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**MINERALOGY OF FULGURITE FROM PUSTYNIA BŁĘDOWSKA
NEAR OLKUSZ**

UKD 552.125.3 fulguryt: 549.514.54+549.514.58(438.31)

A b s t r a c t. Mineralogical examinations have shown that fulgurite occurring within Pustynia Błędowska in south Poland consists of relict quartz, quartz glass (lechatelierite) and low cristobalite.

The occurrences of fulgurite are known both in contemporaneous (Dana *et al.* 1962) and in older geological formations e.g. in Lower Permian deposits (Birkenmajer 1973). Usually the tubes of the latter ones are filled mineral substance and their walls, when compared with those of the former, are intensely recrystallized and thus impoverished in glass.

Fulgurites are particularly common in desert areas. They are developed as arenaceous elongated single or bifurcated tubes, 1—3 cm in diameter.

Mineralogy of fulgurites is generally little known. The majority of papers dealing with this subject is descriptionary in character (Ławicki 1824, Aleksandrowicz 1859, Niedźwiecki 1889, Weyberg 1902, Julien 1903, Morawiecki 1928, Birkenmajer 1973). The paper of Roemer (1876) reporting the occurrence of these forms near Starczynów within Pustynia Błędowska, does not differ from them.

The fulgurite in question consists of tubes, approximately 5 cm in diameter. Even macroscopically three distinct zones can be distinguished within their porous walls: inner, middle and outer one (Phot. 1), differing in colour. The first is milky white, the second pinkish and the latter — smoky, locally nearly black. Moreover, the above parts differ in the content of pores. These are most abundant in the inner one, whereby the outer zone contacting with sand displays lower porosity. As follows from microscopic examination, these pores are spherical in shape and have no

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conjunctions with each others. Their diameters are generally approx 1.5 mm. Outer zone of these ring sections is isotropic and often displays fluidal structure (Phot. 2), due to remelting phenomena of quartz grains and following of the whole matrix. Pseudomorphs of quartz, filled with isotropic substance, are locally preserved. In middle and outer parts the glassy mass is accompanied by more or less altered quartz grains. Usually they are fractured and isotropised (Phot. 3). Some quartz grains are surrounded by radial mineral aggregates showing optical properties of cristobalite (Phot. 4). Its refractive indices are: $n_o = 1.484$ and $n_e = 1.487$ and birefringence very low (approx. 0.002). Consequently, the mineral under consideration appears to be isotropic.

X-ray examinations of all the three zones distinguished have shown that the dark outer zone is most abundant in glass. Only the most important reflections of low cristobalite ($4.02, 2.85 \text{ \AA}$) and quartz were found in their diffraction patterns (Fig. 1). In other zones the amount of quartz increases, whereby cristobalite is still present.

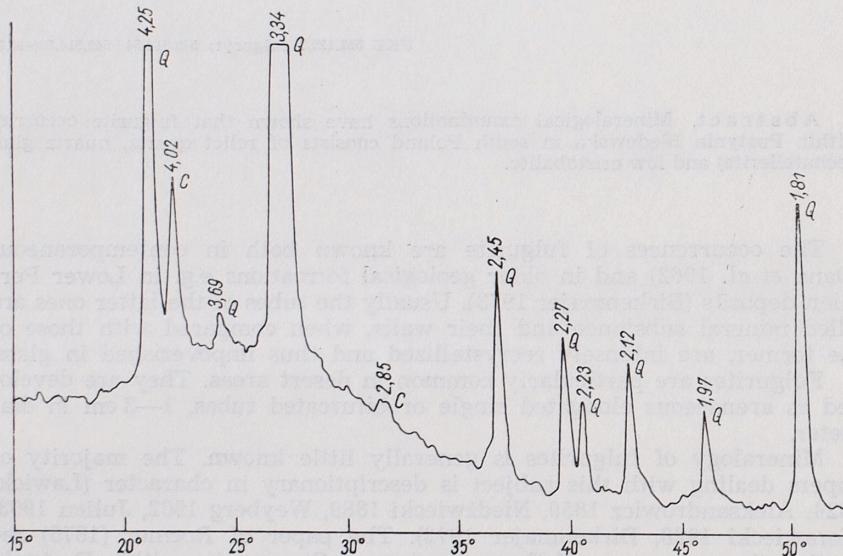


Fig. 1. X-ray diffractometer pattern of fulgurite

Mineral composition of individual fulgurite zones in question have been also investigated by means of infrared absorption analysis (Fig. 2). As follows from the obtained data, apart from characteristic quartz bands ($1165 \text{ cm}^{-1}, 1085 \text{ cm}^{-1}, 800 \text{ cm}^{-1}, 780 \text{ cm}^{-1}, 695 \text{ cm}^{-1}, 520 \text{ cm}^{-1}$ and 467 cm^{-1}) there occurs the band 621 cm^{-1} , typical of low cristobalite (Pljushnina 1967).

