

# MYANMAR

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**M**yanmar continued to suffer a sharp decline, both in exploration and mining projects. In fact, no new foreign firm entered into joint-venture operations in 2000. Consequently, there was a considerable decrease in foreign exchange earnings from the mining sector.

The acute shortage of hard currency (foreign exchange) kept the state-owned hardrock mines barely operational, resulting in steadily declining mine and mill production. Only one gold mine (Kyaukpahto), three lead-zinc-silver mines (Bawdwin, Bawsaing and Yadanatheingi), and two coal mines (Kalewa and Namma) remain under state ownership. There are several parties from the private sector seeking to operate these state-owned mines. From past experience, however, especially in tin-tungsten and lode-gold mining and also iron and steelmaking, the government regards the Myanmar private industrial enterprises as not at all reliable for sustainable and profitable mining which forms the *raison d'etre* for privatising the mining sector.

During 2000-2001 (up to February 2001) only one foreign mining company had committed additional investment to the mining sector

and this amounted to just US\$ 6.12 million – about one third of the sum committed in 1999-2000 (three companies and US\$18.5 million). Bonuses and dead rents paid by four foreign exploration companies amounted to US\$122,113, about 10% of that of the preceding year (US\$1.12 million). Of the four foreign exploration companies (one new), only two are currently active, one for gold and the new entrant for zinc. Of the remaining two companies (both searching for gold-copper), one is preparing to resume operations soon but the other is still struggling with financial problems.

Quite immune to the low foreign capital investment impact, the domestic private sector mining of gold, jade and gemstones has thrived. The Mines Ministry in turn has benefited, earning higher revenues (in local currency) through leases, royalties, rentals, other sundry taxes and technical services (such as chemical analyses, geophysical surveys and drilling) in addition to normal production ratio quotas in joint ventures (gold and tin-tungsten).

The bulk of foreign exchange income has come from annual and biannual mineral sales (through routine exports and gems emporia),

**Ratio of Ownership in Mining Sector  
(Based on 1985-1986 prices)**

Ownership	1997-1998		1998-1999		1999-2000		2000-2001 <sup>e</sup>	
	Kyats (Million)	%	Kyats (Million)	%	Kyats (Million)	%	Kyats (Million)	%
State	221.7	11.56	178.7	9.04	177.0	6.53	181.8	5.5
Co-operative	51.3	2.67	16.4	0.83	32.4	1.19	35.2	1.06
Private	1645.4	85.77	1789.0	90.13	2502.9	92.28	3087.4	93.44
<b>Total</b>	<b>1918.4</b>	<b>100.00</b>	<b>1976.1</b>	<b>100.00</b>	<b>2712.3</b>	<b>100.00</b>	<b>3315.4</b>	<b>100.00</b>

<sup>e</sup> estimate

Remarks: The increasing annual investment figures reflect a degree of periodical inflation; the emphasis, however, is on the discernible decrease in government participation.

most from jade sales, which have soared. So much so, that GDP within the mining sector grew by 29.5% in 1999-2000. As compared to that of the national economy as a whole, the mining sector's share of GDP was 0.8% in 1998-1999 and increased to 1.1% in 1999-2000.

The table on the preceding page shows how private sector participation in Myanmar's mining sector has increased.

In the National Economic Development Scheme of the Third Short-Term Five-year Plan (2001-2002 to 2005-2006), the mining sector still holds the fifth position, next to the fourth-ranking energy, behind agriculture, livestock breeding and fisheries and forestry sectors.

### Exploration

As planned, the Department of Geological Survey and Mineral Exploration (DGSE) continued geological mapping and mineral prospecting on a regional scale of 1 inch:1 mile (1:63,360) in Kachin State (3,820 km<sup>2</sup>), Shan State (4,356 km<sup>2</sup>), Mandalay Division (181 km<sup>2</sup>) and Sagaing Division (2,043 km<sup>2</sup>) for a total of 10,400 km<sup>2</sup>. Altogether 14 lithostratigraphic units ranging from Precambrian to Holocene in age were differentiated with faunal evidence and tectonic affiliations. Occurrences of iron ore, manganese, coal, gold, copper, pyrites and barytes have been found in 15 localities. Thus far, 76.38% of the country has been geologically mapped.

To modernise and update geological mapping and map production (especially for mineral exploration), through the use of remote sensing, geographic information system, and digital and computer-aided techniques, the DGSE has accepted the offer of a three-phase training programme by the Metal Mining Agency of Japan (MMAJ) in selected areas of Myanmar.

The first phase, consisting of trial field reconnaissance surveys, was carried out in

January 2000 in the Popa-Meiktila and Monywa-Salingyi (porphyry copper targets) and Lebyin-Shweminbon (gold-copper skarns) areas by MMAJ experts, Mr Shuichi Miyatake and Dr Craig A. Feebrey. In the second phase, these two MMAJ geologists gave a two-day workshop at DGSE in July 2000 on 'Intrusive-Related Mineralisation and Its Detection Using Satellite Sensors', and on 'Porphyry Cu-Au Systems'. With two separate field parties, detailed field surveys in Monywa (porphyry-type or porphyry-related copper deposits), Kawlin-Pinlebu-Bamauk (copper-gold targets) areas, and a regional survey in Thabeikkyin (gold-sulphide veins) area were carried out. A third phase is planned during 2001-2002: the Japanese International Co-operation Agency will provide a geologist for two years to train DGSE geologists, and a detailed survey funded by an Overseas Development Aid programme will be carried out, most probably at the Shangalon copper prospect within Kawlin-Bamauk district in Sagaing Division.

