An Overview of the Sierra Leone Minerals Sector

I FACTS IN BRIEF

- Sierra Leone's primary mineral resources are diamonds, rutile, bauxite, gold and small amounts of iron ore and limonite. The mineral sector in Sierra Leone is made up of three sub-sectors: a) large-scale production of non-precious minerals – rutile and bauxite; b) large scale production of precious minerals – diamonds; and c) artisanal and small-scale production of precious minerals – mainly diamonds, and to a much lesser extent, gold.

- The mining sector contributed around 20% of GDP and fiscal revenues equal to 8% of GDP until the closure of the bauxite and rutile operations in 1995. It continues to supply 90% of exports due to the thriving artisanal diamond component. Mining and quarrying employ about 14 percent of the total labour force.

- Export revenues reached more than $176 million in 2006, thereby returning, at least in nominal terms, to the previous peak achieved in 1991. With the prospect of new modern gold and diamond mines opening in the next 3-5 years, it is estimated that annual mineral export revenues could exceed $370 million.

The economy of Sierra Leone is based on agriculture and mining. The bulk of the population is engaged in subsistence farming. Plantation agriculture is significant only in certain parts of the country. Mining has been of vital importance to the country's export trade. In the late 1980s, budget figures showed annual revenue from mining of about US$98.5 million. The onset of civil war during the 1990s seriously disrupted the country's mining sector but, following the end of the war in 2002 and the re-establishment of law and order, there is now every hope that the mining sector will once again provide a vital cog in the economy and that many of the known but unexploited mineral deposits will be developed.

II GEOLOGICAL OVERVIEW

Most of the country is underlain by rocks of Precambrian age (Archaean and Proterozoic) with a coastal strip about 50 km in width comprising marine and estuarine sediments of Tertiary and Quaternary to recent age. The Precambrian (mainly Archaean) outcrops over about 75% of the country and typically comprises granite-greenstone terrain. It represents parts of ancient continental nuclei located on the edge of the West African Craton. Regional reconnaissance mapping indicates that the Archaean basement can be subdivided into infracrustal rocks (gneisses and granitoids); supracrustal rocks (containing greenstone belts); and basic and ultrabasic igneous intrusions. The infracrustal gneisses and granitoids were formed and reworked during two major orogenic

cycles, an older Leonean episode (~2,950-3,200 Ma) and a younger Liberian episode (~2700 Ma).

The Leonean orogenic episode commenced with the intrusion of a basic igneous suite (the Pre-Leonean amphibolites) and by the formation of a greenstone belt represented by the Loko Group which is now deeply eroded. The Loko Group comprises amphibolites, silimanite quartzites and ironstones. It appears to have formed on a gneiss/granitoid basement in which several granitoid bodies related to an earlier plutonicorogenic episode have been distinguished mainly in the northern part of the country. Only the main deformational phase of the Leonean orogenic episode which resulted in folds and fabrics trending east-west has been distinguished. Minor gold and cassiterite mineralization associated with portions of the Loko Group is probably related to a late Leonean granitisation event which accompanied the formation of major shear zones in the craton.

Other volcano-sedimentary sequences are preserved within the granites, gneisses and migmatites. Highly folded greenstone belts predominate in the north and central Sierra Leone. In the southeast, the metamorphic facies increases, first with the Kambui Schists and finally with the Mano-Moa Granulites. Greenstone belts of the Kambui Supergroup are believed to have been deposited upon a post-Leonean basement and accompanies by basic to ultrabasic intrusives. The Kambui Supergroup includes most of the schist belts exposed in the Sula Mountains and the Kangari, Kambui, Nimini and Gori Hills; the Marampa Group; and the two small greenstone belts of Serekolia and Sankarama in the northeast. These greenstone belts comprise a lower volcanic unit composed of ultrabasic lavas and basic lavas with pillow layers, overlain by a sedimentary unit comprising tuffs, pelitic and psammitic sediments, with conglomerate layers and ironstone bands. The greenstone belts are the principal hosts of the gold mineralisation of the country.

Other associated mineral deposits include molybdenite, columbite-tantalite and chromite. The Marampa Group, bounded on its eastern margin by a tectonic contact, is important for its iron-ore deposits and forms the upper part of the Kambui Group. Late Liberian granitoids, marginal to, and within, the Kambui Supergroup, are associated with important zones of shearing and deformation where gold, sulphide and molybdenite mineralisation has been concentrated.

The Rokel-Kasila Zone bounds the main part of the West African Craton on its west and southwestern margin in Sierra Leone, and appears to form part of a north-south orogenic belt. Within this belt, the Marampa Group appears to represent some of the oldest rocks. The Kasila Group, also considered to be part of the Kambui Supergroup, comprises a high-grade series of granulites, consisting of garnet, hypersthene and hornblende gneisses, quartzites and associated migmatites. Where eroded, signi_ cant secondary deposition of

titanium minerals have formed from this unit. The Kasila Group also contains bauxite.

A late Precambrian to Cambrian sedimentary and volcanic assemblage, the Rokel River Group, was deposited unconformably on a basement complex. Deposition was probably in a fault-bounded basin of the intracratonic type along the line of the Rokel-Kasila Group following the formation of the tectonic zone at the end of the Liberian or during the Eburnean Orogeny. The Rokel River Group and the Kasila Group to the west were deformed during the Rokelide orogenic episode (~550 Ma). Deformation increased in intensity westwards.

The Saionya Scarp Group forms a small ingression into Sierra Leone in the northwest of the country, and is composed of horizontally-bedded arkoses, grits and shales with intruded dolerite sills. The group appears to belong to that part of the Gres Horizontaux of Guinea which has been classi_ ed as Ordovician, based on the discovery of the graptolites Monograptus riccartonensis and Monograptus priodon in shales near Telimele.
In Sierra Leone, the Saionya Scarp Group rests unconformably on The Rokel River Group.

Dolerite intrusions are common as dykes trending mainly east-west within the basement complex, and as extensive sills above the Rokel River Group. Kimberlite dykes and pipes follow a similar pattern in the east of the country and could also be present in the north and west.

The Freetown igneous complex forms an intrusive body on the coast, with arcuate outcrop concave towards the west. It is composed of a layered complex of gabbro, norite, troctolite and anorthosite. Platinum occurs in the gravels of many of the streams that cut the outcrops of anorthosite and anorthositic gabbro in the noritic gabbro complex of the Freetown Peninsula. The relation of this complex with the other units is obscured by the coastal veneer of Tertiary sediments of the Bullom Group which lies unconformably on the basement. Tertiary and more recent weathering has led to lateritisation across a large part of Sierra Leone, affecting mainly the greenstone belts and the extensive dolerite intrusions. The bauxite deposits formed within the Kasila Group are a result of this weathering process.

III THE CIVIL WAR YEARS AND AFTERMATH

Prior to the civil war, Sierra Leone had established an active mining sector built upon significant exports of diamonds, rutile and bauxite. Although relatively modest by global standards, the sector was significant in terms of the country's population and GDP. It underpinned much of the country's formal economic activity, contributing 20% of GDP, as much as 15% of fiscal revenues, and accounting for over 90% of exports. Mining and quarrying provided a

livelihood for over 250,000 people, and employed about 14% of the total direct and indirect labour force. Despite the sector operating at only a fraction of its potential, its contribution was significant enough to qualify Sierra Leone as a resource-rich country.

