

Antimony

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(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, 0.1 %, of the approximately 143 000 t that the United States Geological Survey (USGS) estimated to have been produced worldwide in 2002. The second largest producer of antimony is South Africa, which produces 4% of the world's total production. China is the dominant force in the world antimony market, producing an estimated 91% 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 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 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. In addition, there are two lead smelters that recycle antimonial lead from spent lead-acid batteries and other sources.

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, where the 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. (www.novapb.com) 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. The Nova Pb plant commenced recycling of spent aluminum pot lining at the end of 2002. This reduces the plant's capacity by 50% to 45 000 t/y of lead.

Canadian Antimony Mines

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

Apocan Inc., a subsidiary of Amspec of the United States (www.amspeccorp.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, which saw monthly antimony prices¹ exceed US\$2500/t for the first time since September 1996, it was expected that the company would evaluate re-opening the operation; however, the mine remained closed throughout 2002 and into 2003.

An information page discussing antimony is available from a New Brunswick government web site at www.gnb.ca/0078/minerals/antimony_bismuth-e.pdf. A contact in the provincial government for further information about antimony is John Griggs (e-mail John.Griggs@gnb.ca).

In Newfoundland and Labrador, the Beaver Brook antimony deposit was developed by Roycefield Resources Ltd. In the 1990s, the company developed a 0.5-km ramp and undertook lateral development, including test mining of about 20 000 t of development ore grading about 5% Sb. The 400-t/d mill began operation in November 1997 and the first concentrate was shipped to Amalgamet Canada Limited (www.amalgamet.com) prior to the end of 1997.

Roycefield also built a hydrometallurgical demonstration plant to produce antimony trioxide. The company estimated the cost of a commercial hydrometallurgical plant at about \$17 million. Continued low antimony prices forced Roycefield to suspend the commissioning of the 400-t/d mill in February 1998 and the operation was put on care and maintenance in 1999. Thereafter, Beaver Brook Resources Inc. was reported to have purchased the property from Roycefield, which had entered into receivership. It is believed that Beaver Brook Resources is a private company.

A geological map of the island of Newfoundland showing the location of the Beaver Brook deposit is available on the internet at www.gov.nl.ca/mines&en/geosurvey/maps/pros_envir_Nfld.pdf. For more information about antimony in the province, contact John Clarke (e-mail edwardclarke@gov.nl.ca).

PRICES

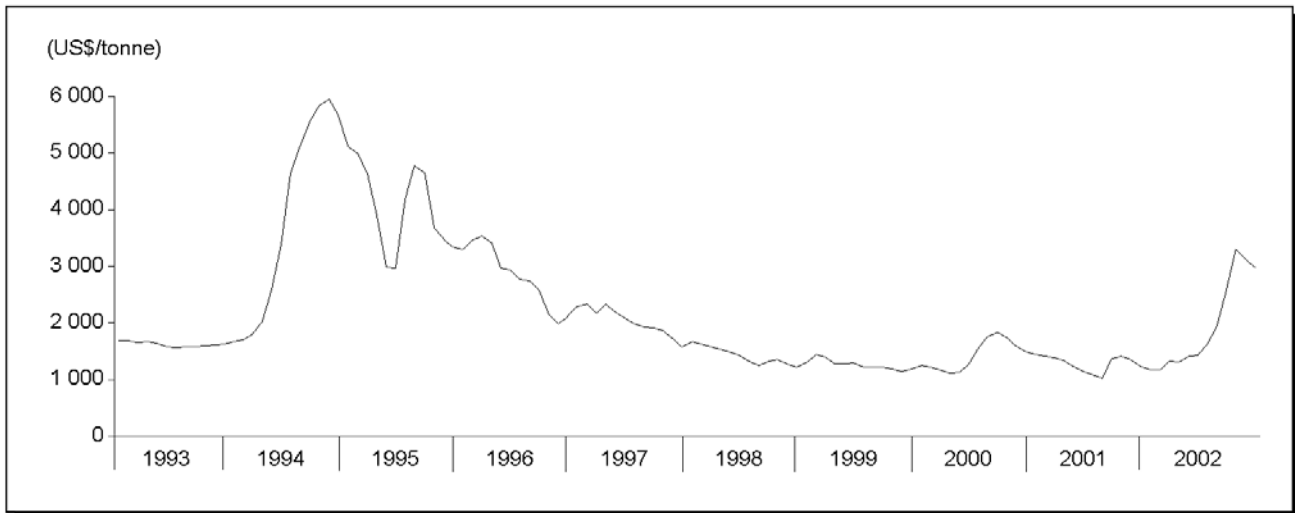
Metal Bulletin's free market prices for antimony regulus grading 99.65% Sb with a maximum selenium content of 50 ppm are shown in Figure 1 for the period 1993 to 2002. Prices increased rapidly from US\$1569/t in July 1993 to reach a maximum of US\$5955/t in November 1994. This large price increase of nearly 380% in 16 months encouraged producers to increase production capacity either through the development of antimony sources or the re-opening of those mines 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 then declined to US\$2975/t by June 1995 and recovered rapidly to US\$4787/t by August 1995. From then onward, prices trended downwards to US\$1109/t in April 2000. 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\$3300/t in October 2002. Prices then declined steadily to an average of US\$2162/t for November 2003, 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, producing over 90% of the world's mine supply. Figure 2 shows Chinese and world production of antimony from 1997 to 2002. Data for 2002 are estimated.

