THE STRATEGIC MINERALS PROBLEM:

OUR DOMESTIC OPTIONS

by

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As we progress into the 1980s and beyond, increasing world demand for high-grade mineral deposits, and their corresponding depletion, can be expected to intensify competition for the world's strategic materials. A growing militance among the less-developed supplier nations in their quest for a new world economic order, and the simultaneous exercise of Soviet power and influence in the continuing East-West struggle, will further disturb the increasingly competitive environment and heighten its potential for generating international conflict. The precise effect of these developments on US national security interests is difficult to foretell; the continuing high level of US dependence on certain foreign mineral supplies is, however, a cause for concern.

Today critical materials availability poses no significant problems for Army readiness and combat effectiveness. The best time to develop an awareness of potential problems, however, is before they become crises. Timely planning and appropriate action are essential for all elements of the Department of Defense, as well as other government agencies, if problems related to strategic minerals availability are going to be controlled and a strong US strategic minerals position is going to be regained and maintained.

THE PROBLEM

There is no shortage of minerals in the earth's crust. It is, rather, the variations in the concentration and distribution of economically recoverable mineral deposits that provide the potential for disruption in international relations. Although rich in mineral resources compared to most industrialized nations, the United States still imports more than half its domestic requirements for at least 19 important nonfuel minerals, as shown by the chart on the next page.[1] In some cases, the importation of a mineral is simply economical: because of higher domestic labor costs or environmental restrictions, it is cheaper to purchase elsewhere than to rely on domestic sources. In several instances, however, there are no domestic sources, the mineral is in short domestic supply, or there is an inadequate domestic production capacity. Under these circumstances, US dependence on foreign suppliers has obvious strategic implications.

Conflicting assessments of the US materials situation are not uncommon between analysts or government policymakers. Evaluations of the current status and future implications of the US strategic materials position vary. While the fact of US dependence on foreign sources for many critical materials is indisputable, opinions differ on the degree to which such dependency represents vulnerability to economic or political coercion, on the economic advantages and concomitant political risks of interdependence, and on the policies and actions the United States should adopt to cope with possible materials-related problems.

Illustrative of how much opinions can vary are the following excerpts from two different congressional committee reports published the same month, December 1980. A special study of the Joint Economic Committee of the US Congress reads:

> The degree of supply restriction entailed in price gouging or cartel-like action would not have a serious effect on US defenses. The portion of US consumption of critical materials required for defense production—generally 10 percent to 20 percent in the event of war and about one-half of that in peacetime . . . can be met from domestic production, stockpiling, and substitutes under any foreseeable supply restrictions.[2]

A quite contrary view was expressed by the Defense Industrial Base Panel of the House Committee on Armed Services:

> A shortage of critical materials, combined with a resulting dependence on uncertain foreign sources for these materials, is endangering the very foundation of our defense capabilities. These shortages are a monumental challenge to the Congress, the Department of Defense, the defense industry, and the civilian economy.[3]

It is true, as indicated in the first quotation above, that for most critical materials the US military requirement represents a very small portion of overall domestic consumption and could no doubt be met from available supplies through priority allocations and emergency release of materials from stockpiles. Title I of the Defense Production Act of 1950, as amended, provides specific authority for such priority allocations. The application of appropriate provisions of Title I could alleviate most of the materials-related problems and delays commonly encountered in the development of weapon systems and other materiel by the Army and her sister services. This is not the case, however, for all

US RELIANCE ON IMPORTS

The United States relies on foreign imports for more than half of its consumption of the materials listed.

Material	*Percent Imported*	*Primary Sources, 1975-81*
Columbium	100%	Brazil, Canada, Thailand
Mica (sheet)	100	India, Brazil, Madagascar
Strontium	100	Mexico, Spain
Titanium (Rutile)	100	Australia, Japan, India
Manganese	98	Gabon, South Africa, Brazil, France
Tantalum	96	Thailand, Canada, Malaysia, Brazil
Bauxite & Alumina	93	Jamaica, Australia, Guinea, Surinam
Chromium	90	South Africa, USSR, Zimbabwe, Turkey
Cobalt	90	Zaire, Benelux, Zambia, Finland, Canada
Platinum-group metals	89	South Africa, USSR, UK
Asbestos	85	Canada, South Africa
Tin	81	Malaysia, Thailand, Indonesia, Bolivia
Nickel	77	Canada, Norway, New Caledonia, Dominican Republic
Cadmium	66	Canada, Australia, Mexico, Benelux
Potassium	66	Canada, Israel
Mercury	62	Algeria, Spain, Italy, Canada, Yugoslavia
Zinc	62	Canada, Mexico, Spain, Honduras
Tungsten	59	Canada, Bolivia, South Korea
Gold	56	Canada, Switzerland, USSR

