APPLICATION OF BLACK SEA BOTTOM SEDIMENTS FOR NATURAL ECOLOGICAL FERTILISER, RECULTIVATION OF EXHAUSTED SOILS

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Possibilities for implementation of the Black Sea sapropel bottom deposits as an ecological fertiliser for the purpose of re-cultivation of waste lands are discussed.

The soil layer occupies an insignificant part of the earth weathering crust (from several sm to 1 or 2m) and it comes to be the basis for life activity of the organism world. Soil-formation is an extremely complex process, especially in the conditions of the desert regions.

Because of the active interference of the human society in Nature, at today's stage of its development, the value of the soil cover grows rapidly. Humus and clay minerals are the main ingredients of soil. They adhere to grains of sand and form aggregates which permit microorganisms, nutritives and air to penetrate to plant roots.

It becomes clear that expansion of the arable desert areas and their transformation into earthly oases is the prime task for countries like Syria, Saudi Arabia, UAE (United Arabic Emirates), Israel, etc.

During last years, deep-water organic mineral (sapropeloides, diatomic, coccolithophoridic) sediments of Black Sea, come to be a subject of specialized research, purposing their application as natural ecological fertilizer and for recultivation of desert areas.

The sapropeloides are widely spread everywhere in the continental slope and the abyssal botton, and they are practically inexhaustible as reserves (Fig. 1).

It's known that the organic matter in soils is a nourishing environment for the microorganisms which influence beneficially the growth of the plants. In the form of alkiline salts of humic acids, the organic matter stimulates the growth of plants, rises the fruitfulness and improves the quality of the agricultural production. Also, it improves the structure of the soil, keeps the moisture and doesn't allow the nourishing salts and microelements to go out.

Deep-water organic mineral muds in Black Sea are in peat stage of their development. Thanks to the anaerobic environment where they precipitate, they don't pass through the stage of full-decomposition and in semi-decomposed position, they are accumulated in the hydrogen-sulphide zone.

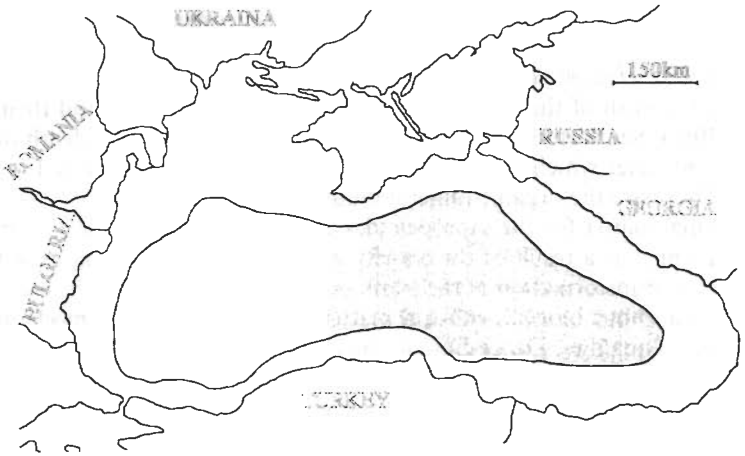

Fig. 1. Spread of deep-water organic-mineral sediment's in Black Sea

Having in mind the fact that coccolithophoridic, sapropeloides and diatomic muds mutually make seams and they are comparatively homogeneous mixture, they will be considered as a complex organic mineral fertilizer, where sapropeloides occupy at about 80% of the total volume of the stuff. Organic mineral muds are valuable not only with organic matter but also with carbonate component and amorphous silicates. In their mineral part, homogeneous with the organic one, there are macrocomponents such as: calcium, iron, magnesium, aluminium, manganese, etc. In the mineral part of the sediments, there are more than twenty microelements which are contained in concentrations, exceeding many times the concentrations of the soils. These microelements are important stimulator for the growth of plants. In the sapropeloides and diagenetic sulphides, it is watched dressing of gold, silver and rhenium (the last reaches 5,4 mg.t-1 in the sapropeloides).

