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JOHN'S CORNER:

MINERALS - The Elements and What They Do (Part 33)

by John Ferguson

51) Antimony (Sb) - Antimony is an element sometimes referred to as a metalloid. It is metallic in appearance (bright and silvery) but brittle, and with more of a crystal structure than other metals.

Antimony is found in igneous rocks at 0.2 ppm, shale's at 1.5 ppm, and limestone at 0.2 ppm. In soil, antimony ranges from 2-10 ppm. Very little antimony is in fresh or seawater.
Adding a little antimony to lead makes it harder and is commonly used in making bullets. The electro-plates used in lead acid batteries in our automobiles use antimony. When antimony is cast, and as it cools, it emits melodic sounds. Unlike most elements, antimony expands as it cools.

Antimony is below and in the same column on the periodic table as arsenic hence, it has similar properties. The most common electrical or valence state of antimony is +3.
In nature, antimony is often found with sulfite minerals like stibnite (Sb_2S_3) and may substitute for arsenic (As) in other minerals. Over 100 known minerals contain antimony. Antimony is sometimes concentrated in coals, carbonaceous shale, and sewage sludge.
In addition to hardening lead antimony is used in making flame resistant clothing, other fabrics, and even children's toys. It is found in some semi-conductors and other electrical devices.

The composer Mozart is believed to have been killed by antimony poisoning. Mozart ingested a compound of antimony "tartar emetic" (an antimony potassium salt) which doctors prescribed as a hangover cure. Mozart was a heavy drinker.

Antimony in the form of lead antimonate was used as a yellow pigment on ornamental bricks in the Babylonian King Nebuchadnezzar's palace.

Antimony often occurs in soluble forms of which some may be complexed by humates which increase its mobility in the soil. Antimony is easily absorbed hence clay sediments may become enriched with this element. Depending on other soil minerals, antimony may be fixed or readily move through the soil profile.

Antimony contamination is becoming a major problem from land applications of sewage sludge and the burning of coal.

In humans, antimony is found in our bones and other tissues. However, antimony does not seem to accumulate in our bodies. Historically antimony compounds have been used to treat several medical problems. Some antimony compounds have been found to cause cancer in rodent studies when breathed.

Gardening and Landscaping Problems Associated with Antimony (Sb)

Antimony is not considered an essential element for plants; however it is easily absorbed by plants, if present in the soil, in soluble forms.

One study found increased auxin production by rhizobacteria with increased antimony concentration in the soil (Picard and Bosco 2006).

There is no evidence of toxicity to plants unless extremely high levels of antimony are encountered. Most plants have from 1-30 ppm in their tissues. Spinach grown on contaminated soils had 1,130 ppm of antimony.

Sources: coal, sewage sludge, Biosolids compost (compost made from sewage sludge), metal smelters

52) Tellurium (Te) - Tellurium is known as a silvery white, semi-metal. Tellurium is in the same column of the periodic table as selenium at the boundary between metals and non-metals and has properties of both.

Tellurium is found in igneous rocks at 0.001 ppm, land plants at 2-25 ppm, and in land animals at 0.02 ppm. Very little tellurium is found in fresh or seawater. Tellurium is rarer on Earth than the universe in general.

Tellurium is used in making rubber, tinting glass and ceramics, electronic devices, and as a catalyst in oil refining. Tellurium is used as an alloying agent as it makes alloys easier to machine and mill.
Tellurium is also used to make our Blu-ray players.
Tellurium is found in tumor suppression protein sequences, as it works with selenium to help the body fight cancer, tumors and viruses.

There is no known biological role for tellurium. It is found in human blood at only 6 ppb, in tissue at 15 ppb, and none in our bones. When we ingest tellurium, it is slowly excreted in our urine with some being converted to a obnoxious and volatile dimethyl telluride ($Te(CH_3)_2$) which is then expelled in our breath and sweat glands and has a pungent garlic like odor. This odor can last for weeks.

Microorganisms can absorb tellurium and then emit it in a volatile form by methylating it to dimethyl telluride ($Te(CH_3)_2$). Tellurium is fixed by organic matter and some coals can have 20-2,000 ppm of tellurium.

Recent studies have found that tellurium compounds have anti-oxidant properties including anti-tumor and chemo protective effects (Zemolin et al. 2013).

Gardening and Landscaping Problems Associated with Tellurium (Te)

Tellurium has no known biological function. New research has found that fungi can incorporate it in place of sulfur and selenium into some of their amino acids.
Plants absorb tellurium easily and the amount in their tissues is related to the amount in the soil. Plants can absorb tellurium from the soil and have been found with levels of 6 ppm, although most plants have far less. Onions and garlic can have 300 ppm and is what give them their strong odor.

Sources: coal and fly ash from coal, smelters

53) Iodine (I) - "As one moves down the Halogen column on the periodic table, the elements mellow a bit, from vicious fluorine (#9) to deadly chlorine (#17) to barely-liquid bromine (#35) - until you reach iodine, an element so comparatively benign that it is used to cure hoof fungus in horses."

Iodine is gray-black substance that is barely solid at room temperatures; however, with a little heat it quickly evaporates (sublimates) into a beautiful violet vapor without going through a liquid phase. This effect is increased in areas of high humidity.

Iodine is released from rocks during weathering, where it is rapidly transported to ocean basins. Most of the iodine in nature (70%), is found in ocean sediments.

