



2010 Minerals Yearbook

SWEDEN

THE MINERAL INDUSTRY OF SWEDEN

By Harold R. Newman

Sweden continued to be an active mining country in 2010. Natural resources have long formed the basis of the country's economy, and the Fennoscandian Shield, which forms a large part of the Nordic countries, has historically been one of the most active mining areas in Europe. The principal mineral-rich mining centers in Sweden were the Norrbotten and the Skellefte districts.

Minerals in the National Economy

Sweden was a significant mineral producer in the European Union (EU). Metal mining and metal products manufacturing dominated the mineral industry and continued to be important to the country's economy. The country has substantial base-metal, gold, and iron ore deposits, which were being developed and exploited actively. The output of the mineral sector contributed 0.3% to Sweden's gross domestic product in 2010. Trade was important to the national economy and enabled Sweden to be one of the leading mineral commodity export countries in the EU (Mbandi Information Services (Pty) Ltd., 2011).

Production

Sweden had a variety of mineral resources and was one of the EU's significant producers of ores and metals, in terms of output. Sweden was the leading producer of iron ore in the EU and was the 10th ranked iron ore producer in the world (Jorgenson, 2011). The country produced ferrous and nonferrous metals, including copper, gold, iron ore, lead, silver, and zinc, and extracted industrial minerals, including crushed stone, dimension stone, and feldspar. In 2010, primary aluminum production and crude steel production increased, along with refinery production of ferrochrome (table 1).

Structure of the Mineral Industry

The Swedish mineral industry was composed mostly of privately owned companies and operated on a free-market basis. The Government was the major equity owner of the Luossavaara-Kiirunavaara AB's (LKAB) iron ore operation, however, and had significant ownership in the Svenskat Stal AB steel operation (48%). Table 2 is a list of the major mineral industry facilities, their production capacities, and the mineral products they produced in 2010.

Mineral Trade

Sweden was a major trading country; the amount of mineral commodities produced depended mainly on the external demand for these mineral commodities. The volume of Swedish exports was up by 14% in 2010 compared with that of 2009. The volume of imports increased by 17% in 2010 compared with

that of 2009. In 2010, the volume of exports to the United States increased by 31% whereas the volume of imports decreased by 3% compared with that of 2009 (Statistics Sweden, 2010).

In 2010, U.S. exports to Sweden were valued at \$4.7 billion, and U.S. imports from Sweden were valued at \$10.5 billion. Significant mineral commodity exports to Sweden from the United States included metallurgical-grade coal (valued at \$63.5 million), nuclear fuels materials (\$86.1 million), coal and fuels (\$56.3 million), precious metals (\$54.6 million), and nonferrous metals (\$39.6 million). Significant import commodities from Sweden to the United States included semifinished iron and steel mill products (valued at \$542.9 million), petroleum products (\$416.6 million), fuel oil (\$249.3 million), unmanufactured steelmaking and ferroalloying materials (\$116.3 million), and iron and steel products, except advanced manufactured (\$82.6 million) (U.S. Census Bureau, 2010 a, b).

Commodity Review

Metals

Aluminum.—Kubikenborg Aluminium AB (KUBAL) was one of the leading industrial facilities in central Sweden and the only major aluminum producer in the country. KUBAL reduced its annual aluminum output in 2009 owing to decreased demand; however, it received increased orders in 2010 from clients in Europe and the United States and increased production based on a forecasted growth in demand for aluminum (United Company RUSAL, 2010).

Copper.—Avalon Minerals Ltd. of Australia announced an upgrade and expansion of its estimated resources at the Viscaria copper and iron project located 4 kilometers (km) from LKAB's Kiruna Mine in the Norrbotten area of northern Sweden. Resources at the Viscaria project in 2010 were estimated to be 66 million metric tons (Mt) of ore of both volcanic massive sulfide (VMS) and skarn type mineralization for an estimated 600,000 metric tons (t) of contained copper and 241 Mt of dry units of iron in accordance with the Australian Code for Reporting of Exploration Results, Mineral Resources, and Ore Reserves. VMS deposits are a type of metal sulfide ore deposit, mainly of copper, lead, and zinc, which are associated with and created by volcanic-associated hydrothermal events in submarine environments. Skarn deposits are formed by metamorphic effects at elevated temperatures at the contact of intrusive plutons and carbonate country rocks (Mining Weekly Online, 2010).

