Bismuth

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

The chemical symbol for bismuth is Bi.

As the only "edible" heavy metal, bismuth is used in pharmaceutical products such as non-prescription stomach remedies, which contain bismuth subsalicylate. Bismuth is also used in antibiotics that treat stomach ulcers and burns.

In metallurgy, bismuth is used as an additive or alloying element, for example, as a hardening agent in lead used in lead-acid automotive and standby batteries. Bismuth's low melting point is utilized in fusible links, which are used to engage automatic fire sprinkler systems. When bismuth solidifies, it expands, unlike most other metals. This property improves "pressure tightness" and reduces shrinkage when bismuth is added to alloys. Other bismuth applications include use in ceramics, glass, electronics and cosmetics.

The outlook for bismuth use is thought to be encouraging due to increasing restrictions on the use of lead. Such restrictions have meant that bismuth is used to replace lead in some potable water equipment, as a substitute for shot-gun pellets used to hunt waterfowl, and to increase the machineability of alloys.

The world mine production of bismuth in 2002 was estimated by the United States Geological Survey (USGS) to have been 4070 t, 86% of which was produced by China, Mexico and Peru (Figure 2). According to the USGS, Canada produced about 4% of the world's bismuth at the mine stage. In 2002, China, Mexico, Belgium and Peru produced 79% of the world total of 5190 t of refined bismuth, according to the USGS.

CANADIAN DEVELOPMENTS

Canadian primary bismuth production for the period 1995 to 2001 is shown below.

Canadian refined bismuth production data are withheld for confidentiality reasons.

On average, for the period 1995 to 2002, 85% of Canadian-mined bismuth originated in New Brunswick from Noranda Inc.'s (www.noranda.com) Brunswick mine. Bismuth is a by-product of lead-zinc mining at the Brunswick mine at Bathurst. The metal is recovered at Noranda's lead smelter in Belledune, New Brunswick, as an intermediate bismuth lead alloy.

Teck Cominco Limited (www.teckcominco.com) recovers bismuth metal from the concentrate feed to its Trail, British Columbia, lead-zinc operation.

PRIMARY BISMUTH PRODUCTION IN CANADA, 1995-2002

	New Brunswick	British Columbia	Total	Value
		(tonnes)		($000)
1995	148	11	159	1 815
1996	w	w	150	1 598
1997	182	14	196	1 956
1998	175	11	186	2 078
1999	249	16	264	2 941
2000	194	8	202	2 343
2001	252	6	258	3 176
2002 (p)	189	–	189	1 905
Total	1 389	66	1 604	17 812

Source: Natural Resources Canada.
– Nil; (p) Preliminary; w Withheld.
Note: These data do not include bismuth recovered from recycling.

From 1995 to 1996, Adex Mining Corp. evaluated the Mt. Pleasant property in New Brunswick. Adex took bulk samples and undertook a metallurgical research program at the site of the former mine as part of a feasibility study for the production of tin and indium. The ore under consideration also contained 0.08% bismuth. Due in large part to the low indium prices in 1997 and the high estimated capital cost, Adex was unable to develop the orebody. At a rate of 2000 t/d, the mine would have produced approximately 400 t/y of bismuth, thereby increasing primary world bismuth supply by over 10%. The company was delisted in June 1999 but continues to hold the Mt. Pleasant property. Adex did not maintain a web site at the time this article was written. The site where Adex provides filings to securities regulators at www.sedar.com/command_servlet?cmd=Display CompanyDocuments&issuerNo=00002586&lang=EN did not show any submissions later than December 7, 1998.

