

Barbara KAZIMIERSKA*, Hubert SYLWESTRZAK*

EPI-IMPSONITE - THE ALTERATION PRODUCT OF BITUMINOUS SUBSTANCE FROM MELAPHYRE FROM SOKOŁOWIEC NEAR ŚWIERZAWA

UKD 549.883.01/02/08epi-impsonit:622.271.2:552.323.5:551.736.1/438-35
zielonogórskie, Świerzawa

Abstract. A veiny mineral association consisting of quartz, chalcedony, carbonates, chlorite and an organic mineral resembling asphalt was found in a melaphyre quarry (Rotliegendes) at Sokółowiec. Detailed studies (elementary analysis, chromatography, determination of bitumens, carbonates and *n*-alkanes, IR spectroscopic analysis, fusibility and CS₂-solubility tests, reflectance measurements) have shown that the organic mineral can be assigned to pyrobitumens of the epi-impsonite series (acc. to the combined classification of Jacob-Abraham). It is therefore a moderately altered pyrobitumen whose parent substance was presumably bitumens originating from the s.c. pyroschist horizon from Świerzawa (Lower Rotliegendes), which is older than the melaphyre. Similar mineral associations have been reported from the Intraseductive synclinorium.

INTRODUCTION

A singular mineral association was found in the vein zone with a N-S strike and a vertical dip of an abandoned melaphyre quarry situated S of the village of Sokółowiec near Świerzawa (Fig. 1). The association consists of quartz, carbonates and an organic mineral determined macroscopically as asphalt (Sylwestrzak 1979).

GEOLOGICAL SETTING

An oval melaphyre stock about 250 m in diameter penetrates through Lower Rotliegendes rocks within the tectonic trough of Świerzawa. This melaphyre, together with other basic vulcanites in its neighbourhood, is assigned to igneous rocks of the eruptive horizon II of the Rotliegendes (Kozłowski, Parachoniak 1967). In view of certain deviations from the norm, the cited authors think it conceivable that the dark volcanic rock occurring in the quarry is a Tertiary basalt, yet this view seems to be hardly acceptable.

Mineralization within the zone has the form of veins and impregnations. The ca-taclasis zone of melaphyre is about 70 cm in width, with individual veinlets being not more than 5 cm thick and continuous over a small length (1-1.5 m). Asphalt concen-

* Geological Institute, 00-975 Warszawa, Rakowiecka 4.

trations occur in the central parts of veinlets and in the enclosing altered melaphyre. Asphalt veinlets attain a thickness of 2 cm.

Melaphyre has a porphyritic texture. Scarce pseudomorphs after olivine phenocrysts are embedded in the groundmass showing an intersertal texture. The principal rock components are basic plagioclases (labradorite) with a lamellar habit. Some lamellae can be up to 0.5 mm in length but are generally much smaller (0.1–0.2 mm). Between the feldspar lamellae are embedded relics of augite grains and fine-aggregate chloritic groundmass. In the parts of the rock subject to augitization, augite has decomposed into chlorite and nodules of ore minerals. Pseudomorphs after olivine phenocrysts also show dependence on the degree of alteration. In poorly altered melaphyre they are filled up with a greenish flaky chlorite mineral showing weak pleochroism and normal interference colours that rarely pass into a blue subnormal colour. In the intensely altered rock, pseudomorphs are filled up with carbonate minerals. Devitrified glass of a greenish colour appears in small amounts.

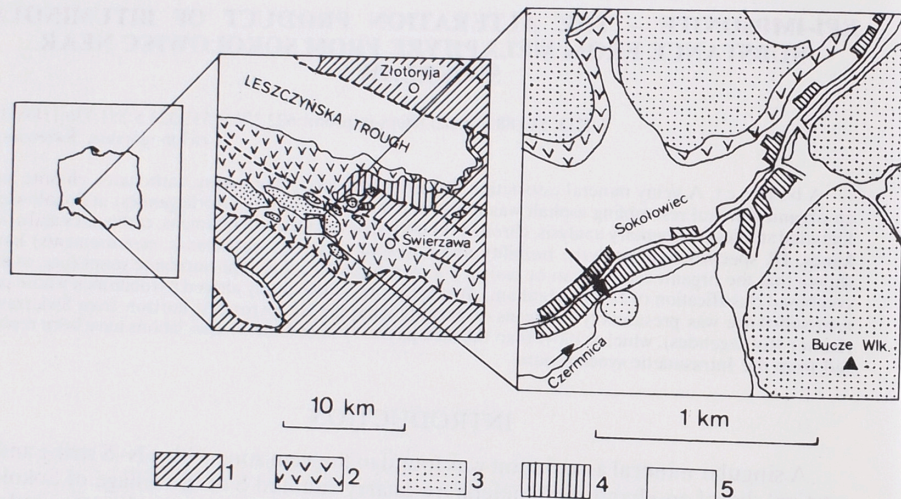


Fig. 1. Location of the melaphyre quarry with asphalt mineralization
1 – Lower Palaeozoic, 2 – Permian sedimentary rocks, 3 – Permian melaphyres, 4 – Permian porphyry, 5 – Cretaceous and younger rocks

In the cataclased parts adjoining the veinlets, melaphyre grades into breccia, the fragments of which are intensely chloritized. The colour of chlorite becomes brighter and its tinge changes from greenish to yellow-green. Between rock fragments there appear fine-aggregate chalcedony impregnations and calcite veinlets about 1 mm in thickness, which in places crosscut the cataclased rock and in places are separated from it by a thin (about 0.2 mm) chlorite lining. There also appear nest-like, irregular concentrations in which chalcedony, chlorite and carbonates occur jointly or separately. The sequence of mineral formation is difficult to determine because there are cases where chalcedony encloses spherical chlorite aggregates with a radial structure, but such aggregates also happen to be disrupted and cicatrized with chalcedony. Calcite grains embedded in the chalcedony groundmass are up to a few mm in size, being generally automorphic. Carbonates also appear within chlorite aggregates (sometimes in their central parts) as irregular concentrations within chalcedony, and also as thin rectilinear veinlets crosscutting all the other rock components.

