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 shotgun pellets used to hunt waterfowl, and to increase the machineability of alloys.

The world mine production of bismuth in 2001 was estimated by the United States Geological Survey (USGS) to have been 5810 t. Estimated Chinese production increased sharply from 400 t in 1999 to 2500 t in 2000. This increased Chinese production base was estimated to have continued into 2001 as well. According to the USGS, Canada produced about 4% of the world's bismuth at the mine stage. Other than China, which produced an estimated 42% of world production in 2001, the large producers are Mexico and Peru, which produce about 1000 t each, followed by Boliva at 750 t.

CANADIAN DEVELOPMENTS

Canadian primary bismuth production for the period 1993 to 2001 is shown below.

PRIMARY BISMUTH PRODUCTION IN CANADA

	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	3 163
Total	1 200	66	1 415	15 894

Source: Natural Resources Canada.
w Withheld.
Note: These data do not include bismuth recovered from recycling.

Canadian refined bismuth production data are withheld for reasons of confidentiality.

On average, for the period 1995 to 2001, 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.

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.

PRICES

Monthly *Metal Bulletin* prices from 1995 to September 2002 are shown in Figure 1. More detailed price information is available from the Sidech site at <www.sidech.be/more.htm#D>; click the "Graph" link under the heading "World Production and Bismuth Price."

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 respective web sites.

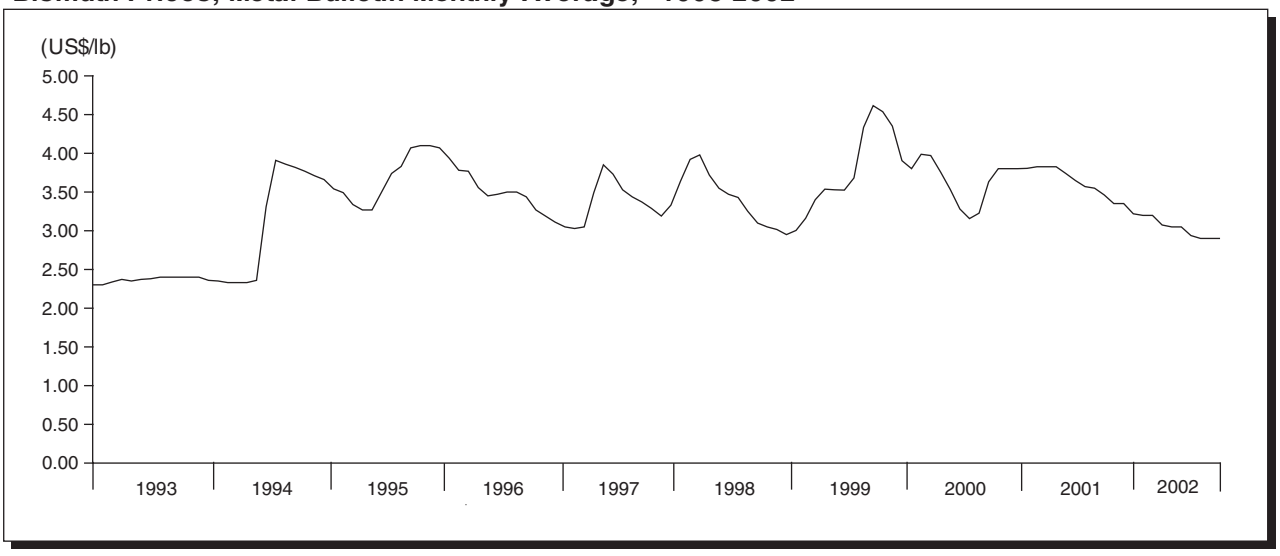
INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to October 2002, 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>
- *Northern Miner* (daily headlines): <www.northernminer.com>
- Various on-line encyclopedias
- Any web search engine such as <www.google.com/advanced_search>