Avalon's development strategy at Viscaria was to commence production of copper from the existing open pit in the A, B, and Z zones by 2013; expand the copper and iron estimated resources to more than 100 Mt through ongoing exploration; and reopen the A zone underground mining operations. Avalon

completed a prefeasibility study, which confirmed the technical and financial viability of the project. A bankable feasibility study was underway in 2010 based on production of 3 million metric tons per year (Mt/yr) of ore by 2013 (Avalon Minerals Ltd., 2010).

In 2010, Boliden Minerals AB's Aitik Mine, which is located in northern Sweden, was Sweden's largest copper mine. The deposit consisted of chalcopyrite and pyrite material yielding copper with gold and silver byproducts. The Aitik Mine produced 67,168 t of copper concentrate with 3,600 kilograms (kg) of silver and 2,000 kg of gold as byproducts. The mine expansion was completed in 2010 and was to increase production capacity from 18 Mt/yr in 2010 to 36 Mt/yr in 2011 (Boliden Minerals AB, 2010a).

Boliden Metals AB's Rönnskär smelter was one of the world's most efficient copper smelters and the leading facility for the recycling of copper and precious metals. Metals and chemicals were extracted from mined concentrates (75%) and various recycled materials (25%). The main products were copper, gold, lead, and zinc clinker. The smelter had the capacity to produce 250,000 t/yr of copper (Boliden Minerals AB, 2010b).

Gold.—Dragon Mining Ltd. of Australia's Svartliden Mine is located 700 km north of Stockholm and west of the Skellefteå Mining District in an area that was developing into a gold-rich province referred to as the "Gold Line." All ore was mined from the eastern area of the Svartliden Mine's open pit and was processed through a carbon-in-leach processing plant. Dragon Mining announced that the assay results from 22,000 meters (m) of core drilling that was done to try extend the operational life of the mine were encouraging and confirmed the presence of higher grade mineralization along the southern edge of the open pit. A technical review was to be undertaken to determine the viability of deepening the open pit to include those identified mineralized zones that were not included in the existing open pit design (Dragon Mining Ltd., 2010).

Lappland Gold Miners AB announced that a new mineral resource estimate at the Faboliden project formed the basis of alternate open pit optimizations and for studies into options for underground mining. The 2010 mineral resource estimate listed the measured and indicated mineral resources at a cutoff grade of 0.4 gram per metric ton (g/t) gold were 57.8 Mt grading 1.05 g/t gold and 2.8 g/t silver. In addition, the estimated inferred mineral resource was 32.4 Mt grading 1.04 g/t gold and 3.4 g/t silver. Both the tonnage and grades in the measured and indicated mineral resource estimates were lower than previously reported estimates (Lappland Gold Miners AB, 2010).

Gold-Ore Resources Ltd. announced the results of an updated mineral resource estimate for the Bjorkdal Mine. The 2010 estimated measured and indicated mineral resources for the open pit and underground mine totaled 26,107 kg of gold. The updated mineral resource estimate indicated a 52% increase in previously estimated resources and could extend the mine life of Bjorkdal. The Skellefteå mining district where the Bjorkdal Mine is located had been the focus of exploration for gold-rich polymetallic deposits since the mid-1920s. The Skellefteå district contained more than 85 known deposits and, in 2010, there were 5 base and precious metals mines operating in the district (Gold-Ore Resources Ltd., 2011).