The content of chalcedony in the rock increases in the direction of veinlets, accompanied by the growth of its crystals. As a result of this, there form parts of the rock which, viewed under the microscope, look like typical chalcedonite made up of spherical-radial interfingering aggregates. Occasionally zones of growth are visible. The phenomenon of “chalcedony cross” is pronounced. In the spaces between chalcedony crystals a low-birefringent substance and fine-aggregate carbonates have been noted. In some places chalcedony has undergone recrystallization, passing into quartz. In the central parts of veinlets quartz druses grow from both sides towards free spaces. Quartz crystallizing in this way does not show the presence of chalcedony relics, while successive zones of growth are visible on crystals growing in fissures, displaying the characteristic “fortress” image when viewed under the microscope.

Asphalt occurs in veinlets and in impregnation zones in several distinctive forms:

1. The filling of free spaces between automorphic quartz and calcite crystals growing from both sides in the central parts of veinlets. These concentrations attain a thickness of 20 mm.
2. Irregular nest-like concentrations up to 20 mm in thickness round veinlets in the altered rock. They have a character of impregnations and contact directly with the rock in the absence of other vein minerals.
3. The nest-like filling of small interstices within chalcedony and quartz.
4. Thin laminae on the surface of quartz grains, and in the case of grains exhibiting growth zones, lying on these zones, thus accentuating the successive growth stages of this mineral.
5. Nodular concentrations on the cleavage planes and fracture cracks of calcite, sometimes accentuating the banded structure.
6. Fine drop-like concentrations showing feathery arrangement within spherical-radial chalcedony crystals.
7. The filling of the central parts of spherical and reniform chlorite aggregates and encrustations on such aggregates.

The characteristic forms of occurrence of asphalt are shown on photographs 1–4.

All these forms are usually coexistent. The lack of clear-cut succession in the formation of non-hydrocarbonaceous components of mineralization indicates that this sequence was probably affected by insignificant changes in conditions.

EXPERIMENTAL AND RESULTS

General description

The asphaltic substance, defined as asphalt on the basis of its macroscopic features, is black in colour with pitchy lustre, friable, completely opaque in thin section, with a characteristic conchoidal fracture. Its Mohs hardness is about 2.5 but is difficult to determine because of friability. Density $d = 1.305 \text{ g/cm}^3$ (the mean of three pycnometric determinations). The substance readily ignites in a candle flame and burns after being removed from the flame, giving off a strong peculiar smell. An X-ray diffraction pattern has revealed that the substance studied is wholly amorphous. The presence of quartz and calcite reflections in the carefully separated material shows that ash content is affected to a certain extent by impurities which cannot be removed mechanically.

In order to obtain more definite data, the organic substance was subjected to detailed investigations.

Determination of bitumens and hydrocarbons

Bitumens were determined by weight in chloroform extract in Soxhlet apparatus.

Extraction was carried on until luminiscence disappeared. The content of hydrocarbons and their composition were determined by the method of column chromatography. The results are listed in Table 1.

Table 1
The content of bitumens and hydrocarbons

Organic substances	Content (wt.%)
Bitumens (chloroform extract)	11.05
Hydrocarbons in bitumens	25.5
Hydrocarbons in the sample	2.82
Saturated hydrocarbons	56.0
Aromatic hydrocarbons	44.0
Hydrocarbons in total bitumens	14.28
<i>n</i> -alkanes (<i>n</i> -paraffin hydrocarbons) from C ₁₇ and C ₁₈	0.6

Determination of *n*-alkanes

To determine the content and composition of *n*-alkanes, gas-liquid chromatography was used under the following experimental conditions: instrument – Chrom 4; column length 3 m; Ø 3 mm; filling – solid phase: 80/100-mesh Gas-Chrom P, liquid phase: SE 52 silicone; programme – isothermal run at 50°C for 30 min., then a rise in temperature from 110–300°C at a heating rate of 3°C/min. and holding at 300°C for about 20 min.; carrier gas – argon; flame-ionization detector.

The results of chromatographic analysis are given in Table 2.

Table 2
The results of chromatographic analysis of *n*-alkanes

C ₁₇	1.2		C ₂₄	10.9	±0.07	C ₃₀	4.7	±0.03
C ₁₈	0.9	±0.01	C ₂₅	11.8	±0.07	C ₃₁	3.8	±0.02
C ₁₉	2.4	±0.01	C ₂₆	9.3	±0.06	C ₃₂	2.7	±0.02
C ₂₀	4.1	±0.02	C ₂₇	10.1	±0.06	C ₃₃	1.5	±0.01
C ₂₁	4.6	±0.03	C ₂₈	7.7	±0.05	C ₃₄	1.3	±0.01
C ₂₂	6.8	±0.04	C ₂₉	6.6	±0.04	C ₃₅	trace	
C ₂₃	9.7	±0.06						

From the values obtained the transformation index of hydrocarbons, CPI, was calculated. It is:

$$\text{CPI} = \frac{51.7}{48.4} = 1.07$$

$$\text{CPI} = \frac{10.1+6.6}{2 \times 7.7} = 1.08$$

The value of CPI 1.07–1.08 points to a low degree of transformation of the initial substance.