¹ *Metal Bulletin* average of the monthly high and monthly low prices. The price stated is for antimony regulus in warehouse grading a minimum of 99.65% Sb with a maximum selenium content of 50 ppm.

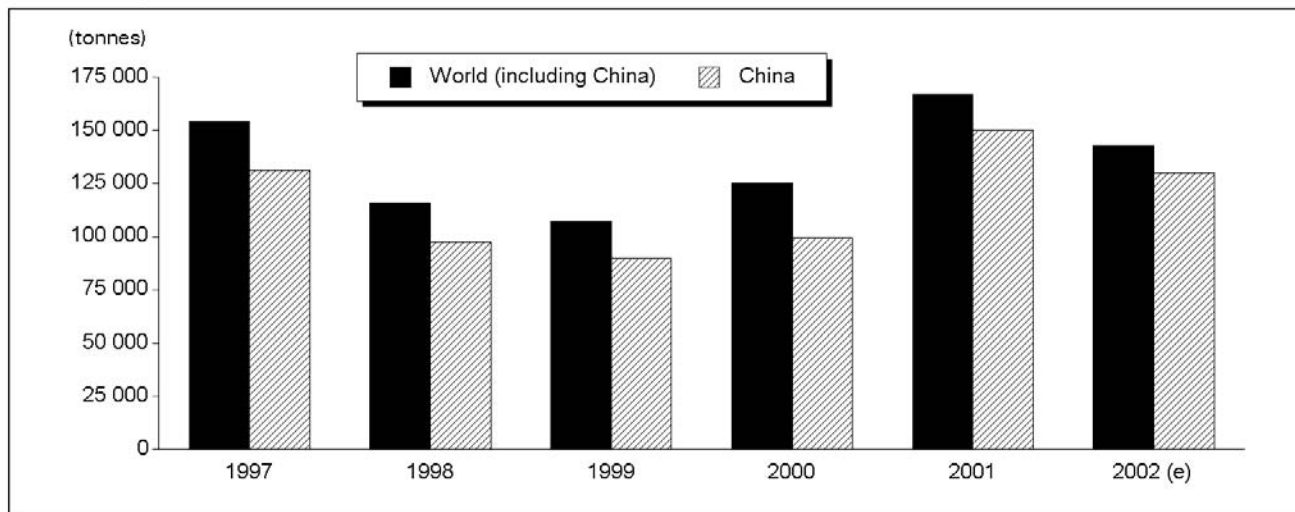
Figure 1
Antimony Prices, *Metal Bulletin* Monthly Average, (1) 1993-2002



Source: *Metal Bulletin*.

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

Figure 2
Antimony Production, 1997-2002



Source: United States Geological Survey.

(e) Estimated.

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
- *The 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"):
<http://search.news.yahoo.com/search/news/?n=10&p=antimony>
- *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 November 2003. (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/cmty/com_e.html.

NOTE TO READERS

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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	6.6%
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: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002).