Iron and Steel.—LKAB's Kiruna Mine was the world's largest underground iron ore mine; it has an ore body that is 4-km long and 80-m thick and reaches to a depth of about 2 km. LKAB announced that it had been granted an environmental permit for a new open pit mine located at Gruvberget. This would be LKAB's first new iron ore mine in 50 years. Production at the new Gruvberget Mine was expected to be 2 Mt/yr. The ore body contains both hematite and magnetite; initially only magnetite would be mined. The open pit contained an estimated 12 Mt of minable ore; however, LKAB estimated that there was an additional 25 Mt of ore available and that the ore was open at depth. This meant that the life expectancy of the mine could extend beyond the planned phase of 8 years (International Mining, 2010).

Industrial Minerals

Fluorspar.—Tertiary Minerals plc of the United Kingdom held an exploration license in the Vasterbotten district of northern Sweden covering the Storuman fluorspar deposit. The Storuman deposit is a large area of flat-lying sandstone-hosted fluorspar mineralization that extends across an area of about 2 km by 1.2 km where the mineralized horizon is typically 3-m to 10-m thick across the license area. The Australian Joint Ore Reserve Committee (JORC)-compliant mineral resource was estimated to be an indicated resource of 25 Mt of 10.28% fluorspar (CaF₂), an inferred resource of 2.7 Mt of 9.57% CaF₂, for a total estimated resource of 27.8 Mt. The JORC mineral estimate was based on the results of 56 diamond drill holes completed by Tertiary Minerals. With an estimated output of about 100,000 t/yr from an open pit operation, the Storuman Mine would be a medium-scale producer and a leading fluorspar producer in Europe (Tertiary Minerals plc, 2010).

Rare Earths.—LKAB was investigating the tailings ponds at the Kiruna and the Malmberget operations; these ponds were thought to contain large quantities of rare-earth elements bound in the phosphate mineral apatite, which is considered an impurity in iron ore. LKAB planned to conduct a study to determine the conditions for the recovery of apatite and rare-earth elements from the tailings in the ponds. Test drilling results indicated the occurrence of about 15 different rare-earth elements in the apatite. Estimates showed that there was enough apatite in the tailings ponds for the production of 400,000 t/yr of concentrates for a period of 14 years. Startup of production was not expected before 2015 (Steel Orbis, 2011).

Mineral Fuels, Related Materials, and Other Sources of Energy

Renewable Energy.—In 2010, Sweden had the largest share of renewable energy in the EU. About 40% of Swedish energy consumption was covered by renewable energy sources. The Government had set its target at 49% use of renewable energy by 2020. Renewable energy was projected to cover about 20% of the EU's final energy consumption by 2020 (Nordic Energy Solutions, 2010).

The Government announced plans for the construction of 2,000 wind turbines during the next 10 years. The goal was to increase energy production from renewable sources by

25 terawatt-hours. The Markbygden wind farm would have 1,101 wind turbines and would be the largest wind farm in Europe; the farm's production of energy would be equivalent to that of the production of two nuclear reactors. Construction of the wind farm was expected to be completed by 2022 (Arab Construction World, 2010).

Uranium.—Nuclear power in Sweden received a significant boost when the Government announced plans in 2010 to lift the nearly 30-year ban on nuclear powerplants. The policy change was part of a new drive to increase energy security and combat global warming.

Hodges Resources Ltd. of Australia announced that it had received encouraging results from its 2010 summer exploration programs at the Åsenbogravan and the Nörr Dottern projects, which are located within the Arvidsjaur uranium province of northern Sweden. The Åsenbogravan project was claimed to cover multiple occurrences of stratabound and (or) structurally controlled uranium-bearing polymetallic mineralization that was originally identified by the Geological Survey of Sweden (SGU). The presence of hematite-bearing breccias and a multiple commodity signature of mineralization have drawn some comparisons with an iron oxide-copper-gold (IOCG) mineralization style. Historical work on IOCG areas completed by the SGU included surface sampling, trenching, and drilling, which defined at least three uranium prospects of significance within the project area. Uranium mineralization was originally discovered in the Nörr Dottern project area by the SGU; subsequent exploration efforts by the SGU resulted in the discovery of eight significant uranium-bearing prospect areas (Hodges Resources Ltd., 2010).

