MINERAL RESOURCES: SHOULD WE FEAR A SHORTAGE?

Our great-grandparents barely used a dozen different metals. Today, household objects contain virtually the entire periodic table. Mineral raw materials are vital to the functioning of a modern economy, in particular where deploying new technologies is concerned. The prices for some metals have experienced meteoric rises in recent years, and competition is fierce for access to resources. As a matter of fact, what do we know about these resources exactly?

In 2013, do we have a clear idea of the planet's mineral potential?

Strangely enough, we do not. Public investments in mining exploration are weak compared to the amounts dedicated, for example, to space research. If you add together the budgets of the European Space Agency and of the French and German space agencies, the CNES and the DLR, the figure you get it is at least five billion euros per year. In comparison, the sum of the combined budgets for European geological surveys amounted to 760 million euros only in 2010, and it should be noted that only a modest portion of that goes to the acquisition of new field data on the subsoil. Our knowledge of the cosmos is better than that of earth beneath our feet. Even in rich Europe, very little investment has been made towards improving the knowledge of the subsurface. During the past two decades, politicians have showed little interest in the issue of raw materials.

A potential shortage of certain mineral raw materials is frequently alluded to. Are such concerns justified?

Our great-grandparents, in the early twentieth century, barely used a dozen different metals. They were surrounded by iron, copper, zinc, and lead in their daily life. Aluminum was still in its infancy. One hundred years later, we use almost the entire periodic table every day. Today, the simplest of mobile phones contains about forty distinct minerals, from crushed limestone for plastic filler, to the rarest earth metals. The new energy paradigm, which opposes consumption of fossil fuels, is also very hungry for minerals. Over the course of a hundred years there has been an extraordinary diversification of the range of raw materials essential to the functioning of our modern economy, along with a massive increase in the use of mineral resources per capita. Between 1919 and 2012, world population has multiplied by 4.5, while the tonnage of raw materials used (at least considering the 14 most common ones) is 20 times greater. Per capita intensity has increased fivefold. Copper consumption has seen a 3% increase per year. For rare earths metals such as dysprosium and neodymium, the increase was 10% per year. It is a mad rush.

Mineral resources consumption in the US

(source: World Resources Institute)

In order nor to lapse into recklessness neither into paranoia, how can we measure the risk of shortage, or at

least the risk of tensions to come, and how can we differentiate between strategic raw materials and critical raw materials?

First of all it is necessary to clearly distinguish costs, which arise from industrial issues (extraction, transport), and prices, which reflect the situation of financial markets. High prices may stem from a mismatch between supply and demand, without costs having increased. They may also reflect a relative or temporary paucity of certain materials, which may cause problems for anyone who uses them – be it firms, industrial sectors or even countries. This brings us to the distinction you mentioned.

A government must watch over the general interest, while a business is concerned primarily with its own production cycle. They may therefore have very different views of what is “critical”. This is the subtle difference between “critical” and “strategic” resources. From the point of view of a car or aircraft manufacturer, a given raw material is strategic if its availability can affect the profitability of their activities, or simply their very pursuit. Even raw materials whose value within an object is marginal compared to its selling price can, if they run out, make it impossible to produce said item. For instance the value of neodymium, a rare earth metal contained in the permanent magnet of microphone, speaker and vibrator parts of any mobile phone, is less than one dollar. “No can do” without the neodymium to produce the high performance miniaturized magnets indispensable in the making of any cell phone. The same problem occurs with tantalum capacitors.

Raw materials are said to be critical when they are affected by a large number of risk factors that must be identified. Material is critical when, firstly, it is subject to high supply risks (and/or a strong volatility of its prices) and, secondly, when the occurrence of these risks would have important consequences. Criticality studies have proliferated in recent years. The European Union has published a comprehensive study in 2010 regarding the 14 substances that the EU is the most vulnerable for. The United States had established their own list in 2007. Inventories of critical resources must be monitored closely. Professor Thomas Graedel of Yale University directs the largest research team in the world investigating the analysis of critical factors. He significantly refined the definition of criticality – and our very security depends upon that notion.

