Part IV

Philippine Mineral Resources

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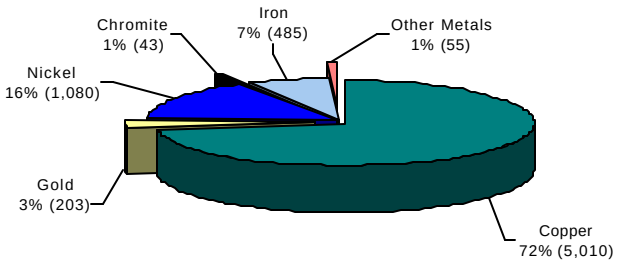
A. INTRODUCTION

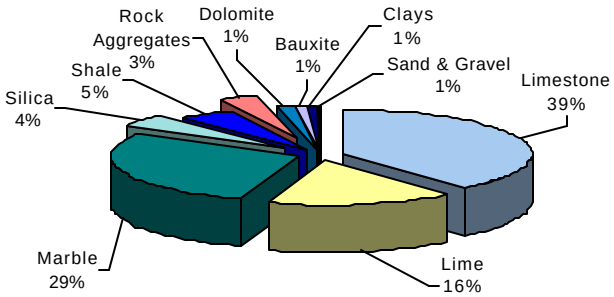
Minerals are natural substances, usually comprising "inorganic element or compound, having an orderly internal structure and characteristics, chemical composition, crystal form, and physical properties" (NAMRIA-DENR, 1991). Any concentration of these minerals, with a potential economic value that can be extracted at a profit, is considered a mineral resource.

Despite its small area, the Philippines is one of the world's richly endowed countries in terms of mineral resources. In 1994, the estimated levels of metallic and non-metallic mineral reserves stood at 7 billion metric tons and 50 billion metric tons, respectively. Copper accounted for the bulk of metallic mineral resources of about 72 percent; while nickel's share was estimated at 16 percent (Figure 1). Among the non-metallic minerals, limestone and marble accounted for about 39 and 29 percent, respectively (Figure 2). In terms of chromite resources, the Philippines is also one of the most endowed countries. In fact, the country's refractory chromite resource in Zambales[1] is considered as one of the largest in the world.



Source: Mine Technology Division, MGB.

FIGURE 1. ESTIMATED PHILIPPINE METALLIC MINERAL RESERVES, 1994



Source: Mine Technology Division, MGB.

[1] Zambales is a province located in the northern part of the Philippines.

FIGURE 2. ESTIMATED PHILIPPINE NON-METALLIC MINERAL RESERVES, 1994

The mining industry plays a very important role in the country's economic development. For one, the industry provides employment opportunities to a significant portion of the population, directly and indirectly. The launching of a mining project spurs local and regional economic development as mining firms invest in road infrastructure, utilities, and other facilities within the mine site. Mining, likewise, contributes to the country's foreign-exchange earnings through exports. Furthermore, the industry provides additional revenues for the government through taxes and fees paid on mining and other related activities.

Compared to other natural resources, the mineral resource is unique, as illustrated below:

1. The special features of mineral resources, initially unknown, fixed in size and location, and variable in quality, result in characteristics that create both problems and opportunities. For one, the mining activity involves high-risk investments. Mineral deposits must first be discovered, entailing large exploration costs. The inherent variability in size, quality, and other geological parameters can also result in the variability of mine site revenue, and the operating and capital costs that ultimately affect the returns on investment. There is also the considerable time lag between exploration and the start of commercial operation. And finally, there is always the uncertainty in the mineral commodity markets that could lead to temporary or permanent closure of operations.

2. The mineral reserves are dynamic. Fluctuating world metal prices and technological advances determine the feasibility and profitability of extracting the ore reserve, thus, causing the boundary between ore and waste, and between economic and sub-marginal deposits to change over time.

3. The mining activities involve operations that have significant impact on the environment. In most facets of the mining activities, there is always the potential for environmental and ecological problems -- from the construction of mining facilities, the extraction of ore, to the processing of minerals.

4. Mineral resources are non-renewable. Once extracted, the ore is gone and will take a very long time to replenish. Mining activity, therefore, is faced with the sustainability issue. Serious implications may arise if this issue is not properly addressed. While the construction of the asset account for the other natural resources is undoubtedly important, it is more crucial for the minerals because of the exhaustibility of these resources.

The asset accounts can yield indicators on sustainability, such as the level of resources, the extraction rate, the expected life of the assets, the new discoveries and the other volume changes. These indicators can serve as guide in policy formulation and legislation regarding our mineral assets.

B. CONCEPTUAL FRAMEWORK

B.1. Scope and Coverage

Mineral resources include both the metallic and non-metallic minerals. In terms of their economic contribution to the country, the important metallic minerals include gold, copper, iron, chromite, nickel, manganese, cobalt, lead, zinc, molybdenum, mercury, and aluminum; while coal, phosphate rock, magnetite, sulfur, guano, barite, bentonite, clay, diatomite, feldspar, gypsum, perlite, silica, gravel and sand, basalt, marble, limestone, shale, diorite, jade, opal, quartz, rhodonite, obsidian, agate, and serpentinite are all classified as non-metallic minerals.

The study of the asset account, however, was limited to metallic minerals or minerals characterized by opacity, ductility, conductivity, and a particular luster. Among the metallic mineral resources included were gold, copper chromite, nickel, iron and manganese.

B.2. Framework for the Asset Account

The framework for the asset account of the mineral resources is shown below:

	OPENING STOCK
Less:	Extraction (Depletion)
Plus/Less:	Other Accumulation (Changes due to Economic Decisions)
Plus/Less:	Other Volume Changes (Other Changes due to Decisions Other than Economic)
Revaluation*:	CS - (OS - Ext +/- OA +/- OVC)
Equals:	**CLOSING STOCK**

* For Monetary Valuation

The asset account shows the level of stocks of a particular resource at a given point in time and records the transactions that cause the changes in the level of this mineral resource. The transactions relevant to the asset account include extraction, other accumulation, and other volume changes.

The *opening and closing stocks* consist of proven reserves of mineral deposits at the beginning and ending of the accounting period, respectively. The *extraction* of minerals during the period is deducted from the opening stock. Since minerals are non-renewable resources, the total extraction level during the period is treated as depletion.

Changes in the reserve level that result from economic decisions are accounted for in *other accumulation*. Other accumulation includes discoveries and reassessment of exploitability of reserves due to changes in relative prices and technology. The cut-off grade of the ore reserve is also a determining factor that influences economic reserves, the mine life, and even the extraction level.

Other transactions that are not due to economic decisions, but nevertheless affect the level of reserves, are recorded under *other volume changes*. These transactions would include the closure of mines either as a result of a permanent ban on the extraction of the mineral in consideration of environmental concerns, abandonment of mine site due to peace and order problems that are more likely to last for a longer period of time, or other similar situations that are beyond the mining firms' control.

C. OPERATIONALIZING THE FRAMEWORK

C.1. Sources of Data

Preparing the mineral resources asset account requires detailed information on reserves, level of extraction, transactions involving other accumulation and other volume changes, and structure of mineral production costs.

The data used in constructing the asset accounts in physical terms basically came from the reports compiled by the Mines and Geosciences Bureau (MGB) of the Department of Environment and Natural Resources (DENR). One of these reports is the Philippine Metallic and Non-metallic Mineral Reserves (PMNMMR), which contains the summarized information on mineral ore reserve, by type of deposit, by geographic location, and by firm with information on their status, level of reserves classified into positive, probable, and possible with corresponding average grade.

Starting 1990, the MGB embarked on refining and improving the data on reserves, which resulted in the presentation of an updated and un-updated section to the reports on the mineral reserves. The updated section covers mining companies whose reports on ore reserves have been obtained through audited company reports. Included in this report are submitted but unverified ore reserve reports, previous PMNMMR Reports, and other reliable documentary sources available during the last two years. On the other hand, the un-updated section covers mining companies, operators, or claim owners whose reported ore or mineral reserves and whose status of operations remained unchanged or un-updated for the last three years or more. The Mine Technology Division (MTD) of the MGB has been continuously trying to update the reserve status of these companies.

