



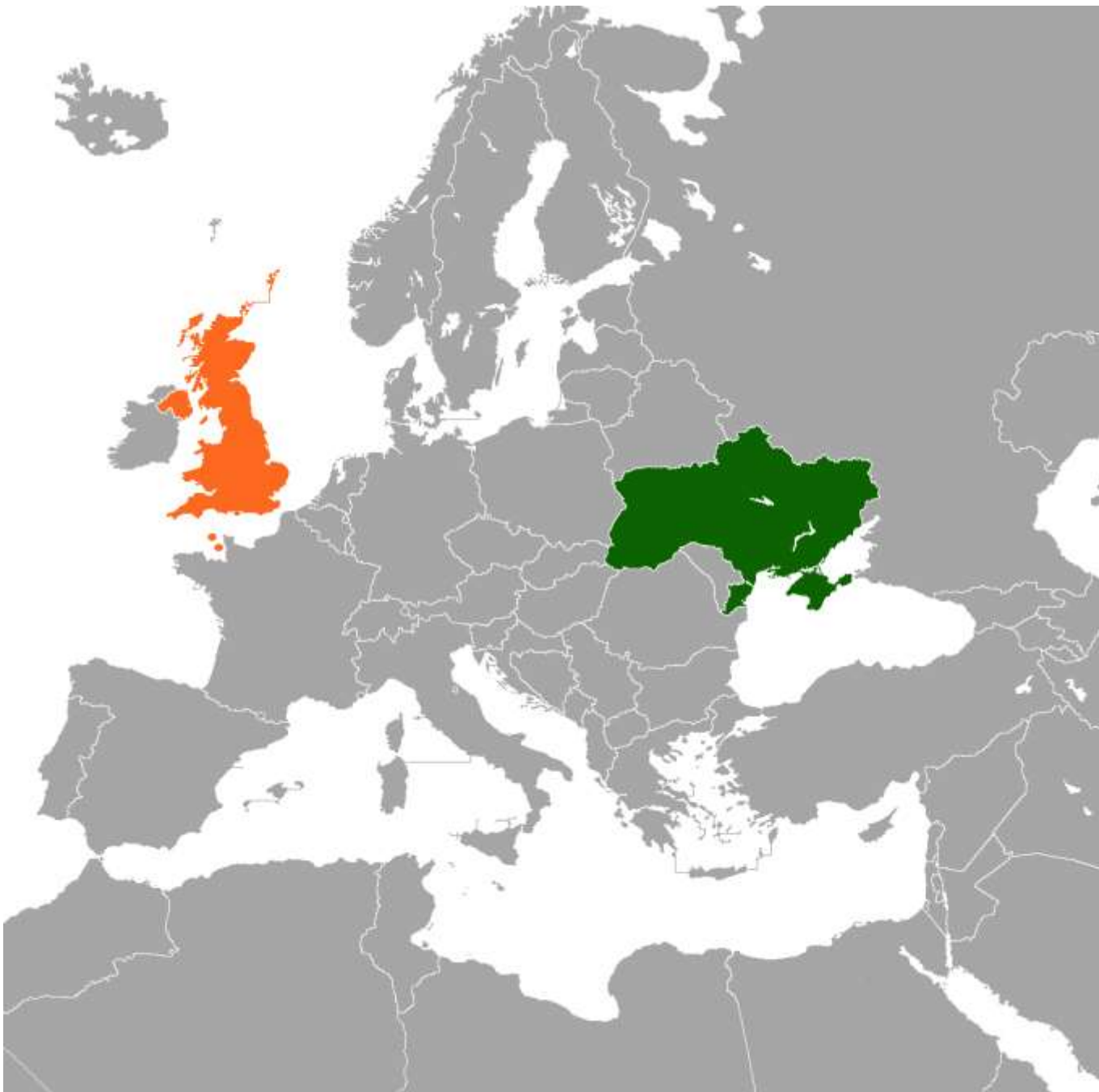
Super Basins 19: Exploration in Ukraine

Preparing for the day when
Ukraine can be rebuild

