

# **BEGINNINGS OF SEISMIC STUDIES IN THE N CARPATHIANS AND THE CARPATHIAN FORELAND BASIN**

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**48 INHIGEO SYMPOSIUM, KRAKÓW, POLAND, 31.07-04.08.2023**

# TALK OUTLINE

1. SHORT INTRO TO SEISMIC REFLECTION SURVEYING

2. NORTHERN CARPATHIANS

- *geological background*
- *history of petroleum industry*

3. SEISMIC EXPLORATION IN THE NORTHERN

CARPATHIANS - GREAT START AND GREAT

ACHIEVEMENTS

4. SUMMARY



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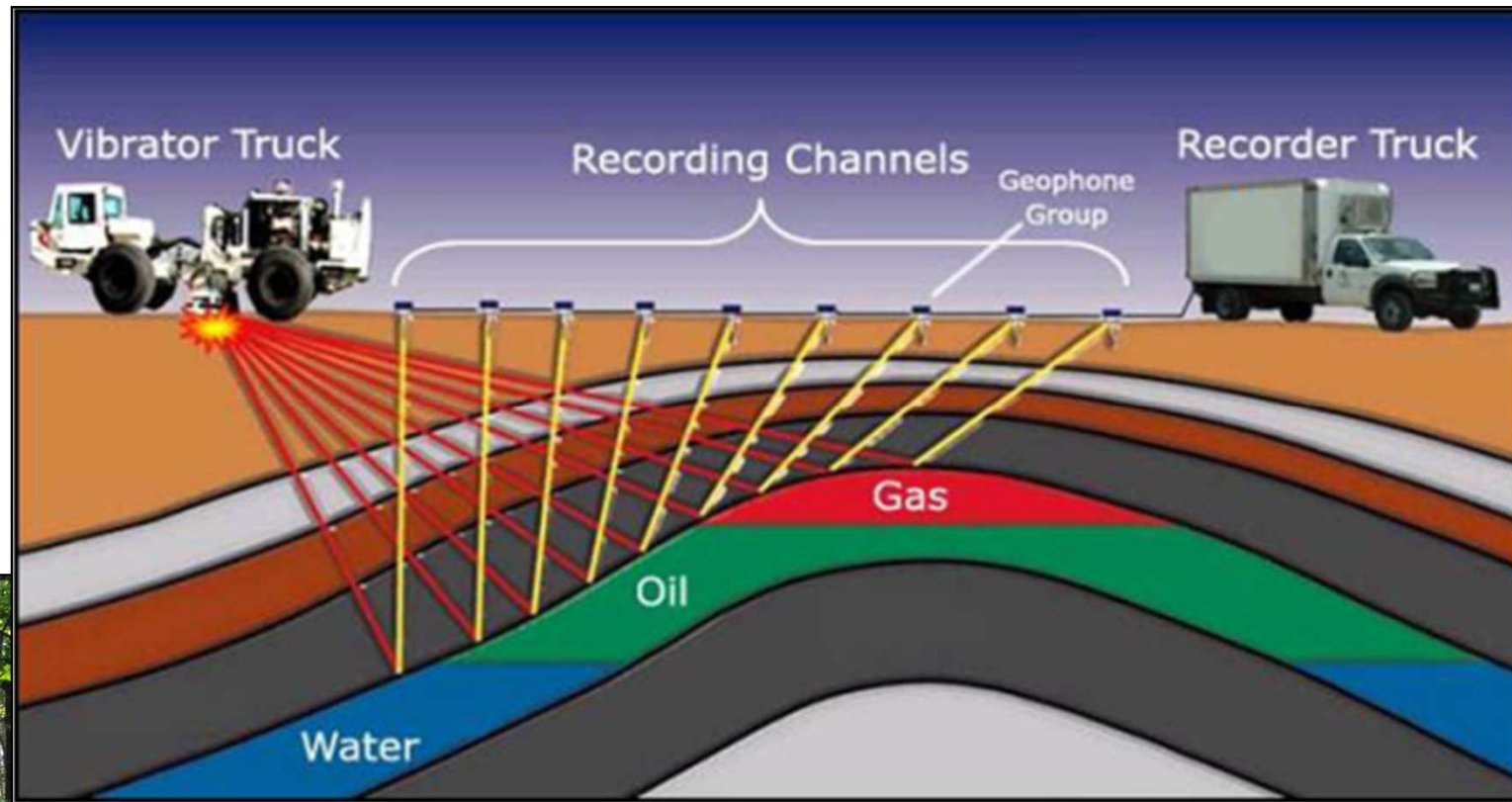
# SEISMIC REFLECTION SURVEYING



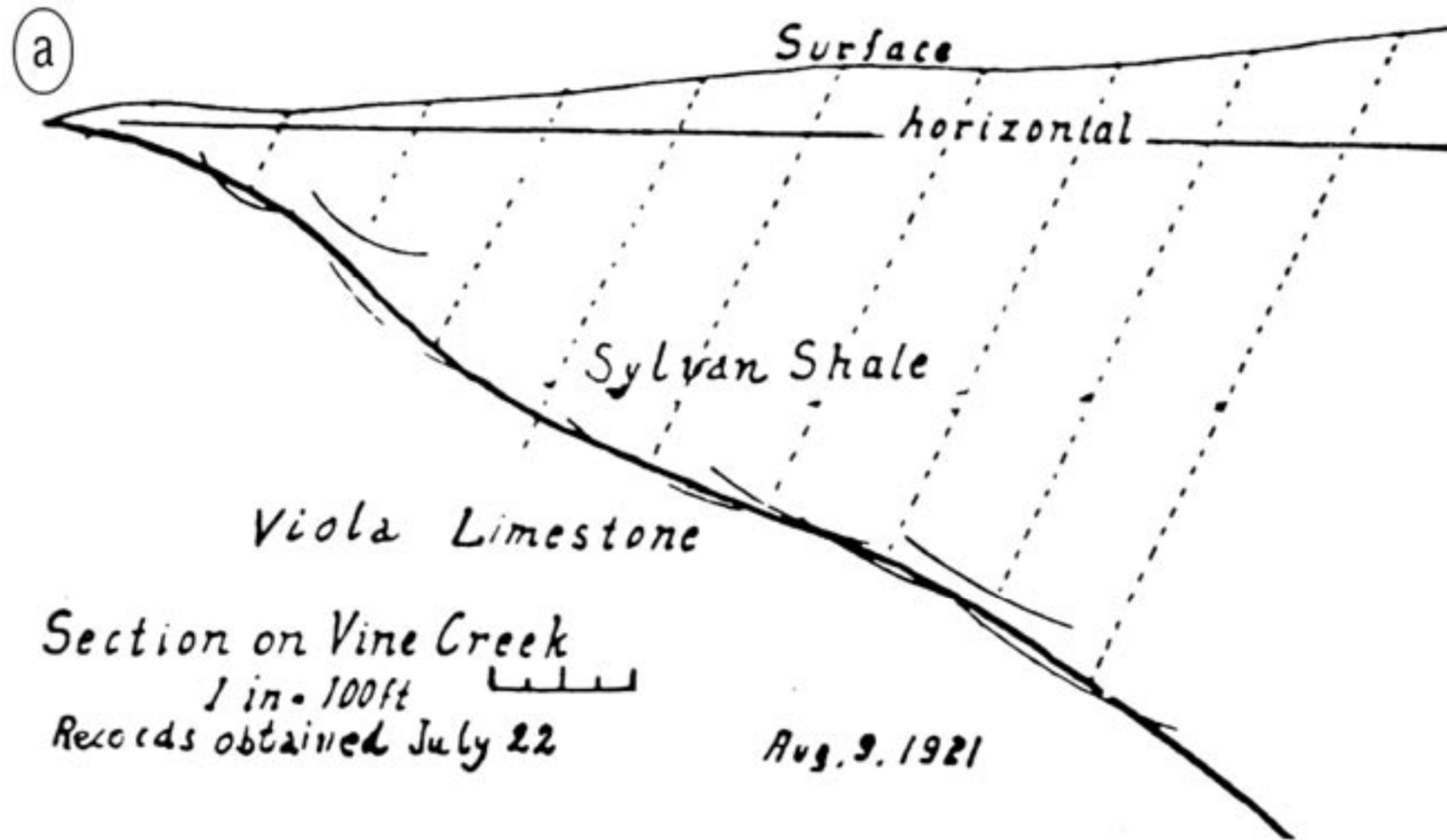
Seismic reflection surveying is directly comparable to ultrasonography

# SEISMIC REFLECTION SURVEYING

Land (onshore)  
seismic reflection  
surveying



# SEISMIC REFLECTION SURVEYING



The very first seismic reflection profile acquired in 1921 by Karcher identified a dipping reflecting boundary between two rock layers, the Sylvan shale and the Viola limestone, Oklahoma, USA.

# SEISMIC REFLECTION SURVEYING



2-14 APRIL 2023

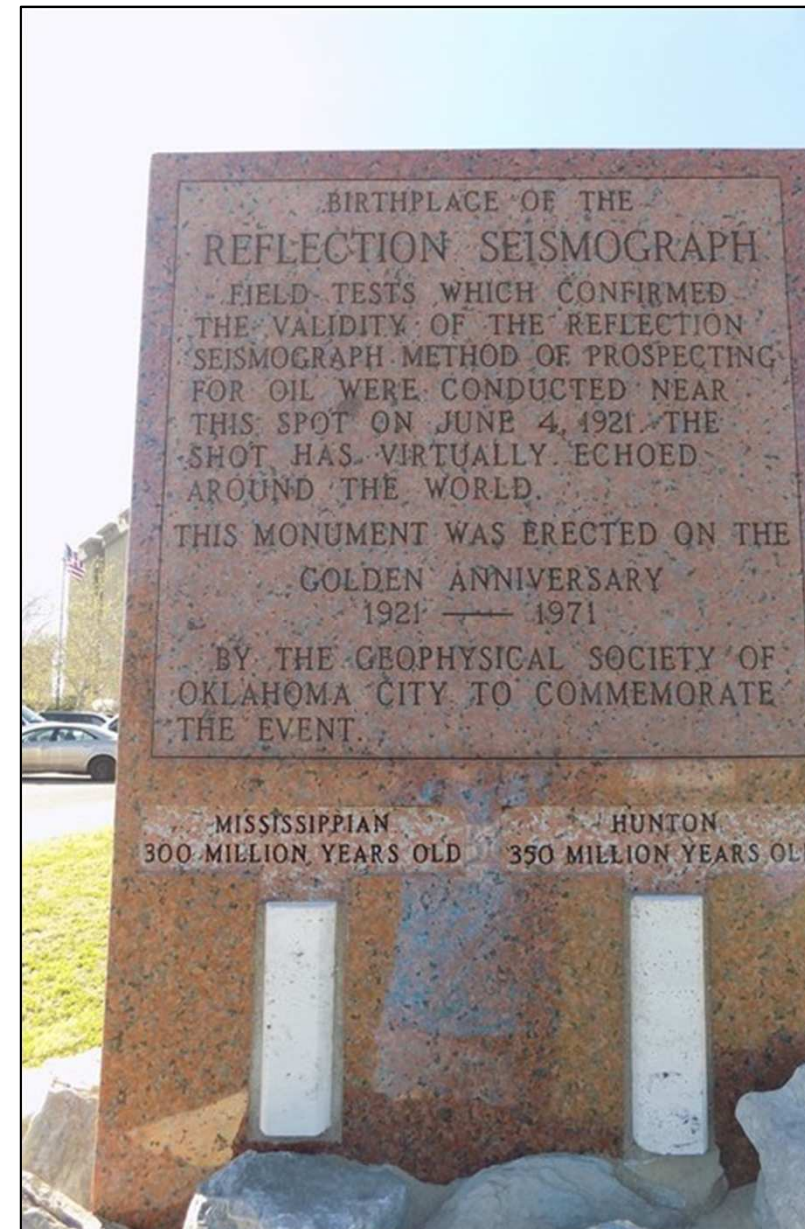
## SEISMIC REFLECTION CENTENNIAL:

*MAPPING THE EARTH BENEATH OUR FEET*

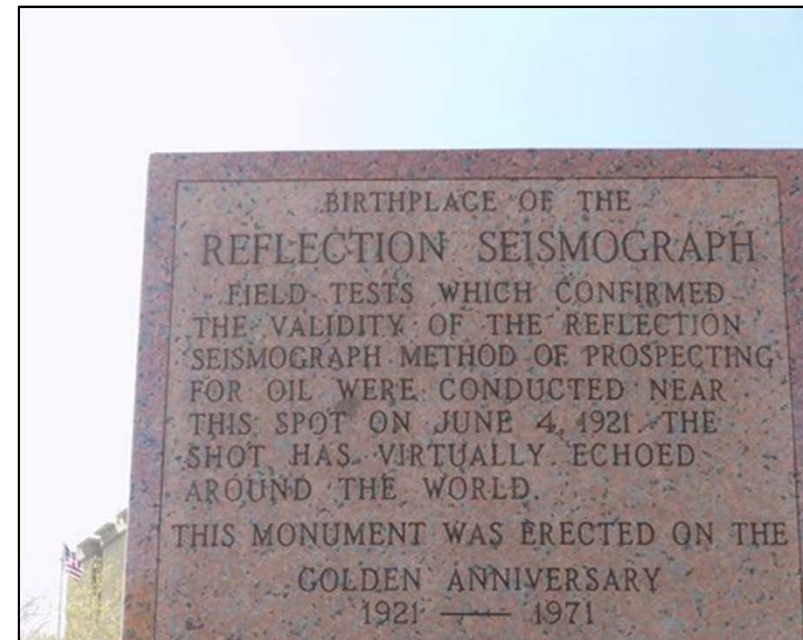
HAMM INSTITUTE FOR AMERICAN ENERGY, OKLAHOMA CITY, OK, USA

SEG     [go.seg.org/src](http://go.seg.org/src)

The poster features a stylized illustration of a landscape with hills and trees. In the foreground, a seismic recording truck is shown with a large vibrator unit. The truck is labeled 'RECORDING TRUCK' and 'VIBRATOR'. The background shows a cross-section of the earth with seismic waves reflecting off a subsurface layer. The text is overlaid on the illustration.

