

Antimony

Bill McCutcheon

*The author is with the Minerals and Metals Sector,
Natural Resources Canada.
E-mail: bmccutch@nrcan.gc.ca*

Note: This is a brief review of antimony in Canada with general information and not a comprehensive review.

The chemical symbol for antimony is Sb.

Canada produces a very minor share, less than 1%, of the approximately 150 000 t that the United States Geological Survey (USGS) estimated to have been produced worldwide in 2001. The second largest producer of antimony is the Russian Federation, which produces between 3 and 4% of the world's total production. China is the dominant force in the world antimony market, producing an estimated 89% of world production, according to USGS data.

The largest single application for antimony is in the manufacture of flame retardants used in plastics, vinyls and synthetic fibres. Antimony is also used as an alloying element in lead used for making automotive batteries; the addition of antimony increases the strength and hardness of the lead. When lead-acid automotive and lead-acid standby batteries are recycled, much of the contained antimony can be recovered for making antimonial lead for use in the battery-making process. Antimony metal is also used in solders and for bearings. Stibnite (Sb_2S_3) is the predominant ore mineral of antimony. Antimony metal is sold as regulus, grading 96% Sb. Prices for antimony largely depend upon the Chinese production (Figure 1); with the increased production from China, prices have declined dramatically since 1994.

Antimony is alloyed with lead to improve the hardness. The resultant "hard lead," with a 3-9% antimony content, has superior strength and corrosion resistance relative to unalloyed lead. Hard lead is used in the grids, terminals and lead-oxide paste of automotive and standby batteries. In addition, antimonial lead lining is used to protect pipes, valves,

pumps and sheets used in the chemical industry. Higher antimony contents of up to 13% are needed for casting alloys.

Other elements can be used to harden lead, such as cadmium, calcium, copper, selenium, strontium, sulphur or tin. Hydrated aluminum oxide and certain organic compounds can be used for flame retardants. In paints, pigments and enamels, various compounds of chromium, tin, zinc or zirconium can be used in place of antimony.

CANADIAN DEVELOPMENTS

Antimony is recovered in Canada from primary concentrates and from recycled automotive batteries at two primary lead smelters that produce antimony-lead alloys. These alloys are used for lead-acid battery production. Canadian antimony mines remained closed, primarily due to low antimony prices.

Teck Cominco Limited <www.teckcominco.com> operates lead-zinc mines whose ore contains significant amounts of by-product antimony. At its Trail, British Columbia, lead-zinc smelter/refinery, Cominco recovers antimony from concentrates and from recycled lead-acid batteries in order to produce an antimony-lead alloy.

Noranda Inc. <www.noranda.com> operates the Brunswick lead-zinc mine at Bathurst, New Brunswick, whose ore contains significant amounts of by-product antimony. At Noranda's lead smelter located in Belledune in the same province, the company recovers antimony from concentrates and from recycled lead-acid batteries in order to produce an antimony-lead alloy.

The two Canadian secondary lead smelters use scrap batteries for feed and these batteries contain antimony alloyed with the lead; the antimony in these batteries can be recovered with the lead. The two secondary lead smelters are owned by **Tonolli Canada Ltd.** in Toronto, Ontario, and **Nova Pb Inc.** near Montréal, Quebec. These two plants are dependent upon recyclable lead-acid batteries from neighbouring states, such as New York, to supplement feed from Canadian sources; without such imports, there

is insufficient feed in Canada to keep both plants operating viably.

Canadian Antimony Mines

Canadian antimony mining has ceased due to the low price of antimony brought about by the large Chinese exports.

Apocan Inc., a subsidiary of Amspec of the United States <www.amspecorp.com>, owns the Lake George antimony mine in New Brunswick. Lower antimony prices forced the mine's closure in 1989. In mid-1994, Apocan decided to proceed with permitting and the rehabilitation work needed to re-open the mine. In October 1995, final permits were obtained for the mine re-opening. The mine started producing in mid-1996 and was officially opened in November 1996. However, mechanical problems with the hoist forced a shut-down of the operation at year-end. Before repairs could be completed, antimony prices dropped so low that the company decided to keep the operation shut. Since that time, the mine was permitted to flood. In the mid-1990s, the company considered building an antimony smelter to process the concentrate but there was significant local opposition to the idea. With the increase in prices in late 2002, it is expected that the company will evaluate the re-opening of the operation.

