

USGS Mineral Resources Program

Antimony—A Flame Fighter

As part of a broad mission to conduct research and provide information on nonfuel mineral resources, the U.S. Geological Survey (USGS) supports science to understand

- How and where antimony resources form and concentrate in Earth's crust
- How antimony resources interact with the environment to affect human and ecosystem health
- Trends in the supply of and demand for antimony in the domestic and international markets
- Where undiscovered antimony resources might be found

Why is this information important? Read on to learn about antimony and the important role it plays in the national economy, in national security, and in the lives of Americans every day.

Antimony is a brittle, silvery-white semimetal that conducts heat poorly. The chemical compound antimony trioxide (Sb_2O_3) is widely used in plastics, rubbers, paints, and textiles, including industrial safety suits and some children's clothing, to make them resistant to the spread of flames. Also, sodium antimonate (NaSbO_3) is used during manufacturing of high-quality glass, which is found in cellular phones.

Humans have known about stibnite (Sb_2S_3), a lead-gray antimony sulfide mineral, since ancient times. Egyptians used powdered stibnite in black eye makeup to create their signature look. Pedanius Dioscorides, a 1st century A.D. Greek physician, recommended stibnite for skin ailments. French and German doctors in the 17th century prescribed antimony-containing mixtures to induce vomiting. Antimony was later recognized to be an intense skin irritant and a lethal toxin, particularly when swallowed.

In the 11th century, the word antimonium was used by medieval scholar Constantinus Africanus, but antimony metal was not isolated until the 16th century by Vannoccio Biringuccio, an Italian metallurgist. In the early 18th century, chemist Jons Jakob Berzelius chose the periodic symbol for antimony (Sb) based on stibium, which is the Latin name for stibnite.

How Do We Use Antimony?

Most of the world's antimony is used (as antimony trioxide) in flame-retardant materials; powdered trioxide is chemically inserted or physically blended into many different materials, including textiles. Although antimony trioxide is not a flame retardant by itself, when it is combined with halogens (such as bromine) in polymers, the resulting mixture suppresses, reduces, and delays the spread of flames.

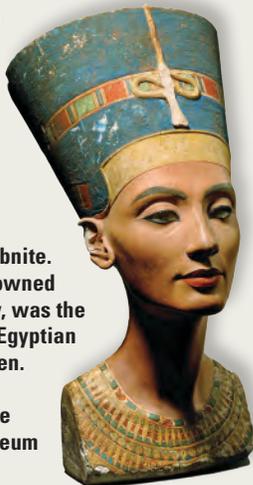
Alloys of antimony and lead provide enhanced electrical properties to batteries as well as increased hardness to ammunition. Battery electrodes coated with antimony-lead alloys have more efficient recharge and are able to be fully drained multiple times with sustained performance. Many cellular phones use antimony-bearing batteries. Research for lithium-ion battery replacements led to the development of antimony nanocrystals for future use in high energy density batteries. Ammunition made with antimony-lead alloys is capable of penetrating some armor.

Antimony is used during the production of plastics, including polyethylene terephthalate or PET, used for common items like soda bottles. Sodium antimonate is used during the manufacturing of high-quality glass to remove bubbles and trace iron and impart a sun-resistant property.



Time-lapse burn test comparing industrial suits with (left) and without (right) flame retardants that include antimony trioxide. Photograph courtesy of Thor, suppliers of AFLAMMIT® flame retardants for work wear.

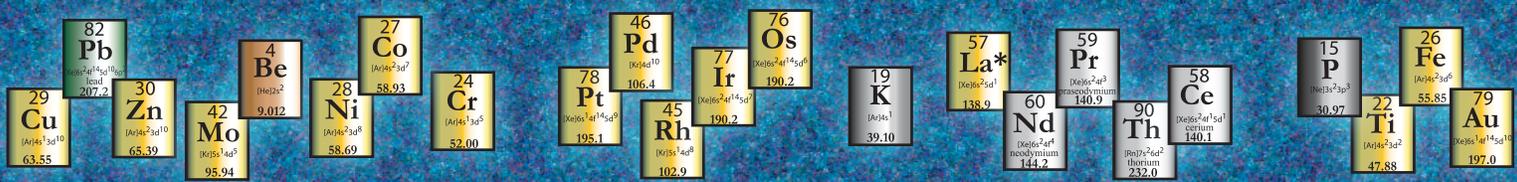
Bust of Queen Nefertiti, sculpted around 1340 B.C., with the signature Egyptian eye makeup likely made with stibnite. Nefertiti, renowned for her beauty, was the royal wife of Egyptian king Akhenaten. Photograph courtesy of the Egyptian Museum of Berlin.