nonenergy materials. For a few of the more exotic metals, an almost complete lack of US reserves coupled with a relatively high military requirement may be of strategic significance. Such material dependencies require detailed study, and their associated vulnerabilities continuous monitoring; for it is particularly important that changing conditions be recognized in time to be met with appropriate political, economic, or military initiatives.

Conditions may change rapidly with regard to either a critical material or a critical supplier. A mineral may become less critical if new ore deposits are discovered, if substitutes are developed, or if an improvement in technology permits economic exploitation of lower-grade ores. On the other hand, technological advances in weaponry or other materiel development may bring about a significant increase in the economic or strategic importance of a specific mineral. Similarly, the economic or political vagaries of the international scene may help or may harm relations between a critical material supplier and the United States.

Two relatively unfamiliar metals that require continuous scrutiny are tantalum and columbium. In 1980 US consumption of the former, used extensively in electronic devices and in high-temperature alloys, was equivalent to 170 percent of world mine production for that year, with the excess coming from industry stocks and recycling. And demand for tantalum is expected to increase at an annual rate of about four percent through 1990. Columbium is also of economic and strategic significance today, and it has the potential for even greater significance in the advanced power generation systems of the next century. It is currently used as an alloying element in large-diameter pipeline steels, and in ship-plate and heavy-machinery steels. The great potential for the use of columbium lies in the fact that certain of its alloys are the most efficient superconductors known, with the ability to transmit an electric current with zero resistance at cryogenic temperatures. Demand for this material is expected to increase at an annual rate of about six percent through 1990, with a much greater demand thereafter as a result of the full development and application of superconductor technology. It is worth noting that at present there is no US domestic mining industry or mineral reserve base for either tantalum or columbium.[4]

Recent assessments of material vulnerability generally agree on which imported nonenergy minerals are most vulnerable to supply interruptions or to coercive price increases potentially damaging to the US economy. Regardless of the criteria used in classifying materials with respect to criticality, strategic importance, or vulnerability, certain minerals repeatedly turn up on the "most important" or "most vulnerable" lists. Chromium, cobalt, manganese, and the platinum-group metals are identified most frequently, with tantalum, titanium, and columbium as the leading contenders in terms of vulnerability. With the exception of titanium, US "reserves" of these materials—those deposits economically recoverable under current technological and economic conditions—amount to less than one tenth of the quantities required to meet anticipated cumulative US demand to the year 2000.[5] When identified "resources" are considered—that is, *all* deposits, to include those *not* economically recoverable under current technological and economic conditions—the forecast through 2000 appears somewhat more optimistic. It must be remembered, however, that the successful exploitation of additional resources depends upon an increase in demand driving up prices or an advance in extractive metallurgy technology driving down costs.[6]

Future defense and energy programs will doubtless require components that are more resistant to high temperatures and corrosion, and they can thus be expected to generate increased demand for these critical materials. The Pratt and Whitney F-100 turbofan engine, which powers the F-15 and F-16 aircraft, foreshadows the technology of such programs. That engine requires 5366 pounds of titanium, 1656 pounds of chromium, 910 pounds of cobalt, 171 pounds of columbium, and 3 pounds of tantalum.[7] The M-1 tank, although requiring smaller quantities of

critical materials for its engine, still presents a sizable requirement for some of these materials when considered in terms of future tank production rates.[8]

IMPROVING THE US MATERIALS POSITION

Awareness of the strategic material problems facing the United States has been growing in both government and business circles in recent years. An interagency study initiated by the Carter Administration in 1978, *The Domestic Policy Review of Nonfuel Minerals*, projected material supply-and-demand relationships through the year 2000 and identified several imported critical minerals that would be of greatest concern to the United States and its allies.[9] The study report has been criticized, however, for not conveying a sense of urgency about the seriousness of the situation and for not identifying any practical solutions.

