EN

COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 4.11.2008
SEC(2008) 2741

COMMISSION STAFF WORKING DOCUMENT

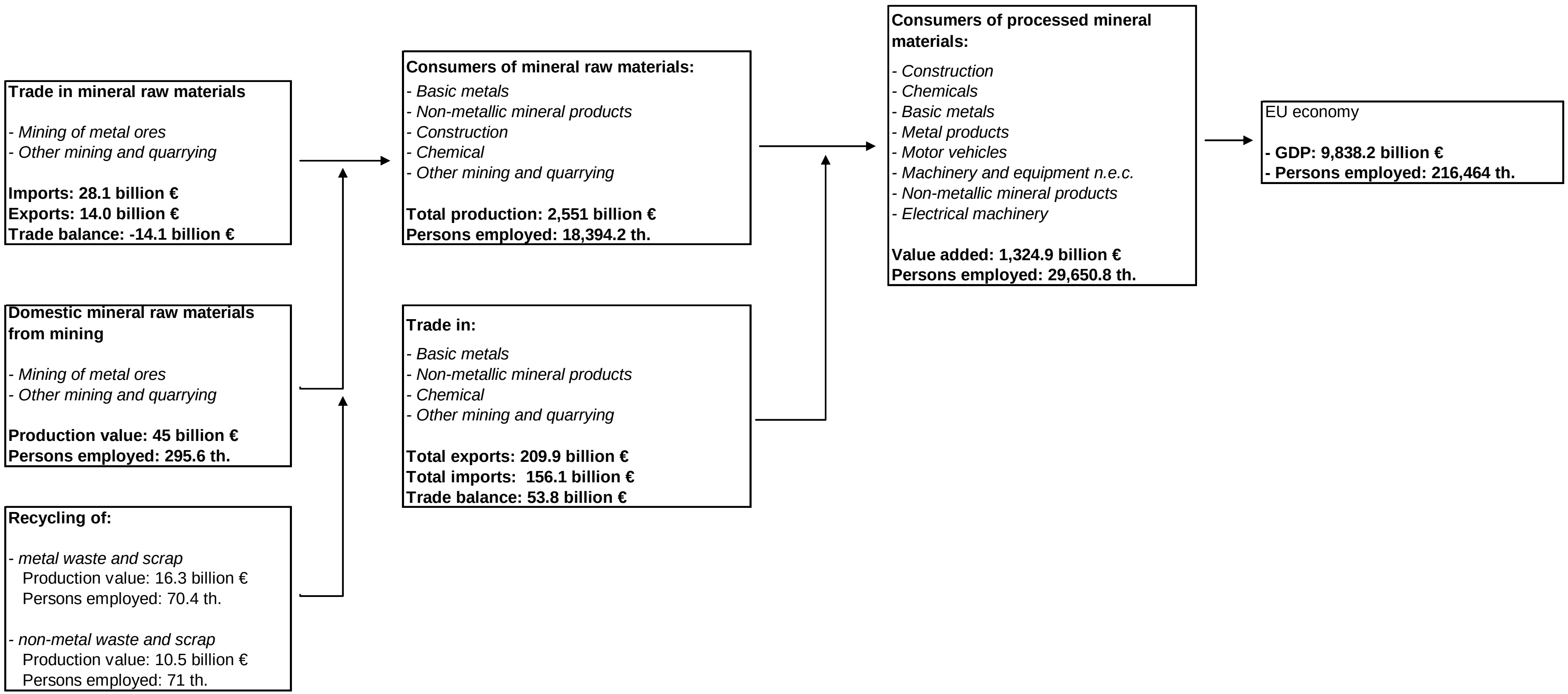
accompanying the

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

The raw materials initiative — meeting our critical needs for growth and jobs in Europe

{COM(2008) 699}

Annex 1 — Mineral raw materials value chain in EU27 (2005).



Notes:

-The sectors in the various boxes are the selected "clients" for the production of the sectors in the previous step of the value chain: "mining …" and "other mining …" sell their production to "basic metals", "non-metallic mineral products", etc., which, in turn sell their production to "construction", "chemicals", etc.

-Consumers of raw materials and processed minerals include intra-branch consumption: for example sales from "other mining and quarrying" to "other mining and quarrying"

-Only top consumers have been included, while Inter-industry transactions have been calculated from Input-Output tables for a series of EU countries

-External trade: COMEXT; Recycling: NACE Rev1 code 37; Value added and employment: Eurostat SBS and National Accounts; Data on scrap trade value not available.

Annex 2.