Where Does Antimony Come From?

Although antimony occurs worldwide and in many types of deposits, just two deposit types contain the majority of the global antimony supply. Carbonate-replacement deposits (for example, Xikouangshan, Hunan Province, China) and gold-antimony epithermal deposits (for example, Yellow Pine, Idaho, U.S.) provide 80 percent of the world's antimony.

The carbonate-replacement deposit type accounts for 60 percent of the world's antimony and is the main source of commercially consumed antimony. Stibnite, the most common antimony mineral, occurs in veins hosted in carbonate rocks such as limestone. Nearly pure stibnite may occur in lenses tens of meters long, making for very rich ore. Gold-antimony epithermal deposits are the second most common type and contain 20 percent of the world's antimony. In these deposits, ore occurs in veins but in lower overall concentrations than carbonate-replacement type. Veins connect to each other in three-dimensional networks to form a low-grade, high-tonnage deposit that can be mined in open pits. Host rocks commonly include shale, limestone, quartzite, granite, calc-silicate rocks, and various volcanic rocks. The remaining 20 percent of antimony comes from magmatic polymetallic veins and hot spring deposits.



Did you know . . . Antimony was a favorite slow-acting poison among murderers in the 1900s.

Worldwide Supply and Demand for Antimony

The world's production could satisfy the consumption of antimony in the near future, but the amount produced may not be enough if global antimony consumption substantially increases and new sources are not developed. China is the world leader in antimony production, but in 2013 their antimony mine production declined by about 20 percent from that in 2011. In 2013, the U.S. imported 85 percent of the antimony that was consumed domestically—71 percent of that came from China.

No U.S. antimony mines were active in 2013, but a smelter in Montana produced antimony from imported concentrates and oxides. As of 2015, there is renewed interest in mining the historic Yellow Pine deposit, which is a gold-antimony epithermal deposit in central Idaho. The Sunshine Mine, in the Coeur d'Alene mining district in northern Idaho, was the sole domestic producer of antimony from the late 1990s until early 2001. However, the tripling of antimony prices between 2009 and 2014 may provide an economic incentive for mines to open.



The open pit in the Yellow Pine deposit, Idaho was a major producer of gold, antimony, and tungsten, and contains the largest antimony resource in the United States. Photograph by Stephen Box; property access courtesy Midas Gold, Inc.

Did you know . . . The word "alcohol" is rooted in the Egyptian word "kuhl" for powdered antimony.

How Do We Ensure Adequate Supplies of Antimony for the Future?

The U.S. defense, energy, and manufacturing industries are dependent upon foreign antimony sources and could be affected by the declining global antimony supply. Although antimony substitutes are available, they are less effective and more expensive. Thus, potential domestic sources of antimony are being explored, and stockpiling strategies are planned. The Stibnite mining district (including the historic Yellow Pine deposit in central Idaho) contains an estimated 41,000 metric tons of antimony, making it the largest domestic antimony resource. The Coeur d'Alene mining district, in northern Idaho, has a quartz-stibnite vein deposit, making this district the second largest in the nation having produced a significant amount of antimony in the past.

In order to predict where future antimony supplies might be located, U.S. Geological Survey (USGS) scientists study how and where antimony resources are concentrated in Earth's crust and use that knowledge to assess the likelihood that undiscovered antimony deposits may exist in an area. Techniques to assess mineral resources have been developed by the USGS to support the stewardship of Federal lands and to evaluate mineral resource availability in a global context. The USGS also compiles statistics and information on the worldwide supply of, demand for, and flow of antimony. These data are used to inform U.S. policymakers.



Stibnite specimen from Wuling Antimony Mine, Jiangxi Province, China. Similar stibnite specimen shown in headers, photograph by Joseph Budd. Both stibnite photographs courtesy of the Robert Lavinsky collection (<http://www.irocks.com/>).

Did you know . . . Antimony expands when it freezes, just like water.

For More Information

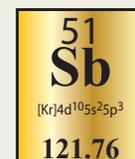
- On production and consumption of antimony:
<http://minerals.usgs.gov/minerals/pubs/commodity/antimony/>
- On grouped stibnite-quartz deposits:
<http://pubs.usgs.gov/of/1995/ofr-95-0831/CHAP26.pdf>
- Descriptive model of simple antimony deposits:
<http://pubs.usgs.gov/bul/b1693/Md27d.pdf>
- A thorough overview of antimony:
<http://pubs.usgs.gov/of/2003/of03-019/of03-019.pdf>

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The USGS Mineral Resources Program is the principal Federal provider of research and information on antimony and other nonfuel mineral resources.

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Did you know . . . Antimony occurs naturally in more than 260 minerals.