The Impact of Hostilities

Sierra Leone slipped off the investment radar for most major mining companies well before the outbreak of hostilities in 1991. The effective nationalization of the diamond industry and increasing political instability relegated the country to, at best, a speculative exploration target. Although the established rutile and bauxite operations continued to play an important economic role, large-scale exploration activities effectively came to a stand-still more than 20 years ago. As the sector's economic importance declined, so too did the capacity of key Government departments to regulate sector developments.

The onset of civil conflict heralded the collapse of the mining sector. Large-scale rutile and bauxite operations were abandoned in 1995 by which time the vast majority of the lucrative diamond trade had also switched to illegal channels. In 1999, only 9,300 carats of diamonds were officially exported, as compared to peaks of 2 million carats a year during the 1970s. The limited exploration activities that had taken place were abandoned altogether and much of the mine infrastructure was destroyed.

Recognising the need to establish an enabling environment for attracting new investment into mineral exploration and development, new mining policies were adopted in 1995 and 1998. The fact that these policies coincided with the forced closure of two foreign-owned mines meat, however, that their impacts were neglible. Without a return to peaceful times and greater political stability, credible international investors would not consider Sierra Leone as a potential exploration target.

The End of Hostilities

The end of hostilities marked the start of a strong economic recovery. Double-digit economic growth during 2001 and 2002 led to a significant period of economic expansion. Real GDP growth averaged nearly 8 per cent per annum for the period 2003 to 2006 and is forecast by the International Monetary Fund to continue at over 6 per cent per annum in the medium-term.

The mining sector has played an instrumental role in Sierra Leone's nascent economic recovery. In four of the last five years, the rate of growth recorded in the mining sector has exceeded that in the remainder of the economy. The resurgence of the mining sector has been two-fold. First, the Government – with external support – has had considerable success in increasing the proportion of diamonds mined that pass through official channels. Official exports have increased to 582,000 carats in 2006, with 84 per cent of this amount being mined by artisanal and small-scale miners. The U.S. dollar value

per carat has also increased significantly, suggesting that larger, more valuable diamonds are increasingly returning to official export channels.

Second, three mechanized mines have been reactivated. The country's first Kimberlite diamond mine has been operating since 2004 and is progressively expanding production. Also, both of the rutile and bauxite deposits that were developed before the war are once again being mined. The rutile mine is on-track to return to pre-war production levels this year, and plans are in place to expand operations further. The mine's owners have also acquired the rights to mine bauxite at Moyamba and successfully produced over 1 million tons in 2006.

In 2006, the estimated value of official mineral exports reached a record of US$176 million. This represented around 91 per cent of total export earnings. Faced with a large current account deficit, which creates reliance on foreign aid to fund Sierra Leone's import needs, the rapid increase in mineral exports has provided a much-needed injection of foreign exchange.

As a result of the many channels through which revenue streams flow from the mining sector to Government, it is difficult to accurately determine the sector's contribution to public revenues. It is clear though that it fell significantly as diamond smuggling increased and the formal mining sector collapsed. The World Bank estimates that having provided 8 per cent of Government revenues immediately prior to the civil war, the sector's fiscal contribution plummeted to only 1 per cent of total Government revenues by the end of the hostilities. Despite the strong rebound of the mining sector in recent years, its contribution to public revenues remains weak, in part reflecting significant continued avoidance of official export channels. It is estimated that the sector contributed around 29 billion Leones to public revenue in 2006, which is equivalent to around 3.1 per cent of total public revenues.

The resumption of rutile and bauxite mining has re-established the two mines as two of the largest private sector employers in Sierra Leone. Prior to their closure these mines employed over 3,000 workers. The vast majority of income-earning opportunities generated by the mining sector, however, are in artisanal diamond mining. The World Bank has estimated that up to 40,000 people are directly engaged in mining for diamonds and that the associated population of immediate family dependents could include 100,000 to 200,000 people. If those people that are indirectly dependent on artisanal diamond mining through forward and backward linkages are included, the World Bank estimate reaches 200,000 to 400,000 people dependent upon artisanal mining for the greater part of their livelihood. This represents between 4 percent and 8 percent of the population.

The Future

Notwithstanding its relatively small size, Sierra Leone is widely recognized as a highly prospective target for mining activities. The return to political stability in Sierra Leone coupled with positive global developments in the mining sector now offers the ideal opportunity to rejuvenate the domestic mining sector and to allow it to once again underpin the formal economy and support the Government's developmental objectives.

Key developments that have significantly improved the prospects of the Sierra Leonean mining sector include:

- The successful implementation of an IMF-supported economic reform programme, which has established a sound macroeconomic environment. Inflation has been kept under control, the exchange rate has stabilized, and access to foreign exchange has improved;
- The introduction of the certificate of origin scheme and implementation of the subsequent Kimberley Process, which has facilitated a rapid return of diamond exports to official channels. This has drawn the attention of the international community, which has increasingly shown its willingness to support wider sector reforms; and
- Strong global demand for minerals, underpinned by rapid growth in emerging economies such as China, which has fuelled an investment boom in the mining sector. Worldwide exploration budgets have quadrupled from US$1.9 billion in 2002 to an estimated US$7.5 billion in 2006, an increasing proportion of which is being spent in Africa. Of particular interest to Sierra Leone is the dominance of junior exploration companies in this revival, since they will be most likely to underpin the exploration investments needed to establish Sierra Leone's mineral potential, and the increasing appetite of major mining companies to make large investments in high-risk, emerging economies.

While the resurgence of the Sierra Leonean mining sector has been impressive, it has so far focused on the re-establishment of closed mines or exploitation of previously proven reserves. The greatest challenge in the immediate post-conflict situation has been to attract and retain foreign investment in the mining and minerals sector. This requires measures to create the enabling environment for such investment that succeeded in re-opening rutile, bauxite and kimberlite diamond mining as well as resumption of prospecting and exploration operations.

IV IN DETAIL: A HISTORY OF MINING ACTVITY IN SIERRA LEONE BY KEY MINERAL

Organised mining in Sierra Leone really only began after the promulgation of the Minerals Act in 1927. This Act was amended as the Revised Minerals Act in 1960, and was adhered to until 1994, when a more dynamic and investor-friendly Mines and Minerals Decree was passed, which later became the Mines and Minerals Act of 1996.

In the 1930s and 1940s some significant mineral discoveries were recorded by the Geological Survey of Sierra Leone, notably iron ore at Marampa, chromite near Hangha in the Kambui Hills and alluvial diamonds in Kono. These deposits were developed into medium- to moderate-sized mines by, respectively, Sierra Leone Development Co (Delco), Sierra Leone Chrome Mines and Sierra Leone Selection Trust (SLST). Delco exploited the Marampa iron ores from 1930 until 1976, mining lateritic material initially but subsequently mining specular haematite (65% Fe). Almost 90 km of railway were constructed with exports routed through the port of Pepel. Shortly before closure the operation was exporting close to 1.0 Mt/y of iron ore. The Hangha chromite deposits comprise a number of small impersistent lenses averaging 42% Cr_2O_3. They were worked for a time by open pit and were believed to continue at depth but underground mining was deemed uneconomic.

Diamonds

The Sierra Leone diamond fields cover an area of about 7,700 square miles (about one quarter of the country) in the south-eastern and eastern parts of Sierra Leone. The diamond producing areas are concentrated in Kono, Kenema and Bo Districts and are mainly situated in the drainage areas of the Sewa, Bafi, Woa, Mano and Moa Rivers. Alluvial diamond concentrations occur in river channel gravels, flood-plain gravels, terrace gravels, gravel residues in soils and swamps. In 1956, the Alluvial Diamond Mining Scheme (ADMS) was introduced in order to regulate the tremendous rush into diamond mining all over Kono District and part of Kenema and Bo Districts. The ADMS was essentially a scheme for artisanal and small-scale miners, and involved licensing mining plots to Sierra Leoneans and regulating the buying and selling of diamonds, as well as their export by the then sole exporter, Diamond Corp of West Africa (DICORWAF), a subsidiary of De Beers. The introduction of the ADMS gave rise to a proliferation of artisanal mining activity but large areas with a thick overburden cover still remain intact because they are too deeply buried for manual operations.

