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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.

This week and next week we will conclude our study of the elements found in plants and animals including humans. Today we look at elements 66-74 which are dysprosium, holmium, erbium, thulium, ytterbium, lutetium, hafnium, tantalum, and tungsten. Unless one is a scientist you have most likely never heard of some of them. However new research has shown that many of them are linked to longer lifespans in mammals including humans.

66) Dysprosium (Dy) - Dysprosium is a shiny soft silvery metal that can be easily cut and can be machined without creating sparks. In its pure form, it is essentially worthless as it corrodes extremely fast. This rare earth element is found in igneous rocks at 3 ppm, shale at 4-6 ppm, and sandstone at 7.2 ppm while limestone only has 0.9 ppm.

This element is often used in combination with other elements to produce magnets with different properties. Dysprosium iodide (DyI_3) is used to make a red color found in high discharge lighting.

It is used to make extremely strong magnets, powerful beams of light and in nuclear reactors to absorb neutrons.

What little enters the food supply ends up in the bones of mammals at 0.01 ppm.

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Gardening and Landscaping Problems Associated with Dysprosium (Dy)

Plants roots absorb very little dysprosium and there is no published research on how it affects plants.

Sources: mineral sands of igneous rocks, Himalayan Sea salt, re-mineralizer

67) **Holmium (Ho)** - The earth's crust contains 1.4 ppm of holmium and it is the 56th most abundant element and is 20 times more abundant than silver even though most of us have never heard of it.

Of the rare earth elements, holmium's value is for its unique property called the "magnetic moment" and has the highest value of any element. This means when placed in a magnetic field, the holmium atoms line up and concentrate the magnetic field making it more intense. This element is used in MRI machines because of this effect as it makes extremely strong magnets. Lasers used in eye-surgery use holmium as one the ingredients. Similar to other rare earth elements holmium is also used in making glass to give different colors often in the form holmium chloride (HoCl_3).

Scientists in Switzerland are using holmium atoms on a magnesium oxide surface to make the first single atom, data storage device. The atoms magnetic field is the zero or one of a data bit. The best hard drive data storage technology today requires over 10,000 atoms to store one bit of data. (Science News, April 15, 2017).

The exact effect of holmium on humans is unknown. However, laboratory studies have shown that it stimulates metabolism.

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Plants do not readily absorb holmium hence very little gets into the food chain. Vegetables that were tested have less than 0.1 ppb.

Gardening and Landscaping Problems Associated with Holmium (Ho)

Carya species can accumulate up to 16 ppm of this element.

Sources: mineral sands of igneous rocks, re-mineralizer

68) Erbium (Er) - Erbium is another member of the rare earth family of elements. It is found in igneous rocks at 2.8 ppm, shale at 1.9 ppm, and sandstone at 1 ppm.

It is used in making special lasers used in dentistry to strip stain off tooth enamel. Erbium is also used in MRI equipment along with other rare earth elements and in nuclear reactors to absorb neutrons. A recent use of erbium is in communications systems where it can amplify a pulse of light in optical cables (fiber optics).

Erbium is used in making glass and ceramics as it gives it a soft pink color. Normally when we add energy to something the temperature will rise, however when erbium is added to glass and energy from a laser is shined on it, it gets cooler!

Erbium has no known biological role. However, as in other of the rare earth elements erbium salts have been shown to stimulate metabolism.

Marine and land animals have very small amounts in their bones.

Gardening and Landscaping Problems Associated with Erbium (Er)

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Carya species can accumulate up to 46 ppm of this element.

Sources: mineral sands of igneous rocks, re-mineralizer

69) **Thulium (Tm)** -Thulium occurs in the earth's crust at 0.5 ppm and is the 61st most abundant element.

Thulium is used in crystal matrices to make quantum memory devices and it is used to create a strong green light in many optical devices.

Thulium has no known biological role. However, as in other of the rare earth elements thulium salts have been shown to stimulate metabolism. When thulium is added to calcium sulfate, it will fluorescence when exposed to very low radiation levels.

Vegetables have less than 1 ppb of thulium. Marine and land animals have very small amounts in their bones.

Gardening and Landscaping Problems Associated with Thulium (Tm)

There are no known effects of this element on plants.

Sources: mineral sands of igneous rocks, re-mineralizer

70) **Ytterbium (Yb)** - A soft silvery white metal that is slowly oxidized by air and reacts slowly with water. It is a member of the rare earth elements but twice as common as tin.

Found in igneous rocks at 3 ppm, shale at 1.9 ppm, sandstone at 1.3 ppm, and very little in land plants or animals.

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Used as a doping agent in lasers where it creates color centers that store energy and it is found in many memory devices. The compound ytterbium bromide is used in the lighting industry.

It has no known biological role; however, ytterbium salts stimulate metabolism.

