

# 10

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# The Group structure: main assets<sup>1</sup>

## MINING AND METALLURGICAL

- Polar Division
- Medvezhy Ruchey (100% stake)
- Kola MMC (100% stake)
- GRK Bystrinskoe (50,01% stake)
- Norilsk Nickel Harjavalta Oy (Finland, 100%)
- Nkomati Nickel Mine (South Africa, 50% stake)

## GEOLOGICAL EXPLORATION

- Norilskgeologiya (100% stake)
- Vostokgeologiya (100% stake)
- Intergeoproekt (100% stake)

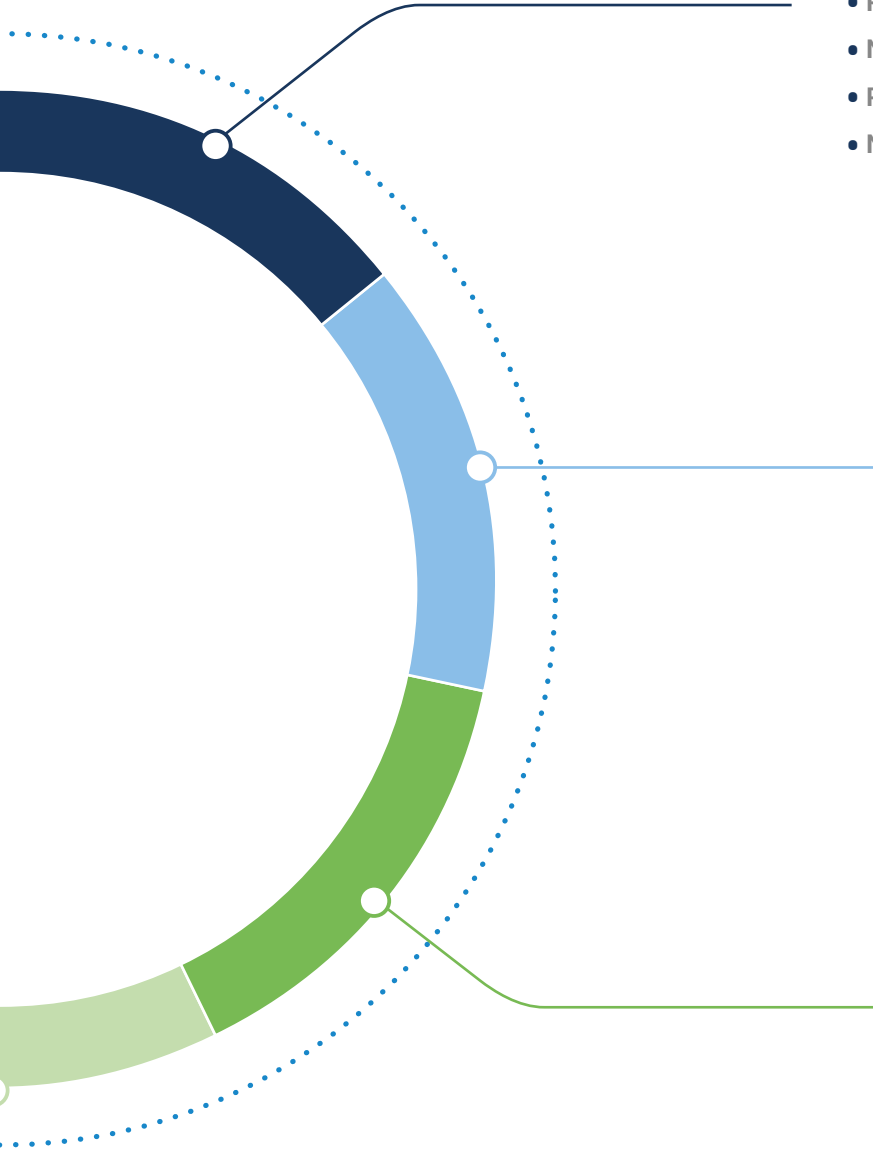
## ENERGY

- Norilskenergo Division
- Taimyrenergo (100% stake)
- NTEK (100% stake)
- Norilskgazprom (100% stake)
- Taimyrgaz (100% stake)
- TTK (100% stake)
- Norilsktransgaz (100% stake)
- Arctic-Energo (100% stake)