Webinar
28 Apr 2023

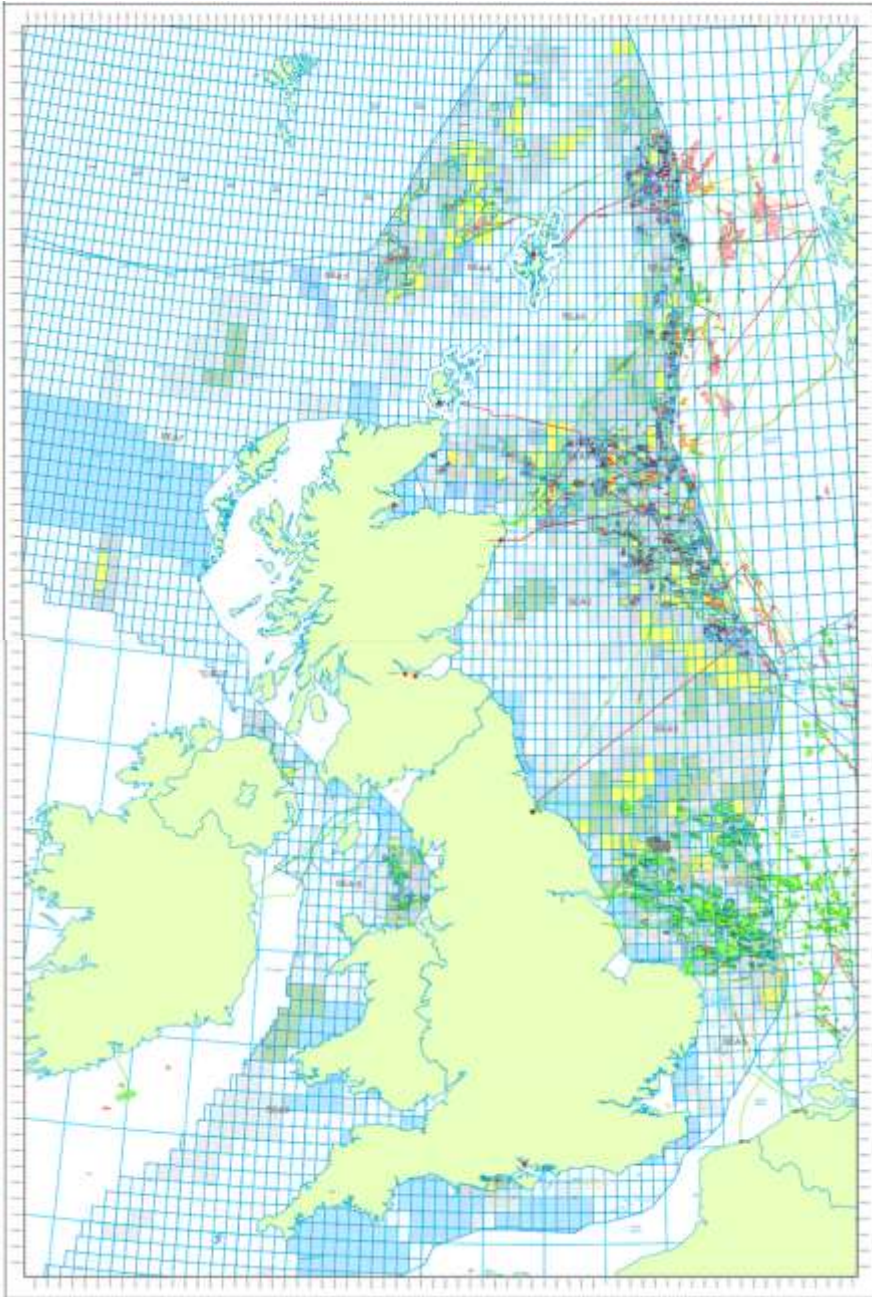
Ivan Karpenko
Head of Regional Exploration @ Naftogaz Group