TABLE 1. CANADA, ANTIMONY PRODUCTION, IMPORTS AND EXPORTS, 2000-2002, AND USE, 1997-2001

Item No.	2000		2001		2002 (p)		
	(kg)	(\$000)	(kg)	(\$000)	(kg)	(\$000)	
PRODUCTION							
	New Brunswick	149 400	320	136 000	302	143 000	395
	British Columbia	214 700	461	97 771	217	-	-
	Total	364 100	781	233 771	518	143 000	395
IMPORTS							
2617.10	Antimony ores and concentrates						
	United States	23	67	14	50	23	72
	Other countries	...	1	-	-	-	-
	Total	23	68	14	50	23	72
2825.80	Antimony oxides						
	United States	1 716	5 801	1 400	4 841	1 521	5 979
	Mexico	-	-	146	391	83	278
	Belgium	105	310	132	354	81	236
	China	81	202	79	205	72	203
	Other countries	159	569	...	-
	Total	2 061	6 882	1 756	5 791	1 757	6 696
2918.13.10.10	Antimony potassium tartrates						
	Italy	66	97	58	118	66	109
	China	15	23	21	38	15	18
	United States	5	10	15	25	10	14
	Switzerland	4	8	1	3	1	1
	Other countries
	Total	90	138	95	184	92	142
8110.00.10	Unwrought antimony, not alloyed; powders, not alloyed						
	United States	112	413	77	257	-	-
	China	13	157	33	119	-	-
	Hong Kong	11	43	13	37	-	-
	Sweden	-	-	2	8	-	-
	Other countries	13	41	1	4	-	-
	Total	177	654	126	425	-	-
8110.00.20.00	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	China	105	268	152	349	-	-
	United States	173	404	85	199	-	-
	Hong Kong	-	-	45	77	-	-
	Germany	15	52	18	73	-	-
	Other countries	12	30	19	52	-	-
	Total	305	754	319	750	-	-
8110.10.00.10	Unwrought antimony; not alloyed; powders, not alloyed						
	United States	-	-	-	-	134	437
	China	-	-	-	-	26	105
	Germany	-	-	-	-	16	55
	Other countries	-	-	-	-	5	15
	Total	-	-	-	-	181	612
8110.10.00.20	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	United States	-	-	-	-	96	311
	China	-	-	-	-	80	233
	Germany	-	-	-	-	8	18
	Total	-	-	-	-	184	562
	Total imports		8 496		7 200		8 084

TABLE 1 (cont'd)

Item No.	2000		2001		2002 (p)	
	(kg)	(\$000)	(kg)	(\$000)	(kg)	(\$000)
EXPORTS						
2617.10	Antimony ores and concentrates	-	-	-	58 179	66 318
2825.80	Antimony oxides					
	United States	-	-	20	43	-
8110.00	Antimony and articles thereof, including waste and scrap					
	United States	62	444	69	425	-
	Germany	-	-	...	21	-
	Other countries	...	3	...	16	-
	Total	62	447	69	462	-
8110.20	Antimony waste and scrap					
	United States	-	-	-	-	6
8110.90	Antimony and articles thereof, including waste and scrap					
	United States	-	-	-	-	48
	Other countries	-	-	-	-	...
	Total	-	-	-	-	48
	Total exports		447		505	66 954
			1997 (a)	1998	1999	2000
					(kg)	2001 (p)
USE (1)						
	Antimony metal used for, or in the production of:					
	Antimonial lead	1 082 374	695 539	792 018	713 226	451 263
	Babbit	65 032	70 162	62 669	56 369	59 015
	Other uses (2)	10 804	25 554	10 696	7 910	6 977
	Total	1 158 210	791 255	865 383	777 505	517 255
	Held by users on December 31 (1)	431 702	89 336	248 754	304 213	202 208

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 1980-2002

	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	777 505	(a) 674 829	304 213	250 406
2001	517 255	626 365	202 208	215 997
2002 (p)	487 013	671 706	278 740	98 252

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, 1994-2002

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002
	(tonnes)								
China	91 000	125 000	129 000	131 100	97 400	89 600	99 300	(r) 97 000	121 550
South Africa	4 540	5 540	5 140	3 420	4 240	5 280	4 100	4 830	5 000
Russia	3 000	3 000	6 000	6 000	4 000	4 360	8 000	4 150	4 000
Tajikistan	2 000	1 000	1 000	1 200	1 500	1 800	2 000	2 500	3 000
Kyrgyzstan	9 590	4 780	6 000	3 062	1 300	1 320	1 505	1 500	1 500
Bolivia	7 050	6 430	6 490	6 000	4 740	2 790	1 910	(r) 2 260	1 390
Australia	1 300	900	1 800	1 900	1 800	1 680	1 510	1 380	1 200
Other	4 050	4 120	4 830	3 440	2 480	1 610	1 420	710	1 040
Total	122 526	150 765	160 255	156 120	(r) 117 456	(r) 108 431	(r) 119 748	(r) 114 336	138 672

Source: International Consultative Group on Nonferrous Metals Statistics, 2003.

(r) Revised.

Notes: Data in table rounded by author to nearest 10 tonnes so totals may not add. Data do not necessarily agree with USGS data.