Mawson Resources Ltd. of Canada's Hotagen uranium mineralized project in northern Sweden consisted of 8,360 hectares of exploration claims and included the Kläppibacken project, where a 50% upgraded National Instrument 43-101-compliant estimate indicated resources of 1.5 Mt grading 0.08% uranium oxide (U_3O_8). In total, 21 separate areas had been identified at Hotagen, including 66 individual uranium mineralized outcrops. Also, results included 40 assays grading above 0.05% U_3O_8 from these outcrops. This was considered significant, as the outcropping rocks accounted for less than 10% of the surface area in the Hotagen prospect area (Mawson Resources Ltd., 2010).

Outlook

Mining is expected to remain important to Sweden's economy. The global role of Sweden as an iron ore producer will increase as production increases. Within 5 to 10 years, iron ore production is expected to reach 50 Mt/yr. Sweden has substantial base-metal, gold, and iron ore deposits, which are expected to continue to be actively developed and exploited. Foreign companies are likely to continue active exploration efforts in Sweden for base metals, diamond, and, particularly, gold. The Government is expected to continue its efforts to increase the production and use of renewable energy in electricity, heating, cooling, and transport with the goal of 49% use of renewable energy by 2020. Also, Sweden has mining laws that are favorable to the mineral industry and a low

corporate tax rate. Companies operating in the mineral resource sector benefit from the country's history of mineral production, available geosciences data, ore potential, extremely low sovereign risk, well-developed infrastructure, and strong mining culture.

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TABLE 1
SWEDEN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2006	2007	2008	2009	2010 ^e	
METALS						
Aluminum, metal:						
Primary	101,180	98,014	81,546	69,708 ^f	78,500	
Secondary ^c	32,000	32,000	32,000	30,000	25,000	
Total	133,180	130,014	113,546	99,708 ^f	103,500	
Copper:						
Mine output, Cu content	86,746	62,905	57,688	55,400 ^f	76,500	
Metal:						
Smelter:						
Primary	194,200	203,107	204,204	125,398 ^f	130,000	
Secondary	64,243	55,148	67,795	65,000 ^c	60,000	
Total	258,443	258,255	271,999	190,398 ^f	190,000	
Refined:						
Primary	229,241	213,894	227,774	205,759 ^f	210,000	
Secondary ^c	25,000	25,000	25,000	25,000	25,000	
Total	254,241	238,894	252,774	230,759 ^f	235,000	
Gold:						
Mine output, Au content	kilograms	6,848	5,159	4,900	5,600	6,300
Metal, primary ^{e, 2}	do.	8,000	8,000	8,000	8,000	8,000
Iron and steel, metal:						
Iron ore concentrate and pellets:^e						
Gross weight	thousand metric tons	23,622 ^f	24,988 ^f	27,713 ^f	20,389 ^f	27,917 ³
Fe content (60%)	do.	14,172 ^f	14,993 ^f	16,628 ^f	12,233 ^f	16,750 ³
Metal:						
Pig iron and sponge iron	do.	3,577	3,815	3,583	3,800 ^c	3,800
Ferroalloys:						
Ferrochromium		136,374	124,403	117,053	31,345	32,000
Ferrosilicon ^c		4,000	4,000	4,000	3,500	3,500
Total		140,374	128,403	121,053	34,845	35,500
Steel, crude	thousand metric tons	5,435	5,673	5,196	2,805	4,844 ³
Semimanufactures ^c	do.	4,500	4,600	4,200	4,000	4,000
Lead:						
Mine output, Pb content		55,644	63,224	65,100 ^c	69,300 ^f	67,700 ³
Metal, refined:^c						
Primary		70,100	69,700	56,800	55,000	56,000
Secondary		43,900	40,000	42,600	42,000	40,000
Total		114,000 ³	139,700 ³	99,400	97,000	96,000
Molybdenum, oxide, roasted, Mo content ^e		3,000	3,000	3,000	2,800	2,800
Nickel, metal, secondary ^e		50	50	50	50	50
Selenium, elemental, refined ^c		20	20	20	20	20
Silver:						
Mine output, Ag content	kilograms	292,255	323,171	293,100	288,600 ^f	302,100 ³
Metal, primary ^c	do.	225,000	225,000	250,000	225,000	230,000
Zinc, mine output, Zn content		210,029	214,576	188,048	192,538	198,687 ³
INDUSTRIAL MINERALS						
Cement, hydraulic ^c	thousand metric tons	2,600 ³	2,500 ³	2,500	2,600	2,600
Diamond, synthetic ^c	thousand carats	20,000	20,000	20,000	20,000	20,000
Feldspar, salable, crude and ground ^c		43,000	42,000	42,000	44,000	44,000
Fertilizer, manufactured:^c						
Nitrogenous	thousand metric tons	400	400	400	400	400
Phosphatic	do.	10	10	10	10	10
Mixed	do.	300	300	300	300	300
Graphite ^c		800	800	--	--	--
Lime ^c	thousand metric tons	600	600	600	600	700
Quartz and quartzite ^c	do.	700	700	700	700	700

