

November 10, 2005

Selenium Market Overview

Highlights

- Yukon Zinc's Wolverine Project could annually produce concentrates containing 760,000 lbs (345 tonnes) of selenium, or about 15% of world demand
- Selenium price has increased in the past 24 months to a recent high over US\$63 per pound from US\$3.75 per pound (average spot price), with a current average spot price plateau above US\$50 per pound
- Contained selenium in forecast Wolverine annual production is valued at US\$38M at US\$50 per pound
- China purchased all refiner inventories in 2003 and has entered into long term contracts for additional supply
- Selenium is currently in extreme supply shortfall with orders exceeding supply
- Selenium supply restricted by static primary supply from mining of copper, nickel and other metals in sulphide ores
- Health benefits of selenium are spawning new uses and increased demand
- A move by governments to mandate inclusion of selenium in fertilizers could significantly increase world demand
- Limited opportunities to develop new supply in short to intermediate term creates positive price outlook

Introduction

This overview of the selenium markets is provided to illustrate the potential significance of selenium production from the Yukon Silver-Zinc Project and the initial development of the Wolverine Deposit. The information in this overview is taken from a number of public and private sources and has been compiled in summary fashion to provide an overview of selenium supply and demand. Selenium is a metal that is finding increased usage at a time when supply appears to be static to shrinking.

The recent dramatic price increase in selenium reflects the depletion of all available supply and strong demand from China. Supply constraints suggest that selenium prices will remain at record levels until new supply is developed. Yukon Zinc's Wolverine deposit is one of the few deposits in the world with abundant selenium that could fill part of the supply gap.

Following this summary, we have provided a list of sources for selenium data that provide additional information, particularly on new findings in medical usage and benefits of selenium.

Yukon Silver-Zinc Project Production

The Wolverine deposit is one of three deposits discovered in the Finalyson District, Yukon, since initial discovery of the Kudze Kayah deposit in 1994. Wolverine is the richest of the deposits and has a very high concentration of selenium compared to all known deposits. Other similar volcanogenic massive sulphide deposits characterized by high selenium contents include deposits in the Mattagamit District, Quebec and Skellefte District in Sweden; both of which are nearing depletion.

The Wolverine deposit contains approximately 2,800 tonnes of selenium (mineable reserves only comprising approximately half of aggregate resources) and hence is an important source of future selenium supply.

Selenium in Wolverine Concentrates	Selenium Content (%)	Contained Selenium Annual Production (3yr average) (lbs)	Contained Value @ US\$50 per lb
Zinc Concentrate	0.17	350,000	US\$17.5 M
Cu Concentrate	0.34	145,000	US\$7.3 M
Lead Concentrate	1.50	263,000	US\$13.2 M
Total		758,000	US\$37.9 M

The Wolverine deposit is in feasibility and test mining phase for planned completion by end of 2005. A production decision in early 2006 would provide for production in the second half of 2007. The project as currently conceived would produce 94,600 tonnes of zinc, 22,300 tonnes of copper and 14,600 tonnes of lead concentrates containing 51,500 tonnes of zinc, 4,800 tonnes of copper, 3300 tonnes of lead, 7,270,00 ounces of silver, 35,800 ounces of gold and 758,000 pounds of selenium.

Prior to 2003, selenium was in surplus and smelters levied penalties for exceeding very low limits resulting in the expected Wolverine concentrates being subjected to large penalties. At that time the Wolverine concentrates were considered undesirable! With the more than ten-fold increase in price and unfulfilled demand, *Wolverine concentrates are now a preferred product* for smelters with the capacity to recover the selenium.

Yukon Zinc is now studying the selenium and smelter markets in preparation for negotiation of the removal of the penalty and securing price participation. Historically, it has cost US refiners approximately US\$4 per pound to recover the selenium from anode slimes. Therefore, at recent prices there is a very large profit margin.