In 1997, Dr. Ricarte Javelosa undertook a case study for ENRA-IEMSD, entitled *Estimates of the Geologic Mineral Reserve of Small-Scale Gold Mines,* to give a snapshot of the reserve stock of small-scale gold mines for 1992. The said study provides an estimate of geologic mineral reserves of small-scale gold mines for the year 1992, classified into *indicated* and *inferred reserve*, with additional information on the claim area hectarage, grade, metal content, and rock type by region, by province, and by town/barangay.

Annual data on tons mined, with corresponding weighted average grade, were also obtained from the Mineral Economics and Policy Division (MEPD) of MGB. These were culled out and consolidated from the Monthly Production Reports of individual mining firms. Similarly, Edwin B. Santelices (1997) undertook a case study for ENRA-IEMSD, entitled *Estimation of Production, Tons Mined, and Tailings Generated by the Small-scale Gold Mining Activity,* to provide, among others, an estimate of the tons mined/extraction of small-scale gold mines from 1988 -1992.

The data used to establish the asset account in monetary terms include the results of the Annual Survey of Establishments (ASE), published by the National Statistics Office (NSO), and the mineral production data from the Mineral News Service (MNS), published by the MGB.

The Integrated Annual Report (IAR) of Metallic Minerals, Non-metallic Minerals, and Quarry Resources, being submitted by individual mining/quarry firms to the MEPD, can be a good source of data, particularly on cost structure to estimate the resource rent, using the Net Price Method (NPM) and the El Serafy (ESM) or User Cost Method (UCM). However, consolidated data on this are not being published currently.

C.2. Estimation Methodology

Asset accounts were compiled for each metallic mineral resource in physical and in monetary terms, for the period 1988 to 1994. In physical terms, the asset account is presented in two ways: in ore form and in metal content. In monetary terms, two methods of valuation were employed: the Net Price Method and the El Serafy or User Cost Method.

C.2.1. Physical Asset Account

The physical asset account was compiled for metallic minerals, which include gold, copper, chromite, nickel and manganese, nickel, iron and manganese. No physical asset account in both ore and metal form was compiled for total minerals. The TWG deemed it more appropriate to compile the physical asset account by type of mineral considering that each mineral has its own peculiarity.

The physical asset account describes, in physical terms, the changes in the mineral reserves level for a given period of time. The volume of reserves, depletion, and other accumulation are presented in both ore form and metal content. Data on reserves are very crucial in establishing the physical asset account. Conceptually, proven reserves should be considered in constructing the account. Proven reserve is defined "as the estimated quantities at a specific date, which analysis of geological engineering data can demonstrate, with reasonable certainty, to be recoverable in the future from known reservoirs, under the economic and operational conditions at the same date" (UNSNA, 1993). Since this classification is not used in the mining industry, there is a need to establish an operational definition. After a lengthy discussion, the compilers of the account and the mining engineers reached a consensus to define proven reserves to include only the positive and the probable reserves.

In compiling the asset accounts in ore form, entries for the opening and closing stocks and for extraction or depletion were provided by the data sourced from the MGB.

Since the gold ore reserve reported in the PMNMMR and the tons mined from the monthly production reports of mining firms submitted to MGB reflect only that of large-scale mines, the 1992 information on the ore reserves of small-scale gold mines and tons mined/extraction from the 1997 studies of Dr. Javelosa and E. Santelices were used, respectively, to show a scenario of the combined stock of reserve of large and small-scale gold mines (see Appendix Tables 16a and 16b, page 167).

The opening stock was established by summing up the closing stock and the extraction of ore reserves from the study of E. Santelices. Ideally, the estimation of the gold reserve stock, which should include both the large and small-scale mines, should be done for all the years covered by the account. However, due to the unavailability of information on small-scale mines, the study was done only for 1992.

In the absence of reliable data on tons mined, information on beneficiated ore were utilized to approximate the extraction of nickel and metallurgical chromite. For manganese, the data on tons mined were available only in 1991. However, there are reports of ore production for the other years. Hence, the ratio of the 1991 volume of production to tons mined was used to derived the tons mined for the other years.

Compiling the asset account in metal content requires the conversion of data in ore form to its metal equivalent. The stock of reserves in metal content was computed by summing up the positive and the probable reserves, multiplied by their corresponding weighted average grade. While it is recognized that ore bodies may contain more than one metal, only the primary metal was considered. For the extraction, the metal content was computed by applying an average weighted grade to the tons mined. The metal content of the tons mined generated for nickel was established by applying the average grade of 2.4 percent. For manganese, the weighted average grade of the 1991 tons mined of 51.6 percent was used to establish the metal content of extraction for the other years covered by the account.

Since only the data on the stock of reserve and depletion are available, other accumulation in ore and its metal content was computed as a residual, by deducting from the closing stock the difference of the opening stock and extraction. The resulting estimate for other accumulation is reflective of the net effect of reclassification and discoveries and closure due to economic decisions.

During the period covered, there were no recorded other volume changes since there was no reported closure of mines due to reason other than economic.

C.2.2. Monetary Asset Account

The monetary asset account describes in money terms the changes in the mineral reserves level at a given period of time. Its basic requirement was the unit price estimation. The CE/ASE and the MNS were the basic source of information in establishing the unit price.

The monetary asset account was compiled only for gold, copper, and chromite. With these three minerals, no monetary asset was compiled for the year when the derived unit resource rent for the NPM or the unit user cost for the El Serafy (ESM) or User Cost Method (UCM) is negative or very negligible. The opening stock, the extraction and the other accumulation of the subsequent year with positive unit rent and positive unit user cost were valued using the derived unit resource rent and unit user cost for that year for the NPM and ESM or UCM, respectively. No monetary asset account was compiled for manganese since it has a positive unit resource rent only in 1993 and a positive unit user cost in 1993 and 1994. Likewise, nickel has negative unit resource rent and unit user cost for the period 1988-1994 except in 1993. In the case of iron, no monetary asset account was compiled since no extraction was done for the years under consideration, which is necessary in deriving the unit resource rent and unit user cost.

a) Net Price Method (NPM) – In the NPM, the resource value is equal to the resource volume (Q_t) multiplied by the difference between the average market value per unit of the resource (P_t) and the per unit (marginal) cost of extraction, development, and exploration, including a normal rate of return to capital (C_t):

$$V_t = (P_t - C_t)Q_t$$

Following the NPM, the resource rent using the CE/ASE data was derived by subtracting from the net operating surplus the annualized opportunity cost of the money invested on fixed assets. An opportunity cost of 15.0 percent was used, based on the feasibility studies conducted by the National Economic Development Authority (NEDA). To operationalize the annualized opportunity cost on the money invested on fixed assets, information on the fixed capital consumption was used with the assumption that this represents the amount of fixed assets used for a particular year. The net operating surplus was derived by deducting from the mining industry's gross value added (GVA) the compensation of employees, indirect taxes, and consumption of fixed capital. GVA, on the other hand, was estimated by subtracting from the value of gross output the value of intermediate inputs.

b) El Serafy Method (ESM) or User Cost Method (UCM) – The user cost, i.e., the discounted net revenue from the sale of the resource is:

$$R\text{-}X = R/(1 + r)^{n+1}$$

where *R* is the annual net revenue from the sale of the resource, assumed to be constant over its lifetime (of n years); X, the *true income* element, is calculated so that $R\text{-}X$ represents a *capital* element whose accumulated investment at an interest rate r during the n years would create a permanent stream of income of X.

Using the ESM method, the user cost or depletion factor $(R\text{-}X)$ was computed by adjusting the net revenue or net operating surplus (R), using the CE/ASE data with the capital component $1/(1+r)^{n+1}$, hence, $R\text{-}X = R * [1/(1+r)^{n+1}]$

For r, 5 and 10 percent were used.

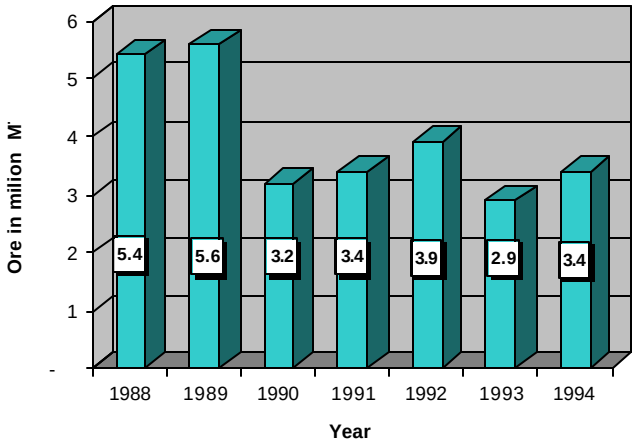
Since the GVA for the Mining and Quarrying Sector, published in the National Accounts, was based on the data from MGB, the resource rent and the user cost values were computed using the structure derived from the CE/ASE. The unit resource rent and the unit user cost were then derived using the production data of MGB.

