The new strategic minerals: uses, location and ownership

By Gill Burke

In a series of articles Gill Burke examines the so called strategic minerals, the nations and companies that produce them, and how power and control of production and supply has shifted in the 1980s.

Gill Burke, PhD, is a consultant on mineral economy, based in London. Address: Third Floor, 16 Hanover Square, London W1R 9AJ, London.

INTRODUCTION

This report examines a group of metallic minerals used in high technology industries, particularly in electronics. The rise in importance of these minerals has been rapid and is relatively recent. It mirrors the dramatic technological advances that have occured over the past decade. Compared to minerals such as bauxite, copper, lead or zinc the amounts used are tiny and production is often measured in pounds rather than tonnes.

Nonetheless, these minor and more exotic minerals and metals are of crucial importance in the manufacture of specialised alloys, chips, wafers and ceramics for a whole host of complex and advanced uses. Their key position entitles them to be called the "new" strategic minerals.

Definitions and concepts

The term "strategic minerals" means different things to different people. Definitions vary and there are no hard and fast rules; at any one moment certain minerals can be classified as strategic, but classifications can change should subsitutes become available or should technological change render particular uses obsolete. As a generalisation it can be said that strategic minerals are those essential for the continuance of modern industry and which come from supply sources that could possibly be restricted fairly suddenly for one reason or another. It is the combination of essential uses and vulnerable supplies which decides whether or not a mineral is strategic.

For a manufacturing company a strategic mineral or metal is one that is essential for the production process. Fear of shortages and high prices - whether caused by depletion, political instability, environmental restrictions or the actions of cartels, - may prompt the company to build its own commercial stockpile to meet possible shortfalls. For some manufacturers, common metals such as copper or lead are thus "strategic".

For a trader or investor, on the other hand, the term "strategic" has come to mean a hedge against inflation and a store of increasing value. Thus the metals they select will tend to be those whose price moves rapidly and which have an active free market that enables easy buying and selling of physical metal. Since many such metals are by-products of others - bismuth for example is generally a by-product of copper, lead or zinc,- their price volatility is further enhanced by changes in supply or demand for the other major metal.

National governments also have a concern with lessening the risks of disruptions of key supplies. Many governments maintain stockpiles of minerals and other commodities variously defined as strategic. Of the published studies of strategic minerals most – from De Mille's seminal work in 1947 [1] to more recent commentators such as Maull [2] or Van Rensburg [3] – have focused on supply disruption's relation to national security. In the past, the primary requirement of national stockpiles was a military one, defined most particularly in terms of national defence.

The USA was the primary, and almost sole significant stockpiling nation. The *Defense Production Act 1950* and its subsequent amendments together with the *Strategic and Critical Minerals Stockpiling Act,* established the development of defence preparedness programmes and actions to decrease dependence upon foreign sources of supply in times of national emergency. The purpose of the stockpile was to serve the interests of national defence only and the aim was that the quantities of materials stockpiled should be sufficient to sustain the United States for a period of not less than three years of national emergency, ie war. Thus the definition of a strategic mineral was ipso facto a military one.

More recently some commentators have redefined the aim of national stockpile policies and thus the definition of what consititutes a strategic mineral. They see the purpose of a stockpile as being to counter threats to vital supplies to industry, whether military or not:

> "With the growing belief that any future military conflict would be of short duration and dependent upon a stockpile of weapons rather than a stockpile of materials, the term "strategic materials" has now come to be associated with those materials which, if they were in short supply, would have a major depressing effect upon our standards of living and from which political instability could develop..." [4]

Whether this definition was based upon sound assessment or not, this wider, and apparently more innocuous, aim still nonetheless had military underpinnings, since it embraced the military application, even in peace-time, of many civilian products.

This is particularly the case in high technology fields. Although the dividing line between swords and ploughshares is a fuzzy one, it is more than simply that both are made of metal, or that one complex computer chip can aid a variety of functions.

Thus, for example, infrared optics (whose production has the largest consumption of germanium) have many beneficial civilan uses such as in cameras and microscope lenses, in satellite mapping or in fire alarms. However, they are also used in weapons guidence and sighting systems and have become crucial to night operations.

The continuing, but now hidden, military agenda, has important implications for countries such as Japan with industrial stockpiles and little overt commitment to military expenditure.

