited in note 183).

213. Stone & MacGillvray, 4 Circum-Pacific Energy and Min. Conf. (cited in note 9).

214. This approach follows the conceptual "model of rent estimation" of Jones, Mead & Sorenson, 19 Nat. Res. J. 894 (cited in note 132). Several assumptions are necessary in this type of representation: (1) there is no uncertainty involved in determining the net present value (NPV); (2) negotiation costs involved in holding a lease sale and the transfer of an entitlement are constant

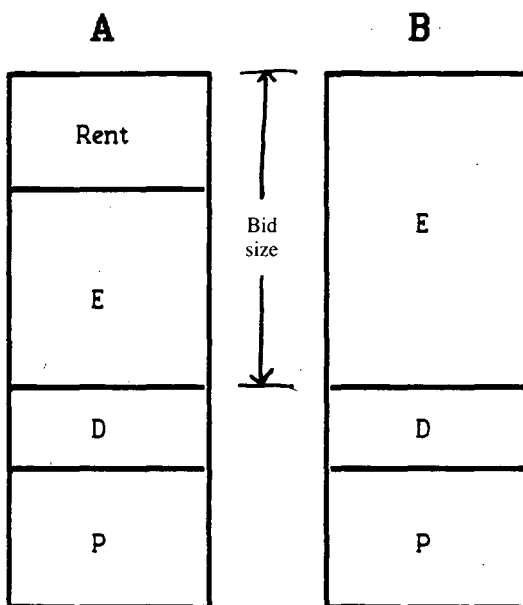


FIGURE 4

A simplified case of exploration offset bidding, where two bidders A and B make identical estimates of the gross net present value of a lease. E, D and P represent respectively the estimated costs of exploration, development, and production. Under a strict bonus bidding case, without royalty charges, bidder A could bid its perceived rent as a bonus and win the entitlement. Under exploration offset bidding, both bidders make identical bids because they are permitted to include estimated costs of exploration in their bids.

any auction, no firm with combined exploration, development, and production costs greater than the estimated net present value of an entitlement would submit a bid. Even though exploration costs may represent a substantial proportion of the dollar amounts of bids, all firms would bid both exploration costs and perceived rents, without regard to the relative amounts of each. It is possible that a marginal firm (one who perceives zero rent) would bid only its estimated exploration costs. As seen in Figure 4, bidder A is more efficient because the total of its exploration and extraction costs is less than bidder B. Yet both firms would make identical bids because the sum of exploration costs and potential rents are the same in each bidder's case.²¹⁵ In this situation the resource manager

across bidders (uniformly reduce NPV) and are not represented explicitly in the figure; (3) the royalty faced by bidders in their decision to bid is constant and is either not represented explicitly in the figure or is assumed to be a portion of each firm's production costs (note that the royalty charge also might represent a social cost because it could force the premature abandonment of a deposit); and (4) a normal profit to the firm is included in the firm's costs.

215. Note that under these conditions bidders with lower costs of development and production would be able to outbid others and win the lease, even if their exploration costs are so high that they perceive zero rent. (There still exists a problem in this scenario with the selection of the inefficient firm.)

would have to use some other criterion on which to allocate the lease.²¹⁶

A bidding system that incorporates exploration offsets closely resembles a work commitment bidding system. Under the work commitment approach, firms present their bids in the form of exploration or development plans. (An exploration offset would be equivalent to the cost of an exploration plan but would not include the plan itself.) The resource manager then selects the plan that is most likely to achieve the goals of the mining code. Noncompetitive work commitments have been used in Canada, the United Kingdom, and Norway for offshore leasing of hydrocarbon minerals.²¹⁷ A scheme for competitive work commitment bidding was incorporated into OCSLA when it was amended in 1978, but this type of bidding has never been used.²¹⁸

Where resource knowledge is lacking, work commitments appear to be a reasonable way for resource managers to gain knowledge about public assets, but there can be disadvantages.²¹⁹ As is the case with exploration offsets, the primary problem is that there is no guarantee that work commitment bidding system will select the most efficient explorer. In fact, an incentive may exist for firms to inflate exploration costs, and there may be significant administrative costs associated with government monitoring of exploration expenses.²²⁰

The genius of a competitive bid system is that it is designed both to select the most efficient miner and to collect a portion of the economic rent for the resource owner. The use of exploration offsets would seem most suited to the leasing of offshore deposits for which there exists little resource information and a high degree of geologic uncertainty. Under these conditions, it is possible that private firms would perceive no rents or only small rents and any social costs incurred from the selection of a firm that is not the most efficient would be minor. Indeed, if the knowledge gained by the resource manager through the use of a bidding system that includes exploration offsets increased the probability that the manager would capture rents in the future, these future returns might well outweigh the initial inefficiency losses. At the same time, this would require that management flexibility be built into the mining code so that the resource manager would have the ability to shift to a different method of allocating entitlements and capturing rents on future disposals.²²¹

216. One possible criterion would be a subjective evaluation of the qualifications of the bidder. OCSLA 43 U.S.C. § 1337(k) (1982) specifies that the Secretary of Interior may grant leases only to "qualified persons." Among equally qualified bidders, established operating experience or other criteria might be used, although there is no precedent in the Act for this kind of allocation decision. Another alternative could be to give the winning bidders the option to explore and develop the lease jointly.

217. OTA, *Oil and Gas Technologies* at 216 (cited in note 172).

218. OCSLA, 43 U.S.C. § 1337(a)(1)(G) (1982).

219. Jones, Mead & Sorenson, 19 *Nat. Res. J.* 904 (cited in note 132).

220. *Id.*

221. See notes 319-38 and accompanying text.

Performance Requirements

Performance requirements²²² are another basic characteristic of a mining code. They can be defined as a set of legal requirements incorporated into a system for mineral disposal that require the dedication of economic resources toward the definition and development of a mineral deposit within a prespecified area and time period.²²³ The rationale behind performance requirements is that the resource "owner" (the government) requires an expeditious return on the development of its mineral assets. Nonperformance runs counter to the resource manager's prescribed development plan.²²⁴ When the government wants public minerals to be developed, performance requirements can be useful tools to assure their development. The government might want to control the pace of ocean hard minerals development in order to achieve the several policy goals discussed above.²²⁵ Figure 5 identifies performance requirements and compares them across both existing and proposed ocean mining codes.

Requirements. OCSLA, DSHMRA, and NSHMA contain requirements to conduct operations diligently, that is to apply steady, continuous effort toward the working of a mineral deposit.²²⁶ In DSHMRA and NSHMA, these "due diligence" requirements are outlined and explained in more detail in the terms, conditions, and restrictions that would attach to licenses and permits.²²⁷ In all three mining codes, failure to conduct operations with due diligence could affect an operator's reputation, and hamper his ability to obtain future development rights.²²⁸ OCSLA also

222. This section is based substantially upon: Porter Hoagland III, *Performance Requirements in Ocean Mineral Development*, 9 *Marine Policy Reports* 5 (1987).

223. Performance requirements are sometimes equated with "due diligence" requirements. See DSHMRA, 30 U.S.C. § 1418 (1982). However, performance requirements are a more general category of requirements that encourage the employment of factors of production in mineral development and that include due diligence requirements as a subset.

224. Nelson, *The Making of Federal Coal Policy* at 53 (cited in note 32).

225. See notes 57-78 and accompanying text.

226. In an early case, concerning water rights, the Supreme Court of Nevada defined the term: "Diligence is defined to be the 'steady application to business of any kind, constant effort to accomplish any undertaking.' The law does not require any unusual or extraordinary efforts, but only that which is usual, ordinary, and reasonable. The diligence required in cases of this kind is that constancy or steadiness of purpose or labor which is usual with men engaged in like enterprises, and who desire a speedy accomplishment of their designs. . . . It is the doing of an act, or series of acts, with all practical expedition, with no delay, except such as may be incident to the work itself." *The Ophir Silver Mining Company v. Carpenter*, 4 Nev. 534, 546 (Helm 1868) (work to construct a ditch for the purpose of appropriating water rights found not prosecuted with reasonable diligence and thus subsequent attempt at appropriation held invalid).

