



# 2011 Minerals Yearbook

---

## SIERRA LEONE

---

# THE MINERAL INDUSTRY OF SIERRA LEONE

By Omayra Bermúdez-Lugo

The mining sector was a significant contributor to Sierra Leone's economy; it accounted for about 90% of export revenues, mainly from diamond exports, and 20% of the country's gross domestic product (GDP). Sierra Leone was the world's 10th ranked producer of diamond, by volume, in 2010 (the latest year for which Kimberley Process data were available) and the world's third ranked producer of rutile. Other commodities produced in the country included bauxite, cement, gold, iron ore, and titanium and zirconium mineral concentrates. Prospective minerals included petroleum and natural gas. Sierra Leone was a participant in the Extractive Industries Transparency Initiative and in the Kimberley Process Certification Scheme (Ministry of Mines and Mineral Resources of Sierra Leone, 2010b, p. 1; Gambogi, 2012; Kimberley Process Rough Diamond Statistics, 2012a, b).

The European Union was Sierra Leone's largest single trading partner; it accounted for about 80% of the country's total exports, of which the majority was agricultural and mineral products. The lack of adequate infrastructure remained a major obstacle to the development of the mining sector. Much of Sierra Leone's basic infrastructure was damaged or destroyed during the civil war, and the country's electrical grid did not have the necessary installed capacity to meet the country's electricity needs; as a result, the mining companies had to rely on their own generators for electricity. Power outages in the country took place 46 days per year, on average. Several projects were underway to increase electrical power generation as well as to refurbish the country's core road network (African Development Bank, 2011, p. 6–8, 14–15; Pushak and Foster, 2011, p. 16).

Sierra Leone's port sector was also undergoing reform. The Freetown Port (Queen Elizabeth II Quay) was the country's principal commercial port and the major logistics hub for trade. The Port of Sherbro handled bauxite and rutile exports, and Pepel Port handled exports of iron ore. Under the port sector reform plan, the Government sought to rebuild and modernize its port system by developing plans to upgrade operational efficiency and encourage private participation. In addition to infrastructure constraints, Sierra Leone's growing agricultural and mining sectors also exerted pressure on the country's water resources (Pushak and Foster, 2011, p. 7, 25).

## Government Policies and Programs

The legislative framework for the mining sector in Sierra Leone is contained in the Mines and Minerals Act of 2009. Under this law, all rights of ownership in and control of minerals in Sierra Leone are vested in the State. The Ministry of Mines and Mineral Resources was the Government agency responsible for the general administration and implementation of the law. The Sierra Leone Geological Survey was responsible for undertaking the geologic mapping of Sierra Leone in addition to reconnaissance and exploration operations, and the compilation,

publication, and dissemination of data and information concerning the geology and mineral resources of the country (Ministry of Mines and Mineral Resources of Sierra Leone, 2010a, p. 12–14).

Applications for mineral rights in Sierra Leone are to be submitted to the Mining Cadastre Office and be accompanied by a nonrefundable application fee. The types of licenses to be granted include a reconnaissance license, an exploration license, an artisanal mining license, a small-scale mining license, and a large-scale mining license. The maximum area to be granted to the holder of a reconnaissance license is not to exceed 10,000 square kilometers (km<sup>2</sup>) and is valid for a period not to exceed 1 year. Reconnaissance licenses can be renewed for a period not to exceed 1 year with no option for a further renewal. An exploration license area may not exceed 250 km<sup>2</sup> and is valid for an initial period not to exceed 4 years. The holder of an exploration license may apply to the Mining Cadastre Office for a first renewal of the license, but the renewal may not be for more than 125 km<sup>2</sup> of the original exploration license area. Exceptions concerning the area limit for a renewal may be granted if data gathered during the initial exploration phase strongly indicate the presence of widespread mineralization (Ministry of Mines and Mineral Resources of Sierra Leone, 2010a, p. 12, 21–31, 38–57).

Artisanal mining licenses may be granted to any citizen of Sierra Leone, to a cooperative society registered in Sierra Leone and made up of citizens of Sierra Leone exclusively, to a joint venture or partnership registered in Sierra Leone and made up of citizens of Sierra Leone exclusively, or to a corporation that has been incorporated or registered in Sierra Leone with 100% of its shares held by citizens of Sierra Leone. No artisanal mining license was to be granted to an applicant in an area designated for small-scale mining operations. An artisanal mining license is to be accompanied by a certified copy of the agreement between the applicant and the Chiefdom Mining Allocation Committee or the rightful occupiers or owners of the land over which the artisanal mining license is granted. The area covered under the license may not exceed one-half hectare, and the license, which is valid for a period of 1 year, may be renewed for up to three additional periods of not more than 1 year each (Ministry of Mines and Mineral Resources of Sierra Leone, 2010a, p. 58–57).

Small-scale mining licenses can be granted to any company incorporated or registered in Sierra Leone with at least 25% of the shares of the company held by citizens of Sierra Leone, or a cooperative society that is registered in Sierra Leone, and of which at least 25% of its members are citizens of Sierra Leone. A small-scale mining license area must be at least 1 hectare but not more than 100 hectares. The license is valid for a period not to exceed 3 years and may be renewed for additional 3-year periods (Ministry of Mines and Mineral Resources of Sierra Leone, 2010a, p. 63–70).