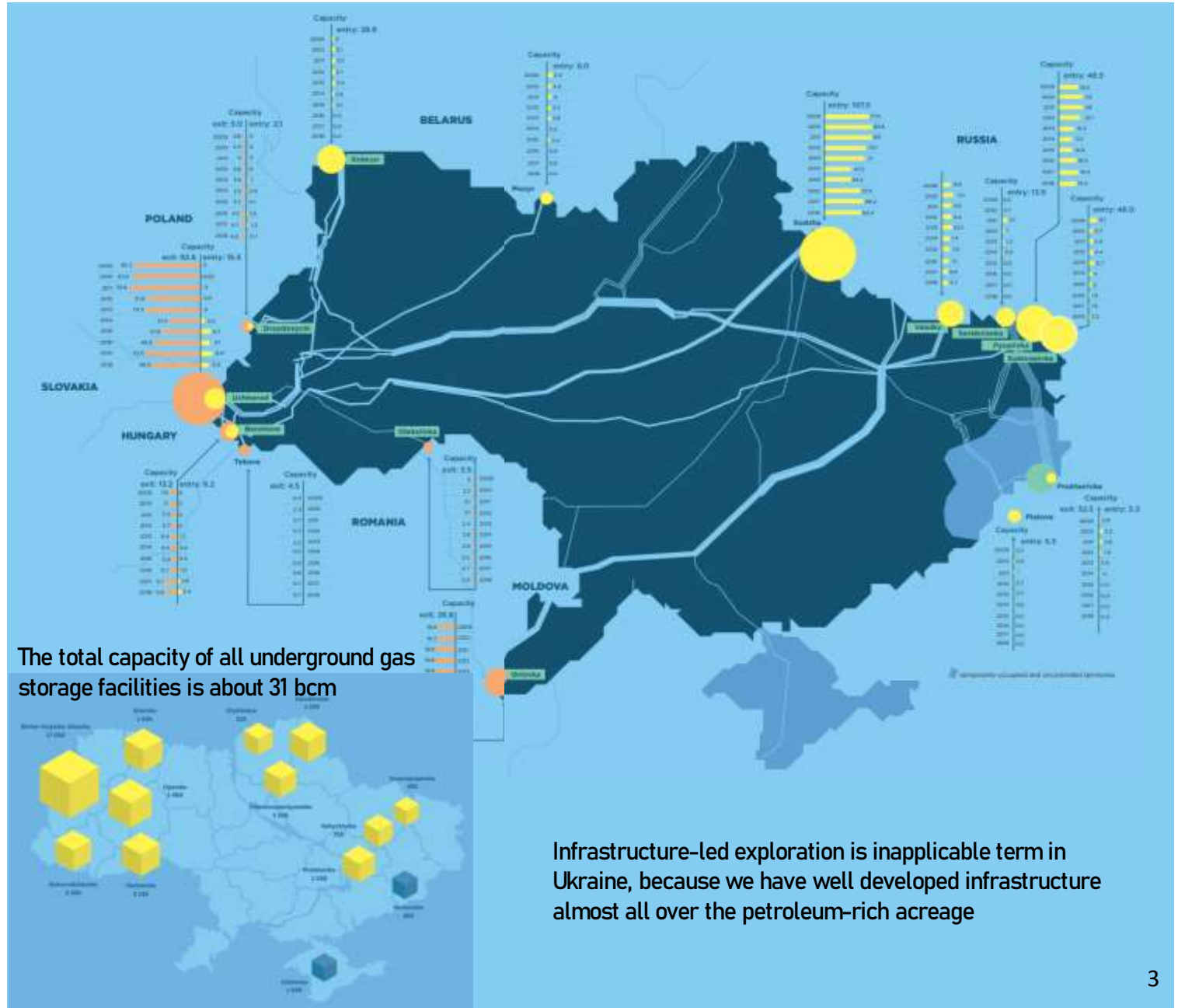


	United Kingdom	Ukraine
Onshore Area	243,610 sq km	603,550 sq km
Area of exclusive economic zone	773,676 sq km	147,000 sq km
Natural gas reserves, 1P / 3P	0.15 tcm (5.3 tcf) / 0.5 tcm (18 tcf)	0.4 tcm (14 tcf) / 0.8 tcm (28 tcf)
Crude oil reserves, 1P / 3P	1.8 / 3.2 bn bbl	0.4 / 0.7 bn bbl
Undiscovered Prospective resources (leads / plays)	3.7 / 11.2 bn boe	5.2 / 20 bn boe

UKCS O&G infrastructure

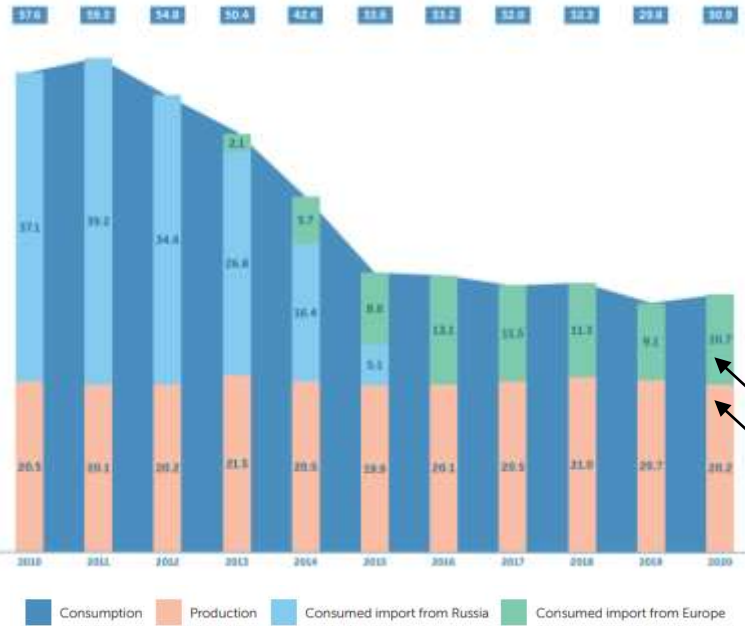


Ukraine Gas Infrastructure

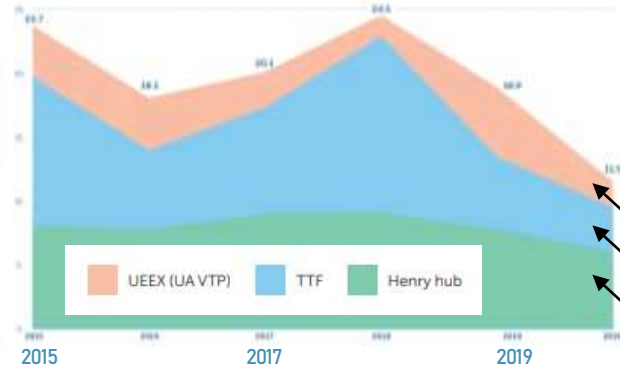


Upstream Market

Gas market balance (production vs consumption)

