

Advances of Overseas Copper Resource Exploration and Selection of Potential Investment Area

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I Reserves Profiles

1995-2008 World Copper Reserves raised 240 million tons, reserve base raised 340 million tons (Table 1)。

Table 1 1995~2006 World Copper Reserves and Reserve Base

	1995	2008	1995	2008
	Reserve	Reserve	Reserve Base	Reserve Base
Cu (10,000t)	31000	55000	61000	100000

Resource: Mineral Commodity Summaries1996 ~ 2009。

World Copper Reserve Distribution

Table 2

Unit : 1000t

Country	Copper Reserve	% Rate of world reserve
Chile	160000	29.09
Peru	60000	10.91
Mexico	38000	6.91
Indonesia	36000	6.55
<u>USA</u>	35000	6.36
China	30000	5.45
Poland	30000	5.45
Australia	24000	4.36
Russia	20000	3.64
Zambia	19000	3.45
Kazakhstan	18000	3.27
Canada	10000	1.82
Other	70000	12.73
Total	550000	100

Resource: Mineral Commodity Summaries 2009

II Exploration Investment

- Since copper price rose in 2003, global copper exploration investment has been increasing year by year. World copper exploration investment hit a record high of USD 2.06 billion in 2007 (Table 3), indicating a coming discovery of a new batch of major copper deposits worldwide. According to the past three years statistics, the proportion of exploration investment in each stages is: 36-39% grassroots exploration, 41-43% later stages exploration (feasibility and prefeasibility), 18-20% mining exploration.

Table 3 World Copper Exploration Investment and Price 1997-2007

Year	Exploration Investment (mln USD)	Copper Price (USD/t)
1997	754.9	2275.73
1998	619.6	1652.88
1999	499.0	1573.66
2000	439.8	1814.26
2001	411.8	1577.77
2002	304.9	1557.5
2003	339.7	1779.87
2004	577.0	2868.34
2005	824.9	3683.64
2006	1373.4	6730.60
2007	2060.0	7118.53

Source: Metals Economics Group—Strategic Report 1997 ~ 2008

III. Output, Demand, Consumption, Price and Trading

Output of world copper mines was 15.53 million tonnes in 2008, refined copper was 18.48 million tonnes, consumption was 18.16 million tonnes. In 13 years, mining output increased by about 5.5 million tonnes, refined copper by about 6.67 million tonnes, consumption by approximately 6.6 million tonnes.

Table 4 World Copper Output, Consumption and Price 1995-2005

Year	World Cu Products Outputs (10 kt)				World Consumption (10 kt)	Price (USD/t)
	Mining	Refining	Solvent Extraction & Electrowinning	Secondary		
1995	1004.2	1181.8	106.9	321.4	1216.5	2936.52
1996	1103.1	1273.5	142.3	315.5	1240.1	2290.46
1997	1138.6	1358.6	176.8	557.0	1301.7	2275.73
1998	1228.3	1410.3	200.9	477.4	1340.6	1652.88
1999	1268.0	1426.3	231.2	527.9	1385.2	1573.66
2000	1323.3	1480.7	230.1	510.1	1519.2	1814.26
2001	1373.6	1568.5	255.6	571.4	1468.6	1577.77
2002	1356.6	1535.1	260.7	556.8	1505.3	1557.50
2003	1370.9	1523.9	265.8	556.9	1530.4	1779.87
2004	1457.9	1582.6	262.7	548.2	1671.6	2868.34
2005	1520.4	1661.0	212.3	555.9	1663.2	3683.64
2006	1521.0	1734.3	272.8	590.9	1697.4	6730.60
2007	1564.3	1798.0	281.0	599.4	1809.8	7118.53
2008	1553.2	1848.4	298.6	495.4	1815.6	6989.00

Source: World Metal Statistics, 1996 ~ 2009

Development Stages of Copper Resources

Overseas: grassroots exploration, prefeasibility study, feasibility study, mine construction, production

