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SOIL AND HUMAN HEALTH

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Abstract: There is a set of properties which differentiate the soils among each other, such as the texture, the content of organic carbon, nitrogen, phosphorus, and potassium, and the content of minor nutrients (Mg, Ca, Fe) and micronutrients (Cu, B, Zn, Mn). The direct effects of soils on human health are from soils contribution to food production and human exposure to potentially toxic compounds and pathogens in soils. Humans may assimilate beneficial or toxic compounds in soil through direct or indirect pathways. The main pathways of direct exposure are: soil ingestion, inhalation dust, and dermal absorbtion. The main indirect exposure pathways of soil constituents are through the food chain or water. Soils are also a source of toxic inorganic and organic constituents, soil pathogen or antibiotics and other products that enhance human health. The study is based on a lot of soil survey reports. In order to improve human health it is necessary to reduce input of potentially toxic trace elements, pesticides and antibiotics better fertilizers with N, P, K and micronutrient, and efficient fertilizer usage. Among the macronutrients more problems puts the nitrogen in the shape of NO_3, due to the risk of nitrate loss through leaching, surface runoff or denitrification. Soil can be a sink, interacting medium, or a source for many potential pollutants, such as heavy metals (Cu, Zn, Pb, Cd, Cr, Co, Hg, Mo, Se, Mn, Fe). Similar with macro-and microelements, soil pathogen can also be threat to the human health. The vast majority of pathogens resist from some days to some weeks. For example, for Escherichia coli, the span of survival is circa 60-70 days, for tuberculosis, bacillus is about 7-18 months

Keywords: soil, clay, zeolite, food, diseases

1. INTRODUCTION

In the natural environment the Pedosphere performs a number of functions, including: biomass prodiction, the storing, filtering and transformation of mineral and organic material, a reservoir of soil biodiversity, storing and cycling of many elements including C, N, P, S, large amounts of water and acting as a buffer to prevent rapid run off [1]

Soils can be defined as four dimensional (space and time) natural bodies, where the lithosphere, the atmosphere, the hydrosphere and the biosphere are interlinked.

There is a set of properties which differentiate the soils among each other, such as the texture, the content of organic carbon, nitrogen, phosphorus, and potassium, and the content of minor nutrients (Mg, Ca, Fe) and micronutrients (Cu, B, Zn, Mn...).

Long before the advent of earth-moving machines and toxic chemicals, even before the of agriculture, humans began to affect the land and its biota in ways that tended to destabilize natural ecosystems. An example of soil abuse can be seen in the rainfed, oarts of the Mediterranean region, which has borne the brunt of human activity intensively and for a long period [2]. The land has been denuded of its natural vegetative cover, and the original mantle of fertile soil has been, raked off by the rains and carried down the valleys toward the sea.

Written history on some of the effects of soils on human health goes as far as circa 1400 BC. In the modern world, we recognize that there are numerous such direct and indirect effects. The direct effects of soils on human health are from soils contribution to food production and human exposure to potentially toxic compounds and pathogens in soils [3]

Since 1960 the world's cultivated land area has increased by 12% while the population has almost tripled. Since 1961, the arable land available per person has decreased from 0.45 to 0.22 ha [4]

Humans may assimilate beneficial or toxic compounds in soil through direct or indirect pathways [5]

The main pathways of direct exposure are: soil ingestion, inhalation dust, and dermal absorbtion. The main indirect exposure pathways of soil constituents are through the food chain or water.

Essentially, all life depends upon the soil. There can be no life without soil and no soil without life [6]

Early societes generally revered the earth and tended to deify it. The earth was held sacred as the embodiment of a great spirit, the creative power of the universe. The indissoluble link between humanity and soil is manifest in the very name "Adam", derived from "adamah" a Hebrew noun of feminine gender meaning earth or soil. Together, therefore, Adam and Eve signify "Soil and Life".

Soil health can be considered as analogous to human health. Both must be in a state of well-being with respect to their physical, chemical and biological characteristics [7]

Soils are also a source of toxic inorganic and organic constituents, soil pathogen or antibiotics and other products that enhance human health [8]

2. MATERIALS AND METHODS

The study is based on a lot of soil survey reports effectuated within the Pedological and Agrochemical Office Timis, and also on personal studies and from bibliographical studies.