## SALES AND DISTRIBUTION

- NORMETIMPEX (100% stake)
- Metal Trade Overseas SA (Switzerland, 100% stake)
- Norilsk Nickel Asia Limited (Hong Kong, 100% stake)
- Norilsk Nickel USA Inc. (USA, 100% stake)
- Norilsk Nickel Metal Trading Co., Ltd. (China, 100% stake)

<sup>1</sup> Ownership in subsidiaries (direct and indirect) is indicated from the authorised capital.



## SUPPORTING BUSINESS

- Norilsk Support Complex (100% stake)
- Polar Construction Company (100% stake)
- Norilsknickelremont (100% stake)
- Pechengastroy (100% stake)
- Nornickel – Shared Services Centre (100% stake)

## RESEARCH

- Gipronickel Institute (100% stake)

## TRANSPORT

- Polar Transport Division
- Murmansk Transport Division
- Arkhangelsk Transport Division
- Arkhangelsk Transport Division
- Bystrinsky Transport Division
- Yenisey River Shipping Company (81,99% stake)
- Krasnoyarsk River Port (89,3% stake)
- Lesosibirsk Port (51% stake)
- Norilsk Airport (100% stake)
- NordStar Airlines (100% stake)
- Norilsk Avia (100% stake)

# Performance indicators for 10 years

Norilsk Nickel Group saleable metals production	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>NORILSK NICKEL GROUP<sup>0</sup></b>										
<b>Nickel, t, thereof</b>	<b>279,889</b>	<b>295,840</b>	<b>295,098</b>	<b>300,340</b>	<b>285,292</b>	<b>274,248</b>	<b>266,406</b>	<b>235,749</b>	<b>217,112</b>	<b>218,770</b>
from own Russian feed	232,813	235,518	234,906	223,153	219,273	223,224	220,675	196,809	210,131	216,856
from 3d parties feed	47,076	60,322	60,192	77,187	66,019	51,024	45,731	38,940	6,981	1,914
<b>Copper, t, thereof</b>	<b>400,778</b>	<b>388,027</b>	<b>377,944</b>	<b>363,764</b>	<b>371,063</b>	<b>368,008</b>	<b>369,426</b>	<b>360,217</b>	<b>401,081</b>	<b>473,654</b>
from own Russian feed	382,443	365,698	362,854	344,226	345,737	345,897	352,766	344,482	397,774	473,515
from 3d parties feed	18,335	22,329	15,090	19,538	25,326	22,111	16,660	15,735	3,307	139
<b>Palladium, koz, thereof</b>	<b>2,794</b>	<b>2,855</b>	<b>2,806</b>	<b>2,732</b>	<b>2,662</b>	<b>2,752</b>	<b>2,689</b>	<b>2,618</b>	<b>2,780</b>	<b>2,729</b>
from own Russian feed	2,676	2,723	2,704	2,624	2,529	2,582	2,575	2,526	2,728	2,729