Geopolitical issues

The critical nature of some minerals, the vulnerability of nations to supply disruption and thus the implied relationship between raw materials and national security inevitably raise questions concerning international relations. This has been most clearly articulated by commentators in the United States who see US dependence and vulnerability as having world shaking ramifications:-

> "Because the United States is the leader of the industrialised democracies' international system, American import dependency is particularly significant. Because of this inescapable leadership role.....what the United States does will have important implications on the cohesion of the western industrial world."[5]

Such a view may seem overly simplistic and highly reminiscent of British commentators earlier this century when Britain rather than the United States was the major imperialist power. In contrast to earlier British pride in Empire however, latter-day US hegemony seems to cause it's supporters nothing but anxiety and suspicion. Thus, the same commentators expressed concern that:

> "Several recent developments within the developed nations that are resource-rich have created fresh concerns not only about possible future shortages in certain minerals, but also about the West's solidarity. Canada and Australia, long regarded as extremely favourable environments for minerals investments have, for example, sharply increased taxes and placed numerous regulations on minerals projects" [6]

These remarks were made in the late 1970s, and perhaps should be seen in the context of the furore over the Carter administration's environmental protection legislation and the uproar this caused in the US mining industry. Many operations closed down rather than invest in lessening environmental degraation or in anti-pollution measures, thus increasing import dependency. Nonetheless, the doubts expressed about 'solidarity' would seem more applicable to client states than to allied sovereign governments. They also interestingly echo views expressed thirty years earlier by the Senate Armed Services Committee, which saw apparent allies as swindling – 'gouging' – the USA through strategic minerals price inflation during the Korean war.[7]

Other commentators have focused less on the solidarity of dubious allies and more on the aggressive nature of perceived enemies. Their analysis defines strategic minerals as the infantry in a geopolitical "resource war". The basic premise of the resource war concept is that the Soviet Union operates its foreign policy to a large extent for the purpose of making it as difficult and expensive as possible for the West to obtain energy and mineral supplies.

Discussion of the concept has been particularly intense in the United States. In his book "The Real War", erstwhile President Nixon quotes deceased Soviet leader Brezhnev as stating:

> "It is our intention to deprive the West of its two main treasure troves: the oil fields of the Persian Gulf, and the strategic mineral resources of central and southern Africa." [8]

Similarly, in 1981, the US Secretary of Defense's publication *"Soviet Military Power"* claimed that the USSR was seeking to develope a viable oil and strategic minerals denial strategy either through physical disruption, market manipulation or domination of producer or neighbouring states:

> "By undermining Western ties with the oil and rawmaterials producers

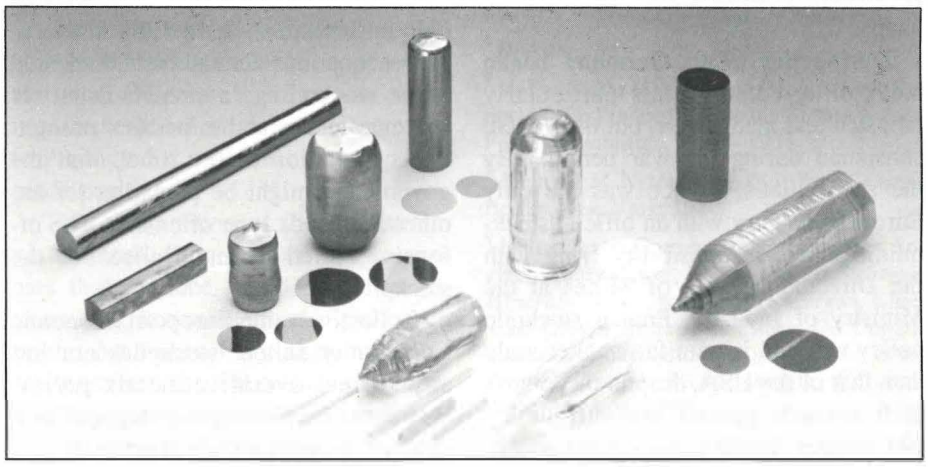
Traditional minerals, eg iron, nickel and bauxite still play a strategic role in peace and war as illustrated in Fig 1. But technological developments in many industrial sectors have increased the demand for new strategic minerals. Photo below shows semiconductor crystals and oxide crystals to be used in the electronics industry.

and exacerbating differences in the Western Alliance over policies toward these regions, the Soviets seek to erode both the economic health and the political cohesion of the West."[9]

And in 1983, the Chief Staff Officer of the US Bureau of Mines chose an picture from a 1940s Soviet chemistry textbook (Fig 1) to illustrate that "the USSR is well aware of the role of minerals in peace and war."[10] In this, rather excessivley warlike, picture a tank fires bullets labelled Al, Fe, Ni, etc. The tank's treads are also similarly labelled Pb, Cu, etc. as is the tracer that lights up the sky and the aeroplane flying overhead.