227. See, e.g., U.S. Dept. of Commerce, National Oceanic and Atmospheric Admin. (NOAA), *Deep Seabed Hard Mineral Resources Exploration License USA-3*, Docket No. 401, Attachment A (August 29, 1984). Exploration license applications, amendments to the applications, exploration licenses, amendments to the licenses, and terms, conditions, and restrictions of the licenses are kept on file at the Ofc. of Ocean Minerals and Energy, NOAA, Washington, D.C.

228. OCSLA, 43 U.S.C. § 1337(d) (1982); DSHMRA, 30 U.S.C. § 1413(c)(3) (1982); NSHMA § 304(b)(4) (1988) (cited in note 19).

FIGURE 5
Performance Requirements in Ocean Hard Mineral Entitlements

	<i>OCSLA</i>	<i>DSHMRA</i>	<i>H.R. 5464</i>
Due Diligence	yes	yes	yes
Bond	\$50,000 per lease or \$300,000 per "area"	none	none
Rental/ Minimum Royalty	\$741/sq km/year	none	none
Term	5-10 years for exploration, production limited only by ability to produce in paying quantities (or drilling or well-reworking conducted)	10 years plus extensions for exploration, 20 years for commercial recovery or more if commercially feasible	10 years plus one extension for exploration, 20 years for commercial recovery or more if commercially feasible
Area	23 sq km or as determined by the public manager	variable, but approximately 150,000 sq km	unlimited?
Partial Relinquishment	proposed in 1974 for phosphorites and sand/gravel	possible through transition from license to permit within "logical mining unit"	possible through transition from "logical exploration unit" to "logical recovery unit"
Expenditure Requirements	none	exploration and commercial recovery	exploration only
Plans	exploration and development/ production	exploration and commercial recovery	exploration and commercial recovery
Reports	monthly operations	annual	none
Affect on Reputation	yes	yes	yes

*(Current performance requirements for OCS hydrocarbon minerals).

requires the posting of performance bonds of \$50,000 per lease or \$300,000 per leasing area, which could be forfeited if the posting firm is nondiligent.²²⁹

All three existing or proposed mining codes limit the period of time in which exploration and development and production (or commercial recovery) may occur.²³⁰ DSHMRA and NSHMA allow extensions for exploration activity upon approval from the resource manager.²³¹ Each

229. 30 C.F.R. § 256.58 (1987).

230. OCSLA, 43 U.S.C. § 1337(b)(2) (1982); DSHMRA, 30 U.S.C. § 1417 (1982); NSHMA § 309 (1988).

231. DSHMRA, 30 U.S.C. § 1417(a) (1982); NSHMA § 309(a) (1988).

mining code allows production or commercial recovery to continue as long as commercially viable.²³² Although not technically a performance requirement, area size limits define the locus of activities subject to performance requirements. Oil and gas lease tracts are limited under OCSLA to 23km² but can be enlarged at the discretion of MMS or to unitize tracts over one pool.²³³ DSHMRA "logical exploration units" are not limited specifically, but existing licenses average about 150,000km².²³⁴ NSHMA apparently has no limit to the size of exploration areas (except perhaps the size of the national seabed²³⁵). Presumably, the resource manager would decide an appropriate logical exploration or recovery unit on the national seabed.²³⁶ The Department of the Interior's 1974 draft EIS on OCS Hard Mineral Mining Operating and Leasing Regulations did suggest the use of gradual area relinquishment from exploration (36 blocks) to development (9 blocks) to production (3 blocks).²³⁷ Gradual relinquishment, which forces the developer to identify the most promising deposits within a certain time period, is a true performance requirement. In differentiating exploration areas from commercial recovery areas, DSHMRA and NSHMA may contain implicit relinquishment requirements.²³⁸

Because they include detailed descriptions of activities that may be or have been performed, plans and reports also are considered as performance requirements. OCSLA requires exploration plans and combined development and production plans to be submitted and approved by MMS.²³⁹ Monthly operations reports must also be filed.²⁴⁰ DSHMRA and NSHMA require exploration and commercial recovery plans to be approved by the resource manager prior to undertaking these activities.²⁴¹ Under DSHMRA regulations, U.S. deep seabed licensees must conform "reasonably" to their exploration plans.²⁴² Determination of reasonable conformance by NOAA occurs retrospectively, although NOAA maintains the right to berth observers on exploration cruises.²⁴³ In making its determination, NOAA may consider "legitimate periods of time when there is no or very low expenditure."²⁴⁴ Additionally, DSHMRA regulations require

232. OCSLA, 43 U.S.C. § 1337(b)(2) (1982); DSHMRA, 30 U.S.C. § 1417(b) (1982); NSHMA § 309(b)(1) (1988).

233. OCSLA, 43 U.S.C. § 1337(b)(1) (1982).

234. DSHMRA, 30 U.S.C. § 1413(a)(2)(D),(2)(E) (1982).

235. NSHMA § 305(a)(4),(5) (1988).

236. Broadus, Prepared Statement (cited in note 73).

237. BLM, 1974 Proposed Regulations DEIS at 254 (cited in note 80).

238. DSHMRA, 30 U.S.C. § 1413(a)(2)(E) (1982); NSHMA § 305(a)(5) (1988).

239. OCSLA, 43 U.S.C. §§ 1340(a),(b),(c),(e), 1351 (1982).

240. 30 C.F.R. § 250.93 (1987).

241. DSHMRA, 30 U.S.C. § 1413(a) (1982); NSHMA § 303 (1988).

242. 15 C.F.R. § 970.602(c) (1988).

243. *Id.*; DSHMRA, 30 U.S.C. § 1424 (1982).

244. 15 C.F.R. § 970.602(c) (1988).

annual reports of activity. Licensed deep seabed explorers must submit an annual report to NOAA demonstrating reasonable conformance to their activity and expenditure schedule.²⁴⁵

Only OCSLA requires rentals or minimum royalties to be paid on a lease.²⁴⁶ Private developers may credit minimum royalties against royalty payments.²⁴⁷ But rentals force firms to move toward production sooner than they might in their absence and so are true performance requirements, as well as revenue generators for the government. DSHMRA requires licensees to make "periodic reasonable expenditures," but these may be determined by the licensee and certified by NOAA.²⁴⁸ NOAA's proposed commercial recovery regulations also will require periodic reasonable expenditures, although this was not specified as a requirement for permittees under the Act.²⁴⁹ NSHMA does not require periodic expenditures for exploration or recovery.²⁵⁰

Performance as Public Conservation. For public minerals, owned or in some sense controlled by the government, performance requirements are, in a very real sense, a directed allocation of factors of production. This allocation responds to the institutional requirements of a mining code that are independent of private development decisions. Because of this direction, there exists a risk of allocating these resources too rapidly.²⁵¹ Should this happen, significant opportunity costs that preclude investment of capital and labor resources in other, more productive endeavors, like onshore mining, could be incurred. Private mineral developers will resist these opportunity costs, if they are perceived to increase their costs of operation. As a result, the government may have to encourage a developer to begin operations earlier or to continue marginal operations. In addition, the government may confront higher enforcement costs in attempting to ensure performance.²⁵²

245. 15 C.F.R. § 970.901(b) (1988).

246. OCSLA, 43 U.S.C. § 1337(b)(6) (1982); 30 C.F.R. § 202.151 (1987).

247. Seim, telephone communication (cited in note 174).

248. DSHMRA, 30 U.S.C. § 1418(b) (1982); 15 C.F.R. § 970.602(c) (1988).

249. National Oceanic and Atmospheric Administration, Deep Seabed Mining Regulation for Commercial Recovery Permit, 51 Fed. Reg. at 26,814 (1986) (cited in note 25).

250. NSHMA does require that licensees or permittees "pursue diligently" activities proposed in exploration or commercial recovery plans. NSHMA § 308(a)(1)(C) (1988).