The period for which a large-scale mining license is granted is stated in the license and may not exceed 25 years or the estimated life of the ore body proposed to be mined, whichever is shorter. The holder of a large-scale mining license may apply to the Ministry of Mines for subsequent renewals of the license at any time, and a renewal may be for all or part of the large-scale mining license area, but renewal applications must be submitted not later than 1 year before the expiration of the license. The renewal is not to exceed 15 years for each renewal sought (Ministry of Mines and Mineral Resources of Sierra Leone, 2010a, p. 71–78).

A 15% royalty was to be paid to the Government for special stones, defined as those precious stones whose market value is above \$500,000; a 6.5% royalty for precious stones; a 5% royalty for precious metals whose market value is below \$500,000; and a 3% royalty for all other minerals (Ministry of Mines and Mineral Resources of Sierra Leone, 2010a, p. 102).

On July 25, the Government signed into law The Petroleum (Exploration and Production) Act (2011), which replaces the Petroleum (Exploration and Production) Act (2001). The law also establishes the Petroleum Directorate, which is tasked with monitoring all petroleum operations in the country, including assisting in the assessment of prospective investors in the sector, participating in the bidding process, assessing royalties and bonuses due to the Government, and ensuring the establishment of a central database for petroleum-related activities, among other tasks. The Sierra Leone National Petroleum Co. is responsible for the management on behalf of the Government of all commercial aspects of petroleum operations in the country. Under the new petroleum law, licenses are granted through a competitive bidding process. If, under the advice of the Petroleum Directorate, the terms and conditions set out by potential investors during the bidding process are considered not favorable to the state, a call for direct negotiations with other potential investors may be issued by the Government. The type of petroleum rights that could be acquired under this new law include a reconnaissance permit, a petroleum license, and a permit to build and operate pipelines. Petroleum licenses are granted only to an individual or company registered or incorporated under Sierra Leone's Companies Act (Act No. 5) of 2009 and are valid for a maximum period of 30 years. Petroleum licenses can be extended only once for a period of 10 years (Revenue Watch Institute, undated; Sierra Leone Government Printing Office, 2011, p. 9–15, 23–24, 31).

The Government was also in the process of drafting a Precious Minerals Trading Act, which would establish legislation concerning diamond cutting and polishing, diamond trading, and taxes on the export of diamond by artisanal miners. In addition to drafting new legislation for precious minerals, the Government was in the process of pursuing an agreement with other member states of the Mano River Union to harmonize diamond royalties and export taxes for diamond mined in Sierra Leone and was also considering the establishment of a National Minerals Agency to oversee governance of the mining sector (International Monetary Fund, 2011, p. 33–34).

The Government's program to restructure the country's basic infrastructure included plans to restore the generation, transmission, and distribution of electricity facilities. In this

regard, it signed a memorandum of understanding with a subsidiary of the California-based Joule Investments Group to add 350 megawatts of generation capacity to the Bumbuna hydroelectric powerplant at a cost of \$750 million. The plant was expected to quadruple the country's generation capacity by 2017. The electricity generated from this powerplant was to be integrated into a high-capacity transmission line that would interconnect Côte d'Ivoire to Guinea through Sierra Leone and Liberia. The project was to be developed by the West African Power Pool (WAPP) as part of a series of infrastructure programs in West Africa. The WAPP was established in 2006 by the Economic Community of West African States (ECOWAS) to address the issue of power supply deficiency within West Africa. WAPP's Côte d'Ivoire–Liberia–Sierra Leone–Guinea Redevelopment Sub-program would consist of the construction of a high-voltage transmission line that would run from the town of Man in Côte d'Ivoire to Linsan in Guinea and pass through Buchanan in Monrovia and Yekepa in Liberia and through Bumbuna in Sierra Leone, all of which will have associated high-voltage substations. The project, part of which would be funded by the European Union (EU) and the World Bank, was expected to be commissioned by 2014 (African Development Bank, 2011, p. 4–8; Pushak and Foster, 2011, p. 7; West African Power Pool, 2011, p. 8, 11).

Only 8.9% of the country's 11,555 kilometers (km) of road network was paved and, to a more or lesser extent, the entire network was in need of repair. The EU funded or made commitments to fund several projects to support the road sector, including the rehabilitation and maintenance of selected road networks, the refurbishment of selected sections of the Trans West African Highway, and the rehabilitation of 650 km of rural roads in four districts. The EU also provided technical support to assist the Sierra Leone Roads Authority. On December 20, the Government signed a contract with China Railway Seventh Group Co. Ltd. to rehabilitate the 11.26-km road from Regent to Koss Town at a cost of \$30 million. The road was expected to be completed by early 2014 (African Development Bank, 2011, p. 4–8; Reuters Africa, 2011; State House of the Republic of Sierra Leone, 2011; Delegation of the European Union to Sierra Leone, undated).

## Production

Output levels for most mineral commodities decreased during the year with the exception of bauxite production, which increased by 34% to about 1.5 million metric tons (Mt); cement production, which increased slightly (3%) to 310,890 metric tons (t); and zirconium concentrate, which increased by about 20% to 8,496 t. Gold production decreased by 39% to 164 kilograms (kg) from 270 kg in 2010; ilmenite production decreased by 12% to 15,946 t from 18,206 t; diamond production decreased by 18% to 357,161 carats from 437,516 carats; and rutile production decreased by less than 1% to 67,916 t from 68,198 t. Iron ore production was resumed during the year, nearly 30 years after the closure of the Marampa iron ore mine in 1985. Data on mineral production are in table 1.

