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VALE'S PRODUCTION AND SALES IN 1Q19



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Production and sales in 1Q19

Rio de Janeiro, May 8th, 2019 – Vale S.A (“Vale”) iron ore fines production totaled 72.9 Mt in 1Q19, 28% and 11% lower than 4Q18 and 1Q18, respectively, mainly as a result of the impacts following the Brumadinho dam rupture and the stronger than usual weather-related seasonality.

Vale pellet production¹ totaled 12.2 Mt in 1Q19, 23% and 5% lower than 4Q18 and 1Q18, respectively, mainly due to stoppages of pellet plants, following the Brumadinho dam rupture, as well as scheduled maintenances carried out in Tubarão and Oman.

Iron ore fines and pellet sales volume was 67.7 Mt in 1Q19, 30% and 20% lower than in 4Q18 and 1Q18, respectively. The decrease when compared to 4Q18 was a result of the following effects: (i) the usual weather seasonality (14 Mt); (ii) the impact of production stoppages following the Brumadinho dam rupture (7 Mt); (iii) new inventory management procedures at Chinese ports, which impacted the timing of sales revenue recognition (6 Mt); and (iv) abnormal rains impacting shipments from the Ponta da Madeira port in the Northern System (5 Mt); which were partially offset by inventory drawdowns from Chinese ports in 1Q19 (3 Mt).

Regarding the inventory management procedures mentioned above, according to previous practices, once a commercial agreement was reached, ownership of the product at our blending facilities was transferred to the customer and revenue was recognized, irrespective of retrieval of the ore by the customer. Consequently, the ore sold had to be segregated at the port awaiting retrieval, and therefore port operational capacity was constrained due to lack of stockyard flexibility. According to the new commercial practices, ownership of the product and hence revenue recognition is only granted upon cargo retrieval, which affects the timing of sales revenue recognition.

The share of premium products² in total sales was 81% in 1Q19, remaining practically in line with 4Q18. Iron ore fines and pellet quality premiums reached US\$ 10.7/t³ in 1Q19 vs. US\$ 11.5/t in 4Q18, mainly due to lower market premiums for Carajás fines, which were partially offset by the positive impact of new contract terms for pellets sales.

Production of finished nickel reached 54,800 t in 1Q19, 14.4% lower than 4Q18 and 6.5% lower than 1Q18. The decrease was mainly due to lower production from: (i) PTVI, due to the scheduled maintenance shutdown at the Matsusaka refinery, in Japan; (ii) VNC, due to the scheduled maintenance at the Dalian refinery, in China; and, (iii) Sudbury, due to timing differences in the nickel processing chain.

¹ Including third party capacity utilization.

² Pellets, Carajás, BRBF (Brazilian Blend Fines), pellet feed and Sinter Feed Low Alumina (SFLA).

³ Iron ore premium of US\$ 5.6/t and weighted average contribution of pellets of US\$5.1/t.

Copper production reached 93,800 t in 1Q19, 14.6% lower than 4Q18 and in line with 1Q18. Production decreased mainly due to lower feed grades and lower plant throughput at various operations.

Coal production totaled 2.2 Mt in 1Q19, 29% and 9% lower than in 4Q18 and 1Q18, respectively, as a result of extremely severe rains throughout the quarter.

Production summary

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
Iron ore ¹	72,870	100,988	81,953	-27.8%	-11.1%
Pellets	12,174	15,812	12,780	-23.0%	-4.7%
Manganese ore	365	495	434	-26.3%	-15.9%
Coal	2,213	3,108	2,432	-28.8%	-9.0%
Nickel	54.8	64.0	58.6	-14.4%	-6.5%
Copper	93.8	109.8	93.3	-14.6%	0.5%
Cobalt	1,195	1,437	1,327	-16.8%	-9.9%
Gold (000' oz troy)	108	133	113	-18.8%	-4.4%

¹ Including third party purchases, run-of-mine and feed for pelletizing plants.