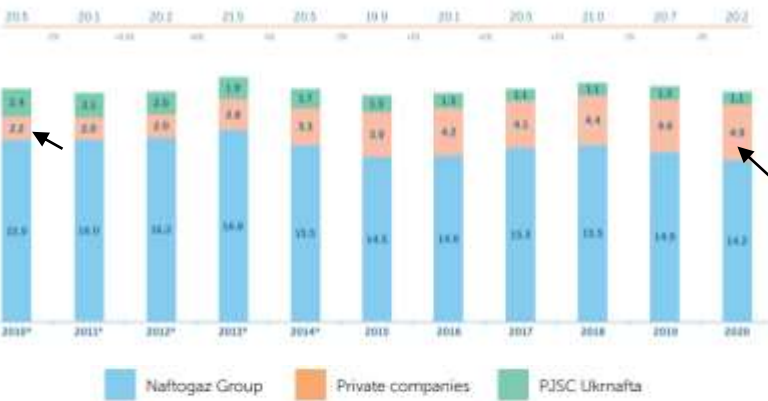


Gas prices in Ukraine, EUR / MWh



April 2023: TTF 41 EUR/MWh
 April 2023: UEEEX 27 EUR/MWh

Gas production in Ukraine



TOTAL NUMBER OF ISSUED LICENSES IN UKRAINE INCLUDING ACREAGE, RESERVES AND PRODUCTION IN THE RESULT OF 2020

Company	Number of licenses	Acreage, sq.km	Natural gas reserves, bcm	Gas production, bcm
UGV (Naftogaz Group)	206	19 260	502.6	14.230
Ukrnafta (Naftogaz Group)	82	1 742	189.4	1.125
Naftogaz of Ukraine	39	29 825	0.2	0
Diloreto Group	30	3 955	2.0	0.769
Geo Alliance Group	15	3 629	2.7	0.203
Nadra of Ukraine	10	2 574	0.2	0.004
Zasyadko Mine	9	1 908	0	0
Zakhidnadraserwis	7	1 774	0	0.204
DTEK Oil&Gas	6	1 152	13.4	1.845
PPC (JXK ObG)	6	404	1.5	0.239
KUB-GAS	6	824	0.6	0.104
Cub Energy	6	708	0	0.034
Plast	5	695	1.5	0.018
Smart Energy Holding	5	451	0.5	0.401
Mizhrehionalna gas company	5	1 221	0	0
Goryzonty Group (MND)	4	160	0.2	0.004
Arab Energy Alliance UA	2	181	0.6	0.011
Nadra Geoinvest	2	93	0.3	0.102
UNB	1	34	6.1	0.725
Energy 95	1	61	0.9	0.050
Cadogan Petroleum	1	12	0	0.001
Nadra Oleska PSA (Nadra of Ukraine)	1	7 886	0	0
Nadra Yuzivska PSA (Naftogaz Group)	1	6 324	0	0
Others	92	9 861	19.3	0.161
Total	542	94 734	741.9	20.230



Total: 444 fields
Eastern O&G Region
 16,2 bn boe discovered

- 1. Dnieper-Donets basin
- 2. Donbas coal basin

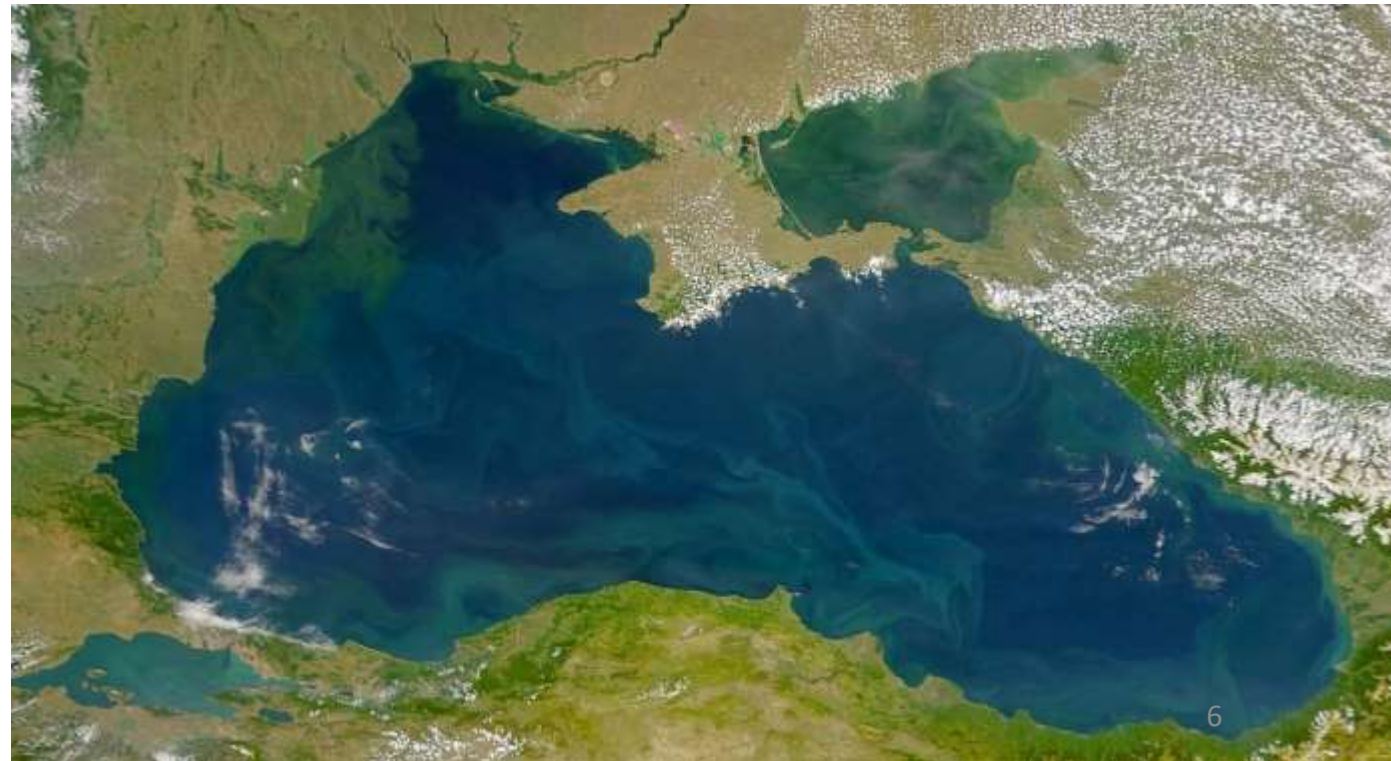
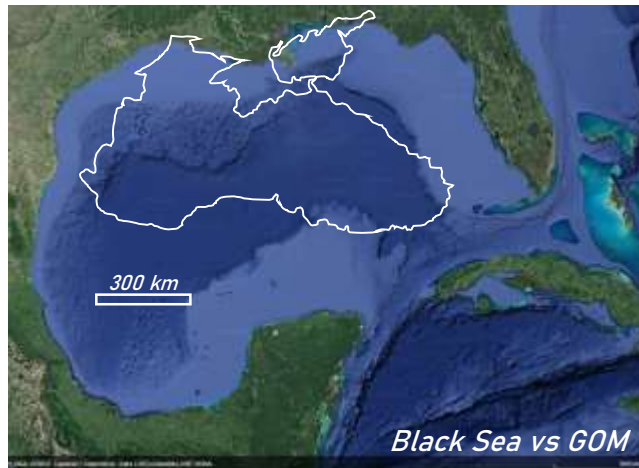
Western O&G region
 3,6 bn boe discovered