Roycefield Resources Ltd. developed the Beaver Brook mine, near Gander, in the province of Newfoundland and Labrador. The mine began underground development in 1995. In May 1996, the province awarded the company "EDGE" status, which conferred certain tax holidays, start-up assistance, and other assistance to encourage significant new business investment in the province; a condition of granting such status was that Roycefield would process the antimony to antimony trioxide within the province.

The mine/mill operation was built to produce 400 t/d of antimony, based on 13 years of reserves at a 5% antimony cutoff grade. Mining commenced in July 1997 and continued for five months to November, accumulating an ore stockpile for the start-up of the mill. The mill start-up began in November with the first concentrate shipped before year-end. Amalgamet Canada Limited <www.amalgamet.com> and Roycefield had reached an agreement whereby Amalgamet Canada would be the exclusive sales agent for Roycefield's antimony concentrates. The concentrate specifications were 65% Sb with combined arsenic plus lead content not to exceed 0.5% and combined selenium plus mercury content to be less than 10 ppm.

After operating a mini-pilot plant, a demonstration plant was commissioned in January 1998 to further develop Roycefield's hydrometallurgical processing

technology, designed to convert the antimony sulphide to antimony trioxide in which sulphur was removed from the concentrates and recovered as elemental sulphur. Roycefield estimated that the commercial hydrometallurgical antimony trioxide and associated chlor-alkali plant for chemical regeneration would cost about \$17 million. Low antimony prices forced the company to suspend mill commissioning in February 1998. In mid-July 2000, the company was still maintaining the mine in a care-and-maintenance mode awaiting higher prices. Since that time, Roycefield went into receivership and **Beaver Brook Resources Inc.**, based in Newfoundland and Labrador, is reported to have purchased the mine. As of October 2002, the operation was still on care and maintenance.

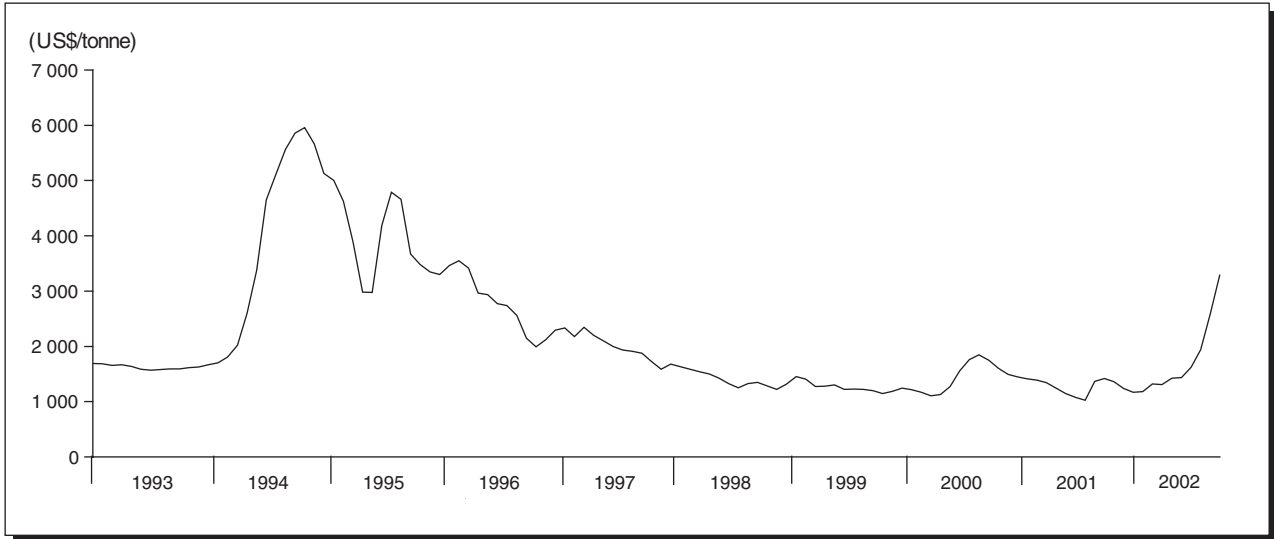
PRICES

Metal Bulletin's free market prices for antimony regulus grading 99.65% Sb with a maximum selenium content of 50 ppm are shown in Figure 1 for the period 1993 to 2002. Prices increased rapidly from US\$1569/t in July 1993 to reach a maximum of US\$5955/t in November 1994. This large price increase of nearly 380% in 16 months encouraged producers to increase production capacity either through the development of antimony sources or the re-opening of those previously shut down. In addition, manufacturers began recycling their off-specification material while producers concentrated on increasing recovery rates. Simultaneously, however, the rapid price increase and high price discouraged future antimony use.