Sierra Leone is known for producing mostly gem quality diamonds including some spectacularly large stones of very high value. The largest ever discovered (Feb. 1972) was a 969.8 carat diamond code-named the “Star of Sierra Leone” (the third largest diamond ever found worldwide). Recently (1996), two stones weighing 188 and 283 carats and a 500 carat bort were recovered and sold.

SLST began mining diamonds in Kono in the 1930s, and by 1951 cumulative production had exceeded 11 Mct. SLST's annual production averaged 750,000 ct/y from the mid-1950s until the mid-1970s and was virtually all alluvial. Combined with ADMS output, Sierra Leone's total diamond output during this period was 1.0-2.0 Mct/y of good-quality diamonds. In 1970, the government acquired a 51% interest in SLST's assets through the newly formed National Diamond Mining Co. After 1975, exports declined to less than 0.3 Mct/y by the early 1980s, and official exports dwindled to less than 10,000 ct during the war years (1991-2002).

Kimberlites, the primary host rocks for diamonds, have been discovered in the Koidu and Tongo areas. Reserves are estimated at 6.3 million carats down to a depth of 600m at Koidu and 3.2 million carats to a depth of 600m at Tongo. Mining leases were granted to Rex Mining Company and Branch Energy at that time to exploit the known kimberlite deposits. Branch Energy has transferred their Mining lease at Koidu to Koidu Holdings S.A.

Current Mining and Exploration Activity

Kimberlite Mining

The prospect of large-scale mechanized kimberlite mines is now very real if an enabling investment environment can be put in place. Koido Holdings holds a Mining Lease covering an area of 1.54 square miles in the Tankoro Chiefdom, Kono District, to mine the Kimberlite Pipes and dykes, granted in 1995. At present, activities in the mine are focused on the mining of a vertical pit at No. 1 Pipe. Vertical pit mining is a relatively new mining technique, which has been used successfully in one Chrome Mine in Zimbabwe. By supporting the vertical side walls of the pit, a large open pit air shaft roughly the size of the ore body is being established. This method of mining is very costly but it reduces the volume of waste stripping as well as the impact on the environment and local community.

Koidu are currently producing 120,000 carats of diamonds per year from Kimberlite Pipe No. I. They have plans to increase production, and claim to have sufficient identified reserves to permit ongoing mining for at least another 15 years. Production from No. 2 Pipe was suspended in May 2005 pending revaluation of the economic viability of the ore body (although it is now understood to be investigating plans to mine a second pipe in late 2008.

An Exploration Lease was also granted to Koidu Holdings S.A. to carry out exploration activities over the Tongo kimberlite dykes. The company plans to inject US$25,000,000 in the Tongo Area to develop this into another producing mine.

Another Company, Olympus Development Company, is also exploring the Panguma kimberlite dykes, which are part of the Tongo kimberlite dyke system. The search for other kimberlitic source rocks continues because it is well known that not all alluvial diamond occurrences in the country could be linked to the known sources (Koidu and Tongo kimberlite groups) through alluvial dispersion. As a result of this, four (4) Regional Reconnaissance Exploration Licences have been granted to three Companies namely: Sierra Leone Diamond Corporation (SLDC), North West Diamond and Gold Company, Sierra Diamonds Limited to explore for these source rocks. Sierra Diamonds Ltd. Has since relinquished most of its regional concession in place of four (4) smaller areas which have been mapped out as anomalous for further investigation.

Annual exports of kimberlite diamonds since 2004 are as follows:

Year	Weight	Value
2004	78,458.29 cts	USD 13.86 million
2005	116,665.22 cts	USD 22.51 million
2006	112,040.02 cts	USD 23.45 million
2007 (to Aug)	128,653.37 cts	USD 23.96 million

Alluvial Diamonds

Artisanal and small-scale diamond mining activities are widespread in the Kono District as well as Kenema, Bo and Pujehun Districts. About 1,700 artisanal mining licenses are currently operating in these areas.

SLDC Exploration Limited is operating an industrial scale alluvial diamond mine in the Bandakoro and Bolima areas in the Sandor Chiefdom Kono District. The company has so far exported 22,540.17 carats of diamonds valued at USD 8,396,163.82. The company employs 529 permanent staff and 406 casual labourers.

Meanwhile, other players have identified further prospects. Mano River Resources and Petra Diamonds are working together to explore prospects within Kono District, and the former has entered into an agreement with BHP Billiton that could see the major Australian minor take a majority interest in an exclusive prospecting license in the country's south-east.

Within the past 3 years, there have been persistent reports of diamond occurrences and artisanal mining in North-Western Sierra Leone. The Geological Survey has now conducted short intensive reconnaissance surveys of the areas in question- the Kamaranka-Kamakwei and the Kambia zones. The former is underlain by basement granite and gneiss, and the latter by the Kasila gneisses, and basement granite.

Mineralogical Studies of heavy mineral samples have clearly indicated the presence of kimberlite indicator minerals, picro-ilmenite and pyrope garnets, g6 and g7 garnets. The latter two have been used in South America to uncover kimberlite dykes and pipes and this supports the original suspicion that the provenance of these diamonds have been formed from small numerous and thin kimberlite dykes which have been weathered to a lesser or greater extent. These diamonds are associated with gold, which has quite recently been recovered as a primary and secondary product.

Global production of diamonds reached 179 million carats in 2006, valued at over US$ 13 billion. Official diamond exports from Sierra Leone have begun to plateau. Total carats exported fell in 2005 and 2006, although the price realized per carat continues to rise.

The export figures for alluvial diamonds for the years 2000 to 2007 are as follows:

Year	**Weight**	**Value**
2000	50,281	10 million USD
2001	222,520	26 million USD
2002	351,859	41 million USD
2003	506,723	76 million USD
2004	613,299	113 million USD
2005	559,043	119 million USD
2006	491,526	102 million USD
2007 (to Aug)	**348,018**	**85 million USD**

Gold

Gold was discovered in several localities in the years from 1926, in the Sula Mountains and Kangari Hills, and in the Koinadugu, Tonkolili and Bo Districts.

All greenstone belts in Sierra Leone (with the possible exception of the Marampa Group and perhaps the Kambui Hills) are known to contain gold. Rivers and streams draining these areas also carry gold. Prospecting activities by the Geological Survey established the existence of gold in the following localities within the granite-greenstone terrain of Sierra Leone:

- The Sula Mountain area including Lake Sonfon, Maranda and Yirisen.
- The Kangari Hills area especially Baomahun, Makong and Makele.
- The Nimini Hills
- The Loko Group Schist belt in the Kamakwie-Laminaia area, northern Sierra Leone
- The Gori Hills.

The most important known lode gold deposits occur around the Lake Sonfon area, Kalmaro, Makong, Baomahun and Komahun.

The Lake Sonfon area contains steeply dipping quartz and pegmatite veins showing sulphide mineralization and with gold assay values of up to 0.67 oz/ton. Gossanous floats assaying up to about 3 oz/ton were also found. At Kalmaro, mineralized quartz veins and lenses intruding talc-chlorite-carbonate schists have been traced for about 800m strike length, assaying up to 0.8 oz/ton.

