

JOHN'S CORNER:

MINERALS - The Elements and What They Do (Part 36)

by John Ferguson

63) Europium (Eu)

As you might have guessed, Europium is named for the continent Europe and is the 50th most common element on earth. It is a soft silvery metal and reacts readily with water and oxygen. Europium is found in igneous rocks at 1-2 ppm, shale's and sandstones at 1 ppm.

Unlike other rare earth elements, the value of Europium is not on magnetism but on luminosity. Paints made from this element can glow for many minutes or even hours after being exposed to a strong light source. It is used in cathode ray tubes (CRT), monitors, television set, etc. It is used in many types of compact fluorescent light bulbs. This element is so reactive that it will oxidize over time even when stored under oil.

Europium is not easily absorbed by plants hence very little gets into the food chain. It has no known biological role. However, laboratory animals fed diets with Europium increase their lifespan by 100%.

Gardening and Landscaping Problems Associated with Europium (Eu)

Present in some plants at 30-130 ppb (parts per billion), however most vegetables are far less at 0.04 ppb.

Members of the *Carya* family often have 16 ppm.

Sources: mineral sands of igneous rocks

64) Gadolinium (Gd)



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Gadolinium is another member of the "Rare Earth" group. Gadolinium is a silvery-white, malleable, and ductile metal. It is found in nature only in oxidized form, and even when separated, it usually has impurities of the other rare earths.

It is found in igneous rocks at 5.4 ppm, shale's at 4.3 ppm, sandstones at 2.6 ppm, and very little in limestone at 0.7 ppm. Gadolinium is the 41st most common element on earth and is more common than tin (Sn).

Many gardeners know the importance of para-magnetism to have healthy gardens. Gadolinium compounds are highly paramagnetic. This property makes this element very useful in medical applications where it improves contrast for procedures like MRI's. One example is injecting gadopentetate dimeglumine ($C_{14}H_{18}GdN_3O_{10}$) into one's blood stream and the MRI will show where the blood is going (showing the exact location of internal bleeding).

Gadolinium also has the unique property of going from ferro-magnetic to para-magnetic at near room temperatures (Currie point). In ice water, it will stick to a magnet but as it warms up it and becomes paramagnetic, it will fall off.

Gadolinium will also absorb neutrons and is used in nuclear reactors. Gadolinium is also used in microwave applications.

Very little gadolinium is found in the human body, however if ingested it quickly accumulates in the bones and liver of land mammals. Gadolinium has no known biological role but its salts stimulate metabolism.

Gardening and Landscaping Problems Associated with Gadolinium (Gd)

Most plants do not absorb gadolinium into their roots hence very little enters the food chain. A few land plants can absorb up to 70 ppm of this element, particularly the *Carya* species.
Sources: mineral sands of igneous rocks

65) Terbium (Tb)

Terbium is a soft silvery metal that is slowly oxidized in air and will react with cold water (most elements react with hot water). Terbium is found in the earth's crust at 1 ppm and is the 57th most abundant element (twice as common as silver). It is found in igneous rocks at 0.9 ppm, shale's at 0.58 ppm, and limestone at 0.07 ppm. Land plants have only 0.0015 ppm and land animals at 0.0004 ppm.

This element has the unique property that it will change its shape when placed in a magnetic field. This means a rod will grow longer or shorter depending on the magnetic field. This allows any solid material to be turned into a loud speaker; hence, it is used in many speaker applications. In making glass it is used as a coloring agent giving glass a beautiful red color.

The amount of terbium in the human body is not known, and has no known biological role. Very little terbium is absorbed by plant roots hence very little gets into the food chain. Vegetables that have been studied had less than 1 ppb in them. The small amount absorbed by humans ends up in the bones.

Terbium is a rare earth element and is four times more costly than platinum. It is commonly used in lasers and low energy lighting.

Gardening and Landscaping Problems Associated with Terbium (Tb)

No known issues good or bad.

Sources: mineral sands of igneous rocks

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.



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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.

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

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.

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 was 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).



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

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

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.

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 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.



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Gardening and Landscaping Problems Associated with Erbium (Er)

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

Sources: mineral sands of igneous rocks

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 fluoresce 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 is no known effects of this element on plants.

Sources: mineral sands of igneous rocks