Sales summary

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
Iron ore ¹	55,416	80,495	71,221	-31.2%	-22.2%
Pellets	12,314	15,987	13,125	-23.0%	-6.2%
Manganese ore	252	442	338	-43.0%	-25.4%
Coal	2,394	3,433	2,497	-30.3%	-4.1%
Nickel	50.3	59.6	57.9	-15.4%	-13.0%
Copper	90.4	104.1	87.7	-13.2%	3.1%

¹ Including third party purchases and run-of-mine.

Iron ore

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
Northern System	41,015	52,911	40,601	-22.5%	1.0%
Northern and Eastern ranges	23,029	37,023	28,920	-37.8%	-20.4%
S11D	17,986	15,888	11,680	13.2%	54.0%
Southeastern System	19,578	26,532	22,213	-26.2%	-11.9%
Itabira (Cauê, Conceição and others)	9,292	11,254	9,040	-17.4%	2.8%
Minas Centrais (Brucutu and others)	5,191	9,184	7,755	-43.5%	-33.1%
Mariana (Alegria, Timbopeba and others)	5,095	6,094	5,419	-16.4%	-6.0%
Southern System	11,776	20,985	18,530	-43.9%	-36.4%
Paraopeba (Mutuca and others)	4,447	6,687	6,132	-33.5%	-27.5%
Vargem Grande (Vargem Grande and others)	2,432	5,114	4,686	-52.4%	-48.1%
Minas Itabirito (Fábrica and Pico)	4,897	9,185	7,712	-46.7%	-36.5%
Midwestern System	501	559	609	-10.4%	-17.7%
Corumbá	501	559	609	-10.4%	-17.7%
IRON ORE PRODUCTION¹	72,870	100,988	81,953	-27.8%	-11.1%
IRON ORE SALES²	55,416	80,495	71,221	-31.2%	-22.2%
IRON ORE AND PELLETS SALES	67,730	96,481	84,346	-29.8%	-19.7%

¹ Including third party purchases, run-of-mine and feed for pelletizing plants.

² Including third party purchases and run-of-mine.

Production overview

Iron ore production of 72.9 Mt in 1Q19 was 28% and 11% lower than in 4Q18 and 1Q18, respectively, mainly as a result of the impacts following the Brumadinho dam rupture and the stronger than usual weather-related seasonality.

Following the Brumadinho dam rupture, Vale's iron ore fines production was impacted by 11.2 Mt in 1Q19 as a result of the following events:

- On February 4th, 2019, Brucutu operations were stopped following a decision by the 22nd Civil Court of the Comarca of Belo Horizonte, within the scope of Public Civil Action nº 5013909-51.2019.8.13.0024, filed by the Public Prosecution Office of the State of Minas Gerais ("MPMG"), which determined, among other measures, that the company refrained from disposing of tailings or practicing any activity potentially capable of increasing the risks of the Laranjeiras dam.
- On February 4th, 2019 (and again on February 20th, 2019), Vale disclosed its intention to advance the decommissioning process of all upstream dams and its decision to anticipate the temporary suspension of the production of concentration plants at the Vargem Grande Complex;
- On February 18th, 2019, Brazil's National Mining Agency ("ANM" – Agência Nacional de Mineração) published the new Resolution No 4 recommending stricter dam safety parameters;

- On February 20th, 2019, Vale confirmed that the safety parameters of the Vargem Grande, Grupo and Forquilha I, II and III tailings dams could be potentially lower than what the new resolution recommended;
- On February 20th, 2019, the ANM carried out inspections at the sites and determined the suspension of activities at the entire Vargem Grande Complex and Fábrica Complex.
- On March 15th, 2019, Timbopeba mine production was halted, following the decision made by the 2nd Civil Court of the Comarca of Ouro Preto, within the scope of Public Civil Action N° 5000435-60.2019.8.13.0461, filed by the MPMG.
- On March 19th, 2019, Vale became aware of the ruling by the Lower Public Treasury court of Belo Horizonte held on March 18th, 2019, within the scope of the Public Civil Action N° 5013909-51.2019.8.13.0024, filed by the MPMG, that authorized the resumption of activities at the Laranjeiras dam and Brucutu mine, and also required the Minas Gerais State Agency of Environment and Sustainable Development (“SEMAD”) to comply with the decision.
- On March 20th, 2019, Alegria mine production was halted, following Vale’s decision to suspend on a preventive basis the Alegria mine operation.
- On March 21st, 2019, Vale received from SEMAD the Provisional Operational Authorization (“APO”) for the Laranjeiras dam, allowing the return of operations at Brucutu mine.
- On March 22nd, 2019, the resumption of Brucutu operations was suspended following an injunction by the Court of Santa Bárbara, within the scope of the public civil action n° 5000153-77.2019.8.13.0572, filed by the MPMG.