Deep-water organic mineral muds can be used as a complex fertilizer or as a component together with other mineral stimulators-perlite, zeolite which surpass them in argotechnical properties. Sapropeloides can be used directly in the soil in natural position without additional processing of the stuff. Other important advantages of the sapropeloides are:

- Unlimited store of the stuff in the water area which is situated at a depth of 200 - 2200m. The biggest lifts of the sapropeloides horizon are at depth of 700 - 1800m. The contents of organic matter increase with the increase In depth.
- The possible exploitation of the stuff will not lead to negative conse quences for the marine environment. It's due to the fact that the industrial stores are situated in large depths in the hydrogen sulphide zone where there is no life. On contrary, It is supposed that the exploitation of the sapropeloides will have ecologically positive effect which, although slowly , will influence the level of the hydrogen sulphide zone.

To make the qualities of the stuff clear, let us consider in more details, the composition and properties of the depp-water sapropeloides of the Black Sea.

They were created some 5-10000 years ago, due to an ecological cataclysm, caused by the gush of the ocean waters through the Bosphorus and their mixing with the Black Sea waters. At that time a mass development and death of plankton occurred, after which sediments of some 1-2m depth were created on the sea bottom. Those are the organic mineral muds or the sapropeloides.

As initial matter for the sapropeloides, serve the dying flora and fauna of the Black Sea which as a result of the activity of the anaerobic bacteria, pass through the process of transformation of the plant and animal plankton in benthos and they create an exogenous biogenic-mineral matter with specific physicomechanical and biogeochmical qualities. Depending on the character of the feeding up, the mineral component has (in the case-mixed) salicate-carbonate composition.

The granulometric composition of the sediments creating the sapropeloides is rather variable. The basic mass is represented by aleuropelites and pelo-aleurites and the quantity of the fraction, larger than 0,5mm, is less than 10%.

Psammite and aleurite admixture of the sediments is mainly quarz, plagioclas, vulcanic glass (at different rate of decomposition), opal and chalcedony (rare grains), marcasite, calcite and aragonite, and oftenly met fragments of shell detritus.

As a rule, clay-formations are finely-dispersive, in their basic mass they are slightly non-glacial. Crystal aggregates as hydromica with prolonged morphology are more well-expressed. X-ray defractometrical study shows that the group of hydromica is predominant in clays. With large presence is the group of chloriteiron-containing, from the type of chamosite. There're also single crystals of kaolinite, vermiculite, montmorillinite and mixedlayering formations. Admixtures of allophane and hydrotalkit are possible.

In the sapropeloides, the carbonate minerals are represented mainly by low-magnesial calcite, aragonite, dolomite, calcite.

The presence of different quantity of amorphous oxides of the silicon-opal, chalcedony and vulcanic glass is very typical. The presence of such minerals make difficult the quantity-research of the mineral and chemical composition of the sediment.

In the sediments of the sapropeloides horizon, the content of Corg varies in a wide range-most often some 5-6%. The maximum indicators of Corg reach 18% Bearers of the high indicators are more often dense rubber-like slender-laminar sapropeloides, taken from carbonate layers butt they are met in lump and earth-viewed sapropeloides. There is a clear positive correlation between the content of Corg in the sediments and their dathymetrical position. In the scope of the interval of 300-1500m this dependence has nearly linear character (Fig.2).

In the covering layer of the sapropeloides which is represented by mass pelitomorphous muds, the composition of Corg quickly decreases till some 1% and even lower.