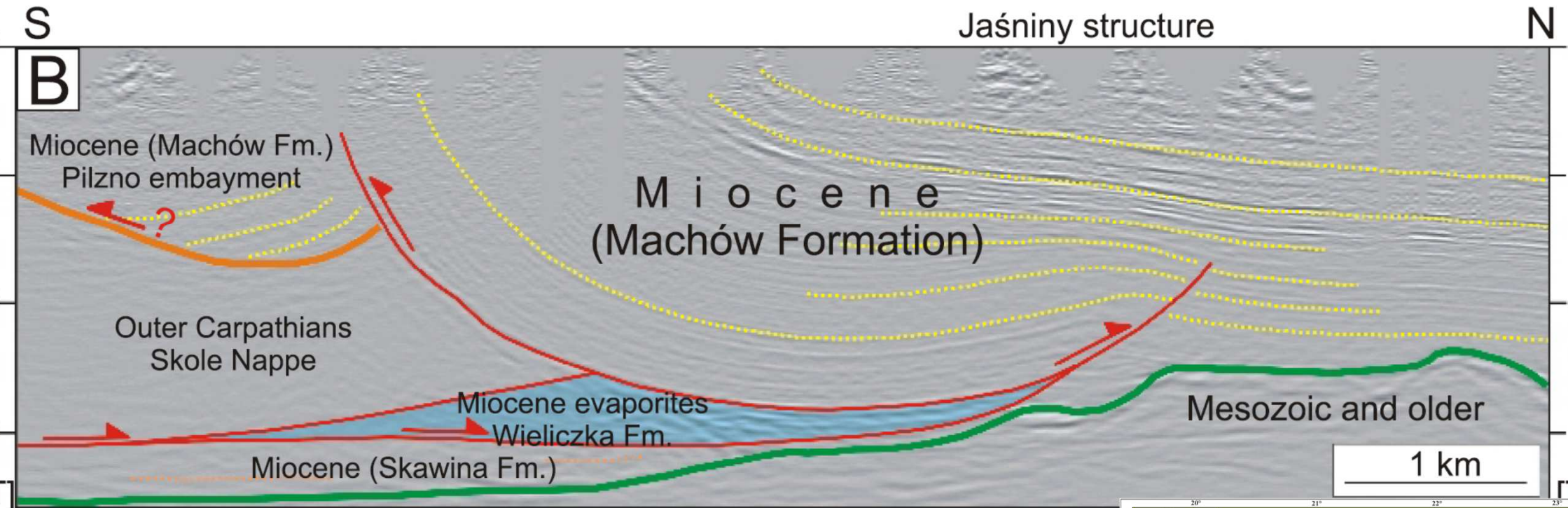


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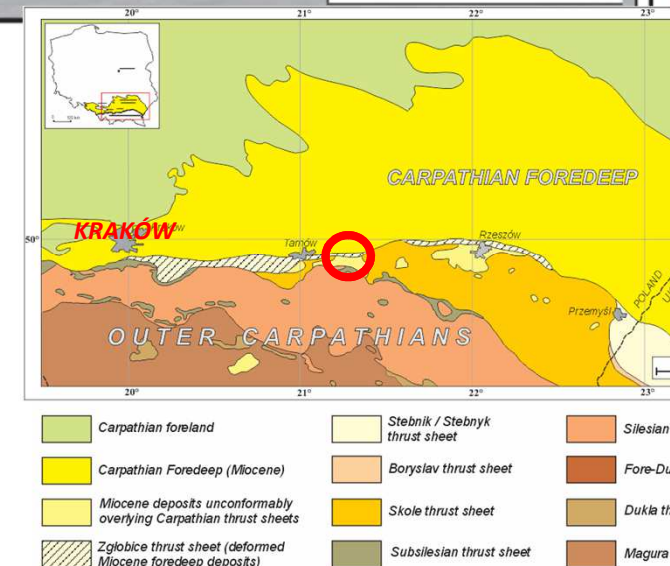


Seismic methods have revolutionized our understanding of the Earth, and fundamentally transformed resource exploration and hazard assessment over the past 100 years. Building on his experiences in geophysics during World War I, John Clarence Karcher and a team of OU faculty in 1921 first pioneered the technology of using sound energy to record reflections from the subsurface with a series of experiments on the Isle and Vines Brach, Oklahoma. These pioneering efforts quickly were applied to exploration for oil in Oklahoma and surrounding regions, and subsequently were employed in basic research that has "greatly advanced our understanding of the oceans, continents, and the theory of plate tectonics" (Prof. J. H. Karcher, The Pickens School of Geology, OSU)

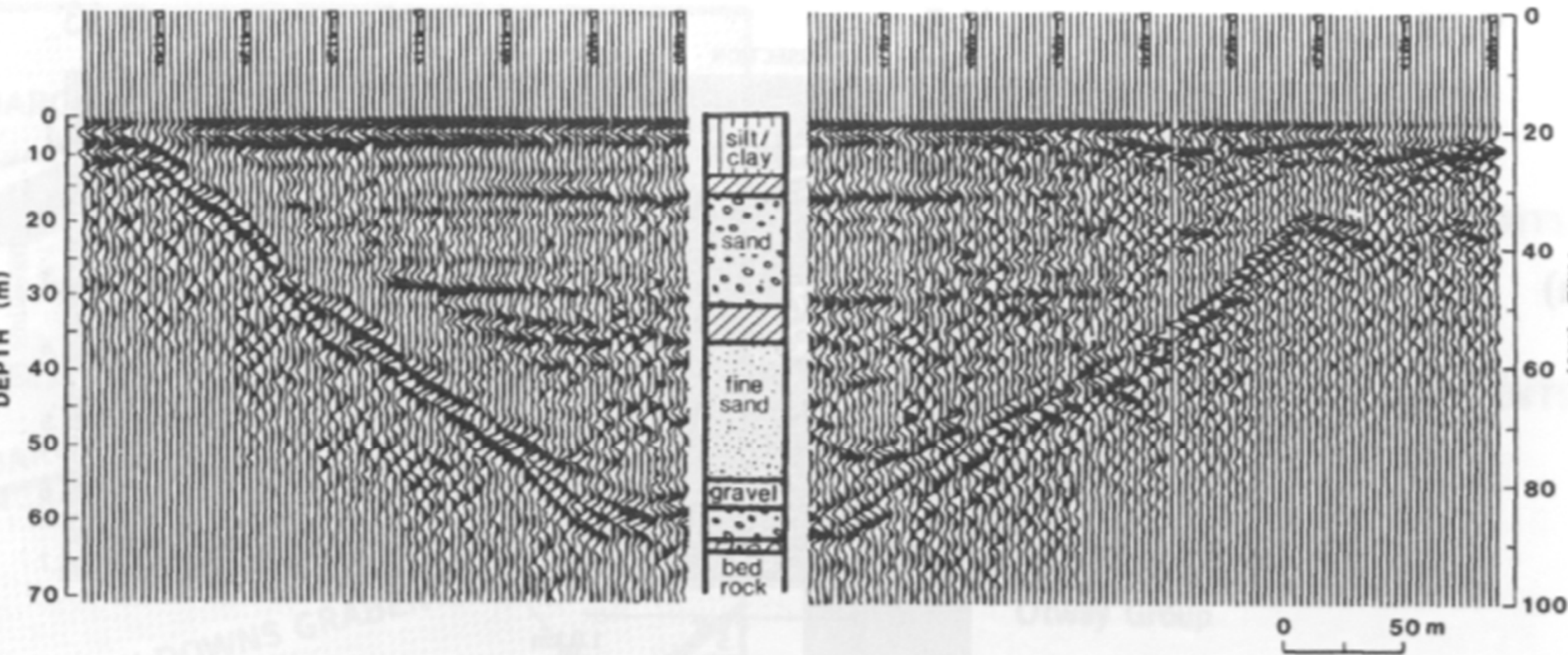
# SEISMIC REFLECTION SURVEYING



Carpathian front imaged on seismic reflection data in vicinity of Pilzno (Krzywiec et al., 2014)

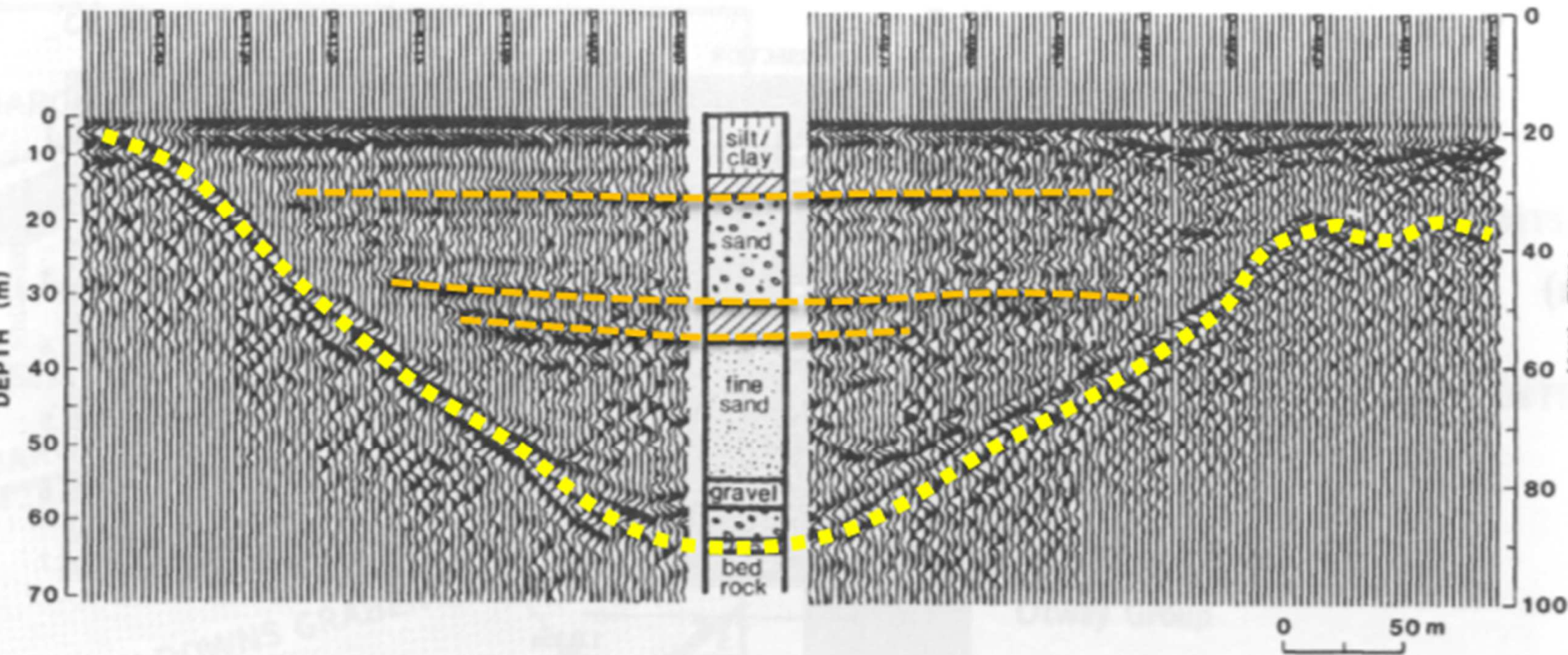


# SEISMIC REFLECTION SURVEYING



Incised valley filled by clastic deposits imaged on shallow high-resolution seismic profile, Canada (Sharma, 1997).

# SEISMIC REFLECTION SURVEYING



Incised valley filled by clastic deposits imaged on shallow high-resolution seismic profile, Canada (Sharma, 1997).