## Structure of the Mineral Industry

Most of Sierra Leone's mining and mineral processing operations were privately owned. During the year in review, at least 13,891 people were directly employed in industrial mining operations. An estimated 150,000 to 200,000 artisanal miners were employed in the informal sector. Table 2 is a list of major mineral industry facilities.

### Mineral Trade

Based on revised statistics reported by the Kimberley Process Certification Scheme on January 3, 2012, a total of 437,050 carats of diamond worth \$105.7 million was exported from Sierra Leone in 2010 (the latest year for which Kimberley Process data were available); this indicated an increase of 8.9% compared with diamond exports in 2009 and an increase in value of 34%. Sierra Leone's total exports to the United States were valued at about \$26.6 million compared with about \$29 million in 2009; \$9.7 million of these exports were rough diamond. Imports from the United States were valued at about \$103 million in 2011 compared with \$61.1 million in 2010; these included \$8.1 million in excavating machinery, \$323,000 in iron and steel products, and \$256,000 in drilling and oilfield equipment (U.S. Census Bureau, 2012a, b).

### Commodity Review

#### Metals

**Bauxite and Alumina.**—Netherlands-based Vimetco N.V. integrated its bauxite mining assets in Sierra Leone with its subsidiary's (Alro S.A.) alumina and aluminum production assets in Romania. This created a vertically integrated operation, which would have bauxite mined in Sierra Leone shipped to the company's alumina refinery in Tulcea and then processed at its aluminum smelter in Slatina. The company's bauxite resources in Sierra Leone were reported to be about 31 Mt of bauxite. Vimetco produced about 1.5 Mt of bauxite in 2011 compared with 1.1 Mt in 2010. The company launched an exploration campaign on two additional bauxite exploration licenses in Sierra Leone, which were located in Kambia (Vimetco N.V., 2011; 2012, p. 19–20).

The Sierra Leone Exploration and Mining Company Ltd. (SLEMCO) continued with its plans to develop the Port Loko bauxite deposits, which are located in the country's Northern Province about 120 km northeast of the capital city of Freetown. Exploration and resource evaluation campaigns for these deposits had been conducted in the 1960s and 1970s and then again in the late 1990s. Jupiter Export-Import Company Ltd. was the last company to evaluate the deposits before they were acquired by SLEMCO. In 2010, SLEMCO hired Canadian company Watts, Griffis, and McQuat Ltd. to conduct a feasibility study so SLEMCO could reevaluate the deposits. The study yielded a bauxite ore body reserve estimate of about 300 Mt and reconfirmed the project's economic viability. In February 2011, SLEMCO carried out satellite imagery surveys of the Buya, the Koya, the Maforki, the Marampa, and the Yoni chiefdoms in the Port Loko district and of the Magbema chiefdom in the Kambia district. The company also conducted

the first of a series of public consultations and disclosure meetings to sensitize the communities that might be affected by the development of the Port Loko deposits. SLEMCO was a subsidiary of Varada Resources Sierra Leone Pte. Ltd. of Singapore (Awareness Times, 2011; Sierra Express Media, 2011; Sierra Leone Exploration and Mining Company Ltd., undated).

**Gold.**—London-based Cluff Gold plc announced an updated resource estimate for its Baomahun gold project, which is located about 180 km east of Freetown in Southern Province. The estimate set out a 46% increase in indicated resources, which totaled 25.6 Mt of ore at an average grade of 2.5 grams per metric ton (g/t) gold. Inferred mineral resources were estimated to be 9.6 Mt at an average grade of 2.8 g/t gold. A definitive feasibility study for Baomahun was expected to be completed by the first half of 2012, and the construction of the mine and related facilities was expected to begin by late 2012. Cluff expected the mine to be operational by 2014 and to produce about 4,200 kilograms per year (kg/yr) of gold. Baomahun would be an open pit mine with a conventional carbon-in-leach processing plant and would have an estimated mine life of 8 years (Cluff Gold plc, 2011; 2012, p. 14–15).

Axmin Inc. of Canada sold 100% of the shares of its subsidiary Nimini Holdings Ltd. to Polo Resources Ltd. for \$16.5 million. Nimini held 100% interest in the Komahun gold project, which is located within the Nimini Hill concession in east-central Sierra Leone. The company had obtained full ownership in early February by acquiring the minority shares in the project from Eldorado Gold Corp. and Flaxman Corp. NV. The Komahun project included exploration licenses for the Nimini Hills East, the Nimini Hills West, and the Matotoka prospects. A preliminary economic assessment conducted in 2009 had indicated that Komahun had the potential to be developed as an underground gold mine with a capacity to produce about 1,600 kg/yr (reported as 50,000 troy ounces per year). A new resource estimate for the project was expected to be completed by the first quarter of 2012 (Axmin Inc., 2011a, b; 2012, p. 5; Peregrine Media Group, 2011, p. 18–19).

