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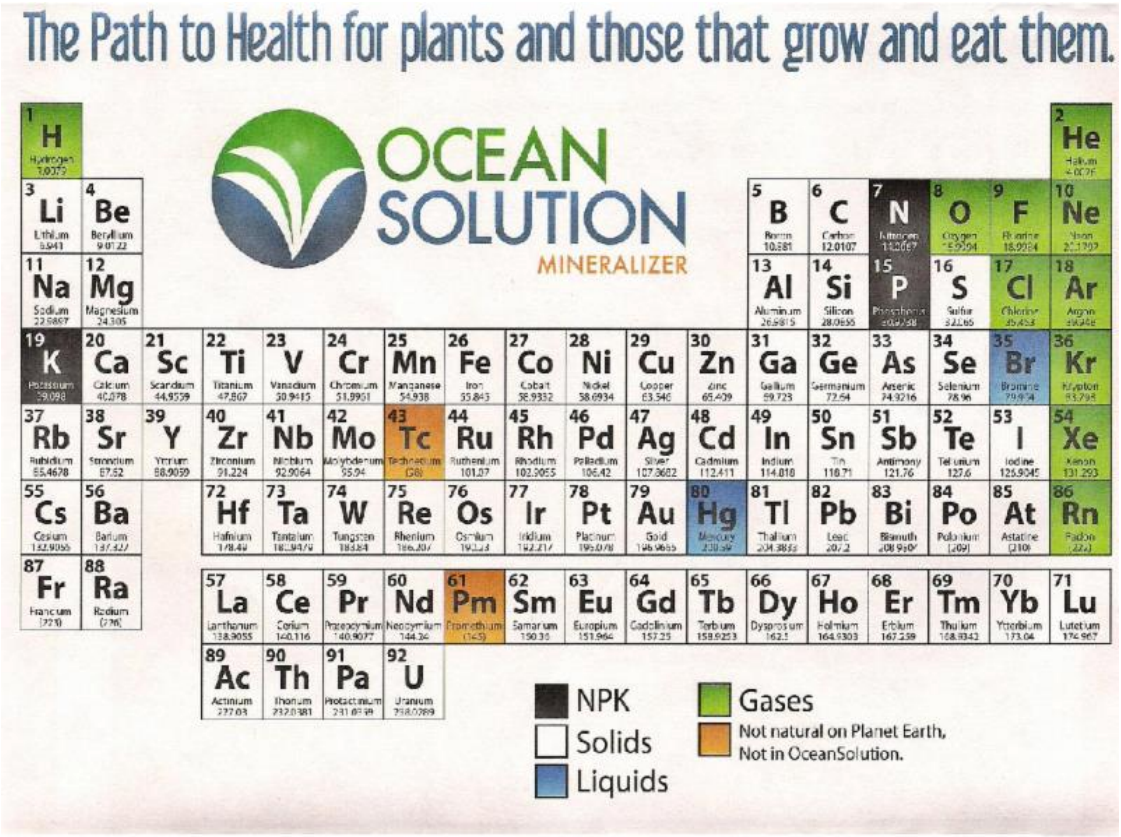
JOHN'S CORNER:

MINERALS - The Elements and What They Do (Part 35)

by John Ferguson

57) Lanthanum (La)

Lanthanum is the first element of a group that we call the "Rare Earth" elements or "Lanthanides". If one looks at the Periodic table below, notice the two rows at the bottom where they are grouped together as they have almost identical chemical properties. However, they have very different magnetic properties.



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Lanthanum is found in igneous rocks at 30 ppm, shale at 20 ppm, and very little in sandstone or limestone. Soils average around 30 ppm, and very little are found in fresh or seawater. However, marine plants can have 10 ppm.

Most of the rare earth elements are not rare in nature but often occur together in various minerals and were hard to separate (hence the name "rare"). Lighter flints are alloys of iron (Fe), lanthanum (La), cerium (Ce), and small amounts of praseodymium (Pr) and neodymium (Nd).
Rare earth elements when oxidized are very heat-resistant and glow brightly when hot; thus, they are used in lantern mantles heated by burning gas. Lanthanum's most common electrical or oxidation state is +3 (as are most of the other rare earths).