DGSE geologists continued to search for limestone and gypsum resources in geologically favourable parts of the country and evaluated those already known. As a result, the 250 Mt Myalate Taung limestone resource in Kyaukse Township, Mandalay Division has been upgraded to 291 Mt by further drilling. Similarly, the Kyaukyan Taung limestone resource (2.26 Mt) in Sintgaing Township, Mandalay Division has been further tested and upgraded. To supplement the already delineated gypsum (alabaster) resource (6.25 Mt) in Ayuchaungphya area in Thayetchaung Township, Tanintharyi Division, further prospecting to the north between Bann Chaung and Tanintharyi river failed to find additional gypsum occurrences. Instead, good quality fluorite float was found in one area and the primary source is thought to be nearby.

At the request of Myanmar Economic Corp. (MEC), under Ministry of Military Affairs, the DGSE planned to drill 11 holes at the already known Mankaung gypsum resource (7 Mt) in

Thibaw (Hsipao) Township, Shan State, to upgrade its tonnage and resource category. Six holes have been completed to date to a depth of 37 m. The gypsum horizon is 28 m in thickness.

Prospecting and exploration for nickel laterite and podiform chromite continued in Falam Township, Chin State and in Webula and Hakhalay areas in Kalay (Kalemyo) Township, Sagaing Division where ophiolites occur. So far, no economic deposits have been found.

Coal and lignite exploration by the DGSE continues. If successful, coal and lignite could supplant the widespread use of firewood in rural areas and thereby prevent extensive deforestation and soil erosion from rampant firewood cutting. It is criminal now in Myanmar to cut down naturally grown trees, plants and even shrubs on public lands without proper permission.

Coal exploration is being carried out in Mongyai area in Thibaw Township, Shan State (Special Region) and in nearby Hweparkhaila Chaung. In Naparkaw area in Mongtong Township, Shan State, a coal resource of 8 Mt has been delineated.

Currently the DGSE is drill-testing lignite resources found in Ho Kho area as a potential feed for a thermal power station at Tarchilaik in Triangle Area, eastern Shan State planned by Mayflower Mining Enterprise Ltd.

Out of a total of 27 exploration blocks originally awarded to the private sector, only four remain as joint venture operations, and only one is being actively explored (by Ivanhoe Myanmar Holdings Ltd (Exploration)). In addition, one more exploration concession, apart from the regular block system, involves active exploration for zinc, with the DGSE involved as a joint venture partner.

Myanmar First Dynasty Mines Ltd retains a 182.5 km<sup>2</sup> area over the Wuntho Massif, Sagaing Division. After three successive years (1995-98) of very systematic exploration the company defined four drill target areas as summarised below.

Drilling at Tonbon encountered copper/gold mineralisation at shallow depth, including 28 m of sulphide and magnetite skarn which averaged 0.1 g/t Au and 0.32% Cu, including

**Summary of Drill Target Areas**

Target Area	Deposit Type Potential	Evaluation Status
Tonbon	Large tonnage porphyry skarn Au-Cu system	Two positive drill holes drilled on southern edge of a large (6 km x 2.4 km) porphyry skarn system; intersected chalcopyrite + pyrite ± chalcocite mineralisation of 28 m @ 0.102 g/t Au and 0.32% Cu including 2.4 m @ 0.527 g/t Au and 1.17% Cu.
Kokko Taung	High-grade gold-quartz-sulphide veins and related Cu-mineralisation	No drill holes. Abundant gold-quartz veins at surface, covering an area of 2 km x 0.5 km
Naungpat	High-grade epithermal vein style Au-Ag	No drill holes. High-density, high-grade gold-bearing epithermal quartz veins.
Namma	Large low-sulphidation epithermal vein style Au-Ag	One positive drill hole. Large (1 km x 4 km) volcanic-hosted low sulphidation epithermal gold system.

a higher-grade 2.4 m interval averaging 0.53 g/t Au and 1.17% Cu. A subsequent project-scale aeromagnetic survey data interpretation defined a large (1 km wide) magnetic low and four surrounding magnetic highs consistent with magnetite-bearing skarn deposit-type signatures. Tonbon is believed to represent a large, highly prospective, porphyry skarn system, with the drilling having intersected the pyritic halo. The Kokko Taung gold/copper prospect has yielded strong gold geochemistry over a 2,000 m x 500 m area. Surface geochemistry and mapping have also defined a very prospective gold drill target at Naungpat (3 km x 3 km). As defined by surface drilling, geochemistry and mapping, it appears to represent a volcanic-hosted low-sulphidation epithermal gold system. Unfortunately, First Dynasty ran into a financial crisis and had to suspend its operations in July 1998.