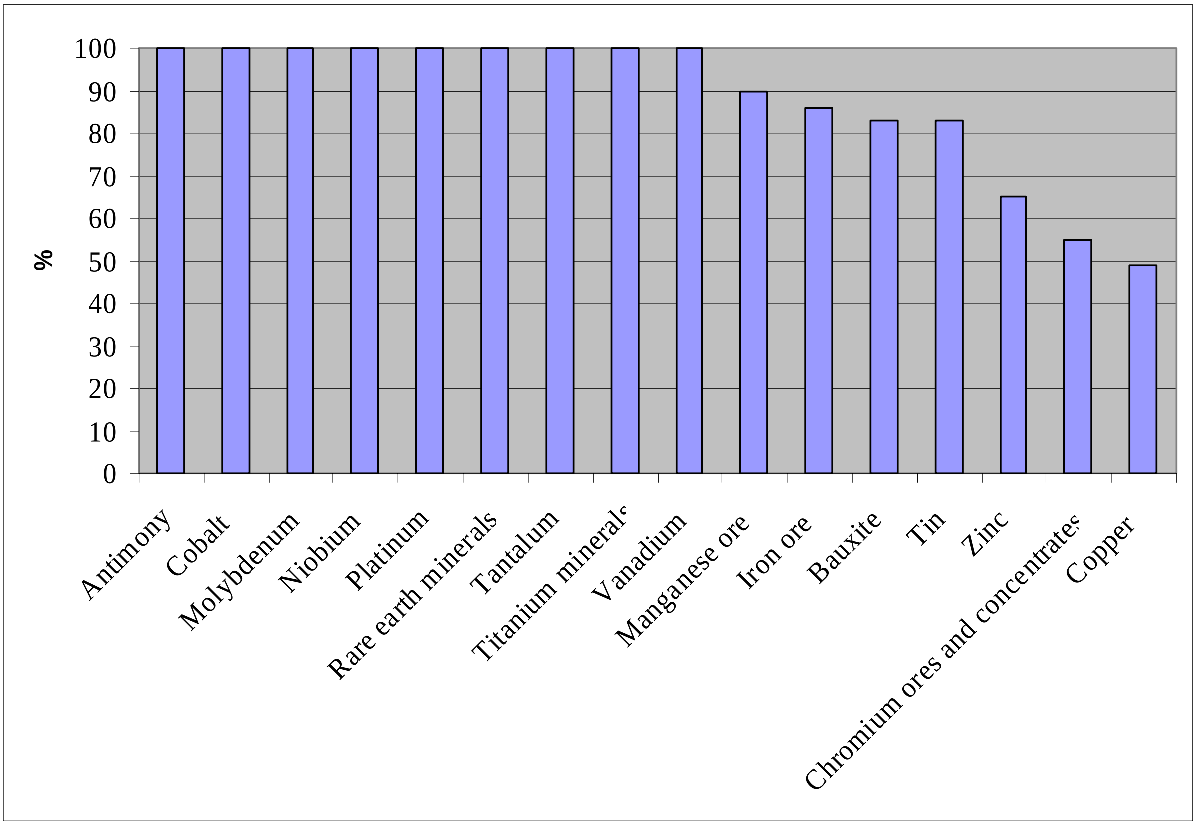
Table 1: Top three producing mining regions for selected industrial minerals 2006).

	First	**%**	**Second**	**%**	**Third**	**%**	**Cum %**
Fuller's earth	USA	72	**EU**	**12**	Senegal	4	88
Graphite	China	60	India	16	Brazil	10	86
Feldspar	**EU**	**60**	Turkey	10	Thailand	7	77
Barite	China	55	India	12	USA	7	74
Perlite	**EU**	**54**	USA	19	Japan	10	83
Boron	Turkey	53	USA	21	Argentina	12	86
Fluorspar	China	51	Mexico	17	**EU**	**7**	75
Zircon	Australia	49	South Africa	28	USA	10	87
Phosphate	Morocco	49	China	18	Israel	4	71
Bentonite	USA	44	**EU**	**24**	Russia	6	74
Vermiculite	South Africa	43	USA	22	Ukraine	14	79
Talc	China	37	**EU**	**16**	USA	11	64
Magnesite	China	32	Turkey	22	**EU**	**21**	75
Kaolin	**EU**	**31**	USA	28	Brazil	19	78
Diamonds (gemstones)	Russia	30	Botswana	24	Canada	13	67
Potash	Canada	30	**EU**	**17**	Belorussia	16	63
Gypsum	**EU**	**23**	USA	18	Iran	11	52
Salt	**EU**	**22**	USA	20	China	18	60
Sulphur	USA	19	Canada	17	China	16	52

Source: DG Enterprise and Industry calculations based on World Mining Data (2008).

Annex 2.

Figure 1: Metal concentrates and ores — net imports as % of apparent consumption (*).



* Note:

- metal concentrates produced at or nearby mining site;

- net imports = imports-exports;

- apparent consumption calculated as EU27 (mine production + imports - exports).

- source: DG Enterprise and Industry calculations based on data from British Geological Survey (2008) and Bureau de recherches géologiques et minières (BRGM; 2008)

Annex 2.

Table 2: Top three producing mining regions for selected metallic minerals (2006).

Metal	First	%	Second	%	Third	%	Cum. %
Rare Earth concentrates	China	95	USA	2	India	2	99
Niobium-Columbium	Brazil	90	Canada	9	Australia	1	100
Antimony	China	87	Bolivia	3	South Africa	3	93
Tungsten	China	84	Canada	4	**EU**	**4**	92
Gallium	China	83	Japan	17	-		100
Germanium	China	79	USA	14	Russia	7	100
Rhodium	South Africa	79	Russia	11	USA	6	96
Platinum	South Africa	77	Russia	11	Canada	4	92
Lithium	Chile	60	China	15	Australia	10	85
Indium*	China	60	Korea	9	Japan	9	78
Tantalum **	Australia	60	Brazil	18	Mozambique	5	83
Mercury	China	57	Kyrgyzstan	29	Chile	4	90
Tellurium	Peru	52	Japan	31	Canada	17	100
Selenium*	Japan	48	Canada	20	**EU**	**19**	87
Palladium	Russia	45	South Africa	39	USA	7	91
Vanadium	South Africa	45	China	38	Russia	12	95
Titanium	Australia	42	South Africa	18	Canada	12	72
Rhenium**	Chile	42	USA	17	Kazakhstan	17	76
Chromium	South Africa	41	Kazakhstan	27	India	8	76
Bismuth	China	41	Mexico	21	Peru	18	80
Tin	China	40	Indonesia	28	Peru	14	82
Cobalt	Congo D.R.	36	Australia	11	Canada	11	58
Copper	Chile	36	USA	8	Peru	7	51
Lead	China	35	Australia	19	USA	13	67
Molybdenum	USA	34	China	23	Chile	22	79
Bauxite	Australia	34	Brazil	12	China	11	57
Zinc	China	28	Australia	13	Peru	11	52
Iron ore	Brazil	22	Australia	21	China	15	58
Cadmium	China	22	Korea	16	Japan	11	49
Manganese	China	21	Gabon	20	Australia	16	57
Nickel	Russia	19	Canada	16	Australia	13	48
Silver	Peru	17	Mexico	14	China	13	44
Gold	South Africa	12	China	11	Australia	11	34