Lanthanum is often found in igneous rocks and in phosphorites used to produce fertilizers. It is used to produce colored glass and electronic components.

Sandy soils have the least of this element with loamy soils the most. Organic matter has a high capacity to bind this element to levels 10X that of surrounding soil. Lanthanum is only slightly soluble hence, it is not very mobile in soils, however microorganisms and earthworms in the soil help release this element.

It is believed that this element is involved with the regulation of metabolism in both plants and animals including humans even though direct evidence has not been found. Lanthanum is found in human bones, and the liver and kidneys.

When added to animal feed it improves weight gain and feed conversion to body mass in all farm animals (chickens, ducks, cattle, pigs, etc.). It also improves milk production in cows and egg production in chickens.

Gardening and Landscaping Problems Associated with Lanthanum (La)
Horticultural research in the United States has largely ignored this element while China has been using it for decades.

Fertilizers enriched with this element stimulate seed germination, seedling growth, and chlorophyll content.

Research in China has found both yield increase and quality improvements across a wide range of crops when lanthanum and other members of this family of elements were present in the soils. There is not any clear evidence of toxic effects of this element on plants; however, it does have an impact on cell membranes of vascular plants and on calcium (Ca) metabolism in some microorganisms.

Mosses tend to accumulate this element, as do *Carya* species. Some hickory trees have been found to accumulate up to 2,300 ppm of this element. Woody plants in general have the ability to absorb more of this element. The concentration of lanthanum found in plants range from below 1 ppb to over 15,000 ppm.

The yeast (*Candida albicans*) can absorb up to 370 ppm per day. It is proposed this may be how Candida causes a debilitating energy sapping disease by stealing lanthanum from the patient.
Sources: fly ash, sewage sludge, animal manures, sands of igneous rock

58) Cerium (Ce)
Cerium is the second member of a group that we call the "Rare Earth" elements or "Lanthanides". It is a reactive grey metal that will tarnish in air, and will burn if scratched with a knife. The most common electrical or oxidation state is +3 (it is also stable at a +4 state). Even though it is called a rare earth, it is almost as common as zinc (Zn) and four times more common than lead (Pb).
Cerium is found in igneous rocks at 60 ppm, shale at 59 ppm, sandstones at 92 ppm, and limestone at 12 ppm. Fresh and seawater have very little cerium. Soils average 50 ppm, and land plants can accumulate 320 ppm. Land animals have only 0.003 ppm.

Cerium is added to diesel fuel to lower the soot ignition temperature allowing it to be trapped by filters. Cerium oxide (CeO_2) is part of catalytic convertors to clean up car exhaust and it is also used to polish glass.

Cerium compounds were used in gas incandescent mantles in the late 1800's to create a bright light. It is used in medicine to treat topical burns and cerium sulfide (Ce_2S_3) is used as a red pigment for plastics.

Cerium is used in flat screen monitors and televisions, and long life low energy light bulbs. Compounds of cerium are used in many appliances and devices.

Cerium has no known biological role; however, cerium salts can stimulate metabolism, lowering cholesterol levels, blood pressure, appetite, and risk of blood coagulation. Cerium is considered non-toxic to animals and humans as the body rapidly excretes it. However, animals that were injected, with large doses of cerium, had a heart attack and died.

A dilute solution of cerium nitrate $Ce(NO_3)_3$ is an effective treatment for bathing the skin of humans with 3rd degree burns.

Gardening and Landscaping Problems Associated with Cerium (Ce)

Very little is known about cerium and how it affects plants. The amount found in plants correlates to the amount in soils. A few plants will accumulate cerium (*Carya sp.* accumulate cerium to 320 ppm). Sources: some phosphate rocks, igneous rocks, sewage sludge

59) Praseodymium (Pm)

Praseodymium is the third member of a group that we call the "Rare Earth" elements or "Lanthanides". It is found in igneous rocks at 8 ppm, shale at 6 ppm, sandstone at 2 ppm and limestone at 1.4 ppm. Marine plants have 5 ppm and land plants have up to 46 ppm. Marine animals have 0.5 ppm and land animals have 1.5 ppm where in mammals it accumulates in the bone and liver. Seawater has only 1 ppt (parts per trillion).