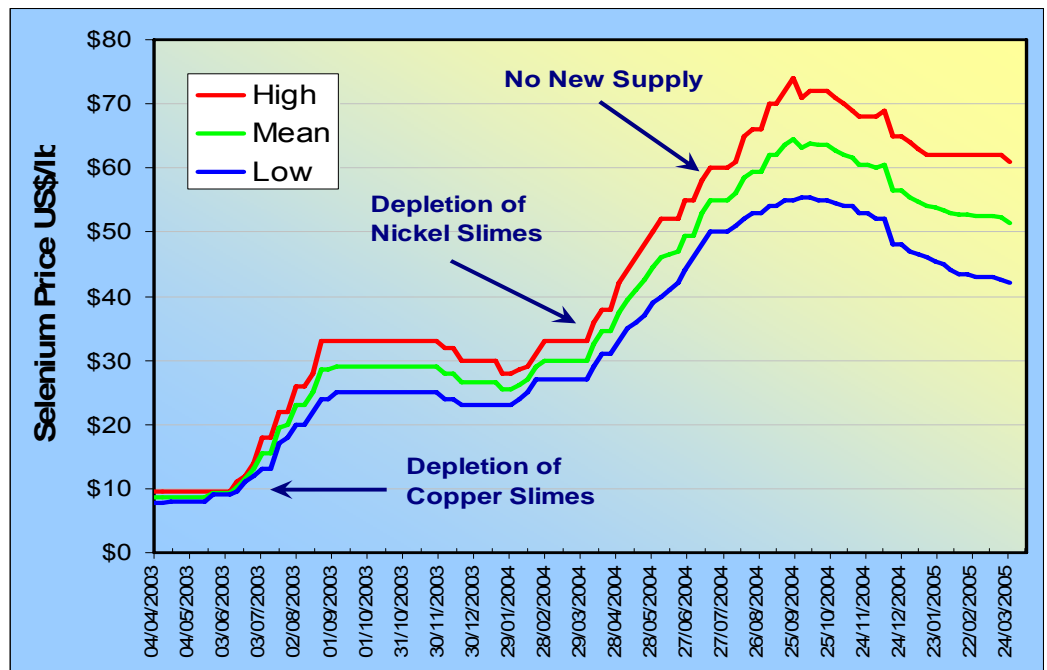
Yukon Zinc has also undertaken preliminary investigation of the recovery of selenium at site and intends to undertake further study to determine potential cost-benefit to the project.

Removal of the selenium penalty and price participation for selenium would provide significant additional revenue, further reducing cash cost of producing zinc at Wolverine to very low levels.

Selenium Prices

The chart to the right illustrates the dramatic increase Selenium prices. Traders are currently reporting high demand for selenium with no supply to fill orders (Platts, Metal Bulletin, Dec. 2004).

The rapid increase in selenium price is the result of large purchases of selenium by China in second half 2003, depleting refinery inventories. This high demand continues and as spot supply dries up, purchasers are now reportedly trying to locate supply under long term contracts with refiners. The shortfall in supply appears to be endemic over the short to intermediate term until new supply is developed.



Source: MetalPrices.com (May 16, 2005)

Selenium Usage

Selenium enjoys a wide range of usages that are expanding. Current usage of selenium is as follows:

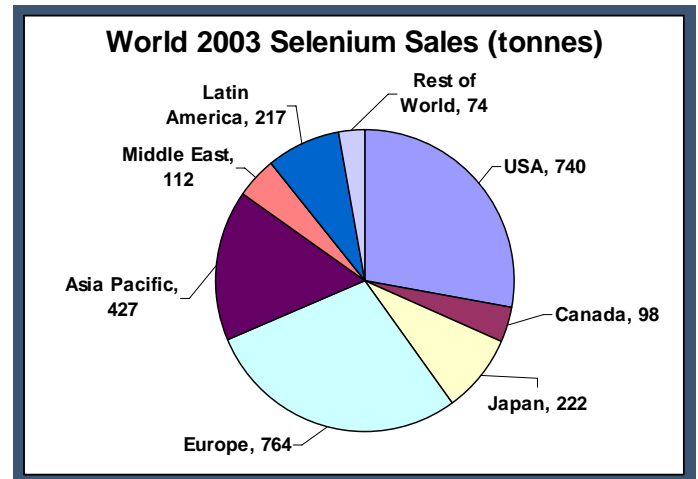
Glass	(25.7%)	Decolorant in container glass and colorant in other glass, solar heat reductant in architectural glass
Metallurgy	(23.9%)	Alloy steel to improve machinability, lead-free alloys, in low antimony-lead batteries, manganese smelting industry and substitution for nickel in steel
Chemicals	(15.2%)	Pharmaceuticals, food supplements, anti-dandruff shampoos, lubricants and rubber compounding
Pigments	(10.3%)	Colorant in cadmium-sulphide pigments used in paint, inks, glazes, enamels
Electronics	(9.1%)	In photoreceptors, laser printing, xerography, xeroradiography and electrostatic textile printing, semiconductors, solar cells and photoelectric cells
Agriculture and Other	(15.7%)	Primarily additive to animal feed and fertilizers

World Consumption

Consumption is estimated at 2,650 tonnes in 2003 and has been increasing at 1.6% per annum over the period 1990 to 2000. Historically, the growth appears steady; however, the recent market activity of China purchasing all available selenium inventories suggests much larger growth rates in China as its economy expands at a very rapid rate.

The major consumers of selenium in order of importance are Europe, United State and Asia-Pacific, with the latter having the highest rate.

At the current price, above US\$50 per pound, annual selenium sales aggregate approximately US\$300 million, which makes it a relatively small market. The small amount of selenium in most products results in modest increase in their cost.



World Production

Total selenium refinery production is estimated at 1,673 tonnes for 2003. The 2003 production is a 10.4% increase over 2002, with the large growth presumably reflecting the shipment of slime and other selenium-bearing materials to the refiners in response to the depletion of selenium inventories and to the significant price increase.

Primary selenium comes primarily from mining of copper, nickel and cobalt ores. Approximately 252 tonnes of selenium is estimated to come from secondary sources of selenium scrap.

Selenium Refinery Production	2003 Production (Metric Tonnes)	Market Share
Japan (Dowa, Sumitomo, Nippon, Shinko)	757	45.2%
Canada (Noranda/Falconbridge)	238	14.2%
Belgium (Umicore)	202	12.1%
Philippines (Umicore Specialty Chemicals)	120	7.2%
Germany (NordDeutsche, PPM Pure Metals)	98	5.8%
Chile, Finland, India, Peru, Serbia, Sweden, USA	258	15.4%
Reported Total	1,673	

Unreported ~ Russia, Korea and China

There would appear to be a significant supply gap; however, with the unreported production from Russia and Korea, the size of the gap is not clear. In Russia, MMC Norilsk Nickel reports recovery of selenium from its nickel-copper-cobalt-PGM operations, and Korea's LG Nikko Copper smelter recovers selenium. Little is known about selenium production in China.

Selenium is sold as commercial grade metal ~99.95% Se, and thermoelectric grade ~99.999% Se. The selenium is sold to the various users for input into glass, alloys, pigments, fertilizers and pharmaceuticals. Many of its uses reflect its unique photoelectric characteristics.

Source and Supply

Selenium is below Sulphur in the periodic table and is found in all sulphide minerals; although generally in small amounts. A few selenium rich minerals are known; however, they are rare and do not provide a primary source of selenium.

Most of the "primary" selenium is recovered from anode slimes that are a byproduct of electro-refining of sulphide copper concentrates. Although copper production continues to increase, much of the new copper production is from leaching of oxide and sulphide ores, without the production of anode slimes containing selenium. The main source of primary selenium therefore appears to be near static. A similar situation exists for nickel as more of production comes from laterite rather than sulphide deposits, and hence this supply is also static to declining. Coal is potentially a major source of selenium; however, the recovery of selenium from coal isn't likely at this time.