Mineralogical examinations of fulgurite from Pustynia Błędowska have shown that it was forming under conditions of typical thermal metamorphism. The increase of temperature caused by atmospheric electrical

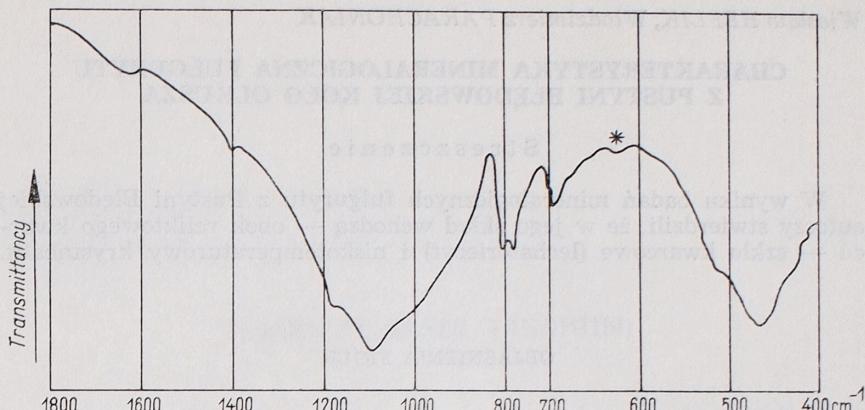


Fig. 2. Infrared absorption spectrum of fulgurite

discharge was, obviously, considerable. Elevated pressure was formed for short period of time due to evolution of water vapour contained in clay minerals and in pores between sand grains.

It is thus concluded that fulgurite in question was formed under conditions of high temperature and low pressure as the product of remelting process of quartz grains. This process resulted in the formation of quartz glass (lechatelierite) which when cooling partly recrystallized first into high and then into low cristobalite (transformation temperature of these two modifications is 268°C). Metamorphism under consideration was very close to that of sanidinite facies.

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**CHARAKTERYSTYKA MINERALOGICZNA FULGURYTU
Z PUSTYNI BŁĘDOWSKIEJ KOŁO OLKUSZA**

S t r e s z c z e n i e

W wyniku badań mineralogicznych fulgurytu z Pustyni Błędowskiej autorzy stwierdzili, że w jego skład wchodzą — obok reliktywego kwarca — szkło kwarcowe (lechaterieryt) i niskotemperaturowy krystobalit.

O B J A Ś N I E N I A F I G U R

Fig. 1. Dyfraktogram fulgurytu

Fig. 2. Widmo absorpcyjne w podczerwieni fulgurytu

Веслав ХЕФЛИК, Владзимеж ПАРАХОНИЯК

**МИНЕРАЛОГИЧЕСКАЯ ХАРАКТЕРИСТИКА ФУЛЬГУРИТА
ИЗ ПУСТЫНИ-БЛЕНДОВСКОЙ БЛИЗ Г. ОЛЬКУША**

Р е з и о м е

Минералогические исследования фульгурита из Пустыни-Блендовской выявили в его составе, кроме реликтивного кварца, лешательерит (сплавленный кварц) и низкотемпературный кристобалит.