One result of such criticism was congressional enactment of the National Materials and Minerals Policy, Research, and Development Act of 1980.[10] This act required the President to report to the Congress his plan for a national materials policy to promote an adequate and stable supply of materials necessary to maintain national security, economic well-being, and industrial production. Passage of the act led to a flurry of compliance activity, including the formation of a Cabinet council chaired by the Department of the Interior. In April 1982 President Reagan transmitted to Congress his recommendations and a report on the activities to be undertaken by his Administration to reduce US materials vulnerability.

A number of domestic actions have been proposed to alleviate the problem of US dependence on foreign mineral suppliers and to make the United States less vulnerable to political, economic, or military coercion. These proposals are in various stages of implementation in both the government and the private sectors. To be successful, most of the initiatives require imaginative research and development, the thoughtful dedication of legislative bodies, and the cooperation of the business and industrial communities. Perhaps the most promising of these proposals are as follows:

1. Revitalize the US mining industry by providing tax incentives and easing environmental regulations.

Congressman James D. Santini, Chairman of the House Mines and Mining Subcommittee, introduced his National Mineral Security Act in May 1981 with these words:

> We cannot afford to continue following the perilous path of indifference leading to a serious mineral calamity . . . . We are in a resource war. We must begin today to establish a coherent national minerals policy. Our national security depends on it.[11]

An omnibus bill that Santini said would "establish a coherent national minerals policy to avoid the coming devastation of a major minerals crisis," the proposed legislation had 39 cosponsors.[12] Hearings were held on the bill in October 1981. It was then returned to committee, and no further hearings had been scheduled as of early August 1982.

Provisions of the proposed National Mineral Security Act provide for the creation of a Council on Minerals and Materials within the Executive Office of the President, a plan to improve the collection and analysis of data on minerals, amended tax laws to assist the mining industry in making capital investments, and amendment of the Administrative Procedure Act in order to achieve certain regulatory reforms. Implementation of these provisions would undoubtedly strengthen the US mining

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industry and help to reduce dependence on foreign supplies of some minerals. Major hurdles must be surmounted, however, before this legislation can be enacted: a sizable US constituency distrusts the motives of the mining industry in general; many people doubt the existence of, or potential for, a "resource war"; and there is strong environmentalist pressure against any relaxation of existing regulations.

2. Increase research and development of domestically available substitutes for overseas materials.

The possibility of substitution varies from mineral to mineral and depends on such factors as physical properties, price, and available technology. Work on the development of substitutes is well under way in industry and government laboratories, and acceptable substitutes for many materials are documented in Bureau of Mines publications. Substitution is not always feasible, however. For some materials—chromium, cobalt, and platinum, for example—available substitutes are too expensive or do not meet performance standards. Large-scale development of acceptable substitutes for these materials would require a minimum of three to seven years of research.[13] Such research-and-development efforts will benefit from a Bureau of Mines project to develop a general methodology for dealing with substitutability of nonfuel materials.[14]

3. Increase emphasis on the exploitation of domestically available low-grade ores.

Increasing domestic production is a realistic alternative for only those minerals of which the United States has significant exploitable resources. Although there is no current domestic *reserve* base for cobalt, chromium, and manganese, for example, substantial subeconomic resources of ores of these materials are available. The Bureau of Mines has developed extractive processes for many such ores, and while the ores cannot be economically mined and processed at present, mines and processing plants could be established and maintained on a standby basis for emergency use. Time and money are again the crucial factors. The exploitation of domestic deposits of these materials would require five to seven years of lead time for exploration and development. Depending upon infrastructure requirements, the establishment of an operational mine could require many millions of dollars, and development would take at least three years and possibly a decade. For some materials, government price guarantees under the Defense Production Act could stimulate domestic production and reopen existing mines with considerable savings of both time and money. Bureau of Mines estimates, for example, envisage the production of 6 million pounds of cobalt a year by 1990 (almost a quarter of US projected demand for that year) should domestic low-grade ore deposits be exploited. The estimated possible domestic cobalt production for the year 2000 is 10 million pounds, about 28 percent of US projected demand.[15]

4. Achieve stockpile goals for strategic materials and thereby provide a three-year emergency supply of the most critical items.