251. Resources could be allocated too rapidly through either public or private decisions. It is assumed here, however, that the government does not stand to lose as much as a private firm in the event that it allocates economic resources too rapidly and, partly as a result, the government will not engage the necessary technical expertise to be able to respond to market signals as quickly or effectively as private firms.

252. Such a situation may have occurred with onshore oil and gas minerals. An analysis conducted by the U.S. General Accounting Office discovered uncollected minimum royalty payments for onshore leases in 1985. The Minerals Management Service stated, when confronted with this discovery, that minimum royalty payments are not monitored at present and will not be monitored "because it would require too many resources to be cost effective." U.S. General Accounting Office (GAO), *Mineral Revenues: Opportunities to Increase Onshore Oil and Gas Minimum Royalty Revenues* (1986).

Speculation and Private Conservation. An often cited rationale for performance requirements is to prevent "speculation." The legislative history to DSHMRA, for example, reveals that government officials were interested in using performance requirements as tools for discouraging speculation.²⁵³ This justification is probably misleading. Speculation, a term which over the years has become perjorative, is in reality only private "conservation" of mineral resources.²⁵⁴ Speculation represents an allocation of economic resources in response to market signals, rather than institutional directives. Because private firms succeed or fail on their abilities to respond to these signals, it is possible that private (as opposed to public) conservation is more likely to allocate economic resources so as to minimize waste.²⁵⁵

Experience with Performance in Deep Seabed Mining. Because performance requirements are triggered upon receipt of a mineral entitlement, the case of deep seabed mining does provide limited insight into the behavior of private firms that face performance requirements for ocean hard minerals. In August and October, 1984, NOAA issued four exploration licenses to four industrial seabed mining consortia (Figure 6).²⁵⁶

The DSHMRA performance requirements are flexible enough to permit private conservation. Indeed, NOAA has relied upon private firms with specialized expertise in economic geology, mining engineering, oceanography, industrial R&D, metallurgy, and marine transportation to make conservation decisions. Already two consortia have amended their U.S.

253. In a joint letter to the House Merchant Marine and Fisheries Committee prior to the enactment of the DSHMRA, the Secretaries of Interior and Commerce explained that "even though deep seabed exploration and production are likely to be in an experimental mode for the near future, we believe that the developer should have a legal obligation to pursue exploration and development diligently. This would help prevent detrimental speculation." 1980 U.S. Code Cong. & Ad. News 1624.

254. Nelson, *The Making of Federal Coal Policy* at 52 (cited in note 32). In a case unrelated to the policy issues of public minerals but nevertheless providing an interesting observation on the meaning of speculation, Justice Oliver Wendell Holmes said:

"... People will endeavor to forecast the future and to make agreements according to their prophecy. Speculation of this kind by competent men is the self-adjustment of society to the probable. Its value is well known as a means of avoiding or mitigating catastrophes, equalizing prices and providing for periods of want. It is true that the success of the strong induces imitation by the weak, and that incompetent persons bring themselves to ruin by undertaking to speculate in their turn. But legislatures and courts generally have recognized that the natural evolutions of a complex society are to be touched only with a very cautious hand, and that such coarse attempts at a remedy for the waste incident to every social function as a simple prohibition and laws to stop its being are harmful and vain. . . ."

Board of Trade of the City of Chicago v. Christie Grain and Stock Co., 198 U.S. 236, 247 (1905) (property rights in price quotations from futures markets held to be unaffected by their limited distribution or their content; limited distribution of the quotations found not to be a restraint of trade).

255. Nelson at 230 (cited in note 32).

256. U.S. Dept. of Commerce, National Oceanic and Atmospheric Admin., *Deep Seabed Mining Report to Congress* 9 (1985).

FIGURE 6
U.S. Deep Seabed Licensee Performance¹

	<i>Ocean Minerals Company (OMCO)</i>	<i>Ocean Mining Associates (OMA)</i>	<i>Ocean Management Incorporated (OMI)</i>	<i>Kennecott Consortium (KCON)</i>
Licenses	one (two sites)	one	one	one
Term	1984-94	1984-94	1984-94	1984-94
Approximate Area (000km ²)	169	150	113	65
Original Planned Expenditure (000 US \$)	undisclosed	13,000	54,000	6,200
Modified Planned Expenditure (000 US \$)	reduced but undisclosed	13,000 (same)	4,600-6,600	596 ²
First Year Expenditure (000 US \$)	undisclosed	1,196	164	121
Second Year Expenditure (000 US \$)	undisclosed	1,020	150	135
Third Year Expenditure (000 US \$)	undisclosed	267	164	63

¹OMI holds an additional exploration license under authorization of the West German government and KCON holds an additional exploration license under authorization of the British government. These two consortia are also subject to performance requirements under those licenses.

²Requested credit of more than \$5 million against original planned expenditure based upon information collected during international conflict resolution.

exploration licenses to delay originally-planned exploration activity.²⁵⁷ As the resource manager, NOAA has determined that the proposed expenditures of each consortium in its exploration plan meets the statutory and regulatory definition, although there have been reductions in the level of

257. Ocean Minerals Company (OMCO) has eliminated at-sea survey cruises that were to be conducted during the first five years of its license and postponed testing of new survey systems to the second half of the license period. OMCO still plans to file for a commercial recovery permit by 1994. Ocean Management Incorporated (OMI) has divided its exploration plan into two stages. The first stage will involve exploration of "prime" areas within its larger license area, and the exploration of other "nonprime" areas will be postponed. OMI reduced its planned expenditures from a previously-announced \$21 million to \$4.6-6.6 million, cut its planned ship time from 310 to a maximum of 180 days, and will not test new survey systems. Both consortia have explained that resource information obtained through an international conflict resolution process, which resolved overlapping seabed exploration area claims, has allowed this reallocation of exploration activity. The Kennecott Consortium (KCON) has requested a credit against its originally-planned exploration expenditures based upon information received from conflict resolution. National Oceanic and Atmospheric Administration, Deep Seabed Mining; Proposed Revision of Exploration License, 52 Fed. Reg. 41,611 (1987) (notice and request for comments).

expenditures.²⁵⁸ The consortia can make or modify these expenditures freely, since there may be periods of no expenditure²⁵⁹ and since reasonable conformance with exploration plans is determined retrospectively.²⁶⁰ Moreover, NOAA has approved already the modifications in two exploration plans,²⁶¹ and additional modifications in the form of five-year exploration period extensions are possible.²⁶² Upon issuance of a commercial recovery permit, NOAA's proposed regulations will allow another ten-year period prior to the initiation of recovery activities.²⁶³

Information Management

Among those issues that concern ocean hard minerals, the treatment of resource information is probably the most salient. Information has relatively greater importance for many ocean hard minerals because of the preliminary understanding that exists.²⁶⁴ Under either leasing or licensing systems, resource information is valuable to private firms that seek access to mineral entitlements. Under OCSLA, information is important to resource managers who estimate fair market value.

Resource information is generated in all phases of mineral development from prospecting through exploration, development, and production. Information generated at any stage can reduce geological uncertainty and lower the costs of mineral recovery. However, we concern ourselves here primarily with the management of information generated prior to a decision to initiate commercial recovery operations. This includes information collected through basic scientific research, government-sponsored geological research and resource assessment, and private prospecting and exploration efforts. As shown in Figure 2, resource information is generated prior to or after the award of an exclusive entitlement. For ease of explication, the term "exploration" is used here to describe efforts of private firms to generate resource information.

Mining Code Provisions. According to OCSLA, resource information gathered by private firms under nonexclusive G&G permits, and under exclusive leases, can be kept proprietary and confidential.²⁶⁵ OCSLA

258. National Oceanic and Atmospheric Administration, Deep Seabed Mining; Approval of Exploration License Revision; Ocean Minerals Co., 50 Fed. Reg. 37,394 (1985) (notice); National Oceanic and Atmospheric Administration, Deep Seabed Mining—Proposed Revision of Exploration License, 51 Fed. Reg. 16,884 (1986) (notice).

259. 15 C.F.R. § 970.602(c) (1988).