Brucutu operations were resumed on April 17th, 2019, following the decision of the Minas Gerais Court of Justice to partially suspend the injunction of the Court of Santa Bárbara, issued on March 22nd, 2019, within the scope of Public Civil Action N° 5000153-77.2019.8.13.0572, filed by the MPMG. Nevertheless, wet processing operations were halted again on May 6th, 2019, following a decision by the Minas Gerais Court of Justice (Tribunal de Justiça do Estado de Minas Gerais - “TJMG”) suspending the effects of the ruling by the Lower Public Treasury Court of Belo Horizonte (1^a Vara da Fazenda Pública e Autarquias da Comarca de Belo Horizonte), within the scope of the public civil action n° 5013909-51.2019.8.13.0024, filed by Public Prosecution Office of the State of Minas Gerais on March 18th, 2019, that had authorized the resumption of activities at the Laranjeiras tailings dam and the Brucutu mine. Vale reiterates that the Laranjeiras dam and all the other geotechnical structures of Brucutu have valid Declaration of Stability (“DCE”) issued by external auditors in March 2019 and is taking the appropriate measures related to the decision.

However, heavy rains in São Luís do Maranhão in March and April affected shipments at the Ponta da Madeira port and the railway transportation at EFC, thus impacting the production volumes at the Northern System.

As a result of both events, Vale reaffirms its 2019 iron ore and pellets sales guidance of 307-332 Mt, as previously announced, and informs that its expected sales volume is currently between the bottom and the middle of the range.

In 1Q19, Vale's product portfolio Fe content reached 64.3%, alumina 1.2% and silica 3.5%.

Northern System

The Northern System, which comprises Carajás and S11D, produced 41.0 Mt in 1Q19, 11.9 Mt lower than in 4Q18 and in line with 1Q18, as abnormal rains at the Ponta da Madeira port (PDM) in March augmented the effect of the usual weather seasonality, however this was partially offset by the successful S11D ramp-up.

Southeastern System

The Southeastern System, which encompasses the Itabira, Minas Centrais and Mariana mining hubs, produced 19.6 Mt in 1Q19, 7.0 Mt and 2.6 Mt lower than in 4Q18 and 1Q18, respectively, mainly due to the above-mentioned stoppages of Brucutu, Timbopeba and Alegria mines.

Southern System

The Southern System, which encompasses the Paraopeba, Vargem Grande and Minas Itabirito mining hubs, produced 11.8 Mt in 1Q19, 9.2 Mt and 6.8 Mt lower than in 4Q18 and 1Q18, respectively, mainly due to the above-mentioned stoppages at the Vargem Grande and Fábrica complexes.

Midwestern System

The Midwestern System produced 0.5 Mt in 1Q19, in line with 4Q18 and 1Q18.

