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Study Of Organic Component Of Georgian Therapeutic Mud "Forfotes" By Infrared Spectroscopy

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Abstract – Therapeutic mud (peloide) is among such valuable objects of the nature which is widely used in medical, cosmetic and resort-sanatorium spheres. The intensive development of resort and non-resort peloidotherapy requires, on one side, the significant amount of therapeutic muds and, on the other hand the possibility of the production of mentioned muds in industrial scale which will allow the local and foreign inhabitants the use of the briquettes, granules, massage creams and handkerchiefs manufactured on the basis of peloides. For this reason the detailed study of Georgian mud deposit and of its unassimilated mud (name-forfotes) became necessary from therapeutic as well as from physical-chemical viewpoint. The goal of our research involved the physical-chemical investigation of organic and inorganic composition of unused peloides (forfotes) which provides the research by infrared spectroscopy.

As a result of the research of the peloides (forfotes) by infrared spectroscopy a number of absorption spectra was revealed which is indicative of the presence of organic compounds of various classes in large quantities. Many of them are repeated in all spectra but by various intensity. Among them are the absorption bands by maxima (3617.98 cm^{-1}, 3417.41 cm^{-1}, 2923.70 cm^{-1}, 2854.27 cm^{-1}, 2723.13 cm^{-1}, 1797.42 cm^{-1}, 1636.42 cm^{-1}, 1457.99 cm^{-1}, 1373.14cm^{-1}, 1018.28 cm^{-1}, 779.14 cm^{-1}, 722.82 cm^{-1}). But there are the bands which are characteristic of each sample. From the viewpoint of organic compounds in forfotes muds the absorption bands are sufficiently expressed the sections of infrared specter: 3700-3000 cm^{-1}, 3550-2700 cm^{-1}, 2000-700 cm^{-1} which confirms the presence of alcohols (primary, secondary, tertiary), phenols hydrocarbons.

Keywords – Peloide, Mud Volcano, Pseudo Volcano, Infrared Spectrum, Therapeutic Mud.

I. INTRODUCTION

1XXI-th century is characterized by increased interest in the use of therapeutic muds (peloides). This fact may be explained by sharp turn for eco-pure raw material of natural origin which, frequently, replaces expensive chemical preparation which, not infrequently, is characterized By contraindication.

In the world information sources the information about preparations and cosmetic goods, prepared on the basis of peloides, is increased yearly. In many of them the future prospects of their use are noted by world leading perfumery-cosmetic firms ("Paloma", "Biolit", „Prado", "Rene Garo", "Aura Neo" and et). The therapeutic mud is acknowledged as the "cosmetic" of XXI –th contury and by a number of researchers-as "medicament". The purposeful investigations – are provided in which not only the possibility of preparation of new therapeutic and cosmetic production on the basis of the peloides is represented but, also, the possible economic effect by realization of mentioned production which in, a number of cases, attains several milliard dollars.

Unfrequently there are countries where the mud deposit is presented in such amounts as in Georgia. In our country up.to 30 mud deposits (pseudo volcano) are fixed. Their practical use was multiply mentioned in literary sources. For example, Akhtala,

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Kumisi and other muds were multiply become as the object of the research of Georgian as well as of foreign scientists. The clear results of mentioned researches are operating balneotherapeutic health resorts of Akhtala and Tbilisi.

The increased interest in the peloides all over the world sets not only the problem of wide use of operating muds, but also the problem of rational use of the deposits. Prospective peloides require the resources of corresponding mud, the wide use of which, primary, depends on the resources of specific deposit. The increase of "productivity" of operating volcanoes is practically impossible. For problem solving the only one way for resources increase is remained - all mud volcanoes must be realized. Detailed and complex study of organic and inorganic components of the peloides of all Georgian unused mud volcanoes is initiated from therapeutic as well as from physical – chemical viewpoints.

By International Committee of medical hydrogeology the therapeutic muds in accordance with the origin, determined composition and characteristic properties are divided to the following genetic groups: turfy, sopropel, mineral – sulfide, sulfide-silty, clay-silty, volcanic and hydrothermal.

Volcanic mud presents ununiform mechanical composition of semiliquid clay formation which is formed from tectonic cracks and oil-gas locations as a result of the rock decomposition ejected by gases and water pressure. Volcanic mud is also identified as "pseudo volcanic".

The deposit of pseudo volcanic mud presents the mud volcano which is the geological formation of various forms, which ejects the mud, together with water or oil, continuous by or from time in time.

The deposit of mud volcano may be presented in the form of one or several mud volcanoes. Mud volcano presents the small size conic elevation, so-called knots, in the center of which the crater with liquid mud is located [1-10].

