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NEWS FROM THE WONDERFUL WORLD OF SOIL AND PLANTS

MINERALS - The Elements and What They Do

Today we continue with our study of all the minerals (elements) in the human body, what they do. See previous newsletters (9/17/21 and 9/24/21) for a list of references and introduction to the Periodic Table.

Today we look at elements 29-32 which are copper, zinc, gallium, and germanium.

29) **Copper (Cu)** - Copper is a common and very useful metal. It is used to make bronze and brass, copper coins, jewelry, cups and goblets to electrical wiring.

Copper is found in igneous rocks at 55 ppm, shale at 45 ppm, sandstone and limestone at 4-5 ppm, and very little in fresh water 0.0002 ppm and less in salt water. In most soils, it is found at 2-200 ppm as it is strongly absorbed by humus. Marine and land plants have 11-14 ppm, and marine animals 4-50 ppm.

The Egyptians as far back as 3,000 BC used the compound copper acetate ($C_4H_3CuO_4$) to treat diseases of the eye. The smelting of copper ore began around 5,000 BC, when copper was extracted from the green ore, we call malachite which is a copper carbonate compound $Cu_2CO_3(OH)_2$.

Copper is an excellent conductor of heat hence is used to make pans, kettles and boilers. Copper is used in making bronze (copper-tin) which was used for weapons before iron was discovered (The Bronze Age). Brass is a copper zinc alloy.

Copper beryllium alloys are often used for the heads of golf clubs. We find that copper is used in hundreds of every day products. One of the most common uses of copper is to make electrical wire since it has excellent electrical conductivity and can easily be made into wire. Copper is malleable and ductile and with an electrical conductivity second only to silver (Ag).

Copper occurs in soils in two electrical states Cu^{+} and Cu^{+2}, where the +2 form is the most stable. Most agricultural soils are now deficient in copper, hence copper deficiency is widespread, and copper deficiency diseases are very common.

In society today over 31% of the population is copper deficient. Deficiency symptoms in humans are premature white grey and silver hair, dry brittle hair, sagging tissue, hernias, varicose and spider veins, aneurysms, anemia, arthritis, ruptured discs in our back, violent behavior, learning disabilities, fatigue, osteoporosis, neuropathies, etc.

We now know that copper and estrogen utilization are tightly linked. Copper imbalances cause every conceivable female organ related difficulty such as premenstrual syndrome, ovarian cysts, infertility, miscarriages, sexual dysfunction, etc. Copper imbalance is also associated with mental deficiency, neurological dysfunction, and psychological disorders.

People with deficient copper in their diets have increased levels of cholesterol, higher blood pressure, and impaired ability to digest glucose. Copper is required for hemoglobin to function properly and in normal bone formation. A low copper diet can lead to poor iron absorption and iron deficiency anemia.

A lack of copper is linked to aneurisms (ruptured cerebral aneurism), skin wrinkles, varicose veins, sagging tissues, as it is used in elastic fibers.

Adequate copper boosts the fat burning in humans hence a lack of copper in our food is contributing to obesity and diabetes (Journal of Nature Chemical Biology).

NOTE: "Micronutrient malnutrition is like a hidden hunger and now affects far more people than caloric malnutrition. Mineral deficiencies are estimated to afflict a third to one-half of the humanity, causing major health problems in both developed and undeveloped countries." From The Hidden Half of Nature -The Microbial Roots of Life and Health, D. Montgomery, PhD.

For example, the artificial sweetener "Aspartame" is a ligand (ties up or binds) for copper, which allows it to react and bind to our DNA, which makes it unavailable for other uses. Dietary interactions with sucrose or fructose inhibit copper absorption to varying degrees.

Copper is essential to all species of life. There are more than 30 copper containing enzymes and it is used by over 300 enzymes. For example, the enzyme Cytochrome c oxidase is required by all cells to produce energy. Other enzymes that need copper protect against free radicals that induce inflammation and cancer. The energy currency of our cells is ATP (adenosine triphosphate) and requires copper for our bodies to make it.

Even though it is not as common, excess copper can also lead to health problems as too much copper interferes with iron and zinc usage in our bodies. Too much copper can be toxic, however vomiting generally starts if an excess of a copper compound is swallowed which acts to prevent acute toxic effects.

Food sources of copper are liver, oysters, potatoes, mushrooms, shellfish, nuts, seeds and whole grains. Seafoods (clams, oysters, crab, lobster), liver meats from lamb and beef, beans and nuts (walnuts and Brazil nuts), sunflower seeds, mushrooms, and copper water pipes are other sources.