The distribution curve of *n*-alkanes (Fig. 2, plots 1–2) reaches a maximum at *n*-C₂₅. This testifies to the terrigenous origin of the substance, whereas the irregular shape of the curve confirms the medium degree of transformation.

Elementary analysis

Elementary analysis of the untreated sample and its chloroform extract was made with a view to obtaining data on the content of basic components forming the mole-

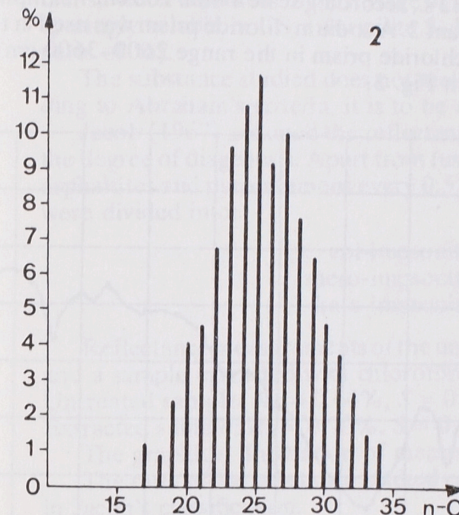
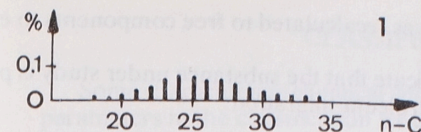


Fig. 2. The content (plot 1) and distribution (plot 2) of *n*-paraffin hydrocarbons

cular structure of the substance studied, as well as on the degree of its oxidation, hydrogenation and condensation of rings.

Chemical composition was determined with a Carlo-Erba 1102 analyser working on the principle of gas chromatography. The percentage of three basic components – carbon, hydrogen and nitrogen – was determined adopting the following procedure. Organic substance was burnt in a tube filled with copper oxide in the presence of catalyst (V₂O₅) in oxygen stream. Carbon dioxide, water and nitrogen oxide formed as a result of the process. The mixture of these products was passed through a tube filled with reduced copper onto a chromatographic column, where separation into N₂, CO₂ and H₂O took place. The results are presented in Table 3.

Table 3
Elementary analysis of the asphaltic substance from Sokolowice

Substance	C	H	N	O+S	ash	C/H
	wt.%					
Untreated substance	79.8	7.1	1.5	12.5	9.65	11.1
Extracted substance	81.9	7.0	1.2	9.9	9.0	11.7
Chloroform extract	75.6	9.9	0.4	14.1	–	7.6
Asphaltenes in the sample	72.7	7.1	1.1	19.1	–	10.2

The content of carbon and hydrogen was recalculated to free components to eliminate the effect of mineral matter.

The results of elementary analysis indicate that the substance under study is poorly oxidized, being the residue after petroleum migration.

IR spectroscopic analysis

The infrared spectrum of the asphaltic substance separated from the rock was recorded between 700 and 3600 cm^{-1} with a Zeiss UR-10 spectrometer. The sample was in the form of KBr disc and the instruments settings used were: slit 4, recording speed 150 $\text{cm}^{-1}/\text{min.}$, recording time 32 s., recording scale 4 mm/100 cm^{-1} , amplification 5–6, band breadth 2, time constant 2. A sodium chloride prism was used in the range 700–2500 cm^{-1} and a lithium chloride prism in the range 2600–3600 cm^{-1} . The spectrum obtained is presented in Fig. 3.

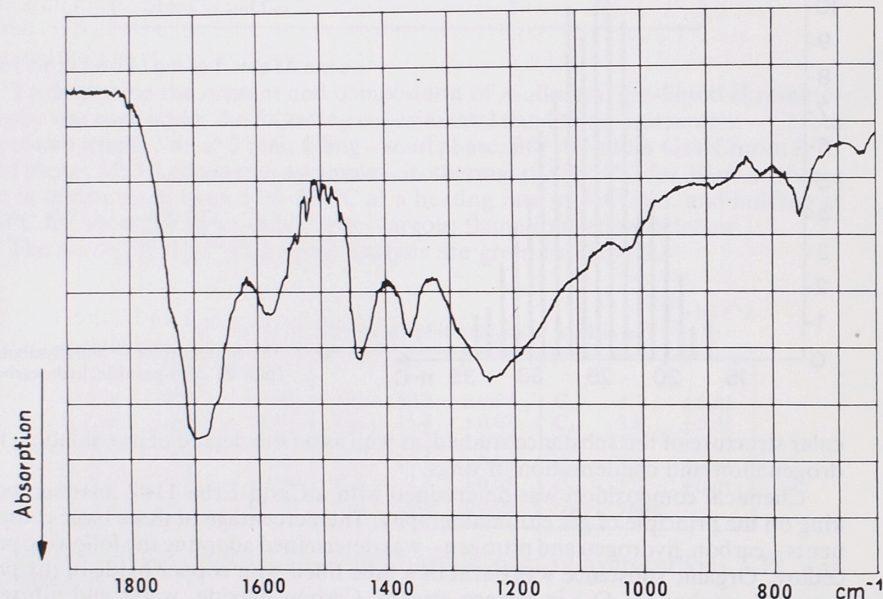


Fig. 3. Infrared absorption after extraction with ether

The following structural elements play a significant part in the spectrum:

- 1) saturated hydrocarbons, i.e. CH_2 and CH_3 groups, displaying CH_2 absorption at 2926 and 1490 cm^{-1} and CH_3 absorption close to 2960 and 1400 cm^{-1} ;
- 2) aromatic hydrocarbons giving rise to the absorption at 1600 cm^{-1} and at 3000–3100 cm^{-1} in the case of polycyclic aromatic compounds;
- 3) carbonyl compounds responsible for the absorption band at 1700 cm^{-1} ;
- 4) carboxyl compounds displaying absorption between 3300 and 3500 cm^{-1} .