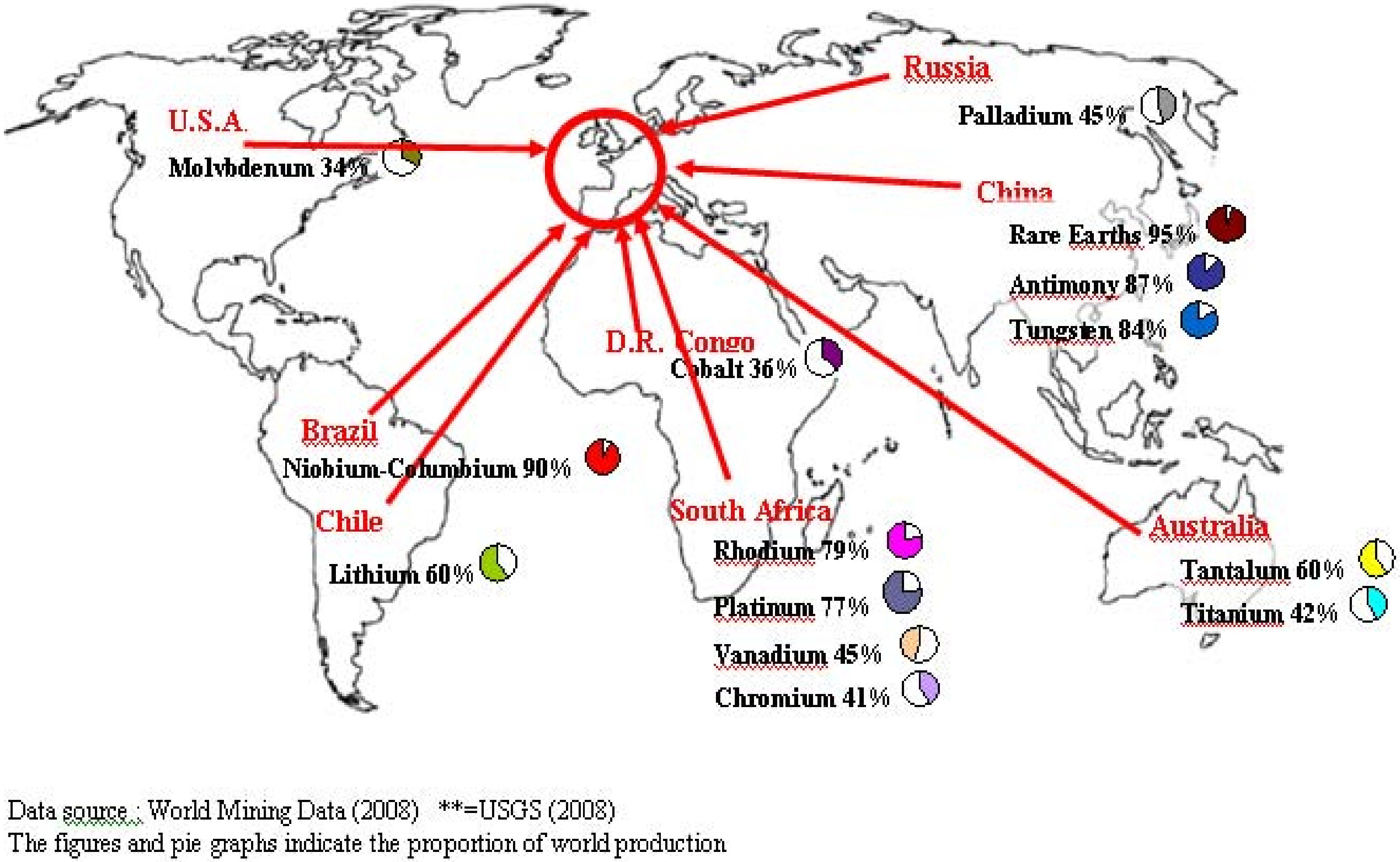
Data source: World Mining Data (2008). * = World refinery Production (USGS, 2008) ** = USGS (2008)

Annex 2 — Table 3: Selected "high-tech materials" applications for "green technologies".

Problem	Solutions	Raw materials (application)
Future Energy supply	Fuel cells	Platinum, palladium
		REE*
		Cobalt
	Hybrid cars	Samarium (permanent magnets)
		REE: Neodynium (high performance magnets)
		Silver (advanced electromotor generators)
		Platinum, palladium (catalysts)
	Alternative energies	Silicon, gallium (solar cells)
		Silver (solar cells, energy collection/transmission)
		Gold, silver (high performance mirrors)
	Energy storage	Lithium, zinc, tantalum, cobalt (rechargeable batteries)
Energy conservation	Advanced cooling technologies	REE
	New illuminants	REE, Indium, Gallium: LEDs, LCDs, OLED
	Energy saving tyres	Various industrial minerals
	Super alloys (high efficiency jet turbines)	Rhenium
Environmental protection	Emissions prevention	Platinum, palladium
	Emissions purification	Silver, REE
High precision machines	Nanotechnology	Silver, REE
IT limitations	Miniaturisation	Tantalum, ruthenium (MicroLab solutions)
	New IT solutions	Indium (processors)
		Wolfram (high performance steel hardware)
	RFID (hand-held consumer electronics)	Indium, REE, silver