**Iron Ore.**—Sierra Leone resumed iron ore production after nearly 30 years. Two mines opened during the year; the Tonkolili Mine, which achieved first production in November, and the Marampa Mine, which began operating in December. The Marampa Mine had been in operation from 1935 to 1975 and then again from 1982 to 1985 but was eventually closed owing to a decrease in the price of iron ore and increases in the mine's operating costs. During the period from 1935 to 1975, the mine was owned and operated by Sierra Leone Development Co. Ltd., and from 1982 to 1985, by Austromineral GmbH, which was a subsidiary of Voestalpine AG of Austria. Owing to Sierra Leone's civil war, the mine remained closed from 1985 to 2009. London Mining plc of the United Kingdom acquired the mining rights for the Marampa Mine in 2006, but a dispute between the company and London-based African Minerals Ltd. concerning an area surrounding London Mining's mining lease delayed the project. The dispute was finally settled in 2009, at which time London Mining launched the first phase of the redevelopment of the mine. The company had originally planned to commission a 1.5-million-metric-ton-per-year (Mt/yr) tailings operation, but in 2011, the company announced that it planned

to further expand production to 5 Mt/yr by 2013. Production of high-specification iron ore (66.2% Fe, 1.88% silica, and 1.02% alumina) began in December. Iron ore concentrate from the processing of Marampa Mine tailings was to be shipped to China and Europe in early 2012. A bankable feasibility study to increase production to 9 Mt/yr was expected to be completed by the third quarter of 2012 (London Mining plc, 2012, p. 10, 13, 22).

The Tonkolili Mine, which is located within the Sula Mountains Greenstone Belt near the village of Farengbeya about 190 km from Freetown, produced a total of 1.3 Mt of iron ore. African Minerals was seeking to partner with Shandong Iron and Steel Group Co. Ltd. of China to carry out the full development of the mine and to build a 200-km railway to transport the ore to Pepel Port. In August, the company signed an agreement under which Shandong was to invest \$1.5 billion in exchange for a 25% interest in the mine. The terms of the agreement included an offtake arrangement under which Shandong was to acquire 2 Mt/yr of iron ore during the first phase of mine development. Shandong planned to export the ore to its steel processing plant in China. An incremental 8 Mt was to be acquired by the company following the commissioning of phase two, and a total of 10 Mt during phase three. African Minerals had yet to determine the capital expenses, operating expenses, and schedule for phases II and III of the project. During the year, about 40,000 t of direct-shipping ore was exported to China. Tonkolili Mine was expected to reach annual production of 20 Mt by 2013, which would place the country among Sub-Saharan Africa's top five leading producers of iron ore. A resource estimate for Tonkolili was carried out in 2009, which yielded a total resource estimate of about 12.8 billion metric tons (Gt) of measured, indicated, and inferred resources, which included 126.6 Mt of direct-shipping hematite lump ore at an average grade of 59.1% iron, 11.5 Gt of magnetite at an average grade of 30.1% iron, and 1.1 Gt of saprolite at an average grade of 40% iron (Ministry of Mines and Mineral Resources of Sierra Leone, 2010b, p. 17–18; SRK Consulting (UK) Ltd., 2010, p. 11–13; Australia's Paydirt, 2011, African Minerals Ltd., 2011a–c; 2012, p. 5–6).

**Titanium and Zirconium, and Rare-Earth Elements.**—Sierra Rutile Ltd., formerly known as Titanium Resources Group Ltd. (name changed on February 24, 2011) operated the Sierra Rutile Mine. The company was the country's sole producer of ilmenite, rutile, and zirconium concentrates. During the year, Sierra Rutile produced a total of 67,916 t of rutile concentrate, 15,946 t of ilmenite concentrate, and 8,496 t of zirconium concentrate. Compared with 2009, ilmenite production decreased by about 12%, and rutile production by only 0.4%. The decrease in the production of these two commodities was mainly the result of moving one of the dredges to a different location within the mine, which resulted in operational downtime. Zirconium concentrate was produced as a byproduct of the mining of ilmenite and rutile (Titanium Resources Group, 2011; Sierra Rutile Ltd., 2012, p. 3, 8).

Sierra Rutile planned to invest \$52 million in two projects to expand its ilmenite and rutile production capacity by 2014. The first project was expected to produce an additional 30,000 to 35,000 t/yr of rutile and 6,000 to 9,000 t/yr of ilmenite from

the Lanti deposit for a period of 7 years starting in 2013. The second project was expected to produce an additional 20,000 to 25,000 t/yr of rutile and about 3,000 t/yr of ilmenite from the Mogbwemo tailings for a period of 6 years starting in 2013 and reaching full production in 2014. The company also planned to commission a feasibility study for the construction of a dredge that would initially mine the Gangama deposit. The company was also looking into the possibility of conducting onstream processing of zircon into a finished or semifinished product. The Sierra Rutile Mine is located in southwestern Sierra Leone near the Imperri Hills, about 30 km from the Atlantic Ocean and 135 km from the capital city of Freetown (Sierra Rutile Ltd., 2011c).