East Asia Gold Corp, (EAGC) plans to drill one or two holes into a copper/gold target just west of the placer gold-mining operation at Wethe, where it is in joint venture with state-owned No. 2 Mining Enterprise (ME 2). It also plans to drill several holes and conduct bulk sampling to evaluate the Shante-Ge Taung placer gold resource. EAGC hopes to begin a feasibility study for this gold property and to complete it by August 2001. If time permits, the company also intends to re-assay some soil samples for Au and Mo at Saladokhtar and Bawdwin, and carry out additional sampling at a new prospect west of Saladokhtar and Subok Taung.

But time is running out, and despite its ambitious plans, it has completed no substantial exploration work at any of its prospects. Instead, it has spent much time in protracted negotiations with ME 2 in respect of its placer gold mining jv. EAGC's exploration permit was due to expire on June 24, 2001.

Ivanhoe Myanmar Holdings, Ltd. (Exploration), wholly-owned by Vancouver-based Ivanhoe Mines Ltd, has concentrated

its exploration activities on the mesothermal gold-quartz veins of the so-called Slate Belt (composed mainly of mudstone, phyllite, sandstone and mica schist) in the Kyauksayit-Momi Taung area. A gold-quartz vein system has been found by trenching, aditing and channel sampling, and spectacularly high gold values were obtained from leached quartz veins in the oxidised zone.

Throughout the prospect area (3 km x 2 km), visible gold occurs in most veins within 1 to 2 m thick limonitic leached quartz boxwork laminae in laminated and book-and-ribbon-textured quartz veins. These veins crop out over a 400 m vertical interval. The highest gold value, encountered in Trench 18, was from a sample assaying 3,475 g/t (111.2 oz/t) over a width of 1.3 m.

Samples constitute surface rock chips collected across the width of the exposed vein system. DGSE laboratories in Myanmar assayed all the samples with initial checking and verification by two internationally accredited laboratories, MAS Laboratories of Bangkok, Thailand, and ANALABS of Perth, Australia, on the preliminary surface samples and pulps. In fact, the initial high-grade gold assays were confirmed. Commensurate with the abundance of visible (coarse) gold, the gold value distribution is highly erratic.

<b>Selected Au Assays of Trenches and Adits</b>		
<b>Sample location</b>	<b>Sample Width</b>	<b>Weighted Average Au Assays</b>
Trench 4	7 m	180 g/t (5.77 oz/t)
(includes)	0.5 m	1,200 g/t (38.4 oz/t)
Trench 7	6 m	40.3 g/t (1.29 oz/t)
Trench 8	6 m	69.8 g/t (2.23 oz/t)
Trench 11	10 m	88.3 g/t (2.83 oz/t)
Trench 12	10 m	152.5 g/t (4.88 oz/t)
Trench 16	2 m	62 g/t (1.98 oz/t)
Trench 18	1.3 m	3,475 g/t (111.2 oz/t)
Adit 1	12.5 m	14.4 g/t (0.45 oz/t)
Adit 2	3.4 m	13.4 g/t (0.43 oz/t)
Adit 3	6.6 m	73 g/t (2.34 oz/t)
Adit 4	1.1 m	69 g/t (2.21 oz/t)

Surface and near-surface oxidation-induced gold enrichments have produced a 'nugget' effect which demands judicious, if not elaborate, bulk sampling. Aditing conducted beneath promising trenches is meant to find out whether veins with high gold values still exist at depth.

Ivanhoe geologists believe that satisfactory gold assays on veins in adits can be expected, adits will confirm several high-grade gold zones across widths of several metres in the oxide zone, and that mineralisation could continue at least 500 m downdip beneath the oxide zone without significant variation in grade, with a potential for local, structurally-controlled ore shoots. Ten adits are currently being driven to depths of up to 30 m below the surface to assess the veins and near-surface oxide gold mineralisation. Gold-copper skarn targets in the Shweminbon area in the northeast will be drilled further only when more funds become available.

The Chinese company, Liaoning Jin Di Construction Consortium, a wholly-owned subsidiary of Liaoning Provincial Construction, having failed to carry out the required exploration work on its exploration blocks, had its joint-venture contract with the DGSE terminated at the end of August 2000.

In accordance with the Mines Ministry's directive to make regional exploration more effective and definitive, Cornerstone Resources (Myanmar) Co. Ltd (CRL) and the DGSE signed a JV contract agreement in July 2000 for mineral prospecting, exploration and feasibility study to develop zinc resources within Loncheng (Longh Keng) area in Mongpaw Township, Shan State. Enclosing the Loncheng Mining Lease (40 km<sup>2</sup>) the exploration concession covers 696 km<sup>2</sup>. CRL had contracted geologists from Crowe, Schaffalitzky Associates Australia Pty Ltd (CSA) to carry out regional exploration a year previously. This programme identified two distinct mineral districts, namely, the Wai Baw polymetallic district (Pb, Zn, Ba, Sb + Cu Ni)

and the Loncheng zinc district (Zn + Pb). In view of easier mineral processing and ore transport, and the known existing resource, Loncheng has been chosen for follow-up exploration work. A total of 116 targets were identified and prioritised. With seconded geologists from the DGSE, CSA geologists began field work in November 2000 including rock, stream sediment and soil (red soil or terra rosa) geochemistry using hand augers to collect samples on a 200 m x 50 m grid (in areas of high potential) and 400 m x 50 m (in areas of lesser potential). Good geochemical anomalies in the vicinity of the already known Loncheng deposit, (Hill No.1 and Hill No. 2) were obtained.