260. *Id.*

261. National Oceanic and Atmospheric Administration, 50 Fed. Reg. 37,394 (1985) (cited in note 258); National Oceanic and Atmospheric Administration, 51 Fed. Reg. 16,884 (1986) (cited in note 258).

262. DSHMRA, 30 U.S.C. § 1417(a) (1982).

263. DSHMRA, 30 U.S.C. § 1417(b) (1982).

264. See generally James M. Broadus & Robert E. Bowen, Developing a U.S. Research Strategy for Marine Polymetallic Sulfides, 17 *Ocean Dev. and Intl. L.* 91 (1986).

265. OCSLA, 43 U.S.C. § 1352 (c) (1982).

regulations also permit group participation in prelease test drilling activities.²⁶⁶ However, resource information must be made accessible to resource managers upon request.²⁶⁷ MMS holds confidential for variable periods all privately-generated information obtained under nonexclusive G&G permits. After the expiration of these periods, resource information becomes available to the public.²⁶⁸ In the event that any prelease drilling activity discovers a significant hydrocarbon occurrence, MMS must publish the discovery but in such a way as to protect the proprietary nature of the find.²⁶⁹

For potential bidders, proprietary information concerning the nature of the resource carries with it an advantage with respect to other bidders in the bidding process. Resource information helps the bidder gauge more accurately the potential revenues and opportunity costs associated with a mineral entitlement. Firms with the advantage of resource knowledge might bid less than the true economic rent in order to capture a portion of the rent for themselves. This concern, that resource information could be used to deprive the government of economic rent, drives an administratively-costly management process of garnering resource information, calculating minimum bids, and, in some cases, setting royalties.²⁷⁰ Depending upon the type of information, MMS holds confidential for variable periods privately-generated information obtained through exploration on a lease.²⁷¹ The proposed OCSLA ocean hard mineral prospecting regulations propose up to a 20-year period during which resource information generated by private firms will be kept confidential.²⁷² In addition to private exploration efforts, OCSLA directs the Interior Department to gain knowledge about hydrocarbon reserves, resources, productive capacity, and production available to meet energy supply emergencies.²⁷³

Both DSHMRA and NSHMA allow for open prospecting activities and the grant of exclusive rights to information, resources, and partial rents through license-permit systems.²⁷⁴ Under DSHMRA, resource informa-

266. 30 C.F.R. § 251.6-3 (1987).

267. OCSLA, 43 U.S.C. § 1352 (a)(1)(A) (1982).

268. 30 C.F.R. § 251.14-1 (1987). The Minerals Management Service has changed its rules governing the protection of geological and geophysical information obtained under a permit, extending the length of the confidentiality periods from 10 to 25 years for geophysical "information" and from 10 to 50 years for geophysical "data." Minerals Management Service, Geological and Geophysical Explorations of the Outer Continental Shelf, 53 Fed. Reg. 4390 (1988) (final rule). It is expected that this rule would apply primarily to oil and gas minerals, but apparently there is nothing in the Federal Register notice that limits the scope of this change only to those minerals.

269. 30 C.F.R. 251.14-1(c)(1) (1987).

270. See for example, Nelson, *The Making of Federal Coal Policy* at 196 (cited in note 32).

271. 30 C.F.R. § 250.3 (1987).

272. Minerals Management Service, 52 Fed. Reg. at 9760 (1987) (cited in note 25).

273. OCSLA, 43 U.S.C. § 1865 (1982).

274. DSHMRA, 30 U.S.C. § 1412 (b)(2) (1982); NSHMA § 301 (c)(2) (1988). Note: NSHMA does not speak specifically to the nature of pre-entitlement prospecting activity.

tion is not critical in the government allocation of access to exploration licenses.²⁷⁵ However, deep seabed miners will have to demonstrate that the resource characteristics of a site are sufficient to sustain a 20-year production in order to obtain a commercial recovery permit.²⁷⁶ Some information required of private firms by NOAA under DSHMRA is kept confidential but is not used by the government for resource evaluations in order to capture rents.²⁷⁷ As a type of intellectual property, resource information was traded by deep seabed mining firms to facilitate the resolution of overlapping exploration area claims.²⁷⁸ DSHMRA also authorizes NOAA to act as a public explorer through the use of "stable reference areas" for, among other things, the purposes of resource evaluation.²⁷⁹

Similar to DSHMRA, the proposed NSHMA includes a requirement that geologic and resource assessment information be contained in an application for commercial recovery of ocean hard minerals.²⁸⁰ Upon certification by the resource manager, license and permit applications are to be published in the Federal Register.²⁸¹ Access to exploration entitlements is not determined competitively, and thus resource information would play a minimal role in their allocation under NSHMA. The proposed NSHMA would provide for a comprehensive research program to be conducted by government agencies, which would include assessing "the extent and nature of hard mineral resources" and encouraging "industrial sponsored studies of the resource potential."²⁸²

Information Spillovers

There are two general side-effects of the activity of information gathering that can affect the economic conservation of ocean minerals.²⁸³ The first suggests that too little effort will be involved in exploration and that it will proceed too slowly, and the second suggests that too much effort

275. Resource assessment of the nodules has been conducted at a broad scale by government agencies and at a finer scale by the seabed mining consortia. See generally Broadus, 235 *Sci.* 857 (cited in note 10).

276. DSHMRA, 30 U.S.C. § 1413(a)(2)(E)(ii)(I) (1982).

277. Licensees and permittees are required to furnish resource information to the government. DSHMRA, 30 U.S.C. § 1423 (1982). Presumably, this helps public managers monitor the degree to which the Act's policy goals are achieved. See notes 57-78 and accompanying text.

278. Broadus and Hoagland, 21 *San Diego L. Rev.* 553 (cited in note 96).

279. DSHMRA, 30 U.S.C. § 1419(f)(4) (1982).

280. NSHMA, § 303 (b)(4) (1988). Presumably this information would be analyzed to help determine an appropriate royalty rate. NSHMA, § 308 (a)(2) (1988).

281. NSHMA § 304(e) (1988).

282. NSHMA § 201(a) (1988). The bill would require the resource manager to disseminate "non-proprietary information" on the resources of the seabed. NSHMA § 201(d) (1988). The earlier draft provided that the research program evaluate the "extent and value" of hard mineral resources. NSHMA § 201(a) (1987).

283. Eckert, 17 *J.L. Econ.* 154 (cited in note 142).

will be involved in exploration and that it will proceed too quickly. In the first case, known as the information "spillover" or "leak," difficulties in holding information confidential may cause firms to delay or underinvest in exploration.²⁸⁴ This could happen because of the "public good" nature of information. There is little incentive for a firm to explore if it expects that the efforts of other firms will result in the generation of information concerning the occurrence, distribution, or grade of minerals that the first firm can obtain at low cost.²⁸⁵ Spillovers or leaks can occur through industrial intelligence gathering, employee transfers, publicly-visible acts of sampling or drilling, or merely the slow accumulation of resource information on a particular deposit by other firms. One recent example is the coastal state leasing of ocean hydrocarbon minerals on submerged lands located near the state-federal offshore boundary in the Gulf of Mexico. Federal revenue generation on OCS leases there benefited from earlier state leasing activity, and this was reflected in the relatively large size of bonuses received on the federal leases.²⁸⁶

Because of the potential for underproduction of information, there are conservation-oriented justifications for encouraging a greater level of exploration effort. The most appropriate method for encouragement is not immediately apparent, however. The allocation of economic rents, exemplified in DSHMRA and NSHMA, both of which deliver portions of potential rents to private firms in order to encourage exploration and development activity, among other things, is one method. Increasing the stringency of performance requirements could achieve the same end; this also might involve trading-off economic rents or, in the extreme, outright public subsidy of exploration effort. Tax incentives are used to encourage exploration activity,²⁸⁷ and, depending upon the mineral, varying amounts of percentage depletion allowances that apply to production also could induce exploration.²⁸⁸

Modification of the size of the lease tract or license area is another

284. U.S. Congress, Office of Technology Assessment (OTA), *An Analysis of the Feasibility of Separating Exploration from Production of Oil and Gas on the Outer Continental Shelf* 28-33, 74 (1975).

