

COPPER

*By Chris Torrible
Rio Tinto*

2002 saw the copper market at a low ebb. There were few signs of fundamental improvement after the severe deterioration that marked the previous year. Cutbacks and disruptions pushed mine and refinery output down, the first global falls since the early 1990s. However, demand disappointed. Economic recovery was slower and more hesitant than had been hoped for, and there was little evidence of any real boost from inventory restocking. Taking the year as a whole another surplus was registered, albeit much smaller than the year before. Prices were, on average, slightly lower than in 2001, but did not touch the low points hit during that year.

Looking at the market summary table, the data for NAFTA stand out. Demand fell by nearly 7%, the second successive fall. Mine output fell 11%, as high cost production continued to be eroded. Most dramatic of all was a 16% fall in refined output, as the closure of secondary plants exacerbated the impact of closures and labour disruptions on primary production.

In contrast the data for the former Eastern bloc show quite different trends. Consumption jumped by 16%, mine output edged upwards, and refined output stagnated. Asia generally was a region with strong demand performance, excluding Japan (Table 1).

Market prices and stocks

Monthly average prices varied over a relatively small range in 2002. The low was above US\$0.67/lb, and the high below US\$0.75/lb, a difference of just US\$0.07/lb. This compares with an 18c/lb range in each of the previous two years. The relative stability in prices reflects a year with few shocks or surprises.

Price expectations were modest at the start of the year, following the exceptionally sharp downturn seen in the final quarter of 2001 and in the wake of September 11. However the producer cuts announced in the final quarter of 2001 helped put a floor under prices.

First quarter demand was disappointing. Demand had been extremely low in the final quarter of 2001 in Europe and the US. Some argued that this represented the final wave of a period of destocking and that consequently demand would recover rapidly. It did not. First quarter orders were better than end 2001, but did not show any real recovery year-on-year. Exchange stocks continued to increase. Nevertheless, prices crept back above US\$0.70/lb on the assumption that better demand growth would soon be seen.

The second quarter saw a recovery in demand, stocks peaked in May and then started to fall (very gently) and prices averaged 75c/lb in June. In retrospect the recovery had been fuelled by restocking, and would not last.

During May, rumours began to circulate that the Chinese Government had authorised purchases for a copper stockpile. This may have represented opportunistic buying of strategic material when prices were still low. Chinese smelters were struggling to find enough concentrate, and local demand was growing slowly. Some argued that it represented a diversification of foreign reserve holdings away from the US dollar, which dominated exchange reserves. Whatever the reason, the rumours proved correct, and it is estimated that over 250,000 t of copper were purchased, with a high level of cathode imports into China from May through November.

By the third quarter the recovery ran out of steam. Exchange stocks were reduced only very slowly, in spite of a high level of Chinese imports. Even allowing for the summer slowdown, order books began to weaken in the industrialised countries. As a result, prices slipped back below US\$0.70/lb and stayed there for the whole quarter.

The final quarter was marked by BHP Billiton confirming that it would extend the cutback at Escondida by holding down the ramp-up of the phase IV expansion and also keep its 90,000 t/y Tintaya mine shut, with a promise to review the situation in mid 2003. Codelco announced it would not maintain its cutbacks, but instead would build a 200,000 t cathode stockpile in Chile, which would be independently audited, and only released when exchange stocks fell back to 800,000 t. The price reaction was muted, unlike the rapid rise after the final quarter announcements in 2001. In part this was because the price had not sunk as low as a year before, and because in 2001 speculators were heavily short, and had to cover, but this time they were not (Table 2).

Consumption

Demand was worse than expected, but still managed some growth against a generally weak economic background. Growth remained below its long-run trend rate. A severe shortage of scrap helped to support cathode demand as fabricators were forced to substitute cathode for scrap.

The split between the older industrial countries, US, Europe and Japan, and the newer economies in Asia is quite startling. Taken together, the old industrial countries saw demand fall by nearly 4%. In Asia (excluding Japan) it grew by 12%. The global shift in manufacturing and investment to Asia, the world's most populous region, is echoed in the copper cathode demand figures. It is important not to lose sight of the fact that ultimate consumption in North America, and to some extent in Europe, has supported Asian demand growth.

A word of warning on the Chinese consumption figure for 2002 is needed, as apparent consumption has been boosted by imports from government stockpiles. Underlying consumption growth was probably slower than shown.