From the shallow soil results, two main anomalous zones are apparent. One zone consists of an approximately 3 km long west-southwest oriented anomaly that stretches away from the existing deposit following the trace of the Loncheng Fault. The other is a larger (3 km x 2 km) area about 3 km to the south of Loncheng, also apparently following a sub-parallel northeast-southwest trend. Values up to 1% Zn were obtained and both zones show excellent correlation with lead. Most recently, a new outcrop of fracture-filling smithsonite about 100 m east of Hill No.2 has been found in a deep swallowhole. This finding, together with the fault-controlled pattern of anomalies (leakage haloes?), and the occurrence of zinc carbonate mineralisation along the stratigraphic contact between limestone and clastics, suggests that the carbonate orebodies are not, as originally believed, localised in karstic depressions and pockets. Deep overburden drilling on the best-looking anomalies with a portable Cobra drill could be the next step in attempting to define reliable drill targets.

The recent market revival in the US and Europe for amber with exotic insect inclusions, has prompted an interest in Myanmar amber (burmite). Vancouver-based Leeward Tiger Co. Ltd visited some amber-producing localities in the Hukawng valley of northern Myanmar in Kachin State in

December 2000. The company believes that good specimens of burmite with beautifully encapsulated insects are readily available in Myanmar, and would fetch handsome prices in US dollars as museum exhibits and for private collections. The DGSE is urging the company to look for a bigger market for burmite. With its superior hardness and greater toughness, burmite is ideal for carving and takes a good polish. Mostly, burmite varies in colour from pale yellow to dull brown. Locally, however, fourteen varieties of burmite are known depending on colour and shade. All bear different names - flame, honey, sessamum, horse-hoof, light red, and so on. The best variety is honey-coloured and translucent to transparent with no disfiguring calcite stringers. During the British colonial rule before World War II, burmite was exported to Europe in limited quantities but could not compete with Baltic or Prussian amber (succinite). Important amber trade centres in Myanmar used to be based on amber mines in Hukawng Valley, Maingkwang, Kamaing, Mogaung and Mandalay. Now the amber trade is much on the decline, if not completely defunct. Mostly the amber is cut into Kachin and Shan earrings, ear cylinders, beads, bangles or bracelets, hair pins, woman's blouse buttons and sundry other small items. The buyers include Shans, Kachins, Shan-Chinese, Nagas, Lushais and some tribes in Assam, India. Of them, the Nagas purchase most. If a good market could be established in Europe or the US for well-carved figurines, statuettes and other various household decorative and women's wear items, the government would like to export burmite in finished products as a foreign-exchange earning commodity.

### **Mining**

Although the foreign investments remained low throughout 2000 and the first quarter of 2001, the mining of gold, jade and gemstones in the private sector prospered. Regrettably, the production statistics are not completely known because of the lack of countrywide mining inspection and absence of production records.

Realising the substantial earning power (for both foreign exchange and local currency) of the mining sector, the government has now relaxed some stiff mining law restrictions, especially for indigenous artisanal mining communities. The mining rights for small-scale mining of gold, jade and gemstones (mostly rubies and sapphires) have been delegated to the chairmen of State/Divisional Peace and Development Councils (virtually equivalent to state or provincial governments in other federal countries) to develop and upgrade the regionwide rural economy. Consequently the widespread mining of these mineral commodities by native artisanal miners is on the rise.

In foreign mining partnerships, too, the equity ratios have been modified (no longer 50:50) and are negotiable. Foreign participation is now permitted in tin-tungsten and gold mining, but not yet in jade and gemstone mining. A more attractive and investor-friendly investment policy in accordance with Myanmar's economic objectives would benefit exploration and mining investments. There is no doubt that the country has high geological potential and is under-explored.

With demand for jade high and jade mining thriving it is not surprising that several discoveries of jadeite-albite have been made at the worksites. Since April 2000, Myanmar Gems Enterprise (MGE), under the Ministry of Mines, began mining jade and gemstones with 10 indigenous enterprises as joint ventures, eight (jade) in Pharkant and two (rubies) in Mõngshu district. The jade and rubies won from these jv workings are sold biannually via gems emporia and periodically on the spot market. The proceeds for the 11 months to February this year exceeded US\$3.9 million.

A large discovery of a jade (jadeite-albite) boulder was made in January this year within the precincts of the Pharkant mining area in Kachin State. The boulder measured 21 m x 6 m x 5 m and weighed over 2,000 t. The finders aptly named the boulder, Kyaukseine

Nagar (Jade Dragon). It was discovered at a depth of 12 m within the Nanthmaw mining concession operated by MGE and Ruby Dragon Jade and Gems Co. Ltd.

Jade occurs in Pharkant-Lonkhin-Htawhmaw, Tamakhan, Phyalayhmaw, Putao region and Mogaung of Kachin State, and Khamti, Mawlu, Mawhan, Mohnyin and Indaw in upper Sagaing Division. Geologically, jade resources occur as jadeite-albite dykes and sills in serpentinised ultramafic rocks (pre-Tertiary age), and as boulders embedded in the Uru Boulder Conglomerate (post-Tertiary age). Resources are vast and sufficient for hundreds of years at current rates of extraction.