from 3d parties feed	118	132	102	108	133	170	114	92	52	0
<b>Platinum, koz, thereof</b>	<b>658</b>	<b>692</b>	<b>696</b>	<b>683</b>	<b>650</b>	<b>662</b>	<b>656</b>	<b>644</b>	<b>670</b>	<b>653</b>
from own Russian feed	636	663	672	658	604	595	610	610	650	653
from 3d parties feed	22	29	24	25	46	67	46	34	20	0
<b>POLAR DIVISION AND KOLA MMC (RUSSIA)</b>										
<b>Nickel, t</b>	<b>232,813</b>	<b>235,518</b>	<b>237,227</b>	<b>233,632</b>	<b>231,798</b>	<b>228,438</b>	<b>222,016</b>	<b>182,095</b>	<b>157,396</b>	<b>158,005</b>
Polar division	124,250	124,200	124,000	124,000	122,700	122,390	96,916	50,860	0	0
Kola MMC, thereof	108,563	111,318	113,227	109,632	109,098	106,048	125,100	131,235	157,396	158,005
from own Russian feed	108,563	111,318	110,906	99,153	96,573	100,834	123,335	126,937	155,110	157,519
from 3d parties feed	0	0	2,321	10,479	12,525	5,214	1,765	4,298	2,286	486
<b>Copper, t</b>	<b>382,443</b>	<b>365,698</b>	<b>363,460</b>	<b>352,466</b>	<b>359,102</b>	<b>354,943</b>	<b>355,707</b>	<b>350,619</b>	<b>387,640</b>	<b>436,201</b>
Polar division	323,705	309,320	303,940	295,610	296,760	297,552	292,632	280,347	306,859	353,131
Kola MMC, thereof	58,738	56,378	59,520	56,856	62,342	57,391	63,075	70,272	80,781	83,070
from own Russian feed	58,738	56,378	58,914	48,616	48,977	48,345	60,134	63,542	78,587	82,987
from 3d parties feed	0	0	606	8,240	13,365	9,046	2,941	6,730	2,194	83
<b>Palladium, koz</b>	<b>2,676</b>	<b>2,723</b>	<b>2,704</b>	<b>2,628</b>	<b>2,580</b>	<b>2,660</b>	<b>2,606</b>	<b>2,554</b>	<b>2,738</b>	<b>2,671</b>
Polar division	2,010	2,053	2,038	1,989	2,006	2,065	1,935	1,703	956	987
Kola MMC, thereof	666	670	666	639	574	595	671	851	1,782	1,684
from own Russian feed	666	670	666	635	523	517	640	815	1,737	1,684
from 3d parties feed	0	0	0	4	51	78	31	36	45	0
<b>Platinum, koz</b>	<b>636</b>	<b>663</b>	<b>672</b>	<b>660</b>	<b>627</b>	<b>627</b>	<b>622</b>	<b>622</b>	<b>660</b>	<b>642</b>
Polar division	505	529	536	529	504	500	488	449	259	260
Kola MMC, thereof	131	134	136	131	123	127	134	173	401	382
from own Russian feed	131	134	136	129	100	95	122	159	385	382
from 3d parties feed	0	0	0	2	23	32	12	14	16	0