The above unit values were applied to the resource and depletion in physical asset account in metal content to arrive at their monetary values for the NPM and the ESM or UCM, respectively. The unit resource rent and the unit user cost for the previous and the current years were also used for valuing the beginning and ending stocks. On the other hand, since the current price and the cost of extraction of minerals at the time the transaction took place is not known, the average of the previous and current years' unit resource rent and unit user cost were utilized as an approximation in valuing the depletion and other accumulation in the NPM and ESM/UCM, respectively. Revaluation was computed as a residual value: closing stock minus opening stock, less depletion plus other accumulation.

D. RESULTS AND DISCUSSIONS

D.1. Gold

Appendix Tables 1a and 1b (page 152) show the physical asset account of gold in ore and metal form, respectively. Gold reserves at the beginning of 1988 was estimated at 101.6 million metric tons (MT), equivalent to about 240 MT of gold metal. Between 1988 and 1994, a total of 27.7 million MT of gold ore, containing about 36 MT of metal was extracted. On the average, this is equivalent to an annual extraction of 3.9 million MT of gold ore. However, actual annual data show that the level of ore extraction dropped by a hefty 42.9 percent in 1990 and 25.7 percent in 1993 (Figure 3). The slight increase in the



world metal price of gold in 1990 failed to raise the country's production. During this year, three major gold mines temporarily ceased operation, evidence of the then problems which besieged the domestic mining industry.

FIGURE 3. EXTRACTION OF GOLD RESERVES IN ORE FORM, 1988-1994

In 1992, the ore extracted has a lower metal content. Despite the increase in ore extraction, from 3.4 million MT in 1991 to 3.9 million MT in 1992, the metal yielded was 1 MT less than that recovered in 1991.

For other accumulation, discoveries and reassessment of exploitability of reserves resulted to a net addition of 80.1 million MT of gold ore or about 111 MT of metal content to the stock of reserves.

In monetary terms, three sets of estimates were derived (see Appendix Tables 2a, 2b and 2c, page 153). Although estimates based from the NPM are higher, the value of the stock of gold using both NPM and ESM at 5 and 10 percent interest rates, showed a decreasing trend between 1988 to 1990 and an increasing trend between 1993 and 1994. No monetary asset account was compiled for 1991 and 1992, since the unit resource rent

and unit user cost for these years had negative values. Another difference between the two estimates is the trend of revaluation in 1988. In contrast to the NPM estimates of positive revaluation, the ESM estimates posted negative revaluation.

D.2. Copper

The reported stock of copper in ore form increased from 4,106 million MT in 1988 to 4,597 million MT in 1994 (Figure 4). However, copper reserves suffered a setback in 1990, when it declined by 7.2 percent from the previous year's level before resuming its increasing trend.

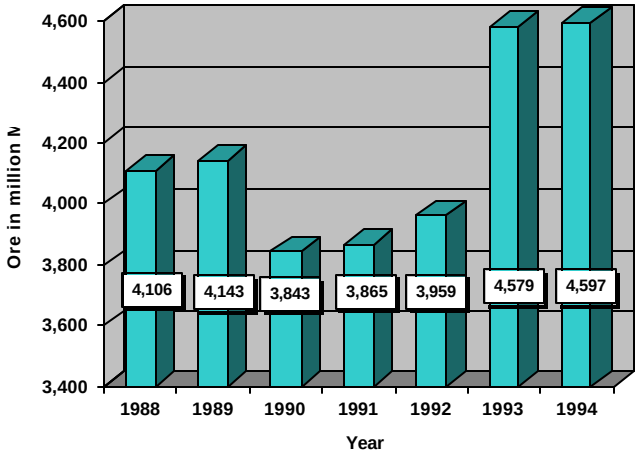


FIGURE 4. CLOSING STOCK OF COPPER RESERVES IN ORE FORM, 1988-1994

From 1988 to 1994, the extraction of copper ore registered a decreasing trend, with an annual average decline of 12.1 percent. The same trend was exhibited by the metal content which declined from 277,746 MT in 1988 to 130,910 MT in 1994 (see Appendix Table 3b, page 154). Copper mining companies slowed down in their production as lower prices of copper metal in the world market discouraged further expansion of activities. Other factors which contributed to the low extraction for the years concerned included power shortages, closure of the Marcopper Mining Corporation in the second half of 1991, the eruption of Mt. Pinatubo, and the unusual heavy rainfall. During the seven-year period, a total of 346 million MT of ore was extracted, with a metal content of 1.3 million MT.

A consistent trend of price change was recorded for both the NPM and the ESM at 5 and 10 percent interests for the years 1988 to 1991, as reflected in the revaluation item. Likewise, a decreasing trend in the closing stock value was also manifested for the years 1988 to 1991 for both the NPM and the ESM at 5 and 10 percent interests. The value of extraction was lowest in 1991 for all pricing methods (see Appendix Tables 4a, 4b, and 4c, page 155).

D.3. Chromite

From 1988 to 1990, on the average, most of the chromite-producing companies experienced a relative boom, as reflected by the increases in their extraction. For the said period, the total chromite ore extraction grew at an annual average of 30.1 percent, despite the earthquake that jolted Luzon island in July 1990. However, starting 1991, a downtrend was experienced as a result of the volcanic eruption (see Appendix Tables 5a and 5b, page 156). This catastrophe deluged service roads with mudflows thus, affecting the transport of the output of one of the biggest chromite producers in that location. Power shortage and other geological factors affected the operations of most chromite mining companies in the succeeding years.

As a result of reduced extraction and positive other accumulation, the stock of total chromite ore reserves registered an annual average growth of 1.5 percent for the period 1988-1994. The corresponding metal content posted an average annual growth of 0.4 percent for the same period.

In contrast with the physical asset accounts for which estimates were undertaken by type of chromite, the monetary asset account for chromite was estimated only on an aggregate basis.

Despite higher NPM estimates over ESM estimates, a consistent decreasing trend in the closing stock value can be noted for the period covered for both valuation methods – except in 1994.

D.3.1. Chemical Chromite

The closing stock of chemical chromite in ore form grew from 2.80 million MT in 1988 to 2.88 million MT in 1994, with significant decreases in 1990 and 1991. The reduction was due to the increased extraction of chemical chromite as well as the result of re-evaluation of chromite mineral reserves. For both years, more than 100 thousand MT of chromite ore were extracted. In 1991, the mineral reserve of a major chromite company was downgraded from 48 percent to 8 percent. As a result, total closing stock was reduced from 2.80 million MT to 1.34 million MT net of extraction. On the other hand, the combined discoveries in 1992 and 1993 more than compensated for the increase in extraction of chemical chromite ore for the same period. Hence, in 1993, the stock of ore reserve increased to 2.89 million MT, with a metal content of 1.1 million MT (Figure 5).

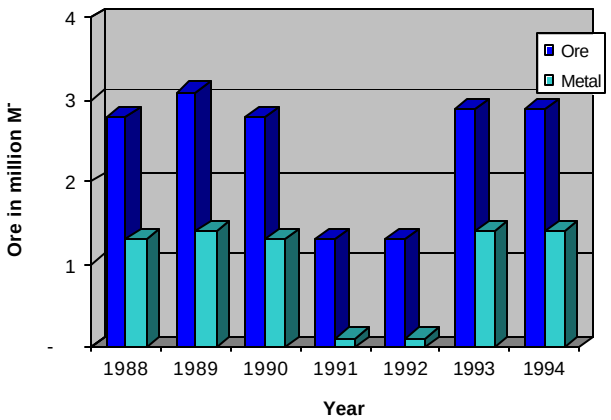


FIGURE 5. CLOSING STOCK OF CHEMICAL CHROMITE RESERVES, 1988-1994

D.3.2. Metallurgical Chromite

From 1988 to 1994, the closing stock of metallurgical chromite ore reserves annually expanded by 5.1 percent (see Appendix Tables 8a and 8b, pages 159). Such increase is a combined effect of decreasing extraction as well as discovery and/or positive reclassification of ore reserves. Though ore extraction was growing from 1988 to 1990, it showed a decreasing trend from 1991 to 1994 due to the gradual reduction in ore extraction of one of the biggest metallurgical chromite companies because of depleting reserves. Meanwhile, discovery and/or positive reclassification of ore reserves were registered for the years 1989, 1991, 1992 and 1994.