Furthermore, it has been shown to be the case that the Soviet Union is as skillful at market manipulation as many capitalists - the examples of dealings in chrome at the time the western nations were theoreticaly applying sanctions to Rhodesia (now Zimbabwe) in the 1960s, and the mutual market support actions with the Republic of South Africa over gold and platinum spring to mind. Such activities might also be seen as resource war strategies but conversely, the market manipulations and destabilising actions of the United States could equally be interpreted in a resource war context.

Whether the cold warrior stances of the resource war concept's protagonists have been modified in the light of the recent rapprochment between the United States and the Soviet Union is unclear. In any case, it is possible to conclude that most industrial nations, regardless of ideology, engage in fact in forms of resource warfare one against the other. This wider, more general form of resource warfare mostly operates to ensure supplies rather than to deny them to antagonists. At times this can be highly overt, but is more often covert through the operation of a variety of policies.



One example of overtly warlike action taken to ensure supplies was the dropping of French paratroopers into Kinshasha, Zaire, in 1978 when secessionist threats by Shaba province made cobalt supply seem problematic.

Another example might be the British Falklands campaign, which many saw as being in part a move to retain a UK presence in the emerging struggle for Antartica and its mineral wealth. Resource warfare can also lead to apparently unlikley alliances such as that between the Republic of South Africa and the Soviet Union mentioned above.

Yet, to conclude that most industrial nations enagage in resource war is merely to observe the workings of policies that arise from competition for scarce resources and that are sometimes brought to extreme conclusions. Nonetheless, such a banal observation should not be taken as reason for ignoring geopolitical issues when discussing strategic mineral location. On the contrary. The very commonplace nature of this 'war' makes matters of location, control and geopolitics into issues of key importance.

Stockpile policies

Although the United States stockpile has been the prototype and remains the most significant, other nations have had or are currently maintaining similar stockpiles of strategic minerals. In addition, there are various stocks in private hands.

During the 1930s Germany began stockpiling some metals particularly tungsten and manganese, but these were consumed during the war period. By the early 1980s, France was the only European country with an official stockpiling policy. responsibility lying with the Director General of Mines at the Ministry of Industry. French stockpile policy was and is on a far smaller scale than that of the USA, despite the latter's shift towards greater self-sufficiency and smaller holdings under the Regan administration. The French government aims to have sufficient minerals to provide French industry with a two - month emergency supply. Details of what metals and minerals are stockpiled remain confidential but copper, lead, tungsten and chromium have been cited in the past.

In the Federal Republic of Germany, government policy concerning minerals was less interventionist than France. Stocks of necessary raw materials were held by industry whilst the government operated a programme of aid and incentives for prospecting and exploration together with a form of insurance scheme – the Hermes guarantee – aimed at covering political risk connected with mining development overseas.

In 1980 there was discussion within the GFR on the possibility of creating a national stockpile of chromium, cobalt, manganese, vanadium and certain kinds of asbestos. The stockpiling operation was envisaged as being a joint undertaking between government and industry with one party paying for the stocks and the other for the stockpiling. The idea was abandoned at that time due to budget constraints and the sufficiency and diversity of industrial stocks. More recently however, the debate has been reopened.

A similar non-interventionist stance has characterised UK policy, but without equivalent incentive schemes for exploration and development that might help ensure supplies. In 1983 however, it was announced that the UK would begin stockpiling 'a small amount' of strategic metals and minerals - prompting speculation at the time that the government might be preparing for another Falklands type offensive. The offensive failed to materialise but the stockpile remained.

Collectively, the European Economic Community neither stockpiles nor has any formal overall minerals policy. However, the Community engages in a number of activities which amount to a supply policy in embryo: the focus within the Community is on research and development, externally it is on aid to help fund projects in *African, Caribean and Pacific states* (ACP) under the Lome Convention.

The remaining OECD nation which maintains a stockpile of strategic minerals is Japan. Japan is almost wholly dependent upon imports for the supply of most minerals and metals, and has been winding down domestic mining and smelting activities over the recent past. This shortage of minerals has been overcome through joint ventures and large scale projects involving consortia of Japanese trading houses, banks and the government often with the host government of a producing country to ensure a relatively stable, extremely diversified mineral supply base for Japan.

The stockpile cannot act as a substitute for this, nor is it intended to since the (unspecified) minerals it contains are only sufficient for a few months. Rather, it operates to cover brief emergencies such as the halting of aluminium shipments in 1988 during the dispute between the Indonesian government and a Japanese consortium over the working of the Asahan project. The Japanese stockpile is intended purely for industrial and not military purposes, but, as has been suggested above, such clearcut distinctions are hard to make.