The jade market is totally controlled by the Chinese in Hong Kong. To counteract or at least mitigate the foreign influence (Hong Kong Chinese on jade and Thais on gemstones), the Myanmar Government maintains its biannual sales through gems emporia in Yangon. The buyers are mostly Chinese. However, the gems emporia are ineffectual in preventing jade and gemstone smuggling across the border to China and Thailand.

Besides its joint-venture activities, the MGE also issues small mining concessions to local gemstone miners and special peace groups (returnees to the legal fold from various insurgencies) in the Mogok and Mõngshu gem-mining districts. Although no spectacular stones have been unearthed in recent times, the gems from these private diggings sell well in the gems emporia. Mogok area still produces fine rubies, but rubies from Mõngshu find a better market in Thailand, especially those amenable to heat treatment (in which the Thais excel).

Despite the government's ban on the use of cyanide in alluvial mining, the production of gold in Kachin State, Sagaing and Mandalay Divisions trebled last year with amalgamation the main process for extracting the gold. The gold price in local currency escalated owing

to private hoarding by the rich and the proliferation of jewellery shops in several major urban centres. Increased use of gold in traditional Myanmar medicines has lifted demand, in addition to the well-established market for gold leaf, used by the pious for gilding myriads of pagodas and Buddha images in this country.

Recently, a big gold rush has developed at Linnfarr on the Chindwin River in Hkamti Township, Sagaing Division. There, fluvial high-grade gold deposits are mined by hundreds of diesel-powered boats equipped with powerful gravel pumps which scour the river bed. The rich auriferous gravels are transferred via flexible plastic pipes to launders on sand-banks nearby, and gold is recovered by hand sluicing. Platinum group metals (PGM) are also won as by-products in these launders. Next to jade, gold mining is the most profitable business, with the local gold price at Kt 65,000/tical (roughly 0.5 oz) and equivalent to about US\$260/oz at the current black market rate. A gross income of US\$300 to \$500/d is a small fortune in itself here. PGM fetch good prices too, and there are several buyers for both gold and PGM at worksites.

Under relentless pressure from the Mines Ministry, Ywama steel mill at Insein near Yangon, which was leased to National Industrial Holdings Ltd for ten years, has recovered at last. In the first eight months of 2000 it produced 572 t of assorted iron rods, 362 t of wire nails, 139.6 t of barbed wire and 47.23 t of zinc-coated screens.

While the tenacious Mandalay Mineral Resources Pty Ltd (MMR) is still arduously seeking a financier to revive the defunct Bawdwin Mine Project and Namtu Slag Feasibility Project, the Bawdwin mine management has finished negotiating with a Yangon-based Chinese company, M-Apex Construction Co. Ltd, to sell the 2-3 Mt of zinc slag which has accumulated at Namtu over several decades. The Chinese company would buy the slags at US\$22/t and at the

rate of 50,000 t/y, and erect a zinc fuming plant at Namtu imported from Yunnan, China. In return, state-owned No. 1 Mining Enterprise (ME 1) would lease a plant site at Namtu to M-Apex. The company would transport the zinc oxide product overland to a zinc smelter in Yunnan. MIC's approval is awaited. ME 1 would get foreign exchange in US dollars from the slag sales and plant-site lease. An Australian company, Anvil Mining NL has also offered to buy zinc slags and ship them to South Africa (where electricity is much less expensive) to extract electrolytic zinc by the plasma furnace route. ME 1 is keeping open the option to let the Australian company take the initiative.

Currently, ME 1 is selling its stockpiled zinc concentrates to companies in Yunnan, in yuan. With this Chinese currency, ME 1 plans to buy a new lead blast furnace from Yunnan Import & Export Co. Ltd, which can smelt lead concentrate with 47% Pb. A delegation from ME 1 has visited the company's factory in Yunnan and inspected the efficiency of the said blast furnace. Chinese engineers will install the blast furnace at Namtu and train Myanmar technicians to run it efficiently. The existing furnace at Namtu requires lead concentrates with a minimum content of 57% Pb, with 10-15% Zn and 1-2% Cu. At present, Bawdwin lead concentrates contain only around 52% Pb due to a decline in lead content and an increase in copper content in run-of-mine ores. To cope with the increasing copper content in Bawdwin ores, oxidised ores from the open pit (with higher Cu content), and sulphide ores from underground workings are now separately concentrated before being sent to the Namtu smelter. A decopperising unit in the lead section of the smelter has been installed but, although this has proved satisfactory when treating high Cu lead concentrates from underground ores, it has not performed well with the oxidised ore from the open pit. These have been makeshift attempts to boost production, especially of lead metal and refined silver from an antiquated smelter without involving

substantial foreign exchange (US dollars) expenditure.

The other two state-owned lead mines of ME 1 are Bawsaing and Yadanatheingi. Both mines, like Bawdwin, are situated in Shan State. Bawsaing produces both lead sulphide (galena) and lead carbonate (cerussite) ores and concentrates. Yadanatheingi produces only lead sulphide ores and concentrates. Sulphide ores and concentrates from both mines are argentiferous. All the lead concentrates are sent to Namtu. Production is declining at both mines and no remedial measures are currently at hand.