The industry is now having to re-evaluate its consumption expectations. Rapid demand in China has partly substituted for growth in the older industrialised countries; it has certainly not provided the extra boost to global demand that

more optimistic projections assumed. Overcapacity in US manufacturing persists, and not just in telecommunications, and European growth remains sluggish, particularly in Germany. It is hard at the moment to see where the next boost to consumption will come from. Although Asia (excluding Japan) is undoubtedly to become more important, medium-term prospects for recovery in the industrialised countries remain dim (Table3).

Mine Production

Copper mine output fell by just over 1% in 2002, the first fall since 1994. The impact of cutbacks, closures, strikes and other planned changes outweighing the build-up to full capacity of some projects brought on stream in 2001, and one or two major production increases.

US output fell for the 5th year in succession, driven down by the closure of high-cost capacity, and some cutbacks. The fall in Mexico was related to labour disputes, and the negative effect of cost-saving measures taken in reaction to low prices.

In South America, Chilean output fell due to cutbacks by Codelco, which affected all four of its wholly-owned operations, and at Escondida, where cuts initiated towards the end of 2001 were extended in the light of poor copper prices. In the final quarter the ramp-up of Phase IV production at Escondida was held back for the same reason. Peruvian output increased, with the first full year's production at Antamina reaching 330,000 t in spite of some severe mud slides in the second half, up 160,000 t, and this offset the impact of the closure of the Tintaya concentrate operation, which coincided with the start up of SX-EW production at Tintaya.

The sharp drop in output in South Africa reflected the switch from open-pit to underground operations at Palabora. But this was largely offset by higher production in Zambia.

The decline in Western production of nearly 2% was partly offset by growth in the Former Eastern bloc. SX-EW output continued to rise, with a 70,000 t increase in the Western world, and therefore the decline in output from operations producing concentrate was correspondingly greater than the fall in total production (Table 4).

Major Changes in Output by Mine

The major changes in mine output at individual operations (changes greater than 9,000 t of contained copper) are listed in the Tables 5 and 6.

Closures, Cutbacks, new Mines and Expansions: A longer View

The focus of this article is on recent developments, but a longer view of production developments is necessary for a better understanding of the current state of the copper industry, and the extent to which copper mining has been reshaped during the years of crisis since 1997.

Table 7 shows regional changes in mine production between 1997, the last of the boom years, and 2002. The three North American countries' collective

production fell by more than 900,000 t, the bulk of this in the US. Output also fell in Europe and Africa.

The countries leading the growth league table are no surprise, with new capacity and expansions pushing output up in Chile, Indonesia and Peru. What is perhaps more surprising is the 500,000 t increase in the former Eastern bloc countries. CIS output rose by more than one third, led by a revival in Kazakhstan and Russia. There was also respectable growth in Poland and China.

US output is now lower than in the CIS, or Indonesia, a remarkable turnaround over five years when it was twice the level of CIS output, and four times as high as in Indonesia. Table 7

Summarising changes by country gives some insight into the scale of developments in copper in the past five years. But the underlying changes have been even greater as regional totals net out many changes at individual operations. Many of the reductions in output have been a consequence of the low-price environment created by over-investment. New mines added 2.4 Mt to production between 1997 and 2002, while closures, including some operations which may re-open if prices recover strongly, came to about 1 Mt. The net balance between expansions and reductions and cutbacks was an increase of 0.7 Mt. Some of the cutbacks are planned to be temporary.

New Projects

Although the copper industry has 'enjoyed' five years of low prices, and is heading for a fifth, investments continue to be made in mining, reflecting confidence in future growth. Many commentators point out that these are not of the same scale as the wave of investments during the good years of the 1990s, when Chile opened up to foreign investors and long-term price expectations were typically US\$1.00/lb. However, that period of investment has left the industry with a legacy of overcapacity and, taken together, the plans listed below would add a significant amount to existing capacity. As demand grows, new capacity will be needed, but there is no apparent shortage of projects (and expansions) to meet that demand, or companies apparently committed to investing.