- 3. Pre-Carpathian foredeep
- 4. L'viv Paleozoic basin
- 5. Volyno-Podillya
- 6. Carpathian foldbelt
- 7. Transcarpathia (Pannonian basin)

Southern O&G Region
 0,7 bn boe discovered

- 8. Odessa shelf (Karkinit graben)
- 9. Black Sea deep waters
- 10. Azov sea
- 11. Pre-Kerch shelf and deep water
- 12. Pre-Dobrogea

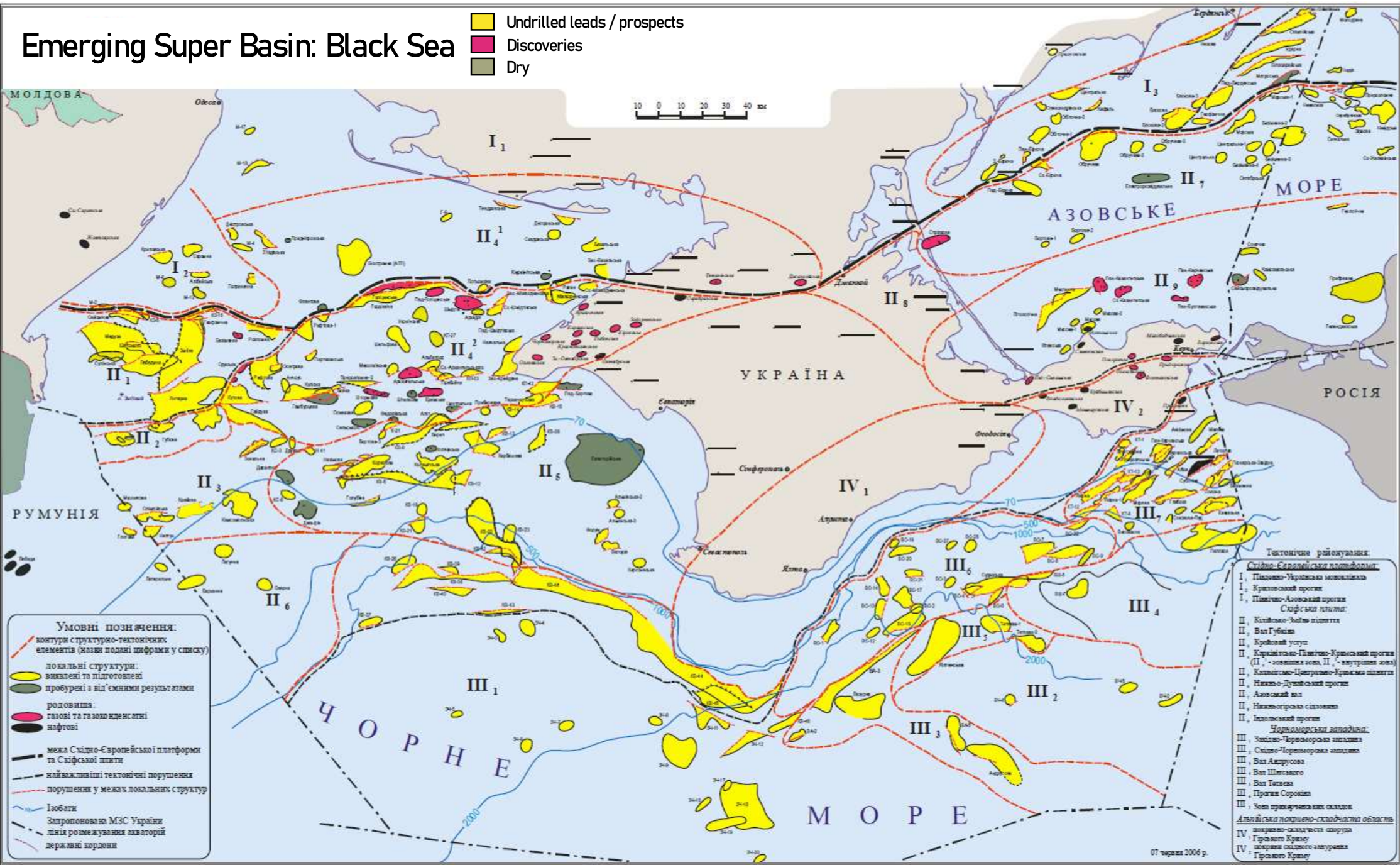
Emerging Super Basin: Black Sea



7,3 bn boe discovered to date (5,8 bn boe discovered '20-'23)