D.3.3. Refractory Chromite

From 1988 to 1994, the reserve stock registered an annual average decline of 5.4 percent, from 9.6 million MT in 1988 to 6.9 million MT in 1994. This was due to the huge negative reclassification of reserves in 1988, 1990, 1991, and 1993, totaling 6.3 million MT in addition to the extraction from 1988 to 1994 of 1.5 million MT, which outweighed the discovery and/or positive reclassification recorded in 1989, 1992, and 1994, amounting to 2.9 million MT. The decline in extraction started in 1990 as the operations of the biggest producer in the country and one of the biggest in the world was greatly affected by the earthquake that shook the Philippines in July of the same year. The following year, the operations of the above company was affected by the eruption of Mt. Pinatubo as reflected in the decrease of its extraction by 10.6 percent (see Appendix Tables 9a and 9b, page 160).

D.4. Nickel

Beginning in 1991, the stock of ore reserves started to decline. In 1993, the nickel metal production tremendously dropped, the effect of the slowdown in the international demand for nickel, coupled with increased production in the earlier years, which dampened the market price of nickel metal.

D.5. Iron

Iron ore, one of the Philippines' largest mineral deposits, is not being extracted at present. This was due to the higher cost of production, making the local prices of iron not competitive to world prices. However, exploration for possible mining sites is still being done. In 1989, there was an addition of 10.1 million MT in total reserves. Several mining areas explored in 1992 were found positive with iron, resulting in a huge increase in ore reserves of 298.6 million MT, with a metal content of 124.0 million MT (see Appendix Tables 11a and 11b, page 162).

D.6. Manganese

During the period 1988 to 1994, manganese reserves in ore form registered an annual average growth of 2.7 percent from 1.4 million MT in 1988 to 1.6 million MT in 1994 (see Appendix Tables 12a and 12b, page 163). The extraction of manganese ore exhibited fluctuations for the years in review. In 1992, exploration for more possible mining sites in several areas was conducted. This resulted to an increase of ore reserves by 203,014 MT, with a metal content of 87,843 MT at the end of the year, gross of extraction.

E. RECOMMENDATIONS

To fully operationalize mineral resource accounting, the following actions, based on the experience of the compilers in doing the asset account – are recommended:

1. To facilitate the compilation of environmental accounts, it is recommended that the IAR be included in the designated statistics[2] of the MGB. The IAR being submitted by mining firms individually to MGB contains data relevant to environmental accounting, which needs to be processed regularly. Confidentiality hinders the compilers from seeing these firm-based reports.

2. The compilers and environmental accounting experts should undertake a more detailed study on the concept of other volume changes so as to operationalize the inclusion of transactions that are not due to economic decisions.

3. Finally, a more comprehensive study is also being recommended by the TWG in the case of a negative unit resource rent or unit user cost.

[2] "Designated statistics is a system that enables the identification and generation of the most critical and essential statistics required for social and economic planning/analysis based on approved criteria. The generation of said data requires processing of administrative based records on a regular basis (Executive Order No. 352, 1996)".

ACRONYMS

ASE	-	Annual Survey of Establishments
CE	-	Census of Establishments
DENR	-	Department of Environment and Natural Resources
ENRA	-	Environment and Natural Resources Accounting
ESM	-	El Serafy Method
GVA	-	Gross Value Added
IAR	-	Integrated Annual Report
IEMSD	-	Integrated Environmental Management for Sustainable Development
MEPD	-	Mineral Economics and Policy Division
MGB	-	Mines and Geosciences Bureau
MNS	-	Minerals News Service
MT	-	Metric Tons
MTD	-	Mine Technology Division
NAMRIA	-	National Mapping and Resource Information Authority
NEDA	-	National Economic Development Authority
NPM	-	Net Price Method
NSCB	-	National Statistical Coordination Board
NSO	-	National Statistics Office
PMNMMR	-	Philippine Metallic and Non-Metallic Mineral Reserves
UCM	-	User Cost Method
UNSNA	-	United Nations System of National Accounts

DEFINITION OF TERMS

Chemical Grade Chromite	chromite intended for use by chemical industries.
Chromite	a brownish-black to iron-black mineral of the spinel group: (Fe, Mg) (Cr, Al) 204. This occurs in octahedral crystals as an accessory mineral in basic and ultrabasic igneous rocks. It also occurs massive and in deposits. This is the most important ore of chromium. It is used in the manufacture of chromium steel and refractory materials, as well as in the production of ferrochrome.
Copper	reddish colored metal with metallic luster. It is ductile, malleable, non-magnetic, and a good conductor of heat and electricity.
Gold	a soft yellow, malleable, and ductile metal. It occurs commonly in nature as native nuggets, or naturally alloyed with silver, copper, and other minerals.
Grade/Ore Grade	refers to the content of the desired element or the amount of potentially recoverable mineral per unit weight. This is usually expressed in g/MT or oz./MT; while for the base metals, it is in percent (%).
Iron Ore (Lump)	ferruginous rock, containing one or more minerals from which metallic iron may be profitably extracted.
Manganese	a hard, brittle, metallic element of group VII of the periodic tables; grayish-white tinged with red; rusting like iron; and not magnetic. This does not occur uncombined in nature and is obtained from minerals which are oxides, silicates, and carbonates. Pyrolusite (MnO2) and rhodocrosite (MnO3) are common ores. Nodules on ocean floors contain about two percent manganese. Used as a deoxidizing and a desulfurizing agent in steel manufacture and in many important alloys. Manganese in steel improves the rolling and furging and its strength toughness, stiffness, wear resistance, hardness, and hardenability.
Metal	any class of chemical elements as iron, gold, aluminum, etc., generally characterized by ductility, malleability, luster, and conductivity of heat and electricity.
Metallic Minerals	minerals with a high specific gravity and metallic luster, such as titanium, rutile, tungsten, uranium, tin, lead, iron, etc. which are good conductors of heat and energy.
Metallurgical Chromite	chromite that is rich in Cr2O3 and Mg.

Metric Ton (MT)	unit of mass and weight that is equal to 1,000 kilograms or 2,204.6 avoirdupois pounds.
Mineral	a naturally occurring inorganic element or compound, having an orderly internal structure and characteristics, chemical composition, crystal form, and physical properties.
Nickel	hard, malleable, ductile, silver-white metallic elements of group VII of the periodic system, capable of taking a high polish; resistant to oxidation and attracted to magnets. Used in alloys, electroplating, and coinage.
Ore	a mineral or aggregate of minerals which contain sufficient grade and quantity to be mined and beneficiated at a profit. The mineral or rock can be further described, depending on the major element contained, e.g., copper ore, gold ore, chromite ore, etc.
Ore Concentrate or Concentrate	the product as a result of beneficiation of ores to increase their grades to marketable level, as in copper, lead, iron, chromite concentrate.
Ore Reserve	refers to the volume of ore, at a specific cut-off grade, that has been estimated through tunneling, drilling, and other means that can be mined and beneficiated at a profit.
Positive Ore Reserve	the reserve where tonnage is computed from dimensions revealed in outcrops, workings, and drill holes; grade is computed with sufficient accuracy from the result of detailed sampling; the sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that the size, shape, and mineral content are well-established.
Possible Ore Reserve	the reserve where tonnage and grade are computed from assumed projections beyond the positive and/or probable reserve based on broad knowledge of geologic character and for which there are few sites for inspection, sampling, measurement, to render it as a criterion of what may be expected as mining operations progress into further reaches.
Probable Ore Reserve	the reserve where tonnage and grade are computed from assumed projections beyond the positive reserve through similar parameters; the sites for inspection, sampling, and measurement are further apart or less adequately spaced to ensure that they are high enough to assume continuity between points of projections, although lower than that for positive ore reserve.