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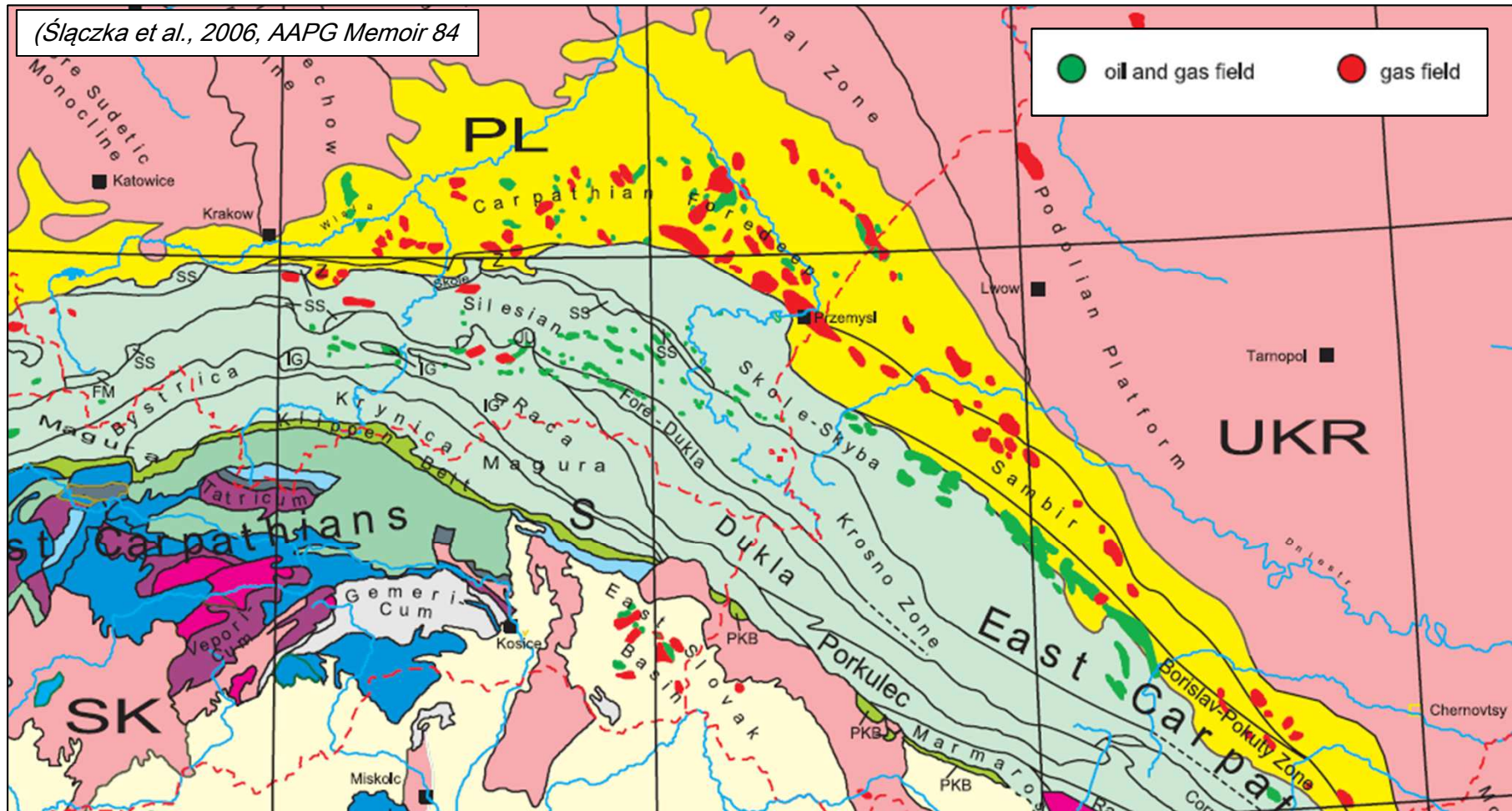
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# N CARPATHIANS – GEOLOGICAL BACKGROUND



The Alpine-Carpathian orogenic system and its foreland  
(from Oszczypko et al., 2006, AAPG Memoir 84)

# N CARPATHIANS – GEOLOGICAL BACKGROUND



Oil and gas fields are located within the Outer Carpathian FTB and its foreland basin

Triassic – Paleogene Outer Carpathian thrust sheets (nappes) are predominantly built of the deep water turbidites.

Coarse-grained clastics, rich in organic matter form source rocks, coarse grained sandstones form good-quality reservoirs

Traps are mostly structural, related to various folds formed during emplacement of the Carpathian FTB

The Eocene foreland basin is rich in accumulations of biogenic gas hosted by gently anticlines developed above basement

# N CARPATHIANS – GEOLOGICAL BACKGROUND



(Kuźniar et al., ...)

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# CARPATHIANS – HISTORY OF PETROLEUM INDUSTRY

First accounts of liquid hydrocarbons (surface oil seeps) in the Carpathians and their practical use have been published in 16th century in medical books on herbs, which often contained also information about other natural substances such as minerals, etc.

Comprehensive descriptions of surface oil seeps and related phenomena has been given by **Gabriel Rzączyński** (1664 - 1737), Polish Jesuit, that published two books on „natural history” of the Polish territories and their surroundings: „*Historia Naturalis Curiosa Regni Poloniae*” (1721) and „*Auctuarium Historiae Naturalis Regni Poloniae*” (1742)

**Stanisław Staszic** (1755 – 1826), Polish priest, philosopher, statesman, geologist, scholar, poet and writer, a leader of the Polish Enlightenment, marked different types of hydrocarbons on his seminal geological map „*Carta Geologica totius Poloniae, Moldaviae, Transylvaniae, Hungariae et Valachiae*” (1815) and provided descriptions of natural oil seeps in the Carpathians, including early methods of oil exploitation using shovels and hand-dug trenches, in his book „*O Ziemiórództwie Karpat*” (1815)

# CARPATHIANS – HISTORY OF PETROLEUM INDUSTRY

**Jan Zygmunt Łukasiewicz** (1822–1882) was a Polish pharmacist and pioneer of petroleum industry. In 1852 Łukasiewicz graduated from the faculty of pharmacy of the University of Vienna. Łukasiewicz had long been interested in the potential of seep oil as a cheap alternative to the more expensive whale oil. In 1853 Łukasiewicz, together with Jan Zeh, distilled clear kerosene from seep oil. On July 31, 1853, Łukasiewicz made one of his kerosene lamps available to a local hospital to illuminate an emergency surgical operation.



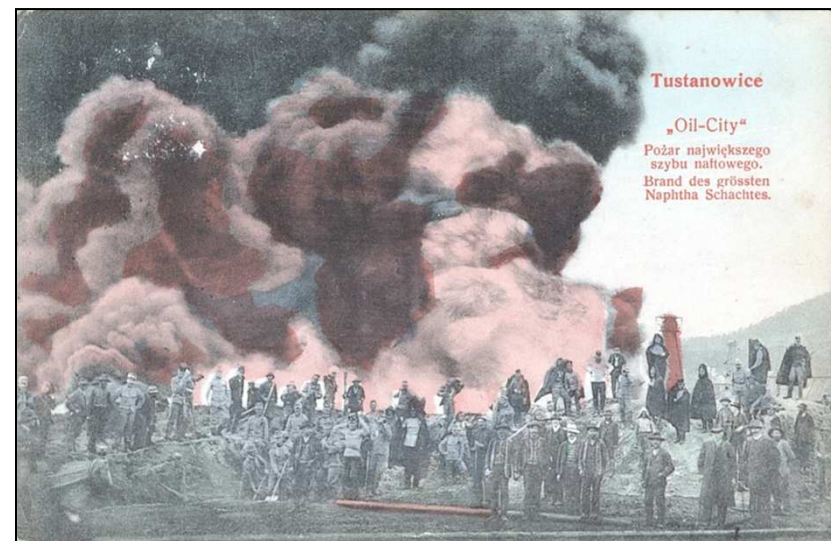
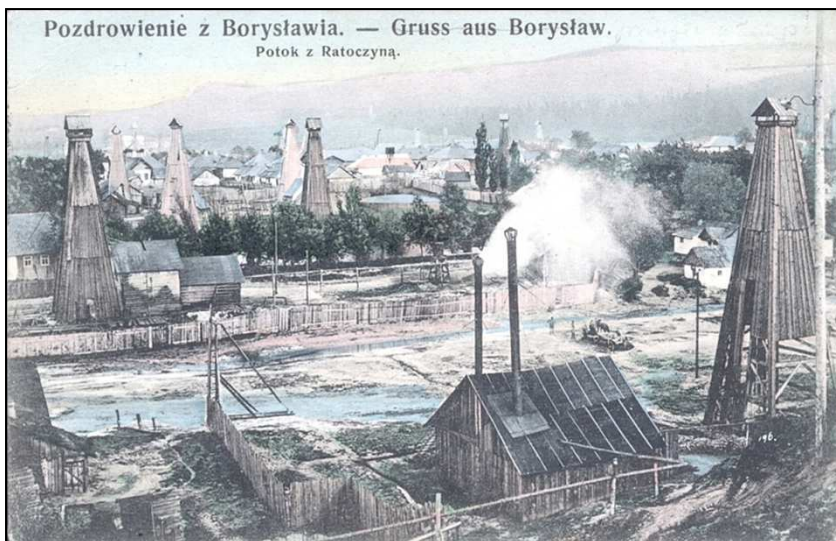
In early 1854 Łukasiewicz moved to Gorlice, where he set up many companies together with local entrepreneurs and landowners. That same year, he opened the "mine" at **Bóbrka** near Krosno. In 1856 in Ulaszowice near Jasło he opened one of the first industrial oil refineries in the world. This marked start of oil exploration in the so-called **western oil district in the Northern Carpathians**

# CARPATHIANS – HISTORY OF PETROLEUM INDUSTRY

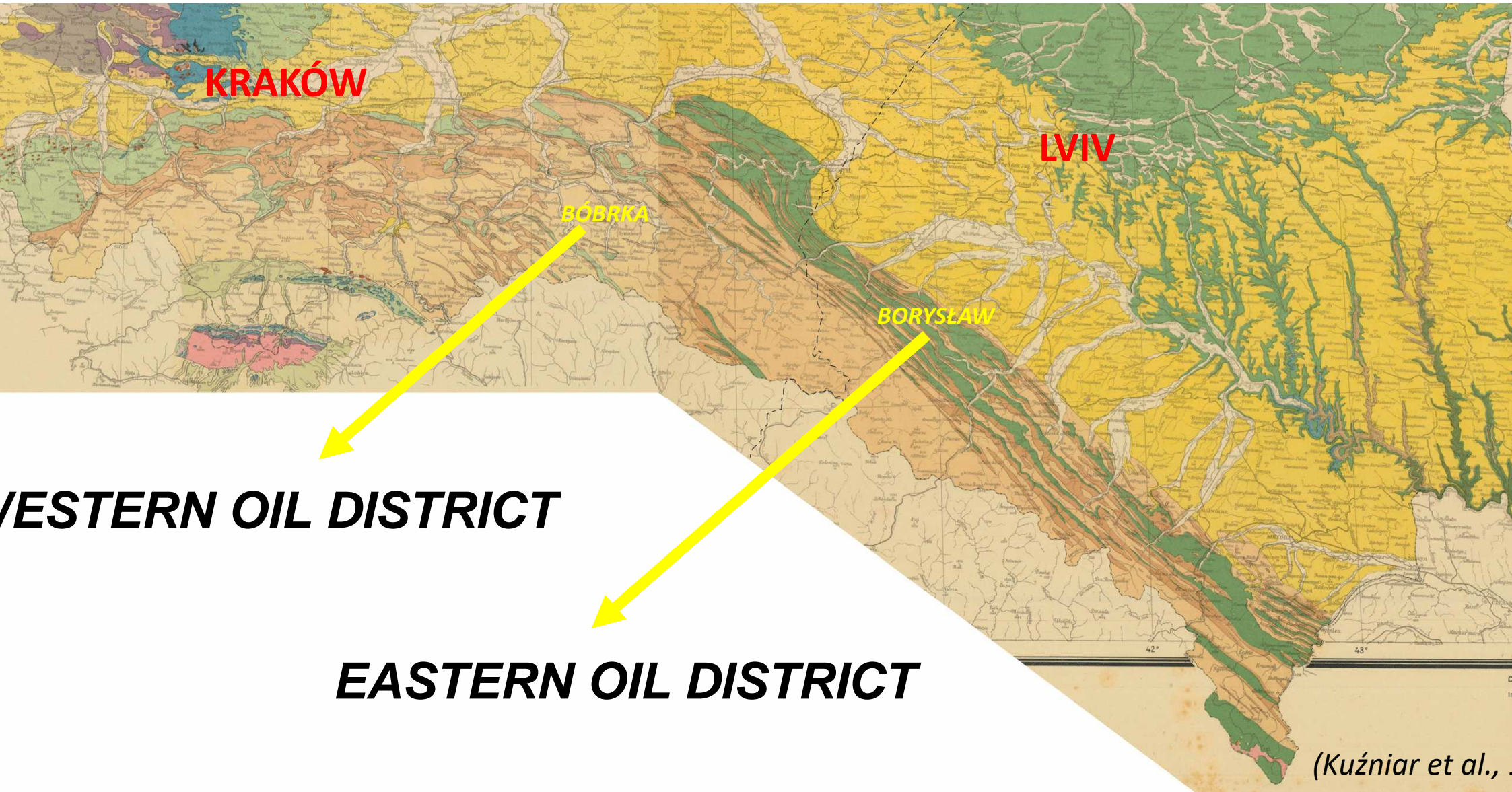
Second phase of development of modern oil industry in the Northern Carpathians associated with the completion in 1896 in **Borysław** area a very successful well „*Potoku*” that yielded daily production in range of 40 tonnes of crude oil.