Pellets

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
Northern System	1,221	919	-	32.9%	n.m.
São Luis	1,221	919	-	32.9%	n.m.
Southeastern System	7,760	9,087	7,872	-14.6%	-1.4%
Tubarão 1 and 2	1,166	1,214	536	-4.0%	117.5%
Itabrasco (Tubarão 3)	575	1,136	1,102	-49.4%	-47.8%
Hispanobras (Tubarão 4)	955	1,145	1,109	-16.6%	-13.9%
Nibrasco (Tubarão 5 and 6)	2,186	2,405	2,295	-9.1%	-4.7%
Kobrasco (Tubarão 7)	1,086	1,312	1,082	-17.2%	0.4%
Tubarão 8	1,792	1,875	1,747	-4.4%	2.6%
Southern System	1,069	2,564	2,705	-58.3%	-60.5%
Fábrica	515	991	979	-48.0%	-47.4%
Vargem Grande	554	1,573	1,725	-64.8%	-67.9%
Oman	1,970	2,612	2,204	-24.6%	-10.6%
Others¹	154	630	-	-75.6%	n.m.
PELLETS PRODUCTION	12,174	15,812	12,780	-23.0%	-4.7%
PELLETS SALES	12,314	15,987	13,125	-23.0%	-6.2%

¹ Third party capacity utilization.

Production overview

Vale's pellet production was 12.2 Mt, 23% and 5% lower than in 4Q18 and 1Q18, respectively, mainly due to the above-mentioned stoppage of the Fábrica and Vargem Grande pellet plants, as well as scheduled maintenances carried out at Tubarão and Oman pellet plants.

Northern system

Production at the São Luís pellet plant was 1.2 Mt in 1Q19, 33% higher than in 4Q18, as a result of the plant ramp-up.

Southeastern system

Production at the Tubarão pellet plants – Tubarão 1, 2, 3, 4, 5, 6, 7 and 8 – was 7.8 Mt in 1Q19, 15% lower than in 4Q18 and in line with 1Q18, as a result of scheduled maintenances at plants 3 and 7, as well as the 5-day stoppage of plants 1, 2, 3 and 4, following the interdiction by the City Government of Vitória of a part of the waste water treatment of Tubarão port, in Vitória (state of Espírito Santo).

Southern system

The Fábrica pellet plant production was 0.5 Mt in 1Q19, 0.5 Mt lower than in both 4Q18 and 1Q18, as operations were halted on February 20th, 2019, following an ANM determination.

The Vargem Grande pellet plant production was 0.6 Mt in 1Q19, 1.0 Mt and 1.2 Mt lower than in 4Q18 and 1Q18, respectively, as operations were halted on February 20th, 2019, following an ANM determination.

Oman operations

The Oman pellet plant production was 2.0 Mt in 1Q19, 25% and 11% lower than in 4Q18 and 1Q18, respectively, due to scheduled maintenance at line A in January and line B in February.

Manganese ore and ferroalloys

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
MANGANESE ORE PRODUCTION	365	496	434	-26.4%	-15.9%
Azul	243	289	234	-15.9%	3.8%
Urucum	83	167	171	-50.3%	-51.5%
Morro da Mina	39	40	29	-2.5%	34.5%
MANGANESE ORE SALES	252	442	338	-43.0%	-25.4%
FERROALLOYS PRODUCTION	41	43	45	-4.7%	-8.9%
FERROALLOYS SALES	25	36	34	-30.6%	-26.5%

Production and sales overview

Manganese ore production totaled 365,000 t in 1Q19, 26.4% lower than in 4Q18 mainly due to lower grades of run-of-mine and the usual weather-related seasonality at Mina do Azul, as well as lower productivity at Urucum.

Manganese ore sales volumes reached 252,000 t in 1Q19, 43.0% lower than in 4Q18, mainly due to the lower production and the impact of heavy rains, which affected São Luís port shipments.

Ferroalloy production totaled 41,000 t in 1Q19, remaining practically in line with 4Q18.

Ferroalloys sales volumes totaled 25,000 t in 1Q19, 30.6% lower than in 4Q18 as a result of a margin over volume strategy.