Copper is relatively immobile in soils and concentrates in the top layers where it is tightly bound to inorganic particles and organic matter. Some bacteria use copper to convert methane into the alcohol methanol.

Many microbes cannot live long on a copper surface particularly the MSRA bacteria which is often fatal to those with impaired immune systems. Some hospitals are now replacing all handles, doorknobs, rails, etc. with copper to reduce these types of infections. However, the microorganism called *Penicillum* can have 20,000 ppm (2%) copper in its tissues.

Research at several universities has found that copper chloride ($CuCl_2$) deactivates the human botulism enzyme (Journal of The American Chemical Society).

Gardening and Landscaping Problems Associated with Copper (Cu)

Copper is now recognized as essential for plant health. It functions as a nutrient that stimulates a plants natural immune system (disease prevention/resistance), and it is required for certain physiological processes such as enzyme and co-enzyme systems.

It is involved with carbohydrate and nitrogen metabolism, involved with lignin synthesis, vitally important to root metabolism, helps in formation of strong stalks, helps form compounds and proteins, amino acids and many other organic compounds, works as a catalyst, helps prevent chlorosis, rosetting and dieback.
Copper is involved with the creation of vitamin A and it is involved with regulating photosynthesis.

Copper plays many roles in plants, the two most common are in nitrogen utilization and lignum formation. Copper is also involved with the formation of proteins. Adequate copper levels help grasses stand up straight and has been shown to reduce head blights in wheat.

Plants absorb copper and is used throughout the plant but most of it remains in the root system. In above ground parts it is used in photosynthesis, carbohydrate distribution, cell wall metabolism, and especially in the production of DNA and RNA.

As increasing amounts of nitrogen are available to plants, the amount of copper in the plant must be increased accordingly for the plant to remain healthy.

Early symptoms of deficiency show up in youngest leaves and stems, dieback of stems and shoots, yellowing of leaves, stunted growth, distortion of young leaves and pale green leaves are often symptoms of copper deficiency. Seed stalks may also become limp and fall over. In trees, a deficiency may show up as white tip or bleaching of younger leaves and in summer dieback.

Plants deficient in copper have below average root mass and plants grown on soils with less than 2 ppm copper produce fewer seeds.

Excess calcium or nitrogen makes copper unavailable to plants. Hence, liming soils reduces plant ability to absorb copper (artificial fertilizers create acidic soil conditions with a lower pH which then are limed to increase the pH). Too much phosphorous (P) or potassium (K) will induce deficiencies of copper.

Organic matter like humus helps hold copper in the soils where plants can absorb it. Peat and muck soils are often deficient in copper as are soils that are low in quality organic matter.

It is rare but excess copper symptoms resemble iron deficiency. The use of sewage sludge (biosolids) can lead to an excess of copper in soils. Repeated use of poultry manure or poultry manure fertilizers can cause an excess of copper.

Note: Most Texas soils are deficient in copper.

Sources: basalt sand, granite sand, and re-mineralizer

30) **Zinc (Zn)** - Zinc is a blue-white metal that is brittle when cast, it tarnishes easily, and it chemically reacts with both acids and alkalis. Zinc is the 4th most widely consumer metal in the world where most of it is found in the mineral sphalerite which is a zinc sulfide mineral.

Zinc was first recognized as a separate element in 1764 and as an essential nutrient for plants, humans, and animals in 1869. However, statues made of zinc have been dated to the time of Christ.

Most pennies used in currency today are made of zinc as the value of the copper in a penny would be worth more than the penny itself. Zinc is often associated with galvanizing steel to prevent rusting and in its use to protect ships propellers and hulls from corrosion. Zinc is found in hundreds of products like paint, rubber, plastic, other chemicals, batteries, automotive equipment, computers, and many household devices. Zinc is used in sunscreens in the form of zinc oxide (ZnO). Note: Several universities have found that zinc oxide becomes toxic after just two hours exposure of ultraviolet light from the sun. (Journal Photochemical & Photobiological Sciences, 2021)

Zinc is listed in the Periodic table as a metal of Group 12, which includes mercury (Hg) and cadmium (Cd). Zinc occurs mainly in nature at its +2 electrical (oxidation) state.