285. *Id.* at 75. See also Rooney, 8 *Nat. Res. J.* 655 (cited in note 161); Eckert, 17 *J. L. Econ.* 155 (cited in note 142).

286. *State of Texas v. Secretary of Interior*, 580 F. Supp. 1197 (E.D. Tex. 1984) (OCSLA's "fair and equitable" standard for distribution of 8(g) lease revenues received on federal leases within 3 miles of the Texas territorial sea found to include "enhancement in value" of federal tracts resulting from prior offshore leasing in state waters). Also see *Louisiana v. Watt*, 631 F. Supp. 648 (E.D. La. 1985). See generally Jeffrey J. Leitzinger & Joseph E. Stiglitz, "Information Externalities in Oil and Gas Leasing," 5 *Contemp. Pol'y Issues* 44 (1984).

287. John C. Siegesmund III & John R. Maxfield, *Demystifying the Tax Aspects of Development and Depletion*, 31 *Proc. Rocky Mtn. Min. L. Inst.* 4.02[2][a] (1985).

288. *Id.* at 4.04(2) (1985). Anderson suggests that, although it applies to production, percentage depletion encourages exploration by making mineral discoveries more valuable. Robert C. Anderson, *Federal Mineral Policy: The General Mining Law of 1872*, 16 *Nat. Res. J.* 601, 607 (1976).

method. Both the proposed OCSLA regulations²⁸⁹ and the proposed NSHMA²⁹⁰ leave open the question of the size of entitlements, presumably to be determined on a case by case basis through negotiation between the resource manager and the applicant. An interesting, yet unanswered question for research concerns the relationship between the size necessary to prevent information spillover and the optimal size of a production unit. This relationship should vary with the existing level of geologic uncertainty. For example, an initially large area for exploration could obviate information spillovers. But a performance requirement that requires a portion of the entitlement area to be relinquished has the potential for forcing exploration too rapidly in the absence of spillovers. Of course, exploration might reveal a mining unit larger than the initial exploration area, in which case this kind of performance requirement works even more adversely. NSHMA (modeled after DSHMRA in this regard²⁹¹) apparently considers such an eventuality by distinguishing "logical exploration unit" from "logical recovery unit" and by not specifying relative sizes of the two types of entitlements.²⁹²

Under OCSLA, information is kept confidential in order to encourage exploration for hydrocarbon minerals. The draft ocean hard mineral prospecting regulations have proposed lengthening this confidentiality period. Like a patent on an invention, confidentiality creates a monopoly over the use of the information, and the possibility of obtaining this monopoly is used as an inducement for private exploration efforts. Unlike a patent and more like a trade secret, however, the information is not widely-disclosed. One major drawback to allowing information to be privately-held in this manner is that the benefits that could accrue to other users of information go unrealized. Information leaks erode the information monopoly, and thus benefit a wider group but, at the same time, reduce the incentive for individual exploration.²⁹³ Because of leaks, one might expect that information protection would be an effective inducement for only a relatively short period of time.²⁹⁴

Under agreement, OCS hydrocarbon explorers may share the costs of drilling shallow test wells or deep stratigraphic test wells.²⁹⁵ Ostensibly

289. Minerals Management Service, 52 Fed. Reg. at 9762 (cited in note 25).

290. NSHMA § 305(a)(4) (1988).

291. DSHMRA, 30 U.S.C. § 1413(a)(2)(E) (1982).

292. NSHMA § 305(a)(5) (1988).

293. See generally J. Hirshleifer & John G. Riley, *The Analytics of Uncertainty and Information—An Expository Survey*, 26 J. Econ. Lit. 1375, 1404 (1979). Dodds and Bishop argue for the public release of all mineral information. Daniel Dodds & Richard C. Bishop, *On the Role of Information in Mineral Exploration*, 59 Land Econ. 411 (1983).

294. "Common lore in the (OCS oil and gas) industry is that there is no such thing as a 'tight hole.' That is, information about a new discovery always leaks out." Leitzinger and Stiglitz, 5 *Contemp. Pol'y Issues* 49 (cited in note 286).

295. 30 C.F.R. § 251.6-3 (1987).

these cost-sharing exploration activities are authorized to reduce duplicative exploration efforts.²⁹⁶ However, because information resulting from these tests is shared among the participants (and may be shared later among other firms who pay an additional premium for the information²⁹⁷), group exploration is another method for encouraging exploration that might not be conducted by firms acting individually. The results of deep stratigraphic tests are held confidential for 25 years but are publicly-disseminated in the event a lease is issued within 50 geographic miles of the test hole.²⁹⁸ Although group exploration activities have not been proposed for ocean hard minerals under either OCSLA or NSHMA, this concept certainly deserves further attention.²⁹⁹

NSHMA proposes a major government research program, with the public release of information, as one means to compensate for under-exploration. As shown in Figure 7, this research program would add to existing government "exploration" efforts.³⁰⁰ The government funds basic oceanographic research that leads to mineral discoveries, such as the marine massive sulfide deposits at oceanic spreading centers.³⁰¹ In 1986, the Department of the Interior spent an estimated \$25 million on offshore geologic surveys.³⁰² Furthermore, on a broad scale, the U.S. government conducts "economic geological" research on a wide variety of minerals both onshore and offshore.³⁰³ Good examples include current research on the massive sulfides of the Gorda Ridge³⁰⁴ and the cobalt-rich ferromanganese encrustations on Pacific islands and seamounts.³⁰⁵ Except for certain classes of information collected from private explorers, information

296. 30 C.F.R. § 251.6-3(a) (1987). See notes 307-13 and accompanying text.

297. 30 C.F.R. § 251.6-3(a) (1987).

298. Minerals Management Service, 53 Fed. Reg. 4390 (1988) (cited in note 268). Twenty-three deep stratigraphic test wells have been drilled since 1974. These tests usually are conducted in areas where it is believed that there may be little chance of discovering hydrocarbons. However, in 1978 one test conducted off Point Conception, Calif. did discover significant "shows" of crude oil.

299. See Mark Isaac, *The Value of Information in Resource Exploration: The Interaction of Strategic Plays and Institutional Rules*, 14 *J. Envtl. Econ. Mgmt.* 313 (1987).

300. Porter Hoagland III & James M. Broadus, *Seabed Material Commodity and Resource Summaries* 85 (1987).

301. Gregory McMurray, *The Gorda Ridge Technical Task Force: A Cooperative Federal-State Approach to Offshore Mining Issues*, 5 *Marine Mining* 467 (1986).

302. Federal Coordinating Council for Science, Engineering and Technology, Committee on the Oceans and Atmosphere, Subcommittee on Marine Research, *Federal Marine Science Budget Summary FY 77-86* at 42 (1985).

303. A good, comprehensive summary of marine economic geology is V.E. McKelvey, *Subsea Mineral Resources* (1986).

304. R.A. Zierenberg & R.A. Koski, *Form and Composition of Sediment-Hosted Sulfide-Sulfate Deposits, Escanaba Trough, Southern Gorda Ridge*, 67 *EOS: Transactions of the American Geophysical Union* 1282 (1986) (abstract); Gorda Ridge Technical Task Force, *Gorda Ridge Symposium Program* (1987) (includes abstracts of presentations, some of which discuss the sulfide deposits of the Gorda Ridge).