So raw materials can be critical without being strategic?

Of course. Copper is critical because it is impacted by critical factors such as the decline in the grade of deposits or the risk of under-production which might arise as soon as 2020, but it is not strategic for a company if the latter can replace it, through minor technological adaptations, with aluminum. As a matter of fact, many companies don't exactly know if, for them, a particular mineral is critical or strategic in their supply chain. If an industrial manufacturer is unfamiliar with its tier 2 or 3 suppliers, it may easily ignore that these suppliers are themselves endangered by raw material shortage. Some companies are wise enough to implement avoidance strategies while others persist in their belief that a supply policy based on "just in time" inventory control and approximate control over a chain of subcontractors is enough to avert any danger. That could lead to a cruel reality check.

Considering things at a planetary scale, are mineral resources likely to deplete?

No. Today, the problem is not a lack of geological resources. Rich deposits can still be found, even close to the earth's surface. There are still many countries that lack proper prospection because they are not attractive in terms of development for the mining industry. Depletion is not to be feared, even more so if we include the deep and hidden deposits about which the world map still largely blank. We have almost no idea what is to be found in the deep underground, even in developed regions such as Europe. And yet, the mining industry knows how to dig up to three kilometers deep thanks to highly automated processes whose impact on the surface is marginal. They are already doing that in South Africa and Canada. In Europe, they are already operating at a depth of 1500 meters in Finland and Sweden, and at 1200 meters depth in Poland. Of course, acquisition costs increase with depth, however the impact of technology should not be underestimated, as it can offset some of these costs. The opportunities are enormous and they are even more so if you include the seabed, which represents two-thirds of the planet. There is one caveat however: deep marine exploitation would cause complex environmental problems.

Then why have politicians and business leaders expressed so much concern?

Because deposits are often found in areas with poor access, barring modern exploration technology, and because of the investment required. The capital cost required to bring a new deposit into production is averaging just under $ 400 million – an average, it should be noted, that conceals large disparities. Investors, who are still largely Westerners, are reluctant to invest in countries with high political or legal risk or with weak governance. Iran, for example, has a huge potential in terms of copper or zinc, but conditions are obviously not attractive enough to Western investors. Exploration requires substantial capital, rare expertise and leading edge technologies in order to secure the lowest extraction costs.

What is the business model behind exploration?

In order to develop deposits, one needs to bring together operators that must be very strong financially and capable of organizing exploration projects and then development projects. The discovery of a new deposit is only the beginning of a long economic process. The mining industry needs high political and legal security as it is characterized by high capital intensity and high risk (political and technical risks and the risk of falling prices). To launch prospecting projects, coordinated action is necessary between state and industrial operators, be they public or private. The role of the government is to create a stable and predictable legal and fiscal environment, because the mining industry is one of a long term nature. Rules must be clear, without governments exerting discretion or behind-the-scene maneuvers, and operators must know precisely what the conditions are to obtain a prospecting permit and an operating license. Any uncertainty or insecurity weighing on investors is a powerful deterrent against exploration. The government must also provide investors with basic knowledge on the potential of the subsoil. No private player will ever bear the cost of drawing up an inventory of the mineral potential of a country or region. Such data infrastructure is considered public good the world over.

Is access to deposits easier in developed countries?

In rich countries, access is also difficult, but for other reasons. The inhabitants of these countries at once display a desire for frantic consumption of mineral-intensive products and a “not in my backyard” attitude. Elected officials refuse to grant exploration licenses in their constituencies, especially during election years. This collective hypocrisy is leading us to a dead-end.

How active is Europe on the topic of mineral raw materials?