Zinc is found in igneous rocks at 70 ppm, shale at 95 ppm, limestone at 20 ppm, freshwater and seawater at 0.01 ppm. In soils, zinc is found at 50 ppm, in marine plants at 150 ppm and land plants 100 ppm. In marine animals, it can range from 6 to 1,500 ppm and land animals at 160 ppm. In some coals, zinc levels can reach 19,000 ppm. Zinc weathers easily hence is readily available in most natural soils. In the soil, zinc may occur in many forms from microbial bodies to over a dozen of different chemical compounds. A couple common forms of zinc in rocks (minerals) are sphalerite, which is zinc sulfide (ZnS) and zinc carbonate ($ZnCO_3$).

Leaf cutter ants use zinc atoms in the teeth of their jaws to make extremely sharp cutting edges. This allows them to cut using only 60% of the energy and muscle mass normally required.

Over 300 enzymes in humans require zinc to function properly and zinc is part of the RNA molecule. In the United States 50% of our population is deficient in zinc (Zn) and 20% is severely deficient according to the U.S. National Institute of Health. Over 3,000 proteins use this vital element which affects many aspects of our health. Zinc deficiency in humans is associated with numerous health effects and is the fifth leading cause of death in the developing world (800,000 people die annually from zinc deficiencies according to the World Health Organization). In addition, another 1 billion people are zinc deficient.

Symptoms and diseases of zinc deficiency are pica (geophagia), loss of sense of smell and taste, infertility, failure of wounds and ulcers to heal, immune status failure, poor growth, high infant mortality, small and poorly functioning ovaries and testes, child remains in a pre-

puberty state, anemia, hair loss, acrodermatitis enteropathica, frizzy hair, diarrhea, depression, paranoia, oral and perioral dermatitis, anorexia nervosa, prostate enlargement, severe body odor, anorexia and bulimia.

Many pancreatic digestive enzymes depend on zinc.

Congenital birth defects associated with zinc deficiency: Down' syndrome, cleft palate, brain defects, small or absent eyes, micro- or agnathia, spina bifida, clubbed limbs, webbed toes and fingers, hiatal hernias, umbilical hernias, heart defects, lung defects, and urogenital.

Zinc is an important element for proper nervous system function and zinc has antioxidant properties and anti-inflammatory properties. A paper in the Journal Biological Trace Element Research found an association between higher zinc levels in people and reduced inflammation.

Zinc combined with the amino acid carnosine (zinc-carnosine) provides powerful actions against Helicobacter pylori infections that cause so many stomach and digestion problems (H. pylori is known to cause stomach cancer). Reported in the winter edition of Life Extension 2016, it has been found that zinc-carnosine heals ulcers (inhibits growth of H. pylori), repairs damaged mucus linings, and reduces inflammation.

Additionally, zinc is required for proper functioning of our digestive and immune systems. Zinc also helps protect the hippocampus from inflammation caused by stress.

Zinc lozenges have been proven to support the immune function of our cells that reduce the symptoms of viruses and greatly speed recovery from colds and flu by 300%. Zinc has been

found to inhibit the replication of many types of viruses. However, for zinc to work it has to be inside the cell.

Zinc deficiency has been linked and is associated with many comorbidities linked to COVID-19. Zinc ionophores (hydroxychloroquine, quercetin, and EGCG found in green tea) help move zinc into our cells.

As with many elements, eating foods with glyphosate on them prevents the body from absorbing enough zinc. A study from MIT found a strong correlation between glyphosate and Covid-19 severity. “A significantly number of Covid-19 patients are zinc deficient, which is associated with worse Covid outcomes”.

Researchers at the University of Texas at Arlington (10/2017) have found that zinc supplements slowed down the growth of esophageal cancers. Essentially, they stated, "zinc selectively inhibits cancer cell growth". Conversely, people low in zinc are more prone to cancer and other diseases. Zinc has also been shown to limit the duration and severity of influenza infections.

A loss of the sense of smell and taste are often symptoms of a lack of zinc.

Excesses of copper and iron or high vegan diets reduce the availability of dietary zinc. Milling and processing of grains removes over 50% of what little zinc was in the grain. Heavy losses of zinc occur in sweat hence zinc deficiency in un-supplemented diets can occur in athletes and those whom work outside in hot summers.

The disease *Pneumonia* caused by bacteria has a strong nutritional link to zinc. This disease kills over one million people each year. They found that animals with low levels of Zinc (Zn)

succumbed to the disease 3 times faster than those with normal levels. Zinc is required by the immune system of mammals to kill this bacterium.

A study published in the journal Mayo Clinic Proceedings found that celiac disease, or gluten sensitivity, is highly associated with a zinc deficiency.