Production	the yield or output of a mine, metallurgical plant, or quarry.
Proven Reserve	total of positive and probable reserves.
Refractory Grade Chromite	alumina-rich chromite (Al is equal or greater than 20 percent).
Zinc	alustrous, bluish-white metallic element in group II of the periodic system. Used in many alloys, including brass, bronze, nickel-silver, German silver, Babbitt or bearing metal, and as soft solder -- in die-casting alloys; in zinc zirconium alloy which is ferromagnetic at very low temperatures to galvanize from steel and other metals as protection against corrosion; in electroplating; in metal spraying; in photo-engravers plates and printing; in cable wrappings; in electric fuses; and in zinc compounds.

APPENDICES

APPENDIX TABLE 1a. GOLD PHYSICAL ASSET ACCOUNT (ORE FORM IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	101,556,592	106,932,190	109,981,548	124,589,870	145,968,467	149,785,296	180,832,363
Extraction	5,355,906	5,581,765	3,189,152	3,380,589	3,865,449	2,871,598	3,443,929
Other Accumulation	10,731,504	8,631,123	17,797,474	24,759,186	7,682,278	33,918,665	4,316,695
Other Volume Changes							
Closing Stock	106,932,190	109,981,548	124,589,870	145,968,467	149,785,296	180,832,363	181,705,129

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 1b. GOLD PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	240	269	262	257	279	294	379
Extraction	6	6	3	3	2	8	8
Other Accumulation	35	(1)	(2)	25	17	93	(20)
Other Volume Changes							
Closing Stock	269	262	257	279	294	379	351

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.

APPENDIX TABLE 2a. GOLD MONETARY ASSET ACCOUNT, USING THE NET PRICE METHOD AT 15% INTEREST RATE

	VALUE IN PESOS						
	1988	1989	1990	1991	1992	1993	1994
Opening Stock	14,974,641,845	17,177,216,690	8,805,581,863	-	-	12,178,676,269	15,699,722,129
Extraction	378,750,495	292,394,746	79,301,632	-	-	331,392,552	512,254,058
Other Accumulation	2,209,377,890	(48,732,458)	(52,867,755)	-	-	3,852,438,412	(1,280,635,144)
Other Volume Changes							
Revaluation	371,947,451	(8,030,507,623)	(3,723,935,957)	-	-	-	16,503,612,430
Closing Stock	17,177,216,690	8,805,581,863	4,949,476,520	-	-	15,699,722,129	30,410,445,357

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

APPENDIX TABLE 2b. GOLD MONETARY ASSET ACCOUNT, USING THE EL SERAFY METHOD AT 5% INTEREST RATE

	VALUE IN PESOS						
	1988	1989	1990	1991	1992	1993	1994
Opening Stock	6,987,936,737	3,175,492,390	1,589,489,954	-	-	308,535,052	397,737,363
Extraction	122,763,622	53,614,680	11,662,529	-	-	8,395,512	29,363,146
Other Accumulation	716,121,131	(8,935,780)	(7,775,019)	-	-	97,597,823	(73,407,866)
Other Volume Changes							
Revaluation	(4,405,801,856)	(1,523,451,976)	(1,131,028,610)	-	-	-	1,913,296,658
Closing Stock	3,175,492,390	1,589,489,954	439,023,796	-	-	397,737,363	2,208,263,009

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

TABLE 2c. GOLD MONETARY ASSET ACCOUNT USING THE EL SERAFY METHOD AT 10% INTEREST RATE

	VALUE IN PESOS						
	1988	1989	1990	1991	1992	1993	1994
Opening Stock	3,256,222,525	1,197,405,719	606,697,898	-	-	15,733,986	20,282,928
Extraction	54,056,749	20,300,890	3,870,801	-	-	428,136	2,277,782
Other Accumulation	315,331,034	(3,383,482)	(2,580,534)	-	-	4,977,077	(5,694,454)
Other Volume Changes							
Revaluation	(2,320,091,091)	(567,023,449)	(532,169,060)	-	-	-	168,780,201
Closing Stock	1,197,405,719	606,697,898	68,077,504	-	-	20,282,928	181,090,893

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

Note : Refer to Table 15 for the Unit Resource Rent and Unit User Cost used.

APPENDIX TABLE 3a. COPPER PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	3,881,254,934	4,105,662,899	4,142,081,418	3,842,637,754	3,864,982,190	3,959,544,315	4,579,417,648
Extraction	66,129,925	65,736,617	57,598,691	47,078,346	42,091,493	36,482,635	30,444,179
Other Accumulation	290,537,890	102,155,136	(241,844,973)	69,422,782	136,653,618	656,355,968	48,406,649
Other Volume Changes							
Closing Stock	4,105,662,899	4,142,081,418	3,842,637,754	3,864,982,190	3,959,544,315	4,579,417,648	4,597,380,118

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 3b. COPPER PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	17,282,097	17,934,882	18,089,858	16,523,343	17,743,066	17,099,641	20,362,753
Extraction	277,746	256,373	230,395	183,606	155,739	149,579	130,910
Other Accumulation	930,531	411,349	(1,336,120)	1,403,329	(487,686)	3,412,691	(49,070)
Other Volume Changes							
Closing Stock	17,934,882	18,089,858	16,523,343	17,743,066	17,099,641	20,362,753	20,182,773

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.

APPENDIX TABLE 4a. COPPER MONETARY ASSET ACCOUNT, USING THE NET PRICE METHOD AT 15% INTEREST RATE

	VALUE IN PESOS					
	1988	1989	1990	1991	1992	1993
Opening Stock	50,698,544,846	67,585,674,579	49,076,213,633	38,897,488,171	-	-
Extraction	930,724,076	830,815,885	583,706,455	240,868,662	-	-
Other Accumulation	3,118,200,099	1,333,039,296	(3,385,064,212)	1,840,996,361	-	-
Other Volume Changes						
Revaluation	14,699,653,709	(19,011,684,357)	(6,209,954,795)	(35,712,971,733)	-	-
Closing Stock	67,585,674,579	49,076,213,633	38,897,488,171	4,784,644,138	-	-

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

APPENDIX TABLE 4b. COPPER MONETARY ASSET ACCOUNT, USING THE EL SERAFY METHOD AT 5% INTEREST RATE

	VALUE IN PESOS					
	1988	1989	1990	1991	1992	1993
Opening Stock	455,461,908	5,959,836,748	3,786,121,336	2,648,159,329	193,303,834	597,215
Extraction	49,808,018	69,425,739	42,572,736	15,713,220	851,078	13,177
Other Accumulation	166,871,547	111,393,197	(246,890,270)	120,098,567	(2,665,091)	300,647
Other Volume Changes						
Revaluation	5,387,311,311	(2,215,682,871)	(848,499,001)	(2,559,240,843)	(189,190,450)	1,991,920
Closing Stock	5,959,836,748	3,786,121,336	2,648,159,329	193,303,834	597,215	2,876,604

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

APPENDIX TABLE 4c. COPPER MONETARY ASSET ACCOUNT, USING THE EL SERAFY METHOD AT 10% INTEREST RATE.

	VALUE IN PESOS					
	1988	1989	1990	1991	1992	1993
Opening Stock	4,989,956	316,743,619	192,739,401	113,472,987	4,049,519	7,168
Extraction	2,492,700	3,629,641	2,018,490	651,403	17,805	61
Other Accumulation	8,351,280	5,823,738	(11,705,741)	4,978,777	(55,755)	1,385
Other Volume Changes						
Revaluation	305,895,083	(126,198,316)	(65,542,183)	(113,750,842)	(3,968,792)	(500)
Closing Stock	316,743,619	192,739,401	113,472,987	4,049,519	7,168	7,993

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

Note : Refer to Table 15 for the Unit Resource Rent and Unit User Cost used.