See footnotes at end of table.

TABLE 1—Continued
 SWEDEN: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2006	2007	2008	2009	2010 ^c	
INDUSTRIAL MINERALS—Continued						
Stone:^c						
Dimension:						
Mostly unfinished	thousand metric tons	170	170	170	170	180
Granite	do.	132	132	132	132	124 ³
Limestone	do.	32	32	32	32	43 ³
Slate	do.	16	16	16	16	16
Other	do.	6	6	6	6	6
Crushed:						
Dolomite	do.	450	450	450	450	450
Granite	do.	3,500	3,500	3,500	3,500	3,500
Limestone:						
Chalk	do.	80	80	80	80	80
For cement manufacture	do.	4,000	4,000	4,000	4,000	4,000
For lime manufacture	do.	950	950	950	950	950
For other construction and industrial uses	do.	1,800	1,800	1,800	1,800	1,800
For agricultural uses	do.	650	650	650	650	650
For other uses	do.	1,500	1,500	1,500	1,500	1,500
Total	do.	8,980	8,980	8,980	8,980	8,980
Sandstone	do.	20	20	20	20	20
Undifferentiated	do.	30,000	30,000	30,000	30,000	30,000
Other	do.	350	350	350	350	350
Sulfur:^c						
Metallurgy	do.	240	240	240	240	240
Petroleum	do.	60	60	60	60	60
Total	do.	300	300	300	300	300
Talc, soapstone ^c		14,000	14,000	14,000	15,000	12,000
MINERAL FUELS AND RELATED MATERIALS						
Coke, metallurgical ^c	thousand metric tons	1,400	1,400	1,400	1,400	1,400
Gas, manufactured:^c						
Coke oven gas	million cubic meters	500	500	500	500	500
Blast furnace gas	do.	3,500	3,500	3,500	3,500	3,500
Peat:						
Agricultural use ^c	thousand cubic meters	1,716 ³	1,700	1,280	1,400	1,400
Fuel	do.	3,041	3,000	1,500	1,500	1,500
Petroleum, refinery products:^c						
Liquefied petroleum gas	thousand 42-gallon barrels	5,000	5,000	5,000	5,000	5,000
Naphtha	do.	500	500	500	500	500
Gasoline, motor	do.	35,000	35,000	35,000	35,000	35,000
Jet fuel	do.	600	600	600	600	600
Distillate fuel oil	do.	54,000	54,000	54,000	54,000	54,000
Residual fuel oil	do.	36,000	36,000	36,000	36,000	36,000
Other	do.	21,000	21,000	21,000	21,000	21,000
Refinery fuel and losses	do.	10,000	10,000	10,000	10,000	10,000
Total	do.	162,000	162,000	162,000	162,000	162,000

^cEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ¹Revised. do. Ditto. -- Zero.