CVRD's plans to build a 700,000 t/y copper business, based on resources in Brazil are continuing to evolve. The development of Sossego, which will produce about 150,000 t/y of copper in concentrate from 2004, is under way, and the mine is expected on stream in 2004. The small SX-EW mine, 118, will be developed soon after, as the two operations will have synergies, and will produce about 50,000 t/y. A pilot plant is already under construction. A gold-copper deposit, Igarape-Bahia, which is above the large Alemao deposit, should also be developed by 2005, with output for a short period of 30,000-40,000 t/y of copper in concentrate. This development will lead the way to the development of the Alemao deposit, reducing the requirements for pre-stripping and so the construction cost. Alemao should produce 150,000 t/y copper in concentrate, and could be on stream by 2005-06. Another deposit, Cristalinho is also under consideration, for similar scale development. The

company also has the Salobo deposit, and is seeking a low capex route to develop a mine with potential to produce 200,000 t/y. Any decision is still some way off. CVRD is continuing to explore in Carajas, where its existing infrastructure gives it advantages in building and operating mines.

Chilean greenfield prospects are fewer than in the 1990s, but still exist. BHP Billiton has got environmental permits for its Spence mine, but while enthusiastic about its potential has not committed to development. The latest plans for Spence are for an SX-only operation, with oxide and sulphide leach running side by side, producing 200,000 t/y of copper.

Codelco has a number of possible SX-EW prospects in the region near Chuquicamata, including Gaby Sur, Toki and Opache, all recent discoveries. Of these, only Gabi Sur looks likely to be developed as a stand-alone operation, with production at 150,000-170,000 t/y. The others could be developed by leveraging the existing operations and infrastructure, and in recognition of this Codelco has created a new division Codelco Norte, which includes Chuquicamata and Radomiro Tomic. There are rumours that additional, potentially very interesting resources have been found in the area.

Codelco Norte could provide substantial future growth for that company, demonstrating the potential for new discoveries in the vicinity of old operations (Chuquicamata started up in 1915). Codelco's 20,000 t/y bioleach joint venture with BHP Billiton at Mansa Mina near Chuquicamata is progressing, and success could open up other prospects. Some recent reports suggest that an operation of 150,000-200,000 t/y is under consideration.

The potential for expansion is more important in Chile than new mines. The largest is already under way at Escondida. The phase IV expansion was commissioned late last year, and will boost output to 1.3 Mt/y. However, cuts are being made in line with current market conditions, and output will be well below that level this year. There are additional resources for development at Escondida. Escondida Norte will likely be developed in the next few years, but will basically allow Escondida to maintain its concentrate output in the face of falling ore grades at the current mine. There will be some additional production from marginal leach projects and tailings retreatment.

Codelco's major expansion project is under way at El Teniente, with another 100,000 t/y of output due on stream in 2003. This will be followed by a 140,000 t/y expansion at Andina. Codelco has also managed minor expansions at other operations, notably Radomiro Tomic, which started up as a 220,000 t/y SX-EW operation in 1997, produced 255,000 t, and is being expanded to over 300,000 t/y. A 25,000 t/y expansion was planned at Los Bronces, and with new ownership in the shape of Anglo American it is possible that further expansion will be contemplated.

Concentrator expansions to offset falling grades are planned at two of the new Chilean mines. At Collahuasi, approval has been given for an expansion which will raise copper production by about 50,000 t/y. Antofagasta has applied for environmental permits to expand its Los Pelambres mine.

Elsewhere in Latin America, expansions are possible at Toquepala in Peru (+40,000-50,000 t/y) and at Cananea in Mexico, where both concentrate and SX-EW operations could be increased, giving a total gain of about 40,000 t/y.

A major new development in Australia is MIM's plan to revamp its Isa copper mine by turning it from an underground operation to an open pit, with an expansion of over 100,000 t/y copper output as a result. In the interim, minor adjustments are planned to add 50,000 t/y to production. Newcrest's board has approved development of its Telfer prospect, and output of 25,000 t/y of copper in concentrate is anticipated. With Sterlite, the Indian smelter now in control of the Nifty mine, the development of its sulphide ore now looks likely, with output of 50,000 t/y of copper from 2005 or soon after. Two small expansions are also due in Australia: a 25,000 t/y boost at the short life Golden Grove mine, and a minor expansion of under 30,000 t/y at WMR's Olympic Dam mine. The expansion at Olympic Dam may have been put off track by a fire which affected the refinery last year, but there is underlying potential for substantial further expansion. A major expansion to 500,000 t or even 600,000 t/y has been mooted, but remains uncertain.