The main emphasis of this article is to the effects on human health, because humans may assimilate

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toxic compounds by soil ingestion and through the food chain or water.

3. RESULTS AND DISCUSSIONS

In order to improve human health it is necessary to reduce input of potentially toxic trace elements, pesticides and antibiotics better fertilizers with N, P, K and micronutrient, and efficient fertilizer usage.

Another path to improve human health is the reduction of greenhouse gas emissions through reduced tillage enhanced carbon sequestration and promotion of sustainable intensification.

The best measurement of any potential effects is the bioavailability of soil compounds or elements.

Risk of nitrate

Among the macronutrients more problems puts the nitrogen in the shape of NO_3, due to the risk of nitrate loss through leaching, surface runoff or denitrification. In the European Union a limit of 50 mg l^{-1} of nitrate has been imposed on any ground – or surface – water to be used as a source of drinking water and any surface water where eutrophication is considered to be a risk. In addition to issues of water pollution, nitrate can also be involved in the emission of damaging gases to the atmosphere. It was claimed that NO_3^- from drinking water or vegetables was reduced to nitrite NO_2^- by bacteria in the mouth and when nitrite entered the stomach reacts with amines *from the breakdown of proteins to form N-nitrosamines which are carcinogenic. In the present much larger study contradicted this theory. A lot of studies from the UK have shown a negative correlation between nitrate and incidence of stomach cancer.

Methemoglobinemia or blue-baby is a serious disease that can kill infants less than 1 year old.[9]

Nitrite can react with haemoglobin, and block the site that normally transports oxygen around the body. It is now thought that the conditions only occurs when water is contaminated by gastroenteric bacteria from sewage or manure heaps, as can occur if a shallow well is dug or farm premises. In such cases nitrate and bacteria both contaminate the water. There are no reports of blue-baby syndrome associated with bacteriologically clean water from a mains supply.

Any nitrate escaping from soil to streams, rivers, or lakes can increase the growth of water plants, as algae. When algae die the bacteria decomposing them use oxygen dissolved in the water, thus deoxygenating the water.

Heavy metals

Soil can be a sink, interacting medium, or a source for many potential pollutants, such as heavy metals (Cu, Zn, Pb, Cd, Cr, Co, Hg, Mo, Se, Mn, Fe). These metals are retained of the humus and nimerals, like clay minerals or zeolites. The vegetation, which growths on the soils reached in heavy metals, can provokes at animals a lot of diseases when the content is bigger than accepted limit.

Soil pathogen

Similar with macro-and microelements, soil pathogen can also be threat to the human health. The vast majority of pathogens resist from some days to some weeks. For example, for Escherichia coli, the span of survival is circa 60-70 days, for tuberculosis, bacillus is about 7-18 months [10]. The greatest span of survival in soil have had the sporulated grems such as Bacillus anthracis, Clostridium chauvoei, tetani, septicum ,perfringens etc., wich arrived even tens years.

The contamination risk with tetanic bacillus are greater in the soil fertilized with manure.

The anthrax is a terrestrial disease which appears, as a rule, through the contamination with Bacillus anthracis, frequently taked over days, weeks or years ago.

Source of antibiotics

Soils are also a source of antibiotics and other products that enhance human health. Pasteur l., and his collaborator Joubert have been observed as long ago as 1877 that exist some bacteriums which can produced inhibited substances for the vital activity for other bacteriums. This finding goes way back to 1929 with the discovery of Penicillium by Alexander Fleming.

Soil micropopulation as fungus bacteriums, algas are sources for antibiotics, as Penicillium =, Streptomyces griseus, Streptomyces aureofaciens, Aspergillus etc. Between 1983-1994, 60 % of new cancer drugs originated from natural products isolated from the soil.

Microelements by soil ingestion

The animals which lives in the natural conditions, makes sure of the microelements by soil ingestion. For example, in the conditions of a permanently pasturing, the ovines ingurgitate up to 75 kg soil, the cows up to 600 kg soil in a year.