Domestic: prospecting, general exploration, detailed exploration, mine construction, production

- World copper mining output in 2008 was 0.71% less than 2007. According to incomplete statistics, there are 36 mines with annual output over 100 kt, 78 mines over 50 kt/yr, 88 mines over 40 kt/yr, 101 mines above 30 kt/yr, 125 mines above 20 kt/yr.**
- Chile is the largest producer with output accounting for 34.32% of the world sum. USA, Peru, Australia, China and Russia totaly produce 700~1200 kt per year, taking up 33.62% of the world sum, followed by Indonesia, Canada, Poland, Kazakstan, Zambia, whose outputs are 400-600 kt, accounting for 16.95% of the world sum.**
- Major mines increased outputs: Cerro Verde in Peru adds 54.3 kt; Pinto Valley in USA adds 45.3 kt; Safford increases 59.5 kt; Bagdad adds 10 kt, Bingham Canyon adds 27.8 kt, Robinson adds 12.6 kt; Kansanshi in Zambia adds 31.8 kt; Frontier in D.R.Congo adds 71.5 kt, Kinsevere adds 15 kt.**
- Major mines decreased outputs: Norte Copper in Chile reduces 150 kt, Escondida cuts 154 kt; two mines in Indonesia cuts 213.6 kt; Cananea in Mexico cuts 64 kt; Alumbrera in Argentina cuts 9.5 kt.**

- Subprime mortgage crisis broke out in USA in late 2007, tuning into international financial crisis in 2008, world economy entered into recession. Demand in international minerals market decreased sharply, mineral prices slumped. In order to reduce losses, global mining companies began to close high cost mines or cut some mines' production, and postpone new projects one after another.
- As for copper, announced production cut plan by copper mines was 545.7 kt, accounting for about 3.5% of the 15.532 million tonnes production worldwide in 2008. 7 mines announced closure or production cut were listed in table 5 with annual output over 45 kt/yr. USA is the major production cut follower.

Table 5 Production Cut Plan Announced by Cu Producers

Projects	Country	Owner	Published in	Capacity (t/yr)	Cut (t/yr)
Morenci	USA	Freeport McMoRan	Jan. 2009	370000	185000
Chino/Cobre	USA	Freeport McMoRan	Dec. 2008	100000	100000
Pinto Vally	USA	BHP Billiton	Jan. 2009	70000	64167
Safford	USA	Freeport McMoRan	Dec. 2008	109000	54500
Bwana Mkubwa	Zambia	First Quantum Minerals	Oct. 2008	50000	50000
Kamoto	D.R. Congo	Katanga Mining	Jan. 2009	70000	47000
50 Let Oktyabrya	Kazakstan	Sussian Copper	Oct. 2008	45000	45000
Sum				814000	545667

Source: Metals Economics Group—Strategic Report 2009, vol.22, No.1

- **IV. Service Year of World Copper Reserve**

Yearly average increase rate during 1995-2008

Reserve : 4.51%

Mine Production: 3.41%

Refining Production: 3.50%

Consumption: 3.13%

Assume annual increase rate of mining production is 3.4%, the service year of world existing copper reserve is 22, until year 2031. However, more exploration works on reserve base would add new reserves.

Conclusion 1: Take world existing copper reserve and exploration input into consideration, world copper reserve is abundant for long term development in the future.

V. Potential New Copper Mines in the Next 5 Years

(4.5 million tonnes capacity in all at feasibility and prefeasibility study stages)

- According to Metal Strategic Study Group of Canada, from 2008 to 2012, there are 24 potential new large copper projects worldwide, with annual production capacity above 50 kt each. At present, they are at mine construction (pre-production) and feasibility study stages. Total copper reserve/resource is about 133 million tonnes, which is able to add about 3.41 mln t/yr copper capacity, accounting for 22% of world current mining output. Average operation cost is as cheap as USD 0.59/pound (USD 1,300/t, table 5).
- 5 major projects at feasibility stage-Levikhinsky, Pulang, Esperanza, Alejandro, Hales, haven't been included due to unreliable operation cost information. Production capacities of all the 5 projects are above 100 kt/yr. If put into production in schedule, 913 kt/yr capacity can be added. Agua Rica project in Argentina, which is 100% controlled by Yamana Gold hasn't been included either, due to undecided development schedule. Feasibility study report described results in 2006.
- **Conclusion 2: If only above mines put into production in schdule, can supplies in world copper market be abundant to meet long term needs.**