Praseodymium is used to make special glass lens that glass blowers use to protect their eyes and it is used to give glass and pottery glaze a clear yellow color.

Praseodymium is used in magnets and many types of lighting. It has the unique property, that when exposed to magnetic fields, it lowers its temperature and has helped scientists approach within 1/1,000 th of a degree of absolute zero.

It is used in making carbon arc lights to create daylight white light for motion picture filming and it creates the color in fake cubic zirconia based peridot.

Praseodymium is used to alloy with magnesium (Mg) to increase strength where it is used in aircraft engines.

It has no known biological role, however recent research has shown praseodymium salts enhances proliferation of normal cell growth and doubles the life span in laboratory species.
Gardening and Landscaping Problems Associated with Praseodymium (Pm)
Plans do not absorb praseodymium very well; hence, vegetables only have 1-2 ppb in them, so very little gets into the food chain.

Sources: mineral sands of igneous rocks

60) Neodymium (Nd)

Neodymium is a bright silvery-white metal that quickly tarnishes when exposed to air. This metal is different from the other lanthanides as it has it has three oxidation or electrical states (+2, +3 and +4).

This member of the rare earth family is found in igneous rocks at 28 ppm, shale at 16 ppm, sandstone at 11 ppm and limestone at 4 ppm. Marine plants have 5 ppm but land plants can have 460 ppm as in some *Carya* species. Marine animals have 0.5 ppm. In mammals, it accumulates in the bone and liver.

When neodymium (Nd) is combined with iron (Fe) and boron (B) where it is called NIB, it makes excellent strong permanent magnets. These magnets are so strong they can be dangerous to be around. These magnets are used to make stud-less jewelry.

It is used in crystal matrices to make quantum memory devices and it allowed for the miniaturization of many electrical components. Neodymium is used in alloys of high strength, computer hard drives, mobile phones to wind turbines and hundreds of products.

If neodymium oxide (Nd_2O_3) is added to molten glass, the result is a beautiful deep lavender color. Neodymium glass is also used to produce powerful lasers.

Neodymium is a lighter rare earth element that is proven to enhance normal cell growth and double the lifespan of laboratory species.

Neodymium has no known biological role but can have effects of the human body. Neodymium salts and dust are very irritating to the eyes. If ingested the salts are only slightly toxic if they are soluble and non-toxic if they are insoluble.

The level of neodymium in sewage is less than the other lanthanides which suggest more of it is retained in our bodies.

Gardening and Landscaping Problems Associated with Neodymium (Nd)

Neodymium is not readily absorbed by plants as it only averages around 10 ppb hence very little enters the food chain. However, some plants can accumulate up to 3,000 ppb.
Sources: mineral sands of igneous rocks

61) Promethium (Pm)

Do the unique arrangement or protons and neutrons there is no stable arrangement or stable isotopes of this element. Promethium is radioactive with a half-life of 2.6 years; as a result, promethium did not exist in nature (biosphere) until nuclear explosions occurred.
Promethium was once used to make luminous dials for watches and luminous paints and was used in some electrical devices.

If ingested it accumulates in the bones and liver of mammals. Promethium has no role in any living thing.

Gardening and Landscaping Problems Associated with Promethium (Pm)
None

Sources: nuclear fall out

62) Samarium (Sm)

Samarium is a "light" rare earth element and is found in igneous rocks at 6 ppm, shale at 5.6 ppm, and sandstone at 2.7 ppm. In pure form, it is a silvery-white metal that is stable in air.
Samarium-cobalt magnets are not as strong as others mentioned but they can operate at higher temperatures where other types would lose their magnetism. Samarium is used in electrical devices and in chemical and medical research.

Samarium is found in both marine animals and land animals at less than 1 ppm. It has no known biological role. However, as in other rare earth elements, samarium enhances normal cell growth and doubles the life span of laboratory species. Samarium salts also stimulate metabolism.
Gardening and Landscaping Problems Associated with Samarium (Sm)

Normally land plants have very little samarium in them (less than 1 ppm) as it is not taken up by roots; however a few plants can accumulate up to 23 ppm.

Sources: mineral sands of igneous rocks