Norilsk Nickel Group saleable metals production	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
<b>GRK BYSTRINSKOE (RUSSIA, ZABAYKALSKY KRAI)<sup>②</sup></b>										
Copper, t	0	0	0	0	0	0	0	0	0	19,417
Gold, koz	0	0	0	0	0	0	0	0	0	90
Iron ore concentrate (66%), t	0	0	0	0	0	0	0	0	0	346
<b>NORILSK NICKEL HARJAVALTA (FINLAND)</b>										
<b>Nickel, t, thereof</b>	<b>28,452</b>	<b>49,159</b>	<b>48,525</b>	<b>45,518</b>	<b>44,252</b>	<b>42,603</b>	<b>43,479</b>	<b>53,654</b>	<b>59,716</b>	<b>60,765</b>
from own Russian feed	0	0	0	0	0	0	424	19,012	55,021	59,337
<b>Copper, t, thereof</b>	<b>4,983</b>	<b>11,279</b>	<b>5,681</b>	<b>1,006</b>	<b>6,549</b>	<b>10,629</b>	<b>13,048</b>	<b>9,598</b>	<b>13,441</b>	<b>18,036</b>
from own Russian feed	0	0	0	0	0	0	0	593	12,328	17,980
<b>Palladium, koz, thereof</b>	<b>18</b>	<b>48</b>	<b>34</b>	<b>21</b>	<b>39</b>	<b>74</b>	<b>78</b>	<b>64</b>	<b>42</b>	<b>58</b>
from own Russian feed	0	0	0	0	0	0	0	8	35	58
<b>Platinum, koz, thereof</b>	<b>5</b>	<b>15</b>	<b>12</b>	<b>9</b>	<b>16</b>	<b>31</b>	<b>33</b>	<b>22</b>	<b>10</b>	<b>11</b>
from own Russian feed	0	0	0	0	0	0	0	2	6	11
<b>NORILSK NICKEL AUSTRALIA (AUSTRALIA)</b>										
Nickel, t	1,223	0	0	8,975	2,826	0	0	0	0	0
<b>NORILSK NICKEL TATI (BOTSWANA)<sup>③</sup></b>										
Nickel, t	17,401	11,163	9,346	12,215	6,416	3,207	911	0	0	0
Copper, t	13,352	11,050	8,803	10,292	5,412	2,436	671	0	0	0
Palladium, koz	100	84	68	83	43	18	5	0	0	0
Platinum, koz	17	14	12	14	7	4	1	0	0	0
<b>NORILSK NICKEL NKOMATI (SOUTH AFRICA)<sup>④</sup></b>										
Nickel, t	3,005	5,525	5,815	9,624	11,920	11,359	11,350	8,486	8,006	6,597
Copper, t	1,436	3,082	2,927	4,594	5,034	4,938	5,301	4,007	4,504	3,055
Palladium, koz	11	23	24	32	46	48	53	40	46	33
Platinum, koz	3	7	9	12	20	19	20	15	20	13