There are several prospects in Asia. Two are seeking finance, the 100,000 t/y expansion of the Monywa SX-EW operation in Myanmar and the 60,000 t/y Sepon prospect in Laos. Oxiana hopes to be able to start work on the first stage at Sepon in August, but initial production will focus on gold, with copper output scheduled for 2005.

Deposits under consideration by Ivanhoe Mines in Mongolia are also of increasing interest. New material has continued to be discovered, and the company hopes it can benefit from infrastructure investment which may be agreed between the Chinese and Mongolian Governments, and which would bring access to markets much nearer. It is early to talk of possible scale of operations.

In Zambia, Anglo's withdrawal has made the prospect of Konkola Deeps' development much less likely. However, several smaller companies are actively looking at projects in Zambia and the Democratic Republic of Congo (DRC). First Quantum, already running and hoping to expand the Bwana MKuba mine, is studying the feasibility of developing the Kansanshi prospect. Output would be SX-EW (60,000 t/y) and concentrate (60,000-70,000 t/y copper). It is possible that development of infrastructure in the region, notably hydroelectric power supply, will provide a springboard for further investments. Longer run, there is still interest in some larger prospects, including Lumwana in Zambia and Tenke Fungurume in the DRC.

In North America, activity has not quite ground to a halt. Inco is finally making progress with the development of its Voisey's Bay deposit in Canada, although this will be much more important for nickel than copper; copper output is likely to be under 50,000 t/y. Phelps Dodge has built a demonstration plant for the concentrate leaching technology it has developed with Placer Dome, at Bagdad. The plant came on stream a month or so ahead of schedule, and will produce about 15,000 t/y. The concentrate is leached in a

pressure leach vessel, and the solution is then mixed with lower grade stockpile leach solution before electrowinning. The company hopes the process can be applied to the primary ores at its El Abra and Cerro Verde operations in Chile.

Looking to the longer term, Rio Tinto is continuing to explore its Resolution prospect in Arizona. Resolution is a very large underground resource which may be amenable for block caving. Few details have yet been released, and the economics remain uncertain at this early stage, but it has the potential to be a major new mine. Phelps Dodge is continuing to examine SX-EW prospects in the Safford District.

Elsewhere there are a few projects of note. RTB Bor is intending to revive its copper mines in Serbia, raising output over three years from 50,000 t to 130,000 t/y. In Spain, permitting for Las Cruces SX-EW prospect is continuing, and output of 60,000 t/y is possible. In Sweden, Boliden is looking at expanding its 60,000 t/y Aitik mine, in order to improve its competitiveness. Development continues very slowly at the Iranian greenfield and expansion projects. Two mines are under development, at Meduk and Songoon, each planned to produce about 50,000 t/y of copper in concentrate, but uncertainties remain over the precise start up dates. The 40,000 t/y expansion at Sar Chesmeh should be on stream this year or next.

The Udokan deposit in Siberia is being tendered by the Russian Government. This enormous deposit was discovered in the 1960s and has never been developed due to formidable infrastructure requirements. UGMK, owner of Urals copper producer Uralelectromed, has submitted a bid proposing an integrated operation producing 150,000 t/y. Kazakh producer, Kazakhmys, is also thought to be in the bidding.

Raw Materials Markets

Concentrates tightened again in 2002, after a temporary easing was seen in 2001, and mine closures and cutbacks due to low prices have not been matched by smelter cuts. Indeed, custom-smelting capacity has continued to increase, notably in India and China.

Contract treatment and refining charges (TCRCs) fell back to similar levels to those seen in 1999-2000, but the spot market experienced extreme tightness and on average spot TCRCs were only half of the 2001 level.

This divergence reflects two factors. First, contract TCRCs for 2002 were fixed early in the year (apart from the small tonnage left for mid-year negotiations) but the market tightened enormously during the year. The average of spot TCRCs over the year reflects this increasing tightness. In early 2002 spot terms were close to contract terms, by the end of the year they were only one third of contract terms. The second factor was the growth in Chinese and Indian demand, which is highly reliant on spot purchases.

Scrap, the other major raw material for copper production, was also very tight. Russia's ban on copper scrap exports proved remarkably effective, and it may

be that the scrap pool in Russia had also been run down to low levels by high exports in previous years. Chinese scrap imports continued at a very high level.

Refined Output

Global refined copper production fell by more than 2%, with Western output falling nearly 3% but output in the former Eastern bloc virtually unchanged. This reflected tight concentrate and scrap markets.