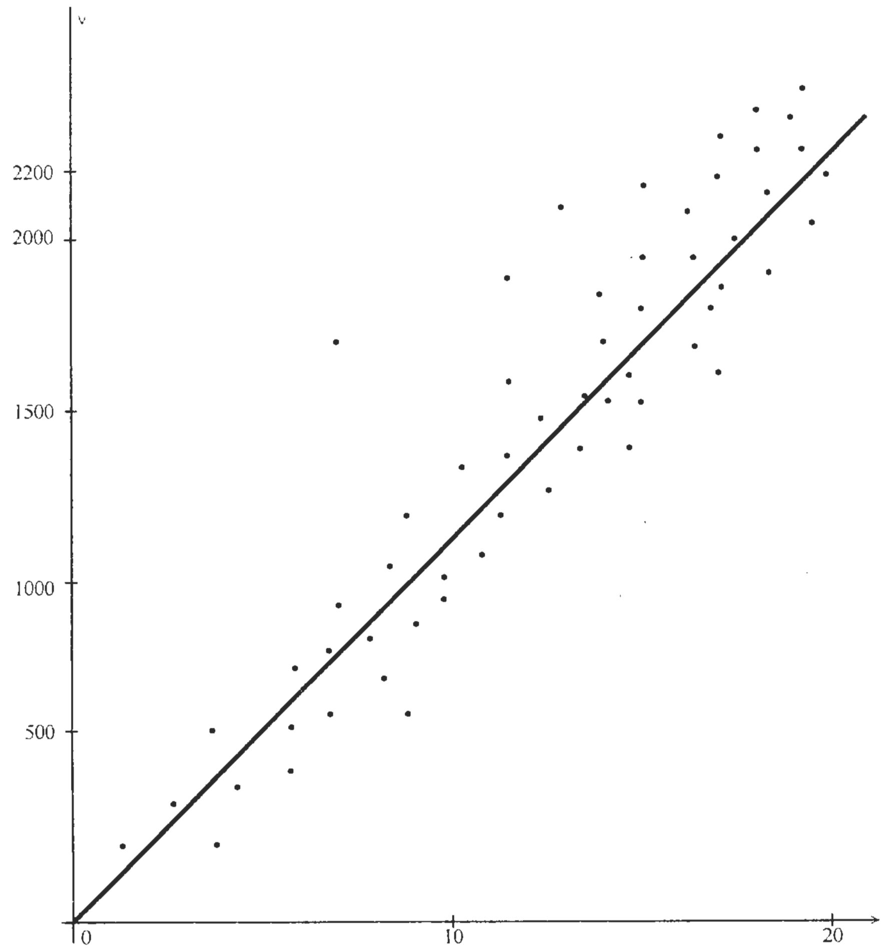

Fig.2. Distribution of Corg in the sapropeloides in dependence with depth

The results of the total chemical analysis show that holocene sapropeloides possess significant differences from the indicators characterizing the well-known formational standards as neogenic clays in the Russian platform, clays and argillites in the continental sector of the statosphere, pelagic silicate muds, etc. In general the composition of the mineral matter of the sapropeloides does not differ very much from the composition of the lutite formations, spread on the continents.

The comparison of the holocene sapropeloides to the pelagic formations, such as red clay and silicite (diatomic) muds, shows that they occupy a middle position between these two standards. According to the composition of silica, dialuminium trioxide and alkilene oxides, the sapropeloides are near to the red clay, and the composition of diiron trioxide and titanium oxide closes them to the silicate muds.The microelement composition of the holocene sapropeloides is determined by different methods. For some elements a good identity of results is not reached. In such cases, the average meanings of the two methods with close indicators are accepted as possible.

Having in mind, the high degree of dressing with organic matter, it is likely to expect an increased content of many elements in the holocene sapropeloides. Practically, this can be settled for certain about the zinc, copper, uranium and molybdenum. The coefficient of concentration of the first tree elements varies between 1,2 and 8. There is an impressive dressing of the sapropeloides with molybdenum which exceeds with 1 or 2 the clark content of the element in the lutites of the stratosphere.

The characteristic of the sapropeloides as a geological formation, wouldn't be so complete without some data about their organic matter.

The production of the chloroform bitumen from the sapropeloides changes in the range of 0,5-2,0% on dry assay. The element composition of the bitumen is as follows (average values): carbon 7,3% hydrogen 10,85%, oxygen 10,9%, nitrogen - 0,8% sulpher is not determined. The group components of the bitumen are distributed in the following way: oils - 19-35%, tars - 45-51%, asphalt - 20-30%.

According to the infra-red spectra of the bitumites, in their hydrocarbon part participate components with linear and branched carbon chain. It is notable that the aromatic hydrocarbons present in minimum quantity.

The quantity of humic acids is low: from traces to 0,8% High indicators are typical for the sediments in the periphery of the shelf and the upper part of the continental slope. Here, in difference to the bitumites, there is a presence of aromatic structure (data of IRS).

Infra-red spectra of kerogen shows that as a whole, the organic matter of the sapropeloides consists mainly of aliphatic heterogeneous structures with many oxygen-containing groups of acid and alcoholic character. The well-expressed peak of 100-1200sm-1 connects with the presence of cycloparaffinic structures. The absence of C-C relation from aromatic structures is typical. In this way, it was established that deep-water organic mineral sediments of the Black Sea's bottom contain the main improving-components of the soil-humus and clay minerals. The latter enclose the mineral aggregates of the soil, stick them and form small aggregates which retain the moisture, absorb cancerous elements and ensure the penetration of the roots of the plants into the micro-organisms, nourishing salts and air.