① Total amounts may vary from the sum of numbers due to arithmetical rounding. The production results of Nkomati are not included in the total amounts of the Group.

② Norilsk Nickel Group owns 50.01% of Bystrinsky GOK (Chita Copper Project). Production results are reported as metal contained in saleable concentrate on a 100% basis and are fully consolidated in the Group's total operating results. The hot commissioning of the project started on October 31, 2017.

③ The sale of the asset was closed on April 2, 2015.

④ Norilsk Nickel Group owns 50% of Nkomati. Production results are reported as metal contained in saleable concentrate on a 50% basis and are not consolidated in the Group's total operating results.

# Resources and reserves

Minerals reserves and resources as at December 31, 2018 <sup>0</sup>	Ore kt	Metal grade						Contained metal					
		Ni %	Cu %	Pd g/t	Pt g/t	Au g/t	6 PGM g/t	Ni kt	Cu kt	Pd koz	Pt koz	Au koz	6 PGM koz
<b>TAIMYR PENINSULA</b>													
<b>Proven and probable reserves</b>	<b>683,625</b>	<b>0.92</b>	<b>1.73</b>	<b>4.23</b>	<b>1.12</b>	<b>0.24</b>	<b>5.60</b>	<b>6,286</b>	<b>11,858</b>	<b>92,864</b>	<b>24,600</b>	<b>5,331</b>	<b>122,982</b>
<b>Proven reserves</b>													
Talnakh ore field, including	328,571	0.79	1.55	3.84	1.04	0.23	5.08	2,600	5,080	40,582	10,938	2,398	53,664
rich	51,627	2.52	3.10	6.25	1.30	0.23	7.89	1,299	1,603	10,380	2,156	385	13,100
cuprous	19,770	0.97	3.93	9.56	2.32	0.64	12.01	192	776	6,073	1,472	405	7,633
disseminated	257,174	0.43	1.05	2.92	0.88	0.19	3.98	1,109	2,701	24,129	7,310	1,608	32,931
Norilsk-1 deposit (disseminated ore)	21,628	0.35	0.51	3.95	1.58	0.18	5.82	76	110	2,744	1,101	122	4,045
<b>Probable reserves</b>													
Talnakh ore field, including	311,622	1.14	2.11	4.64	1.13	0.27	6.07	3,549	6,588	46,529	11,347	2,676	60,828
rich	79,629	2.90	3.95	7.11	1.40	0.26	9.05	2,308	3,145	18,199	3,581	664	23,160
cuprous	61,380	0.75	3.17	7.12	1.86	0.52	9.20	461	1,944	14,057	3,666	1,017	18,153
disseminated	170,613	0.46	0.88	2.60	0.75	0.18	3.56	780	1,499	14,273	4,100	995	19,515
Norilsk-1 deposit (disseminated ore)	21,804	0.28	0.37	4.29	1.73	0.19	6.34	61	80	3,009	1,214	135	4,445
<b>Measured and indicated resources</b>	<b>1,708,565</b>	<b>0.70</b>	<b>1.31</b>	<b>3.56</b>	<b>1.00</b>	<b>0.21</b>	<b>4.78</b>	<b>11,892</b>	<b>22,437</b>	<b>195,441</b>	<b>55,122</b>	<b>11,565</b>	<b>262,296</b>
Talnakh ore field, including	1,561,555	0.73	1.40	3.55	0.96	0.22	4.71	11,456	21,877	178,029	48,335	10,840	236,698
rich	113,786	3.23	4.25	7.96	1.60	0.29	10.10	3,675	4,840	29,123	5,845	1,069	36,950
cuprous	68,710	0.98	4.08	9.40	2.40	0.66	12.04	674	2,806	20,755	5,297	1,467	26,588
disseminated	1,379,059	0.52	1.03	2.89	0.84	0.19	3.91	7,107	14,231	128,151	37,193	8,304	173,160
Norilsk-1 deposit (disseminated ore)	147,010	0.30	0.38	3.68	1.44	0.15	5.42	436	560	17,412	6,787	725	25,598
<b>Inferred resources</b>	<b>440,898</b>	<b>0.85</b>	<b>1.74</b>	<b>4.22</b>	<b>1.09</b>	<b>0.25</b>	<b>5.54</b>	<b>3,750</b>	<b>7,653</b>	<b>59,754</b>	<b>15,435</b>	<b>3,545</b>	<b>78,321</b>
Talnakh ore field	1,068	0.28	0.28	3.69	1.46	0.13	7.78	3	3	127	50	4	267
Norilsk-1 deposit (disseminated ore)	439,830	0.85	1.74	4.22	1.09	0.25	5.54	3,747	7,650	59,627	15,385	3,541	78,054
<b>KOLA PENINSULA (disseminated ore)</b>													
<b>Proven and probable reserves</b>	<b>100,918</b>	<b>0.58</b>	<b>0.27</b>	<b>0.03</b>	<b>0.02</b>	<b>0.01</b>	<b>0.05</b>	<b>581</b>	<b>271</b>	<b>93</b>	<b>60</b>	<b>29</b>	<b>155</b>
Proven ore reserves	45,074	0.58	0.25	0.03	0.02	0.01	0.05	261	112	42	30	13	73
Probable reserves	55,844	0.57	0.28	0.03	0.02	0.01	0.05	320	159	51	30	16	82
<b>Measured and indicated resources</b>	<b>327,277</b>	<b>0.69</b>	<b>0.33</b>	<b>0.05</b>	<b>0.03</b>	<b>0.02</b>	<b>0.08</b>	<b>2,247</b>	<b>1,089</b>	<b>488</b>	<b>314</b>	<b>177</b>	<b>862</b>
<b>Inferred resources</b>	<b>144,211</b>	<b>0.63</b>	<b>0.31</b>	<b>0.04</b>	<b>0.03</b>	<b>0.01</b>	<b>0.07</b>	<b>909</b>	<b>448</b>	<b>184</b>	<b>121</b>	<b>60</b>	<b>320</b>