One of the names of mud volcanic deposit is forfotes (location – Signakhi municipality, Georgia) the peloides of which is the object of our research. The bounds of the forfotes mud volcano involves up to 165 operating and 15 extinct "knots". Operating griphons and other rocks release mud, water, oil and gas over the total slope of knolt field.

Picture 1. Mud pseudo volcano of forfotes

The work is dedicated to the study of organic composition of Georgian therapeutic mud - forfotes by infrared spectroscopy.

II. EXPERIMENTAL

2.1. Materials

The samples of forfotes mud were prepared for study of organic component for analysis

2.2. Infrared spectroscopy

Fourier infrared spectra were recorded for the samples of therapeutic mud. The sample research was carried out at infrared spectrometer Thermo Nicolet, Avatar. 370 which regulates automatically the passing of infrared spectrum in researched sample in the range from 400cm^{-1} to 4000cm^{-1} at room temperature. Accuracy of measurement – 0,5 cm^{-1}. Recording of the spectrum was

carried out in Vaseline oil: Researched sample was mixed with Vaseline oil and was applied on the plate of KBr. The fitting of the curves was carried by means of Origin 6,5 and of Gauss curves – by the use of Monte-Carlo method.

III. Research Goals and Discussion

Conditional dividing of infrared spectra of organic compounds is taken as the following areas:

- In the area of 4000-2400 cm^{-1}, as a rule, the valence oscillations of the bonds between C, O, N and H atoms are manifested. In this area the intensity of the absorption is very high except $S-H$ bond;
- In the area of 24000-1900cm^{-1} the valence oscillations of triple $(C \equiv C; -C \equiv N; -\overset{+}{N} \equiv \overset{-}{C}; N \equiv \overset{+}{N}-)$ and double bonds $(C=C=C; C=C=0; -N=C=C; -N=C=S; R_2C=\overset{+}{N}=\overset{-}{N}; CO_2$ და $N_3^-)$ are fixed;
- In the area of 1900-1300 cm^{-1} $C=O; C=C; C=N;$ NO_2 and other valence oscillation are mainly fixed, as well as OH – oscillations;
- The area 1300-900 cm^{-1} is used for $C-O; C-C; C-N; N-O$ and $N-H; C-H$ in some OH bond for determination of deformative and valence bonds;
- In the area of 900-500cm^{-1} the $C-H$ deformative of cyclic, amino groups are oscillations mainly revealed. Moreover, in this area the absorption bands, characteristic for $C-Hal$ bond, may be fixed [5-10].

IV. Results and Discussion

At fixing of infrared spectra number of bands are revealed which is indicative of the presence of organic compounds of various classes in forfotes muds in large quantities. Many bands of absorption are repeated in all spectra (Picture 1) and are differed only by intensity.

Their unambiguous attachment to one or other organic compound is very complicated problem. Generally, it should be explained that the bonds in the area of 3610-2670 cm^{-1} correspond to the absorption of infrared rays caused by valence oscillations of H-atoms associated with C and O For symmetric and asymmetric oscillations of CH_4 – group with similar data the following maxima are characteristic: 2962 cm^{-1}, 2878 cm^{-1}, 1480 cm^{-1}, 1390 cm^{-1}. The absorption bonds characteristic of CH_2 functional group, are located nearly in the same area (2925 cm^{-1}, 2850 cm^{-1}, 1465 cm^{-1}). $\equiv C-H$ functional oscillations are located in higher area of wave oscillations (in the range from 3360 cm^{-1}, to 3200 cm^{-1}). For asymmetric oscillations of $C(CH_3)_2$ functional group the absorption bands of the ranges: 1390-1370 cm^{-1} and 1790-1750 cm^{-1} must be conformable.

From the viewpoint of organic compound the area oh 3700-3000 cm^{-1} in infrared spectrum of forfotes is highly expressed; Discrete band by maximum of 3618 cm^{-1} was attached to ν_{OH} - oscillation of free $O-H$ group and center of gravity of absorption wide band in the range from 3350 cm^{-1} to 3150 cm^{-1} - to the oscillations of intermolecular bonds (3190 cm^{-1}). Both versions indicate to the existence of alcohols (primary, secondary, tertiary) and phenols in forfotes mud.

Along with it on the presence of alcohols the circumstance is indicative of the fact that the absorption bands on infrared spectrum of researched sample, corresponding to oscillations of existing $C-O$ bonds, present, for example, 1045 cm^{-1} for primary alcohols, 1110 cm^{-1} for secondary ones and 1150 cm^{-1} – for tertiary alcohols. Mentioned bands on the spectra are expressed at ascending branch on the left of the center of gravity, presented at 1018 cm^{-1}. Maximum of absorption bond at 1635 cm^{-1} is the "echo" of the deformetive oscillation $(\delta(C=CH-H))$ $O-H$ group of alkanes. Their intensive absorption bands are fixed in the range from 1000 cm^{-1} to 700 cm^{-1} which is indicative of the presence of oscillations of $(\delta(C=-H))$ bonds.