This discovery well was outshined by further wells drilled in this part of Carpathians such as „Wilno” well drilled in 1902 that produced up to 400 tonnes of crude oil per day, „Litwa” well that produced up to 800 tonnes per day, or famous „Oil City” well drilled in 1908 with production that peaked around 2500 tonnes per day. All those discoveries shifted gross production into the **eastern oil district**

## **in the Northern Carpathians**



# N CARPATHIANS – GEOLOGICAL BACKGROUND



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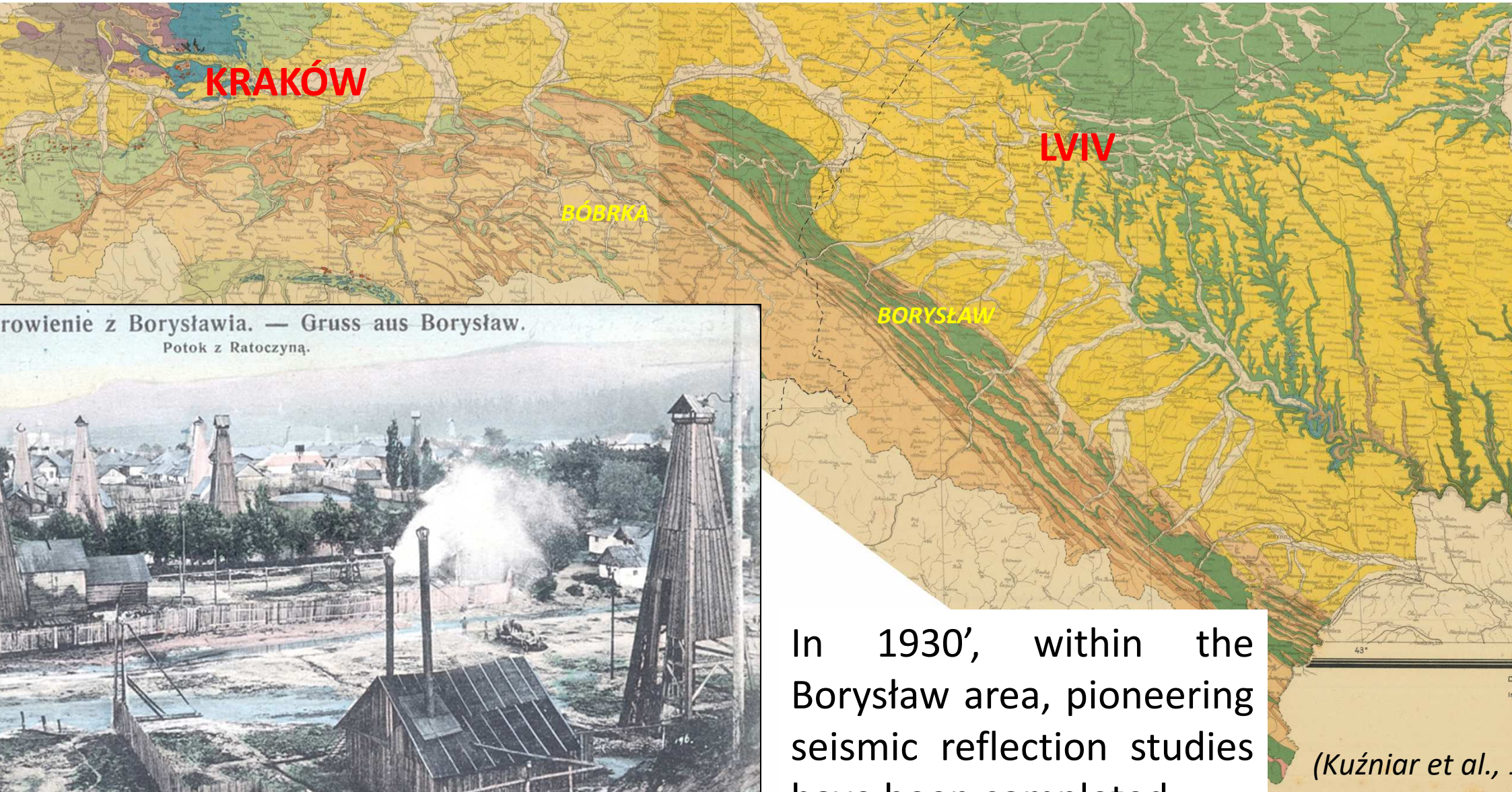
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# N CARPATHIANS – GEOLOGICAL BACKGROUND



In 1930', within the Borysław area, pioneering seismic reflection studies have been completed

(Kuźniar et al., )

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS

3: first seismic refraction survey was completed by „Seismos” company from Hannover in vicinity of Kraków, its goal, fully achieved, was to map Miocen salt deposits.

3: state-controlled “Pionier” company based in Lwów was established, with the main goal of exploration for hydrocarbons in new areas and development of new, promising exploration techniques including geophysical surveying. Department of Geophysics was soon established, and **Zygmunt Mitera**, **Stanisław Wyrobek** and **Afrykan Kisłowski** were sent abroad in order to obtain necessary training and first-hand experience in modern geophysical exploration techniques.

3: “Pionier” purchased 6-channel seismic reflection acquisition system from Seismograph Service Company (USA).

4: first seismic reflection survey acquired in Borysław area

6: “Pionier” purchased another seismic reflection acquisition system from **Heiland Research Corporation**

6: production of geophones started in Poland in order to offset import of expensive geophysical equipment from abroad

7: extensive seismic data acquisition within the Carpathians and their foreland basin.

8: Zygmunt Mitera and Stanisław Wyrobek left „Pionier” company and established their own geophysical company „Geotechnika” based in Przemyśl. They purchased 12-channel seismic reflection acquisition system and started several ambitious exploration projects, not only in the Carpathian region but also in central Poland.

9: all these very promising geophysical studies were abruptly terminated by World War II

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS

## ON REFLECTIONS FROM STEEPLY DIPPING BEDS

C. A. HEILAND

Professor of Geophysics, Colorado School of Mines

### ABSTRACT

A brief report is given of some experimental work on known geologic conditions conducted by the Pionier Company in southeastern Poland. This is a region of steep dips, severe folding, overthrusts, and step-faulting. The geologic conditions are first described, and this is followed by a discussion of the mathematical and physical aspects of the problem. It is pointed out that the problem is essentially one of dimensions. Its solution ordinarily demands that the azimuth of shooting, in relation to strike, and the travel time relations at right angles to the strike, be known. But for the steep dips encountered in mountainous country, this is not always possible. The *Time Gradient* is a convenient criterion of the dip component in the direction of shooting. The problem is reduced to one of finding the time gradient in the direction of maximum dip. Curves of the time gradients are given for horizontal and for dipping beds. The method is applied to selected records and found to work well. The conclusion is reached that, where shots in different azimuths are impossible, there is an optimum azimuth, just as there is an optimum spread; but it may take much experimentation to determine where this azimuth is.

### INTRODUCTION. ACKNOWLEDGMENTS

By far the greatest amount of reflection work in oil exploration has been done on gentle-dip structures. Observations have been made, however, in mountainous country, on steeply dipping flanks of Gulf Coast salt domes, on Paleozoic uplifts in the Midcontinent, and of structures in California and elsewhere, but they have not been described in the literature.

A brief report on studies made along this line may, therefore, be of interest. As the title of this paper indicates, an exhaustive treatment of the problem is not intended. Rather, a few examples, typical problems of this kind, will be described. The data here utilized were obtained in the course of some experimental work on known geologic conditions, were conducted by the Pionier Company in southeastern Poland, and were made available through the courtesy of Dr. Z. Z. Z.

In the following, the geologic conditions, under which the observations were made, will be described first. This will be followed by a discussion of the mathematical and physical aspects of the problem. Then, a number of selected records, obtained with SSC and HRC-type equipments, will be exhibited and discussed relative to their geophysical significance.

*Geophysics*, 1936, 1(2): 257-270

A brief report is given of some experimental work on known geologic conditions conducted by the Pionier Company in southeastern Poland. This is a region of steep dips, severe folding, overthrusts, and step-faulting. The geologic conditions are first described, and this is followed by a discussion of the mathematical and physical aspects of the problem. It is pointed out that the problem is essentially one of dimensions. Its solution ordinarily demands that the azimuth of shooting, in relation to strike, and the travel time relations at right angles to the strike, be known. But for the steep dips encountered in mountainous country, this is not always possible. The *Time Gradient* is a convenient criterion of the dip component in the direction of shooting. The problem is reduced to one of finding the time gradient in the direction of maximum dip. Curves of the time gradients are given for horizontal and for dipping beds. The method is applied to selected records and found to work well. The conclusion is reached that, where shots in different azimuths are impossible, there is an optimum azimuth, just as there is an optimum spread; but it may take much experimentation to determine where this azimuth is.

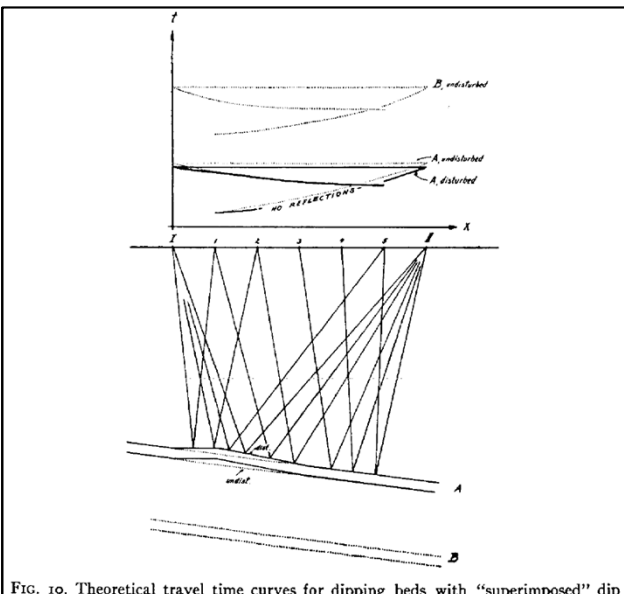
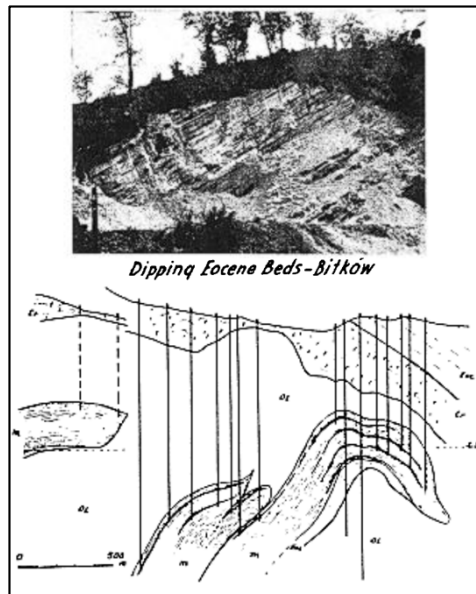


FIG. 10. Theoretical travel time curves for dipping beds with "superimposed" dip



Dipping Eocene Beds - Birkow

Important paper developed problems of acquisition and interpretation of seismic reflection data acquired above complex folded and thrust structures with steeply dipping beds

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS

Carl August Heiland (1899- 1956), a pioneering geophysicist, was born in Heidelberg, Germany. He was educated at the universities of Heidelberg and Göttingen, and received his PhD degree in 1923.

Following two years in the geodetic and geophysical instrument department of Carl Zeiss Jena Werke in Berlin, he came to Houston as Askania's American representative in 1925.

In 1926 he joined the faculty of the Colorado School of Mines, and in 1927 began the first formal course in geophysical prospecting to be given in the U. S. He remained as head of the Department of Geophysics until 1948, i.e. until his retirement.

In 1934, after several years of an association with Plains Exploration Company, Dr Heiland founded Heiland Research Corporation.

Heiland published numerous technical papers as well as landmark textbook *Geophysical Prospecting* (1940). His society affiliations included Society of Exploration Geophysicists, Geological Society of America, American Association of Petroleum Geologists, American Institute of Mining, Metallurgical and Petroleum Engineers, Society of Economic Geologists, American Geophysical Union and the Seismological Society of America.



# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS

era.

temy zastosowania sejsmicznych metod refleksyj-  
w Polskich Karpatach Wschodnich w świetle  
dotychczasowych wyników<sup>1)</sup>.

*tems of Application of Seismic Reflection Methods in the  
Eastern Carpathian Mountains in the Light of Present  
Investigations).*

stosowanie poszukiwawczych metod geofizycznych  
patach napotyka na duże trudności zarówno natury tech-  
j, jak i metodycznej, z powodu skomplikowanej budowy  
icznej i tektonicznej tych obszarów. Trudności tech-  
wynikają przede wszystkim z górzystości i nierówności  
erenowych obszarów, na których należy wykonać po-  
Na trudności metodyczne składają się głównie wa-  
budowy geologicznej formacyj karpackich w jakich na-  
rzeprowadzić badania. Jako korzystne warunki geolo-  
można z punktu widzenia zastosowania metod geofi-  
ych uważać struktury niezbyt skomplikowane, mało  
zgowe, o upadach nie przekraczających zwykle 40°.  
ury takie powinny odznaczać się istnieniem wyraźnych  
izykalnych związanych z występującymi tam seriami  
by z pożytkiem można wybrać odpowiednią do posta-  
go problemu metodę geofizyczną.

óśród znanych metod geofizyki stosowanej, stosunkowo  
ęcej możliwości praktycznych przedstawiają dla wa-  
w karpackich metody sejsmiczne i to zarówno refrak-  
jak i też refleksyjne. Wynika to z istoty tych metod,  
opierając się na własnościach zmiennej sprężystości  
ozwalają na określenie nie tylko rodzaju, głębokości,  
i sposobu zalegania badanych seryj warstw. Tak szcze-

Opublikowano za zezwoleniem Dyrekcji S. A. „Pionier“ we Lwowie.  
ocznik Pol. Tow. Geol. XII.

1

*Annales Societatis  
Geologorum Poloniae,  
1936, 12: 1-21*

*Geophysics, 1938, 3(3): 225-233*

PRESENT STATUS AND FUTURE ASPECTS  
OF GEOPHYSICAL EXPLORATION  
IN POLAND\*

Z. A. MITERA†

Geophysical methods of prospecting were introduced in  
in 1923, or at about the same time as in the Gulf Coast. In the  
stage local seismic refraction and electrical surveys were em-  
for private mining and oil companies. The Mintrop's ref-  
method has shown success in locating extension of salt deposi-  
Wieliczka and in Wapno. The Sundberg electromagnetic meth-  
not entirely successful in mapping some lead and copper ore de-  
The same refers to the use of electromagnetic methods for map-  
oil structures. Steep anticlines and complicated structures in  
oil mostly occurs within the area of the Carpathian Range we  
favorable to be worked out with these methods which we  
entirely developed and proved at that time.

Actual results obtained in the early days of the applica-  
geophysical methods of prospecting in Poland are not known.  
results in many cases are guarded by private companies as secret  
were never published.

In 1926 the Polish Geological Survey took an interest in the  
plication of geophysical methods to solve many problems con-  
with regional structural and mining geology in Poland. In the  
year the Geophysical Department of the Geological Survey was  
formed and it introduced the original torsion balances of R. I.  
to solve some structural problems in Carpathian Foreland.

