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Original scientific paper

TREPEL – A PECULIAR SEDIMENTARY ROCK OF BIOGENETIC ORIGIN FROM THE SUVODOL VILLAGE, BITOLA, R. MACEDONIA

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A b s t r a c t: In the paper are shown results of the mineralogical-petrographical examinations of the trepel as a peculiar sedimentary rock of biogenetic origin from the Suvodol village near Bitola city, Republic of Macedonia. According to the microscopic (in polarizing translucent light), SEM, chemical, X-ray powder data was determined that examined trepel is composed mainly of opal (of biogenetic origin) as well as quartz, feldspars (plagioclases, K-feldspars), illite – hydromicas, chlorites of minor importance. Further examinations are in progress because the aforementioned results are based on one randomly selected trepel sample.

Key words: trepel; opal; biogenetic origin; alga Diatomeae

INTRODUCTION

The recent excavations of the coal deposits from the area of the Suvodol village, Bitola are forced to mining works of a thick hanginwall trepel layer, the thickness of which is even cca 50–70 m. So, the excavated trepel mass as a barren soil quantity reaches a huge ratio. In spite of the common trepel use in the world for the light brick, cement production etc., the excavated trepel mass from the mentioned microlocality actually still represents a potentially non-metallic raw material interesting for the further examinations.

According to the mentioned motive for trepel use in the non-metallic inorganic industry, induce an action for further mineralogical-petrographical examinations as primary and crucial task of major importance.

EXPERIMENTS

Geological setting

Treated trepel deposits were discovered in the Pelagonian depression, Macedonia, at the Suvodol, Brod-Gneotino villages and wider region, cca 15 km eastward from Bitola city (Fig. 1).

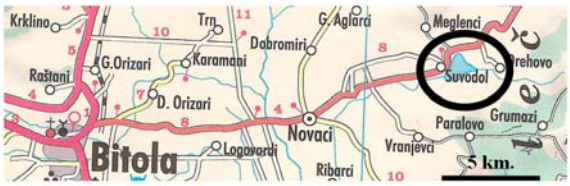

Fig. 1 Geographical situation of the Suvodol village and the wider region of Bitola city

According to the geological map (Fig. 2) for the Selečka mountain (characterized by very complex composition of gneisses, micaschists etc. of Precambrian age) can be seen that the geological-petrographical composition of the Suvodol village area is rather simplified as follows:

1. Within the frame of the Pelagonian depression at the Mojno, Suvodol, Vranjevci villages were discovered lakes sediments (of Upper Pliocene age) composed of sands, clay, marly clay, conglomerates (R. Stojanov, 1958).

2. According to the recent excavation mine works for coal exploitation at the Suvodol village a peculiar geological profile was opened as follows:

– the uppermost part is presented by agricultural soils etc. (of alluvial-deluvial age) the thickness of which is cca 0,5 – 1,0 m;

– the lower part belongs to a biogenetic formation composed of trepel sediments (the thickness of which is cca 50 – 70 m) and coal deposits at the bottom of the abovementioned open profile.

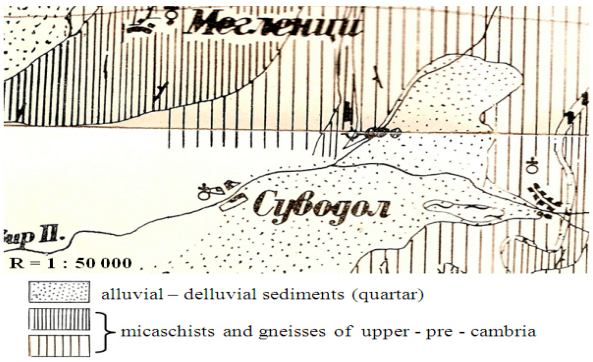

Fig. 2. Geological map of the Suvodol village area (R. Stojanov, 1958)

Macroscopic description

Examined trepel sample from the Suvodol village actually represents a sedimentary rock (of biogenetic origin) with grayish to grayish-white color, very light and soft (1–2 by Mohs), fine to superfine grained structure, porous, shell-like break, tongue sticky etc. (Fig. 3).