For the period 1993 to September 2002, monthly prices peaked at US\$5995/t; they declined to US\$2974/t by June 1995 and recovered rapidly to US\$4787/t by August 1995. From then onward, prices trended downwards to US\$1108/t in April 2000, a decline of nearly US\$4900/t. Since that time, prices drifted upwards to US\$1844/t and then declined to US\$1493/t by year-end 2000, reaching a nadir of US\$1025/t in August 2001. Since then, prices have increased. The increase was hastened by problems at Chinese mines in the summer of 2002, which sent prices up to an average of US\$2585/t in September 2002, the last month for which data were available at the time of writing.

As can be seen from the USGS data, China is the dominant antimony producer. In 1993, China's share of world production was 69%; it rose to 71% in 1994 and then, from 1995 to 1999, it remained between 80% and 85%, thereafter rising to an estimated 89% in 2001. Figure 2 shows Chinese and world production of antimony from 1997 to 2001. Data for 2001 are estimated.

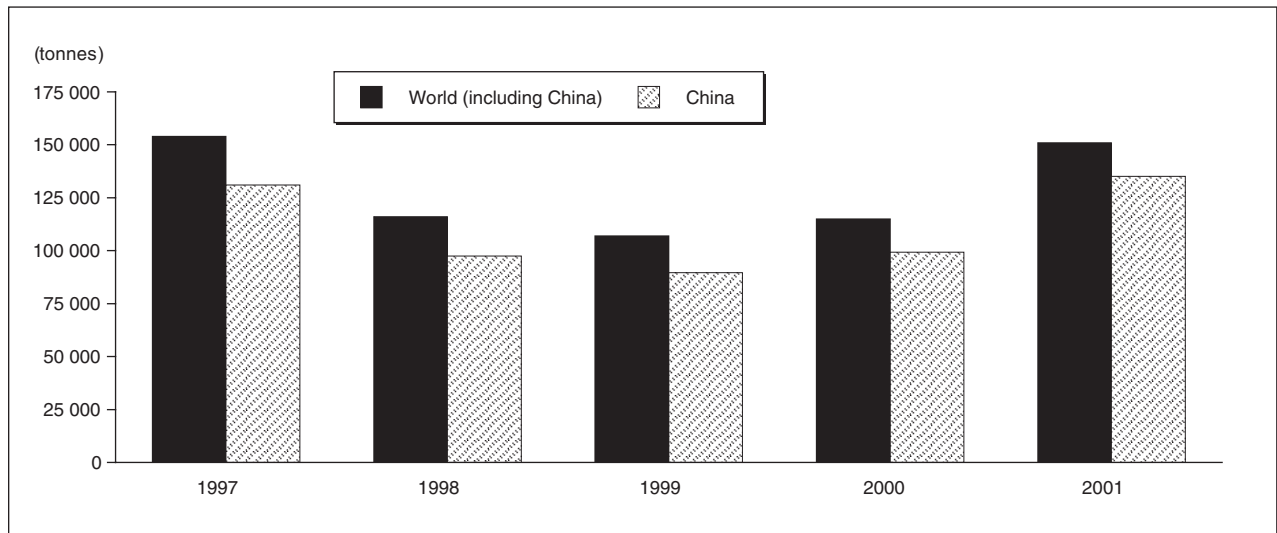
Figure 1
Antimony Prices, Metal Bulletin Monthly Average,¹ 1993-2002



Source: *Metal Bulletin*.

¹Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, regulus 99.65%, max. Se 50 ppm.

Figure 2
Antimony Production, 1997-2001



Source: United States Geological Survey.