Considerable activity in geophysical prospecting was carried  
in the years 1928 to 1930 when the "Pionier Exploration Co."  
created by the government and all leading oil companies in P.  
Geological and geophysical prospecting for new oil and gas re-  
were the principal aims of that company. At the same time the  
stitute of Geophysics and Meteorology at the University of Lw.  
cooperation with the Pionier Co., undertook extensive mag-  
measurements in the Carpathian Foreland in the southeaster-

\* Paper read at the Annual Meeting, New Orleans, Mar. 19, 1938.

† Consulting Geophysicist, Instructor of Geophysics at the Mining Academy,  
Krakow, Poland.

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS



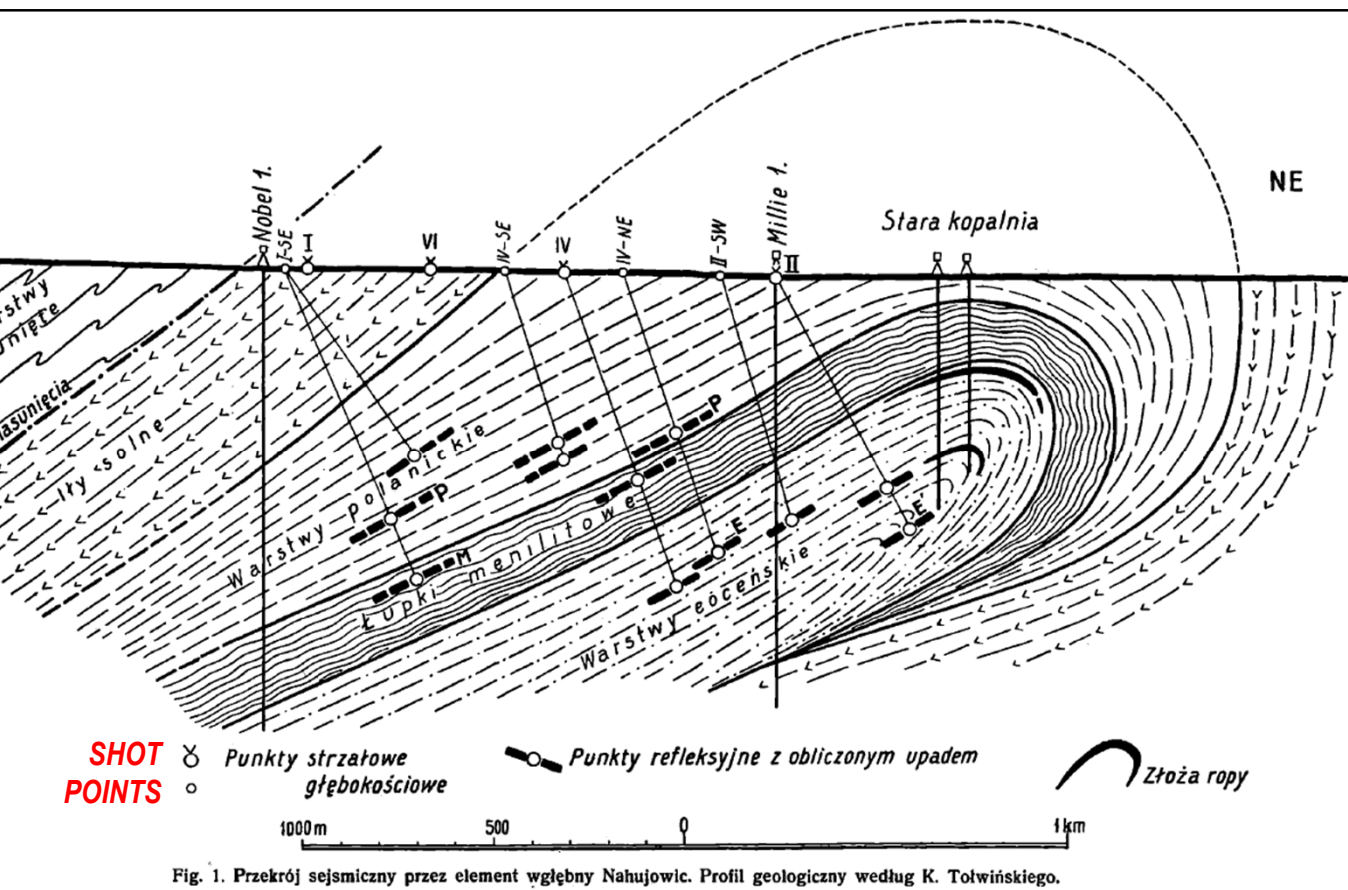
# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS



THOSE WERE THE  
TIMES ...

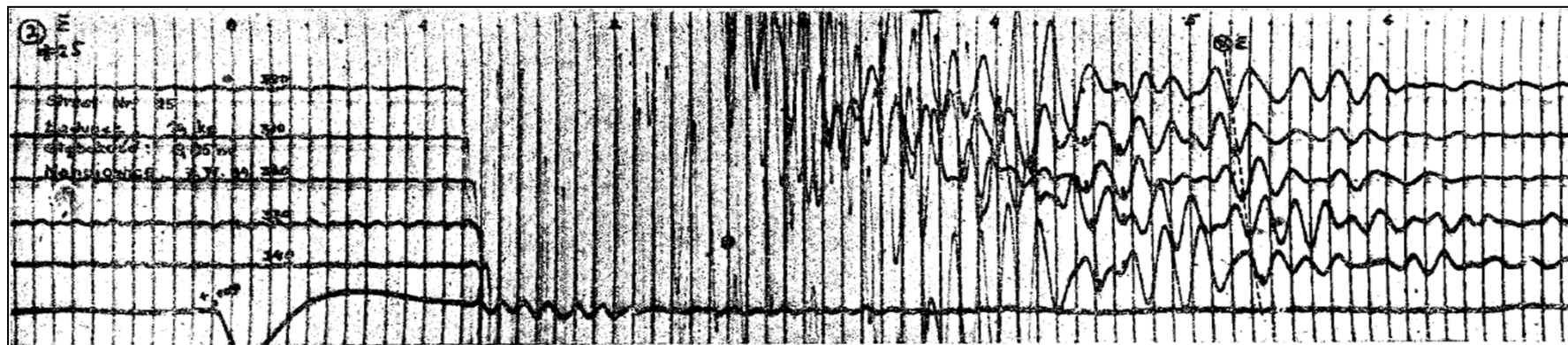


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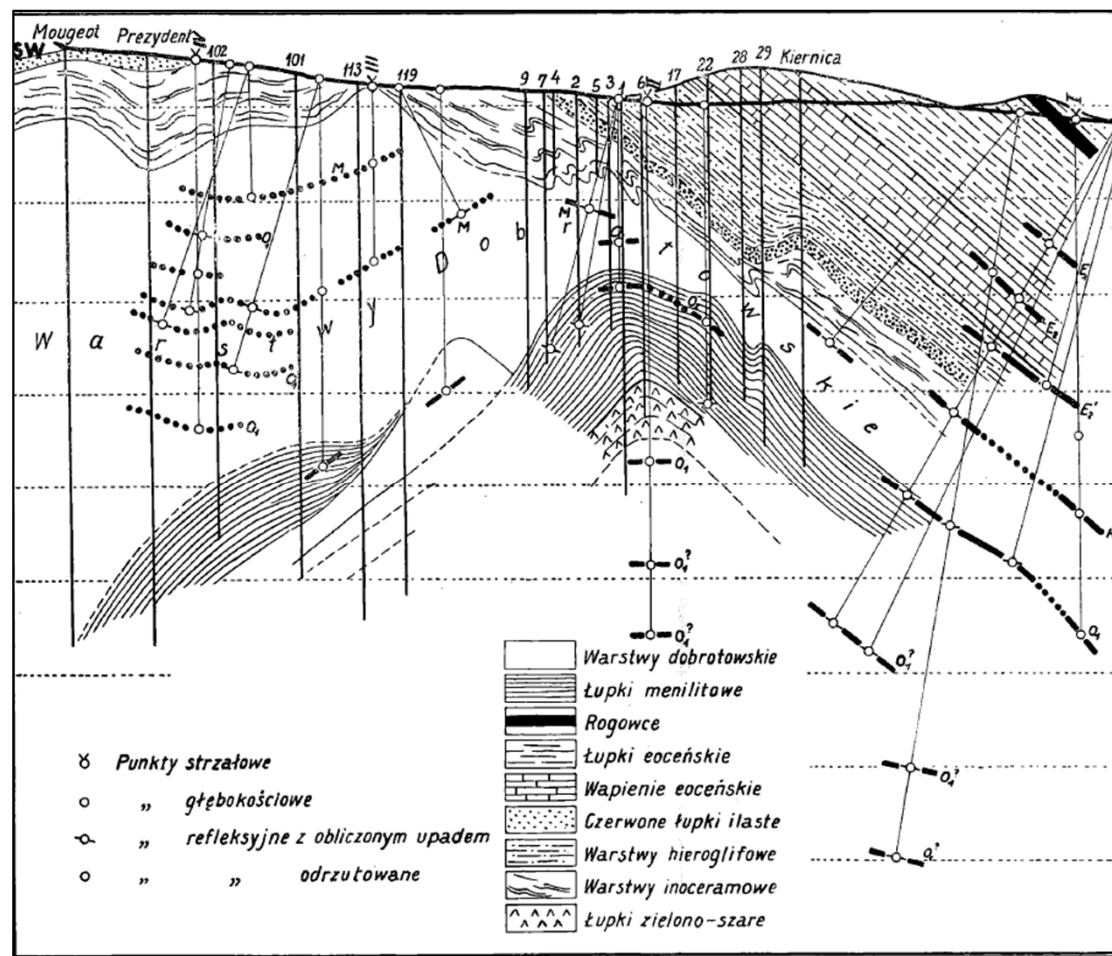
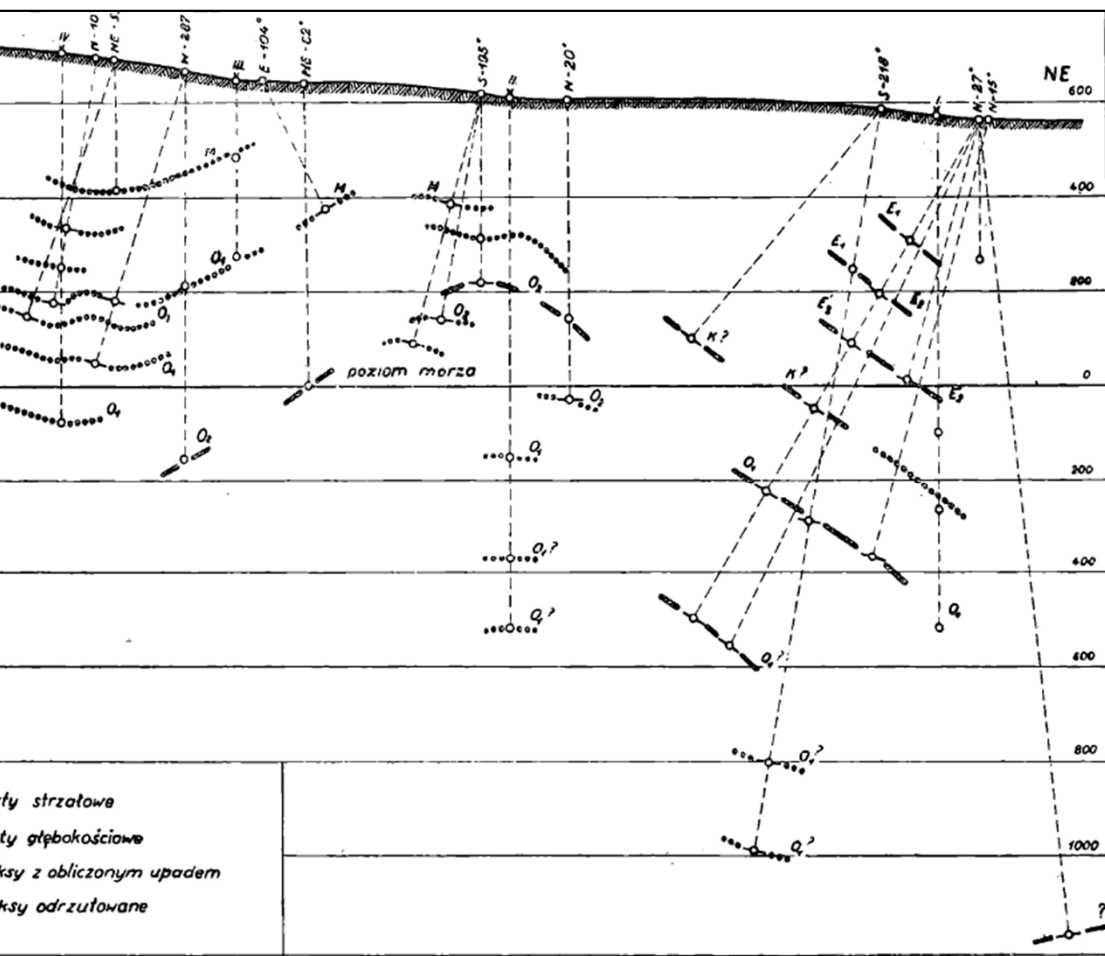


Interpreted seismic profile of very first pilot seismic reflection survey acquired in vicinity of Borysław (Mitera, 1936)

seismic field record



# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS



Seismic profile [left] and its geological interpretation [right] from Bitków area (Mitera, 1936)

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS

## ROBEK „Pionier” Profil sejsmiczny Stryj–Bilcze Wolica–Rozdół

(Komunikat zgłoszony na X Zjazd Naftowy).

icne, wykonane przez Oddział A. „Pionier” na profilu Stryj–Wolica (dalszy ciąg prac eksperymentalnych na terenie Daszawy).

ższej profil o długości 25 km przebiega Stryja wzdłuż szosy lwowskiej w kierunku SSW–NNE (odcinek Derżów–Kijowiec–Rozdół).