Fig. 3. Macroscopic figure of common trepel piece

The examination of the physical properties of the treated trepel sample gives data as follows:

– volume mass 0.60 – 0.70 g/cm^3
– water absorption 85 – 95 %
– open porosity 50 – 60 %
– total porosity 68 – 75 %
– density 2.41 g/cm^3.

Microscopic examinations

A) The microscopic examinations with the polarizing translucent light show that treated trepel sample is characterized with a micro-cryptocrystalline ground mass of optic isotropic nature. This groundmass is composed of opal inside of which there are very fine to superfinegrained quartz, feldspars, chlorites, illite-hydromica inclusions (Fig. 4).

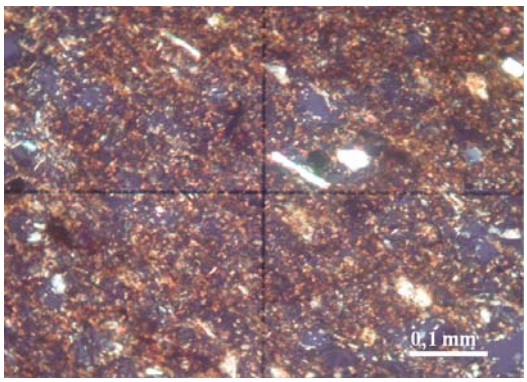

Fig. 4. Superfinegrained quartz, feldspars, illite, chlorite, (like spots and fibres) enclosed in the finegrained opal structure of biogenetic origin (N^+)

In the thin section there are rather completed or fragmented globular structures of opal (of vegetative origin) of major importance. The diameter of the mentioned opal globules amounts cca 0.05 – 0.1 mm (Fig. 5).

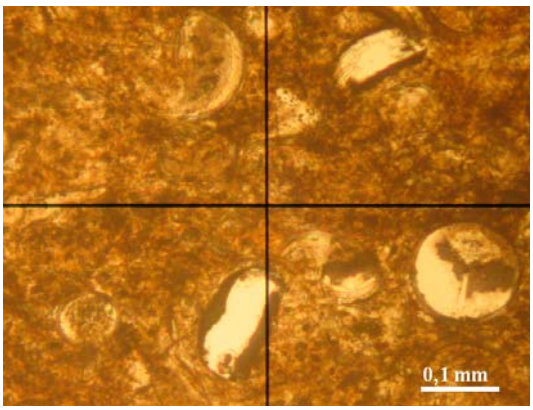

Fig. 5. Isotropic globular structure of trepel composed mainly of opal globules (N+)

In the opal groundmass fibres – pipes of opal vegetative products of alga Diatomeae long 0.1 – 0.3 mm can be rarely encountered (Fig. 6).

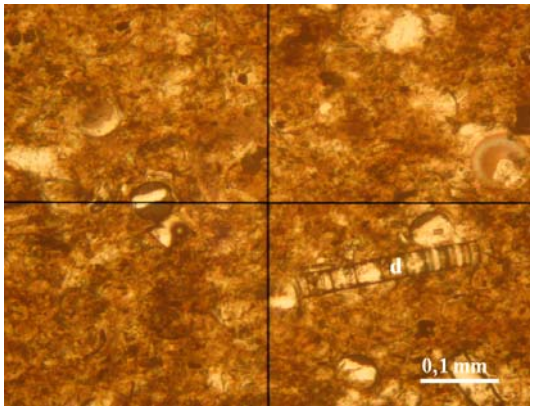

Fig. 6. A rare relics of alga Diatomeae (d) enclosed in trepel globular structure (N^+)

Very rarely biogenetic products of opal with forms of transversely cuttered cones can be seen in the section. These forms are not yet definitively determined (Fig. 7).

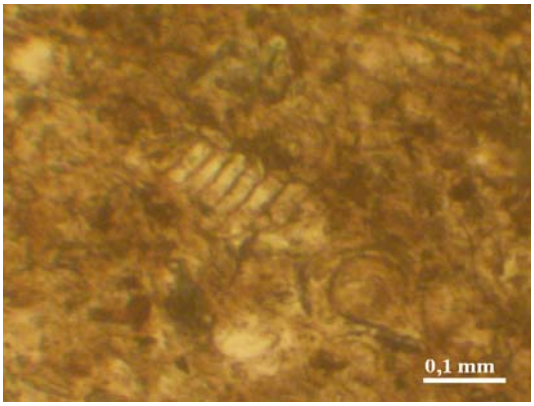

Fig. 7. Non yet determined microfossil of zoogenethic origin in the trepel mass (N^+)

Opal products with irregular fibrous forms remembering of roots of vegetative origin can be also rarely encountered in the thin section (Fig. 8).