In the Makong area, quartz veins, veinlets and stringers, sometimes with megascopically visible gold, occur in the upper reaches of the Kwifwifwi stream. Further exploration in the Makong area revealed an extensive system of mineralized quartz veins in en-echelon arrangement.

At Baomahun, the gold mineralization is also associated with sulphides and follows the contact between magnetite rich garnet-cummingtonite schists and cordierite schists. The contact zone is about 100m wide and extends about 1.5 km. The Baomahun deposit was divided into three areas by the Geological Survey, namely Eastern, Central and Western with an estimated reserve of about 1 to 2 million ounces of gold.

At Komahun in the Nimini Hills greenstone belt, significant gold mineralization occurs over an area of about 400m * 100m. Drill core assay values of up to 1 oz/ton and averaging about 0.25 oz/ton over 20m were obtained.

Following the discovery of gold in Sierra Leone, several mining companies were involved in alluvial gold production. Some of the more prominent early starters include the Coastal Exploration Syndicate Ltd; Maroc Ltd; Balia Gold Mining Company; the Sierra Leone Development Company; Gold and Base Metals of Nigeria (which took over from the Pampana Mining Company); etc. There was continuous but low key gold mining from 1930 to 1956 with a total official production of 342,784 troy ounces. Gold mining more or less ceased in 1956 with the advent of the Alluvial Diamond Mining Scheme. It was later resumed, with production increasing steadily in response to favourable market forces, reaching a peak annual production (official) of 30000 ounces in 1984. The primary gold deposits in the country are still untapped.

<u>Current Gold Exploration and Mining Activity</u>

Globally, mineral exploration for gold has grown significantly in recent years, driven largely by the rapid acceleration in prices since 2004. The rapid emergence of a middle class in both China and India has led to significant increases in demand, while total gold output has remained largely unchanged since 2000. A recent characteristic of the gold market that could benefit Sierra Leone is the shifting pattern of global gold production away from the traditional producers. South Africa, Australia, the United States and Canada

have all seen significant falls in production over the last decade, while new gold producing countries like Ghana and Tanzania have rapidly risen in prominence.

In addition, a hallmark of the recent exploration boom has been new and increasing exploration in regions that have previously been perceived as being subject to high political risks. The ongoing struggle to replace reserves is making exploration in emerging economies the norm. Sierra Leone is ideally placed to benefit from these developments.

At present, the only gold production in Sierra Leone comes from alluvial deposits. It has been estimated that up to 50,000 ounces was mined annually prior to the civil conflict, but official exports today are less than one-tenth of that amount. Recorded exports for the year to end June 2007 were US$ 2.5 million. Artisanal and small-scale gold mining activities are predominant in the Tonkolili, Bombali, Koindugu and Kono Districts. The price of gold is now at an all-time high, in excess of $1,000 per ounce, which is added incentive for investors.

Notwithstanding the limited gold exports in recent years, Sierra Leone is thought to be well-endowed with gold deposits. Preliminary investigations in the 1960s identified very favourable geological conditions for the existence of hard-rock minerals. These are primarily typified by abundant greenstone strata, a condition which accounts for major gold mines in several countries. Exploration work has revealed considerable deposits of alluvial gold and lode gold and form excellent prospects for investors.

Exploration activity has resumed in recent years. Over 20 prospecting and exploration licenses have been issued for gold and one such license will soon submit proposals for a mining lease in Baomahun, Valunia Chiefdom, Bo District, Southern Region.

Cluff Gold and Mano River Resourcess both have active appraisal programmes. The former continues to define the Baomahun discovery. Recent results have already identified a mineral resource of over 1.1 million ounces of gold, and a scoping study confirmed that an open-pit mine could produce between 140,000 to 200,000 ounces annually. Mano River Resources has three gold exploration concessions, which coincide with the richest traditional areas of artisanal gold working in Sierra Leone. All three deposits are considered to have the potential to host gold deposits significantly larger than the known gold deposits at Baohamun and Komahun.

The Baomahun gold prospect in the southern Kangari Hills is currently under an Exploration Licence (EXPL) granted to Baomahun Gold Mines now Winston Mine Limited. Other Exploration Licences have also being granted to Golden Leo Resources and Golden Prospect to explore for lode gold. Amalgamated Minerals

and Mining Limited, holders of Exploration License No 2/06 in the Mabonto area, Kafe Simiria Chiefdom, have applied for a mining lease.

Bauxite

Bauxite serves mainly as a feedstock for aluminium production. The global market continues to grow with global production rising from 137 million tons in 2001 to 177 million tons in 2006. Sierra Leonean production makes up just under 1% of this volume. Vast reserves of bauxite are already proven, and as is the case for rutile, demand for bauxite in the medium-term will continue to be underpinned by robust economic growth in China and India.

The occurrence of bauxite in Sierra Leone was first recorded in 1920 and 1921 on the road from Falaba to Waia in northern Sierra Leone. Other bauxite occurrences include those between Moyamba and Mano (weathered dolerite sills of the Rokel River Group); the bauxite deposits of the Freetown Peninsular; the Krim-Kpaka deposits in Pujehun District, southern Sierra Leone; the Kamakwie and Makumre bauxite deposits in northern Sierra Leone. The most important bauxite finds were made by the Geological Survey in the Mokanji and Gbonge Hills in 1960 and by Sierra Ore and Metal Company (SIEROMCO) in Port Loko in 1972.

Sierra Leone bauxite ore was formed from weathering of the hypersthene/feldspar rich rocks of the Kasila Group under tropical conditions, which resulted in the loss of iron and silica leaving a high concentration of alumina. The Kasila Group is a high grade metamorphic belt trending NNW, and it forms the coastal rim to the West African Craton. Bauxite seems to occur all along the entire stretch of the belt from Moyamba in the south, through Port Loko to Kambia District in the northwest.

The Gbonge - Mokanji bauxite belt in the Moyamba District, southern Sierra Leone, was mined by SIEROMCO (wholly owned subsidiary of Alusuisse) from 1963 to 1995. The bauxite belt is about 55km wide and strikes NNW. A second bauxite deposit is located in the Port Loko area, Northern Province. The Port Loko deposit is the northern extension of the Mokanji bauxite belt, having the same NNW Kasila trend.

The Mokanji deposit is variable in quality; blending from various faces yields a shipping grade of 55 to 56 % alumina and 3 - 4 % silica. Sieromco was able to attain a maximum annual production of about 1.5 million tons. Transport over short distances to the port at Nitti, situated on one of the numerous outlets of the Sherbro River, is an added advantage.

The Port Loko bauxite deposit is of medium grade with about 48% alumina and approximately 3 to 3.5% silica. Feasibility studies carried out by SIEROMCO indicated a mineable deposit with reserves of over 100 million tons out of which 77.3 million tons of bauxite have been proved. The deposit is also easily

accessible - it lies between 60km to 90km from the capital and at an even shorter distance to the Port of Pepel. The old railway used by Marampa Mines runs right through the deposit, linking it to the Port. Up to 2 million tons per annum of iron concentrate was usually shipped from the Pepel Port. Other positive factors include the presence of a good road and the infrastructure constructed by the old Marampa Mines. **The Port Loko Bauxite lease is being allocated to Gondwana Investments S.A.**

Current bauxite exploration and mining activity

Bauxite production grew steadily from 150,000 t/y to an annual output of 1.5 Mt in the late 1980s. The production rate subsequently declined to about 800,000 t/y by the time of the mine's closure in January 1995 when RUF rebel forces overran the operations. Now, the **former bauxite mine owned by SIEROMCO has now been taken over by a new company, SIERRA MINERALS HOLDINGS**, a subsidiary of Titanium Resources Group (TRG). The company commenced mining operations in March 2006 and has reported production and export of bauxite up to June 2007 as follows:

Year and Month	**Bauxite production (mt.)**
2006	
February	88,831
March	104,180
April	106,810
May	199,824
June	83.997
July	114,627
August	103,894
September	101,756
October	101,756
November	106,162
December	58,222
TOTAL	*1,071,059*
2007	
January	95,886
February	83,393
March	96,612
April	114,157
May	129,754
June	103,581
TOTAL HALF YEAR	**623,343**

The company has a planned production of 1.0 million tones per annum for the next 10 years and currently employs up to 400 workers.