Studies conducted in March and August by SGS Lakefield Research Ltd., which included the drilling of 232 holes and analyses of 327 samples, confirmed the existence of rare-earth mineralization within the Sierra Rutile Mine operation. The rare-earth-bearing mineral present was monazite. An indicated resource of 33,000 t of high-tension tailings (HTTs) and magnetic tailings at an average grade of 1.44% rare-earth oxides was reported. The HTTs, which reportedly contained high concentrations of cerium (49.77%), lanthanum (22.31%), neodymium (17.76%), praseodymium (4.30%), and samarium (3.90%), would be obtained as a byproduct of the mining of ilmenite and rutile. The Sierra Rutile Mine generated about 1 t of HTTs for every 2 t of rutile produced (Sierra Rutile Ltd., 2011a, b).

### **Industrial Minerals**

**Diamond.**—Diamond production in Sierra Leone was mainly from alluvial mining, the majority of which came from the Bo, the Kenema, and the Kono districts along the drainages of the Bafi, the Mano, the Moya, the Sewa, and the Woyie Rivers. Diamond production, as reported by the Kimberley Process, decreased by 18% to 357,161 carats compared with 437,516 carats in 2010. During the year, diamond exports by volume decreased to 357,248 carats compared with 437,050 carats in 2010. During the same period, the value of Sierra Leone's diamond, in terms of dollars per carat, increased by 44% to \$348 per carat from \$242 per carat (Bank of Sierra Leone, 2012; Kimberley Process Rough Diamond Statistics, 2012a, b).

Koidu Holdings S.A. was in the process of developing the Koidu Kimberlite Project (KKP), which is located within the Tankoro Chiefdom in Kono District, about 360 km east of the capital city of Freetown. The project consisted of a cluster of primary diamond deposits, which included two kimberlite pipes (K1 and K2), a series of dykes, and four kimberlite blows. Koidu Holdings planned to invest \$150 million to initially mine the two kimberlite pipes as open pits for 5 years and then transition to underground mining for 12 years. Underground mining was also to be used for the development of the surrounding kimberlite dykes and blows. The company planned to commission a treatment plant by the first quarter of 2012 and to achieve first production of 35,000 carats by the second quarter of 2012. During the year, the Koidu project employed 983 people, 90% of which were reportedly Sierra Leonean

nationals. An additional 468 Sierra Leonean nationals were contracted during the year to work on the mine's expansion project. Koidu Holdings also held a mining license for the Tonguma Project, which is located in the Lower Bambara Chiefdom, Kenema District, about 68 km south of the KKP. The license for Tonguma covered an area of about 142 km<sup>2</sup> and contained several kimberlite dyke zones (International Mining, 2011; Koidu Holdings S.A., 2011a, b).

Stellar Diamonds plc through its subsidiary Sierra Leone Ltd. completed a 1,600-t bulk sampling program for Dyke 1. Dyke 1, which was 2.5 km long, was one of four kimberlite dykes located within the company's 33-km<sup>2</sup> Tongo exploration concession area in eastern Sierra Leone. The bulk sampling program for Dyke 1, which was completed in September, yielded 1,006 carats. The average grade of the sample was 101 carats per 100 t processed. Two diamond parcels totaling about 949 carats were exported to Antwerp for valuation. The parcel was valued at an average price of \$186 per carat. Stellar planned to conduct a drilling and bulk sampling program for Dyke 1 and Dyke 4 by the first quarter of 2012; the results would be used by the company to complete a diamond resource estimate for Tongo (Stellar Diamonds plc., 2012, p. 12–13).

Other companies exploring for diamond in Sierra Leone included Dove Diamonds & Mining Inc., which was a subsidiary of New York-based Dolat Ventures Inc.; Calone Mining Company (SL) Ltd., which was a subsidiary of Golden Valley Mines Ltd. of Canada; and Sierra Leone Hard Rock Ltd., which was a subsidiary of Guernsey-based Paragon Diamonds Ltd. Dove Diamonds mined diamond in an area along Sewa River known as the Baimbawai Pool, which is located within the Tinkonko Chiefdom of the Bo District of Southern Province. Calone Mining held exclusive exploration licenses for a 450-km<sup>2</sup> area located in the Sula Mountains about 30 km east of Makeni and for a 260-km<sup>2</sup> area located west of the Nimini Hills between the villages of Tungie and Sefadu, within the Chiefdoms of Nimiyama, Gorama Kono, and Nimikoro in the Kono District and the Chiefdom of Gorama Mende in the Kenema District. Sierra Leone Hard Rock held four mining exploration licenses covering a total area of 162 km<sup>2</sup> along the Bafi River.

### **Mineral Fuels**

**Petroleum.**—Sierra Leone did not produce or refine petroleum and was dependent upon imports for its petroleum requirements. The discovery in 2007 of the Jubilee oilfield offshore Ghana had, for the past several years triggered the interest of international petroleum companies in exploring along a new hydrocarbon province offshore West Africa, which is known as the West Africa transform margin (WATM). The WATM stretches 1,500 km between two tectonic plates along the coasts of eastern Ghana, Côte d'Ivoire, Liberia, and Sierra Leone. At least two companies, including African Petroleum Corp. Ltd. of Australia and Houston-based Anadarko Petroleum Corp., explored for petroleum along the Sierra Leone-Liberia basin within the WATM. Anadarko held a 55% participating interest in Block SL–07B–11 offshore Sierra Leone. In November, the company announced that it was in the process of mobilizing a drilling ship to Sierra Leone to top

set the Mercury-2 appraisal well on Block SL–07B–11, and then to move the drill ship to the Jupiter exploration prospect on the same block. African Petroleum held a 100% interest in Block SL–03, which is a 3,135-km<sup>2</sup> area offshore Sierra Leone located about 150 km from Anadarko's Block SL–07B–11. During the year, African Petroleum completed a 3-dimensional seismic survey that covered an area of about 2,500 km<sup>2</sup> within Block SL–03 and planned to complete the analysis of the collected data by the end of April 2012. The company also planned to drill a prospect within the block in 2013 (Anadarko Petroleum Corp., 2011; African Petroleum Corp. Ltd., 2012, p. 4).