305. Frank T. Manheim, *Marine Cobalt Resources*, 232 *Sci.* 600 (1986).

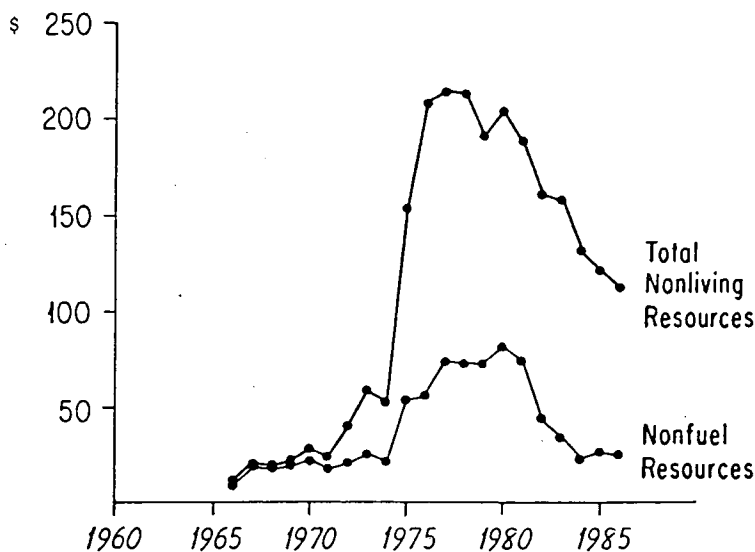


FIGURE 7

Estimated U.S. federal government expenditures on marine nonliving resources: 1966-1986. Dollar figures expressed in millions of 1983 U.S. constant dollars. "Total nonliving resources" include oil and gas and ocean hard minerals. "Nonfuel resources" include only ocean hard minerals. Expenditures are equivalent to total program costs, which include funding for environmental research, environmental impact statements, lease sales, and resource assessment, among other things.

generated by government agencies is publicly available. The National Geophysical Data Center in Boulder, Colorado serves as a depository for information on ocean mineral resources.³⁰⁶

With government exploration, two problems that have implications for conservation arise. First, there are opportunity costs associated with directing public exploration effort into ocean minerals as opposed to some other public activity. For example, government exploration efforts might divert public resources away from monitoring and controlling environmental effects. Second, given appropriate motivation, private firms with specialized expertise in ocean exploration, who exist on the basis of their ability to respond to market signals, are likely to be more efficient explorers than public agencies. In considering public exploration, the government should consider these conservation issues and compare them to the costs of private underexploration and the incentives that might be necessary to induce private efforts.

306. National Geophysical Data Center, A Computerized Data Base and Bibliography on Marine Minerals, Marine Minerals Data (Data Announcement 87-MGG-06) (1987). This publication contains a schedule of charges for outputs from the database.

Discovery Rushes

Historically, most mining codes have contained provisions that motivate exploration either to achieve specified policy goals or to counteract the effects of information spillovers. More recently, attention has been given to the situation where there is a "rush" to discover and too much effort is devoted to exploration. The 1872 Mining Law has been criticized for encouraging an overinvestment in exploration, because entitlements under this mining code are contingent upon the discovery of a valuable mineral deposit.³⁰⁷ In part because information is not disseminated widely, explorers may perceive individual net benefits of additional exploration effort on public lands or for public resources, particularly in areas that already have been explored. Thus a mining code that permits private firms to conduct exploration prior to the transfer of entitlements could result in a form of "common pool" resource misallocation.³⁰⁸

The traditional method of correcting the inefficiencies of excessive exploration effort is to assign exclusive rights to mineral developers prior to exploration. OCSLA ameliorates discovery rushes by auctioning-off rights to explore and exploit, and in theory the most efficient mineral developers are willing to bid the most to capture these rights.³⁰⁹ (Some observers, however, believe that, prior to a lease sale under OCSLA, an overinvestment in exploration might occur because more than one firm can obtain geological and geophysical information on the same lease, but only one firm will end up winning the rights to conduct detailed exploration on the lease.³¹⁰ Thus exploration effort invested by losing bidders, which sometimes is only the cost of purchasing information from a firm specializing in geophysical activities and interpreting the information, is wasteful. This is the primary rationale behind the regulations that allow firms to share the costs of shallow test wells and deep stratigraphic tests.)

DSHMRA and NSHMA do not make the issuance of exploration licenses contingent upon discovery. Thus, on the surface, they appear to obviate overinvestments in information.³¹¹ Both mining codes offer po-

307. Anderson has observed this situation under the location-patent system for onshore public lands. Anderson, 16 *Nat. Res. J.* 601 (cited in note 288).

308. Hirshleifer & Riley, 26 *J. Econ. Lit.* 1404 (cited in note 293). Eckert, 17 *J. L. Econ.* 162 (cited in note 142), makes the point that it is the nonexclusive nature of the right to explore that results in the potential for overinvestment in exploration.

309. Mead, Moseidjord, Muraoka & Sorenson, *Offshore Lands* at 48 (cited in note 136).

310. Mason suggests that overexploration could occur under a leasing system in which information is held confidential. Charles F. Mason, *Exploration, Information, and Regulation in an Exhaustible Mineral Industry*, 13 *J. Envtl. Econ. Mgmt.* 153, 154 and n. 5 (1986). See also Darius W. Gaskins, Jr. & Thomas J. Teisberg, *An Economic Analysis of Presale Exploration in Oil and Gas Lease Sales* (Robert T. Masson & P. David Qualls, eds.), *Essays on Industrial Organization in Honor of Joe S. Bain* 241 (1976). These observers suggest that, although too much investment in exploration could occur, allowing exploration prior to the assignment of rights (resulting in lower uncertainty to risk-averse firms) may be the "only feasible way" for the most efficient bidders to be selected. Gaskins & Teisberg at 249.

311. See note 121 and accompanying text.

tential rents to the explorer as encouragements to counterbalance information spillovers.³¹² Under these two mining codes, however, there could be a "rush" to obtain exploration entitlements, and there is no mechanism to ensure that the most efficient firms will obtain those rights.³¹³

Balancing Information and Revenue Generation

Some commentators have considered methods by which rents could be traded away by the government in order to encourage exploration but at the same time allocate entitlements competitively.³¹⁴ In this regard, one observer has suggested a competitive "research expenditure" bidding system,³¹⁵ analogous to the exploration cost offset approach under consideration by MMS for the disposal of ocean hard minerals under OCSLA.³¹⁶ Under such a scenario, explorers (researchers) bid away economic rent in the form of an exploration program. The implications for economic conservation of the exploration offset approach have been discussed already.³¹⁷

At some future point, geological uncertainty might be reduced to the point that there would be little need to encourage additional exploration effort by trading-off rents.³¹⁸ At this time, the system could be switched from a competitive exploration expenditure system to a competitive bonus bid system, and financial rents might then be collected. A determination of the switch point would be a difficult decision for the government. It might be made on the basis of increases in industrial interest in obtaining entitlements, as a signal of rents appearing due to lower uncertainty costs (more knowledge). Switching from one competitive method to another raises the issue of increased legal uncertainty created through modification of the disposal system.

MANAGEMENT FLEXIBILITY AND LEGAL UNCERTAINTY

Several government studies have attempted to address the issue of mining code flexibility (or adaptability) for ocean hard minerals.³¹⁹ As

312. See note 143-147 and accompanying text. The performance requirements found in these two mining codes could induce exploration activity, but we expect that these requirements will have only a minor influence on the rate at which exploration is conducted.

313. See note 144 and accompanying text.

314. Hirshleifer & Riley, 26 *J. Econ Lit.* 1405 (cited in note 293).

315. Rooney, 8 *Nat. Res. J.* 654 (cited in note 161). Rooney refers briefly to "exploration expenditure bidding" as an analog but does not elaborate on this variant.

316. Minerals Management Service, 52 *Fed. Reg.* at 9760 (1987) (cited in note 25); Stone and MacGillvray, 4 *Circum-Pacific Energy and Min. Conf.* (cited in note 9).

317. See notes 211-221 and accompanying text.

318. Rooney, 8 *Nat. Res. J.* 659 (cited in note 161).

319. Stratton Commission, *Marine Resources and Legal-Political Arrangements for their Development*, Panel Reports, Vol. 3 at VII-117 (cited in note 72); NAS Panel, *Mining in the Outer Continental Shelf and in the Deep Ocean* at 64 (cited in note 72); Geological Survey, *Program Feasibility Document: OCS Hard Mineral Leasing* at 66 (cited in note 10); Geological Survey, *USGS Symposium* at 272 (cited in note 2).