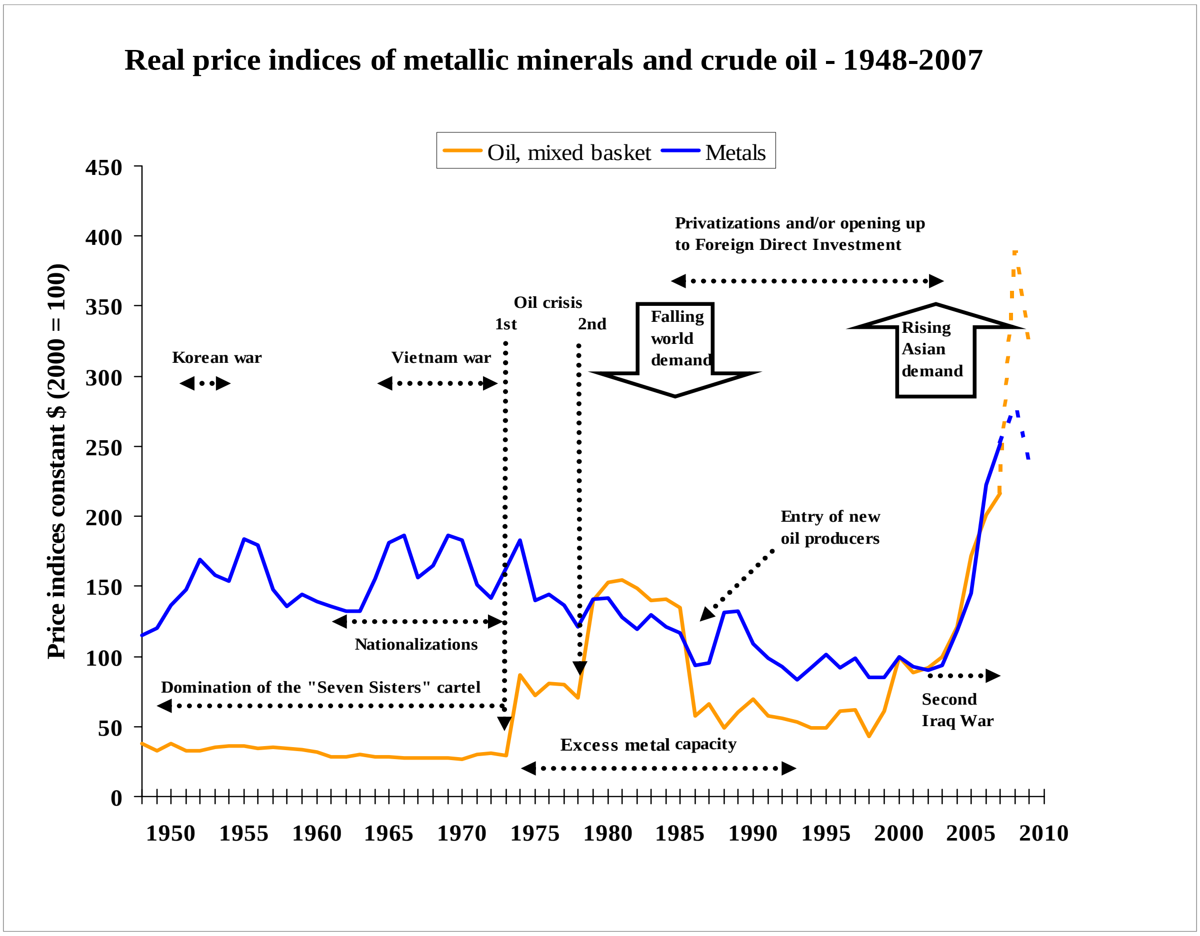
* = Rare Earth Elements (Scandium, Yttrium and lanthanides). DG-ENTR selection based on data provided by RWTH Aachen, 2008; BRGM, 2008 and USGS (2008).

Annex 3 — Major global producers of selected high-tech metals (2006).



Annex 4.

Figure 1: Real price indices of metallic minerals and crude oil — 1948-2007



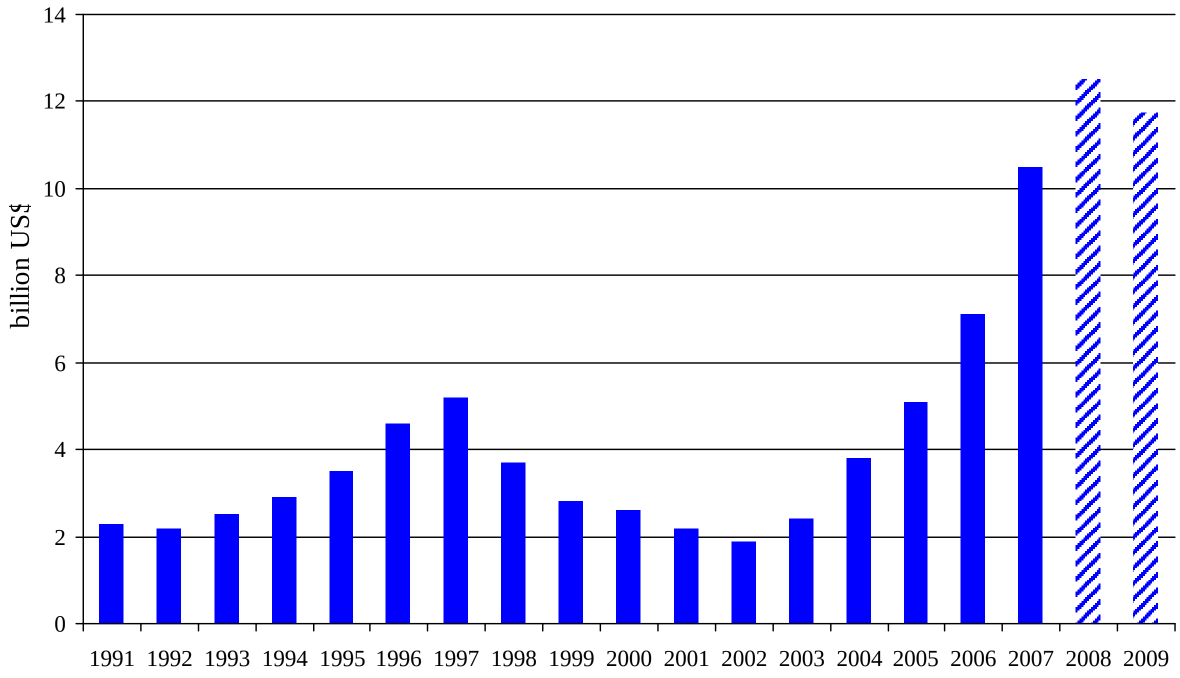
Source: Radetzki M (2008), A Handbook of Primary Commodities in the Global Economy, Cambridge University Press. Numbers until 2007 updated by the author; 2008 (dotted) represents estimates of Commission services as consolidated 2008 indices are not available (the values related to the 2008 indices are based on 2008/Q2 and Sept 2008/2 data; see http://www.imf.org/external/np/res/commod/index.asp) .