The EU is a far cry from offering a uniform image. In Sweden there are 66 mining projects, in 2013, at different stages of development, 12 of which are in operation. In Finland there are 54. And in Spain, 23. Seventeen EU countries house at least one project. But there is not a single one in France, even though it is a country well-endowed geologically, possessing several crystalline basement zones. France is at the level of Estonia, Denmark, or Malta, countries that are not prone to having metal deposits. France, like all countries in which public authorities have turned their backs on their own mineral resources, and failing to take the issue of minerals seriously as a whole, finds itself particularly vulnerable in a competition for resources that is constantly on the rise.

Where is the threat coming from?

In Europe, the notion of an industrial policy has long been frowned upon. And strategic mistakes are paid dearly. Our main enemy is our vision, a vision guided by short-term profit. However, some countries, led by China, are far-sighted. They don’t want to be mere exporters of raw materials with low added value anymore. They want to produce and export products with high added value: today, it’s wind turbines and solar panels and high-end electronics. Tomorrow it will be electric cars and airplanes. Chinese authorities have always remained committed to the belief that an industrial policy is of vital importance. General Motors says that the next big crisis in raw materials will be with copper. What is your take on this?

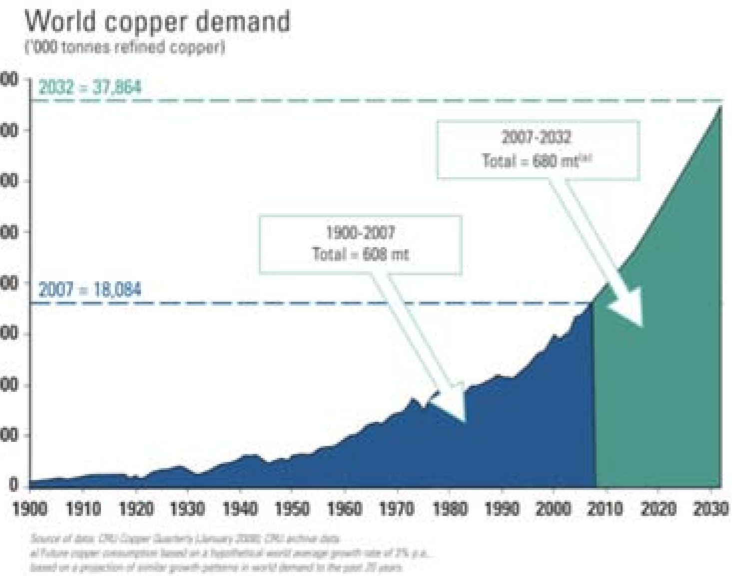
A crisis is a transient state – whereas the world is actually about to permanently switch to a new paradigm. We are starting to realize that despite all our technological advances, humanity remains highly dependent on natural resources, arable land, drinking water, energy, biodiversity and mineral resources. Our dependence on natural resources is as strong as it was a hundred thousand years ago, and perhaps even stronger – because our highly technological societies need raw materials that are sometimes extremely scarce and which were unused only two or three decades ago. We are only starting to think about how to manage these dependences. To have come to believe it was possible to break the link between growth and resources through technology or, worse still, through the virtualities of modern finance, was an illusion that could prove catastrophic if we do not take action.

Back to GM and copper...

GM has made a meaningful analysis. Many factors contribute to lasting tensions on copper. For primary copper, between 1980 and 2010, production has increased by 2.6% per year, reaching 16 million tons in 2011, which amounts to a doubling of production every 27 years. This means that by 2050, we will have to produce more copper than we have since the dawn of mankind. This is also true for many other mineral raw materials. In 2013 the average car contains 25 kilograms of copper and the automotive industry absorbs 6% of the world’s copper. By 2030, it will be 9%, with 50 kilograms per car, especially if we switch to hybrid or electric vehicles.