Table 5 Operation Costs of World Potential Copper Mines 2008-2012

Projects	Country	Stage	Copper reserve/resource (kt)	Copper capacity Kt/yr	Operation time	Operation cost (USD/p)
Tenke Fungurume	D.R. Congo	Preproduction	5829	115	2009	<0.19
Boleo	Mexico	Preproduction	2929	55.75	2010	<0.07
Muliashi North	Zambia	Preproduction	695	60	2009	0.24
Rosemont	USA	Feasibility study	2874	106.122	2010	0.38
Mihevskoye	Russia	Feasibility study	1584	81	2009	0.39
Rio Blanco	Peru	Feasibility study	7107	191	2011	0.41
Galeno	Peru	Feasibility study	4301	144	-	0.49
Toromocho	Peru	Feasibility study	10026	250	2012	0.51
Las Cruces	Peru	Preproduction	1093	72	2008	0.53
Quellaveco	Peru	Feasibility study	7047	200	2012	0.55
Oyu Tolgoi	Mongolia	Feasibility study	31337	440	2011	0.64
El Arco	Mexico	Feasibility study	5267	188	2011	0.65
Tia Maria	Peru	Preproduction	2257	120	2010	0.65
Los Chancas	Peru	Feasibility study	1997	80	2013	0.65
Marcona Copper	Peru	Feasibility study	3063	60	2009	0.69
Tanpakan	Philippines	Feasibility study	12890	300	2013	0.70

Table 5 Operation Costs of World Potential Copper Mines 2008-2012

Projects	Country	Stage	Copper reserve/resource (kt)	Copper capacity Kt/yr	Operation time	Operation cost (USD/p)
Miniere Musoshi	D.R. Congo	Preproduction	2471	57.5	2009	0.71
Prominent Hill	Australia	Preproduction	1862	117	2008	0.73
Costancia	Peru	Feasibility study	1798	90	2012	0.74
Yandera	Papua New Guinea	Feasibility study	2253	100	2011	0.75
El Morro	Chile	Feasibility study	7046	172	2011	0.76
Lumwana	Zambia	Preproduction	6083	150	2008	0.78
Mirador	Ecuador	Preproduction	4978	62.2	2009	0.84
Petaquilla	Panama	Preproduction	5840	223	2011	0.85
Total/Average			132627	3407.572		0.59

Source: Metals Economics Group—Strategic Report 2008, vol.21, No.5

VI. World Exploration and Prefeasibility Study Projects and Distribution

According to incomplete statistics in 2008, there are 38 Cu exploration projects and 62 prefeasibility study projects. See table 6 and table 7.

Country	Exploration No.	Prefeasibility No.	Country	Exploration No.	Prefeasibility No.
Chile	5	8	Kazakstan		2
Peru	6	4	Philippines	1	2
Brazil	1	2	India	1	1
Cuba		1	South Korea		1
Bolivia		1	Australia		8
Ecuador	1		Papua New Guinea	1	2
USA	7	4	Turkey		1
Mexico	1	3	Sweden	1	1
Canada	6	9	Russia	4	3
South Africa		1	Finland		1
D.R. Congo		1	Armenia	1	2
Congo-Brazzaville		1	Botswana	2	1
Zambia		2	Total	38	62

Table 6 World Copper Exploration Projects (38 grassroots exploration projects)