Note to the graph: UN's Index of Manufactured Export Prices from Industrialised countries in US Dollars is used as deflator (base year 2000 = 100). Metal Price index: Copper (26.64%); Aluminium (36.33%); Iron ore (12.46%); Tin (1.38%); Nickel (10.38%); Zinc (5.88%); Lead (2.08%); Uranium (4.84%). Oil index: Average of equally weighted U.K. Brent, Dubai and West Texas Intermediate. Sources: IMF, UNCTAD, United Nations, World Bank.

Note: The cyclical nature of the metal industry can be observed throughout the 20th century. Since the mid-seventies, real metal prices have displayed a gradually declining trend, generally believed to be the result of excess capacity and the dematerialisation of the industrial economies. In periods of higher demand for raw materials, supply may not be able to keep pace, resulting in higher prices. In the mining industry it typically takes many years between identifying economically viable deposits and the start up of actual mine production. This is due to many factors, such as raising sufficient investment capital, long planning and permit phases, potential bottlenecks in infrastructure, time lags in delivery of mine equipment, and lack of skilled staff. Once supply catches up with demand due to increased production, recycling, substitution and/or innovation, prices usually decline again, and excess supply capacity may occur.

Annex 4.

Figure 2. Global mining exploration expenditure (with 2008/2009 estimates)



Source: Raw Materials Data, Stockholm, 2008

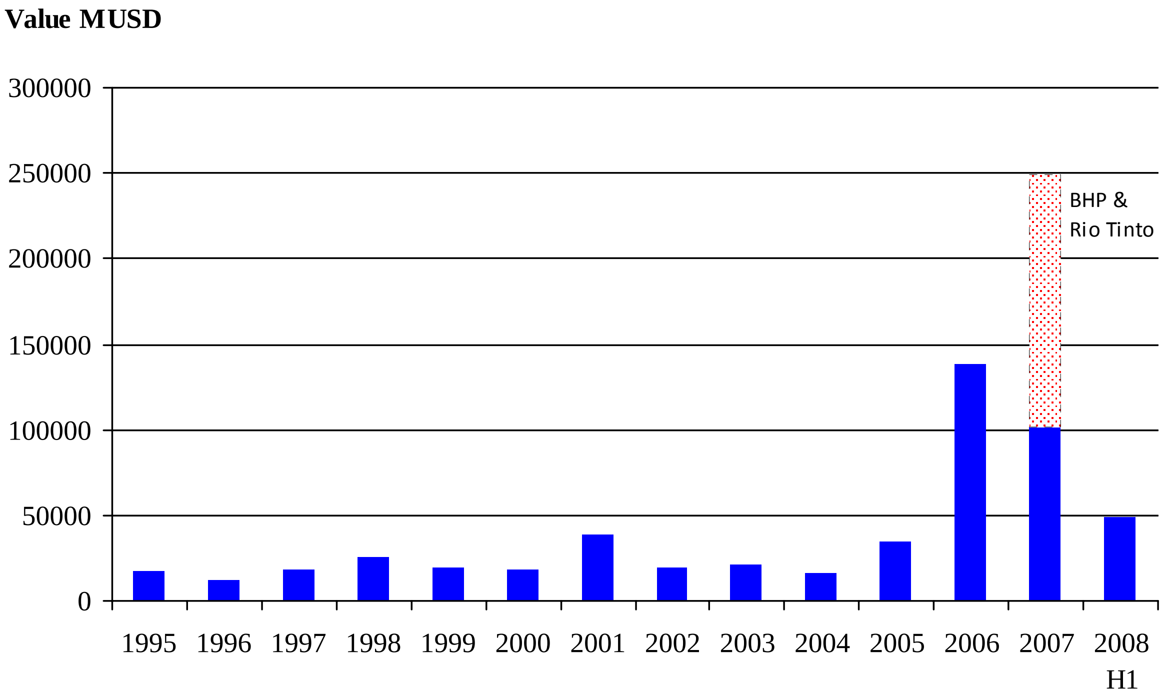
Annex 4.

Table 1. Examples of non-energy raw material export restrictions.

Raw material	**Country**
Aluminium (ores, concentrates, unalloyed unwrought metal)	China
Cokes	Ukraine, China
Copper (ores, concentrates, intermediates, unwrought metal, master alloys)	China
Ferroalloys of chromium, nickel, molybdenum and tungsten	China
Ferrous scrap	Russia, Ukraine
High-tech metals (Rare earths, Tungsten, Indium)	China
Iron ore	India
Magnesium (ores, concentrates, intermediates, unwrought metal)	China
Manganese	China
Molybdenum (ores, concentrates, intermediates, unwrought metal)	China
Nickel (ores, concentrates, unwrought metal, electroplating anodes)	China
Non-ferrous scrap	e.g. China, India, Pakistan, Russia
Raw hides and skins, wet-blue leather	e.g. Argentina, Brazil, India, Pakistan
Yellow phosphorus (chemical)	China
Wood	Russia

Annex 4.

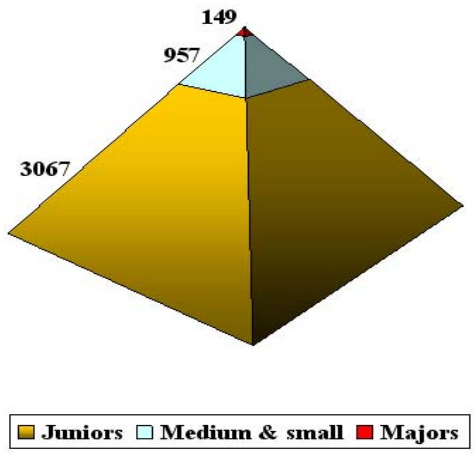
Figure 3. Overview of mergers and acquisitions in the mining sector.