Food sources for zinc are oysters and crabs, lobster, beef liver, nuts (cashews, almonds, pecans), and seeds including pumpkin.

Gardening and Landscaping Problems Associated with Zinc (Zn)

In soil, clays and organic matter help the soil hold onto zinc so it does not leach. As soil temperature increases zinc becomes easier to leach out of our soils. Another good reason to keep all our flowerbeds covered with several inches of quality aged native mulch.

Zinc is considered a micronutrient and plant tissue contains 3-100 ppm depending on the species. Zinc is required for enzyme activity, carbohydrate, starch, and seed formation. Many plant enzymes systems require zinc to work properly. Adequate zinc helps plants withstand hot and dry conditions and helps plants be more resistant to bacterial and fungal diseases. Zinc is required for healthy plants, as it is involved with a plants immune system in many ways.

When zinc is supplied in an organic form, it increases its bioavailability to plants. Plants can absorb zinc in many forms from elemental, oxidized (Zn^{+2}) and chelated states.

A few functions or activities of zinc are: required by azotobacteria non-symbiotic nitrogen-fixing bacteria, acts in the formation of chlorophyll, aids in the prevention of chlorosis in some plants, stimulates plant growth, aids in bud development, prevents the occurrence of mottled

leaf in citrus, white bud in corn and other disorders. It aids in the formation of plant enzymes and hormones, and is important for the sweet taste in vegetables and fruits. Zinc is required for certain physiological processes such as enzyme and co-enzyme systems. These include alcohol dehydrogenase, superoxide dismutase, carbonic anhydrase, RNA polymerase. Zinc is also used as an enzyme activator.

Zinc availability increases in acidic soils and in soils with high levels of quality organic matter. Soils that are well aerated also have more bio-available zinc.

Zinc deficiencies in soils and plants are common. However, a plants response to deficiencies varies widely, hence the diagnosis is rather complex. It takes visual, plant tissue analysis, and soil testing together to properly diagnose the deficiency.

Deficiencies are most evident in younger leaves as chlorosis, necrosis, or mottling. It occurs mainly in high pH soils, sandy soils low in organic matter, and organic soils of peat and muck. Too much phosphorous fertilizer induces deficiency along with distorted or puckered leaf margins and short internodes. Onions are sensitive to zinc deficiency and shows as striping, bending and twisting of the tops.

Other deficiency symptoms are the terminal leaves are small, bud formation is poor, and leaves have dead areas, yellow interveinal in mottled regions. Rosetting of terminals is another deficiency symptom.

Many of the plant species we call weeds often grow to correct soils problems hence weed populations tend to increase in soils deficient in Zinc.

Application of water soluble phosphorous (P) from artificial fertilizers prevents the soil from holding adequate zinc which then leads to deficiencies in the plant. This also occurs with usage of poultry manure fertilizers as they are high in phosphorous. This often results in low levels of

zinc in our food supply and the health problems mentioned above. This action then prevents microbes like *Rhizobium* from fixing nitrogen from the air to the soil. Excess calcium (Ca) in the soil can also lead to deficiencies. This is common in agricultural fields where the use of artificial fertilizers has acidified the soil, which then requires repeated liming with calcium products to increase the pH.

Too much nitrogen in the soil (think artificial fertilizers or poultry manure again) elevates certain amino acids and proteins in a plants root system disturbing the absorption and transport of zinc in and into plants.

Artificial fertilizers have destroyed soil structure in many of our agricultural areas resulting in poor drainage. Farmers have to install drain tiles to correct this problem. Soils with poor drainage decrease zinc availability (lack of zinc in our food supply) and conversely well-drained soils increase availability.

Another factor in zinc shortages in our food supply is caused by the herbicide glyphosate (Round-Up) as it ties up and prevents the absorption of essential minerals, especially those with a +2 electrical state. This is a reason eating genetically modified foods (GMO's) which have extremely high levels of glyphosate on them causes many kinds of health problems like zinc deficiency and cancer.

Zinc and iron are taken up by plants by the same mechanism, hence a deficiency of zinc in the soil often leads to plants absorbing too much iron (Fe) which hurts plant health making them more susceptible to insects and disease.

In soils, levels of zinc above 500-ppm cause problems as it prevents the plant from the absorption of other critical elements.

Poultry manure may contain 495 ppm of zinc and repeated use of poultry manure fertilizers can lead to zinc toxicity issues. Human sewage sludge (Biosolids) can have 131 ppm to over 1,670 ppm of zinc and repeated usage will cause problems as will fertilizers made from sewage sludge (ex. Milorganite, Hou-Actinite, etc.).