Figure 1

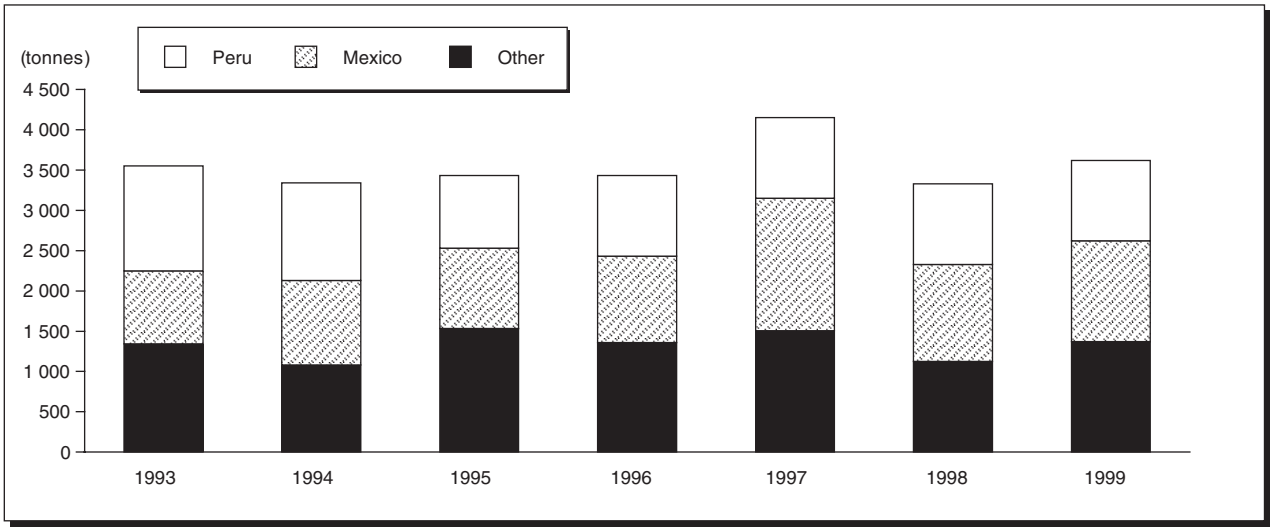
Bismuth Prices, Metal Bulletin Monthly Average,[1] 1993-2002



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
Bismuth, World Mine Production, 1993-99



Source: United States Geological Survey.

- 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>

COMMERCIALLY 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/bismuth/html>.

Studies from other sources may be available.

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 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 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 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 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/index_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: *Customs Tariff* , effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States* , 2002.

TABLE 1. CANADA, BISMUTH PRODUCTION AND TRADE, 1999-2001, AND USE, 1996-2000

Item No.		1999		2000		2001 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION (all forms) (1)							
	New Brunswick	206 572	2 285	194 230	2 250	251 530	3 089
	British Columbia	10 563	117	7 998	93	6 022	74
	Total	217 135	2 402	202 228	2 343	257 552	3 163
EXPORTS							
8106.00	Bismuth and articles thereof, including waste and scrap						
	United States	108 421	1 236	120 275	1 228	42 510	447
	Netherlands	39 977	461	41 090	477	20 110	225
	Belgium	–	–	20 134	207	20 117	212
	Japan	39 574	405	38 088	409	13 096	158
	Other countries	–	–	61 432	716	2 044	30
	Total	187 972	2 102	281 019	3 037	97 877	1 072
IMPORTS							
2836.99.10.10	Bismuth carbonates						
	United States	65 905	189	283 295	849	126 560	387
	Spain	1 922	6	1 495	4	7 574	22
	Germany	–	–	150	...	544	2
	Total	67 827	195	284 940	853	134 678	411
8106.00.00.10	Unwrought bismuth, not alloyed; powders, not alloyed						
	China	14 723	160	29 740	357	66 640	584
	United States	25 549	271	7 567	99	32 872	171
	Belgium	6 630	87	8 072	113	11 158	161
	United Kingdom	–	–	4 842	56	7 503	76
	Other countries	601	8	7 899	28	2 473	41
	Total	47 503	526	58 120	653	120 646	1 033
8106.00.00.21	Unwrought bismuth, alloyed; powders, alloyed, articles of bismuth						
	United States	1 506	47	5 149	187	2 329	140
	Mexico	–	–	–	–	1 092	17
	United Kingdom	–	–	–	–	100	5
	Canada	1 003	12	–	–	–	–
	Peru	136	2	–	–	–	–
	Total	2 645	61	5 149	187	3 521	162
8106.00.00.22	Bismuth waste and scrap						
	United States	63 570	782	74 524	936	56 161	741
	Canada	–	–	–	–	3 170	38
	Germany	–	–	–	–	1 137	14
	China	–	–	981	12	–	–
	Total	63 570	782	75 505	948	60 468	793
	Total imports		1 564		2 641		2 399

		1996	**1997**	**1998**	**1999**	**2000** (p)
				(kg)		
USE (1)						
	Use (1), refined metal (available data)					
	Fusible alloys and other alloys	13 118	10 846	14 641	17 066	12 553
	Other uses	–	–	–	–	–
	Total	13 118	10 846	14 641	17 066	12 553

Sources: Natural Resources Canada; Statistics Canada.
– Nil; **...** Amount too small to be expressed; (p) Preliminary.
(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 1980-2001

	Production All Forms (1)	(2) Use
	(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 (p)	257 552	..

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.