During 2000-2001 (up to February 2001), ME 1 and its indigenous production-sharing joint ventures, namely, Hawsaing Mining Co., Wa Development General Trading Co. and Kachin National Development Co., produced 40 t of galena (20% Pb), 13,000 t of smithsonite (35% Zn) and 15 t of smithsonite (15% Zn) respectively, all from Shan State. The production ratio with all these jvs is 30:70 (ME 1:Company).

The S&K (Sabedaung and Kyisindaung) copper mine, operated by Myanmar Ivanhoe Copper Co. Ltd, a 50:50 jv between Vancouver-based Ivanhoe Mines Ltd. and ME1 in the Monywa area, Salingyi Township, Sagaing Division, produced 26,546 t of cathode copper, slightly over the rated capacity of 25,000 t/y for the SX-EW plant. To raise output to 30,000 t/y or more, the mining rate is to be increased and larger-capacity units are to be installed in the plant through a series of plant modifications. Thanks to the Myanmar Government's aversion to further foreign exchange borrowing, these plant modifications are being funded from the mine's cash flow. In the meantime, Ivanhoe has had to install an acid neutralisation plant to bring down the increasing level of acid and iron in raffinate due probably to the higher than expected content of chalcopyrite and pyrite in the ore being heap-leached. Without this plant, electricity consumption would be higher and cathode production lower.

For a full expansion of the present operation to 150,000 t/y, the Letpadaung Taung deposit, situated some 10 km to the south of the S&K mine, would have to be developed. The total resource available would then be approximately 1,000 Mt at 0.5 to 0.6% Cu. But it would require a minimum capital cost of US\$400 million. According to Daniel Kunz, president of Ivanhoe, a number of Japanese financial organisations are willing to finance the project and market the copper produced.

Normally, the Myanmar Government would not tolerate another large debt or loan financing, and even if the hurdle is overcome another remains - the availability of sufficient electricity for the much larger project. The present operation uses 9-10 MW, but the full expansion would raise the requirement to over 60 MW. Will it be possible within a few years? Who knows?

Within the framework of its production-sharing jv contract with ME 1 signed in October 1999, Cornerstone Resources (Myanmar) Ltd (CRL) has carried out (with CSA consultants) a reassessment of the Loncheng zinc carbonate deposit's drill-indicated resource. This has resulted in a 27% decrease (from 233,500 t to 171,194 t), a review of metallurgical options for treating zinc carbonate ores, and extensive regional mapping and geochemical sampling covering both the mining lease and exploration concession areas.

The small size of the deposit and the urgent necessity for further systematic exploration to find additional zinc occurrences in the area had been emphatically and explicitly expressed in the Final Report on the Loncheng zinc deposit by MRDC geologists in 1957. This should have forewarned CRL not to commit planned mining for 30,000 t/y of zinc ore and metal (99.99% Zn) extraction. The Loncheng project now hinges on finding enough additional zinc or zinc-lead resources, and CRL has submitted a report for continuing intensive exploration for one more year.

In August 2000, a production-sharing jv contract was signed between ME 1 and Mayflower Mining Enterprise Ltd for zinc ore production from the Mawkhi (Wallay) area in Myawaddy Township, Kayin State. So far, no news about mining and ore production has been received. In the past, Mayflower has tried hard to acquire the Loncheng deposit but failed because of lack of foreign financing. The current jv contract stems from the company's initial success in selling zinc ores to Padaeng Industries Ltd, a Thai mining company. These ores, already mined and dumped, were left by fleeing KNU (Karen National Union) insurgents and Thai illegal miners in the wake of the Myanmar army's clean-up operations. For the time being the future of this jv is dubious.

The No. 2 Mining Enterprise (ME 2) has no tin-tungsten mines left. Its Mawchi mine is now operated by a production-sharing jv between ME 2 and Kayah Minerals Trading Co. (KMTTC) with the production ratio 30:70 (ME 2:Company). As in most of ME 2's jv operations, mining at Mawchi is by the tribute system. In addition to its nine jv tin-tungsten mines (Kanbauk, Hermyingyi, Heinda, TMT, Kyaukmedaung, Mawchi, Bokepyinn, Theindaw and Pagaye), ME 2 has issued mining leases to private individuals in Kayah State, Pyinmana, Mawlamyaing, Dawai (Tavoy) and Myeik (Mergui) Townships in the southeastern and southern parts of the country.

Two of the jv mines (TMT and Pagaye) have ceased production and the private partners are planning to return the mines to ME 2. The production of tin, tungsten and mixed ore from the mining leases amounted to only 220 t last year. Among the jv mines, Mawchi produced most (621 t) against the other mines' total of 618 t. The Heinda jv mine with the Thai company, Myanmar Pongpipat Co. Ltd (MPC) produced 442 t of tin (cassiterite) concentrates.

Kyaukpahto, in Kawlin Township, Sagaing Division, is the only lode-gold mine remaining

with ME 2. The enterprise is under heavy pressure from the Mines Ministry to boost output from Kyaukpahto, and the mine's management is negotiating with interested private operators for the retreatment of gold tailings (containing 1-2 g/t Au) to recover gold as a means of supplementing the current gold production. Since its inception, the mine has produced refined gold (99.99% Au) as shown in the following table.