Infrared spectroscopic analysis has revealed that the saturated structures present in the sample dominate over aromatic ones. The strong absorption in the region characteristic of carbonyl groups may be indicative of secondary oxidation of the asphaltic substance.

CLASSIFICATION CRITERIA

Some characteristic chemical and physical properties, assumed to be the essential parameters in the classification scheme of Abraham (1960), serve to determine the degree of transformation of asphaltic substances. The most important features of asphalts and asphaltic pyrobitumens are their fusibility and solubility in carbon disulphide. Asphalts are readily soluble in CS_2 (gilsonite dissolves in 99–100%, grahmite in 90–100%, taking pure mineral as a basis) and fusible. Asphaltic pyrobitumens, which represent the last stage of diagenesis, are completely infusible and very sparingly soluble in CS_2 (wurtzilite 5–10%, albertite 2–10%, impsomite 6 to trace parts of %).

The substance studied does not melt at 800°C and its solubility is 4%, so according to Abraham's criteria, it is to be assigned to pyrobitumens.

Jacob (1967) assumed the reflectance of a substance to be the main indicator of the degree of diagenesis. Apart from fusibility, he established the boundary between asphaltites and pyrobitumens every 0.5% *R_m*. Accordingly, asphaltic pyrobitumens were divided into:

epi-impsonites	0.5 – 2% <i>R_m</i>
meso-impsonites	2.0 – 3.5% <i>R_m</i>
kata-impsonites	> 3.5% <i>R_m</i>

Reflectance measurements of the untreated asphaltic substance from Sokołowiec and a sample extracted with chloroform gave the following values:

Untreated sample: $R_0 = 0.64\%$, $S = 0.004$, modal value $R = 0.66\%$.

Extracted sample: $R_0 = 0.70\%$, $S = 0.02$, modal value $R = 0.71\%$.

The graphical illustration of measurements is presented in Figure 4.

The rank of the substance studied corresponds to the stage of high-volatile coals in Jacob's classification.

The best effects from the geological and technological point of view are obtained from the combination of the classification schemes of Abraham and Jacob, illustrated by the reflectance vs. CS_2 solubility plot (Fig. 5). On the plot, the point corresponding to the asphaltic substance from Sokołowiec is also within the field of epi-impsonites, and this confirms the earlier conclusions.

COMPARISONS AND CONCLUSIONS

The coexistence of asphaltic and mineral substances in veins and geode fillings has been noted on frequent occasions. An example of this is the occurrence of asphalt veins in the Cretaceous sediments near Rabka (Flysch Carpathians), in which are embedded automorphic, bilaterally developed short-columnar quartz crystals. A part of these crystals (Łaszkiewicz 1960) contain inclusions of asphaltic substance, which testifies to the simultaneous geochemical mobility of the organic and mineral components of mineralization.

The occurrence of asphaltic substances in veins crosscutting the Mesozoic sedimentary rocks of SE Turkey was the object of detailed studies (Lebküchner 1964). The studies showed that asphaltic substances, originating from black bituminous shales, were subject to transformation while migrating through tension fissures associated with overthrusts and anticlinal axes. This gave rise to compounds that may be assigned to asphaltites and asphaltic pyrobitumens.

The occurrence of asphaltic substance in veins crosscutting basic igneous rocks has also been reported from several localities. For example, coaly substance defined

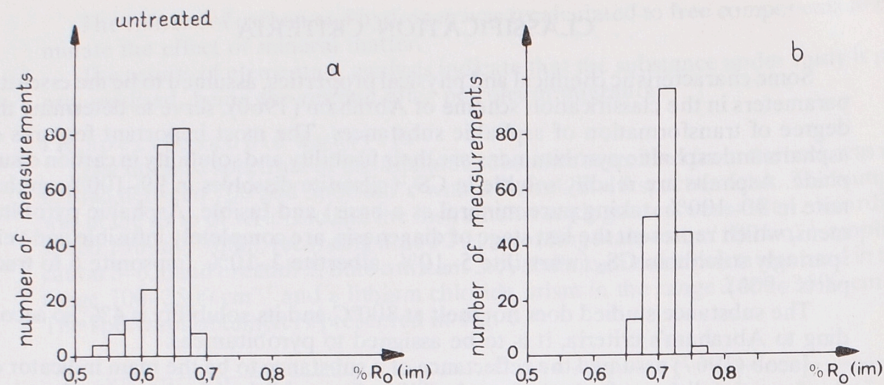


Fig. 4. Reflectance bar charts of organic substance
a - Untreated sample. b - Sample extracted with chloroform

as "anthracite" has been found to occur in the Lahn-Dill Devonian haematite iron ores associated with diabases. This coal, showing close macro- and microscopic similarity to bright coal varieties of the highest rank and to anthracite, has a high content of volatile components indicating that it is the product of transformation of the Palaeozoic petroleum (Harder 1954, Ramdohr 1950).