From the "composition" of infrared spectrum the clearly expressed absorption bands by maxima 2950 cm^{-1}, 2924 cm^{-1}, 2854 cm^{-1}, 1458 cm^{-1} and 1373 cm^{-1} characterized for Vaseline, were neglected.

Taring info account the fact that the Vaseline oil is one of the products of petroleum refining, it is expected that the mud contains hydrocarbons.

Absorption bonds of mentioned compound on infrared spectrum of the mud are overlapped by the bonds characteristic for Vaseline. The definite expansion of existing bands in the range of 3000-2800 cm^{-1}, characteristic for Vaseline, may be the exidence of mentioned reason, in comparison with rather discrete bond of Vaseline.

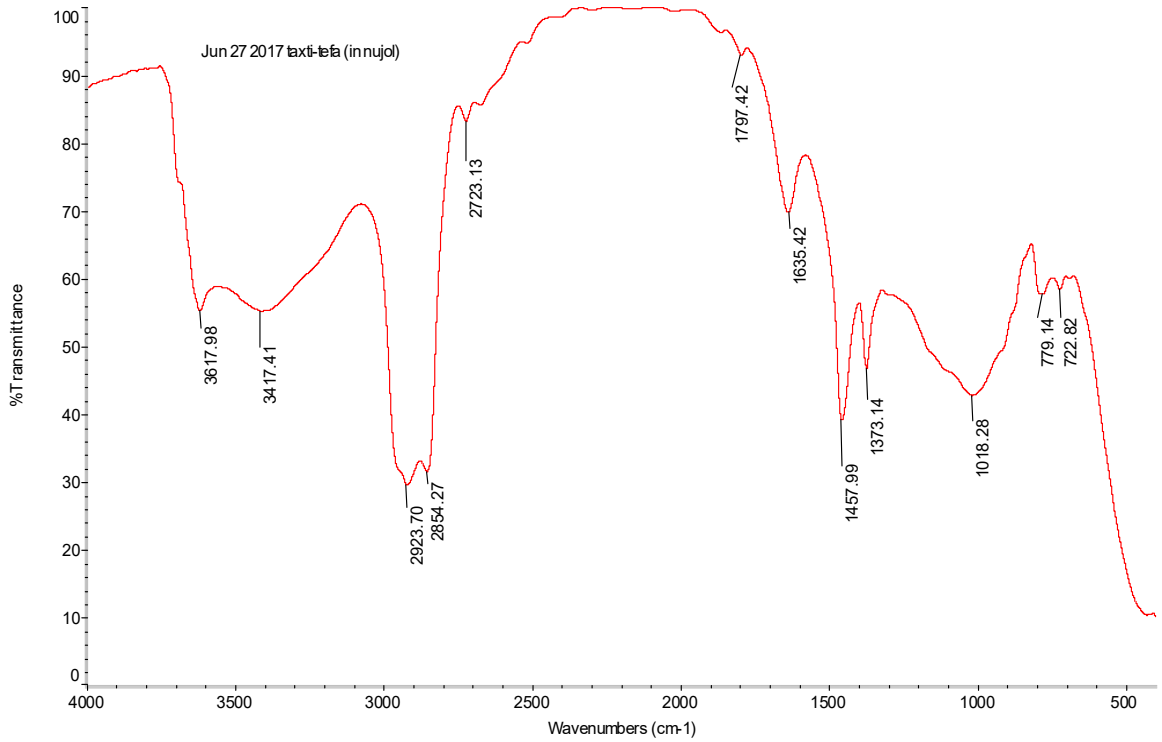

Fig. 1. Infrared spectrogram of forfots

V. Conclusions

Therefore, "forfotes" of Georgian therapeutic muds – ingredient of organic component are diversified and contain mainly hydrocarbon fragments, phenols, alcohols. It was established that in forfotes mud quite a number of absorption bonds are highly expressed in the areas of infrared spectrum: 3700-3000 cm^{-1}, 3550-2700 cm^{-1}, 2000-700 cm^{-1}, which confirms the presence of alcohols (primary, secondary, tertiary) phenols and hydrocarbons. Investigation of forfotes mud by means of infrared spectroscopy has shown that mentioned mud contains, inorganic compounds besides organic ones. This fact regnures the research continuation

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