In addition to the successful resumption of production at the Gondama mine, there are a number of exploration prospects. The most heavily defined prospect is that at Port Loko, although other proposals have been put forward, included the integrated bauxite-alumina plant proposal in the Kambia District.

Rutile and Ilminite

Rutile is a high-grade titanium ore, which is processed into titanium dioxide overseas for use mainly in paint, paper and welding rods. Sierra Leone is known for its particularly high-grade rutile. Titanium has a wide range of applications and is the metal of choice for the rapidly-growing aviation industry. In the medium-term, demand for the metal is expected to continue to be driven by the Chinese commodity boom.

Rutile was discovered in Sierra Leone in 1954 in the gravels of the Lanti River south of the Gbangbama region in the Southern Province. Four groups of deposits are known to be distributed around the country: the Gbangbama Deposit, the Sembehun Deposit, the Rotifunk Deposit and the Kambia Deposit. Sierra Leone has the largest natural rutile reserves in the world and was accordingly the largest producer of natural rutile worldwide, accounting for a third of the total world production.

Substantial quantities of rutile in the form of coarse crystals occur in the gravels of the Little Scarcies River, around the confluence with the Mabole River in the Kambia District. Rutile also occurs as an accessory mineral in the high-grade gneisses of the Kasila Group. It was washed out during weathering and erosion of the rocks and shed in the flats at the foot of the surrounding hills and concentrated in the drainage system.

The Gbangbama group consists of at least six major deposits: Mogbwemo, Bamba-Belebu, Pujubu, Lanti, Gbeni and Gangama. Rutile was mined from the Mogbwemo deposit by Sherbro Minerals from 1967 to 1971. Technical problems led to the closure of the mine in 1971. Bethlehem Steel/Nord Resources took over in 1972 and registered as Sierra Rutile Limited (SRL). After a few years of exploration, production was resumed at Mogbwemo in 1979. The first three deposits of the Gbangbama group have now been almost completely mined out. Mining has also taken up about 30% of the Lanti deposit but the rest are in various stages of mine feasibility study and could be classified as mineable. At the end of 1994 the Gbangbama group had an estimated 150 million tons of rutile (grade: 1.5 to 2%) and also large reserves of ilmenite and zircon.

The Sembehun group is also made up of six deposits, namely: Kibi, Dodo, Benduma, Komende, Mokamatipa and Matehun. General exploration which started in 1990, revealed the presence of over 180 million tons of rutile with grades ranging from 1.2 to 1.6% rutile.

A German company (Bayer-Preussag) explored the Rotifunk deposits and outlined an inverted Y-shaped deposit 0.5 to 2km wide and 12km long close to Rotifunk Town approximately 60km distance ESE of Freetown and 30km from the coast. An Australian company, HAZECARE (PTY) applied for and was granted a Special Exclusive Prospecting Licence (SEPL) in 1990, and re-evaluated the deposits. The indicated resource estimate was 235 million tons at 0.62% rutile. The deposit essentially consists of a 6-7m thick horizon of sandy clay within the Bullom Group sediments. A laterite capping 3-5m thick forms the overburden.

The country's large rutile deposits located east of the Gbangbama Hills were first developed in 1967 by Sherbro Minerals, managed first by Pittsburg Plate Glass Co and then Bethlehem Steel Corp. The rutile operation had a difficult history during the early years but was on a sound footing from 1982 when Nord Resources Corp assumed total ownership through to Consolidated Rutile becoming joint owner in 1993 until the cessation of mining in 1995 for security reasons. The operating company, **Sierra Rutile Ltd, a subsidiary of Titanium Resources Group (TRG)**, was the world's largest producer of natural rutile, accounting for about one-quarter of global output and established itself as the largest international producer of rutile before its only rutile mine was shut down in 1995.

Current Rutile Exploration and Mining Activity

Sierra Rutile Ltd. began rehabilitation work in April 2005 and after a ten year gap due to the rebel war, began production and exporting of rutile in March 2006. The mine is again producing significant quantities of rutile and Sierra Leone has once again established itself as a major international exporter of the commodity. The operations currently involve one dredge but a second dredge is being installed and is expected to be commissioned soon. Rutile production is expected to increase from the present 110,000 metric tons to 220,000 metric tons per year from the year 2008, and to be sustained at this level for the next 10-13 years. The company is also looking into the possibility of introducing a third dredge to treat tailings from previous mining.

The company has also acquired the rights to mine the Rotifunk prospect, which has shown significant potential for rutile and ilmenite mining. At present, employment stands at 1,000 workers and this number is expected to increase as operations expand.

Details of rutile production in 2006 and 2007 are as follows:

Year and Month	**Production wt (mt.)**
2006	
March	3,112
April	5,517
May	7,222

June	7,430
July	8,711
August	7,718
September	8,722
October	6,900
November	9,124
December	9,347
TOTAL 2006	*73,803*
2007	
January	6,056
February	5,905
March	8,324
April	5,964
May	8,094
June	7,662
TOTAL 2007	*42,005*

The Rotifunk rutile deposit also contains about 2 million metric tons of ilmenite and 125,000 tons of Zircon and is now being explored by Gondwana Investments S.A. Another Company SL Minerals has been recently granted an Exclusive Prospecting Licence to prospect for the Mabole-Little Scarcies Rutile deposits around the Kambia Area.

Iron Ore

Iron ore was discovered in the Marampa area in 1926. In 1933, the Sierra Leone Development Company (DELCO) started iron production, continuing for over 40 years until it went into liquidation in 1975 due to worldwide economic recession. There are at least 40 million tons of tailings containing 27.7% Fe. The primary ore has an estimated tonnage of 92 million tons at 37.8% Fe. The Marampa iron ore deposits form part of a greenstone belt with massive beds of specularite schist interstratified with quartz-mica schists. The formation has been traced as far as Kukuna near the Guinea border and to the south at Toma and Makalawa.

The other deposits investigated include the Tonkolili and Bagla Hill deposits. The Tonkolili iron deposit occurs in the Archean Sula Mountains-Kangari Hills greenstone belt, close to the village of Farengbeya, in the Northern Province. The ores extend over an area approximately 24km in length and about 2.5km wide forming a series of beds striking at 045 degrees and with almost vertical dips. The iron occurs as residual or secondary ore caps resting on Precambrian banded iron formation. The caps are the result of tropical weathering and leaching of underlying quartz-magnetite rock and interbedded iron rich amphibolites. Estimates for the capping alone are about 120 million tons at 56.3% iron, and at least 600 million tons for the primary ore. The Tonkolili iron

ore is also associated with primary gold and sulphide deposits occurring in quartz veins, stringers and silicified zones within the Sula Mountains greenstone belt. Grades of up to 6 g/ton gold are not uncommon.