In the US, the largest single change was due to the closure of Phelps Dodge's Hurley refinery; the closure of marginal SX-EW mines also made a contribution, as did the complete elimination of secondary refining. The fall in Canadian output reflected the permanent closure of Noranda's Gaspé smelter (annual capacity 160,000 t/y, but producing much less at the time of closure) and the strike at the same company's Horne smelter, which started in mid year and is still continuing. These two smelters fed Noranda's East Montreal CCR refinery (Table 8).

China

China, once again, provided the brightest regional spot for the copper industry, with demand forging ahead and local copper raw materials unable to keep pace Chinese imports rose sharply again. Using estimated copper content Chinese imports of copper in all forms (except scrap) rose by 370,000 t in 2002, an increase of nearly 20%. Imports have more than doubled since 1998. A summary of the breakdown of imports is shown in Table 9.

China has become a major factor in all aspects of the global copper market, now, on some measures, having overtaken the US as a copper consumer. However, part of this growth has undoubtedly been substituting for growth elsewhere as high levels of investment are cementing China's role as a manufacturing hub for the world. There are also considerable uncertainties over stock levels, with so much cathode imported into China by traders, and material sometimes left in bonded warehouses, and with the strategic stockpile purchases made last year adding to potential confusion over underlying fundamentals.

In recent years the appetite for copper in China has outstripped even the most bullish expectations. With its combination of dynamism and uncertainty it remains a major wild card for forecasters and analysts.

Corporate Activity

Compared to the major mergers seen in some previous years, the pace of corporate activity was slow in 2002. A number of significant changes of ownership occurred, some representing the tying up of loose ends in the industry.

Anglo American relinquished its foothold in Zambia, by withdrawing from its involvement in Konkola Copper Mines, injecting US\$30 million into the company to cover near-term expenses, and making a further US\$26 million available in the form of a loan with favourable terms. KCM has continued to

run the Nchanga and Konkola mines at a rate close to that achieved under Anglo, but is having to rethink its medium-term plans as development of Konkola Deeps no longer looks viable.

After withdrawing from Zambia, Anglo gained a further interest in copper, with the US\$1.3 billion purchase of Disputada in Chile from Exxon. Disputada owns two mines, Los Bronces (200,000 t/y) and El Soldado (70,000 t/y) and a smelter at Chagres (150,000 t/y). With this disposal by Exxon, the copper industry loses its last important oil company ownership interest.

BHP Billiton passed its interest in the 200,000 t/y Ok Tedi mine in Papua New Guinea to local interests, in return for an indemnity against any future environmental claims. The tailings from Ok Tedi are directed into a local river, but the local authorities recognise the economic benefits of the ongoing operation. In Argentina, Rio Tinto and BHP Billiton have both sold out of their 25% holdings in Alumbrera.

Grupo Mexico spent much of 2002 coming to terms with its rather indigestible purchase of Asarco, which had been made in 1999, when the downturn in copper was widely expected to have been short-lived. The company faced the conundrum of separating its less appetising US assets, with their potential environmental liabilities, from the more attractive assets in Peru. This issue was at least partly resolved this year, with Grupo Mexico buying out Asarco's share of Southern Peru Copper Corp. (SPCC), and committing the proceeds to cover potential environmental liabilities in the US.

Indian copper companies have been looking for overseas investments in mining, in order to supply the smelters which they have built and are expanding. Last year, Sterlite acquired the Nifty mine in Australia. Although currently only producing electrowon copper, Sterlite plans to produce 70,000 t/y of copper in concentrate within two years. More recently, Sterlite has been named as preferred bidder for Konkola Copper Mines by the Zambian Government. KCM is currently in between owners since Anglo American withdrew as mentioned above.

In 2003, the most important corporate change has been the takeover of MIM by Xstrata. Xstrata already has zinc and coal production, but the takeover, amongst other things, brings it into the copper business. Xstrata was based on assets previously owned by Glencore, a major trading house, which retained an interest in the company when it was floated, and board level representation. It is quoted in London, but based in Switzerland. If Xstrata's strategy to rank with the major diversified miners proves successful, it is unlikely that MIM will be its last acquisition in mining.