Minerals reserves and resources as at December 31, 2018 <sup>1</sup>	Ore kt	Metal grade						Contained metal					
		Ni %	Cu %	Pd g/t	Pt g/t	Au g/t	6 PGM g/t	Ni kt	Cu kt	Pd koz	Pt koz	Au koz	6 PGM koz
<b>AUSTRALIA (Honeymoon Well)</b>													
Measured and indicated resources (nickel sulfide ores)	173,300	0.68	0	0	0	0	0	1,180	0	0	0	0	0
Inferred resources (nickel sulfide ores)	11,900	0.68	0	0	0	0	0	81	0	0	0	0	0
Inferred resources (nickel laterite ores)	339,000	0.81	0	0	0	0	0	2,746	0	0	0	0	0
<b>TOTAL RUSSIAN ASSETS</b>													
Total proven and probable reserves	784,543	0.88	1.55	0.12	0.03	0.01	0.16	6,867	12,129	92,957	24,660	5,360	123,137
Total measured and indicated resources	2,035,842	0.69	1.16	0.10	0.03	0.01	0.13	14,139	23,526	195,929	55,436	11,742	263,158
Total inferred resources	585,109	0.80	1.38	0.10	0.03	0.01	0.13	4,659	8,101	59,938	15,556	3,605	78,641
<b>TOTAL RUSSIAN AND INTERNATIONAL ASSETS</b>													
Total proven and probable reserves	784,543	–	–	–	–	–	–	6,867	12,129	92,957	24,660	5,360	123,137
Total measured and indicated resources	2,209,142	–	–	–	–	–	–	15,319	23,526	195,929	55,436	11,742	263,158
Total inferred resources	936,009	–	–	–	–	–	–	7,486	8,101	59,938	15,556	3,605	78,641

Reserves and resources in South Africa (Nikomati) as at June 30, 2018 <sup>2</sup>	Ore kt	Metal grade				Contained metal			
		Ni %	Cu %	Co %	4 PGM g/t	Ni kt	Cu kt	Co kt	4 PGM koz
Proven and probable reserves	84,450	0.31	0.12	0.02	0.89	261	101	17	2,412
Measured and indicated resources	172,200	0.35	0.14	0.02	0.96	603	241	34	5,315
Inferred resources	46,350	0.40	0.13	0.02	0.97	185	60	9	1,445

<sup>1</sup> Data regarding the mineral resources and ore reserves of the deposits of the Taimyr and Kola peninsulas were classified according to the Australasian Code for Reporting of Mineral Resources and Ore Reserves (JORC code), created by the Australasian Institute of Mining and Metallurgy, the Australian Institute of Geoscientists, and the Minerals Council of Australia, subject to the terminology recommended by the Russian Code for Public Reporting of Exploration Results, Mineral Resources, Mineral Reserves (NAEN Code). Data regarding the reserves and resources is based on the balance-sheet reserves of A, B, C1 and C2, categories (according to the terminology of the State Committee for Mineral Reserves) as of the end of the given calendar year.

Figures given as "Total" may differ from the sum of individual numbers due to rounding. Certain values may in some instances vary slightly from previously published values.

The six platinum group metals (PGMs) are platinum, palladium, rhodium, ruthenium, osmium, and iridium. Hereafter in the annual report, troy ounces are used as a weight measure for PGMS and gold.

Proven and probable ore reserves are included in mineral resources.

Ore losses applied ranged from 1.6 % to 26% and dilution from 6% to 31.9%.

Excluding deposits in Zabaykalsky Krai.

<sup>2</sup> The Group owns 50% of Nkomati, which operates a nickel mine of the same name. The co-shareholder of the company is African Rainbow Minerals. Nkomati's performance is reflected in financial results using proportional consolidation according to our stake and not reflected in other totals.



# Energy consumption by MMC Norilsk Nickel<sup>o</sup>

Type of energy	2016		2017		2018	
	Consumption in volume terms	RUB '000	Consumption in volume terms	RUB '000	Consumption in volume terms	RUB '000
Heat power	5,587,849 Gcal	4,702,584	4,737,249 Gcal	4,393,019	4,295,081 Gcal	4,606,657
Electric power	5,158,974 thousand kWh	5,272,779	4,489,188 thousand kWh	4,854,566	4,174,431 thousand kWh	4,668,543
Motor fuel	344 t	17,797	268 t	15,348	273 t	14,612
Diesel fuel	58,671 t	2,657,599	52,684 t	2,431,146	52,859 t	2,598,687
Heating oil	40,479 t	582,489	40,360 t	566,985	44,233 t	840,447
Natural gas	545,712,000 m <sup>3</sup>	1,363,718	497,141,000 m <sup>3</sup>	1,458,756	493,279,000 m <sup>3</sup>	1,482,681
Coal	49,760 t	20,612	17,359 t	4,204	16,473 t	7,545
Kerosene and aviation fuel	115 t	5,008	124 t	6,122	127 t	6,083

• Data on energy consumption is presented only by MMC Norilsk Nickel (excluding Kola MMC, Norilsk Nickel Harjavalta, GRK Bystrinskoye).  
No other types of energy were used besides those specified in the table.