The Bagla iron ore deposit occurring in south eastern Sierra Leone is a metamorphosed banded magnetite silicate rock made up of alternating layers of magnetite and quartzite; forming part of the Mano-Moa Granulites. The three main sections of the ironstones trend northeast, parallel to foliation, and have a total outcrop area of about 1.7 million square metres. Preliminary evaluation work by Bethlehem Steel Mining Company gave an ore reserve estimate of 384 million tons of primary ore (magnetite) at 18.1% Fe and about 90 million tons of haematite ore at 34.3% iron. Initial beneficiation work revealed that the iron content could be upgraded to 52.3%. S.L. Minerals has being granted the lease to explore for the Bagla Hills Formation.

Other minor occurrences include the Krim Kpaka deposit in southern Sierra Leone with 9 million tons at 40% iron, and the Kukuna ore body in north western Sierra Leone with 15 million tons at 39% iron.

Current Iron Ore Exploration and Mining Activity

A mining lease was originally issued in 2005 to a locally based company, TECSBACO International Co. Ltd., which has since transferred the lease to London Mining Company (LMC) that will take over the Marampa Iron Ore Mining Project.

Negotiations with London Mining Company for a Mining Agreement to develop the Marampa Iron Ore Mining deposits are in progress, and Government is currently studying proposals submitted by the company including the use of the railway and port at Pepel. Government recently signed a Memorandum of Understanding with LMC regarding the rehabilitation of the Marampa Railway and Pepel Port and the use of the facilities by LMC and other potential users.

SLDC are also engaged in an intensive drilling programme within its exploration licenses covering the Tonkolili iron ore deposits and part of their Marampa deposit.

Other Minerals

PLATINUM

Alluvial platinum was discovered in the Big Water and Whale Rivers around York in the Freetown Peninsular in the late 1920s. It was found in almost all the streams draining the western part of the Freetown Complex between Freetown and York Village: at the Guma Valley stream; in small streams at the Ogu Farm area (between Baw-Baw and the Whale River estuary); etc. Its occurrence was also reported in eastward flowing streams eg. tributaries of the Orogu River

and the Benguema stream. Good quantities of platinum were found in association with ilmenite, magnetite, some chromite and specks of gold.

Platinum was mined in the Freetown Peninsular between 1929 and 1949. Most of the platinum was produced by panning and sluicing of gravels from the Big Water and Guma Water prospects and by 1949 about 5255 ounces were produced. Large nuggets of up to 14g were recovered from the slopes in the Big Water prospect. Examination of coarse platinum grains recovered from the Toke River and Ginger Water indicated proximity to the source rocks. The probable sources are pyroxene rich anorthositic and troctolitic gabbros of the Freetown layered basic Complex. The streams carrying the best values have their sources in, or cut across in their upper reaches, an intrusion of coarse grained anorthosite and anorthositic gabbro between Good Luck Hill and York Pass in the Peninsular. However no platiniferous rocks have been intersected by drill holes, thus presenting an interesting exploration target.

Exclusive Prospecting Licences have been granted to two companies investigating most of the western part of the Peninsular.

CHROMITE

Chromite was first discovered in Sierra Leone by the Geological Survey in 1929 when deposits were located at Jalahun, about 12 miles to the south of Blama, and in the Kambui Hills above N'gerihun, a village situated on the Kenema-Panguma motor road some 10 miles to the north-east of Kenema and 5 miles north-east of the Sierra Leone Government Railway at Hangha. Subsequently the Geological Survey located further deposits near the village of Tuba in the Perri Chiefdom, not far from where the Potoru-Zimi motor road crosses the Moa River, and on the eastern slopes of the Gori Hills to the north-east of Bandajuma. These deposits lie in almost a straight line, and scattered chromite in the form of boulders, pebbles and gravels have been found in other places located near this line and are probably all that now remain from the erosion of larger deposits.

Mining operations were confined to the deposits in the Kambui Hills above N'gerihun, partly because they are the most accessible and partly because they appear to be larger and richer in Cr_2O_3 content than the other deposits. The deposits are situated about half-way up the eastern slope of the Kambui Hills, about 500 ft. above the village of N'gerihun, and have been connected by road to the main road near that village. The whole of the output of the mine was transported by lorry to Hangha and thence by rail to Cline Town, near Freetown where the company had set up installations for stocking and shipping the ore. The distance from the mine to the port was approximately 180 miles. Trial shipments totalling 1226 tons of chromite were made during the years 1937 and 1938 to explore the markets in the United States and the United Kingdom. As these were received favourably, mining by opencast methods commenced in 1939 when

10585 tons chromite valued at $21 629 were won. To the end of 1949 the total production of chrome ore from these deposits had amounted to 136,018 tons, valued at approximately $550 000. The ore has a relatively low chromic oxide content which averages between 43 and 44 %. Cr_2O_3 but the iron-chrome ratio is favourable. Much of the ore is suitable for beneficiation, and preliminary experiments have shown that much of it can be improved to 50 %. while still retaining the favourable iron-chrome ratio. It was proposed to construct a branch railway from Hangha to a point close under the hill, and there to install a mill to crush, wash and concentrate the lower grades of ore. The cleaned chromite will be loaded from the mill directly into the railway wagons. It was thought that the product from the mill will satisfy the requirements of the chemical trade. There are four main deposits in this area, and these differ from each other slightly in their content of chrome, iron or silica so that the mine was able to supply ore acceptable by the metallurgical, refractory or chemical industry.

The chromite occurs in lenticular-shaped bodies of serpentine and talcose schist of the Kambui Schist Series. Anthophyllite-schist, tremolite-schist, actinolite-schist and chloritic schists occur the margins of these bodies, and biotite-schist has formed near their contact with the surrounding rocks. These are a much kaolinised granitic gneiss, mica-schists, and amphibolites and hornblende-schists. The schists overlie biotite-granite which is intrusive into them, and injection gneisses have been formed near the contact. The schist and the foliation of the granite strike to 30°east of magnetic north and dip steeply to the north-west. The deposits, and the direction of the hill range, are parallel to the strike of the schists. Occasional narrow dykes of dolerite intrude the granite. The chromite occurs massive, and as small crystals disseminated through the talc and serpentine and, to a lesser extent, the actinolite and tremolite-schists.

The massive chromite appears to be confined to the serpentine. In places the serpentine has been replaced by chalcedonic silica. Long-fibred anthophyllite asbestos is found, but it is too brittle to be of much value. Green encrustations of nickel silicate occur in some of the weathered serpentine and schists. No indication of the primary mineral from which it has been derived has yet been seen. The amphibolites and hornblende-schists outcrop on the higher slopes of the hill and are probably metamorphosed lavas of basaltic type. They have weathered to a brown clay-like material that has left the hillside in an unstable condition. Some of the early workings were overwhelmed in a landslide of this material. The cuts have disclosed evidence of a series of earlier landslides. At least two old hill surfaces with their characteristic covering of laterite gravel are plainly visible in the rubble of irregularly arranged blocks of amphibolites in brown limonitic clay. The junction between the landslide material and the underlying serpentine and schists is slickened, and boulders of serpentine and chromite have been sheared from their outcrops and carried forward beneath the amphibolites. A few loose blocks of chromite have been discovered beneath rubble above deposits now being mined, and this suggests that other bodies of serpentine with chromite in them may be found further into the side of the hill.