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet include:

- United States Geological Survey (USGS):
<<http://minerals.usgs.gov/minerals/pubs/commodity/antimony/>>
- Search by company name in the SEDAR data base for companies publicly traded in Canada:
<www.sedar.com/search/search_form_pc_en.htm>
- *Canadian Mining Journal*:
<www.canadianminingjournal.com>
- *Northern Miner* (daily headlines):
<www.northernminer.com>
- Various on-line encyclopedias
- Any web search engine such as
<www.google.com/advanced_search>
- For physical and chemical properties, concentrations in various media, etc.:
<www.webelements.com/webelements/elements/text/Sb/key.html>
- Yahoo search of metals and minerals (use keyword "antimony"):
<biz.yahoo.com/news/mining.html>
- *American Metal Market*, search (some articles do not require paid subscription to access):
<www.amm.com>
- *Mining Journal*, search (some articles do not require paid subscription to access):
<www.mining-journal.com/index1.htm>
- *Metal Bulletin* (information by paid subscription):
<www.metalbulletin.co.uk>

COMMERCIALY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services Ltd. in the United Kingdom. Further information is available at the company's web site at <www.roskill.co.uk/antimony.html>.

Studies from other sources may also be available.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of October 2002. (3) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about antimony in Canada. More detailed information is available from the United States Geological Survey, whose web site is noted above. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States	EU
		MFN	GPT	USA	Canada	MFN
2617.10	Antimony ores and concentrates	Free	Free	Free	Free	Free
2825.80	Antimony oxides	Free	Free	Free	Free	7.2%
2918.13.00.10	Antimony potassium tartrates	Free	Free	Free	Free	6.5%
81.10	Antimony and articles thereof, including waste and scrap					
8110.10.00.10	Unwrought antimony; not alloyed; powders, not alloyed	Free	Free	Free	Free	7%
8110.10.00.20	Unwrought antimony, alloyed; waste and scrap; powders, alloyed; articles of antimony	Free	Free	Free	Free	Free-7%

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (41st Annual Edition: 2001).

TABLE 1. CANADA, ANTIMONY PRODUCTION, IMPORTS AND EXPORTS, 1999-2001, AND USE, 1996-2000

Item No.	1999		2000		2001 (p)		
	(kg)	(\$000)	(kg)	(\$000)	(kg)	(\$000)	
PRODUCTION							
	New Brunswick	109 845	226	149 400	320	136 000	300
	British Columbia	246 900	507	214 700	461	97 768	216
	Total	356 745	733	364 100	781	233 768	516
IMPORTS							
2617.10	Antimony ores and concentrates						
	United States	31	99	23	67	14	50
	Australia	-	-	-	-	...	...
	China	-	-	...	1	-	-
	Total	31	99	23	68	14	50
2825.80	Antimony oxides						
	United States	1 481	4 781	1 716	5 801	1 419	4 885
	Mexico	-	-	-	-	146	391
	Belgium	20	48	105	310	132	354
	China	95	193	81	202	79	205
	Other countries	587	2 100	159	569	-	-
	Total	2 183	7 122	2 061	6 882	1 776	5 835
2918.13.10.10	Antimony potassium tartrates						
	Italy	7	11	66	97	58	118
	China	12	24	15	23	21	38
	United States	7	13	5	10	15	25
	Switzerland	...	...	4	8	1	3
	Other countries	3	5	...	...	...	...
	Total	29	53	90	138	95	184
8110.00.10	Unwrought antimony, not alloyed; powders, not alloyed						
	United States	78	299	112	413	77	256
	China	127	469	41	157	33	119
	Hong Kong	-	-	11	43	13	37
	Sweden	-	-	-	-	2	8
	Other countries	24	88	13	41	1	4
	Total	229	856	177	654	126	424
8110.00.20.00	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	China	67	148	105	268	152	349
	United States	84	168	173	404	85	199
	Hong Kong	-	-	-	-	45	77
	Germany	-	-	15	52	18	73
	Other countries	4	16	12	30	19	52
	Total	155	332	305	754	319	750
	Total imports		8 462		8 496		7 243
EXPORTS							
2617.10	Antimony ores and concentrates	-	-	-	-	-	-
2825.80	Antimony oxides	-	-	-	-	-	-
	United States	-	-	-	-	20	43
	Total	-	-	-	-	20	43
8110.00	Antimony and articles thereof, including waste and scrap						
	United States	58	491	62	444	69	425
	Germany	-	-	-	-	...	21
	Other countries	-	-	...	3	...	16
	Total	58	491	62	447	69	462
	Total exports		491		447		505
			1996 (a)	1997 (a)	1998	1999	2000 (p)
			(kg)				
USE (1)							
	Antimony metal used for, or in the production of:						
	Antimonial lead	600 981	1 082 374	695 539	792 018	713 226	
	Babbitt	76 149	65 032	70 162	62 669	56 369	
	Other uses (2)	11 670	10 804	25 554	10 696	7 910	
	Total	688 800	1 158 210	791 255	865 383	777 505	
	Held by users on December 31 (1)	153 734	431 702	89 336	248 754	304 213	