In rodent studies, 14% of ingested ytterbium by the mother is transferred to the newborn mice.

It is not absorbed readily by plant roots, hence very little gets into the food supply.

Gardening and Landscaping Problems Associated with Ytterbium (Yb)

Vegetables can have 0.08 ppb of ytterbium but some lichens can absorb 900 ppb.

None

Sources: mineral sands of igneous rocks, some coals have 170 ppm, re-mineralizer

71) Lutetium (Lu) - Originally called Lutecium but changed to Lutetium by international agreement. Lutetium is the last of the lanthanide series of rare earths and is the densest and hardest of this group. It is another of the rare earth series that is found in igneous rocks at 0.5 ppm, shale at 0.33 ppm, and very little in sandstone or limestone. There is very little lutetium found in marine or land animals.

Lutetium is a silvery white metal that is the costliest element in the world even though it is more common than silver. It often occurs in the ore monazite and it is used as a catalyst in cracking, alkylation, and polymerization in many industrial processes.

No known biological role, however ytterbium salts stimulate metabolism. The highest amounts are in our bones with some found in our livers and kidneys.

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Gardening and Landscaping Problems Associated with Lutetium (Lu)

Members of the *Carya* species can accumulate up to 4.5 ppm

None

Sources: mineral sands of igneous rocks, re-mineralizer

72) **Hafnium (Hf)** - Hafnium is a lustrous silvery metal that is ductile and resists corrosion. Powdered hafnium will burn in air and is resistant to most acids.

Hafnium is found in igneous rocks at 3 ppm, shale at 2.8 ppm, sandstones at 3.4 ppm and only 0.3 ppm in limestone. Soils average around 3 ppm of hafnium while almost none is found in seawater.

It is used in electric plasma torches to cut steel and can be anodized into attractive colors.

No known biological role

Gardening and Landscaping Problems Associated with Hafnium (Hf)

Hafnium has no known biological role in plants even though plants have 0.01-0.4 ppm of hafnium depending on the soil they were grown. Some marine plants will accumulate 10 ppm in their tissues.

Sources: mineral sands of igneous rocks, sewage sludge at 3 ppm, re-mineralizer



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73) **Tantalum (Ta)** - Tantalum is a silvery shiny soft metal that is found in igneous rocks at 2 ppm, shale at 0.8 ppm, sandstone and limestone at 0.05 ppm and extremely little in seawater at 0.0000025 ppm. However, marine animals accumulate up to 410 ppm.

Virtually every modern electronic device from cell phones to TVs to computers used tantalum capacitors in its circuits. Tantalum is almost impervious to chemical attack and resist corrosion hence it is used in surgery implants from plates for skull fractures to bolts to fasten broken bones.

Tantalum carbide is harder than diamonds. It has a very high melting point of 6,760 °F (3,738 °C) where it is used in special cutting tools.

Tantalum has no known biological role and appears to be non-toxic.

Gardening and Landscaping Problems Associated with Tantalum (Ta)

None

Found in plants at less than 5 ppb.

Sources: mineral sands of igneous rocks, re-mineralizer

74) **Tungsten (W)** – Tungsten is found in igneous rocks at 1.5 ppm, shale at 1.8 ppm, sandstone at 1.6 ppm and limestone at 0.6 ppm and soils at 1 ppm. Seawater has very little tungsten in it at 0.0001 ppm, but marine plants have 0.35 ppm. There is very little tungsten in land animals (0.005 ppm) where it is found in the heart muscle and our teeth.

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Tungsten is a lustrous silvery-white metal and is the strongest metal at very high temperatures and it is very inexpensive. However, it has the same density as gold hence commonly used to make gold plated ingots (fake gold).

Tungsten carbide is used in cutting tools and in items that need to stay sharp, it is much harder than steel and does not fracture like diamonds. Due to its hardness, it is used in armor piercing bullets and to replace lead in shotgun shells.

Other uses include; used like lead in radiation shielding, used in special welding electrodes and used in incandescent light bulbs.

In humans, tungsten is found in our bones and in our spleen.

Gardening and Landscaping Problems Associated with Tungsten (W)

Required by some bacteria to live and grow. They contain an enzyme, which incorporates tungsten that can reduce carboxylic acid molecule to an aldehyde.

Tungsten has similar chemical properties as molybdenum (Mo) and has been found to substitute for molybdenum (Mo) in several microbial enzymes.

Plants can absorb tungsten from the soil and some trees can have 100 ppm. The species *Pinus sibiricus* is an accumulator plant.

Watering with a sodium tungstate (Na_2WO_4) solution, increases the growth and yield of grapes and alfalfa. Barley has been found to absorb tungsten when it was applied to a soil.

Sources: mineral sands of igneous rocks, fly ash from burning coal, sewage sludge, re-mineralizer.

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