Soil can acts upon human health completely or only through its components. In this sense, a major role plays the clay minerals and zeolites.

Clay minerals

As beneficial agent for human health, the clay can be used as active principle in pharmaceutical formulations orally administrated (SMECTA – gastrointestinal protectors, laxatives, antidiarrhoeaics) or for topical application (dermatological protectors and cosmetics). Also, the clay can be used in pelotherapy and sometimes as nutritional supplement or detoxifier of human organism.

But, the clay can cause several medical problems as result of ingestion (geophagia), inhalation and absorbtion through skin lessions due to the presence in its composition of a numerous chemical elements, like heavy metals [11]

Clay minerals are responsible for many of the soil's most important physical and chemical properties such as cation exchange and shrink-swell properties, as how well a particular soil will attenuate a specific pollutant [12]

The therapeutic virtues of the clays are conditioned by the properties of clay minerals, like surface area, electric change, exchange properties.

The clay can also be used as natural product in the aesthetic medicine in the shape of poultices or face mask.

An antimicrobial skill for Escherichia coli and

Staphilococus faecalis was made obvious for montmorillonite, treated with Cu – 10 ppm, respectively Cu – 55 ppm.

The use of some clayey materials in order to preparation some pharmaceutical products needs an investigation relative to the absence of toxic elements (As, Cd, Pb, etc) or of the minerals like serpentine, silica, involved in human pathology.

Clay minerals are distinguished on the basis of their different crystal structures (Figure 1)