"Old" and "new" strategic minerals

In the past strategic minerals stockpiles have mainly consisted of such non-fuel minerals as chromium, copper, silver and tin – all used in manufacture, – together with minerals used in nuclear warfare such as cobalt and uranium. In 1982 in the UK, the Select Committee of the House of Lords considered that the metals that were most strategically important to the EEC – which had critical roles in the economies of the Member states and for which they were 85% dependent upon external sources – were the following:

- Chromium
- Manganese
- Phosphate rock
- The Platinum Group Metals

In addition certain other minerals were also critically important but less vulnerable because of possibilities of substitution. These were:

- Antimony
- Cobalt
- Molybdenum
- Nickel
- Niobium
- Tantalum
- Titanium
- Vanadium

Were a similar catagorisation to be done now, there would be important additions reflecting recent developments in electronics technology. Minerals such as beryllium and germanium (already in the USA stockpile); 'heavy minerals' such as ilmenite and rutile; and rare earth metals such as gadolinium and yttrium would all probably be included.

But together with these new additions, several existing strategic minerals and metals have accquired new uses as a consequence of the electronics revolution. Bismuth (on the USA list), previously best known as additive to steel and a stomachic, now has a crucial role as an alloy. Niobium, which was mainly used in steel by the construction industry, now is important in the manufacture of specialised types of high strength-low alloy steels and in superalloys and ceramics.

The Platinum group (which with cobalt are the most vulnerable due to concentration of location) now have new uses in thick-film and thin-film electronic devices and as sputtered thin-film forming the contact surfaces on silicon and gallium arsenide wafers. Platinum and iridium form the crucibles which are used by the electronics industry to melt the specialised materials from which single crystals are grown. Also, electronics now accounts for about one third of western world palladium consumption.

Thus, when examining the "new" strategic minerals it seems sensible to include some of the "old" in their new manifestations.

Format and presentation of report

The report will be published in three issues of RMR. In Vol 7 Nos 2 and 3 fifteen minerals or groups of minerals are examined. In each case an estimate of world production and reserves is given together with information of various types of use. The major producing companies are discussed in locational context with details of output where possible.

Quantities are given in metric tonnes, save when stated otherwise for specific reasons. Definitions for 'resource' and 'resource base' are those used by the US Bureau of Mines.

Vol 7 No 4 sums up with an analysis of the data given in the previous issues. This examines the implications of location and ownership and discusses questions of control. The concept of "resource war" is reconsidered. It will be argued that, in most cases, power and control of production and supply has shifted from producing countries and mining TNCs to a few specialised refiners. This is partly because many of the new strategic minerals are found as by-products of common and easily available base metals such as copper, lead and zinc. But also, it is because of the requirements of advanced electronics technology for materials of very high grade purity.

This examination of the new strategic minerals, those nations and companies that produce them and those nations that consume them, leads to a briefer but concomitant examination of Japan, especially of the "Japan Incorporated" concept. It also leads to examination of some key locations in developing countries. Brazil and China both occupy important long term positions as producers, especially of niobium and of rare earths.

Whilst it is true to say that the Platinum Group minerals retain their locational strategic exclusivity, and Brush Wellman of the USA have near monopoly of beryllium production, nonetheless the findings of this Report suggest that analysts of resource strategy need to look beyond the old arguments of dependency and cold war to find concepts and theories for a changing world.

Notes:

[1] John B DeMille, *Strategic Minerals*, USA, 1947.

[2] Hans W Maull, Raw Materials, Energy and Western Security, *Studies in International Security*, No 22, Macmillan & IISS, USA, 1984.

[3] WCJ Van Rensberg, *Strategic Minerals*, Vols I and II, Prentice Hall, New Jersey, 1986

[4] British Parliamentary Papers. House of Lords; Session 1981-82 20th Report. Report of the Select Committee on the European Communities, *Strategic Minerals*, p 324. Appendices to the Minutes of Evidence. Memorandum by Professor J Nutting, ScD, F Eng, University of Leeeds, *Some problems of substitution in relation to strategic metals.*

[5] Amos A Jordan and Robert A Kilmarx, Strategic Mineral dependence: the stockpile dilemma, *Washington Papers* Vol VII, No 70, p 15. Centre for Strategic and International Studies, Washington, Sage,1979.

[6] Ibid page 36.

[7] United States Government Publications, Report of the Proceedings of the Senate Armed Forces Committee, 1950 – 1955.

[8] Richard M Nixon, *The Real War*, Warner Books, New York, 1980.

[9] United States Government Publications, Soviet Military Power, 1981, quoted in *Strategic Minerals Policy*, p 8. John D Morgan, Chief Staff Officer, Bureau of Mines, US Department of the Interior. Paper given to the International Precious Metal Institute, Williamsburg, VA, April 1983.

[10] Morgan, ibid, p 8. ■