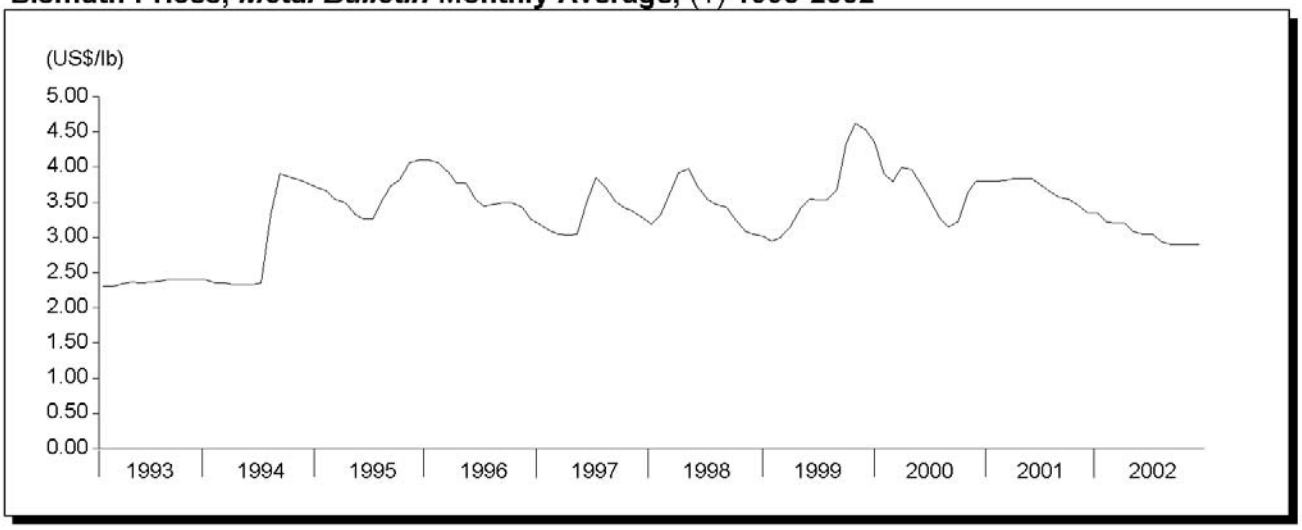
An information page discussing bismuth is available from the New Brunswick government web site at www.gnb.ca/0078/minerals/antimony_bismuth-e.pdf. A contact in the provincial government for further information about bismuth is John Griggs (e-mail John.Griggs@gnb.ca).

Fortune Minerals Limited (www.fortuneminerals.com) owns 80% of the NICO gold-cobalt-bismuth deposit located 160 km from Yellowknife, Northwest Territories. During the year Strathcona Mineral Services completed a scoping-level economic assessment of the deposit followed by a a second study to assess a scenario involving predominantly underground development supplemented by ore from two smaller open pits. As of the end of 2002, diluted mineable indicated resources at the deposit to be mined by underground methods were 4.48 Mt grading 3.55 g/t gold, 0.16% cobalt and 0.25% bismuth in addition to the 2.7 Mt grading 0.73 g/t gold, 0.12% cobalt and 0.15% bismuth to be mined by open-pit methods. The bismuth could be trucked to Trail, British Columbia, for processing at Teck Cominco Limited's smelter. Fortune's filings with securities regulators are available at www.sedar.com/command_servlet?cmd=Display CompanyDocuments&issuerNo=00002470&lang=EN.

PRICES

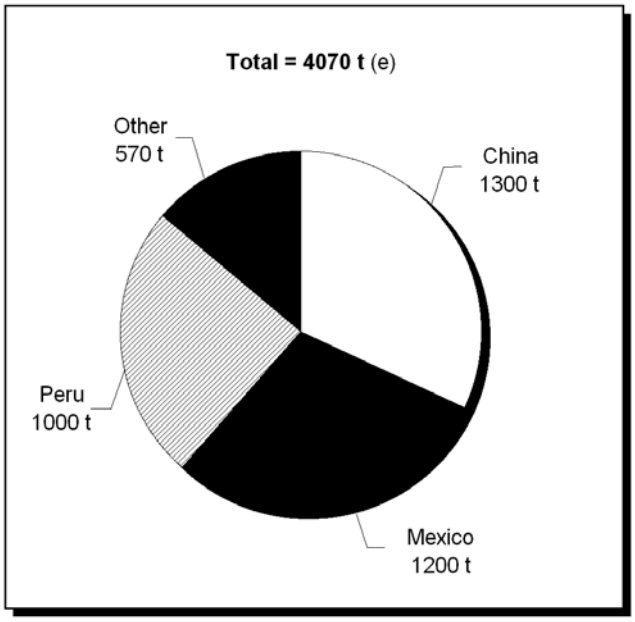
Monthly *Metal Bulletin* prices from 1995 to 2002 are shown in Figure 1. The average of the *Metal Bulletin* high monthly and low monthly average prices for bismuth declined in 2002 from US$3.22/lb to US$2.90/lb, reaching US$2.95/lb in August 2003. More detailed price information is available from the Sidech web site at www.sidech.be/graph.htm.

Figure 1
Bismuth 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, 99.99% min., tonne lots.

Figure 2
World Mine Production of Bismuth, 2002



Sources: Data from U.S. Geological Survey.
(e) Estimated.

PRODUCT INFORMATION

Those who wish to purchase bismuth should contact the producers. In Canada the following firms produce and sell bismuth:

- Teck Cominco Limited www.teckcominco.com
- Falconbridge Limited www.falconbridge.com

Additional information such as addresses and phone numbers can be found on their web sites.