In the Devonian amygdaloidal diabases of Harz ("Oberharzer Diabaszug") W of Lerbach there occur veinlets up to 6 cm in thickness, filled up with quartz, carbona-

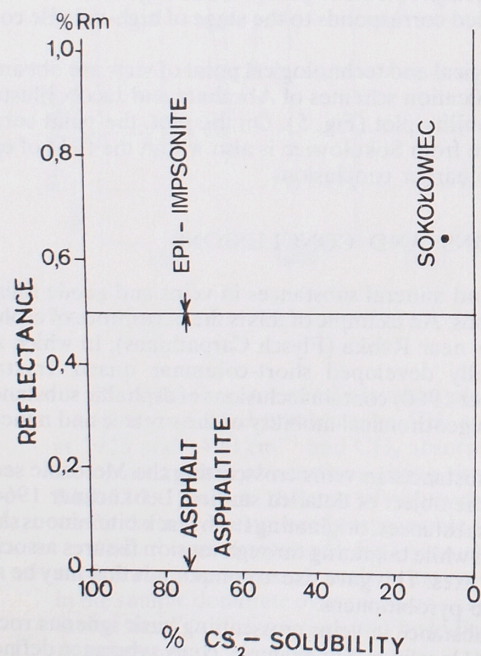


Fig. 5. Diagram of diagenesis of asphaltic substance acc. to Jacob-Abraham

tes, a small amount of haematite and a coaly substance resembling anthracite. Studies have shown that the organic substance consists mainly of paraffin hydrocarbons from $C_{13}H_{28}$ to $C_{22}H_{46}$, with the characteristic double prevalence of even over odd hydrocarbons and $C_{14}H_{30}$, $C_{16}H_{34}$ and $C_{18}H_{38}$ compounds being dominant, and also of aromatic hydrocarbons (phenanthrene or anthracene). Isotopic investigation has revealed that the coaly substance is of organic origin (Koritnig et al. 1970).

Organic origin has also been advanced for the paraffin organic substance occurring in quartz-calcite-saponite fillings of geodes and amygdales in the basalts of the eastern part of the Gobi Desert. Since silica coexisting with the organic substance cannot be genetically connected with basic magma, and since silicic and bituminous rocks occur among the enclosing rocks, it has been assumed that sedimentary rocks are the source of bituminous substances (Minskij, Korolev 1961).

The occurrence of asphaltic substance - pyrobitumen in the Sokolowiec melaphyre is not the first report of mineralization of this type from the Sudetes. In the middle of the last century, solid hydrocarbons were noted in cracks 0.5-1.5 cm wide and in fissures of agates and amethysts filling up geodes in the amygdaloidal melaphyre at Rudawa near Nowa Rudaw. The substance from Rudawa was described as black, bright, with a conchoidal fracture, burning with a large bright flame (Dücker 1869). The same author also described black asphalt with a conchoidal fracture, filling up fissures in melaphyre from Ratno near Klodzko. Thin asphalt veinlets filling up fractures in the Rotliegendes bituminous shales were reported from the same locality (Fiedler 1863).

The nature of the pyrobitumen from Sokolowiec and its mode of occurrence indicate that the source of asphaltic substance in this case should also be sought in sedimentary rocks. The parent rocks could have been the lower and upper pyroschists from Świerzawa (horizons I and II of Rotliegendes Anthracosia shales). From a comparison with other occurrences of similar mineral associations it appears that epi-impsonite of the pyrobitumen series from Sokolowiec represents medium-grade metamorphism of bitumens. Of the cited examples the Tertiary asphaltites from Rabka, post-Cretaceous bitumens from the Gobi basalts, and the Triassic-Cretaceous asphaltites and asphaltic pyrobitumens of eastern Turkey show a lower grade of metamorphism. The coaly substance from the Harz Devonian diabases and the Lahn-Dill iron ores exhibits a higher grade of metamorphism. Generally speaking, the metamorphism of asphalts in the discussed mineralization occurrences may depend on their geologic age. It seems certain, however, that this relationship is not direct.

It is feasible that the evolution of organic substance depends to a larger extent on the environment than on the parent material, and the determination of primary substances does not seem possible.

Acknowledgements. The authors' thanks are due to Mrs K. Tokarska for preliminary reflectance measurements and to Mrs Z. Rzepkowska and Mrs J. Nowak for valuable discussion.

Translated by H. Kisielewska

REFERENCES

- ABRAHAM H., 1960: Asphalts and allied substances. Vol. 1, D. van Nostrand Co., New York.
DÜCKER von, 1869: An Herrn Eck. Fester Kohlenwasserstoff im Melaphyrenmandelstein bei Neurode. *Z. Dtsch. Geol. Ges.* Bd 21.
FIEDLER H., 1863: Die Mineralien Schlesiens mit Berücksichtigung der angrenzenden Länder. Breslau.
HARDER H., 1954: Beitrag zur Petrographie und Genese der Hämatiterze des Lahn-Dill-Gebietes. *Heidelberger Beiträge zur Mineralogie und Petrographie*. Bd 4, 54-66.