1994
16,418,811,691
105,554,816
(39,565,922)
-
16,273,690,954

1994
2,876,604
60,708
(22,756)
13,074,877
15,868,016

1994
13,591
69
(26)
(25)
13,471

APPENDIX TABLE 5a. CHROMITE PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	29,823,558	27,452,192	29,385,727	25,770,981	27,130,116	30,561,845	28,998,599
Extraction	359,721	567,604	608,580	488,744	276,028	133,888	155,036
Other Accumulation	(2,011,645)	2,501,139	(3,006,166)	1,847,879	3,707,757	(1,429,358)	1,176,984
Other Volume Changes							
Closing Stock	27,452,192	29,385,727	25,770,981	27,130,116	30,561,845	28,998,599	30,020,547

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 5b. CHROMITE PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	9,918,520	9,146,539	9,314,505	7,919,792	8,275,440	9,309,929	9,291,799
Extraction	54,921	93,294	95,006	81,311	46,616	32,626	40,431
Other Accumulation	(717,060)	261,260	(1,299,707)	436,959	1,081,105	14,496	140,246
Other Volume Changes							
Closing Stock	9,146,539	9,314,505	7,919,792	8,275,440	9,309,929	9,291,799	9,391,614

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note:

1. *Chromite includes Refractory, Metallurgical and Chemical Chromite.*
2. *Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.*

APPENDIX TABLE 6a. CHROMITE MONETARY ASSET ACCOUNT, USING THE NET PRICE METHOD AT 15% INTEREST RATE

	VALUE IN PESOS						
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
Opening Stock	-	986,540,507	1,004,657,224	1,297,623,817	-	-	5,844,851,327
Extraction	-	10,062,638	12,906,809	11,484,091	-	-	25,432,447
Other Accumulation	-	28,179,355	(176,568,528)	61,714,614	-	-	88,219,409
Other Volume Changes							
Revaluation	-	-	482,441,929	(366,159,128)	-	-	-
Closing Stock	-	1,004,657,224	1,297,623,817	981,695,212	-	-	5,907,638,290

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

APPENDIX TABLE 6b. CHROMITE MONETARY ASSET ACCOUNT, USING THE EL SERAFY METHOD AT 5% INTEREST RATE

	VALUE IN PESOS						
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
Opening Stock	-	57,495,217	58,551,053	176,932,816	-	2,704	2,699
Extraction	-	586,447	1,359,849	1,183,965	-	9	1,558
Other Accumulation	-	1,642,282	(18,603,094)	6,362,538	-	4	5,403
Other Volume Changes							
Revaluation	-	-	138,344,707	(125,993,056)	-	-	714,393
Closing Stock	-	58,551,053	176,932,816	56,118,333	-	2,699	720,937

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

APPENDIX TABLE 6c. CHROMITE MONETART ASSET ACCOUNT, USING THE EL SERAFY METHOD AT 10% INTEREST RATE

	VALUE IN PESOS						
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
Opening Stock	-	4,094,385	4,169,574	23,554,326	-	0	0
Extraction	-	41,762	162,543	138,731	-	-	0
Other Accumulation	-	116,951	(2,223,638)	745,531	-	-	1
Other Volume Changes							
Revaluation	-	-	21,770,933	(20,534,390)	-	-	84
Closing Stock	-	4,169,574	23,554,326	3,626,736	-	0	84

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB;
Integrated Annual Report, Mineral Economic and Policy Division, MGB;
Annual Survey of Establishments, NSO;
Mineral News Service, MGB; Group Estimates

Note : *Refer to Table 15 for the Unit Resource Rent and Unit User Cost used.*

APPENDIX TABLE 7a. CHEMICAL CHROMITE PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	2,800,000	2,800,000	3,089,000	2,800,000	1,336,017	1,322,635	2,875,607
Extraction	82,704	88,575	110995	108,797	68,550	11,079	-
Other Accumulation	82,704	377,575	(178,005)	(1,355,186)	55,168	1,564,051	-
Other Volume Changes							
Closing Stock	2,800,000	3,089,000	2,800,000	1,336,017	1,322,635	2,875,607	2,875,607

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 7b. CHEMICAL CHROMITE PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	1,344,000	1,344,000	1,390,012	1,344,000	113,277	110,572	1,144,492
Extraction	8,849	8,477	9,856	10,608	6,026	974	-
Other Accumulation	8,849	54,489	(36,156)	(1,220,115)	3,321	1,034,894	-
Other Volume Changes							
Closing Stock	1,344,000	1,390,012	1,344,000	113,277	110,572	1,144,492	1,144,492

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: *Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.*

APPENDIX TABLE 8a. METALLURGICAL CHROMITE PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	15,140,018	15,026,664	15,144,887	13,172,168	17,551,652	20,762,976	19,705,403
Extraction	67800	136,296	193,484	108,000	51,219	15856	13575
Other Accumulation	(45,554)	254,519	(1,779,235)	4,487,484	3,262,543	(1,041,717)	549,741
Other Volume Changes							
Closing Stock	15,026,664	15,144,887	13,172,168	17,551,652	20,762,976	19,705,403	20,241,569

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 8b. METALLURGICAL CHROMITE PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	4,735,786	4,684,867	4,749,281	3,615,906	5,515,230	6,519,790	6,154,963
Extraction	6,509	15,756	23,083	14,764	8,651	2,678	2,293
Other Accumulation	(44,410)	80,170	(1,110,292)	1,914,088	1,013,211	(362,149)	(58,883)
Other Volume Changes							
Closing Stock	4,684,867	4,749,281	3,615,906	5,515,230	6,519,790	6,154,963	6,093,787

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: *Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.*

APPENDIX TABLE 9a. REFRACTORY CHROMITE PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	11,883,540	9,625,528	11,151,840	9,798,813	8,242,447	8,476,234	6,417,589
Extraction	209,217	342,733	304,101	271,947	156,259	106,953	141,461
Other Accumulation	(2,048,795)	1,869,045	(1,048,926)	(1,284,419)	390,046	(1,951,692)	627,243
Other Volume Changes							
Closing Stock	9,625,528	11,151,840	9,798,813	8,242,447	8,476,234	6,417,589	6,903,371

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 9b. REFRACTORY CHROMITE PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	3,838,734	3,117,672	3,175,212	2,959,886	2,646,933	2,679,567	1,992,344
Extraction	39,563	69,061	62,067	55,939	31,939	28,974	38,138
Other Accumulation	(681,499)	126,601	(153,259)	(257,014)	64,573	(658,249)	199,129
Other Volume Changes							
Closing Stock	3,117,672	3,175,212	2,959,886	2,646,933	2,679,567	1,992,344	2,153,335

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: *Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.*

APPENDIX TABLE 10a. NICKEL PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	1,566,100,857	1,581,417,435	1,573,109,861	1,618,697,239	1,157,473,662	1,156,826,707	1,068,984,083
Extraction	444,600	658,400	608,100	557,200	593,900	346,900	431,000
Other Accumulation	15,761,178	(7,649,174)	46,195,478	(460,666,377)	(53,055)	(87,495,724)	(701,954)
Other Volume Changes							
Closing Stock	1,581,417,435	1,573,109,861	1,618,697,239	1,157,473,662	1,156,826,707	1,068,984,083	1,067,851,129

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 10b. NICKEL PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	17,841,009	18,273,107	18,036,419	18,658,809	15,259,619	15,227,134	13,966,617
Extraction	10,670	15,802	14,594	13,373	14,254	8,326	10,344
Other Accumulation	442,768	(220,886)	636,984	(3,385,817)	(18,231)	(1,252,191)	(34,457)
Other Volume Changes							
Closing Stock	18,273,107	18,036,419	18,658,809	15,259,619	15,227,134	13,966,617	13,921,816

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: *Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.*

APPENDIX TABLE 11a. IRON PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	182,352,108	182,352,108	192,452,108	192,450,308	182,530,674	481,092,574	481,092,574
Extraction	-	-	-	-	-	-	-
Other Accumulation	-	10,100,000	(1,800)	(9,919,634)	298,561,900	-	(316,667,477)
Other Volume Changes							
Closing Stock	182,352,108	192,452,108	192,450,308	182,530,674	481,092,574	481,092,574	164,425,097

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 11b. IRON PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	78,648,781	78,648,781	84,838,817	84,838,058	78,774,178	202,841,338	202,841,338
Extraction	-	-	-	-	-	-	-
Other Accumulation	-	6,190,036	(759)	(6,063,880)	124,067,160	-	(128,394,775)
Other Volume Changes							
Closing Stock	78,648,781	84,838,817	84,838,058	78,774,178	202,841,338	202,841,338	74,446,563

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: *Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.*

APPENDIX TABLE 12a. MANGANESE PHYSICAL ASSET ACCOUNT (ORE FORM, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	1,395,730	1,394,786	1,394,786	1,391,186	1,397,586	1,586,516	1,587,716
Extraction	2,365	3,084	15,421	4,215	14,084	1,234	-
Other Accumulation	1,421	3,084	11,821	10,615	203,014	2,434	50,588
Other Volume Changes							
Closing Stock	1,394,786	1,394,786	1,391,186	1,397,586	1,586,516	1,587,716	1,638,304