Nickel

Finished production by source

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
Canada	25.8	27.1	28.8	-4.8%	-10.4%
Sudbury	12.6	14.1	14.0	-10.6%	-10.0%
Thompson	3.1	1.9	5.2	63.2%	-40.4%
Voisey's Bay	10.2	11.1	9.6	-8.1%	6.3%
Indonesia	15.7	19.9	13.8	-21.1%	13.8%
New Caledonia ¹	6.3	8.3	7.3	-24.1%	-13.7%
Brazil	4.3	5.5	5.7	-21.8%	-24.6%
Feed from third parties ²	2.7	3.2	3.0	-15.6%	-10.0%
NICKEL PRODUCTION	54.8	64.0	58.6	-14.4%	-6.5%
NICKEL SALES	50.3	59.6	57.9	-15.4%	-13.0%

¹ Production at VNC reached 5,400 t in 1Q19, while production of finished nickel from VNC totaled 6,300 t in 1Q19, the differences stemming from the time required for processing into finished nickel.

² External feed purchased from third parties and processed into finished nickel in our Canadian operations.

Production and sales overview

Production of finished nickel reached 54,800 t in 1Q19, 14.4% lower than 4Q18 and 6.5% lower than 1Q18. The decrease was mainly due to lower production from: (i) PTVI, due to the scheduled maintenance shutdown at the Matsusaka refinery, in Japan; (ii) VNC, due to the scheduled maintenance at the Dalian refinery, in China; and, (iii) Sudbury, due to timing differences in the nickel processing chain.

The Long Harbour refinery continued its successful ramp-up with 51% of its 1Q19 production achieving plate grade quality compared to 18% in 4Q18. Production at the New Caledonia site was 39.0% lower than 4Q18 and 42.1% lower than 1Q18 due to a new maintenance program that is being implemented as a response to operational issues observed in 2018 such as power outages, lime production delays and autoclave availability.

Nickel sales volumes were 50,300 t in 1Q19, 15.4% lower than in 4Q18. Reduced sales were the result of lower production and a management decision to increase inventories of high-quality nickel due to lower LME prices at the beginning of 1Q19 – these actions are consistent with Vale's strategy of prioritizing value over volume.

In 2019 Vale is focused on the turnaround of the nickel business through flowsheet optimization, cost reduction programs and improvements in asset performance, aiming to enhance competitiveness of the operations. As the focus is on value over volume, Vale's revised nickel production guidance is 232,000-236,000 t in 2019, mostly due to VNC's revised operating plan that includes the implementation of a new staged maintenance program.

Canadian operations

Production from Sudbury source ore reached 12,600 t in 1Q19, 10.6% lower than 4Q18 and 10.0% lower than 1Q18. Sudbury production was lower due to inventory and timing differences when processing Sudbury source nickel through the Clydach refinery in Wales.

Production from Thompson source ore reached 3,100 t in 1Q19, 63.2% higher than 4Q18 and 40.4% lower than 1Q18. The fluctuations over previous periods were a result of Thompson fully transitioning to a mine-mill operation in 2018 and the timing differences when shipping and processing Thompson source concentrate in Sudbury.

Production from the Voisey's Bay mine source reached 10,200 t in 1Q19, 8.1% lower than 4Q18 and 6.3% higher than 1Q18. Production was lower than 4Q18 due to Long Harbour carrying out its planned maintenance in 1Q19. Production was higher than in 1Q18 due to the higher production rates at Long Harbour in 1Q19.

Production at the Long Harbour processing plant reached 10,100 t in 1Q19, 7.7% lower than 4Q18 and 17.4% higher than 1Q18. Production was lower than 4Q18 as Long Harbour conducted planned maintenance activities in 1Q19. Production was higher than 1Q18 as Long Harbour continued to successfully ramp up operations in 1Q19.

Indonesian operation (PTVI)

Production of finished nickel from PTVI reached 15,700 t in 1Q19, 21.1% lower than 4Q18 and 13.8% higher than 1Q18. Production was lower than 4Q18 due to the annual scheduled maintenance shutdown at the Matsusaka refinery, in Japan, that further processes matte produced in Indonesia, along with the impacts of the relining of the hydroelectric Larona canal, in Indonesia, which caused PTVI to temporarily shift to diesel-generated power at lower productivity rates. Production was higher than 1Q18 as the supply chain from PTVI to the Clydach refinery in Wales was more fully established in 1Q19 than in 1Q18. PTVI source feed continued to be processed at our Clydach refinery, in line with Vale's strategy to optimize margins and produce Class I products rather than Class II products.