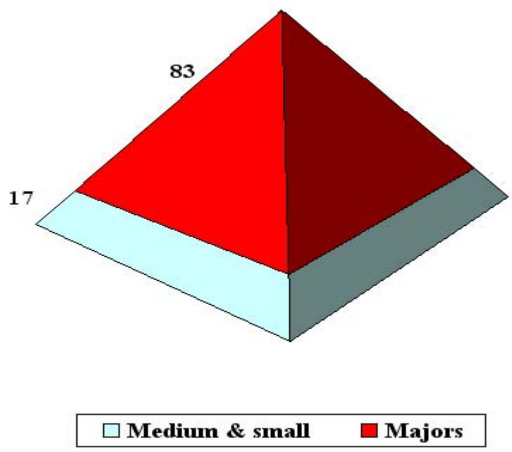


Source: Raw Materials Data, Stockholm, 2008

Note: The possible merger between BHP Billiton and Rio Tinto is currently under investigation by the European Commission. A final decision is expected early January 2009.

Annex 5 — Market structure of metal mining companies.





Market structure metal mining companies (in numbers; left) and market control (in percentages; right).

Source: Raw Materials Group, Stockholm (2008).

Note: While companies specialising in construction minerals are notably SMEs supplying local or national markets, producers of industrial minerals and metallic minerals operate globally. The metal mining industry is largely dominated by privately owned Trans National Companies (TNCs), or mining "majors"[1]. These "majors" represent only a small fraction of the 4000+ companies, with production facilities including mining, smelting and refining. The "majors" represent about 83% of the total value of all non-fuel minerals production, whilst the remaining 17% is accounted for by about 1000 medium sized and small companies. The majority of the metal mining companies consist of "junior" companies, essentially specialising in exploration. If juniors find a deposit, it is usually sold to a major mining company, capable of raising the necessary capital, experience and competence to invest in actual production.

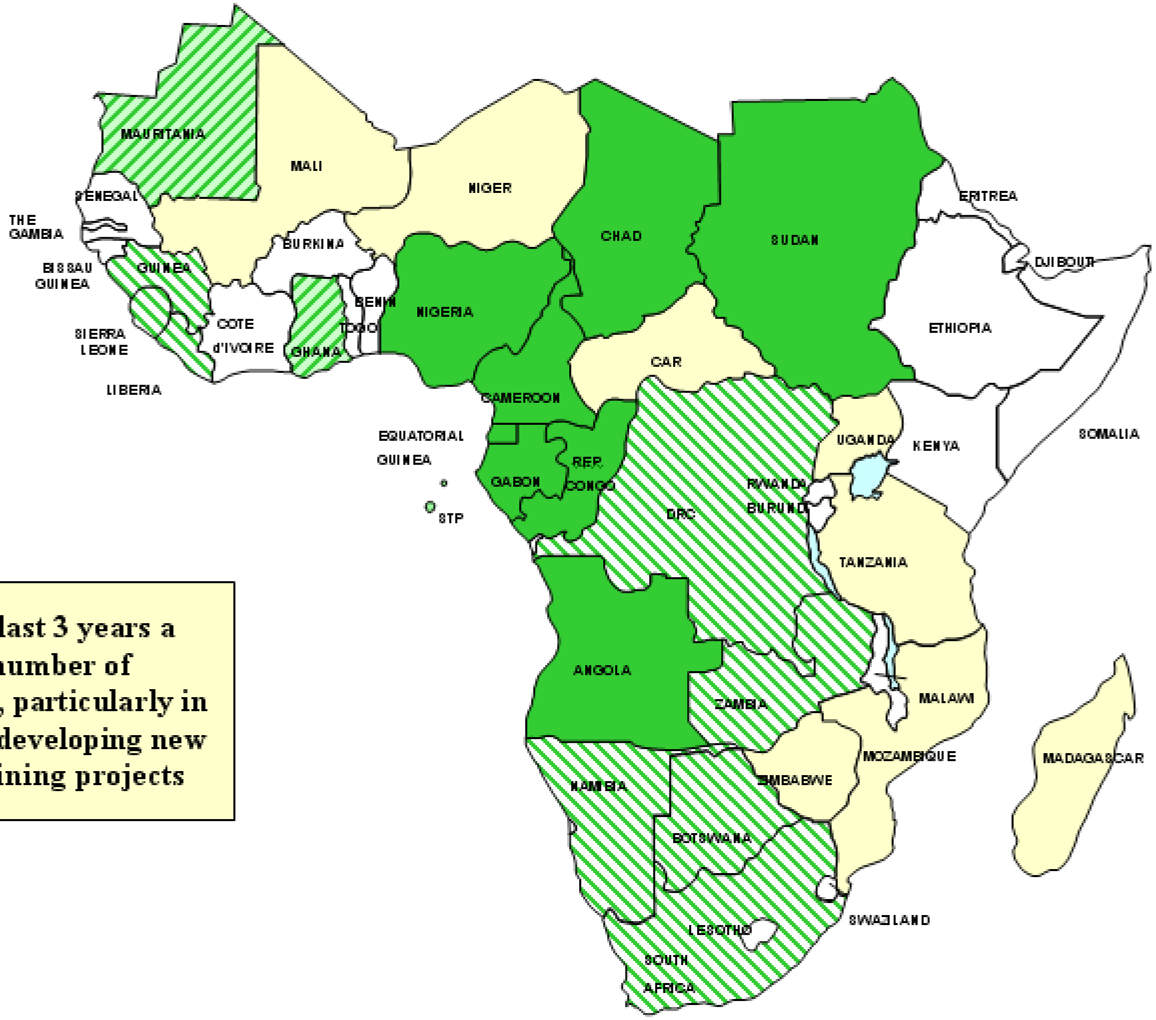
World top 10 companies in non-energy minerals mining in 2007.