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

APPENDIX TABLE 12b. MANGANESE PHYSICAL ASSET ACCOUNT (METAL CONTENT, IN METRIC TONS)

	1988	1989	1990	1991	1992	1993	1994
Opening Stock	566,655	566,279	566,279	564,407	567,214	647,787	648,930
Extraction	1,221	1,592	7,960	2,176	7,270	637	-
Other Accumulation	845	1,592	6,088	4,983	87,843	1,780	67,856
Other Volume Changes							
Closing Stock	566,279	566,279	564,407	567,214	647,787	648,930	716,786

Sources: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB
Integrated Annual Report, Mineral Economic and Policy Division, MGB
Group Estimates

Note: *Refer to Tables 13 and 14 for the computation of the metal content of the stock of reserves and extraction.*

APPENDIX TABLE 13. SUMMARY OF PHILIPPINE METALLIC RESERVES IN ORE AND METAL FORM, BY COMMODITY, 1987-1994

TYPE OF MINERAL	POSITIVE RESERVE			PROBABLE RESERVE			TOTAL RESERVE	
	Ore Form (In MT)	Weighted Ave. Grade	Metal Content (In MT)	Ore Form (In MT)	Weighted Ave. Grade	Metal (In MT)	Ore Form (In MT)	Weighted Ave. Grade
PRIMARY GOLD		Gm Au/Mt			Gm Au/Mt			
1987	80,802,724	1.95	158	20,753,868	3.94	82	101,556,592	240
1988	83,020,975	2.08	173	23,911,215	4.01	96	106,932,190	269
1989	82,782,072	2.01	166	27,199,476	3.54	96	109,981,548	262
1990	93,494,827	1.64	153	31,095,043	3.34	104	124,589,870	257
1991	106,455,521	1.66	177	39,512,946	2.59	102	145,968,467	279
1992	100,942,225	1.68	170	48,843,071	2.53	124	149,785,296	294
1993	117,284,763	1.84	216	63,547,600	2.56	163	180,832,363	379
1994	117,300,752	1.74	204	64,404,377	2.28	147	181,705,129	351
PRIMARY COPPER		% Cu			% Cu			
1987	3,422,377,935	0.45	15,400,701	458,876,999	0.41	1,881,396	3,881,254,934	17,282,097
1988	3,672,213,338	0.44	16,157,739	433,449,561	0.41	1,777,143	4,105,662,899	17,934,882
1989	3,691,080,957	0.44	16,240,756	451,000,461	0.41	1,849,102	4,142,081,418	18,089,858
1990	3,459,844,113	0.43	14,877,330	382,793,641	0.43	1,646,013	3,842,637,754	16,523,343
1991	3,506,457,285	0.46	16,129,704	358,524,905	0.45	1,613,362	3,864,982,190	17,743,066
1992	3,591,540,875	0.43	15,443,626	368,003,440	0.45	1,656,015	3,959,544,315	17,099,641
1993	3,638,418,608	0.42	15,281,358	940,999,040	0.54	5,081,395	4,579,417,648	20,362,753
1994	3,505,159,074	0.42	14,721,668	1,092,221,044	0.5	5,461,105	4,597,380,118	20,182,773
REFRACTORY CHROMITE		% Cr203			% Cr203			
1987	5,160,352	31.03	1,601,257	6,723,188	33.28	2,237,477	11,883,540	3,838,734
1988	4,168,087	31.25	1,302,527	5,457,441	33.26	1,815,145	9,625,528	3,117,672
1989	4,633,238	30.08	1,393,678	6,518,602	27.33	1,781,534	11,151,840	3,175,212
1990	5,270,710	29.86	1,573,834	4,528,103	30.61	1,386,052	9,798,813	2,959,886
1991	4,189,496	31.13	1,304,190	4,052,951	33.13	1,342,743	8,242,447	2,646,933
1992	4,403,283	30.2	1,329,791	4,072,951	33.14	1,349,776	8,476,234	2,679,567
1993	4,874,269	30.92	1,507,124	1,543,320	31.44	485,220	6,417,589	1,992,344
1994	5,446,311	31.03	1,689,990	1,457,060	31.8	463,345	6,903,371	2,153,335
METALLURGICAL CHROMITE		% Cr203			% Cr203			
1987	10,408,496	32.73	3,406,701	4,731,522	28.09	1,329,085	15,140,018	4,735,786
1988	10,391,767	32.71	3,399,147	4,634,897	27.74	1,285,720	15,026,664	4,684,867
1989	10,442,581	32.84	3,429,344	4,702,306	28.07	1,319,937	15,144,887	4,749,281
1990	8,646,150	27.86	2,408,817	4,526,018	26.67	1,207,089	13,172,168	3,615,906
1991	11,797,688	31.99	3,774,080	5,753,964	30.26	1,741,150	17,551,652	5,515,230
1992	12,773,829	30.77	3,930,507	7,989,147	32.41	2,589,283	20,762,976	6,519,790
1993	11,278,276	29.52	3,329,347	8,427,127	33.53	2,825,616	19,705,403	6,154,963
1994	10,992,017	29.1	3,198,677	9,249,552	31.3	2,895,110	20,241,569	6,093,787
CHEMICAL CHROMITE		% Cr203			% Cr203			
1987	2,800,000	48	1,344,000				2,800,000	1,344,000
1988	2,800,000	48	1,344,000				2,800,000	1,344,000
1989	2,885,000	47.12	1,359,412	204,000	15	30,600	3,089,000	1,390,012
1990	2,800,000	48	1,344,000				2,800,000	1,344,000
1991	1,332,017	8.36	111,357	4,000	48	1,920	1,336,017	113,277
1992	1,322,635	8.36	110,572				1,322,635	110,572
1993	2,875,607	39.8	1,144,492				2,875,607	1,144,492
1994	2,875,607	39.8	1,144,492				2,875,607	1,144,492
NICKEL		% Ni			% Ni			
1987	1,481,354,059	1.13	16,739,301	84,746,798	1.3	1,101,708	1,566,100,857	17,841,009
1988	1,478,060,994	1.13	16,702,089	103,356,441	1.52	1,571,018	1,581,417,435	18,273,107
1989	1,480,153,559	1.13	16,725,735	92,956,302	1.41	1,310,684	1,573,109,861	18,036,419
1990	1,529,279,478	1.14	17,433,786	89,417,761	1.37	1,225,023	1,618,697,239	18,658,809
1991	1,147,604,873	1.31	15,033,624	9,868,789	2.29	225,995	1,157,473,662	15,259,619
1992	1,148,924,112	1.31	15,050,906	7,902,595	2.23	176,228	1,156,826,707	15,227,134
1993	1,061,394,588	1.3	13,798,130	7,589,495	2.22	168,487	1,068,984,083	13,966,617
1994	1,063,003,376	1.3	13,819,044	4,847,753	2.12	102,772	1,067,851,129	13,921,816
IRON		% Fe			% Fe			
1987	169,842,108	41.66	70,756,222	12,510,000	63.09	7,892,559	182,352,108	78,648,781
1988	169,842,108	41.66	70,756,222	12,510,000	63.09	7,892,559	182,352,108	78,648,781
1989	174,342,108	42.17	73,520,067	18,110,000	62.5	11,318,750	192,452,108	84,838,817
1990	174,340,308	42.17	73,519,308	18,110,000	62.5	11,318,750	192,450,308	84,838,058
1991	170,020,674	41.69	70,881,619	12,510,000	63.09	7,892,559	182,530,674	78,774,178
1992	370,839,764	45.19	167,582,489	110,252,810	31.98	35,258,849	481,092,574	202,841,338
1993	370,839,764	45.19	167,582,489	110,252,810	31.98	35,258,849	481,092,574	202,841,338
1994	151,915,097	43.81	66,554,004	12,510,000	63.09	7,892,559	164,425,097	74,446,563
MANGANESE		% Mn			% Mn			
1987	1,287,730	39.83	512,903	108,000	49.77	53,752	1,395,730	566,655
1988	1,286,786	39.83	512,527	108,000	49.77	53,752	1,394,786	566,279
1989	1,286,786	39.83	512,527	108,000	49.77	53,752	1,394,786	566,279
1990	1,286,186	39.82	512,159	105,000	49.76	52,248	1,391,186	564,407
1991	1,292,586	39.84	514,966	105,000	49.76	52,248	1,397,586	567,214
1992	1,225,871	38.96	477,599	360,645	47.19	170,188	1,586,516	647,787
1993	1,225,771	39.03	478,418	361,945	47.11	170,512	1,587,716	648,930
1994	1,249,675	42.16	526,863	388,629	48.87	189,923	1,638,304	716,786

Source: Philippine Metallic Mineral Reserves, Mine Technology Division, MGB.