PTVI nickel in matte production reached 13,100 t in 1Q19, 36.4% lower than 4Q18 and 23.4% lower than 1Q18. Production was lower in 1Q19 due to a combination of scheduled maintenance related to the Larona canal relining, leading to the temporary use of diesel-generated power at the plants, and electric furnace operational issues that led to an unscheduled maintenance shutdown.

New Caledonia operation (VNC)

Production of finished nickel from VNC reached 6,300 t in 1Q19, 24.1% lower than 4Q18 and 13.7% lower than 1Q18. Production decreases were due to the downstream Dalian refinery, in China, conducting scheduled furnace maintenance in March-April 2019.

Production of nickel oxide and nickel hydroxide cake at VNC reached 5,400 t in 1Q19, 38.6% lower than 4Q18 and 41.9% lower than 1Q18. As a response to operational issues that could be observed in 2018, such as power outages, lime production delays and autoclave availability, a new proactive maintenance program is being implemented to stabilize the operation. The program will be implemented in a staged approach that will intentionally reduce production until 2H19. This new operating plan will increase asset reliability and improve final product quality aligned with the needs of the battery production industry. Nickel oxide represented 80% and nickel hydroxide cake 20% of VNC's 1Q19 site production.

Brazilian operation (Onça Puma)

Production reached 4,300 t in 1Q19, 21.8% lower than 4Q18 and 24.6% lower than 1Q18. The decreases were mainly due to scheduled maintenance activities and lower feed grades. For the remainder of the year, there is only one more maintenance shutdown, scheduled for the month of June.

Copper

Finished production by source

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
BRAZIL	61.4	77.2	66.1	-20.5%	-7.1%
Sossego	20.5	25.1	22.5	-18.3%	-8.9%
Salobo	40.9	52.2	43.7	-21.6%	-6.4%
CANADA	32.4	32.5	27.2	-0.3%	19.1%
Sudbury	23.3	21.8	15.1	6.9%	54.3%
Thompson	0.3	0.4	0.2	-25.0%	50.0%
Voisey's Bay	6.4	7.8	8.4	-17.9%	-23.8%
Feed from third parties	2.4	2.6	3.5	-7.7%	-31.4%
COPPER PRODUCTION	93.8	109.8	93.3	-14.6%	0.5%
COPPER SALES	90.4	104.1	87.7	-13.2%	3.1%

Production and sales overview

Copper production reached 93,800 t in 1Q19, 14.6% lower than 4Q18 and in line with 1Q18. Production decreased mainly due to lower feed grades and lower plant throughput at various operations.

Sales volumes of copper reached 90,400 t in 1Q19, 13.2% lower than in 4Q18, reflecting lower production volumes. Sales volumes are lower compared to production volumes due to payable copper vs. contained copper content: part of the copper contained in the concentrates is lost in the smelting and refining process, hence payable quantities of copper are approximately 3.5% lower than production volumes.

Vale's copper production guidance is 407,000-417,000 t in 2019.

Brazilian operations

Production of copper in concentrate at Sossego totaled 20,500 t in 1Q19, 18.3% lower than 4Q18 and 8.9% lower than 1Q18. Production decreases were due to lower ore grades and lower mill processing rates.

Production of copper in concentrate at Salobo reached 40,900 t in 1Q19, 21.6% lower than 4Q18 and 6.4% lower than 1Q18. Production decreases were due to lower ore grades and lower mill processing rates.

Canadian operations

Production of copper from Sudbury reached 23,300 t in 1Q19, 6.9% higher than 4Q18 and 54.3% higher than 1Q18. Production was higher than 4Q18 due to strong mine performance and higher than 1Q18 as Coleman mine was not operating in 1Q18. Coleman mine, a high

copper-bearing ore body, returned to operation in 2Q18 and has been operating at planned rates ever since.