## Metric conversion table and currency exchange rates

### METRIC CONVERSION TABLE

Length		Area		Weight	
1 km	0.6214 mi	1 sq m	10.7639 sq ft	1 kg	2.2046 lb
1 m	3.2808 ft	1 sq km	0.3861 sq mi	1 metric tonne	1,000 kg
1 cm	0.3937 in	1 ha	2.4710 acres	1 short tonne	907.18 kg
1 mi	1.609344 km	1 sq ft	0.09290304 sq m	1 troy ounce	31.1035 g
1 foot	0.3048 m	1 sq m	2.589988 sq km	1 lb	0.4535924 kg
1 in	2.54 cm	1 acre	0.4046873 ha	1 g	0.03215075 oz t

### CURRENCY EXCHANGE IN 2014–2018

Index	2014	2015	2016	2017	2018
Average rate Russian Rouble / US Dollar for the year ended 31 December	38.42	60.96	67.03	58.35	62.71

# Glossary

**Agglomeration.** The process of compacting and forming a solid mass from ore fines (dust), concentrates or metal-bearing waste by heat to obtain agglomerate.

**Anode.** Crude metal (nickel or copper) obtained from anode smelting and fed for electrolytic refining (electrolysis) whereby it is dissolved.

**Cake.** Solid residue from filtering pulp during leaching of ores, concentrates or metallurgical intermediates, and purification of processing solutions.

**Cathode.** Pure metal (nickel or copper) obtained as a result of electrolytic refining of anodes.

**Concentrate.** A product of ore concentration with a high grade of the extracted mineral, which gives its name to the concentrate (copper, nickel, etc.).

**Concentration.** Artificial improvement of metallurgical feedstock mineral grades by removal of a major portion of waste rock not containing any valuable minerals.

**Conversion.** Oxidation process to turn matte into converter matte (in smelting copper-nickel concentrates) or blister copper (in smelting copper concentrates) and remove slag (carbon, sulphur, iron and other impurities).

**Converter matte.** A metallurgical intermediate produced as a result of matte conversion. Depending on the chemical composition, the following types of converter matte are distinguished: copper, nickel and copper-nickel.

**Cuprous ores.** Ores containing 20% to 70% sulphides, with the following metal grades: 0.2–2.5% for nickel, 1.0–15.0% for copper, 5–50 g/t for platinum group metals.

**Disseminated ores.** Ores containing 5% to 30% sulphides, with the following metal grades: 0.2–1.5% for nickel, 0.3–2% for copper, and 2–10 g/t for platinum group metals.

**Drying.** Removal of moisture from concentrates performed in designated drying furnaces (to a moisture level below 9%).

**Electrolysis.** A series of electrochemical reduction-oxidation reactions at electrodes immersed in an electrolyte as a result of passing of an electric current from an external source.

**Electrowinning.** Electrodeposition of metal from ores that have been put in solution. Ore or concentrate is leached with agents that dissolve metal-containing minerals or the entire material, so that the metal is deposited on the cathode. The electrolyte is typically reused in the process. The end product is high-purity metal cathode.

**Filtration.** The process of reducing the moisture level of the pulp by forcing it through a porous medium.

**Flash smelter.** An autogenous smelter for processing dry concentrates, where the smelted substance is finely ground feedstock mixed with a gaseous oxidiser (air, oxygen), which holds melted metal particles suspended. The heat from oxidation reactions is actively used in the process.