Projects	Country	Projects	Country
Kotayk Copper/Molybdenum	Armenia	Canariaco Copper	Peru
Dikoloti Nickel	Botswana	Constancia Copper	Peru
Matsitama Copper	Botswana	Haquira Copper	Peru
Arapiraca Copper/Gold	Brazil	Las Bambas Copper	Peru
Creston Molybdenum	Canada	Pukaqaqa Copper	Peru
Ferguson Lake Polymetallic	Canada	Trapiche Copper/Molybdenum	Peru
Fyre Lake Copper	Canada	Far South East Gold	Philippines
Mount Milligan Gold/Copper	Canada	Bystrinskoye Copper	Russia
Onaping Depth Nickel	Canada	Kultuminskoye Copper/Gold	Russia
Raglan South Nickel	Canada	Lugokanskoye Copper/Gold	Russia
Delta Copper	Chile	Stepnoye Base Metal	Russia
Inca de Oro Copper/Gold	Chile	Stora Sahavaara Iron Ore/Copper	Sweden
La Fortuna Gold	Chile	Ann Mason Copper	USA
Papomono Copper	Chile	Birch Lake Copper/Nickel/PGM	USA
Relincho Copper D	Chile	Empire Copper	USA
Panantza Copper	Ecuador	Mesaba Copper/Nickel	USA
Askot Polymetallic	India	Pebble East Copper	USA
San Javier del Cobre	Mexico	Pumpkin Hollow Copper	USA
Kodu Copper/Gold	Papua New Guinea	Resolution Copper	USA

Table 7 World Copper prefeasibility study Projects (62 projects)