A hydrocarbon assessment for an area of about 202,700 km<sup>2</sup> offshore Guinea, Liberia, and Sierra Leone was published by the U.S. Geological Survey in March 2011. This assessment estimated mean volumes of undiscovered hydrocarbon resources in this area to be 3.2 billion barrels of oil, 23,629 billion cubic feet of gas, and 721 million barrels (Mbbbl) of natural gas liquids. The estimated mean size of the largest oilfield expected to be discovered in this area was 783 Mbbbl of oil and the estimated mean size of the expected largest gasfield was 4,695 billion cubic feet of gas. The estimate, however, did not include economically recoverable reserves (Brownfield, 2011).

### **Outlook**

World Bank reports indicate that Sierra Leone has made progress in improving its investment climate since 2007 and that the country could leverage infrastructure investments to further improve its economy if it develops a clear national plan for infrastructure development and integrates it into the process of designing and negotiating mining concession contracts. The country has, among other things, reduced business registration time, cut registration costs by more than 50%, simplified business taxes, and offered better investor protection. Although the country's existing infrastructure appears to be inadequate to support mining activities, foreign direct investments in the minerals sector have not been deterred. The coming online of projects for bauxite, gold, iron ore, and titanium minerals are likely to boost the economy in the short run. The Tonkolili iron ore mine alone is expected to increase real GDP by 45% in 2012 and exports by a factor of four. Phase 2 of the Tonkolili project is expected to double the GDP once completed. Recent discoveries in the hydrocarbon sector indicate the likelihood of major oilfields being discovered offshore Sierra Leone but exploration was still at an early stage (International Monetary Fund, 2011, p. 7–8).

### **References Cited**

- African Development Bank, 2011, Infrastructure and growth in Sierra Leone: Tunis Belvédère, Tunisia, African Development Bank summary report, 17 p.
- African Minerals Ltd., 2011a, African Minerals Limited executes agreements with Shangdong Iron & Steel Group Co. Ltd. to invest \$1.5 billion in the Tonkolili project companies: London, United Kingdom, African Minerals Ltd. press release, August 1, 2 p.
- African Minerals Ltd., 2011b, Loading of first Tonkolili iron ore shipment commences: London, United Kingdom, African Minerals Ltd. press release, November 4, 2 p.
- African Minerals Ltd., 2011c, Update on Shangdong investment—Project commissioning and marketing: London, United Kingdom, African Minerals Ltd. press release, December 15, 2 p.