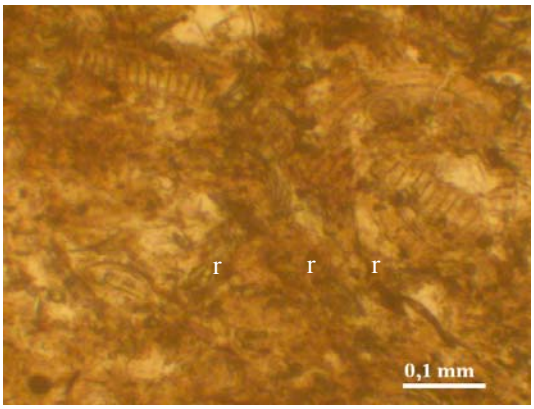

Fig. 8. Microfossils of vegetative origin resembling like roots (r) of microplants (N^+)

The globular structures (of vegetative origin) of opal are quantitatively predominant in the examined trepel sample. The rock structure is globular – isotropic, the texture is massive – homogenous.

B) The examinations by the SEM-method confirm the microscopic polarizing data especially from point of view that the globular structures have biogenetic nature. So, completed and fragmented globules of alga Diatomeae are shown on the SEM-pictures which disks resembling to disks of sunflower with or without peripheral ends.

It's evidently, that the globules of vegetative origin belong to two or more different types. These "sunflower" disks are completely perforated with discrete caverns, hollows along the total disk surface.

It's evident also that the trepel porosity is connected with the aforementioned caverns inside the surface of the globular structures. (Fig. 9, 10).

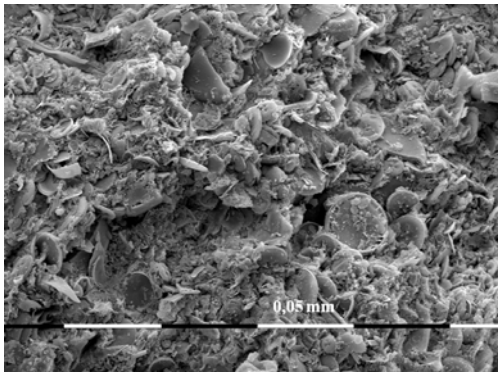

Fig. 9. SEM-photo of a common trepel mass composed of numerous microrelics – opal globules of biogenetic origin

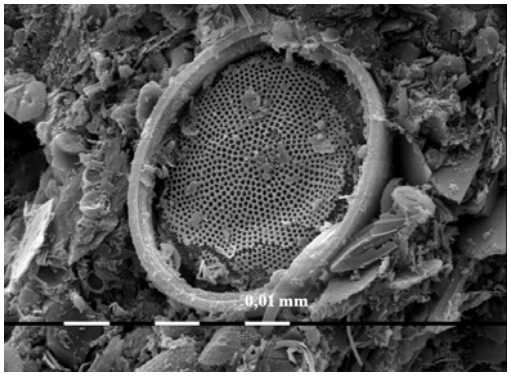

Fig. 10. Arachnoidiscus orantus – microfossil with a typical globular form

X-ray powder examinations

According to the X-ray powder examinations (DRON, 36 kV, 18 mA, CuKα/Ni) in the treated trepel sample were determined: opal, quartz, illite-hydromica structure type, feldspars (plagioclase, K-feldspars), chlorites (Fig. 11).