"untried" resources, some ocean hard minerals initially may yield small or nonexistent rents. Over time, as onshore resources deplete,³²⁰ ocean resources may become important sources of some commodities that deliver economic rents either for the treasury or for the inducement of private efforts that serve specific policy goals. It can be useful for the resource manager to have the ability to make marginal changes in an ocean mining code to control uncertainty and achieve resource conservation or other policy goals. This kind of flexibility can be implemented at many different levels.

Levels of Management Flexibility

Revenue generators and performance requirements might be negotiated for each entitlement. The proposed NSHMA suggests that royalties would be set or negotiated for each commercial recovery permit.³²¹ The application of such a system on a case-by-case basis could incur substantial administrative costs. For ocean hard minerals, for which at least initially there may be a small number of permits, such a system might be administratively feasible.

In 1983, participants at a symposium organized by the U.S. Geological Survey suggested that "instead of a rigid regulatory structure, such as that imposed on companies seeking to mine manganese nodules, a more flexible approach be followed in which lease terms and conditions be tailored uniquely for each offering."³²² Flexibility of this type, on a lease sale-by-lease sale basis, also might incur administrative costs, but would be less costly than flexibility on an individual permit basis. Individual lease sale flexibility could permit experimentation with combinations of core provisions in order to determine the most appropriate combination.

Multiple mining codes might be employed spatially or temporally. The Stratton Commission Report, in 1969, suggested use of a mining code modeled after the 1920 Minerals Leasing Act.³²³ This Act established a dual system in which solid minerals are leased competitively in "known geological structures" but are leased on a first-come, first-serve preference right basis in areas where geological structures are unknown.³²⁴ The Com-

320. Broadus, 235 Sci. 235 (cited in note 10).

321. NSHMA § 308(a)(2) (1988) (cited in note 19). The bill would require that terms, conditions, and restrictions (which include royalties) be "uniform for all licenses and permits, except to the extent that factual circumstances, including differing physical and environmental conditions, require the establishment of special terms, conditions, and restrictions." NSHMA § 308(b) (1988).

322. Geological Survey, USGS Symposium at 272 (cited in note 2).

323. Mineral Leasing Act, 30 U.S.C. § 226 (1982) (oil and gas lands); 30 U.S.C. § 211(a) (1982) (phosphate deposits); 30 U.S.C. § 272, 273 (1982) (sulphur).

324. National Research Council, Board on Mineral and Energy Resources, *Known Geological Structures Under the Mineral Leasing Act: Interpreting and Applying the Term "Known Geological Structure of a Producing Oil and Gas Field"* (1986). Tank, *Legal Aspects of Geology* at 457 (cited in note 23).

mission recommended that flexibility be incorporated into a system for ocean hard minerals such that "the specific terms under which these OCS lands are yielded to private development could be adjusted to reflect differences from case to case and over time in our knowledge of and capability to exploit mineral potentials."³²⁵

One mining code might be employed with marginal adjustments over time, as in OCSLA. For OCS oil and gas leases, the federal government determines a uniform minimum bid for the bonus and applies a uniform royalty to all entitlements.³²⁶ By averaging over all entitlements in this manner, administrative costs are reduced, but marginally productive deposits may be overlooked, and the government may fail to capture the full rent from rich deposits. Minimum bids, rentals, and royalties might be modified from time to time to respond to changing market conditions.³²⁷

Flexibility, Discretion, and Legal Uncertainty

A fundamental question concerns the degree to which management flexibility raises the level of legal uncertainty and thereby deters private investment in public mineral development. The relative profitability and even commercial feasibility of specific entitlements are affected by the resource manager's discretionary power to modify terms and conditions subsequent to issuance of entitlements.³²⁸ Ocean mineral interests have expressed dissatisfaction with the number of discretionary steps accorded the Secretary of Interior under OCSLA.³²⁹ As most recently exposed in *Secretary of the Interior v. California*,³³⁰ this discretionary power represents a potential loss of entitlements, even after lease issuance and substantial investments have been made.

Notwithstanding legal uncertainty at the entitlement level, it is beneficial for resource managers to have the authority to adjust the core provisions of a mining code. This authority allows a mining code to adapt to society's changing values and goals over time. In 1978, amendments to OCSLA provided for different types of bidding systems to be tested on a trial basis.³³¹ The limited experience with these systems has shown

325. Stratton Commission, Marine Resources and Legal-Political Arrangements for their Development, Panel Reports, Volume 3 at VII-117 (cited in note 72).

326. OTA, Oil and Gas Technologies at 156 (cited in note 172).

327. Minerals Management Service, 51 Fed. Reg. 39,810 (1985) (cited in note 210).

328. All three mining ocean mining codes compared here do contain certain degrees of management discretion concerning the suspension, termination, or transfer of mineral entitlements. See, e.g. OCSLA, 43 U.S.C. §§ 1334(c),(d), 1337(e), 1351(j) (1982); DSHMRA, 30 U.S.C. §§ 1416, 1425(b) (1982); NSHMA §§ 310, 311, 312(b) (1988).

329. Greenwald, Prepared Statement (cited in note 139). See note 115 above.

330. 464 U.S. 312 (1984).

331. Jones, Mead & Sorenson, 19 Nat. Res. J. at 888 (cited in note 132).

positive results.³³² More recently, MMS has considered modifying minimum bid and performance requirements for OCS oil and gas minerals in light of reduced demand for these ocean entitlements.³³³ MMS has considered granting easements to Arctic sand and gravel deposits³³⁴ and has under consideration a concept of offsets for post-entitlement exploration costs for ocean hard minerals.³³⁵ In the event that MMS succeeds in implementing the offset approach, it will be beneficial for the agency to have the option of returning to the pure bonus approach as knowledge and geologic certainty increase.

It is important to distinguish management flexibility from the discretionary authority of the resource manager over specific entitlements.³³⁶ It is suggested here that a mining code can be made flexible without a concomitant increase in both managerial discretion and legal uncertainty. Flexibility involves the adjustment of core provisions to improve the probability of achieving policy goals through future public mineral disposals. It is unclear whether any of the existing or proposed ocean mining codes are truly flexible under this definition. The limits of OCSLA's flexibility presently are being tested by consideration of regulatory proposals to modify revenue generation, performance, and information management provisions.³³⁷

Discretionary modification of existing entitlements, as distinguished from mining code flexibility, will increase legal uncertainty by substituting public "conservation" decisions for those of private developers. When compared to the location-patent system of the 1872 Mining Law, all three ocean mining codes appear to authorize a high degree of managerial discretion. The three mining codes examined here contain iterations at which resource managers can wield discretionary power to modify entitlements. As displayed in Figure 2, these discretionary iterations coincide at a minimum with the "activities" for which leases, licenses, or permits are required. Additional discretion may be exerted through stipulations on OCS leases or through the terms, conditions, and restrictions that attach to deep seabed licenses and permits. Except for production and market control provisions applicable in some cases to hydrocarbon min-

332. GAO, Congress Should Extend Mandate to Experiment with Alternative Bidding Systems in Leasing Offshore Lands at 7 (cited in note 165).

333. Minerals Management Service, 51 Fed. Reg. 39,810 (1986) (cited in note 210).

334. Minerals Management Service, 48 Fed. Reg. 15,541 (1983) (cited in note 84).

335. Stone & MacGillvray, 4 Circum-Pacific Energy and Min. Conf. (cited in note 9).

336. Frequent or major changes to core provisions in the name of flexibility still could raise the level of legal uncertainty. Thus the offshore oil and gas industry generally is reluctant for OCSLA to be amended to modify § 8(k), because some risk exists that the oil and gas provisions also might be modified.

337. Minerals Management Service, 51 Fed. Reg. at 39,810 (1986) (cited in note 210); Minerals Management Service, 53 Fed. Reg. 4390 (1988) (cited in note 268).

erals under OCSLA,³³⁸ it is difficult to conclude that any one mining code authorizes a higher degree of discretion. In the design of a mining code for ocean hard minerals, so that the costs of legal uncertainty are minimized while variations in geologic uncertainty are controlled, significant attention might be given to the potential benefits of flexibility and the minimization of discretionary incursions into those entitlements already established.