The Strategic and Critical Materials Stockpiling Act, as amended, requires the establishment of a stockpile of "strategic and critical materials"[16] to protect the United States against costly and dangerous dependence on foreign sources of supply in a period of national emergency. Historically, however, stockpile goals and inventories have not coincided. As of early 1981, stockpile inventories of required materials were valued at $8 billion, whereas they would have had a value of $20 billion had all goals been met. An additional $5 billion in excess materials was being stockpiled that could be sold. Yet even if all excess materials were disposed of promptly—highly unlikely in light of the market disruptions that would ensue—and even if $1 billion a year was to be appropriated for building the stockpile—also highly unlikely—it would still take seven years to achieve all stockpiling goals. In March 1981, the Reagan Administration authorized the purchase of $100 million worth of strategic materials with funds made available by the 96th Congress, and it requested an additional $106 million for fiscal 1982. The National Materials and

Minerals Plan of April 1982 includes a report on the possible use of exchange and barter for acquiring materials for the stockpile, as well as an analysis of the use of Defense Production Act incentives when they might be more cost-effective than stockpile purchases.

5. Encourage increased conservation and recycling of materials.

Concern over shortages of materials has led to increased industrial emphasis on conservation in such areas as preventing the corrosion of metals and decreasing wear on the moving parts of vehicles and equipment. A "useful life" concept has emerged, emphasizing the idea that a product or a piece of equipment with an unnecessarily short life represents a waste of both the materials and the energy expended in its manufacture. The science of tribology, involving improvements in wear control for greater product durability, is accordingly receiving greater attention.

The use of secondary sources—recycling—can increase domestic production to a significant degree for some metals (e.g., platinum, copper, nickel, and tin). Some of the more critical materials, however, are either unsuited for recycling (such as manganese) or their collection, processing, and waste disposal costs prohibit economical recovery (such as some forms of chromium and cobalt products). As prices rise, recovery processes become increasingly competitive, and in the decades ahead recycling will undoubtedly become increasingly important to domestic critical materials production.

6. Open up more federal lands to minerals exploration.

The opening of additional federal lands for exploration has become an extremely controversial subject, with the main battle lines being drawn between environmentalist groups on one side and representatives of the mining industry on the other. Broad policy differences also exist within the federal bureaucracy. The General Accounting Office has charged that restrictions on the use of federal land hinder exploration and development of domestic mineral resources in the United States, whereas other countries are actively encouraging and sponsoring exploration.[17] According to the Bureau of Mines, however, there is no evidence that land restrictions have affected domestic mineral production as yet because current production is making use of mineral reserves identified years ago.[18] Striking examples of government bodies working at cross-purposes can be seen. For example, in May 1981, Interior Secretary James Watt promised an American Mining Congress convention quick action in opening substantial Western public land acreage for mineral production, but one week later the House Interior and Insular Affairs Committee ordered Secretary Watt to withdraw three wilderness areas in Montana from mineral leasing until 1 January 1984.[19]

The current national minerals plan is designed to prevent such internal controversy by continuing an inventory of federal lands for minerals potential and by passage of the "Wilderness Protection Act." This legislation would protect wilderness areas but would allow the President to release such lands for development if he determines that an urgent national need for that development exists. There are undoubtedly commercially promising deposits of strategic and critical materials within the 750 million acres of US public lands, but it is apparent that progress toward the development of mines within that vast acreage that would ease the strategic materials situation will be slow and fragmentary. A reasonable estimate would be that no significant mine production can be expected from these areas for at least five to ten years.

7. Encourage seabed mining under the Deep Seabed Hard Minerals Resources Act, pending development of an acceptable Law of the Sea Treaty.