**Flotation.** A concentration process where specific mineral particles suspended within the pulp attach to air bubbles. Poorly wettable mineral particles attach to the air bubbles and rise through the suspension to the top of the pulp, producing foam, while well wettable mineral particles do not attach to the bubbles and remain

in the pulp. This is how the minerals are separated.

**Fluidised bed furnace.** A furnace where solid particles are intensively mixed under a fluidising impact of heated gas (air, oxygen or flue gases) flowing through the bed of grainy material (powder, granules).

**Intrusion.** Intrusive rock forms within Earth's crust from the crystallisation of magma. Intrusions may be layered, with a regular stratigraphic sequence of rock.

**Leaching.** Selective dissolution of one or several components of the processed solid material in organic solvents or water solutions of inorganic substances. Kinds of leaching: acid leaching (leaching with acids as reagents), chlorine leaching.

**Matte.** Intermediate product in the form of an alloy of sulphides of iron and non-ferrous metals with a varying chemical composition. Matte is the main product accumulating precious metals and metal impurities the feedstock contains.

**Metal extraction.** The ratio between the quantity of a component extracted from the source material and its quantity in the source material (as a percentage or a fraction).

**Metal grade.** The ratio between the weight of metal in the dry material and the total dry weight of the material expressed as a percentage or grammes per tonne (g/t).

**Mine.** A mining location for extraction of ores.

**Ore mixture.** A mixture of materials in certain proportions needed to achieve the required chemical composition of the end product.

**Ore.** Natural minerals containing metals or their compounds in economically valuable amounts and forms.

**Oxide.** A compound of a chemical element with oxygen.

**Probable ore reserves.** Estimated based on the economically mineable part of indicated and, in some circumstances, measured mineral resources, including possible dilution and losses during mining operations.

**Proven ore reserves.** Estimated based on the economically mineable part of measured mineral resources, including possible dilution and losses during mining operations.

**Pulp.** A mixture of finely ground rock with water or a water solution.

**Pyrrhotite concentrate.** By-product of copper-nickel ore concentration.

**Refinement.** The process of extracting high purity precious metals through their separation and removal of impurities.

**Reverberatory furnace.** A smelting furnace in which heat passes to material being processed from contact with gaseous fuel combustion products and the hot inner surface of refractory lining (for example, in producing matte from copper ores or concentrates).

**Rich ores.** Ores with high sulphide content (over 70%) and the following metal grades: 2–5% for nickel, 2–25% for copper, and 5–100 g/t for platinum group metals.

**Roasting.** Heating ore to high temperatures to trigger chemical changes that enable subsequent metal recovery processes.

**Shop area.** A part of a (metallurgical) shop.

**Slag.** Melted or solid substance with a varying composition that covers the surface of a liquid product during

metallurgical processes (resulting from ore mixture melting, melted intermediate processing and metal refining) and includes waste rock, fluxes, fuel ash, metal sulphides and oxides, and products of interaction between the processed materials and lining of melting units.

**Sludge.** Powder product containing precious metals settling during electrolysis of copper and other metals.

**Sublevel caving.** An underground mining method in which ore blocks are developed from top to bottom via sublevels, and ore is extracted by blasting or causing sublevels to cave in. The voids formed after extraction get filled with fractured rock.

**Sulphides.** Compounds of metals and sulphur.

**Tailings pit.** A complex of hydraulic structures used to receive and store mineral waste / tailings.

**Tailings.** Waste materials left over after concentration processes and containing mostly waste rock with a minor amount of valuable minerals.

**Thickening.** Separation of liquid (water) and solid particles in dispersion systems (pulp, suspension, colloid) based on natural gravity settling of solid particles in settlers and thickeners, or centrifugal settling of solid particles in hydrocyclones.

**Tolling agreement.** An agreement to process foreign feedstock with subsequent shipping of finished product. The feedstock and end product are exempt from customs duties.

**Underground (subsurface) mining.** A set of stripping, preparatory and stoping operations.

**Vanyukov furnace.** An autogenous smelter for processing concentrates, where smelting is performed in a bath of slag and matte, with intensive injection of air-oxygen mixture. The heat from oxidation reactions is actively used in the process.

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