Some manufacturers, frightened by the possible shortage of permanent magnets (based on rare earth metals) for hybrid engines, are developing copper-based induction motors, displacing the shortage of rare earths to copper. The firm CRU Consulting, which enjoys worldwide renown in the mining industry, has shown that with a 2.5% increase in consumption of copper per year, a production deficit could be experienced as soon as 2020 and the shortage would amount to 11 million tons of copper in 2035 if it we fail to quickly bring new large deposits into production. Provided, of course, that we discover them. These 11 million tons represent 70% of world production in 2012. However it takes an average of fifteen years between the discovery of a deposit and the start of its production. Now is the time to act if we want copper in 2030.

World copper demand



(source: AQM Copper.com)

Are mineral raw materials doomed to eventually end up with the same depletion cycle as petroleum and gases?

These are two totally different issues. For hydrocarbons, the question of resource depletion is much more relevant, simply because they cannot be found beyond a certain depth, which varies depending on the geothermal gradient: if subsurface temperature is too high, there simply won't be any hydrocarbons. Minerals on the other hand can always be found, even if their grade is lower than at surface level where redox and biological processes related to climate and the movement of groundwater near the surface have enriched certain minerals through geological ages. This is especially true for copper for which the enriched ore of the surface is quite distinct from the ore from the depths. There is a limit nevertheless: beyond a certain depth and certain temperatures, exploring and extracting anything would be too technically difficult, and therefore uneconomic. But let me say this once more: there are more than enough resources in the first three kilometers, even for a humanity comprising nine billion people. Professor Stephen Kessler, of the University of Michigan, has shown that this would remain true if these nine billion people consumed as much copper per capita as Westerners do today.

Accessing mineral raw materials is actually a double problem: accessing the primary resource, of course, but also the secondary resource, that is to say recycled scrap metals.

Another major difference with hydrocarbons must be borne in mind. When you burn gasoline in a car engine, the gasoline disappears. When you install copper in a transformer, you are not destroying the copper. You may change its chemical speciation and turn it into sulphate, but the copper atom is always there. It simply needs to be recovered and recycled. In Europe, scrap metals represent considerable stock, which is usually exported, most of the time illegally, because producers play on the ambiguity between second-hand goods (exportable) and waste (non-exportable in accordance with the Basel Convention). These exports worsen our dependence vis-à-vis imported metals. According to the European Commission, only one third of scraps from electrical and electronic appliances are collected within the European Union. An even smaller portion actually gets to be recycled. A 2012 directive aims to bring the rate of collection of these wastes to 85%. This is essential because a large part of the European problem is the enhancement of our waste. Our stock of minerals and metals must be kept in Europe so as to recycle it in the best possible environmental conditions.

One would think that was self-evident. Why have Europeans waited so long to tackle this issue of waste materials?

In Europe, we are fortunate to have among us several champions of scrap metal recycling who are getting better and better at recycling an ever greater range of waste. But this still requires that these companies have access to streams and that has not been the case hitherto. If there was a deposit charged on mobile phones, their owners wouldn't forget them in a drawer and would make sure they got their deposit back by taking their device to a collection point at the end of its service life. Today, this "dispersed deposit" literally goes to waste. Should it be concentrated, its value would be glaringly obvious in the eyes of all. Introducing policies aimed at changing consumer behavior, therefore, is of the essence.

Progress is very slow and most of the products put on the market in 2012 are still not designed with a view to eventually recycle them. Mobile phones contain neodymium, tantalum, beryllium, but are not assembled to facilitate the recycling of these minerals. Eco-design is a major task for the future, a megaproject – from the outset, products must integrate the imperative for future recycling. Tantalum is one bitter exception at present – while gold can be easily recycled, such is not its case. So far, we have not found a model making it affordable, in economic terms, to dissect micro capacitors to retrieve the tantalum fragments they contain… which is unfortunate, and even tragic, as it is precisely tantalum that directly feeds the conflict in the Great Lakes region in Africa, a "blood minerals" conflict which has already killed millions of people.

Source : http://www.paristechreview.com/2013/02/12/mineral-resources-shortage/