Very large quantities of mineral-bearing concretions ("manganese nodules") have been discovered on the deep floors of the Pacific, Atlantic, and Indian Oceans. These ocean-floor deposits are under intensive investigation by several consortia representing both US and foreign interests. While estimates are preliminary and still highly speculative, a figure of 76 billion tons of nodules has been reported. Mining of these resources could provide an important source

of supply for two of our most critical materials, cobalt and manganese, as well as long-term supplies of nickel and copper. Analyses of Pacific Ocean nodules show approximately 24 percent manganese, 1 percent nickel, 1 percent copper, and 0.35 percent cobalt. A projected ocean mining operation with a capacity of 3 million tons of nodules per year could, with appropriate processing plants, supply 51 percent of US manganese and 100 percent of US cobalt requirements (based on 1979 consumption).[20]

While optimistic estimates predict that seabed mining could make the United States virtually self-sufficient in cobalt, nickel, manganese, and copper by the end of this century,[21] serious legal problems concerning ownership and mining rights remain to be resolved. Given the size of investment required—about $1 billion per project—companies are understandably reluctant to proceed until they can be assured of the security of their investment and of nondiscriminatory access to seabed minerals under reasonable terms and conditions. The proposed Law of the Sea Treaty, which presumably would determine such terms and conditions, is under detailed review by the Reagan Administration because of several "major areas of concern," including the following:

- It establishes a supranational mining company—the Enterprise—that could eventually monopolize production of seabed minerals.
- It requires the United States and other nations to fund the first capitalization for the Enterprise in proportion to their contributions to the United Nations.
- It compels the sale of proprietary information and technology now largely in US hands.
- It limits annual production of manganese nodules and the amount a single company can mine for 20 years, creating artificial scarcities.
- It creates a one-nation, one-vote international body governed by an Assembly and an Executive Council on which the Soviet Union and its allies have three seats, while the United States must compete with its allies for representation.
- It contains provisions establishing the eligibility of "national liberation movements" to share in the revenues of the Seabed Authority.[22]

The Law of the Sea Treaty will be opened for signature in December 1982; US acceptance, however, is unlikely. The chief US delegate to the treaty deliberations reported to the Senate Foreign Relations Committee that the compromise text arrived at in April 1982 does not come even remotely close to meeting President Reagan's objections.

The Deep Seabed Hard Minerals Resources Act, passed by the US Congress in 1980, provides an international legal framework for US mining of the deep sea as an interim measure until an acceptable Law of the Sea Treaty enters into force. Only one industrial consortium, however, is reported to have seabed mining in its current plans.[23] It looks toward commercial production of manganese in the late 1980s.[24]

8. Improve methods for the collection and use of mineral data.

A reliable information system is essential to all materials planning and policymaking. Accurate, timely, and relevant data on the availability of critical materials are required to permit the anticipation and analysis of materials problems, and to formulate appropriate governmental responses. Responsibilities for generating mineral information are shared by the Department of the Interior (primarily the Bureau of Mines and the Geological Survey) and the Department of Commerce. Because of the relationship of these materials to national security, the Department of Defense is also an interested and active participant in the collection of materials information. Under the impetus of the National Materials Policy Act of 1980, the Defense Department has reemphasized this interest and has taken the following steps:

- Personnel from its industrial-resources and research-and-development organizational elements have been assigned

to the staff of the Secretary of Defense. They will work closely as a team with representatives of the Department of Commerce and other interested agencies to fulfill the requirements of the 1980 act.

- The support of the Institute for Defense Analyses has been secured to assist in assessing the overall materials and research-and-development situation and to help develop policy options.
- The charter and objectives of the Interagency Department of Defense Materials Availability Steering Committee, originally established in 1974, have been renewed and updated.
- Contacts have been established with the Department of Commerce, the Department of State, and the Central Intelligence Agency. Also, the continuing cooperation with the Federal Emergency Management Agency and the Department of Interior has been reinforced.
- The Joint Chiefs of Staff, the Army, and the other military departments have been tasked to work with the Defense Department in assessing the effects of import dependency on specific weapon systems, including subsystems and semifinished components and structures.
- The Army, the other military departments, and the Defense Advanced Research Projects Agency have been assigned the responsibility to develop a long-range, DOD-wide materials-substitute research-and-development plan to address our most critical needs.[25]

THE OUTLOOK

All of the actions discussed above clearly have some potential for easing the US strategic minerals position. Bureaucratic inertia and the numerous special interests involved have slowed progress in most cases, however, and actual implementation of proposed actions is likely to be even slower. Illustrative of the difficulties involved in implementing specific programs is the widespread belief that the most pressing issues center on finding solutions to the domestic problems of an inadequate industrial base and insufficient domestic mining, smelting, and refining capacity. Access to materials, it is argued, is of little importance if we do not have the capability to process and fabricate the required components. While noting these important complementary problems, others argue, more to the point, that the fundamental problem is access. If the materials are not available, they maintain, the capability to refine and fabricate them is irrelevant.