To achieve and sustain an annual production target of 6,000 oz (186.6 kg), the whole cycle of mining, milling and refining must be reinforced with proper repair and maintenance that invariably necessitate adequate foreign exchange.

From various mining leases (both alluvial and lode gold deposits) registered with ME 2, in Kachin State (4), Sagaing Division (7), Mandalay Division (21) and Mon State (2), the production of crude gold (fire-refined) last year amounted to 1,492 oz (46.41 kg), of which Kachin State produced 770 oz (23.96 kg) or roughly 51% of the total. Total production from the jv gold mines of ME 2 (Shwegyin, Thayetkhon and Phyaung Taung) amounted to 761 oz (23.67 kg) of which Phyaung Taung's share was 445 oz (13.84 kg) or 58%.

After a long delay in negotiations, EAGC finally signed a profit-sharing jv contract in January 2001 with ME 2, to carry out alluvial gold mining in the Wethe area in Thabeikkyin Township, Mandalay Division. Mining has started with a profit split ratio of 25:75 (ME 2: EAGC). The mining lease, covering an 850 m x 800 m plot, is for six years.

State-owned No. 3 Mining Enterprise (ME 3) deals with iron and steel, coal and lignite, antimony, nickel, industrial minerals, and dimension (decorative) stones. Most of its new mines (barytes, coal, gypsum and limestone) have been stripped of overburden in preparation for mining.

The target for iron and steel is to boost annual production to 50,000 t at the No. 1 Iron & Steel Mill near Pyin Oo Lwin (Maymyo) in Mandalay Division. Technological knowhow was to have been provided by the Italian firm, Danieli but this arrangement has stalled. There was a slight increase in production of pig iron, steel rods and ingots in 2000.

After completion of its Kalewa coal exploration project within six months from an October 1999 start, NEDO of Japan has estimated a coal resource of 15.3 Mt (including 7.43 Mt of measured reserves). It has submitted a positive feasibility study report for the development of coal-based industrial enterprises in the region as proposed in the original MoU (Memorandum of Understanding) with the Japanese consortium comprising Chiyoda Corp., Itochu Corp. and Nissho Iwai Corp. Accordingly, negotiations are in progress for the implementation of the project. To carry out a detailed feasibility study with Japanese financial aid, as the first step in the expansion of production at Kalewa colliery, ME 3 began negotiations with Chiyoda in December last year.

From the No. 1 worksite of Sam Lao in Thibaw Township, Shan State, operated by the production-sharing jv between ME 3 and AAA International Co., 25,540 t of sub-bituminous coal were mined and sold to

<b>Kyaukpahto Production</b>		
<b>Year</b>	<b>Troy oz</b>	<b>Kg</b>
1993-94	1,659.10	50.98
1994-95	5,271.86	163.95
1995-96	3,105.58	96.58
1996-97	5,523.54	171.78
1997-98 <sup>1</sup>	5,828.78	181.28
1998-99	3,913.26	121.70
1999-2000	3,731.74	116.05
2000-2001 <sup>2</sup>	2,814.56	93.47

<sup>1</sup> Peak production

<sup>2</sup> Up to end of February 2001

during 2000. In addition, another production-sharing jv between ME 3 and Eastern Division Welfare Co. Ltd was signed in August 2000 to mine coal from the No. 2 worksite in the same Sam Lao area. In Momauk Township, Kachin State, ME 3's jv partner Bamboo Result Co. Ltd requested to terminate the agreement contract. Drilling in the Lweje area located only small quantities of inferior quality lignite. However, in the same area, Ayeyarwaddy Myitphya Co., another jv partner of ME 3, completed a geological survey and exploration, and now plans to develop a lignite mine.

During 2000, a total of 3,700 t of coal and coal dust from three mines - Kalewa (3,050 t), Namma (72 t) and Sam Lao (658 t) were sent to 11 districts and townships in Yangon Division in upper Myanmar for making firewood-substitute fuel cartridges. Direct sales from the mines, Kalewa (18,222 t) and Namma (1,033 t) amounted to 19,255 t. In future, for manufacture of fuel cartridges, coal and lignite will be supplied from Namma in Lashio Township, Sam Lao in Thibaw Township and Tigyit (Hsikip) in Pinlaung Township, all in Shan State, in addition to supplies from Kalewa.

A total of 168 t of antimony ore (of unspecified grade) was extracted from the Lebyin area, in Thazi Township, Mandalay Division by a jv involving ME 3 and Mayflower Mining Enterprise Ltd. The ores were sent, by railway, to the refurbished antimony processing plant at Kalaw in Shan State operated by Mayflower, to produce antimony concentrates (70-80% Sb). The plant was commissioned in August last year. By year end, the privatised plant had produced 6.38 t (85% Sb) and 8.53 t (65% Sb) of concentrates.