W celu sprawdzenia jakości próbnice, wykonano przy użyciu strzałowych, o średniej głębokości 19 m, zatrzymanych w ilach podszutrowych, oznaczone na profilu numerami 1–30, w odległości co 1,5 km. Wyniki prac i otrzymanych wyników przedstawiono w dalszych 40 liczeniach, usytuowanych obok i pomiędzy otworami.

wgłębszych refleksów obok trudniejszych do uzyskania aniżeli w Daszawie refleksów płytkich.

Ponieważ przypuszczalna głębokość zalegania płyty podolskiej określona została na 2000 do 2500 m, przeto początkowym założeniem było uzyskanie refleksów głębokich, obok niezależnie występujących refleksów płytszych. Stąd, jak widzimy z zestawienia, zużyto dość duże ilości dynamitu.

Późniejsze próby, wykonane z otworów płytkich o średniej głębokości 4–5 m, zatrzymanych na szutrach, pozwoliły uzyskać bardzo wyraźne refleksy, które dzięki stałemu występowaniu wzdłuż całego profilu nazwano „refleksem przewodnim”, a warstwę odbijającą „przewodnym horyzontem refleksyjnym”. Wpływ głębokości otworu na charakter uzyskanych refleksów był tutaj wybitny. Na podstawie analiz i prób w te-

nr	data	rodzaj i uszczelnienie	głębokość	średnia głębokość	liczba strzałów	zużycie dynamitu kg	średnie zużycie dynamitu kg na otwór
25.	VIII. r. 1934	Otwory głębokie Nr 4–20	19	27,0	376	617	32,5
1.	IX. r. 1934	Otwory płytkie do szutrów					
2.	X. r. 1934	Nr pośrodk.	30	4,5	269	191	6,4
3.	IV. r. 1935						
4.	1935	Otwory płytkie do szutrów 831-2-5-6-7	5	4,0	21	8	1,6
5.	I. r. 1936	Otwory płytkie w szutrach 930-1-2-3-4	5	10,0	41	17	3,4

owej powyżej tabeli podane są rezultaty, dotyczące otworów, ilito zużytego dynamitu.

### Wnioski z prac polowych.

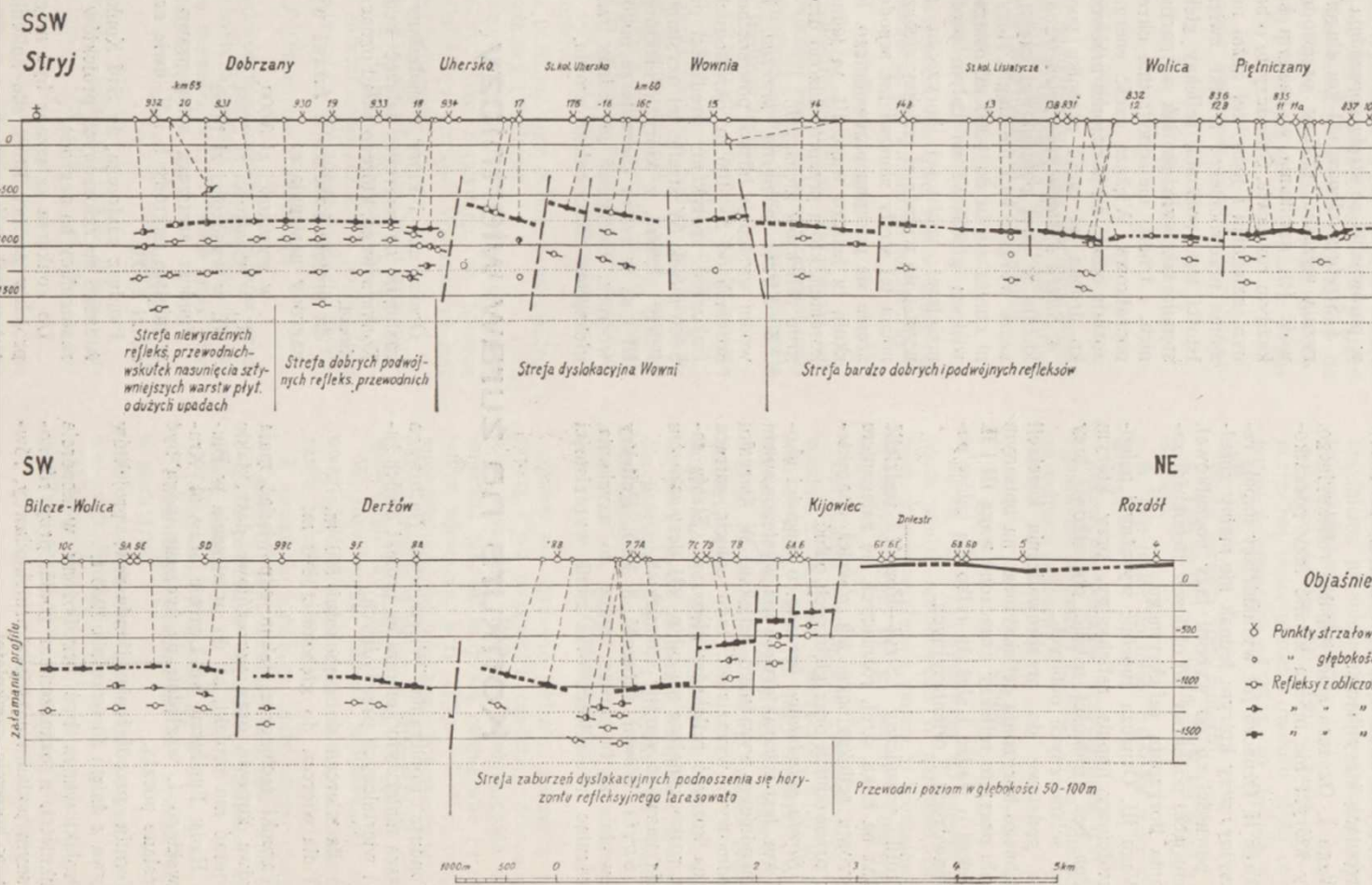
Próbę, podjętą w sierpniu 1934 r. przy użyciu otworów, stwierdziły istnienie

St. Wyrobek: „Badania sejsmiczne w N. Karpatach”, „Przemysł Naftowy”, 1938, 13(9), 221-224.

Przemysł Naftowy, 1938, 13(9), 221-224

Oddział geologiczny S.A. „Pionier”

## Profil sejsmiczny Stryj–Rozdół



Objaśnienie

- ⊗ Punkty strzałowe
- " " " " " "
- Refleksy z obliczeń
- " " " " " "

Results of regional seismic reflection studies in the Carpathian foreland basin that mapped Miocene tectonic horizon and determined tectonic structure of its Miocene infill and older (Paleozoic – Mesozoic) basement (Wyrobek, 1938)

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS

ROBEK  
„Pionier”

## Profil sejsmiczny Stryj–Bilcze Wolica–Rozdół

(Komunikat zgłoszony na X Zjazd Naftowy).

icne, wykonane przez Oddział A. „Pionier” na profilu Stryj–Wolica dalszy ciąg prac eksperymen-

dzonych na terenie Daszawy).  
ższej profil o długości 25 km prze-  
cia Stryja wzdłuż szosy lwowskiej  
–Wolica w kierunku SSW–NNE  
–Kijowic–Rozdół

W–NE.  
ace próbnę, wykonano przy uży-  
w strzałowych, o średniej głębo-  
atrzzymanych w ilach podszutro-  
atrzzymanych w ilach podszutro-  
atrzzymanych w ilach podszutro-  
atrzzymanych w ilach podszutro-  
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wgłębnych refleksów obok trudniejszych do uzyskania aniżeli w Daszawie refleksów płytkich.

Ponieważ przypuszczalna głębokość zalegania płyty podolskiej określona została na 2000 do 2500 m, przeto początkowym założeniem było uzyskanie refleksów głębokich, obok niezależnie występujących refleksów płytszych. Stąd, jak widzimy z zestawienia, zużyto dość duże ilości dynamitu.

Późniejsze próby, wykonane z otworów płytkich o średniej głębokości 4–5 m, zatrzymanych na szutrach, pozwoliły uzyskać bardzo wyraźne refleksy, które dzięki stałemu występowaniu wzdłuż całego profilu nazwano „refleksem przewodnim”, a warstwę odbijająca „przewodnym horyzontem refleksyjnym”. Wpływ głębokości otworu na charakter uzyskanych refleksów był tutaj wybitny. Na podstawie analiz i prób w te-

Prace połowich	Otwory różnej i uszczelnienia	strzałowa ilość	Ilość strzałów średnia głęb. otworu	Ilość strzałów	Zużycie dynamitu kg	Średnie zużycie dynamitu kg na otwór
25. VIII. r. 1934	Otwory głębokie Nr 4–20	19	27,0	376	617	32,5
1. IX. r. 1934	Otwory płytkie do szutrów	30	4,5	269	191	6,4
2 X. r. 1934	Nr pośredn.	5	4,0	21	8	1,6
IV. r. 1935	Otwory płytkie do szutrów 831-2-5-6-7	5	10,0	41	17	3,4
1935	Otwory płytkie w szutrach 930-1-2-3-4	5	10,0	41	17	3,4

onej powyżej tabeli podane są zesty-  
czne, dotyczące otworów, ilu-  
zużytego dynamitu.

### Wniosek z prac połowich.

by, podjęte w sierpniu 1934 r. przy  
ch otworów, stwierdziły istnienie

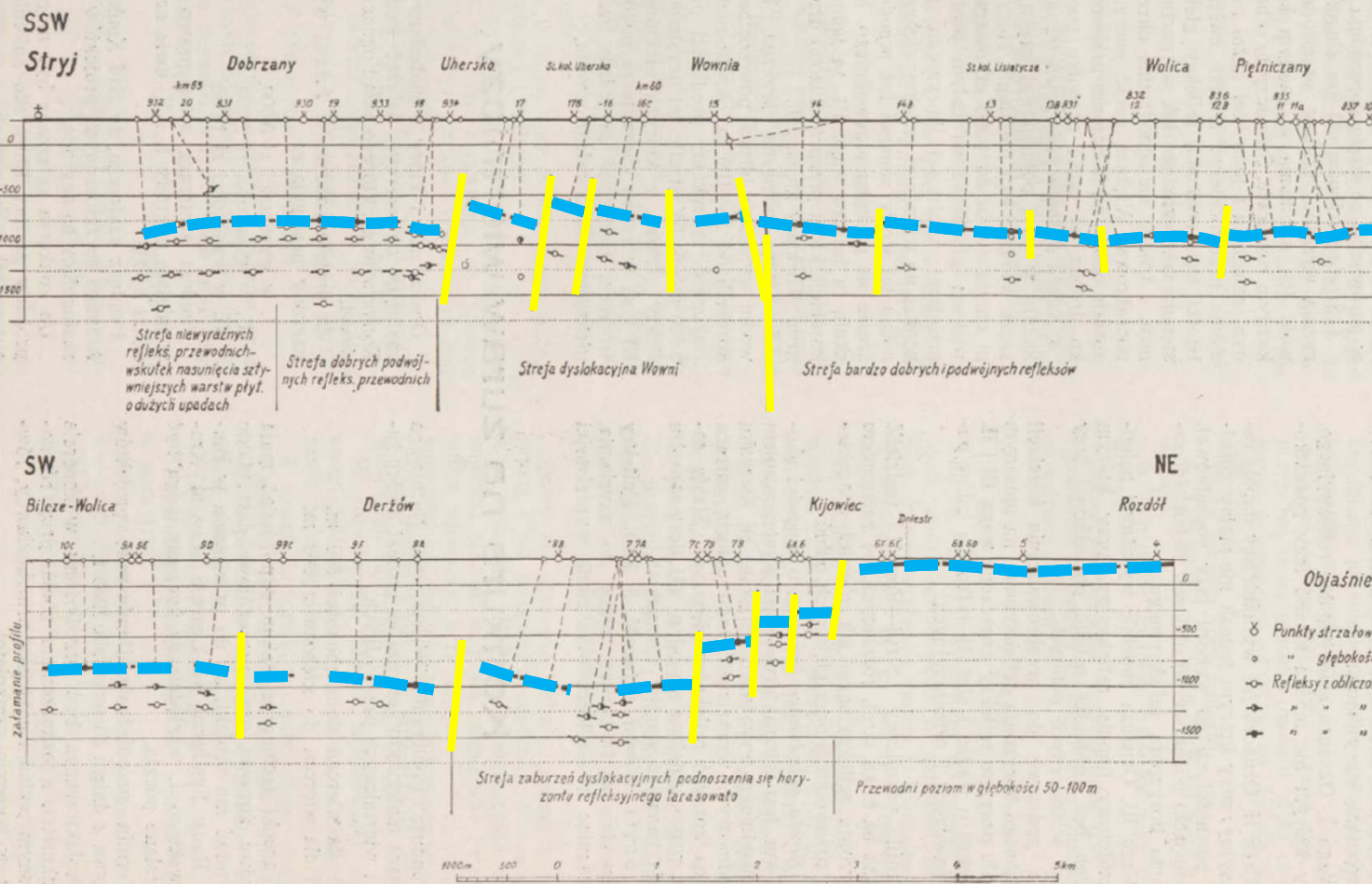
St. Wyrobek: „Badania sejsmiczne  
przez S. A. „Pionier” „Przemysł Naft-  
8.

renie przekonano się, że ładunki umieszczone pod  
szutrami, których miąższość dochodzi do 20 m,  
wywołują wstrząs całej warstwy szutrów,  
a drgania tych warstw szutrowych trwają dłu-  
szy czas do 1 sek. i interferują się z drganiami,  
odbitymi z głębi. Ładunki, umieszczone na szu-  
trach w gł. 2–4 m, względnie w 1/3 głębokości  
całej warstwy szutrów, nie wywołują tych  
drgań, przy czym same szutry działają w tym  
wypadku jak filtry. Wytlumaczenie tego zjawis-  
ka polega również na tym, że wstrząs, wywo-