The long-term resolution of the US strategic minerals problem will undoubtedly require implementation of some or all of these domestic-oriented proposals. Although short-term actions to improve relations with foreign suppliers are also needed to ensure access to current sources of materials, such actions must be regarded as only an "insurance policy" during the time required to achieve greater domestic self-sufficiency.

NOTES

1. The International Institute for Strategic Studies, *Strategic Survey 1981-1982* (London: IISS, 1982), p. 44.
2. US Congress, Joint Economic Committee, *Energy and Materials: A Shortage of Resources or Commitment?* 1 December 1980, pp. 188, 196.
3. US Congress, House Committee on Armed Services, *The Ailing Defense Industrial Base: Unready for Crisis*, 31 December 1980, pp. 1, 24.
4. John D. Morgan, *Current Worldwide Materials Situation*, unpublished manuscript of presentation for the American Defense Preparedness Association, Fort McNair, 5 May 1981, p. 6; US Department of Interior, Bureau of Mines, *Mineral Commodity Summaries, 1981*, pp. 38, 158.
5. US Department of Interior, Bureau of Mines, *Mineral Trends and Forecasts*, 1979, p. 24.
6. Ibid., p. 25.
7. Morgan, p. 5.
8. Each M-1 tank engine requires approximately 343 pounds of chromium, 25 pounds of columbium, 21 pounds of cobalt, and 3 pounds of titanium. Personal communication, Colonel Howard Boone, USA, 1 October 1981.
9. US Government Printing Office, *Report on the Issues Identified in the Nonfuel Minerals Policy Review*, Document No. 944-516 (Washington: GPO, August 1979).
10. US Senate, Committee on Energy and National Resources, *Materials Policy, Research, and Development Act*, Publication No. 96-142, 29 and 31 July 1980.
11. American Mining Congress, *News Bulletin*, 12 May 1981, p. 1.
12. Ibid.
13. Michael R. Gordon, "Will the US Be Left Vulnerable If a 'Resource War' Breaks Out?" *National Journal*, 18 April 1981, p. 643.
14. US Department of Interior, *Bureau of Mines Research 1980*, p. 91.
15. US Department of Interior, Bureau of Mines, *Cobalt*, from Bulletin 671, 1980, p. 15; Amos A. Jordan and Robert A. Kilmarx, *Strategic Mineral Dependence: The*

Stockpile Dilemma (Beverly Hills, Calif.: Sage, 1979), p. 32; Gordon, p. 643.

16. For the purposes of this act, the term "strategic and critical materials" means materials that (1) would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and (2) are not found or produced in the United States in sufficient quantities to meet those needs.

17. *Energy and Materials: A Shortage of Resources or Commitment*? pp. 90, 115.

18. Ibid., p. 116.

19. American Mining Congress, *News Bulletin*, 22 May 1981, pp. 1, 4.

20. *Cobalt*, pp. 15-16; Gordon, p. 642.

21. James Arnold Miller, ed., *The Resource War in 3-D—Dependency, Diplomacy, Defense* (Pittsburgh: World Affairs Council of Pittsburgh, 1980), p. 86.

22. American Mining Congress, *News Bulletin*, 5 June 1981, p. 4.

23. Because of the large capital investment required and the risk involved, seabed mining is beyond the capabilities of most individual companies.

24. US Department of Interior, Bureau of Mines, *Manganese*, from Bulletin 671, 1980, p. 13.

25. Robert F. Trimble, Acting Deputy Under Secretary of Defense (Acquisition Policy), statement before the Committee on Commerce, Science, and Transportation, US Senate, 2 March 1981.