- JACOB H., 1967: Petrologie von Asphaltiten und asphaltischen Pyrobitumina. *Erdöl und Kohle*, Vol. 20, 6, 393–400.
- KORITNIG S., SPITELLER-FRIEDMANN Margot, HOEFS J., 1970: "Kohlige Substanz" aus dem Oberharzer Diabaszug bei Lerbach. *Neues Jb. f. Mineralogie, Monatshefte*, 337–342.
- KOZŁOWSKI S., PARACHONIAK W., 1967: Wulkanizm permski w depresji północnosudeckiej. *Prace Muzeum Ziemi*, 11, 191–216.
- LEBKÜCHNER R.F., ORHUN F., WOLF M., 1972: Asphaltic substances in Southeastern Turkey. *The AAPG Bulletin*, vol. 56, 10, 1939–1964.
- ŁASZKIEWICZ A., 1960: Rzekomo pirogeniczne kwarcy. *Kwart. Geol.*, Vol. 4, 3, 585–593.
- [MINSKI N.A., KOROLEV U.M.] МИНСКИЙ Н.А., КОРОЛЕВ Ю.М., 1961: Ассоциация битуминозного вещества с кварцем, сапонитом и кальцитом в интрузивных базальтах. *Зан. Всес. Мин. Общ. Сер. 2*, вып. 4. Изд. АН СССР, Москва–Ленинград.
- RAMDOHR P., 1950: Die Erzminerale und ihre Verwachsungen. Akademie Verlag, Berlin.
- SYLWESTRZAK H., 1979: Mineralizacja asfaltowa w melafirze z Sokółowca k/Świerzawy. *Prz. Geol.*, 5, 279–280.

Barbara KAZIMIERSKA, Hubert SYLWESTRZAK

EPI-IMPSONIT, PRODUKT PRZEOBRAŻENIA SUBSTANCJI BITUMICZNEJ Z MELAFIRU SOKOŁOWCA KOŁO ŚWIERZAWY

Streszczenie

W pracy opisano ciekawą paragenezę minerałów występującą w nieczynnym łomie melafiru położonym na S od wsi Sokółowiec k/Świerzawy (Sylwestrzak 1979). Melafir ten jest zaliczany do utworów wylewnych 2-go piętra eruptywnego czerwonego spągowca. W obrębie żyłowego zespołu mineralnego wyróżniono kwarc, chalcedon, węglany, chloryt oraz minerał organiczny o wyglądzie asfaltu.

Mineralizacja ma charakter żyłowy i impregnacyjny. Strefa kataklazy melafiru ma szerokość około 70 cm, a poszczególne żyłki w jej obrębie nie przekraczają 5 cm grubości i zachowują ciągłość na niewielkiej długości (do 1,5 m).

Skupienia asfaltu występują w środkowych partiach żyłek oraz w otaczającym przeobrażonym melafirze, osiągając grubość do 2 cm. Charakterystyczne formy występowania asfaltu przedstawiono na fot. 1–4.

Substancja asfaltowa ma barwę czarną, połysk smolisty, przełam muszlowy, jest krucha, nieprzezroczysta, twardość jej wynosi 2,5 w skali Mohsa, gęstość $d = 1,305 \text{ g/cm}^3$, pali się w płomieniu świecy; badania w rentgenowskim preparacie proszkowym wykazały zupełną bezpostaciowość.

Dla bliższej charakterystyki substancji asfaltowej zastosowano badania szczegółowe jak: analiza elementarna (tab. 3), chromatograficzne oznaczenie ilości i składu węglowodorów (tabl. 1), *n*-alkanów (tab. 2), analizę spektrofotometryczną w podczerwieni (fig. 3). Jako główne kryteria klasyfikacyjne przyjęto refleksyjność (fig. 4), topliwą i rozpuszczalność w CS₂ (fig. 5) według Abrahama (1960) i Jacoba (1967).

Badania wykazały, że minerał organiczny należy zaliczyć do pirobituminów z grupy epi-impsonitu. Jest to zatem średnio przeobrażony pirobitumin, dla którego materiałem wyjściowym mogły być substancje bitumiczne starszych od melafiru utworów tzw. poziomu łupków palnych ze Świerzawy zaliczane do dolnego czerwonego spągowca.

Ewolucja substancji organicznej zależna jest prawdopodobnie w znacznie większym stopniu od warunków środowiska niż od materiału wyjściowego i określenie charakteru substancji pierwotnych nie wydaje się możliwe.

OBJAŚNIENIA FIGUR

- Fig. 1. Lokalizacja łomu melafiru z mineralizacją asfaltową
1 – dolny paleozoik, 2 – skały osadowe permu, 3 – melafiry permu, 4 – porfiry permu, 5 – kreda i utwory młodsze.
- Fig. 2. Zawartość (wykres 1) i dystrybucja (wykres 2) węglowodorów *n*-parafinowych
- Fig. 3. Absorpcja w podczerwieni po wytrąceniu eterem
- Fig. 4. Histogramy refleksyjności substancji organicznej
a – próbka nieekstrahowana, b – próbka ekstrahowana chloroformem
- Fig. 5. Diagram diagenety substancji asfaltowej wg Jacoba–Abrahama

OBJAŚNIENIA FOTOGRAFII

- Fot. 1. Skupienia asfaltu (czarny) współwystępujące z chlorytem (ciemnoszary), 1 nikol, powiększenie około 40×
- Fot. 2. Nieregularna żyłka asfaltu (czarny) współwystępującego z chlorytem (ciemnoszary) w obrębie chalcedonu (jasny), także drobne wprysnięcia asfaltu w chalcedonie oraz kropelkowe wydzielenia na granicy ziarn węglanów (wyraźne zarysy, silniejszy relief), 1 nikol, powiększenie około 40×
- Fot. 3. Pierzaste ułożenie wrostków asfaltu w sferolitech chalcedonu, 1 nikol, powiększenie około 50×
- Fot. 4. Kropelkowe wydzielenia asfaltu na strefach wzrostu dużego kryształu kwarcu, nikole częściowo ×, powiększenie około 40×