Rank world	Company name	Headquarters	Share of company, % of value of world mine prod. of all minerals 2007%	Cumulative share of World 2007 %	Revenue M$ 2007
1	Vale	Brazil	5.45	5.45	33115
2	BHP Billiton Group	Austr./UK	4.92	10.37	47473
3	Anglo American plc	UK	3.76	14.13	25470
4	Rio Tinto plc	UK/Austr.	3.59	17.73	33518
5	Freeport McMoran	USA	3.28	21.01	16939
6	Norilsk Nickel	Russia	2.91	23.92	17119
7	Codelco	Chile	2.88	26.80	16988
8	Xstrata plc	Switzerland	2.72	29.52	28542
9	Barrick Gold Corp	Canada	1.61	31.13	6332
10	Grupo Mexico SA de CV	Mexico	1.56	32.69	7078

Source: Raw Materials Data, Stockholm, 2008. Companies ranked by approximate share of total value of world mine production of non-energy minerals in 2007.

[1] World Investment report 2007, United Nations (2007).

Annex 6 — Resource-rich countries in Sub-Saharan Africa (2000-2005).



Over the last 3 years a growing number of countries, particularly in SSA, are developing new oil and mining projects

Definition of "resource rich":

i) average share of hydrocarbon and/or mineral fiscal revenues in total fiscal revenues at least 25% over the period 2000-2005 or
(ii) average share of hydrocarbon and/or mineral export proceeds in total export process of at least 25%.

Source: IMF (2007) Guide on Resource Revenue Transparency, Appendix I

See http://www.sigafrique.net/ for detailed Geological maps

Hydrocarbon-rich
Potentially large medium to long-term hydrocarbon revenue
Potentially large medium to long-term hydrocarbon revenue and mineral-rich
Mineral-rich

EN EN

Annex 7 — Policies and programmes for securing non-energy raw materials — examples from US and Japan

US

According to the Strategic and Critical Materials Stockpiling Act (50 U.S.C. 98 et seq.) the US is conducting i.e. "*scientific, technologic, and economic investigations concerning the development, mining, preparation, treatment, and utilization of ores and other mineral substances that (A) are found in the United States, or in its territories or possessions, (B) are essential to the national defence, industrial, and essential civilian needs of the United States, and (C) are found in known domestic sources in inadequate quantities or grades. These investigations are carried out in order to (A) determine and develop new domestic sources of supply of such ores and mineral substances; (B) devise new methods for the treatment and utilization of lower grade reserves of such ores and mineral substances; and (C) develop substitutes for such essential ores and mineral products".*

In 2008 the US National Research Council released a report[2] on the criticality of non-energy raw minerals for the US economy. In order to determine criticality, the mineral's importance in use and its availability (supply risk) were assessed. Of the 11 raw materials that were analysed, 5 were assessed as being 'highly critical': indium, manganese, niobium, rare earths and the platinum group metals. The proposed approach is presented as an aid to decision makers in taking appropriate steps to mitigate restrictions in the nonfuel mineral supply. It is important to note that the report only addressed in a limited way the mineral needs that are specific to the needs of the defence industry. The US Department of Defence maintains a stockpile of strategic materials to supply the needs of US national defence. In the 1990s, the Congress authorised its disposal, but as a result of reported shortages of certain raw materials, such as titanium, it recently directed the Department of Defence to review its current stockpile disposal policy, which may result in additional adjustments to inventory and sales plans (expected late November 2008).

In another response to the growing need for minerals information, the U.S. Geological Survey (USGS) is conducting a cooperative international project to assess the world's undiscovered nonfuel mineral resources, the Global Mineral Resource Assessment Project (GMRAP). It aims "*to develop and test methods of assessing undiscovered mineral resources on land*". Its primary objectives are to "*outline the principal land areas in the world that have potential for selected undiscovered mineral resources and to estimate the probable amounts of those mineral resources to a depth of one kilometre below the Earth's surface*". The first three commodities for which global undiscovered resources will be assessed are copper, platinum-group metals, and potash; others will follow. GMRAP is currently an 8-year project, which began in 2002. Geological surveys from around the world are involved in this initiative, including the French Geological Survey (BRGM)[3].

---

2 Minerals, critical minerals, and the US economy (2008), National Research Council, the National Academies Press.

3 USGS Fact sheet FS-053-03.

Japan

Early in 2008 the Japanese government published its "Guidelines for Securing National resources"[4], which includes the statement that the Japanese Government "*will support key resource acquisition projects by promoting active diplomacy and helping these projects to be strategically connected to economic cooperation measures, such as official development assistance (ODA), policy finance and trade insurance*". Potential projects must fulfil the criteria 1) "*projects to acquire exploration or development interests*" and 2) "*projects related to long-term supply contracts that contribute to supplying …resources to users in Japan*".

In 2004 the Japanese government created the Japanese Oil, Gas and Metals National Cooperation (JOGMEC)[5]. Among JOGMEC's important activities are providing financial assistance to Japanese companies for mineral exploration and deposit development, gathering and analysing information on mineral and metal markets to better understand supply risk, and managing Japan's economic stockpile of rare metals. JOGMEC defines rare metals as those that (a) are essential to Japanese industry, sectors such as iron and steel, automobiles, information technology, and home appliances and (b) are subject to significant supply instability. JOGMEC took over and manages the Japanese rare-metal stockpiles in cooperation with private companies, with the goal of having stocks equivalent to 60 days of domestic industrial consumption. Stocks exist for seven materials: chromium, cobalt, manganese, molybdenum, nickel, tungsten, and vanadium. JOGMEC is closely observing 7 other raw materials.