Przemysł Naftowy, 1938, 13(9), 221-224

Oddział geologiczny S.A. „Pionier”

## Profil sejsmiczny Stryj–Rozdół

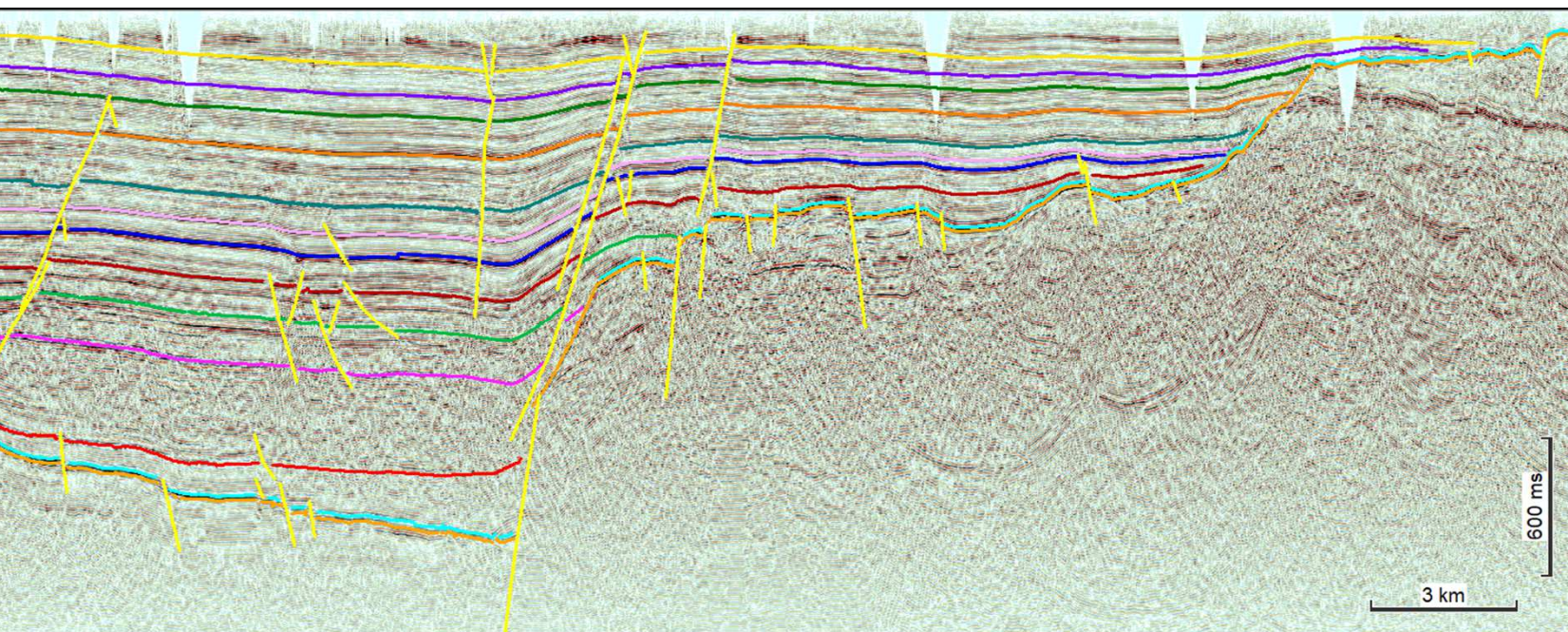


Objaśnienie

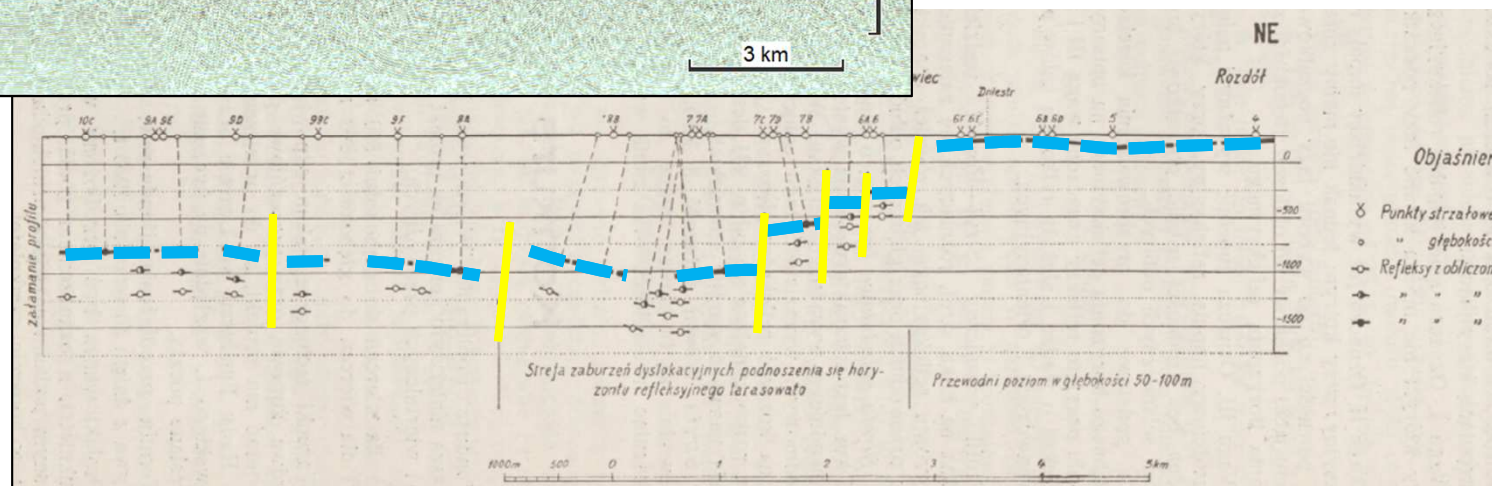
- ⊗ Punkty strzałowe
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Results of regional seismic reflection studies in the Carpathian foreland basin that mapped Miocene and determined tectonic structure of its Miocene infill and older (Paleozoic – Mesozoic) sediment (Wyrobek, 1938)

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS

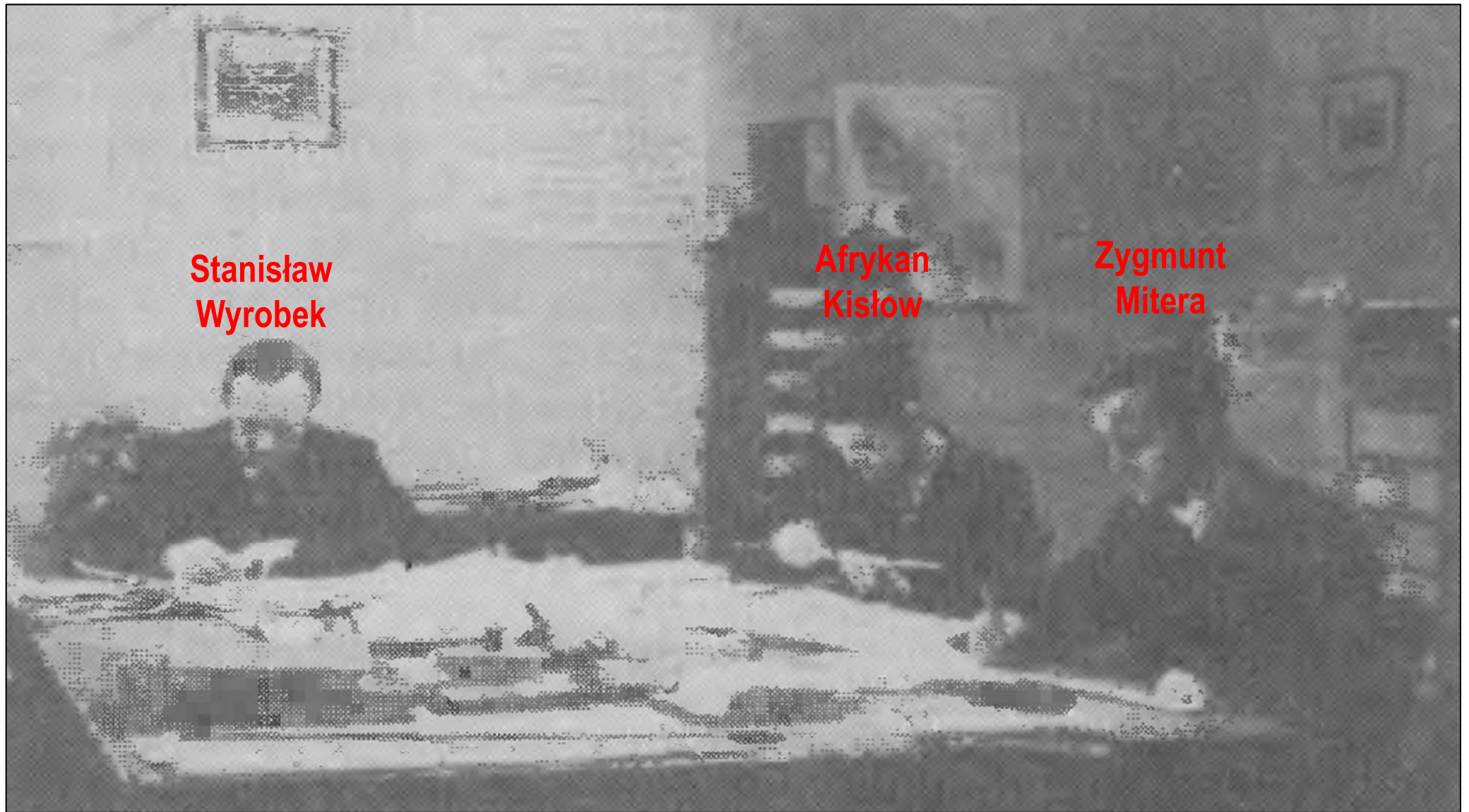


Modern seismic profile from the Carpathian foreland basin



Results of regional seismic reflection studies in the Carpathian foreland basin that mapped Miocene and Paleozoic horizons and determined tectonic structure of its Miocene infill and older (Paleozoic – Mesozoic) (Wyrobek, 1938)

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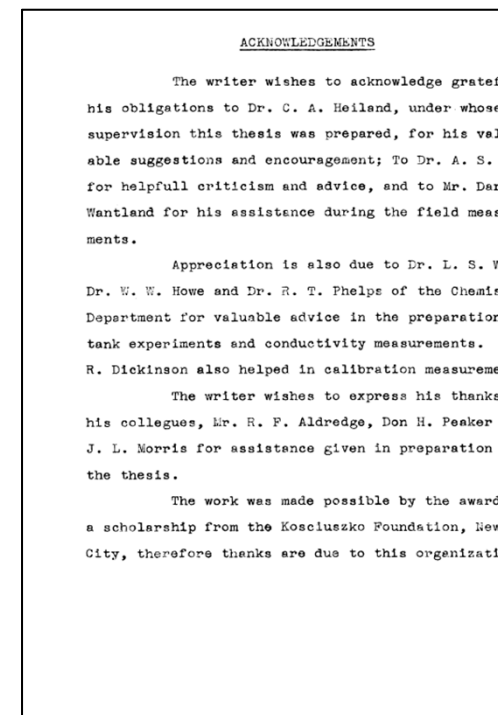
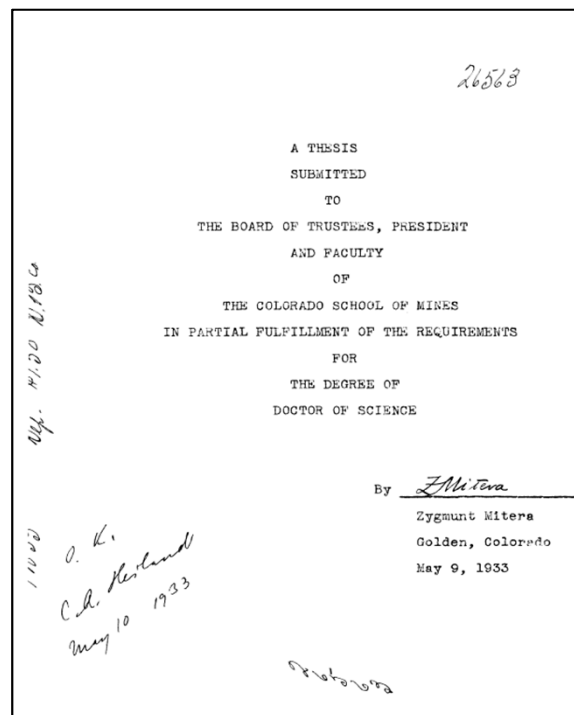
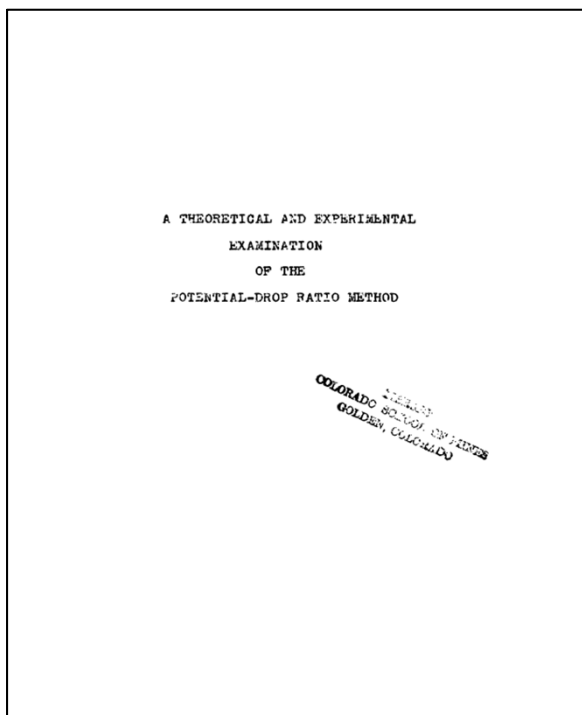