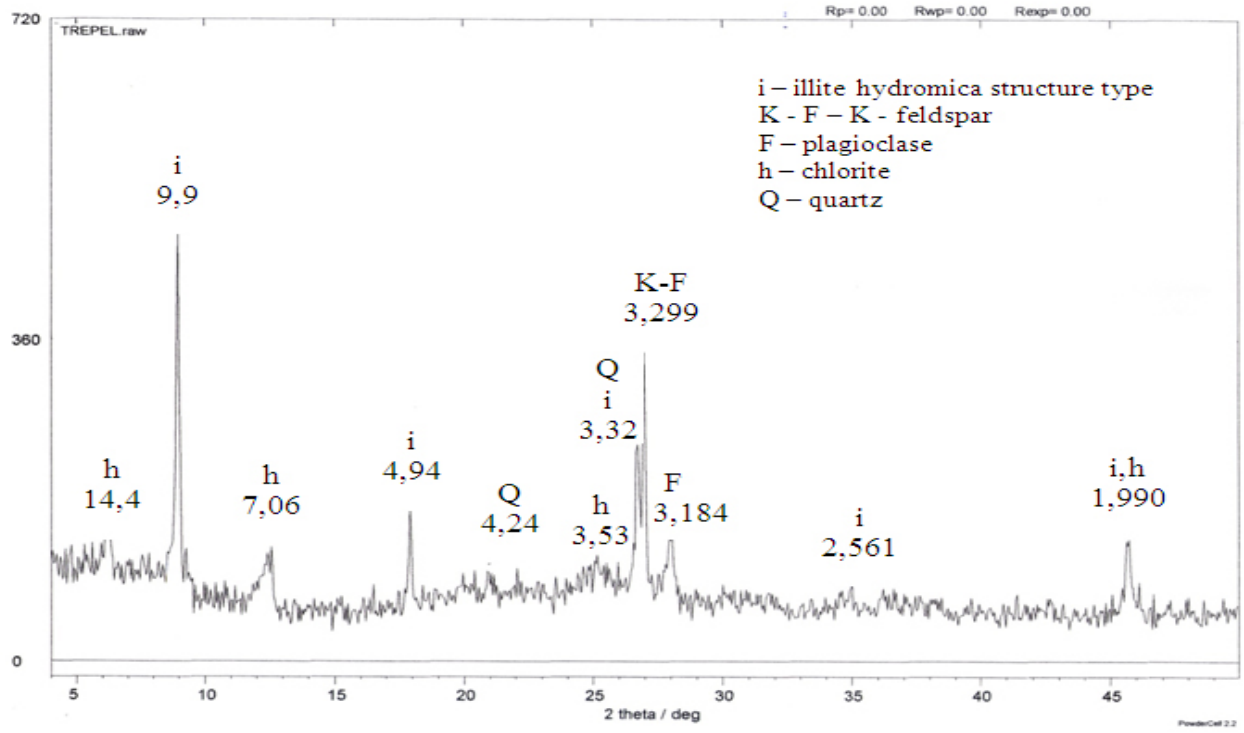

Fig. 11. X-ray diagram of examined trepelChemical examinations

A) A classical chemical - silicate procedure by the wett method was performed for the chemical examination of the treated trepel sample. Were determined results as follows:

Table 1

Chemical analysis, mass [%]

SiO_2	60.5
Al_2O_3	12.75
Fe_2O_3	6.57
CaO	2.60
MgO	2.16
K_2O	1.60
Na_2O	0.93
SO_3	0.95
loss of ign.	12.19
Total	99.80

Table 2

ICPOES analysis of the microelements [ppm]

Ag	< 1	Mn	816
As	8	Mo	1
Ba	81	Ni	39
Bi	10	Pb	19
Cd	< 1	Sb	10
Co	17	Sn	10
Cr	37	Ti	54
Cu	51	Zn	81
Fe	39 371	Hg	< 1

– SiO_2, Al_2O_3, loss of weigh contents evidently indicate for the determined mineral phases - opal, illite, quartz, feldpars, chlorite in treated trepel sample.

– The total (Na_2O + K_2O) alkali oxide content of 2.53 % shows a feldspar containing about 16%.

– Indicated Fe_2O_3 (6.57%), MgO (2.16%) contents are compatible with the determined (Mg, Fe)-chlorites in this trepel sample.

– Rather low CaO content of 2,60% shows that determined plagioclase belong to an albite-oligoclase type.

B) In the treated trepel sample the contents of the microelements (by ICPOES method) were determined (after sample dissolution by mixture of different acids), as follows:

Determined microelements in very low contents represent probably another proof that treated trepels from Bitola city and wider region are not connected with the volcanic processes and emanations from the Kožuf area mountin.