4 http://www.meti.go.jp/english/press/data/nBackIssue200803.html
5 http://www.jogmec.go.jp/english/index.html

Annex 8 — Critical raw materials: a preliminary assessment

In recent times, there have been more and more assessments of the importance and even criticality of the supply of non-energy raw materials to national economies, such as:

- Minerals, Critical minerals and the US economy. National Research Council, 2008.
- Global commodities: a long term vision for stable, secure and sustainable global markets. HM Treasury, 2008.
- Trends der Angebots - und Nachfragesituation bei mineralischen Rohstoffen. RWI Essen, ISI, BGR, 2007.
- Perspectives on the environmental limits concept. DEFRA, UK, December 2007.
- Material Security. Ensuring resource availability for the UK economy. Resource Efficiency Knowledge Transfer Network, UK, 2008.

Different methodologies are being applied to determine the criticality of raw materials, making use of various criteria. What they have in common is that they consider a whole range of factors in relation to the importance of raw materials for the economy and in relation to the availability and reliability of supply. These supply risk factors can have multiple dimensions: geological, technical, environmental and social, political and economic. Examples are: concentration of production at company or country level, increased demand, degree of import dependence, by-product or not, recycling potential, substitution possibilities, political and economic stability of producing countries, etc. It is usually a combination of these factors that is instrumental in defining the criticality of a raw material, for a specific time scale.

In some countries assessments are being carried out, but are not always publicly available[6]. However, it can be assumed that they are at the basis of such policies as stockpiling (e.g. Japan) or protectionist strategies (e.g. China), so the selection of raw materials that are covered by these policies and strategies could be interpreted as being “critical” for their economies.

Analysis of the available information reveals that various raw materials, such as aggregates, iron ore and copper, are considered to be essential for the economies of the developed countries, but not necessarily critical at this moment in time. However, it is noticeable that a number of assessments and policies consider in particular “high tech” materials such as niobium, platinum and titanium as (potentially) critical for the economies of developed countries. This is because they have a number of high tech applications that are important for the economy and because they are marked by a higher degree of supply risk than the more “traditional” base and ferrous metals:

First of all, high tech metals are important for the EU economy and are characterised by sudden demand peaks which are strongly driven by the production of new products based on a new technology ("disruptive technology"); for instance mobile phones use tantalum, and flat panel display TVs **(**TV-LCD) use indium. It is expected that new Light-Emitting Diodes

[6] Study in the field of non-energy raw materials. Prepared by RPA. RWI Essen for the European Commission. September 2008.

(LEDs) making use of gallium will consume 50% less than incandescent light bulbs using tungsten wire, which would make possible low consumption lighting and a major potential reduction in global electricity consumption by 2025. High tech materials are increasingly at the basis of innovative “green techs”, associated with renewable energy (i.e. Cu-Indium-Gallium-Selenium or CIGS photovoltaic "thin-film" technology for solar cells) and with minimising greenhouse gas emissions. For instance, platinum group metals are used for catalysts in car exhausts and future hydrogen-proton-exchange fuel cell (PEMFC) cars, lithium-cobalt batteries for electric-hybrid cars, rhenium and ruthenium superalloys for the production of more energy-efficient aircraft and land-based single-crystal turbine blade turbines, and titanium with composites in the next generation B787 or A 350 commercial aircraft.

Secondly, there are high supply risks. High tech metals are often by-products of mining/processing, which means that their availability is largely determined by the availability of the main product. Due to its low or very low elasticity (sometimes as a by-product of a by-product, as in the case of rhenium and hafnium), production cannot adapt easily to demand, which increases the crisis risk, such as the rush for tantalum in 2000 due to the boom in mobile phones. For some there is a high degree of concentration of production at country level, and they are subject to various protective measures taken by third countries.

The need for Europe to focus particularly on the critical role of high tech metals is confirmed by the French geological survey BRGM. The work of the French geological survey focuses on the higher degree of criticality of high tech metals based on three criticality criteria: possibility (or not) of substitution, essential role, and potential supply risks. In their analysis[7,8,9,10] they identify short to medium risks to their supply of a number of materials: **antimony, chromite, cobalt, germanium, gallium, indium, lithium, magnesium, molybdenum, platinum, palladium, rhodium, rare earths, rhenium, titanium, and tungsten.**

This list might be expanded to take in five more materials (**chromite, manganese, niobium, tantalum and vanadium**) which have also been targeted by the above-mentioned US-report and Japanese stockpiling policy and for which there is a high degree of concentration of producing countries.

Conclusion: Clearly, the above list is only illustrative. It should be assessed further on the basis of a methodology agreed by Member States and other stakeholders, and bearing in mind that criticality assessments are a dynamic concept, which may lead to very different results depending on the timing of the analysis, the geographical scope, short, medium to long term view, technological developments, etc.

---

7 Deschamps Y., Bailly L., Bouchot V., Gentilhomme Ph., Hocquard C., Lerouge C., Milesi J.P., Nicol N., Ollivier P., Pelon R., Salpeteur I. avec la collaboration de Save M., Thomassin J.F. (2002) - Métaux rares à forte demande industrielle. Tantale, germanium, indium et gallium. État de l’art en économie, traitement des minerais, gîtologie. BRGM/RP-51558-FR, 284 p., 22 fig., 45 tabl., 32 ann;

8 Hocquard, C. et Samama, J .C, 2006, Cycles et supercycles dans le domaine des matières premières minérales, analyse des risques et des comportements des acteurs, pp.63-81, in Les techniques de l’industrie minérale, Société de l’industrie minérale, n°29, mars 2006;

9 Hocquard, C., 2008, Strategic metals, high-tech metals, environmentally green metals: A convergence. Abstract, 33rd International Geological Congress 2008 - Oslo, Norway, 6th-14th August;

10 Hocquard, C., 2008, Les nouveaux matériaux stratégiques, métaux high tech, métaux verts, vers une convergence, Agence Rhône-Alpes pour la maîtrise des matériaux (ARAMM) in Mag'Mat, n°26, avril-juin 2008, pp.18-30.