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to October 2003, include the following:

- United States Geological Survey (USGS): http://minerals.usgs.gov/minerals/pubs/commodity/bismuth/
- 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/Bi/key.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

OUTLOOK

Bismuth is a by-product metal; the bismuth revenue in the ore mined is only a fraction of the total ore value in almost all cases. When bismuth prices increase because of sharply increased demand, many operations do not have the capacity to increase production significantly. Because the bismuth constitutes only a small fraction of the revenue produced at the mine, producers will not increase ore production only because bismuth prices increase. While most metal prices are volatile, the price of minor by-products such as bismuth can be much more volatile due to the inability of producers to capitalize on increased demand. The ability of bismuth to substitute for lead is constrained by the higher price for bismuth and by the inability of the bismuth industry to substantially increase production.

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 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 bismuth 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/com_e.html.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2617.90.00.90	Bismuth ores and concentrates	Free	Free	Free	Free
8106.00.10	Unwrought bismuth, not alloyed; powders, not alloyed	Free	Free	Free	Free
8106.00.20	Unwrought bismuth, alloyed; waste and scrap; powders, alloyed; articles of bismuth	Free	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States,* 2003.

TABLE 1. CANADA, BISMUTH PRODUCTION AND TRADE, 2000-2002, AND USE, 1997-2001

Item No.		2000		2001		2002 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION (all forms) (1)							
	New Brunswick	194 230	2 250	251 530	3 102	189 333	1 905
	British Columbia	7 998	93	6 023	74	–	–
	Total	202 228	2 343	257 553	3 176	189 333	1 905
EXPORTS							
8106.00	Bismuth and articles thereof, including waste and scrap						
	United States	120 275	1 228	42 510	447	49 822	516
	Belgium	20 134	207	20 117	212	41 509	371
	Ukraine	–	–	700	11	847	19
	France	69	1	–	–	–	–
	Germany	61 363	715	–	–	–	–
	Other countries	79 178	886	34 550	402	–	–
	Total	281 019	3 037	97 877	1 072	92 178	906
IMPORTS							
2836.99.10.10	Bismuth carbonates						
	France	–	–	–	–	750	128
	Germany	150	. . .	544	2	778	2
	Spain	1 495	4	7 574	22	249	1
	United States	283 295	849	126 560	387	285	1
	Total	284 940	853	134 678	411	2 062	132
8106.00.00.10	Unwrought bismuth, not alloyed; powders, not alloyed						
	China	29 740	357	66 640	584	26 909	259
	Belgium	8 072	113	11 158	161	8 511	122
	United Kingdom	4 842	56	7 503	76	7 687	109
	United States	7 567	99	32 872	171	2 787	30
	Other countries	7 899	28	2 473	41	297	5
	Total	58 120	653	120 646	1 033	46 191	525
8106.00.00.21	Unwrought bismuth, alloyed; powders, alloyed, articles of bismuth						
	United States	5 149	187	2 329	140	2 680	127
	Sweden	–	–	–	–	127	10
	United Kingdom	–	–	100	5	20	5
	Italy	–	–	–	–	178	4
	Mexico	–	–	1 092	17	–	–
	Total	5 149	187	3 521	162	3 005	146
8106.00.00.22	Bismuth waste and scrap						
	United States	74 524	936	56 161	741	44 148	583
	Singapore	–	–	–	–	147	2
	China	981	12	–	–	–	–
	Other countries	–	–	4 307	52	–	–
	Total	75 505	948	60 468	793	44 295	585
	Total imports		2 641		2 399		1 388

		1997	**1998**	**1999**	**2000**	**2001** (p)
				(kg)		
USE (1)						
	Use, refined metal (available data)					
	Fusible alloys and other alloys	10 846	14 641	17 066	12 553	x
	Other uses	–	–	–	–	x
	Total	10 846	14 641	17 066	12 553	20 272

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
(1) Available data as reported by users.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, BISMUTH PRODUCTION AND USE, 1970, 1975 AND 1980-2002

	Production All Forms (1)	Use (2)
	(kilograms)	
1970	..	11 135
1975	156 605	29 267
1980	149 366	10 271
1981	167 885	10 094
1982	(r) 189 132	10 074
1983	253 023	7 241
1984	(r) 166 177	9 398
1985	201 489	7 284
1986	152 930	6 617
1987	165 282	4 547
1988	180 907	6 709
1989 (a)	156 727	16 158
1990	74 300	12 032
1991	59 526	11 877
1992	203 789	9 859
1993	128 870	12 133
1994	129 371	12 585
1995	158 641	12 838
1996	149 839	13 118
1997	195 720	10 846
1998	186 400	14 641
1999	217 135	17 066
2000	202 228	12 553
2001	257 553	20 272
2002 (p)	189 333	..

Source: Natural Resources Canada.

.. Not available; (p) Preliminary; (r) Revised.

(a) Increase in number of companies being surveyed.

(1) Refined bismuth metal from Canadian ores, plus recoverable bismuth content of bullion and concentrates exported. (2) Refined bismuth metal reported by users.