Emerging Super Basin: Black Sea

- Undrilled leads / prospects
- Discoveries
- Dry



Subbotina oilfield discovery proved extension of the oil-rich play offshore

Domino discovery in Romania proved deep water slope play

Sakarya discovery proved deep water biogenic play

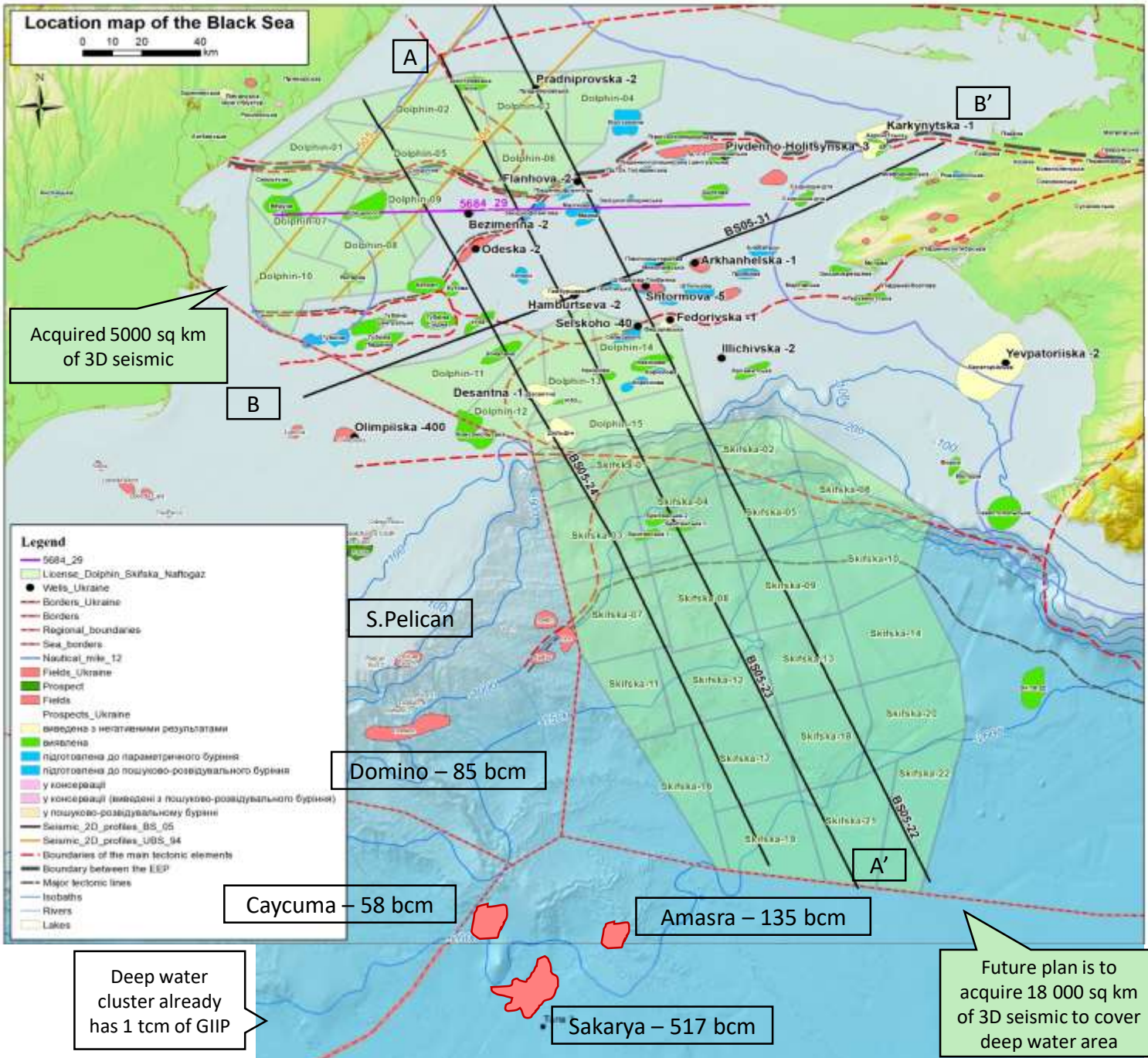
Onshore Pre-Dobrogea potential is proved by two discoveries