Geophysicists at work - „Pionier” office in Lwów (Kisłow & Pawłowski 1987)

# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS



**Zygmunt Mitera** (1903 - 1940): in 1929 graduated from the Department of Mining at the Academy of Mining & Metallurgy (AGH) in Kraków, then continued his studies in exploration geophysics in Germany, Sweden, France, and, since 1931, at the Colorado School of Mines where he obtained PhD degree in 1933; participated in field geophysical studies in Texas and California, worked as first lecturer of exploration geophysics at AGH in Kraków;

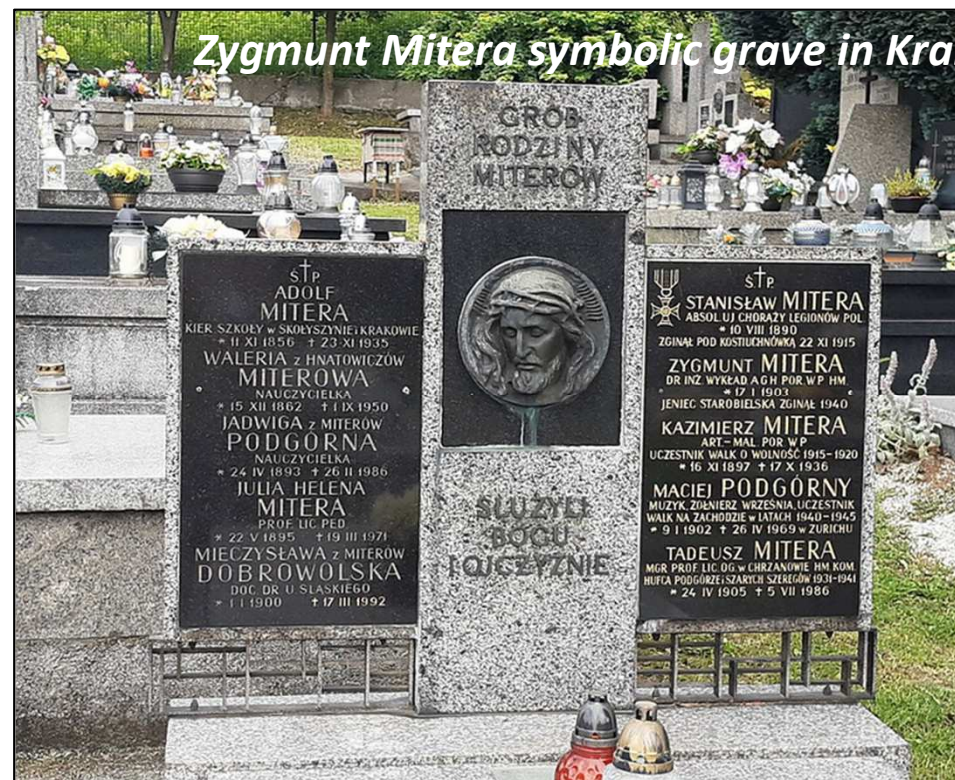


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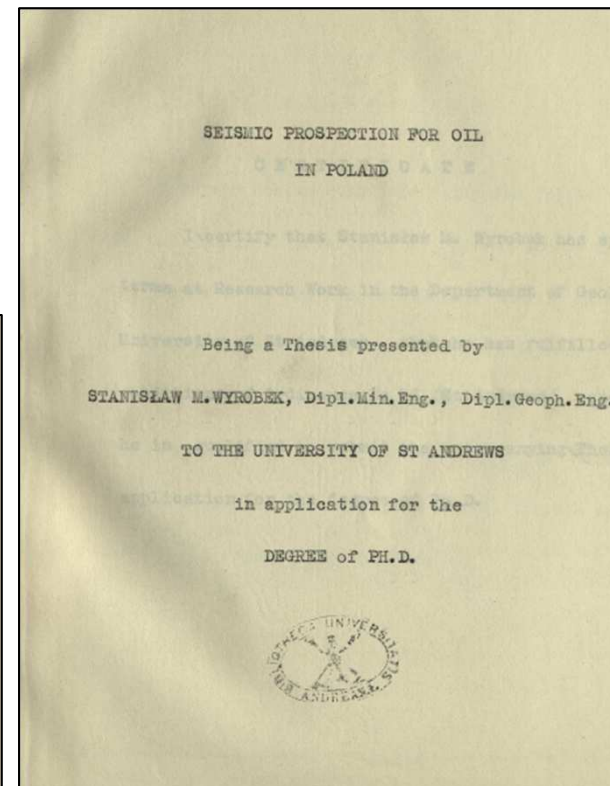
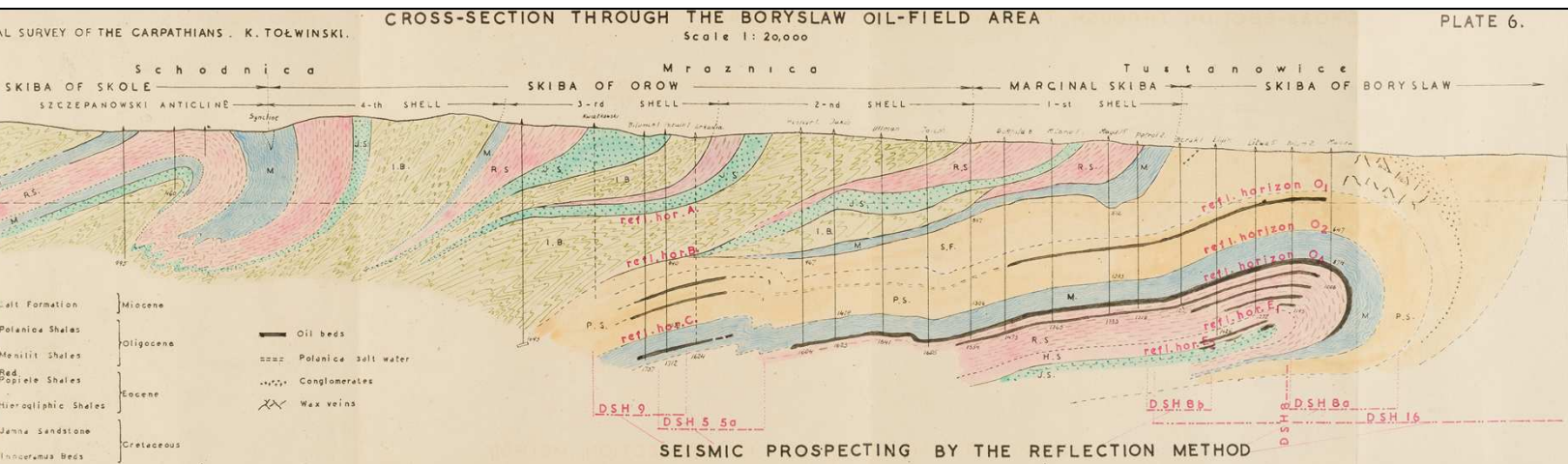
1934 - 1939 was appointed as a head of „Pionier”’s Department of Geophysics; in 1936 co-founded „Geofizyczna Technika” company; in 1938 - 1939 worked as a lecturer at the Jan Kazimierz University in Lwów. In October 1939 Dr Mitera was imprisoned by the Germans and in 1940 murdered during the so-called „Kamianka Massacre”.



# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS



**Stanisław Wyrobek** (1903 - 1979): in 1921-29 studied at the Academy of Mining & Metallurgy (AGH) in Kraków, in 1933-1936 at the University of Strassburg in France. In 1932-33 he worked at the Polish Geological Institute as field geophysicist, and from 1934 as a head of seismic crew in Pionier company; in 1938 co-funded „Geotechnika” company; during WWII emigrated to the UK, where in 1945 he obtained PhD degree from the University of St. Andrews (Scotland).



# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS



Since 1945 Dr Wyrobek worked for British Petroleum as a head of the very first seismic crew; in 1950 he was appointed as head of seismic interpretation group in BP Research Centre. In 1954 Dr Wyrobek moved to BP headquarters in London where he organized central interpretation office for overseas BP seismic projects; between others, his team located first discovery wells of West Sole and Forties fields (North Sea). Other seismic projects supervised by him were located in Italy, France, Germany, Switzerland, Iran, Egypt, Tanganyika, Kenya and Senegal.



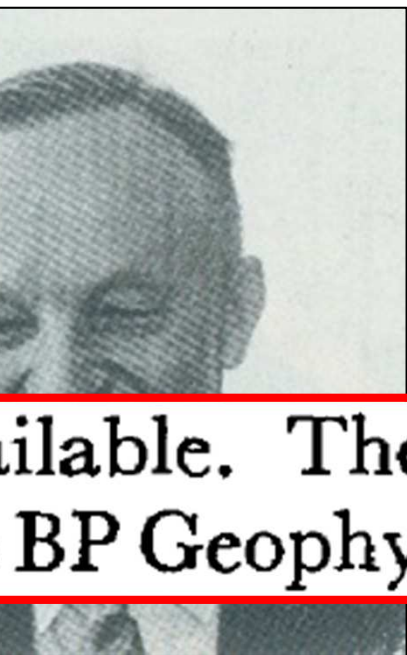
*P.E. Kent, 1967, Outline  
geology of the Southern  
North Sea Basin.  
Proceedings of the  
Yorkshire Geological  
Society, 36(1).*

## VI. ACKNOWLEDGEMENTS

All geologists who have worked in the North Sea, and particularly those from overseas, owe a debt of gratitude to Professor Wills, whose Palaeogeographical Atlas (1951) was so far ahead of other work on the subject, and who made a significant contribution to understanding of the basic problems of linkage between Europe and the Continent.

For permission to quote from the confidential results of North Sea exploration the writer is greatly indebted to the Management of The British Petroleum Company, who have again demonstrated their belief that it is in the interests both of the nation and of the scientific world for fundamental information to be made available. The structural data are largely derived from the work of the BP Geophysical Unit under the leadership of Dr. S. M. Wills. To these scientists and to Mr. R. G. W. Brunstrom, Dr. M. H. ... and Mr. P. J. Walmsley of the Geological Division the au...

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# SEISMIC EXPLORATION IN N CARPATHIANS – BEGINNINGS



**Afrykan Kiszlow** (1908 - 1989): in 1934 graduated from the Academy Mining & Metallurgy (AGH) in Kraków; since 1935 worked as geophysicist for „Pionier” company, first as head of field seismic crews, and since 1938 as head of Department of Geophysics; in 1939 studied exploration geophysics at the University of Strassburg France.

During WWII he remained in Lwów – Borysław area and worked as field geophysicist for Soviet and German occupants.

In 1945 Kiszlow moved to Jasło and then to Krosno in SE Poland in the Carpathians, where he continued his work as geophysicist.

In 1950 Kiszlow moved to Warsaw where he was appointed as a head of Department of Geophysics of Geophysical Exploration Company. In 1956 – 1962 moved to Kraków where he headed geophysical division of Polish Oil & Gas Company. Since 1962 Kiszlow worked as a researcher at the Institute of Petroleum in Kraków until retirement in 1978. In 1965 he obtained PhD degree from the Academy of Mining & Metallurgy (AGH) in Kraków.

# TALK OUTLINE

. SHORT INTRO TO SEISMIC REFLECTION SURVEYING

. NORTHERN CARPATHIANS

- *geological background*
- *history of petroleum industry*

. SEISMIC EXPLORATION IN THE NORTHERN

CARPATHIANS - GREAT START AND GREAT

ACHIEVEMENTS

. SUMMARY



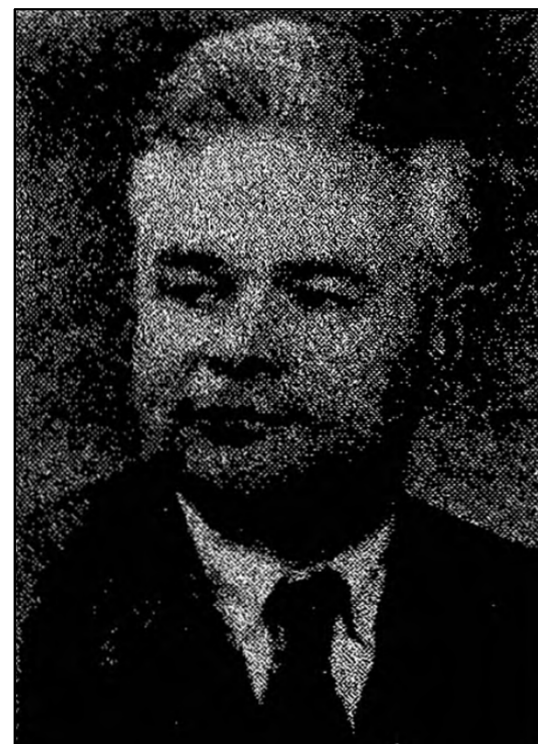
**48 INHIGEO SYMPOSIUM, KRAKÓW, POLAND, 31.07-04.08.2023**

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Early seismic studies in the N Carpathians in 1930' provided excellent data needed for proper understanding of complex subsurface structures of a segment of the Carpathian FTB and its foreland basin. The geophysical community owes a lot to pioneers of seismic surveying such as Zygmunt Mitera, Stanisław Wyrobek and Afrykan Kisłowski. We shall not forget how this all began ...



***WE DEDICATE THIS TALK TO ALL  
GEOSCIENTISTS FROM UKRAINE  
THAT SUFFER BECAUSE OF FULL-  
SCALE WAR OF RUSSIA AGAINST  
UKRAINE***



***THANK YOU FOR  
YOUR ATTENTION***



***48 INHIGEO SYMPOSIUM, KRAKÓW, POLAND, 31.07-04.08.2023***