- African Minerals Ltd., 2012, 2011 preliminary results: London, United Kingdom, African Minerals Ltd., April 11, 14 p.
- African Petroleum Corp. Ltd., 2012, 2011 annual financial report for the period ended 31 December 2011: Perth, Western Australia, Australia, African Petroleum Corp. Ltd., 91 p.
- Anadarko Petroleum Corp., 2011, Anadarko announces successful pre-salt appraisal well offshore Brazil—Updates West Africa activity: Houston, Texas, Anadarko Petroleum Corp. press release, November 9, 2 p.
- Australia's Paydirt, 2011, African Minerals gets started: Australia's Paydirt, December 2011–January 2012, v. 1, no. 190, p. 105.
- Awareness Times, 2011, Short address at the public disclosure meeting of the Sierra Leone Exploration and Mining Company's bauxite project: Awareness Times, February 9. (Accessed May 17, 2012, at [http://news.sl/drwebsite/publish/article\\_200517281.shtml](http://news.sl/drwebsite/publish/article_200517281.shtml).)
- Axmin Inc., 2011a, Axmin closes its acquisition of the minority interest in its Komahun gold project—Sierra Leone: Toronto, Ontario, Canada, Axmin Inc. press release, February 15, 1 p.
- Axmin Inc., 2011b, Axmin spins off Sierra Leone assets into new public company: Toronto, Ontario, Canada, Axmin Inc. press release, March 1, 1 p.
- Axmin Inc., 2012, 2011 annual report: Toronto, Ontario, Canada, Axmin Inc., 48 p.
- Bank of Sierra Leone, 2012, 2011 mineral production—Statistical annex: Freetown, Sierra Leone, Bank of Sierra Leone, 1 p. (Accessed May 17, 2012, at [http://www.bsl.gov.sl/pdf/Statistics\\_June\\_2011/Diamond\\_Production.pdf](http://www.bsl.gov.sl/pdf/Statistics_June_2011/Diamond_Production.pdf).)
- Brownfield, M.E., 2011, Assessment of undiscovered oil and gas resources of the West African Coastal Province, West Africa: U.S. Geological Survey Fact Sheet 2011–3034, 2 p.
- Cluff Gold plc, 2011, Technical report on Baomahun filed on SEDAR: London, United Kingdom, Cluff Gold plc press release, October 21, 2 p.
- Cluff Gold plc, 2012, 2011 annual report and accounts: London, United Kingdom, Cluff Gold plc, 64 p.
- Delegation of the European Union to Sierra Leone, [undated], Roads and transportation: Freetown, Sierra Leone, Delegation of the European Union to Sierra Leone. (Accessed June 20, 2012, at [http://eeas.europa.eu/delegations/sierra\\_leone/eu\\_sierra\\_leone/tech\\_financial\\_cooperation/infrastructure/index\\_en.htm](http://eeas.europa.eu/delegations/sierra_leone/eu_sierra_leone/tech_financial_cooperation/infrastructure/index_en.htm).)
- Gambogi, Joseph, 2012, Titanium mineral concentrates: U.S. Geological Survey Mineral Commodity Summaries 2012, p. 174–175.
- International Mining, 2011, Expanding Koidu diamond output: International Mining, v. 7, no. 9, September, p. 4–6.
- International Monetary Fund, 2011, Second and third reviews under the three-year arrangement under the extended credit facility, request for waivers of nonobservance of performance criteria, request for modification of performance criteria, and financing assurances review: Washington, DC, International Monetary Fund country report, no. 11/361, December, 47 p.
- Kimberley Process Rough Diamond Statistics, 2012a, Annual global summary—2010 production, imports, exports, and KPC counts: Kimberley Process Rough Diamond Statistics, January 3, 1 p. (Accessed May 22, 2012, at [https://kimberleyprocessstatistics.org/static/pdfs/public\\_statistics/2010/2010GlobalSummary.pdf](https://kimberleyprocessstatistics.org/static/pdfs/public_statistics/2010/2010GlobalSummary.pdf).)
- Kimberley Process Rough Diamond Statistics, 2012b, Annual global summary—2011 production, imports, exports, and KPC counts: Kimberley Process Rough Diamond Statistics, September 4, 1 p. (Accessed November 1, 2012, at [https://kimberleyprocessstatistics.org/static/pdfs/public\\_statistics/2011/2011GlobalSummary.pdf](https://kimberleyprocessstatistics.org/static/pdfs/public_statistics/2011/2011GlobalSummary.pdf).)
- Koidu Holdings S.A., 2011a, Expansion project 2011–2106: Freetown, Sierra Leone, Koidu Holdings S.A. (Accessed June 11, 2012, at <http://www.koiduholdings.com/operations-kkp-expansion-project.php>.)
- Koidu Holdings S.A., 2011b, Koidu kimberlite project: Freetown, Sierra Leone, Koidu Holdings S.A. newsletter, June, 8 p.
- London Mining plc., 2012, 2011 annual report: London, United Kingdom, London Mining plc., 111 p.
- Ministry of Mines and Mineral Resources of Sierra Leone, 2010a, A bill entitled the Mines and Minerals Act—2009: Freetown, Sierra Leone, Ministry of Mines and Mineral Resources of Sierra Leone, 178 p.
- Ministry of Mines and Mineral Resources of Sierra Leone, 2010b, An overview of the Sierra Leone minerals sector: Freetown, Sierra Leone, Ministry of Mines and Mineral Resources of Sierra Leone, 29 p.
- Peregrine Media Group, 2011, Sierra Leone investment conference booklet: London, United Kingdom, Peregrine Media Group, October 20, 21 p.
- Pushak, Nataliya and Foster, Vivien, 2011, Sierra Leone's infrastructure—A continental perspective: Washington DC, The World Bank policy research working paper, no. 5713, June, 47 p.
- Reuters Africa, 2011, Sierra signs MOU for \$750 million hydro power boost: Freetown, Sierra Leone, Thomson Reuters, May 26. (Accessed June 20, 2012, at <http://af.reuters.com/article/investingNews/idAFJOE74POOZ20110526>.)
- Revenue Watch Institute, [undated], Sierra Leone—Extractive industries: New York, New York. (Accessed June 13, 2012, at <http://www.revenuewatch.org/countries/africa/sierra-leone/extractive-industries>.)
- Sierra Express Media, 2011, Port Loko endorses SLEMCO—ESHIA report: Sierra Express Media, February 3. (Accessed May 17, 2012, at <http://www.sierraexpressmedia.com/archives/19108>.)
- Sierra Leone Exploration and Mining Company Ltd., [undated], Porto Loko bauxite: Freetown, Sierra Leone, Sierra Leone Exploration and Mining Company Ltd. information sheet, 5 p.
- Sierra Leone Government Printing Office, 2011, The Petroleum (Exploration and Production) Act (2011): Freetown, Sierra Leone, Sierra Leone Government Printing Office, Supplement to the Sierra Leone Gazette, v. CXLII, no. 60, 154 p.
- Sierra Rutile Ltd., 2011a, Maiden JORC compliant rare earth resource on historical tailings confirms rare earth potential at Sierra Rutile: Freetown, Sierra Leone, Sierra Rutile Ltd. press release, August 30, 5 p.
- Sierra Rutile Ltd., 2011b, Rare earth mineralization confirmed at Sierra Rutile mine: Freetown Sierra Leone, Sierra Rutile Ltd. press release, March 3, 4 p.
- Sierra Rutile Ltd., 2011c, Sierra Rutile to expand production: Freetown, Sierra Leone, Sierra Rutile Ltd. press release, October 24, 5 p.
- Sierra Rutile Ltd., 2012, Financial results for the year ended 31 December 2011: Freetown, Sierra Leone, Sierra Rutile Ltd., 59 p.
- SRK Consulting (UK) Ltd., 2010, Technical review of the Tonkolili iron ore project—Sierra Leone: Cardiff, United Kingdom, SRK Consulting (UK) Ltd., June 3, 57 p.
- State House of the Republic of Sierra Leone, 2011, President Koroma launches new projects: Freetown, Sierra Leone, State House of the Republic of Sierra Leone press release, December 21, 1 p.
- Stellar Diamonds plc., 2012, 2011 annual report and accounts: London, United Kingdom, Stellar Diamonds plc., 66 p.
- Titanium Resources Group, 2011, Change of name to Sierra Rutile Ltd.: Freetown, Sierra Leone, Titanium Resources Group press release, February 24, 2 p.
- U.S. Census Bureau, 2012a, U.S. exports to Sierra Leone from 2002 to 2011 by 5-digit end-use code: U.S. Census Bureau. (Accessed July 10, 2012, at <http://www.census.gov/foreign-trade/statistics/product/enduse/exports/c7470.html>.)
- U.S. Census Bureau, 2012b, U.S. imports from Sierra Leone from 2002 to 2011 by 5-digit end-use code: U.S. Census Bureau. (Accessed July 10, 2012, at <http://www.census.gov/foreign-trade/statistics/product/enduse/imports/c7470.html>.)
- Vimetco N.V., 2011, Vimetco transfers bauxite mine to its alumina producer in Romania: Amsterdam, Netherlands, Vimetco N.V. press release, May 5, 1 p.
- Vimetco N.V., 2012, 2011 annual report: Amsterdam, Netherlands, Vimetco N.V., 149 p.
- West African Power Pool, 2011, Consolidated English summary on the Man (Côte d'Ivoire)–Sannequille (Liberia)–Nzérékore (Guinea)–Buchanan (Liberia)–Monrovia (Liberia)–Bumbuna (Sierra Leone)–Linsan (Guinea) interconnection project: Cotonou, Benin, West African Power Pool Environmental and Social Impact Assessment, December, 56 p.