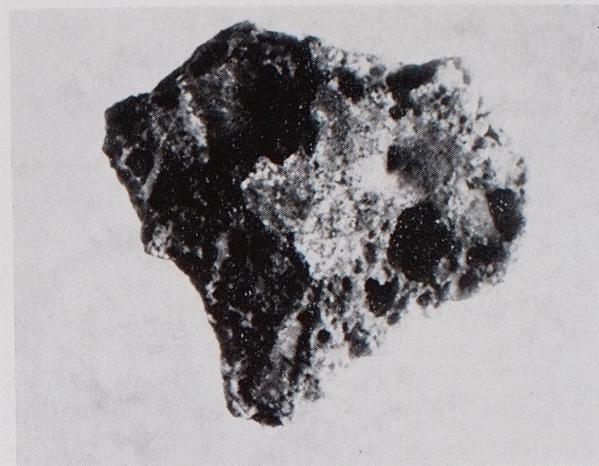
ОБЪЯСНЕНИЯ К ФИГУРАМ

Фиг. 1. Дифрактограмма фульгурита

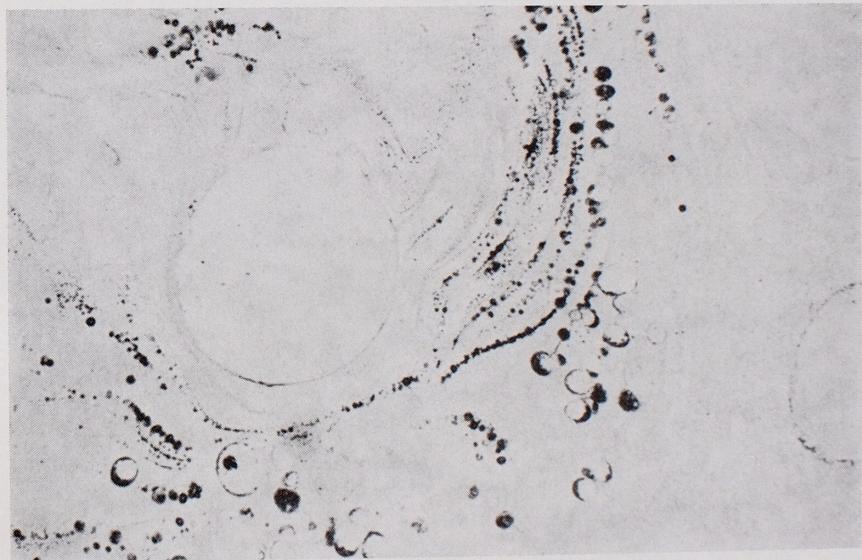
Фиг. 2. ИК-спектр поглощения фульгурита

PLATE I (PLANSZA I, ТАБЛИЦА I)

- Phot. 1. A part of fulgurite displaying distinct porous texture. Natural size
 Fragment fulgurytu o wyraźnej strukturze porowatej. Wielkość naturalna
 Фрагмент фульгурита с явной пористой структурой. Естественная величина
- Phot. 2. Fluidal structure of glass in fulgurite. No nicols, enlarged 80 ×
 Fluidalna tekstura szkliwa fulgurytu. Bez nikoli. Pow. 80 ×
 Флюидальная текстура стекловатого вещества фульгурита. Без николей, увел.
 80 ×



Phot. 1



Phot. 2

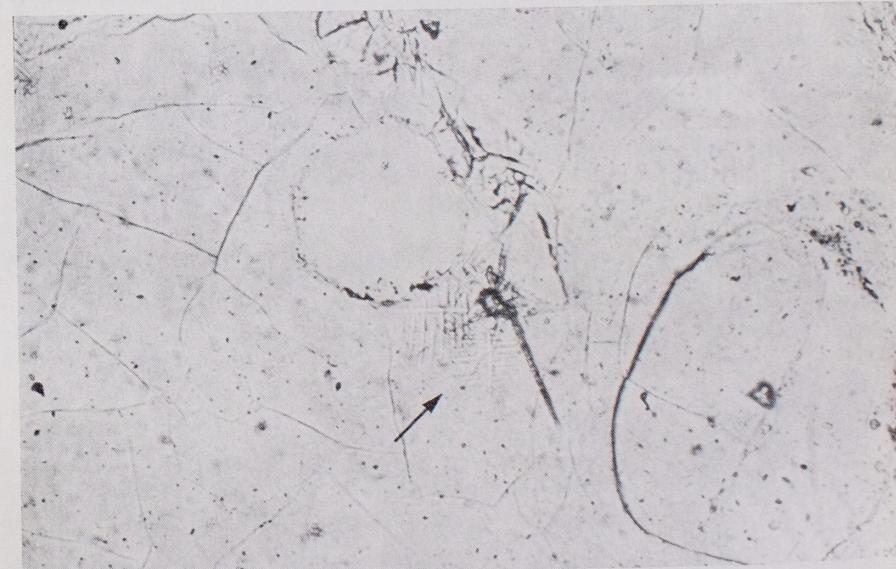
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 Pustynia Błędowska near Olkusz

PLATE II (PLANSZA II, ТАБЛИЦА II)

- Phot. 3. Slightly fused quartz grain in outer part of fulgurite. Crossed nicols, enlarged 80×
 Nadtopione ziarno kwarcu w zewnętrznej partii fulgurytu. Nikole skrzyżowane. Pow. 80×
 Подплавленное зерно кварца во внешней зоне фульгурита. Николи скрещенные, увел. 80×
- Phot. 4. Glass containing distinct recrystallization products (marked by an arrow).
 No nicols, enlarged 80×
 Szkliwo z widocznymi produktami rekrystalizacji (oznaczone strzałką). Bez nikoli. Pow. 80×
 Стекловатая масса с заметными продуктами перекристаллизации (показанные стрелкой). Без николей, увел. 80×



Phot. 3



Phot. 4

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