The deposits are being prospected by diamond drill and ore has been proved to a depth of at least 200 ft. By this means also some bodies of chromite that do not outcrop have been located. The mining of these deposits by opencast is approaching a stage when it ceases to be economical, and a commencement is being made to mine by underground methods.

CASSITERITE

The presence of cassiterite was noted several years ago in the Yeedundu stream in the Nimini Hills, Kono District. Prospecting by the Geological Survey revealed the presence of small quantities in other streams in the same general area. The cassiterite observed in the Yeedundu and Yeegbeh Streams occurs in the form of waterworn grains of up to 0.6cm length and grades of up to 150g per cubic metre were recorded.

A heavy mineral drainage survey and detailed loaming programme indicated a wide distribution of eluvial cassiterite in the Kangi Hills area around Kalangba in the Northern Province. The source of the cassiterite was traced to pegmatite veins intruding amphibolites. A maximum grade of about 65g per cubic metre was recorded for the eluvial cassiterite whilst three pegmatite floats gave the following assay results: 0.74%, 0.45% and 0.42% Sn.

Pitting and banka drilling were also carried out by the Geological Survey in 1985/86 on the eluvial and alluvial deposits associated with the Kangi Hills especially within the drainage basin of the Kanya stream.

Other cassiterite occurrences in Sierra Leone include the Sende River near Dalakuru; the Pampana River near Masanga; the Gberi Hills area (295g per cubic metre) and the Mongo River north of Musaia.

ILMENITE

Ilmenite occurs abundantly in beach sands in the Sulima Area (Pujehun District) and in different localities along the Freetown Peninsular. It occurs in association with rutile in the Kasila Group rocks. It was produced as a by-product of rutile mining operations at Mogbwemo, Lanti etc. by Sierra Rutile Ltd. Abundant granular ilmenite accompanies rutile in the gravels of the Little Scarcies River.

Within the Freetown Peninsular, near Hastings and Waterloo ilmenite occurs in the form of persistent pseudo-stratified deposits in the lower part of the Complex. Other areas with abundant ilmenite in beach sands include the Whale River, York, Toke River, Orugu River and Big Water near York Pass.

In the Sulima Area, the beach sands are light brown and are still being deposited along the coastal areas. Concentrations of black sands containing essentially ilmenite occur both in the beach sands and raised beaches.

LIGNITE

Lignite deposits occur in the Koya Chiefdom in an area south of the Rokel River estuary about 35km east of Freetown. The largest deposit found so far, proved by drilling done by the Geological Survey, occurs in an area around the Konta Creek near the village of Matam. Four separate deposits have been proved in the area each covering approximately 0.6 square km. They are separated by areas devoid of lignite. Outcrops of lignite also occur on creeks north and south of Matam. In the Koya area, 2 million tons have been proved whilst another 20 million tons have been estimated as probable reserves.

The lignite occurs interbedded with sands and clays of the Bullom Group, a series of poorly consolidated near horizontal Quaternary sediments (see geological map). The average thickness of the lignite seams is about 1.25m and they occur underneath an average overburden thickness of 15m giving a strip ratio of 12:1. Some of the lignite seams occur below sea level. The lignite has been used locally as a fuel for firing bricks at the Clay Factory in the eastern part of Freetown.

CLAY

Sierra Leone has two major types of clays:

Transported clays of the Bullom Group Kaolinitic clays occurring as in-situ alteration products of chemical weathering under tropical conditions.

The Bullom Group forms an approximately 50km wide coastal strip from Guinea, through Sierra Leone, to Liberia. Clays occur everywhere within the coastal sediments. In the Songo- Royema area, the clays are interbedded with lignite.
The clays could be used for the manufacture of bricks and the reserves are inexhaustible. A brick manufacturing company set up at Kissy, eastern Freetown, started production in 1979 at a monthly rate of 480000 bricks. The bricks so produced, were used in the construction of the Kissy Low Cost Housing Estate. Lignite, removed as part of the clay mining operations was used to fire the clay.

Given the existing infrastructure at the Clay Factory coupled with the inexhaustible reserves available, it is hoped that the manufacturing industry could be easily revitalised in the not too distant future.

DIMENSION STONE

Sierra Leone has a lot of crystalline igneous and metamorphic rocks that could be used in the stone cutting and polishing industry. The gabbroic Freetown Igneous Complex for instance has several areas where the depth of weathering and fracture pattern are considered positive for the industry. The lithologies of the Freetown Complex are almost identical to those of the Bushveld Complex in South Africa which has a well established dimension stone industry at Rustenburg. One Company, Olympus Ventures (PTY) Ltd. of South Africa, was awarded a mining lease on the western part of the Peninsular. This company has pulled out of this area and has passed over the Mining Lease to CPA Resources Ltd. Which unfortunately could not develop the deposit due to encroachment of the concession by local inhabitants. The company has however applied for an Exploration Licence to explore the potential of the Kasewe hills for the suitability of the andesitic lavas for their development into dimension stone. Other Companies are also in the process of applying for EPLs.

The high grade gneisses and amphibolites of the Kasila Group; the whitish, greyish and pink granites of the granitic terrain; and different varieties of schists; are all potentially useful in the dimension stone industry.

Furthermore, the Kasila Group is very similar petrologically and structurally to the Limpopo high metamorphic grade mobile belt of Southern Africa. A lot of opportunities therefore exist for stone cutting and polishing in Sierra Leone.

NEPHELINE SYENITE

Grade "A" nepheline syenites occur in the Bagbe Alkaline Complex in southeastern Sierra Leone just west of the Bagla Hill. Mapping disclosed that there are two lenticular bodies of syenite and nepheline syenite. Further prospecting work showed that about 30 000 tons per foot of rock of shipping grade could be quarried above water level, and that below that level, the tonnage available per foot of depth would be about 40 000 tons.

Samples analyzed compare very favourably with Canadian Grade "A" syenite including the critical residual iron content after magnetic separation. However more exploration is required for overall reserve determination.

COLUMBITE-TANTALITE AND ILMENORUTILE

The niobium bearing minerals columbite, columbite-tantalite (col-tan) and ilmenorutile, occur in alluvial deposits in Sierra Leone. They appear to have been derived from pegmatite veins located within the granites, close to the granite-greenstone belt contact. The alluvial deposits are especially associated with the Sula Mountain-Kangari Hills schist belt. Columbite-tantalite has been nicknamed “coltan” and has been of immense importance in eastern DR Congo.

Coltan is essential in the manufacture of electrical components known as pinhead capacitors. They regulate voltage and store energy in mobile phones. At the end of 2000 coltan ranged in price from US$200 to US$380 per pound up from just US$40 per pound when the sale of mobile phones became explosive.

Good concentrations of ilmenorutile have been found in gravels of streams draining the eastern part of the Sula Mountains schist belt. Grades of at least 5kg/M^3 have been found in the Madondoneh and Dayikoro streams (tributaries of the Tonkolili River) and in the Mawuru River and associated tributaries. Rich accumulations have also been reported in the Tonkolili River and Waka stream (tributary of Pampana River).

Heavy mineral concentrates collected during gold panning operations from the River Sende near Dalakuru, the Bei stream near Kunya, and from the Tonkolili River near Sakasakala, were found to consist essentially of coarse grains of columbite- tantalite.

Columbite has been found in eluvial and alluvial deposits on the western side of the Sula Mountains schist belt. In 1951 it was found scattered along the track from Bumbuna to Kegbema, northern Sierra Leone. Columbite was produced by the Mineral Research Syndicate in 1954 and 1955 from alluvial deposits in the Valunia Chiefdom, Bo District. In July 1954, 4.25 tons of crude columbite were shipped. Analysis of columbite grains from some localities proved the presence of from 0.75 to 1.42 % WO_3.