CONCLUSIONS

From this comparison of mining codes, it is apparent that much diversity exists in the methods that might be employed for providing access, generating revenues, requiring performance, and managing information. How can the most appropriate methods be identified for the disposal of ocean hard minerals? The answer to this question cannot be determined solely on the basis of past experience. To a large degree, the answer will have to be determined in actual practice, through trial and error. Although the political risks of "experimentation" with disposal methods are potentially great for the managing agency, there is one general principle that can guide the identification process. This principle is economic conservation.

For any prospective mineral deposit, deciding the appropriate moment and rate at which to initiate and conduct exploration, development, or production can be difficult. Yet this timing decision is critical for conservation, in an economic sense, to be achieved. Modern public mineral disposal, as evidenced by the mining codes examined here, is a kind of resource conservation in which public resource managers play an important role in determining the timing of mineral development.

Resource managers concerned with the conservation of ocean hard minerals should consider first methods of access that select developers with the lowest costs of exploration, development, and production. Among the ocean mining codes, OCSLA has the most potential to achieve this selection through its competitive method of access. The collection of economic rent is consistent with a goal of economic conservation. But because rents may be small or nonexistent for many ocean hard minerals, resource managers should not be overly concerned with the size of bonuses or royalties.

Instead, attention should be directed toward minimizing administrative costs. Under OCSLA, substantial administrative costs are spent to ensure that, for oil and gas minerals, private developers do not themselves earn excessive rents. In the early stages of ocean hard mineral disposal, because

338. OCSLA, 43 U.S.C. §§ 1334(g), 1337(b)(7), 1354 (1982).

rents will be small, efforts spent by resource managers to determine fair market value or profits should be minimized. Other examples of administrative costs include holding lease sales, processing license or permit applications, monitoring performance, and monitoring environmental effects (an area of significant administrative costs not examined here). From an administrative standpoint, the performance requirements found in DSHMRA, which allow private developers considerable leeway in implementing a development schedule, may be the least costly of those in any of the mining codes examined here. Although DSHMRA and NSHMA attempt to recover the costs of processing license and permit applications, administrative costs are not reduced through this mechanism but instead are transferred from the government to private developers. Resource managers may discover that the administrative costs of disposal far outweigh the size of potential rents. If indeed this is true, then the disposal of ocean hard minerals will be a misallocation of economic resources.

Care should be taken in implementing encouragements for exploration activity. The nature of information as a public good can lead to under-exploration. Yet there are broad incentives found in U.S. law that encourage mineral exploration and technology development. Moreover, for several years the federal government has conducted a continuous level of research on marine mineral resources, and the results of this research are publicly available. The concept of shared exploration costs, such as the OCSLA deep stratigraphic tests for hydrocarbons, deserves further attention in the case of ocean hard minerals.

The effect of uncertainty of any kind is to increase the costs faced by private developers in proving-out and working a mineral deposit. But because legal uncertainty can be reduced directly through the provisions of a mining code, it is useful to distinguish legal uncertainty from geological uncertainty. Legal uncertainty can be reduced through increasing security of tenure. A traditional distinction between leases and licenses, that leases are more secure and thus legally more certain, has become less important in modern public mineral disposal. But it would seem an unnecessary development, one that would increase uncertainty, to create, as NSHMA would, a "national seabed" with a legal status inequivalent to that of the outer Continental Shelf.³³⁹

339. See text accompanying notes 154-158 above. Clearly, the supporters of the NSHMA proposal must create a national seabed, otherwise they would be, in effect, amending OCSLA. See note 99 above. Although this point appears to revolve around a minor definitional issue, it is significant from a hypothetical management perspective. Essentially, the national "seabed" would become yet another large-scale ocean management enclosure. See generally Ross D. Eckert, *The Enclosure of Ocean Resources* (1979). Because the current version of NSHMA authorizes NOAA as the resource manager, one can imagine interagency jurisdictional disputes should NOAA plan to license or permit areas of the seabed for ocean hard minerals that are in the same location as areas of the OCS that the Department of the Interior plans to lease for oil and gas. This might raise the costs associated with

Legal uncertainty also can be reduced through minimizing the managerial discretion to alter private exploration, development, and production decisions. This perhaps will be the most difficult aspect in the design of an ocean mining code. Resource managers will be unwilling to relinquish discretionary authority over the disposal of public minerals, but it is more likely that economic conservation will be achieved through private decisions about the timing of development.³⁴⁰ At a minimum, once a specific entitlement is made, revenue generators such as royalties should not be changed. It is unclear that the proposed NSHMA would preclude the modification of royalties on a specific entitlement over time. DSHMRA may be looked to for minimizing managerial discretion in performance requirements.

It is important to consider management flexibility as distinct from the discretionary authority of the resource manager over specific entitlements. Many ocean hard minerals are distinguished from their onshore counterparts because of relatively higher costs of discovery and exploration (geologic uncertainty), development and production. These relative cost conditions could change over time, as information is generated, technological advances occur, and onshore resources are depleted, among other things. Because of this potential for change, it is beneficial for resource managers to have the authority to adjust the core provisions of a mining code for future disposals.

Under OCSLA, the government collects financial rents from the disposal of public minerals. The government might also trade away financial rents, as under DSHMRA, in order to achieve certain policy goals like encouraging private firms to recover designated strategic resources, to develop ocean technology, or to help counterbalance the private costs of uncertainty. While the collection of economic rent is consistent with a goal of economic conservation, it does not necessarily follow that trading rents away is also consistent. By trading rents in this manner, it becomes difficult to determine whether economic resources are being allocated efficiently. Furthermore, in the event that rents may be small or non-existent, the potential for preferential encouragement of the ocean mining activity is enhanced. In the case of prospective public resources, such as the ocean hard minerals discussed here, attempts to achieve specified policy goals may supplant a goal of economic conservation.

legal uncertainty for both prospective ocean hard mineral *and* oil and gas developers, regardless of the separation of disposal authorities. Whether it makes sense for MMS and NOAA to handle this kind of problem on a case-by-case basis or whether the Interior Department should handle it internally (if MMS was given ocean hard minerals management authority under some future version of the bill) is an important question for Congress as it considers the bill. Given the current economic significance of most ocean hard minerals, however, the extent to which this kind of problem might occur in the near future seems small.

340. See notes 253-63 and accompanying text.

Given a relatively low level of industrial interest and activity, it appears extraordinary that presently so much attention is being paid toward the development of mining codes for ocean hard minerals. It is possible that recent advances in geologic understanding have triggered efforts to remodel existing law into a shape more favorable to commercial interests.³⁴¹ Changes in marine jurisdictions, like the proclamation of a U.S. Exclusive Economic Zone, also might have kindled interest.³⁴² In any case, both the Congress and the Department of the Interior now have opportunities to examine methods for public ocean hard mineral disposal on the OCS or on a national seabed. But the activity of ocean hard mineral mining in the federal offshore should be viewed neither as necessarily justified from a perspective of economic conservation nor as a foregone conclusion.

A uniform method for the disposal of public minerals, onshore and in the ocean, would be a conservation-oriented, albeit probably unachievable, goal. Such an ideal could rely upon existing broad incentives to generate information and develop technology and thus would not discriminate between ocean exploration activities and those on land. Private mineral developers could consider the relative costs (including geologic uncertainty) of public mineral development across jurisdictions and make conservation decisions based upon these costs and not legal differences. Such a goal is surely chimerical because, not counting the territorial seas and other public lands of individual states, at least six distinct mining codes exist for public minerals in the United States. As public trustees for the disposal of public ocean minerals, both Congress and federal agencies must consider the potential for preferential diversion of economic resources away from other productive endeavors through the implementation of yet another mining code.

341. The discovery of massive sulfide deposits at oceanic crustal spreading centers is a good example. For a compendium of MPS discoveries, see Hoagland & Broadus, *Seabed Material Commodity and Resource Summaries* at 97 (cited in note 300).

342. EEZ Proclamation, 48 Fed. Reg. 10,605 (1983) (cited in note 13).