Onshore Crimea definitely hold remaining potential

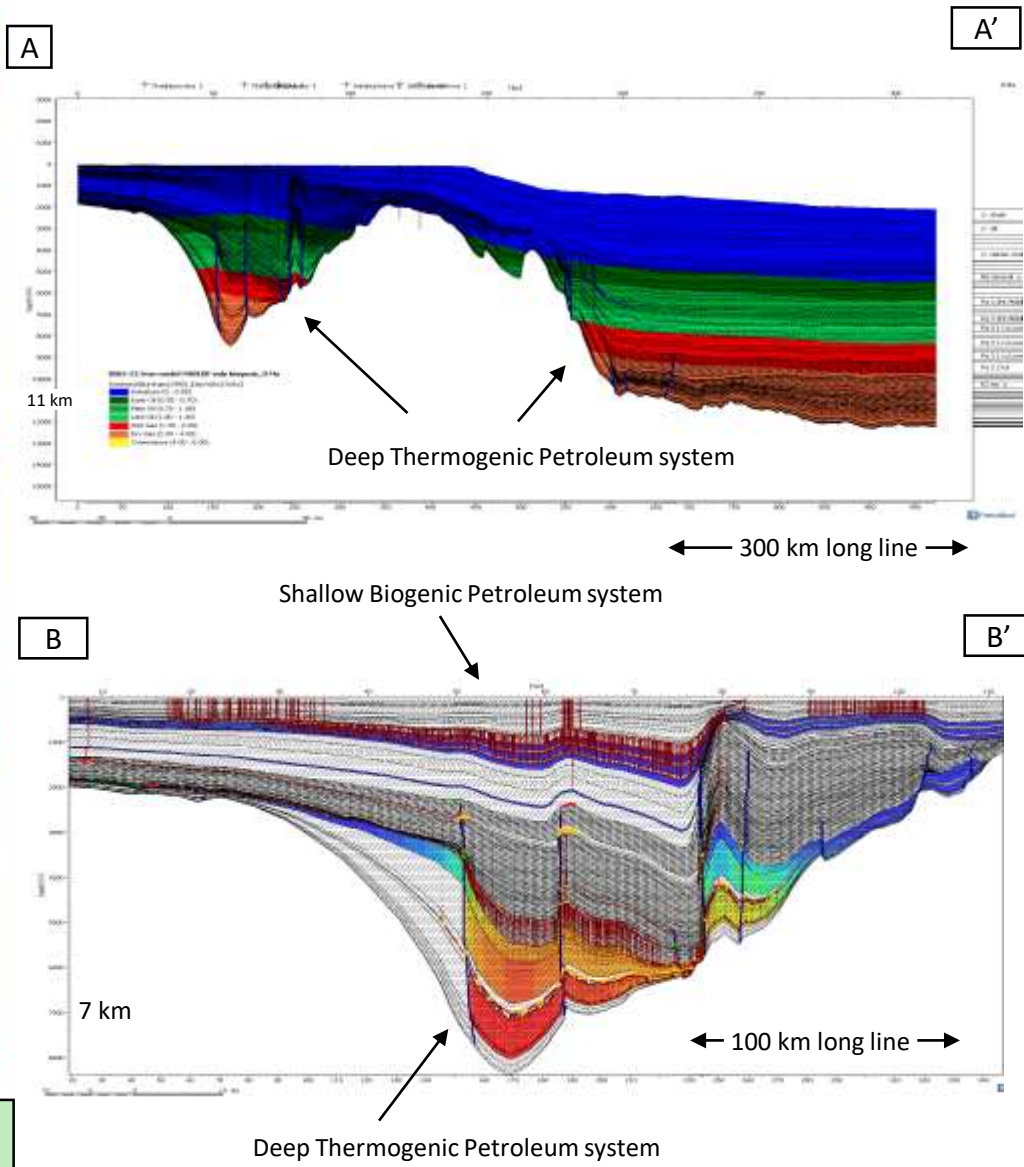
- Умовні позначення:**
- контури структурно-тектонічних елементів (назви подані в списку)
 - локальні структури: виявлені та підготовлені
 - пробурені з від'ємними результатами
 - родовища: газові та газоконденсатні, нафтові
 - межа Східно-Європейської платформи та Скіфської плити
 - найважливіші тектонічні порушення
 - порушення у межах локальних структур
 - Ізобати
 - Запропонована МЗС України лінія розмежування акваторій державні кордони

- Тектонічне районування:**
- Східно-Європейська платформа:**
- I₁ Південно-Українська мезозойська
 - I₂ Кризовий прогин
 - I₃ Північно-Азовський прогин
- Скіфська плита:**
- II₁ Київсько-Закарпатська платформа
 - II₂ Вал Губієв
 - II₃ Кривий уступ
 - II₄ Кривдинсько-Північно-Кримський прогин (II₄ - зовнішня зона, II₄ - внутрішня зона)
 - II₅ Київсько-Центрально-Кримська платформа
 - II₆ Нижньо-Дунайський прогин
 - II₇ Азовський вал
 - II₈ Нижньогірська сідловина
 - II₉ Ілчотський прогин
- Пороморська западина:**
- III₁ Закарпатсько-Пороморська западина
 - III₂ Східно-Пороморська западина
 - III₃ Вал Андрусів
 - III₄ Вал Штєпського
 - III₅ Вал Тетяєва
 - III₆ Прогин Сорочин
 - III₇ Зона прикарпатських складів
- Альпійська покривно-складчаста область:**
- IV₁ Ізразько-Ілчотська область
 - IV₂ Гірського Криму
 - IV₃ Ізразько-Ілчотська область
 - IV₄ Ізразько-Ілчотська область