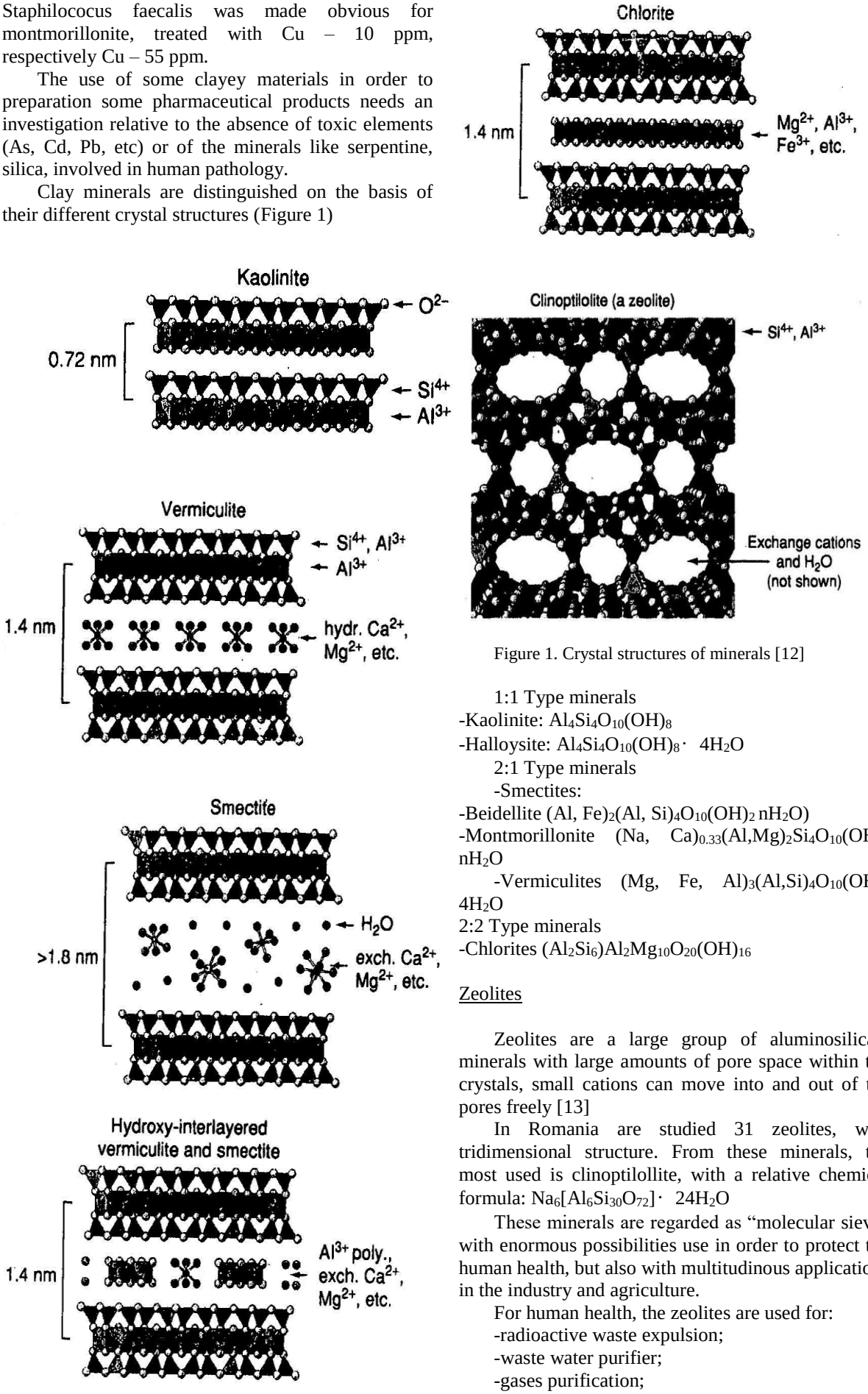

Figure 1. Crystal structures of minerals [12]

1:1 Type minerals

-Kaolinite: $Al_4Si_4O_{10}(OH)_8$

-Halloysite: $Al_4Si_4O_{10}(OH)_8 \cdot 4H_2O$

2:1 Type minerals

-Smectites:

-Beidellite $(Al, Fe)_2(Al, Si)_4O_{10}(OH)_2\, nH_2O)$

-Montmorillonite $(Na, Ca)_{0.33}(Al,Mg)_2Si_4O_{10}(OH)_2\, nH_2O$

-Vermiculites $(Mg, Fe, Al)_3(Al,Si)_4O_{10}(OH)_2\, 4H_2O$

2:2 Type minerals

-Chlorites $(Al_2Si_6)Al_2Mg_{10}O_{20}(OH)_{16}$

Zeolites

Zeolites are a large group of aluminosilicate minerals with large amounts of pore space within the crystals, small cations can move into and out of the pores freely [13]

In Romania are studied 31 zeolites, with tridimensional structure. From these minerals, the most used is clinoptilollite, with a relative chemical formula: $Na_6[Al_6Si_{30}O_{72}] \cdot 24H_2O$

These minerals are regarded as "molecular sieve" with enormous possibilities use in order to protect the human health, but also with multitudinous applications in the industry and agriculture.

For human health, the zeolites are used for:

-radioactive waste expulsion;

-waste water purifier;

-gases purification;

-softening drinking water.

Industrial and agricultural applications:

-oxygen and nitrogen getting from air;
-preservation the energy;
-paper industry;
-additive for detergent making and resin;
-building materials;
-soil fertilization;
-weed-killer effects
-deodorant in animals farm
-dietetic additive for animal food.

4. CONCLUSIONS

1. Soil are the basis for production of the overwhelming majority of food, natural fibres and wood; 805 million people globally are estimated to have been chronically undernourished in 2012-2014.

2. Humans may assimilate beneficial or toxic compounds in soil through direct by soil ingestion or indirect through the food chain or water.

3. The consumtion can provokes nutritional unbalanced associated with liver disease, skin disease, anaemia etc.

4. The atmospheric dust inhalation provokes a series of lung diseases.

5. Some soil components are used as pharmaceutical products (Smecta and so on)

6. Soil can be a source of pathogenic agents or antibiotics

7. The clay minerals and zeolites have a great number of use in some industries and zootechnics, and also as building materials.

8. Zeolites can be used to protect human health against radioactive waste.

9. Soils rich in smectite, zeolites, allophone and hidroxy-interlayered vermiculite and smectite, tend to be very effective at attenuating many organic and inorganic pollutants because of the high surface area and adsorbtive properties. They may also be an important source for heavy metals.

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