Rubber mulches from tires can cause severe zinc contamination of one's' soil as they contain up to 2% of their mass as zinc. When iron is exposed to excess zinc (Zn) it forms the mineral franklinite a zinc iron oxide ($ZnFe_2O_4$) which decreases the availability of both metals to plants. This has been proposed as one of the mechanisms as to why "rubber tire" mulch is so toxic to plants.

Sources: compost, native mulches, kelp meal, seaweed and its extracts, zinc sulfate, basalt sand, re-mineralizer

31) **Gallium (Ga)** - Gallium is the 34th most abundant element on Earth and is found on average in the earth's crust at 18 ppm. Gallium is a soft silvery-white metal that will melt in your hand at room temperature. However, it will not evaporate or boil until it is heated to 2,400 ^oC (4,352 ^oF).

Gallium is also one of the few substances like water that expands in volume when frozen.

If gallium is mixed with indium (In) and tin (Sn) it will not freeze until -19^0 C (- 2^0 F)! This combination of elements is known as "Galinstan" and is used to replace toxic mercury in thermometers.

Gallium is found in igneous rocks at 15 ppm, shale at 19 ppm, with less in sandstone and limestone. Very little gallium is found in fresh or seawater. In soils, gallium occurs at an average of 28 ppm with a range of 0.4-70 ppm. It is found only in small amounts in plants and animals. It occurs in marine plants at 0.5 ppm and land plants at 0.06 ppm, in marine animals at 0.05 ppm and land animals at only 0.006 ppm.

Gallium is generally stable in air and water, but it will react with both acid and alkali chemicals to form various compounds. Gallium is more abundant than lead but there are no natural processes that concentrate it as occurs in lead or other minerals.

Gallium is most commonly found in nature with a +3 electrical (oxidation) state. Aluminum also has a +3 electrical state hence gallium behaves similarly to aluminum in nature. In nature, we often find gallium in the form of gallium oxide (Ga_2O_3).

The production of aluminum (Al) from the bauxite ore is where the majority of our gallium comes from. Smaller amounts are recovered as a by-product of zinc (Zn) and copper (Cu) mining. Other sources include coal flue dusts that can contain 1.5% of this element.

Gallium is used to make semi-conductors but must be very pure (99.9999%) or what is called four nine pure, in the form of gallium arsenide (GaAs). Gallium arsenide has the ability to convert sunlight into electricity. Aluminum gallium arsenide gives LED (Light Emitting Diodes) lights their red color. When used in laptop computers to cell phones as gallium arsenide, it generates less heat than silicon based semi-conductors which helps the batteries last longer.

When gallium nitride is used to make semi-conductors, it produces a full range of colored light in LEDs. The lasers used in Blu-ray technology uses gallium nitride.

New research has found an efficient way to break apart the carbon dioxide molecule (CO_2) back into carbon and oxygen using liquid gallium.

For years, it was assumed that gallium has no known biological role except that it stimulates our metabolism. It has no adverse health effects as we do not accumulate it in our bodies and humans easily excrete it in our urine.

However, recent research has discovered that gallium is an essential nutrient for humans. It is required for metalloenzyme activity in the human brain and it reduces the amount of brain cancer in animal studies. British studies have shown then women whom receive gallium supplements during pregnancy; it reduces the amount of brain cancer in their children.

Gallium has also been shown to inhibit the growth of some types of leukemia cells and some types of breast cancer cells. In animal studies, adding gallium nitrate to their diets contributes to bone formation in rats on a low calcium diet. Gallium is believed to have a stimulatory effect of the absorption of iron by humans.

Since gallium has a +3 oxidation or electrical state, it behaves like iron in many compounds. Gallium compounds are being researched as anti-malaria drugs and gallium nitrate ($Ga(NO_3)_3$) has been used to treat bone cancers.

There is a radioactive form of Gallium called Ga-67, which has a half-life of 78 hours and is used to locate and treat cancers like melanomas since it concentrates in these tissues.

Toxic amounts of gallium are found in residuals from coal combustion, and in sewage sludge (bio-solids) and compost made from them.

Food sources for gallium are nuts and seeds.

Gardening and Landscaping Problems Associated with Gallium (Ga)

Plants show a selective absorption of Gallium depending on the level in the soil. In general, land plants have 0.03-5 ppm dry weight and edible vegetables 0.01- 2 ppm. However, gallium is found in plants tissue up to 30 ppm depending on the species.