For the last five years have been carried out lots of experiments on the use of sapropeloides for agrochemical and agrobiological purposes in the Pushkarov Institute, The Institute of Wheat and Sunflower in General Toshevo and Agricultural Institute in Plovdiv.

The sapropeloides experiments, carried out in the institute of soils (1985) showed that putting 2% sapropeloides in acid soil with PH 5,6, makes the soil nearly alkiline - PH 7,8 and an experiment on green mass of wheat shows 30%

increase in the biomass. The optimum quantity, of sapropeloides improves not only quantities and crops of the soil, but gives a long-run stability of its structure. To illustrate that, we add, in a table-form the report of a vessel-experiment on sapropeloides in salty soil (from the village of Sbor, Pazarjik) which has unfavourable agrochemical composition. The sapropeloides mud is implanted as water-chemical suspension. As increasing the quantity of sapropeloides (>2%), there are no improvement in the indicators which display that the implanted quantity of sapropeloides of 2% is optimum (table 1).

Vessel-experement on wheat for production of biomass

Variations	Biomass in %	Water in %	Ph
Without sapropeloides mud	5,6	100	5,6
Sapropeloides mud 1%	5,7	102	7,3
Sapropeloides mud 2%	7,2	129	7,6 - 7,9

In 1987 the Agricultural Institute in Plovdiv started experiments with sapropeloides on rooting an oil-bearing rose and new vines. The first experiment, carried out on substratum of perlite and sapropeloides in fraction 1:1, registered rapid improvement of the rooting and stability of the plants. For example, at the past substratum of perlite, from 100 numbers of plants, rooted 51, at the mixture of sapropeloides and perlite, rooted 85. In an experiment, performed in a field in Varna, from an area of 250mI cropped with lucerne, was produced twice more green mass. Then the same area was cropped with leguminous plants and the yield, comparatively to the next area, showed an increase of 42% Since 1988 experiments on sapropeloides have been conducted in the Institute of Wheat and Sunflower in General Toshevo but there have been no results yet. There are great possibilities for the application of the sapropeloides in hydrobionics where the first experiments are being carried out.

There are experiments on the use of sapropeloides in the housing for sound-insulation slates, for keremsite filling, for production of filters for cleaning the waters, gases, etc. It is possible to use them in the pharmaceutics as fillers, biostimulators, etc.

Experiments on the valuation of the silicite- sapropeloides sediments as a material for the ceramics (filtering elements, concrete-fillings, etc.) have been conducted. The results are as follows: the temperature of firing of the stuff is comperatively low-950°C. The produced ceramic mass has small bulk weight (1.2-1.6 g/sm³), and it's coloured in pastel hues. The strength of pressure widely varies (from 52 to 235 kg/smI or 5,1-23 MPa). The dense composition of alkiline oxides in the material show a low t° of melting and that is favourable for using it as a component for creation of frosting.

Highly-carbonate coccolithophoridic muds can be separated as an independent product, either. They are found directly in the upper layer of the bottom and has lift of 50sm. They can be used in production of carbonate glasses, in the cement industry and for limestoning the acid soils.

The existence of neat diatomic accumulations in the Black Sea's bottom has been known for a short time. A diatomic field with considerable lift is known in the region of the barrier zone Bosphorus-Black Sea. Obviously, a similar field is forming in the Danube canyon, too. Besides as fertilizers, the neat diatomites can be used for producing highly energetic silicate-amorphous glasses.

The wide area of the use of the sapropeloides is determined by the combination of finely - dispergated and colloid mineral silicates of different metal elements and enormous scale of organic compounds in their content.

The beneficial combination of organic and mineral component and wide areable development of practically inexhaustible store in the water area, make the sapropeloides competetive stuff of the non-organic mineral fertilizers.

Deep-water sapropeloides sediments of the marine bottom are important potential material with multi-purposes application. The further extensive research on their composition and distribution, technological stability in different areas of usage, and technologies on their effective production, are extremely significant and can be used for desert soil cultivation. The intensive wind erosion (deflation) in desert areas is the only disadvantage of their application, which necessitates preliminary development of green belts (wind-breaks).