Барбара КАЗИМЕРСКА, Хуберт СИЛЬВЕСТШАК

ЭПИ-ИМПСОНИТ, ПРОДУКТ ПРЕОБРАЗОВАНИЯ БИТУМИЧНОГО ВЕЩЕСТВА ИЗ МЕЛАФИРА СОКОЛОВЦА ВОЗЛЕ СВЕЖАВЫ

Резюме

В работе описан интересный парагенезис минералов, имеющий место в старой камнеломне мелафира, расположенной к югу от села Соколовец возле Свежавы (Сильвестшак, 1979). Этот мелafir причисляется к эффузивным образованиям 2-го эруптивного яруса красного леженя. В минеральном комплексе жил выделяются: кварц, халцедон, карбонаты, хлорит, а также органический минерал похожий на асфальт. Минерализация носит жильный и вкрапленный характер. Зона катаклаза мелафира имеет в ширину около 70 см, а отдельные прожилки в ней не превышают 5 см по мощности и характеризуются непрерывностью на небольшой протяженности (до 1,5 м).

Скопления асфальта наблюдаются в центральных партиях прожилков и в обрамляющем их преобразованном мелafirе, достигая 2 см мощности. Характерные формы проявления асфальта представлены на фотографиях 1–4.

Асфальтное вещество имеет черную окраску, смолистый блеск, раковинный излом, хрупкое, непрозрачное, твердость его по шкале Мооса составляет 2,5, плотность $d = 1,305 \text{ г/см}^3$, горит в пламени свечи; рентгеновские порошкограммы показали его полную аморфность.

Для более детальной характеристики асфальтового вещества производились специальные исследования, такие как: элементарный анализ (таб. 3), хроматографическое определение количества и состава углеводородов (таб. 1), *n*-алканов (таб. 2), ик-спектрофотометрический анализ (фиг. 3).

За главные классификационные критерия были приняты рефлексив-

ность (фиг. 4), плавкость и растворимость в CS_2 (фиг. 5) по Абрахаму (1960) и Якобу (1967).

Исследования показали, что органический минерал следует причислить к пиробитуминам из группы эпи-импсонита. Таким образом, это вещество является средне преобразованным пиробитумином, исходным материалом которого могли бы быть битумические вещества более древних образований, чем мелафир, так называемого яруса горючих сланцев из Свежавы, причисленных к нижнему красному леженю.

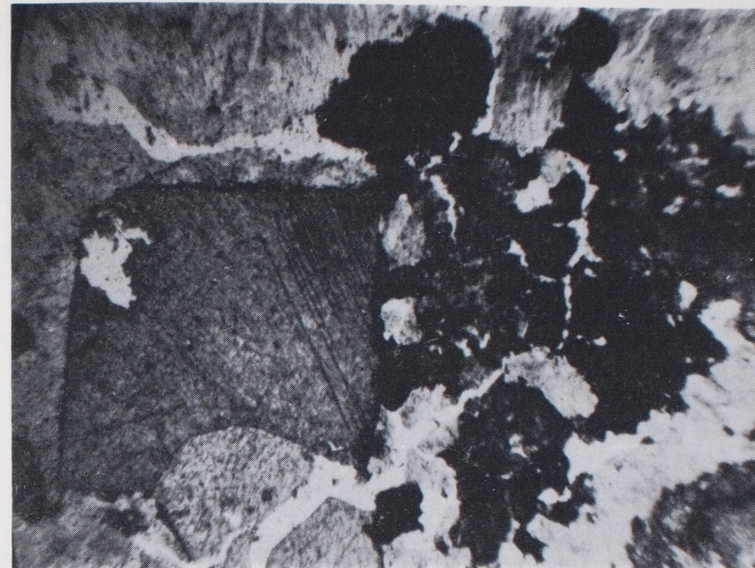
Эволюция органического вещества зависит по всей вероятности, в значительно большей степени от условий среды, чем от исходного материала и определение характера первичных веществ представляется невозможным.

ОБЪЯСНЕНИЯ К ФИГУРАМ

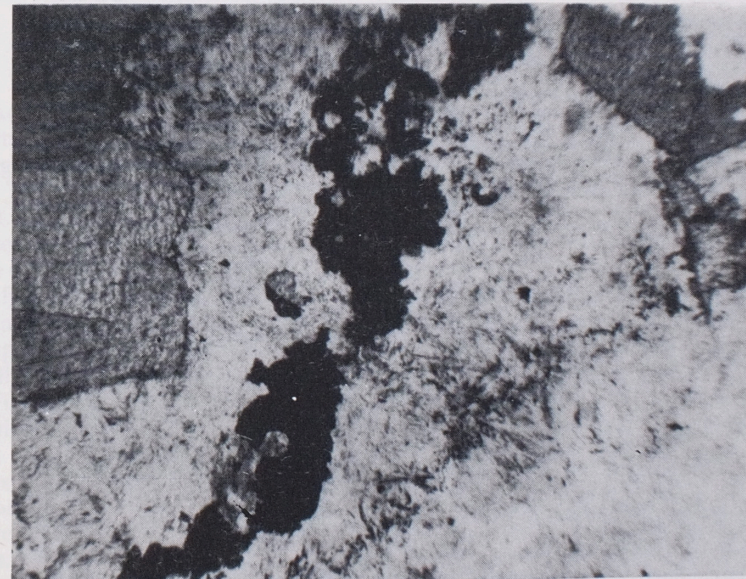
- Фиг. 1. Местоположение камнеломни мелафира с асфальтовой минерализацией
1 - нижний палеозой; 2 - осадочные породы; 3 - мелафиры перми; 4 - порфиры перми; 5 - мел и более молодые образования
- Фиг. 2. Содержание (кривая 1) и распределение (кривая 2) *n*-парафиновых углеводородов
- Фиг. 3. ИК-спектр поглощения после обработки эфиром
- Фиг. 4. Гистограммы рефлексивности органического вещества
a - неэкстрагированная проба, *b* - проба экстрагированная хлороформом
- Фиг. 5. Диаграмма диагенеза асфальтового вещества по Якобу-Абрахаму.