On the contrary, the very low contents of the aforementioned microelements are another evidence for the biogenetic origin of the examined trepel.

DTA/TG results

DTA/TG results of the examined trepel sample are evidently compatible with the X-ray powder data. From DTA-curve obviously can be seen a very broad endo-peak starting of cca 80°C to 300°C with a minimum at 150°C corresponding for opal and minerals of illite-hydromica structure type. The other thermal effects are of minor importance.

TG-curve show a total loss weight of cca 17%, what's is compatible with the mineralogical composition – presence of crystalohydrate minerals (opal, illite) in contents of cca 50 – 70%.

Genesis

A semi-quantitative evaluation of the examined trepel sample from the Bitola area show that it's composed approximatively as follows:

– opal cca 30 – 40 %
– K feldspars + plagioclases cca 10 – 16 %
– illite 20 – 30 %
– quartz cca 15 %
– (Mg, Fe)-chlorites cca 15 %.

The quantitatively predomination of opal (of biogenetic sources – approved by SEM-method) over the aforementioned silicate minerals indicates that treated trepel has a typical biogenetic and common treatment compatible with the literature data. There are certain hypothetic indications that in the treated trepels there is probably opal of chemogenetic origin.

CONCLUSION

– The trepels from the Suvodol village, Bitola city, actually represent typical sedimentary rocks of biogenetic origin, due to the numerous vegetative evidences in forms of very discrete globules – microfossils Arachnoidiscus orantus, alga Diatomeae etc. The opal forms of zoogenetic origin are not excluded in the examined trepel.

– The aforementioned genesis of the examined trepel is completely compatible with the common genetically treatment of these sedimentary rocks from different microlocalities in the world.

– Examined trepel from the Suvodol village is actually an evidence for the continuity of the living micro-organisms after the sedimentation of the former vegetation – main contributor for the creation of the coal deposits in the former lake basin of Miocen-pliocen age. The finegrained vegetative relics, which were sedimented together with quartz, illite, feldspars, chlorites, over the former vegetation products actually represent a special type of stopper preserving reductive conditions useful in the carbonization process for the creation of the coal deposits.

– The mineralogical and chemical composition of the examined trepel evidently offer different possibilities for the development of a complex inorganic technological industry for production for example for light bricks, cements etc.

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Р е з и м е

ТРЕПЕЛ – ПОСЕБНА СЕДИМЕНТНА КАРПА ОД БИОГЕНО ПОТЕКЛО ОД СЕЛОТО СУВОДОЛ, БИТОЛА, Р. МАКЕДОНИЈА

Благој Павловски[1], Симеон Јанчев[1], Љупчо Петрески[2], Агрон Река[3], Слободан Богоевски[1], Бошко Бошковски[1]

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Клучни зборови: трепел; опал; биогено потекло; алги Дијатомеи

Трепелите од с. Суводол, Битола, претставуваат типични слабо врзани седиментни карпи од биогено потекло што е потврдено со бројни докази (од фитогено потекло) во форма на многу дискретни микрофосили од редот на алги Диатомеи.

Наведената генеза на испитуваниот трепел е комплетно во согласност со општиот генетски третман на овие карпи од разни микролокалитети во светот.

Испитуваниот трепел од с. Суводол е вистински доказ за континуитетот на живите микроорганизми (од фитогено потекло) по седиментацијата на растителни продукти одговорни за создавањето на наслојките од јаглен во поранешниот езерски басен од миоцен–плиоцен. Овој седиментен комплекс, составен од трепели и јаглени, де факто претставува една биогено-седиментна формација.

Финозрните фитогени реликти во трепелот, кои беа седиментирани заедно со суперфинозрнестита тиња од кварц, илит, фелдспати, хлорити врз растителните продукти, претставуваат еден специјален заштитен чеп кој обезбедил редукциони услови корисни во процесот на карбонизација на растителни продукти од кои настанале денешните јагленови наслојки.

Минералошкиот и хемискиот состав на испитуваниот трепел евидентно нуди разни можности за развиток на комплексна неорганска технолошка индустрија за производство на лесни тули, цементи итн.