One Company, Time Minerals Research Company Ltd., has obtained an EPL to prospect for ilmenorutile and associated minerals in the Mawuru River, northern Sierra Leone. Analytical work carried out on two fragments(B1 & B2) of columbite recovered from the Bumbuna area (northern Sierra Leone) gave the following chemical composition:

	B1	B2
FeO	12.49%	11.74%
MnO	8.06%	9.80%
TiO_2	2.16%	5.20%
WO_3	1.18%	1.71%
Ta_2O_5	7.70%	8.98%
Nb_20_5	68.17%	61.63%
Total	**99.76%**	**99.06%**

ASBESTOS

Asbestos occurs in serpentinites which are metamorphic alteration products of ultramafic rocks. These rocks occur in all the greenstone belts of Sierra Leone. Asbestos occurrence has been reported in various localities in the country.

In the Sankarama greenstone belt in northeastern Sierra Leone (close to the Guinea border) chrysotile, a serpentine group mineral, occurs as short lenticular seams and veinlets in serpentinite. Other localities include the Batpoka stream between Mondemabe and Lablama; at Baula 5km NNE of Sumbuya; etc. Anthophyllite asbestos is rather abundant in the Mamansu area where it occurs regularly within a strip about 7km in length and about 1km to 2km in width.

APPENDIX

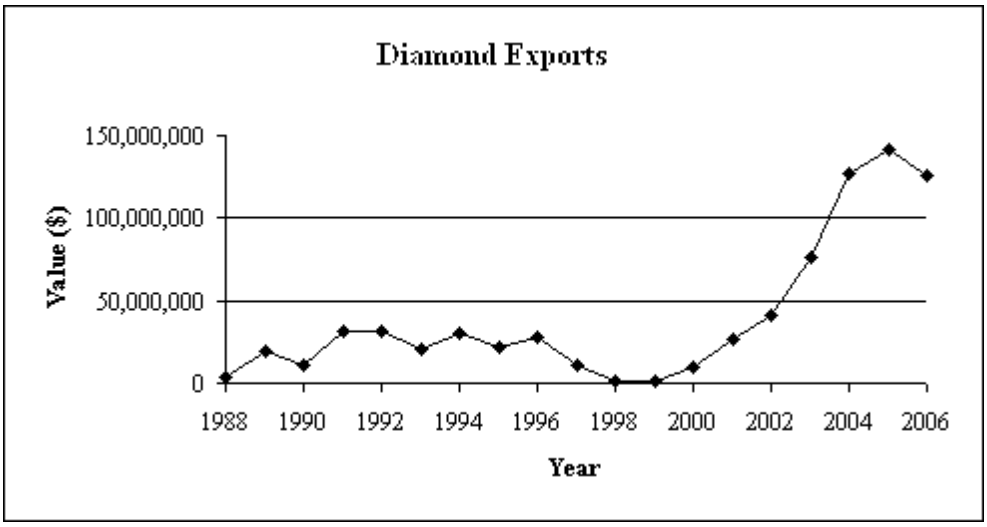
OFFICIAL ANNUAL MINERAL PRODUCTION

	Diamonds (carats) x1000	Gold (oz) x1000	Bauxite (m/t) x1000	Rutile (m/t) x1000	Ilmenite (m/t) x1000	Iron ore (m/t) x1000
1929-64	26,210.4	342.9	170.3	-	-	32,934
1965	1,464.15	-	207.26	-	-	2,144
1966	1,436.7	-	275.16	-	-	2,305
1967	1,419.91	-	341.63	25.14	-	2098
1968	1,519.53	-	421.38	13.9	-	2,557
1969	1,934.47	-	448.88	28.4	-	2,368
1970	2,047.07	-	448.93	44.1	-	2,285
1971	1,944.17	-	590.442	11.9	-	2,547
1972	1,799.35	-	690.82	-	-	2,545
1973	1,354.78	-	691.52	-	-	2,205
1974	1,716.36	-	670.95	-	-	1,923
1975	1,377.19	-	716	-	-	1,361
1976	9,619.4		578.93	-	-	-
1977	10,679.5	-	803.12	-	-	-
1978	542.08	-	801.77	-	-	-
1979	855.16	0.306	592.59	7.6	-	-
1980-84	2,095.4	46.3	3,945.4	302.87	-	752.35
1985	348.7	19.0	1,104.2	93.269	-	-
1986	381.0	12.0	1,335.0	97.0	-	-
1987	302	12	1,279	115.15	-	50.5

1988	11	1.4	1,428	114	48	
1989	134	7.3	1,557	123	55	-
1990	77.8	1.035	1,429.5	140.8	56.4	-
1991	243	0.829	1,177	152	57.0	-
1992	347	2.981	1,365	148	63.9	-
1993	158	5.059	947	152	62.9	-
1994	255	3.950	735	137	47.4	-
1995	213	0.131	-	-	-	-
1996	270	0.523	33	6	-	-
1997	104	-	33	-	-	-
1998	16	-	-	-	-	-
1999	9	28.78	-	-	-	-
2000	77.4	0.13	-	-	-	-
2001	223	16.29	-	-	-	-
2002	351.9	1.06	-	-	-	-
2003	507	2.93	-	-	-	-
2004	691.8	5.57	-	-	-	-
2005	670	7.51	-	-	-	-
2006	660	2.642	1,071.163	74.0	13.82	-
2007	396.72	4.358	623.343	42.01	6.47	-

DIAMONDS EXPORT – 1988-2006

DIAMONDS		
YEAR	CARATS	VALUE (US$)
1988	11	4,140,000
1989	134	19,474,000
1990	77.8	10,523,000
1991	243	31,035,000
1992	347	31,487,000
1993	158	20,198,000
1994	255	30,196,000
1995	213	22,003,000
1996	270	27,650,000
1997	104	10,502,000
1998	16	1,780,000
1999	9	1,245,000
2000	77.4	10,067,000
2001	223	26,022,000
2002	351.9	41,732,130
2003	507	75,989,753
2004	691.8	126,652,634.26
2005	670	141,940,000.00
2006	660	125,304,842



OFFICIAL ANNUAL GOLD EXPORTS

Gold Exports - 1979-2006

Year	Value (Le)	Value ($)	Weight (ozs)
1979	68,000	226.67	300
1980	129,000	322.50	400
1981	1,790,000	447.50	4,000
1982	3,882,000	388.20	10,000
1983	1,574,000	787.00	2,000
1984	16,840,000	561.33	30,000
1985	27,763,000	1,461.21	19,000
1986	69,991,000	5,832.58	12,000
1987	124,983,000	10,415.25	12,000
1988	5,076,000	647.00	1,400
1989	144,546,000	2,227.00	7,300
1990	47,767,000	292.00	1,040
1991	51,402,000	232.00	830
1992	415,200,440	818.00	2,980
1993	932,049,860	1,622.00	5,060
1994	717,000,000	1,195.00	3,950
1995	31,200,000	39.00	131
1996	150,880,000	164.00	520
1997	-	-	-
1998	-	-	-
1999	11,350,043.6	5,748.27	29
2000	51,667	24.84	0.13
2001	7,032,651.70	3,411.57	16.29
2002	53,816,226.81	30,760.55	105.68
2003	131,776,830.76	53,683.08	292.35
2004	460,291,598.02	161,505.83	557.13
2005	790,435,740.00	263,478.58	751.23
2006	3,144,643,805.42	1,062,533.78	2,642.10