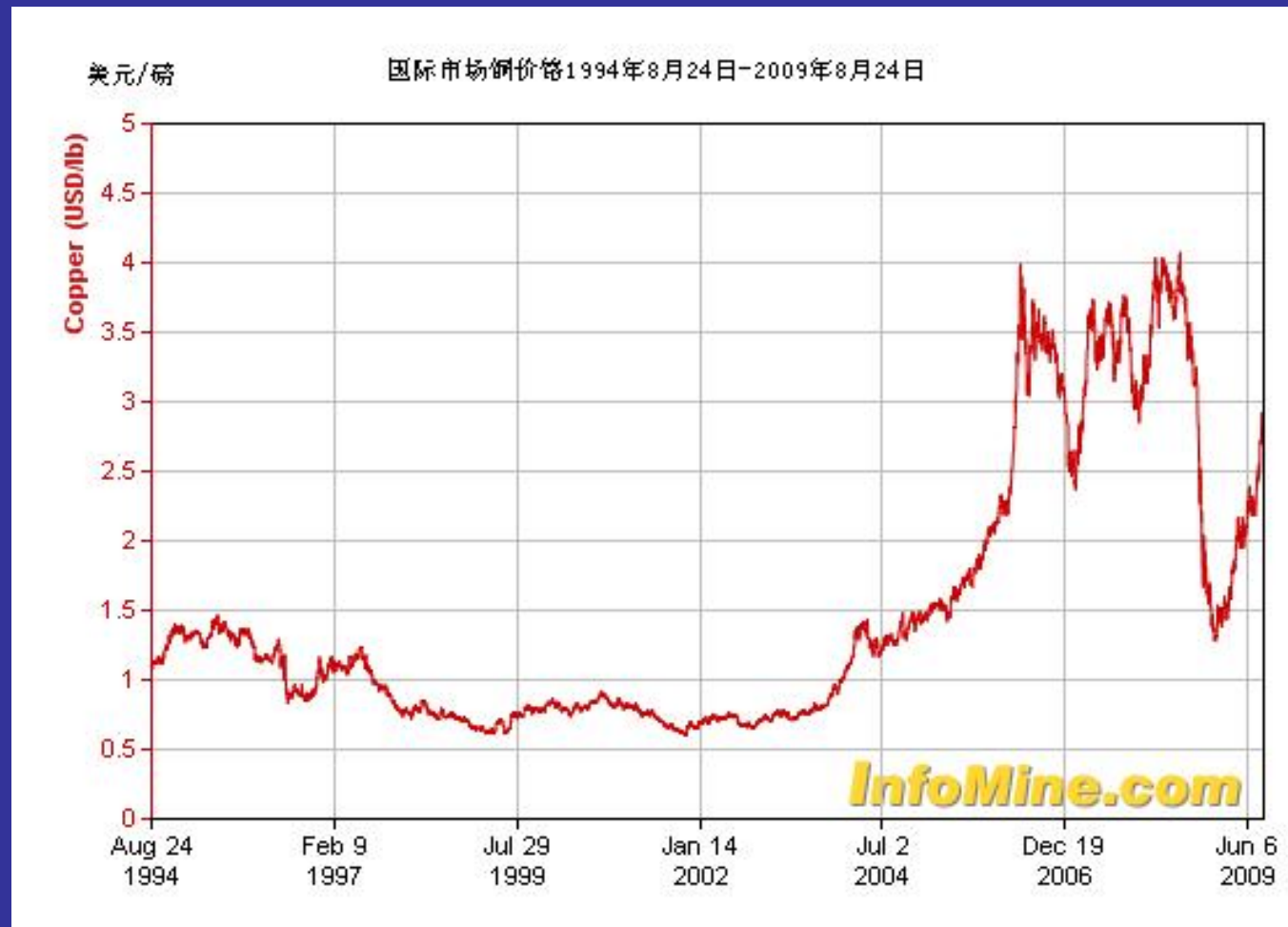
Projects	Country	Projects	Country
Hankavan Copper	Armenia	Kutcho Creek Polymetallic	Canada
Teghout Copper/Molybdenum	Armenia	Morrison Copper/Gold	Canada
Anduramba Molybdenum	Australia	Schaft Creek Copper	Canada
Balcooma Copper	Australia	Sustut Copper	Canada
Carr Boyd Nickel/Gold	Australia	Alejandro Hales Copper	Chile
Esperanza South Copper	Australia	Cerro Casale Gold	Chile
Kalkaroo Copper	Australia	Panulcillo Copper	Chile
Maroochydore Copper	Australia	Puquios Copper	Chile
Mutooroo Copper	Australia	Regalito Copper	Chile
Westmoreland Copper/Gold/Uranium	Australia	San Antonio Copper	Chile
Buen Futuro Gold/Copper	Australia	Santo Domingo Copper/Iron/Gold	Chile
Boseto Copper	Botswana	Konkola North Copper	Zambia
Alemao Copper	Brazil	Mkushi Copper	Zambia
Cristalino Copper	Brazil	Venado Sur Copper	Chile
Bronson Slope Polymetallic	Canada	Shituru Copper/Cobalt	Congo-Brazzaville
Casino Copper	Canada	Kalukundi Copper	D.R. Congo
Harper Creek Polymetallic	Canada	Mantua Copper	Cuba
High Lake Polymetallic	Canada	Keivitsa Polymetallic	Finland
Kenbridge Nickel	Canada	Banwas Copper	India

Table 7 World Copper prefeasibility study Projects

Projects	Country	Projects	Country
Aktogay Copper	Kazakstan	Boyongan Copper/Gold	Philippines
Boschekul Copper	Kazakstan	Kingking Copper/Gold	Philippines
Hyesan Youth Copper	South Korea	Kun-Manie Nickel/Copper	Russia
Bolivar Base Metal	Mexico	Mikheevskoye Copper/Gold	Russia
Los Verdes Copper	Mexico	Ubileynoye Base Metal	Russia
Terrazas Copper/Zinc	Mexico	Salt River Base Metals	South Africa
Frieda River Copper/Gold	Papua New Guinea	Norra Norrliden Zinc	Sweden
Solwara Gold/Copper	Papua New Guinea	Maden K Copper	Turkey
Antapaccay Copper	Peru	Eagle Nickel/Copper	USA
Cerro Negro Copper	Peru	Liberty Molybdenum	USA
Huamachuco (La Arena)	Peru	Nokomis Copper/Nickel/Platinum	USA
Toromocho Copper	Peru	Rock Creek Copper/Silver	USA