Production of copper from Voisey's Bay reached 6,400 t in 1Q19, 17.9% lower than in 4Q18 and 23.8% lower than 1Q18. Production was lower than 4Q18 due to lower feed grades and lower throughput rates at the Voisey's Bay mill. Production was lower than 1Q18 due to lower grades, lower plant throughput and due to the drawdown of previously held Voisey's Bay concentrate inventory at the Sudbury smelter in 1Q18.

Cobalt by-product

Finished production by source

	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
COBALT (metric tons)	1,195	1,437	1,327	-16.8%	-9.9%
Sudbury	129	158	123	-18.4%	4.9%
Thompson	21	24	81	-12.5%	-74.1%
Voisey's Bay	467	557	495	-16.2%	-5.7%
VNC	412	561	589	-26.6%	-30.1%
Others	166	137	39	21.2%	325.6%

Production overview

Cobalt production reached 1,195 t in 1Q19, 16.8% lower than 4Q18 and 9.9% lower than 1Q18. Decreases were mainly driven by the decrease in production at Voisey's Bay and New Caledonia.

Cobalt production from Sudbury was 129 t in 1Q19, 18.4% lower than in 4Q18 and 4.9% higher than 1Q18. Production was lower than 4Q18 as there was a drawdown of Sudbury source cobalt inventory at our Port Colborne cobalt refinery during 4Q18.

Production from Thompson source was 21 t in 1Q19, 12.5% lower than in 4Q18 and 74.1% lower than 1Q18. The production decrease relative to 1Q18 was related to the consumption of in-process inventories and timing of production in 1Q18. Thompson source cobalt had a shorter route to market in 1Q18 than 1Q19 due to the shift at Thompson to a mine-mill operation in 2H18.

Production from Voisey's Bay was 467 t in 1Q19, 16.2% lower than 4Q18 and 5.7% lower than 1Q18. Production was lower than 4Q18 due to the scheduled maintenance being conducted at the Long Harbour refinery in 1Q19. Compared to 1Q18, production was lower due to the 1Q19 scheduled maintenance at Long Harbour and the consumption of previously held Voisey's Bay source cobalt at the Sudbury smelting operation during 1Q18.

Production from New Caledonia reached 412 t in 1Q19, 26.6% lower than in 4Q18 and 30.1% lower than 1Q18. Cobalt was impacted by the decision to decrease nickel production in order to institute a proactive maintenance program that increases asset reliability and an operating plan that improves final nickel product quality aligned with the needs of the battery production industry.

Production from other sources was 166 t in 1Q19, 21.2% higher than 4Q18 and 325.6% higher than 1Q18. Other source production varies according to the cobalt content of external feeds that are consumed in the processes and it also includes PTVI source material being processed through the Port Colborne refinery in the North Atlantic operations.

Other by-products

	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
PLATINUM (000' oz troy)	35	32	31	9.4%	12.9%
PALLADIUM (000' oz troy)	42	42	73	0.0%	-42.5%
GOLD BY-PRODUCT (000' oz troy)	108	133	113	-18.8%	-4.4%

Coal

000' metric tons	1Q19	4Q18	1Q18	1Q19/4Q18	1Q19/1Q18
COAL PRODUCTION	2,213	3,108	2,432	-28.8%	-9.0%
Metallurgical Coal	1,051	1,641	1,401	-36.0%	-25.0%
Thermal Coal	1,162	1,466	1,031	-20.7%	12.7%
COAL SALES	2,394	3,433	2,497	-30.3%	-4.1%
Metallurgical Coal	1,291	1,790	1,432	-27.9%	-9.8%
Thermal Coal	1,103	1,643	1,065	-32.9%	3.6%

Production overview

Coal production totaled 2.2 Mt in 1Q19, 28.8% lower than in 4Q18 as a result of an extremely severe rainy season in comparison to previous years. The heavy rain also affected the access to some mine faces, thus impacting the grade quality of the run-of-mine (ROM) and the mix of thermal and metallurgical coal. Product mix was also affected by the already planned lower ROM grade quality of the mine sections being opened.