Prospects

The LME cash copper price averaged less than US\$0.75/lb during the five years 1998-2002. Stocks built up to record levels. Costs have come down as new mines have come on stream, high-cost mines have shut and many existing mines have cut costs (aided by low TCRCs).

For most of those five years consensus expectations have proved too optimistic. Demand has remained weak in spite of China's emergence as a major consumer. High levels of investment in new mines and expansions have led to the creation of excess capacity. More projects and expansions are under way.

What are the prospects for recovery in the near term ?

So far this year prices have firmed, with exchange stocks trending down more quickly than last year, raw materials markets extremely tight, and the US dollar weakening. Premiums have also firmed, particularly in Asia.

Codelco is building a 200,000 t stockpile of cathode in the desert in Chile, off the LME but independently audited. This has been one factor behind the exchange stock drawdown and tightness in the Asian market.

Demand remains lacklustre in the old industrial countries, particularly in the US, although more buoyant in Asia. At mid-year there are worrying signs of renewed weakness in order books, and little in the way of positive economic news. This suggests that we should treat the stock fall so far this year with some caution.

The market balance shown is based on work carried out by the International Wrought Copper Council (IWCC) this year. Taking current production plans, and assuming slow but accelerating demand growth, this scenario suggests that the market will look reasonably balanced.

It is possible that, if prices slip back again, China will add to its stockpile, seeing this as a strategic move to secure ownership of a commodity which is essential to Chinese development but structurally short within that country.

Of course, all forecasts should be treated with caution. The consensus is for faster demand growth, and a move into deficit. And, with raw materials very tight, production could well undershoot. On the other hand, renewed demand weakness would pose the industry new problems (Table 10).

Table 1: Overview of 2002

	2000	2001	2002	percent change
Mine Production				
Western World	10,954	11,268	11,065	-1.8
NAFTA	2,472	2,342	2,085	-11.0
Latin America	5,337	5,746	5,709	-0.6
Other WW	3,145	3,180	3,283	3.2
Former east bloc	2,395	2,500	2,523	0.9
Total world	13,349	13,768	13,599	-1.2
Refined Production				
WesternWorld	11,571	12,125	11,776	-2.9
Europe	1,849	1,828	1,881	2.9
NAFTA	2,753	2,817	2,367	-16.0
Asia excl China	2,756	2,895	2,922	0.9
Latin America	3,323	3,574	3,556	-0.5
Other Western	890	1,011	1,050	3.9
Former east bloc	3,244	3,419	3,408	-0.3
Total world	14,815	15,544	15,184	-2.3
Consumption				
Western World	12,606	11,770	11,536	-2.0
Asia	4,060	3,800	4,050	6.6
Europe	4,048	3,760	3,605	-4.1
N.A.F.T.A.	3,745	3,300	3,102	-6.0
Other WW	753	910	779	-14.4
Former east bloc	2,535	2,957	3,437	16.2
World	15,141	14,727	14,973	1.7
Global balance	-327	817	211	
LME Cash (cents/lb)	82	71	71	
Data: WBMS, IWCC, ICSG				

Table 2: Trends in Reported Stocks ('000 cathode)					
	1999	2000	2001	2002	change in 2002
LME	790	357	799	856	57
Comex	83	59	244	362	118
Exchange stocks	873	416	1043	1218	175
Producer	234	244	286	240	-46
Consumer	146	160	174	160	-14
Merchant	22	21	27	19	-8
Western total	1,275	841	1,530	1,637	107
Shanghai Metal Exchange	63	108	94	75	-19
Data: WBMS					