¹Table includes data available through January 31, 2012.

²Includes only that recovered from indigenous ores, excluding scrap.

³Reported figure.

TABLE 2
SWEDEN: STRUCTURE OF THE MINERAL INDUSTRY IN 2010

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum		Kubikborg Aluminium AB (KUBAL) (United Company RUSAL, 100%)	Smelter at Sundsvall	125
Cement		Cementa AB (HeidelbergCement AG, 100%)	Plants at Degerhamn, Skovde, and Slite	3,400
Copper:				
Ore, copper content		Boliden Mineral AB	Mines at Aitik, Garpenberg, Kankberg, Kristineberg, Langdal, Mourliden, Mourliden Ostra, Petiknas, and Renstrom	68
Metal		Boliden Metals AB	Smelter and refinery at Ronnskar	240
Feldspar		Berglins Malm & Mineral AB (Omya GmbH)	Mines at Beckegruvan, Hojderna, and Limbergsbo	50
Do.		Silbelco Nordic AS	Mines at Forshammar	30
Do.		Larsbo Kalk AB (Omya GmbH)	Manufactured from marble at Storia	20
Ferroalloys		Vargon Alloys AB	Plant at Vargon	175
Gold:				
Ore, gold content	kilograms	Dragon Mining Ltd.	Svartliden Mine, Skellefte District	300
Do.	do.	Gold-Ore Resources Ltd.	Bjorkdal Mine, Skellefte District	1,200
Do.	do.	Boliden Mineral AB	Mines at Aitik, Akerberg, Kankberg, Kristineberg, Langdal, Petiknas, and Renstrom	2,000
Metal	do.	do.	Smelter and refinery at Ronnskar	15,000
Graphite		Woxna Graphite AB (Tricorona Mineral AB, 100%)	Mine and plant at Kringeltjarn, Woxna (closed 2008)	20
Iron and steel		Svenskt Stal AB (Government, 48%)	Steelworks at Borlange, Lulea, and Oxelosund	3,900
Iron ore		Luossavaara-Kiirunavaara AB (LKAB) (Government, 98%)	Mines at Kiruna and Malmberget	32,500
Kyanite		Svenska Kyanite AB (Svenska Mineral AB, 100%)	Quarry at Halskoberg	10
Lead:				
Ore, lead content		Boliden Mineral AB	Mines at Garpenberg and Renstrom	100
Do.		North Mining Svenska AB	Zinkgruvan Mine at Ammeberg	20
Metal		Boliden Metals AB	Smelter and refinery at Ronnskar	30
Do.		Boliden Bergsoe AS	Smelter and refinery at Landskrona	50
Lime		Svenska Mineral AB	Plants at Rattvik and Boda	250
Limestone		Kalproduction Storugns AB (Nordkalk AB, 100%)	Mines at Gotland Island	3,000
Do.		NordKalk AB	Storugns	3,200
Marble	cubic meters	Borghamnsten AB	Quarry at Askersund	15,000
Petroleum, refined	42-gallon barrels per day	Preem AB (Corral Petroleum Holdings AB (100%))	Refinery at Lysekil	210,000
Do.		Shell Raffinaderi AB	do.	82,000
Do.		AB Nynas Petroleum	Refineries at Gothenburg and Nynashamn	50,000
Silver, metal	kilograms	Boliden Metals AB	Smelter and refinery at Ronnskar	408,000
Do.	do.	Lunden Mining Corp.	Zinkgruvan Mine at Ammeberg	25,000
Zinc, ore, zinc content		Boliden Mineral AB	Mines at Garpenberg, Laisvall, Langdal, and Renstrom	112
Do.		Lunden Mining Corp.	Zinkgruvan Mine at Ammeberg	78
Do., do. Ditto.				