New Uses and Demand Growth

The main drivers for increased selenium usage are considered to be the continued expansion of the glass industry, fertilizers and usage in the health industry.

Interest in selenium in the medical community stems from the recognition of selenium proteins that form numerous enzymes in the body that neutralize peroxides formed from conversion of fat into energy. The peroxides, if not neutralized are known to damage cells in the body and lead to a number of health problems particularly various forms of cancer, but selenium deficiency is also considered a factor in anemia, cardiac dysfunction and high blood pressure, cataracts and macular degeneration, arthritis, male sexual impotency, prostaglandin synthesis, Keshan's and Kashin-Beck disease, and weak skin and hair growth.

Growing uses of selenium include:

- Selenium enriched fertilizers are now being used in Finland, New Zealand, China and United States to get selenium into the food chain and as an alternative to selenium addition directly to animal feed.
- Selenium additives to vitamin supplements
- Selenium treatments are being developed for a number of ailments including dermatology, tendonitis, periodontal disease, rheumatoid arthritis, cancer, macular degeneration and cataracts, herpes and lupus inflammation to name a few.
- Selenium is also being used in new thin-screen technology in copper-indium-selenium solar cells.

Until about 15 years ago, selenium was viewed as a toxic element. With the recent new information developing on selenium, selenium usage is likely to grow.

Substitution

The main areas of substitution of selenium usage include the use of silicon in high voltage rectifiers and solar photovoltaic cells, use of organic photoreceptors in xerographic uses and other colorants in glass and pigments.

The extent of substitution that will occur as a result of increased selenium price is unknown; however, in most applications the amount of selenium used is small and not likely to have a significant impact on product costs.

Selenium Outlook

Although the selenium outlook looks very strong at this time, it is uncertain whether the current supply shortfall and dramatic price increase will result in new supply during the short term. On the supply side, certainly various smelters not currently recovering selenium may add selenium recovery circuits and provide additional primary feed for refiners. Smelters with slimes inventory likely delivered this inventory to refiners in 2003 resulting in the 10.4% increase in refined selenium production in 2003 and early 2004. The current shortfall in selenium for purchase, suggests that these short term supplies have been exhausted.

The overall size of the selenium market is quite small (approximately US\$300 million) even at current high metal prices, and is unlikely to attract much interest from the major mining companies. New supply will therefore likely have to come from increased recovery from smelters, in particular zinc smelters. However, it should be noted that selenium contents in zinc concentrates are generally quite low and only some zinc smelters are likely to have enough selenium to warrant adding selenium recovery circuits.

In the short to intermediate term, supply appears unlikely to increase significantly with one exception: the development of the Wolverine deposit could provide significant new supply of selenium-rich zinc, copper and lead concentrates.

Data on the demand side indicates slow steady growth in the demand for selenium of 1.6% per annum. However, the dramatic drawdown of inventories by China in 2003 and 2005 suggests that demand may be growing at a rate significantly greater than the historical trend.

Sources of Selenium Information:

- 1) USGS Mineral Information: selenium and tellurium January 2004; <http://minerals.usgs.gov/minerals/pubs/commodity/selenium>.
- 2) Selenium, A Global Strategic Business Report, October 2004 (private report prepared by Global Industry Analysts, Inc., San Jose, California; www.globind.com)
- 3) Selenium Tellurium Development Association; www.stda.net.
- 4) Selenium and Relationship to Cancer, P.D. Whanger; www.americanlongevity.net/selenium_cancer.htm
- 5) The International Fertilizer Society- Proceeding 467 (2001); www.fertilizer-society.org/Proceedings/US/Prc467.htm.
- 6) The Linus Pauling Institute; <http://lpi.oregonstate.edu/infocentre/minerals/selenium/>
- 7) Office of Dietary Supplements, National Institutes of Health, United States; <http://ods.nih.gov/factsheets/selenium.asp>
- 8) BC Cancer Agency, Unconventional Therapies-Selenium; www.bccancer.bc.ca/PPI/UnconventionalTherapies/Selenium.htm