Gallium is found in soils in the form of gallium hydroxide $Ga(OH)_3$ which is not very soluble in water hence gallium has low mobility in soils.

In small quantities, gallium stimulates the growth of some microorganisms like the fungus *Aspergillus niger*. It also promotes the growth of algae and the biosynthesis of photosynthetic pigments. In the case of *Anacystis nidulans* it increased oxygen (O_2) production and enhanced other key enzymes.

Supplemental gallium in the form of gallium nitrate $Ga(NO_3)_3$ has been shown to increase the yields and quality of tomatoes. Gallium also increased the absorption of iron (Fe) into the tomatoes increasing the amount of this nutrient.

However, gallium nitrate is phytotoxic to blue-green algae.

Sources: compost, basalt sand, re-mineralizer

32) **Germanium (Ge):** Germanium is an element that is known as a metalloid as it has properties in between those of metals and nonmetals, or stating in another way it has a mixture of metal and nonmetal properties. Germanium is a silvery white and brittle metalloid that is stable in

the air and water and it is almost totally unaffected by acids. Germanium is the 50th most abundant element on earth.

Germanium is found in igneous rocks at 5.4 ppm, shales at 1.6 ppm, and very little in sandstones and limestones. In soils, it is found mainly in the humus component at 1-2 ppm. There is extremely little germanium in fresh or seawater at 0.00007 ppm. In marine animals, it can reach 0.3 ppm. During weathering germanium is easily mobilized as germanous hydroxide $Ge(OH)_2$ and is readily absorbed from aquatic systems by clay minerals, iron oxides and organic matter removing it from the water.

The most common (and stable) electrical or oxidation state is +4, although it can be found at the +2 electrical state in some compounds. Germanium is in the same column on the periodic table as silicon (Si) hence it easily substitutes for silicon (Si) in many minerals and will form complexes with oxygen (O). In nature, germanium is found in association with sulfide ores of copper, lead, and zinc. Significant amounts of germanium are often found in ash and flue dust created from the burning of coal.

The first semiconductors were made with germanium and not silicon, as it did not require the high purity of silicon to work. Germanium was used as the critical element in early diodes and transistors. Additionally, germanium oxide was used as a catalyst in the manufacture of polyester.

Germanium has some interesting properties, unlike metals; germanium grows crystals as it cools from its liquid state. Germanium has the unique property that it is opaque in visible light but is transparent in infrared light. Germanium is required for televisions, computer screens, computer chips, optical fibers, solar cells, and infrared optical systems.

Germanium compounds (salts) generally have a low toxicity for mammals, but are toxic to some forms of bacteria but there is no practical application so far. It is considered a micronutrient, and some studies indicate that it will retard or prevent the growth of cancers in humans. Germanium

is known to enhance the human immune system by stimulating production of several types of natural killer cells. Organic compounds of germanium are used in chemotherapy and as a strong pain reliever in Asian medicine.

A Japanese researcher has found that many herbs with healing properties are accumulators for the element germanium. Most of our food plants contain very little germanium (2-5 ppm), however healing herbs such as garlic, aloe, comfrey, chlorella, ginseng, watercress, Shitake mushroom, and others contain 100-2,000 ppm. The "Holy waters" at Lourdes, France is known worldwide for their healing properties, which contains large amounts of germanium.

Germanium being a semi-conductor (both accepts and gives off electrons), it is a highly efficient electrical impulse initiator intracellularly, and germanium acts as a metallic cofactor for oxygen utilization. This allows organs to attract and use oxygen more efficiently.

Deficiencies of germanium are reduced immune status, arthritis, osteoporosis, low energy, and cancer. A few others health issues that are being linked to germanium deficiency are cirrhosis, neuralgia, leukemia, hypertension, softening of brain tissue, and cardiac insufficiency.

The human body rapidly excretes germanium in our urine hence it needs to be replaced from our food supply daily.

Gardening and Landscaping Problems Associated with Germanium (Ge)

Blue-green algae and diatoms will accumulate germanium in their tissues, as will some of the herbs mentioned above. Germanium is not believed to be an essential element for plants; however, plants easily absorb it if preset in our soils.

High levels of germanium have been found to be toxic to many plants as there is evidence that germanium can substitute for the silicon required by many of plant metabolic processes, which disrupts these processes.

Sources: compost, basalt sand, some humates, some coal ash, re-mineralizer