Note: *Metal Content of Total Reserve = (Positive reserve * weighted average grade) + (Probable reserve * weighted average grade).*

APPENDIX TABLE 14. VOLUME OF EXTRACTION IN ORE AND METAL FORM, BY COMMODITY

TYPE OF MINERAL	EXTRACTION		
	Ore Form (In Metric Tons)	Weighted Ave. Grade	Metal Content (In Metric Tons)
PRIMARY GOLD		Gm Au/Mt	
1988	5,355,906	1.1	6
1989	5,581,765	1.07	6
1990	3,189,152	0.94	3
1991	3,380,589	0.9	3
1992	3,865,449	0.57	2
1993	2,871,598	2.93	8
1994	3,443,929	2.27	8
PRIMARY COPPER		% Cu	
1988	66,129,925	0.42	277,746
1989	65,736,617	0.39	256,373
1990	57,598,691	0.4	230,395
1991	47,078,346	0.39	183,606
1992	42,091,493	0.37	155,739
1993	36,482,635	0.41	149,579
1994	30,444,179	0.43	130,910
REFRACTORY		% Cr203	
1988	209,217	18.91	39,563
1989	342,733	20.15	69,061
1990	304,101	20.41	62,067
1991	271,947	20.57	55,939
1992	156,259	20.44	31,939
1993	106,953	27.09	28,974
1994	141,461	26.96	38,138
METALLURGICAL		% Cr203	
1988	67,800	9.6	6,509
1989	136,296	11.56	15,756
1990	193,484	11.93	23,083
1991	108,000	13.67	14,764
1992	51,219	16.89	8,651
1993	15,856	16.89	2,678
1994	13,575	16.89	2,293
CHEMICAL CHROMITE		% Cr203	
1988	82,704	10.7	8,849
1989	88,575	9.57	8,477
1990	110,995	8.88	9,856
1991	108,797	9.75	10,608
1992	68,550	8.79	6,026
1993	11,079	8.79	974
1994	-		-
NICKEL		% Ni	
1988	444,600	2.4	10,670
1989	658,400	2.4	15,802
1990	608,100	2.4	14,594
1991	557,200	2.4	13,373
1992	593,900	2.4	14,254
1993	346,900	2.4	8,326
1994	431,000	2.4	10,344
MANGANESE		% Mn	
1988	2,365	51.62	1,221
1989	3,084	51.62	1,592
1990	15,421	51.62	7,960
1991	4,215	51.62	2,176
1992	14,084	51.62	7,270
1993	1,234	51.62	637
1994	-		-

Source : Consolidated Monthly Production Reports of Individual Mining Firms, Mineral Economic and Policy Division, MGB.

Note: *Extraction (metal content) = extraction (ore form) * weighted average grade*

APPENDIX TABLE 15. COMPUTED UNIT RESOURCE RENT AND UNIT USER COST BY COMMODITY, 1987-1994, (IN PESOS)

	LIFE INDEX	UNIT RESOURCE RENT (NPM, r = 15%)	UNIT USER COST (ESM, r = 5%)	UNIT USER COST (ESM, r = 10%)
GOLD				
1987	15	62,394,341	29,116,403	13,567,594
1988	20	63,855,824	11,804,804	4,451,322
1989	20	33,609,091	6,066,755	2,315,641
1990	39	19,258,664	1,708,264	264,893
1991	43	(43,811,217)	(2,141,428)	(274,252)
1992	39	(66,296,482)	(3,731,556)	(587,232)
1993	63	41,424,069	1,049,439	53,517
1994	53	86,639,445	6,291,348	515,928
COPPER				
1987	96	2,934	26.3546	0.2887
1988	62	3,768	332.3042	17.6608
1989	63	2,713	209.2952	10.6546
1990	67	2,354	160.2678	6.8674
1991	82	270	10.8946	0.2282
1992	94	(154)	0.0349	0.0004
1993	126	(142)	0.1413	0.0004
1994	151	806	0.7862	0.0007
CHROMITE				
1987	48	(238)	(19.8390)	(2.0650)
1988	81	(291)	(4.7404)	(0.1050)
1989	56	108	6.2860	0.4476
1990	42	164	22.3406	2.9741
1991	58	119	6.7813	0.4383
1992	111	(207)	(1.4234)	(0.0079)
1993	217	(7)	0.0003	0.0000
1994	194	629	0.0768	0.0000

Notes:

1. *To estimate the Unit Resource Rent (UR) using the Net Price Method (NPM):*

$$R_{CE/ASE} = NOS_{CE/ASE} \cdot r(FA_{CE/ASE})$$

$$R_{MGB} = (R_{CE/ASE} / \text{Gross Output}_{CE/ASE}) * \text{value of production}_{MGB}$$

$$\text{Unit Resource Rent (UR)} = R_{MGB} / \text{volume of production}_{MGB}$$

where: $R_{CE/ASE}$ = *Resource Rent, CE/ASE based*
R_{MGB} = *Resource Rent, MGB based*
$NOS_{CE/ASE}$ = *Net operating surplus, CE/ASE based*
$FA_{CE/ASE}$ = *Annualized value of fixed assets*
r = *Rate of return on money invested on fixed assets.*

2. *To estimate the Unit User Cost or Depletion Factor using the El Serafy (ESM) or User Cost Method (UCM):*

$$R\text{-}X = R_{CE/ASE} * \frac{1}{(1+r)^{n+1}}$$

$$R\text{-}X_{MGB} = (R\text{-}X_{CE/ASE} / \text{Gross Output}_{CE/ASE}) * \text{value of production}_{MGB}$$

$$\text{Unit User Cost (UUC)} = R\text{-}X_{MGB} / \text{volume of production}_{MGB}$$

where: $R\text{-}X$ = *Depletion factor*
R = *Net operating surplus*
X = *True income*
$(1+r)^{n+1}$ = *capital component*
r = *Discount rate*
n = *Life index, computed as total reserve over extraction.*

3. *The derived unit resource rent and the unit user cost were applied to the resource and depletion in the physical asset account in metal content to arrive at their monetary values using the NPM and ESM or UCM, respectively.*

APPENDIX TABLE 16a. 1992 COMBINED ORE RESERVES OF LARGE-SCALE MINES (LSMs) AND SMALL-SCALE MINESs (SSMs), IN METRIC TONS

	LARGE-SCALE	SMALL-SCALE	TOTAL
Opening Stock	145,968,467	83,003,691	228,972,158
Extraction	3,865,449	1,158,691 *	5,024,140
Other Accumulation	7,682,278	-	7,682,278
Other Volume Changes			
Closing Stock	149,785,296	81,845,000 **	231,630,296

APPENDIX TABLE 16b. METAL CONTENT OF THE 1992 COMBINED ORE RESERVES OF LARGE-SCALE MINES (LSMs) AND SMALL-SCALE MINES (SSMs), IN METRIC TONS

	LARGE-SCALE	SMALL-SCALE	TOTAL
Opening Stock	279	84	363
Extraction	2	8	10
Other Accumulation	17	(0)	17
Other Volume Changes			
Closing Stock	294	76	370

* *Based on the 1997 study of E. B. Santelices for ENRA-IEMSD, " Estimation of Production, Tons Mined and Tailings Generated by the Small-scale Mining Activity,1992."*

** *Based on the 1997 study of Dr. R. S. Javelosa for ENRA-IEMSD, "Estimation of the Geologic Mineral Reserves of the Small-scale Mines in the Philippines, 1992."*

Assumptions/Considerations:

1. *For the closing stock in ore form of small-scale mines, the indicated ore reserve was considered.*
2. *The opening stock of SSMs in ore form and its metal content were computed by adding the extraction and the closing stock in ore form and metal content, respectively.*
3. *The metal content of the closing stock and the extraction were computed, using the weighted average grade of the indicated ore reserves and the tons mined from the study of R.Javelosa and E. Santelices, respectively.*

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