Kumash Patel
Cobalt – Commodity Report

Cobalt

Uses

Cobalt is used in the production of batteries, medical equipment, electronics and military equipment. Battery production accounts for 52% of the global cobalt sales. Cobalt is also used to make exotic alloys for military applications.

Most lithium-ion batteries are cobalt based. They have an ionized active cathode material. Cobalt is used to achieve high energy density in these batteries. Different metals are used in the cathode customize charge-discharge characteristics of the battery. The anode is always graphite; electrolyte material is subject to optimization. Manganese batteries have a cathode material with a weight percent ranging from 33 – 27 percent (Dunn et al, 2012.). By assuming a similar concentration of cathode material in cobalt-rich compositions, we can estimate amount of cobalt used in battery production. Cobalt batteries have proven to be crucial in smartphones and laptops (devices requiring large storage capacity but low power output). (BU-205, 2018)

However the bulk of battery production is dedicated towards Electric vehicles and Industrial applications. Cathode chemistries such as Nickel Manganese Cobalt Oxide (NMC) and Lithium Nickel Cobalt Aluminum Oxide (NCA) are a better solution for such applications. The amount of cobalt used in these batteries is 66% less than Cobalt-rich compositions. (BU-205, 2018)

Prices

Cobalt prices rose from 2007 to 2018. However the price has dropped by 63% in 2019 on the London Metal Exchange "LME". This is could be an effect of the influx of new cobalt from Democratic Republic of Congo "DRC". It is also interesting to note that DRC makes up about 50% of the world's supply of cobalt, and about 50% of the reserves. Some interactive graphs showing aspects of cobalt production can be accessed here.

42% of the Cobalt demand comes from the battery industry. In recent years, due to the high demand from Electric Vehicles market, the demand for cobalt has increased, and we can infer the effects of that demand on our chart. In 2017, the total value of cobalt production was about 8 billion dollars. Due to rising costs of cobalt, battery companies have been pushing for a new battery chemistry that reduces cobalt, but works for EV applications. If the battery companies were successful, that could also explain the recent 2019 drop in cobalt prices.

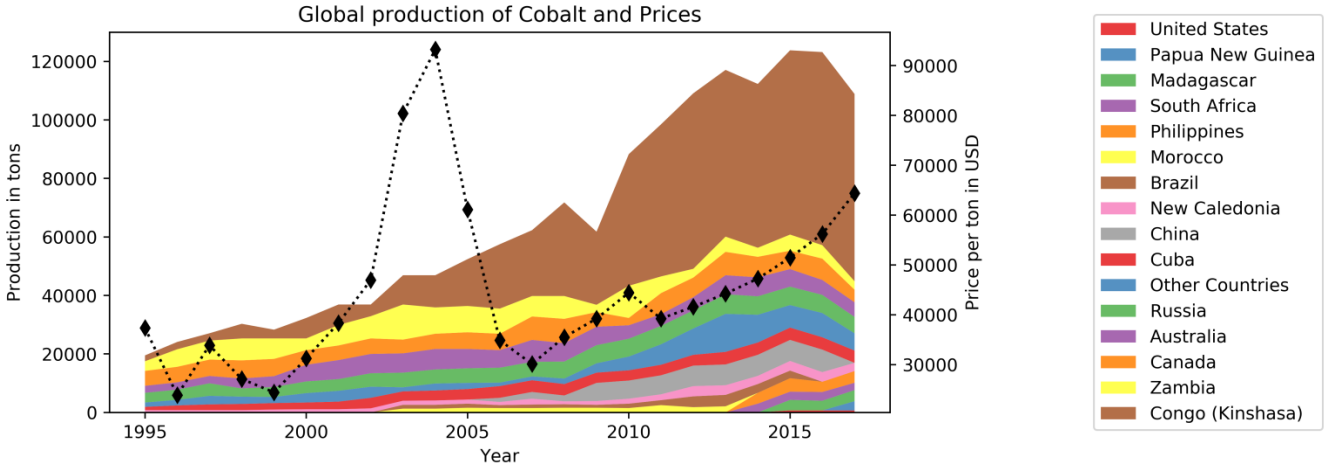

Figure 1 - Global Production of Cobalt (Data from Shedd.K. 2018 and Cobalt Price. 2018)

