Thallium

U.S. Geological Survey mineral commodity specialist assistant Xiaoyu Bi compiled the following information about thallium, a critical component in several chemical, electronic, and medical applications.

Thallium is known as a poison, its use initially suspected in the recent death of a Russian spy, but it has a variety of more important applications in everything from medical imaging to wireless communications.

Thallium is a silvery white, soft, malleable and toxic metal. When exposed to air, however, it oxidizes readily and develops a bluish-gray tinge that resembles the color of lead. Thallium metal is available in various forms including foil, sputtering targets and rods, while thallium compounds are available as submicron, lump and nanopowder. Commercial grades of thallium metal range from 99 percent to 99.9999 percent pure. Thallium melts at 304 degrees Celsius and boils at 1,473 degrees Celsius.

Thallium metal and compounds are primarily used in infrared optical materials and therapeutic medications. Specific applications include medical cardiovascular imaging, gamma radiation detection equipment, filters for light diffraction in acousto-optical measuring devices and wireless communications, low-temperature measurement equipment, and lenses, prisms and windows for infrared detection and transmission equipment. Other uses include as an additive in glass to increase its refractive index and density, as a catalyst for organic compound synthesis, and as a component in high-density liquids for sink-float separation of minerals. Thallium sulfate was widely used as a pesticide until 1975, when its use in the United States was banned.

Thallium metal and its compounds are highly toxic and are strictly controlled to prevent a threat to humans and the environment. Sources of possible thallium releases include gaseous emissions at cement factories, leaching of thallium from ore processing waste, and metal sewer pipe. Thallium and its compounds can be absorbed into the human body by skin contact, ingestion or inhalation of dust or fumes.

Short-term health effects of thallium exposure include gastrointestinal irritation and nerve damage, and long-term health effects include hair loss, changes in blood chemistry, and damage to liver, kidneys, intestinal and testicular tissues. Under the Safe Drinking Water Act of 1974, the U.S. Environmental Protection Agency set the non-enforceable maximum contaminant level goal of thallium in drinking water at 0.5 parts per billion and the maximum contaminant level at 2 parts per billion.

Thallium has a relatively low crustal abundance, estimated to be 0.7 parts per million. While it is widely dispersed, its highest abundance is in alkali feldspars and micas where it substitutes for potassium. Thallium minerals are rare, with thallium occurring in crooksite, lorandite and hutchinsonite.

Thallium is recovered as a byproduct from flue dusts and residues collected principally in the smelting of zinc ores, but also other sulfide ores. Although thallium is contained in ores mined or processed in the United States, it has not been recovered domestically since 1981. Based on the

estimated thallium content of zinc ores, the United States is estimated to have about 18 percent of the world reserve base. World resources of thallium contained in zinc resources total about 17 million kilograms, most of which are located in Canada, Europe and the United States.

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