VII. Selection of Potential Investment Areas

- Affected by international financial crisis, world copper projects demand decreased. Since Q3 2008, copper price in international market dropped sharply. **The best copper exploration and mining rights investment time is from late 2009 to 2010.**



Status of Chinese Invested Copper Resources Overseas

Table 8 Capacities of Chinese Invested Cu Mines Overseas

Projects	Country	Owner	Status	Operation time	Capacity plan (t/yr)
Chambishi	Zambia	China Nonferrous Metal Mining (Group) Co. Ltd. (CNMC)100%	Production		47000
Saindak	Pakistan	China Metallurgical Construction Group Corporation (tenancy)	Production		20000
Khanong	Laos	Minmetals100%	Production		64000
Gaby	Chile	Codelco75%, Minmetals25%	Production		150000
Anayk	Afghanistan	MCC Jiangxi Copper 100%	Construction		220000
Rio Blanco	Peru	Zijing Mining79.9%	Feasibility study	2011	191000
Toromocho	Peru	Chinalco 91%,	Feasibility study	2012	250000
Galeno	Peru	China Minmetals Nonferrous Metals Co. Ltd. and Jiangxi Copper	Feasibility study	-	144000
Bahuerachi	Mexico	Jinchuan Nickel Group	Feasibility study	-	60000
Red Chris	Canada	Jiangxi Copper75%,	-	-	-
Toal					1146000

- **Chinalco purchased Rio Tinto Shares**
- Copper production of Rio Tinto's equity mines was about 730 kt in 2007. It also has entire or partial equities of several undeveloped large mines, such as Resolution (USA), Oyu Tolgoi (Mongolia), Pebble (USA).

- **CNMIM invested in ORD River Resources**
- ORD River Resources is a junior mining company listed on Australian Stock Exchange. It has prospecting rights with copper mining potentials in Australia Northern Territory .

- **China Yunnan Copper Australia Ltd**
- A junior mining company listed on Australian Stock Exchange, conducting copper and polymetallic prospecting in Mt Isa, Queensland.

- **Grassroot Exploration**
- Some Chinese geological exploration units directly applied for prospecting rights from foreign governments; or co-operated with existing prospecting rights owners. E.g. Shandong Provincial Bureau of Geology & Mineral Resources, Exploration Company of China Nonferrous Metals Resource Geological Survey, General Institution of North China Nonferrous Metals Geological Exploration.

Investment Scopes

Includes: acquire reserve/resource equity rights through exploration, directly purchased reserve/resource equity rights. All investments are risky. Minimize risks and maximize profit are the ultimate target of investors. Exploration investment: less capitals, short cycle, large risk, but high profit. Mine development investment: more capitals, long cycle, small risk, stable average profit during mining service period.

To sum up, investment areas should be chosen: **majorly in surrounding countries and developing countries.**

1. Surrounding countries like Mongolia, Kazakstan, Pakistan, Burma, Laos, Thailand, Vietnam, Philippines, Indonesia etc.
2. African countries like Zambia, D.R. Congo, Tanzania, South Africa etc.
3. Middle East countries like Saudi Arabia, Iran.
4. Latin American countries like Peru, Chile, Argentina, Brazil etc.
5. Oceanian countries such as Australia, Papua New Guinea
6. North American countries such as Canada, Mexico.

Conclusion 3: the best way is to hold mining rights and management power.

References :

- 1. Mineral Commodity Summaries, 1996~2009
 - 2. World Metal Statistics, Yearbook, 1996~2009
 - 3. Metals Economics Group——Strategic Report 1997 ~ 2009
 - 4. Annual Review of World Mineral Resources 1999~2007
 - 5. Production Costs of World Newly Built Copper Mines in the Next Five Years, 2009, China Metal Bulletin, No.5
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Thanks