While negotiations between the Australian company, Mt. Burgess Gold Mining Co. NL and ME 3 have been dormant, another Australian company, Anvil Mining NL has shown a strong interest in the development, mining and smelting of nickel laterite ores in

the Tagaung Taung area in Thabeikkyin Township, Mandalay Division, where there is a drill-indicated resource of 40 Mt at 2.02% Ni. Anvil has already held preliminary discussions and visited the site in December 2000. Another Australian company, Mitchell River NL is also interested in Tagaung Taung. It has had discussions with ME 3 and visited the deposit in April this year.

During 2000, the barytes powder factory at Thazi, Mandalay Division, operated by the production-sharing jv of ME 3 and Singapore-based ECI Mineral Pte Ltd. produced 7,186 t of barytes powder. Combined with the stocks in hand, 6,001 t and 1,398 t have been sold respectively to Myanmar Oil & Gas Enterprise and Expan, a foreign company.

The jv between ME 3 and Nawarat Resources Co. began producing marble dimension stone on a commercial scale in August 2000, from the Patlai Inn area in Madaya Township, Mandalay Division. So far, a total of 175,537 m<sup>3</sup> of marble blocks have been extracted. A sale of 50 m blocks made to Maytone Pte Ltd. of Japan earned US\$1,000. The same company has offered to purchase 50 m<sup>3</sup> of marble blocks at US\$200/m<sup>3</sup> on a long-term basis, and export arrangements are under way.

The production-sharing jv contract between ME 3 and Myanmar BPL Resources Ltd, a US company, for granite extraction from the Banbwagon area, in Paung Township, Mon State, was terminated in February 2000 with the approval of MIC.

### **Research and Development**

To save foreign exchange on imports and to promote the manufacture of value-added mineral products, the Ministry of Mines has issued directives to all its enterprises (mining, gems, pearls and marine chemical salts) to undertake research and development. In response, ME 2 has succeeded in producing ammonium para-tungstate (WO<sub>3</sub>) (APT) from wolframite on a laboratory scale. A proposal to build a pilot plant for test production of APT

has been submitted to the Mines Ministry. Likewise, ME3 has succeeded in producing high-carbon ferrochrome and calcium carbide on a small scale. Only the quality has to be improved. ME 3 is also trying to produce hard coke using bituminous coal from the Innbyin area, near Kalaw in Shan State. Myanmar Salt & Marine Chemicals Enterprise has also succeeded in producing magnesia cement from magnesium hydroxide and other additives on a laboratory scale. Commercial-scale production will be attempted after successful pilot plant testing.

Through the Department of Mines, the Ministry of Mines actively participated in ASEAN regional activities during 2000. To co-operate with AFOC (ASEAN Forum On Coal), a National Committee has been formed, with the Deputy Minister of Mines as chairman, and with representatives from the Ministries of Foreign Affairs, Energy, Electric Power, Science & Technology and Mines (director general of DGSE and managing director of ME 3) as members and the director general of the Department of Mines as secretary. As a first step, this committee signed the AFOC Charter in October 2000. Later, a two-man delegation headed by the director general of the Mines Department, attended a special workshop on mining and quarrying within the Asia/Pacific region sponsored by the ASEAN Federation of Mining Associations, in Kuala Lumpur, Malaysia, in November 2000. Another two-man delegation led by the managing director of ME 3 attended the conference on Coal for Energy Security in the ASEAN Region in Jakarta in December, which was jointly sponsored by ACE (ASEAN Centre for Energy) and AFOC. The Department of Mines is currently compiling a coal and industrial minerals database to enable exchange of mineral product information in

conformity with the ASEAN Industrial Mineral Information System. This aims to promote mining, processing, trading and utilisation of industrial minerals.

Myanmar joined BIMST-EC, a five-nation (Bangladesh, India, Myanmar, Sri Lanka and Thailand) Economic Co-operation Pact in August 1997. Out of six major co-operation sectors, Myanmar is project co-ordinator for the promotion of intra-regional investment in the gemstone sub-sector of the Commerce & Investment Sector. Accordingly, the managing director of MGE has been appointed as the 'Focal Point' with whom the Mines Department deals in matters of BIMST-EC commitments for the Ministry of Mines.

Sri Lanka, Myanmar and Thailand all produce and trade gemstones, especially rubies and sapphires but Thailand, alone, has a stranglehold on, or, at least, an upper hand in the global gemstone trade (including Brazil, Colombia, Madagascar, Russia and Tanzania) with a well-established Bangkok market in spite of Myanmar's world-famous finest-quality rubies from the Mogok area. Will BIMST-EC be able to contrive a fair and equitable gemstone trade among its member countries?

<b>Myanmar Production Statistics (t except where stated)</b>			
<b>Commodity</b>	<b>1998-1999</b>	<b>1999-2000</b>	<b>2000-2001</b>
Tin concentrate	311	426	636
Wolfram concentrate	11	22	2
Tin-wolfram conc.	124	184	222
Cathode copper	9,730	27,853	26,546
Lead	1,855	1,717	775
Gold (kg)	172	116	93
Silver (kg)	3,643	2,159	1,432
Coal	31,025	42,773	52,553
Barytes	18,562	27,679	32,669
Gypsum	40,234	43,102	52,573

Production figures represent financial years from 1 April to 31 March. Decline in Pb and Ag production is due to curtailed lead smelting because of high Cu content in Pb concentrates. Steady increase in production of coal, barytes and gypsum is due to additional mines being developed from new discoveries.