Sources: Natural Resources Canada; Statistics Canada.
- Nil; ... Amount too small to be expressed; (p) Preliminary.

(a) Increase in number of companies being surveyed.

(1) Available data as reported by users. (2) Includes solder, type metal and miscellaneous uses.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, USE AND USERS' STOCKS OF ANTIMONY,⁽¹⁾ 1970, 1975 AND 1980-2000

	Use		On Hand at End of Year	
	Antimony Metal	Antimonial Lead Alloy (2)	Antimony Metal	Antimonial Lead Alloy (2)
	(kilograms)			
1970	518 007	635 212	131 501	91 563
1975	454 164	723 155	116 760	170 478
1980	369 732	643 983	42 389	51 405
1981	209 829	691 180	35 105	151 400
1982	161 034	605 502	39 799	76 979
1983	169 648	560 705	24 381	130 104
1984	342 705	648 413	33 524	23 319
1985	184 993	826 846	24 512	20 298
1986	539 655	759 876	28 422	104 360
1987	540 147	692 750	21 172	164 782
1988	585 600	989 100	7 386	142 961
1989	442 942	1 075 354	17 023	135 977
1990	294 321	922 127	13 805	99 882
1991	406 221	924 728	20 248	131 779
1992	355 963	829 795	99 872	149 850
1993	688 542	(r) 884 344	41 123	(r) 127 382
1994	1 084 863	856 959	80 123	135 267
1995	988 338	822 848	150 064	208 132
1996	688 800	733 730	153 734	115 878
1997	1 158 210	665 751	431 702	156 725
1998	791 255	589 087	89 336	190 962
1999	865 383	634 294	248 754	323 633
2000	(p) 777 505	(a) 674 829	304 213	250 406

Source: Natural Resources Canada.

(p) Preliminary; (r) Revised.

(a) Increase in number of companies being surveyed.

(1) Available data, as reported by users. (2) Antimony content of primary and recycled antimonial-lead alloys.

TABLE 3. MINE PRODUCTION OF ANTIMONY, 1992-2001

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	(tonnes)									
China	59,400	60,000	91,000	125,000	129,000	131,100	97,400	89,600	(r) 99 300	92,440
Bolivia	6,022	5,556	7,050	6,426	6,488	5,999	4,735	2,790	1,907	2,072
South Africa	3,951	4,100	4,534	5,537	5,137	3,415	4,243	5,278	(r) 4 104	4,827
Russia	4,000	4,000	3,000	3,000	6,000	6,000	4,000	4,356	(r) 8 000	(r) 4 152
Australia	1,701	2,300	1,300	900	1,800	1,900	1,800	1,679	1,511	1,380
Tajikistan	1,500	2,000	2,000	1,000	1,000	1,200	1,500	1,800	2,000	2,500
Kyrgyzstan	3,000	2,500	9,588	4,778	6,002	3,062	1,298	1,320	1,505	1,500
Other (1)	1,806	1,618	1,575	1,196	2,171	957	1,022	771	1,110	622
Other (2)	3,128	1,876	2,479	2,928	2,657	2,487	1,397	826	389	0
Total	84,508	83,950	122,526	150,765	160,255	156,120	117,395	108,420	(r) 119 826	(r) 109 493
Top 7 as a % of total	94%	96%	97%	97%	97%	98%	98%	99%	99%	99%

Source: International Consultative Group on Nonferrous Metals Statistics, 2002

(r) Revised.

Notes: Other (1) = Canada, Peru, Thailand and Turkey. Other (2) = Czechoslovakia, Guatemala, Honduras, Mexico, Morocco, Romania, United States, Yugoslavia and Zimbabwe.