Table 3: World Consumption				
	2000	2001	2002	percent change
EUROPE				
Belgium	324	315	276	-12.4
France	564	538	545	1.3
Germany	1,310	1,120	1,066	-4.8
Italy	674	676	670	-0.9
Spain	289	299	320	7.0
UK	323	286	250	-12.6
Scandinavia	319	308	260	-15.6
Other	245	218	218	0.0
Total	4,048	3,760	3,605	-4.1
AFRICA				
	126	142	165	16.2
ASIA				
India	240	293	303	3.4
Japan	1,347	1,145	1,123	-1.9
Malaysia	166	160	166	3.8
Saudi Arabia	160	160	160	0.0
South Korea	862	849	936	10.2
Taiwan	628	540	648	20.0
Thailand	151	167	186	11.4
Turkey	230	196	222	13.3
Other	276	290	306	5.5
Total	4,060	3,800	4,050	6.6
AMERICA				
Brazil	330	338	239	-29.3
Canada	272	265	265	0.0
Mexico	464	445	385	-13.5
US	3,009	2,590	2,452	-5.3
Total	4,204	3,897	3,528	-9.5
OCEANIA				
	168	171	188	9.9
Western world	12,606	11,770	11,536	-2.0
China	1,932	2,210	2,684	21.4
Russia	183	224	300	33.9
Poland	290	268	241	-10.1
Other Former East bloc	130	145	145	0.0
Former Eastern bloc	2,535	2,957	3,437	16.2
World	15,141	14,727	14,973	1.7
Asia	4,060	3,800	4,050	6.6
European Union	4,048	3,760	3,605	-4.1
NAFTA	3,745	3,300	3,102	-6.0
Other WW	753	910	779	-14.4
Asia (excl. Japan)	2,713	2,655	2,927	10.2
EU, US, Japan	8,404	7,495	7,180	-4.2

Table 4: Mine Production ('000 t contained Cu)				
	2000	2001	2002	Change
South Africa	160	122	92	-24.6
Zambia	290	320	350	9.4
Other Africa	80	76	82	7.9
Africa	530	518	524	1.2
Indonesia	1,006	1,047	1,163	11.1
Other Asia	331	319	317	-0.6
Asia	1,336	1,366	1,480	8.3
Argentina	145	192	204	6.3
Chile	4,602	4,800	4,629	-3.6
Peru	554	720	843	17.1
Other S America	36	34	33	-2.9
South America	5,337	5,746	5,709	-0.6
Canada	634	620	605	-2.4
US	1,473	1,355	1,150	-15.1
Mexico	365	367	330	-10.1
North America	2,472	2,342	2,085	-11.0
Australia	832	877	860	-1.9
Papua New Guinea	203	204	211	3.4
Oceania	1,035	1,081	1,071	-0.9
Portugal	76	83	77	-7.2
Other	168	132	119	-9.8
Western Europe	244	215	196	-8.8
Western world	10,954	11,268	11,065	-1.8
China	589	565	570	0.9
Russia	570	620	610	-1.6
Kazakhstan	430	476	480	0.8
Poland	460	474	503	6.1
Other Former Eastern bloc	346	365	360	-1.4
Former Eastern bloc	2,395	2,500	2,523	0.9
Total world	13,349	13,768	13,599	-1.2
NAFTA	2,472	2,342	2,085	
Latin America	5,337	5,746	5,709	
Other WW	3,145	3,180	3,271	

Table 5: Main Increases in Production ('000 t contained copper)

		1999	2000	2001	2002	Change
Antamina	Peru	-	-	170	331	161
PT Freeport Indonesia	Indonesia	767	769	749	864	115
El Tesoro SX-EW	Chile	-	-	43	84	41
Morenci SX-EW	US	253	261	329	369	40
Radomiro Tomic SX-EW	Chile	190	191	260	295	35
Ridgeway	Australia		4	7	33	26
Rudna	Poland	251	257	257	280	23
Ray	US	104	99	113	131	18
Tintaya SX-EW	Peru	-	-	-	17	17
Alumbraera	Argentina	200	145	192	204	12
Flin Flon / Snow Lake	Canada	12	11	13	25	12
Mount Isa Cu	Australia	179	183	191	202	12
Ernest Henry	Australia	89	107	102	114	11
Punta del Cobre	Chile	17	16	22	32	10
Cananea SX-EW	Mexico	30	34	40	50	10
Dexing	China	98	102	110	120	10
Cerro Verde SX-EW	Peru	68	71	77	86	10
Zaldívar SX-EW	Chile	147	143	137	146	9
Los Bronces SX-EW	Chile	9	12	12	21	9
Los Bronces	Chile	162	170	171	180	9

Table 6: Main reductions in production ('000 t contained copper)