TABLE 1  
SIERRA LEONE: PRODUCTION OF MINERAL COMMODITIES<sup>1,2</sup>

(Metric tons unless otherwise specified)

Commodity		2007	2008	2009	2010	2011
Bauxite	thousand metric tons	1,169	954	757	1,090 <sup>r</sup>	1,457
Cement		247,380 <sup>r</sup>	254,180 <sup>r</sup>	236,240	300,980	310,890
Diamond <sup>3</sup>	carats	603,623 <sup>4</sup>	371,261 <sup>4</sup>	400,843 <sup>4</sup>	437,516 <sup>r,4</sup>	357,161 <sup>4</sup>
Gold, mine output, Au content	kilograms	212	191	157	270	164
Iron ore:						
Gross weight	thousand metric tons	--	--	--	--	1,300 <sup>5</sup>
Fe content (58%)	do.	--	--	--	--	754 <sup>5</sup>
Titanium:						
Ilmenite concentrate		15,750	17,528	15,161	18,206	15,946
Rutile concentrate		82,805 <sup>r</sup>	78,908	63,864	68,198	67,916
Zirconium concentrate		--	--	5,560	7,092	8,496

do. Ditto. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through May 9, 2012.

<sup>2</sup>In addition to the commodities listed, lignite reportedly was produced, but available information is inadequate to make a reliable estimate of output.

<sup>3</sup>About 60% gem quality and 40% industrial quality.

<sup>4</sup>Source: Kimberley Process Certification Scheme.

<sup>5</sup>Excludes production from the Marampa Mine, which began operating in December 2011.

TABLE 2  
SIERRA LEONE: STRUCTURE OF THE MINERAL INDUSTRY IN 2011

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bauxite	Sierra Mineral Holdings I Ltd. (Vimetco N.V., 100%)	Sierra Minerals Mine, 150 kilometers southeast of Freetown	1,200
Cement	Sierra Leone Cement Corp. Ltd.	Freetown plant	NA
Diamond	thousand carats Koidu Holdings S.A. (BSG Resources Ltd., 65%, and Magma Diamond Resources Ltd., 35%)	Two kimberlite pipes, 2 kilometers from the district capital of Koidu	120 <sup>1</sup>
Iron ore	African Minerals Ltd., 75%, and Shandong Iron and Steel Group Co. Ltd., 25%	Tonkolili Mine, 190 kilometers northeast of Freetown	10,000
Do.	London Mining plc	Marampa Mine, 150 kilometers northeast of Freetown	5,000
Titanium, ilmenite	Sierra Rutile Ltd.	Sierra Rutile Mine, 130 kilometers southeast of Freetown	15
Titanium, rutile concentrate	do.	do.	100
Zirconium concentrate	do.	do.	10

Do., do. Ditto. NA Not available.

<sup>1</sup>Under development.