Iodine occurs in igneous rocks at 0.5 ppm, shale at 2.3 ppm, sandstone at 1.7 ppm, limestone at 1.2 ppm, and soil at 5 ppm. Very little iodine is found in fresh or seawater as it is readily absorbed into plants and animals. Marine plants can have 30-1,500 ppm, and marine animals 1-150 ppm. Land animals only have 0.43 ppm but iodine is essential to their health.
Soils average 2.8 ppm of iodine but it varies widely from 0.1-10 ppm. Soils derived from volcanic ash may have 100 ppm of iodine. Iodine binds readily to organic matter hence tend to accumulate on the surface of soils ("O" horizon).

Under anaerobic conditions, iodine is leached out of our soils. Depending on the chemical form of iodine, it may very stable or very mobile in soils and water. The most common electrical or valence state for iodine is -1.

Iodine is used in colorants and inks, many common chemicals, pharmaceuticals, and used as a catalyst in several applications. When I was a boy, a tincture of iodine was used to treat cuts and scrapes.

Iodine is essential for mammals, especially humans. The World Health Organization estimates that *2 Billion people* are deficient in iodine, which is over 30% of the world's population.
The most famous health problem caused by a lack of iodine is goiter. Many years ago, we used to get iodine from chewing gum (Iodigum) which was later replaced by iodized salt.

Natural occurring salt has iodine in it, but the common manufactured white or bleached salt (sodium chloride - NaCl) does not, as all the trace minerals have been removed, hence iodine has to be added back. However, only 20% of the brands of "iodized" salt have enough iodine to meet even the minimum daily requirement if you eat salt.

Note: Potassium iodate when stabilized with calcium carbonate as found in sea salt at the end of 8 months only 3.5 % of the iodine was lost.

Iodine is essential for proper brain functioning and intelligence, it is important for the metabolism of fats, and it helps with the assimilation of phosphorous and the utilization of calcium.

The human thyroid gland requires iodine to make hormones like thyroxine andtriiodothyronine which are required for metabolic functioning. Iodine also blocks toxins from accumulating in our thyroid gland.

A deficiency of iodine is associated with the occurrence of many forms of cancers, intellectual impairment, severe mental retardation, growth stunting, apathy, impaired movement, impaired speech, and impaired hearing. Iodine has been shown to help prevent cancer and breast cancer cells to not die unless they have iodine. Iodine deficiencies have been associated with goiter, cretinism, numbness in ones fingers, nervousness, flabby skin, drooling, and childlike behavior.

A lack of iodine can cause cravings for chocolate (particularly in women), weight gain, fatigue, intolerance of cold, and prenatal deficiency leads to brain damage in infants.
Many forms of pollution displace iodine in our bodies or prevent us from absorbing it. Fluoride added to our public water systems prevents the body from absorbing iodine in the thyroid gland. This is another reason to filter fluoride out of our water systems and not use toothpaste or other items with fluoride added.

Bromine, which is added to flour and bread, also blocks iodine from being absorbed in our bodies. Then we have many synthetic chemicals called xenoestrogens that are used in hand lotions and other

personal care products prevent the absorption of iodine. Other chemicals found in air pollution prevent iodine absorption.

Selenium deficiency excavates the effects of iodine deficiency and in humans; we cannot use iodine efficiently if we do not have sufficient copper.

Humans lose a lot of iodine when we sweat and it must be replaced, especially in hot and humid weather (e.g. Houston and Gulf Coast).

Iodine occurs in soils mainly in fixed forms where it is readily absorbed by humic and fresh organic matter. Iodine is also absorbed onto clays and in the lattice of many minerals. Hence, the phytoavailability of iodine is low.

Gardening and Landscaping Problems Associated with Iodine (I)

Historically iodine was not considered essential for plants, however some new studies have found that in small amounts iodine has a stimulating effect on growth. However, how iodine influences plant growth is not fully understood.

Cabbages, onions, and mushrooms raised in good soil can have 10 ppm of iodine. Other foods are codfish, oysters, shrimp, herring, lobster, and sunflower seeds.

The lack of iodine in our food is an example of why we need to grow food organically. Farmers use artificial fertilizers which acidify the soil, then they have to lime the fields to raise the pH where the lime reduces the uptake of iodine by plants. Nitrates also prevent humans from absorbing iodine from our food.

Toxicity issues are rare under normal cond itions, as the soil cannot hold enough soluble iodine to cause a problem. Iodine tends to bind tightly to soils hence the phytoavailability is low and not available to roots and not easily volatized. The few rare cases of toxicity reported were from

agricultural fields near coastlines where large amounts of kelp were used as fertilizers. The physical symptoms were chlorosis in the older leaves while the younger leaves became dark green.

Plants more easily absorb soluble forms of iodine, thus marine plants tend to have more iodine than land plants. Marine plants range from 53-8,800 ppm of iodine.
The decomposition of organic matter by bacteria allows soil iodine to become phytoavailable where most of it is in the plants roots. Foliar application of iodine in the form of potassium iodide (KI) has been found to increase the nitrate accumulation in spinach and to increase the vitamin-C content of radishes.

Iodine content of vegetables was found to be lower in summer and higher in winter.
Plants are also capable of absorbing iodine from the atmosphere and can absorb iodine from foliar applications.

Sources: seaweed, saltwater fish emulsion, sewage sludge.