ОБЪЯСНЕНИЯ К ФОТОГРАФИЯМ

- Фото 1. Скопления асфальта (черные) проявляющиеся совместно с хлоритом (темносерый), 1 николь, увеличение около 40×
- Фото 2. Прожилок асфальта неправильной формы (черный), проявляющегося совместно с хлоритом (темно-серый) с обрамлением халцедона (светлый), мелкие вкрапления асфальта в халцедоне, капельные выделения на границе зерен карбонатов (четкий рисунок, более острый рельеф), 1 николь, увеличение около 10×
- Фото 3. Перистое размещение вростков асфальта в сферолитах халцедона, 1 николь, увеличение около 50×
- Фото 4. Капельные выделения асфальта в зоне разрастания крупного кристалла кварца, николи частично X, увеличение около 40×

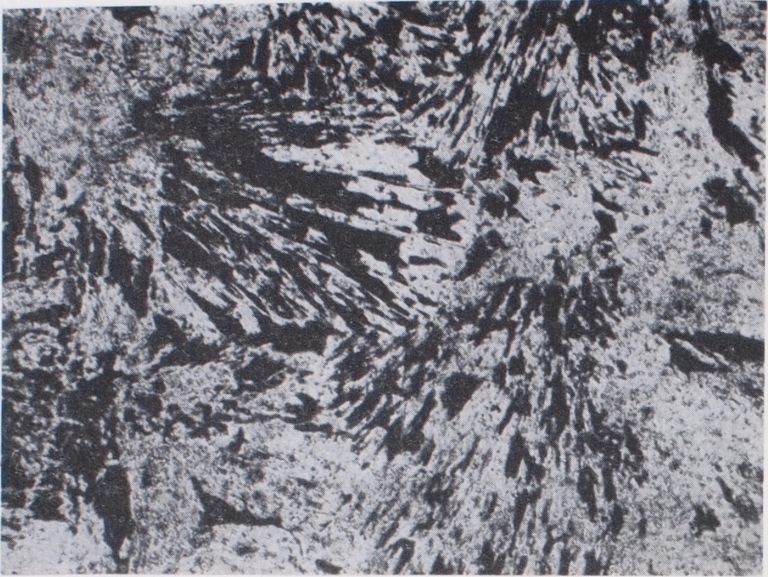


Phot. 1. Asphalt concentrations (black) coexisting with chlorite (dark grey). 1 nicol, about 40×

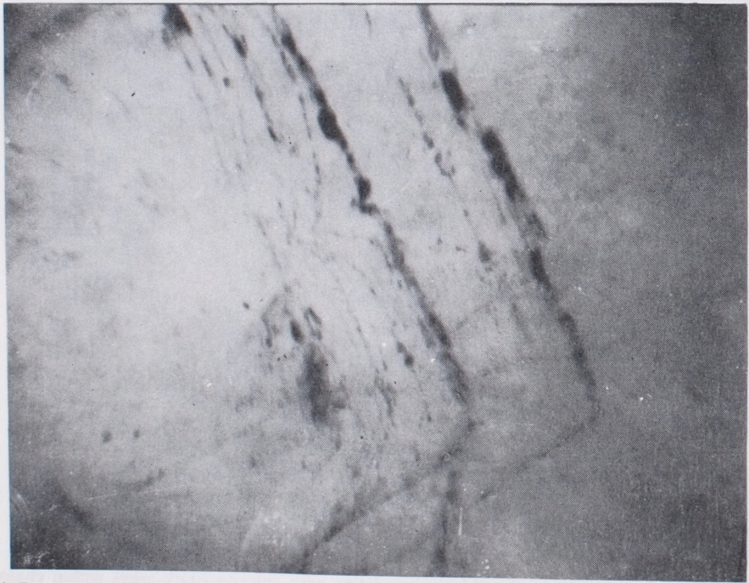


Phot. 2. An irregular asphalt veinlet (black) coexisting with chlorite (dark-grey) within chalcedony (light), fine asphalt inclusion in chalcedony and drop-like concentrations at the boundary of carbonate grains (sharp outlines, stronger relief). 1 nicol, about 40×

Barbara KAZIMIERSKA, Hubert SYLWESTRZAK - Substance from melaphyre from Sokolowiec near Swierzawa



Phot. 3. Feathery arrangement of asphalt inclusions in chalcidony spherulites. 1 nicol, about 50x



Phot. 4. Drop-like asphalt concentrations on the growth zones of a large quartz crystal. Partly crossed nicols, about 40x

Barbara KAZIMIERSKA, Hubert SYLWESTRZAK - Substance from melaphyre from Sokolowiec near Świerzawa