Tintaya	Peru	83	92	85	1	-84
Bingham Canyon	US	274	294	311	260	-51
La Caridad	Mexico	153	137	141	92	-49
Bagdad	US	104	104	111	64	-47
Chuquicamata	Chile	517	527	533	495	-38
Los Pelambres	Chile	18	309	374	336	-38
El Teniente	Chile	353	370	368	330	-38
Sierrita	US	87	90	89	56	-32
Andina	Chile	249	258	253	222	-31
Cyprus Miami SX-EW	US	64	55	40	10	-30
Reward-Highway	Australia	24	23	47	17	-30
Mission	US	91	86	63	37	-26
Palabora	S Africa	112	117	78	52	-26
Escondida	Chile	827	776	643	619	-24
Olympic Dam	Australia	135	209	209	185	-24
Candelaria	Chile	235	216	229	206	-22
Morenci	US	184	126	22		-22
Collahuasi	Chile	383	378	393	373	-20
Chuquicamata SX-EW	Chile	136	127	131	111	-20
Chino	US	70	80	17		-17
Northparkes	Australia	59	59	55	38	-17
Norilsk	Russia	377	355	427	413	-15
Escondida SX-EW	Chile	132	140	151	139	-12
Mount Polley	Canada	17	16	12		-12
Salvador	Chile	70	63	64	54	-10
Daye	China	27	29	33	23	-10

Table 7: Major Production Changes by Country 1992-2002				
	Production		Change	
	1997	2002	'000 t Cu	Percent
Chile	3,493	4,629	1,136	33
Indonesia	548	1,161	613	112
Peru	495	843	348	70
CIS	890	1,186	296	33
Australia	550	860	310	56
Argentina	30	204	173	573
Papua New Guinea	112	211	100	90
Poland	415	503	88	21
China	496	571	75	15
US	1,962	1,150	-812	-41
W. Europe	334	199	-134	-40
Africa	602	525	-78	-13
Canada	651	605	-46	-7
Mexico	352	330	-22	-6
Other	574	622	48	8
TOTAL WORLD	11,504	13,599	2,095	18
Western World	9,452	11,065	1,613	17
Former Eastern bloc	2,052	2,523	471	23

Table 8: World Refined Production (kt Cu)				
	2000	2001	2002	percent change
Belgium	423	424	423	-0.2
Germany	710	694	696	0.3
Spain	316	280	322	15.0
Other	400	430	440	2.3
Total	1,849	1,828	1,881	2.9
AFRICA				
Zambia	256	307	347	13.0
Other	150	146	158	8.2
Total	406	453	505	11.5
ASIA				
India	259	325	374	15.1
Indonesia	158	212	192	-9.4
Japan	1,437	1,426	1,401	-1.8
South Korea	470	476	499	4.8
Other Asia	432	456	456	0.0
Total	2,756	2,895	2,922	0.9
AMERICA				
Canada	551	567	494	-12.9
Chile	2,670	2,882	2,850	-1.1
Mexico	399	448	371	-17.2
Peru	452	472	502	6.4
US	1,803	1,802	1,502	-16.6
Other	201	220	204	-7.3
Total	6,076	6,391	5,923	-7.3
OCEANIA				
Australia	484	558	545	-2.3
WESTERN WORLD TOTAL				
	11,571	12,125	11,776	-2.9
China	1,371	1,427	1,401	-1.8
Russia	824	887	857	-3.4
Kazakhstan	395	422	453	7.3
Poland	486	499	509	2.0
Other Former Eastern bloc	168	184	188	2.2
Former Eastern bloc	3,244	3,419	3,408	-0.3
World Total	14,815	15,544	15,184	-2.3

Table 9: Chinese Trade (kt Cu)						
	1998	1999	2000	2001	2002	% Change
Net Imports						
Concentrate (gross weight)	1,186	1,250	1,801	2,255	2,065	-8%
Blister and anode (gross weight)	83	126	123	89	105	18%
Cathode	250	367	548	783	1,104	41%
Semis (gross weight)	428	488	565	574	681	19%
Scrap (gross weight)	944	1,700	2,494	3,332	3,080	-8%
Copper content (excluding scrap)	1,040	1,264	1,673	2,023	2,392	18%
		22%	32%	21%	18%	
Data: China Trade Statistics						

Table 10: Projection for Total World Copper Balance				
	2001	2002	2003	2004
Mine Production	13,768	13,599	13,879	14,434
Year-on-year change	3.1%	-1.2%	2.1%	4.0%
Refined Production	15,544	15,184	15,350	15,887
Year-on-year change	4.9%	-2.3%	1.1%	3.5%
Consumption	14,727	14,973	15,352	15,858
Year-on-year change	-2.7%	1.7%	2.5%	3.3%
Balance	817	211	-2	29
Source:WBMS, ICSG, Rio Tinto				