Kumash Patel
Cobalt – Commodity Report

Geological Setting

Cobalt can be found in multiple geological settings. In the DRC, cobalt is found with copper in a stratiform sediment-based deposit. A notable example is the Konglowe copper-cobalt occurrence in the DRC, this area is currently being mined by Nzuri copper limited. The occurrence is reported to be 2.94% Cu and 0.34% Co. Countries such as Cuba, New Caledonia, Philippines, Australia, United States, Madagascar and Russia have laterite cobalt deposits from weathered ultramafic rocks. These countries account for a significant portion of the global cobalt production. (Mudd et al., 2013)

Outside of laterite deposits, cobalt mineralizes as linnaeite, siegenite, carrolite and cobaltite. These minerals form from Co substitution into other sulphide minerals like arsenopyrite, pyrrhotite, pyrite or pentlandite. These minerals can be found in Magmatic deposits (Sudbury), Skarn (Pennsylvania), Massive Volcanogenic (British Columbia), Vein or Replacement Deposits (Cobalt, Ontario). (Mudd et al., 2013)

Cobalt is also known to be found on the ocean floor near seafloor hydrothermal systems. Hypothetically this figure is in millions of tons of Cobalt content.

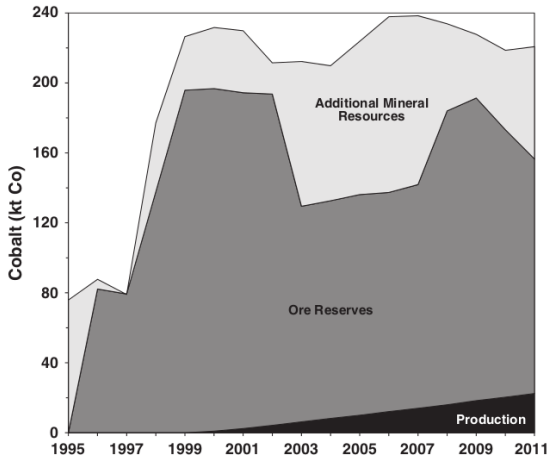

Figure 2 – Cobalt Resources, Reserves and Production over time (Reprinted from Mudd et Al., 2013)

Occurrences in Canada

Outside of Ontario, Cobalt is known to occur in the windy Craggy deposit in BC which is a Volcanogenic Massive Sulphide complex. There are a few sizable cobalt deposits found in Saskatchewan, however since these deposits are primarily unconformity related Uranium deposits. Extraction of cobalt from these sites is unlikely to happen in the near future due to the radioactivity of the ore. (Mudd et al., 2013)

Occurrences in Ontario

Ontario is where majority of Canadian cobalt is extracted from. There is even a city named after the element. Cobalt, Ontario hosted vein type cobalt deposits. Some of these veins hosted grades up to 10% Co. An average source of cobalt ranges between 0.2 to 1% Co. (Mudd et al., 2013)

Mafic and ultramafic intrusive rocks found in the Sudbury complex host significant deposits of massive or disseminated Iron-Nickel-Copper ore. These deposits have Co content that can be hundreds of parts per million or 0.01%. Cobalt is mined as a secondary commodity from these mines. (Mudd et al., 2013)

References

1 .BU-205: Types of Lithium-ion. (2018). Retrieved February 5, 2019, from https://batteryuniversity.com/learn/article/types_of_lithium_ion
2. *Cobalt Price. (*2018). Retrieved February 5 2019, from https://www.metalary.com/cobalt-price/
3. Dunn B., Gaines L., Barnes M., Sullivan J., & Wang M. (2012). *Material and Energy Flows in the Materials Production, Assembly, and End-of-Life Stages of the Automotive Lithium-Ion Battery Life Cycle*. United States. doi:10.2172/1177517.
4. Mudd G., Weng Z., Jowitt S., Turnbull I., Graedel T. (2013). *Quantifying the recoverable resources of by-product metals: The case of cobalt*. Ore Geology Reviews, 55, 87-98. Retrieved from Elsevier. Doi: 10.1016
5. Nzuri Copper Limited, (2018). Investor presentation - April 2018. Nzuri Copper Limited, Australia
6. Shedd, K. B. (2018, December 20). *Cobalt: Statistics and Information.* United States Geological Survey. Retrieved February 7, 2019, from https://minerals.usgs.gov/minerals/pubs/commodity/cobalt/index.html