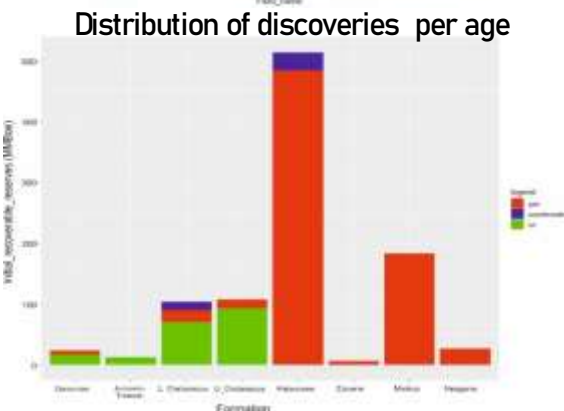
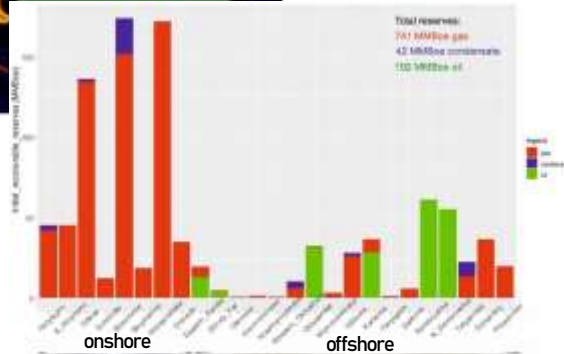
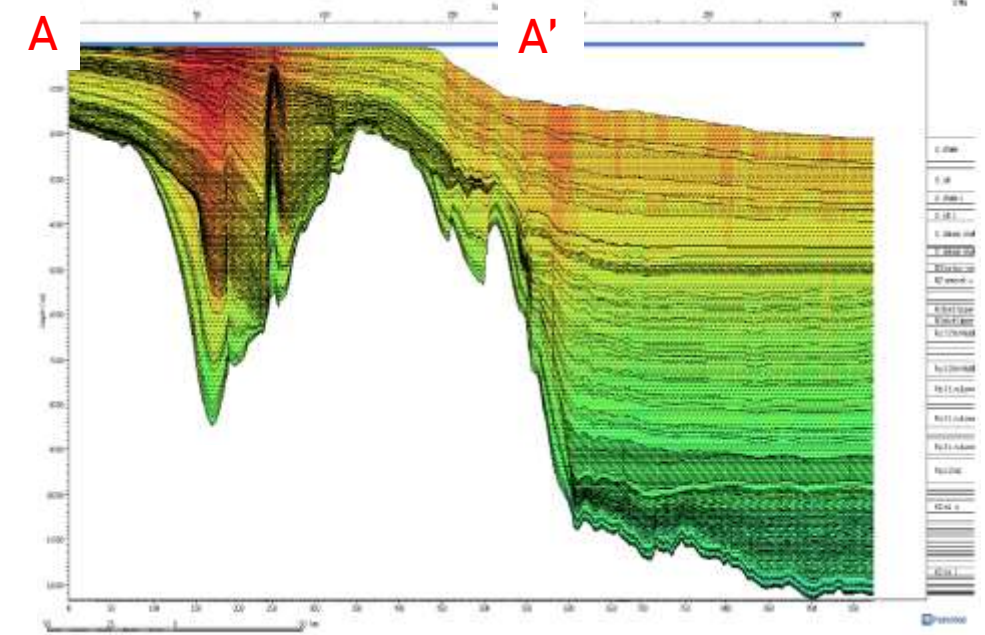
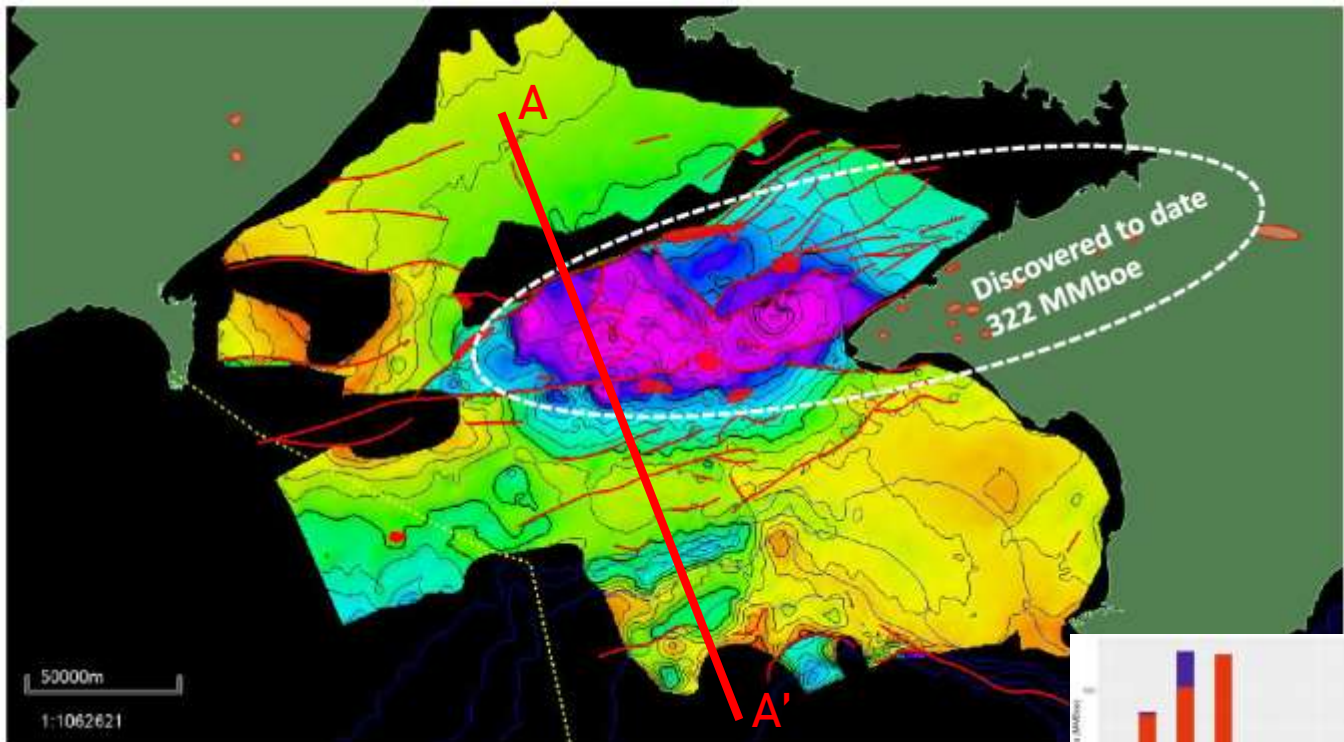
07 червня 2006 р.



Black Sea petroleum systems



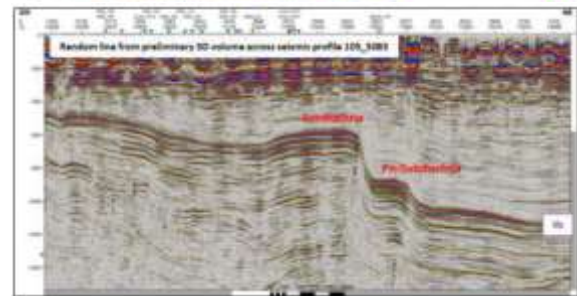
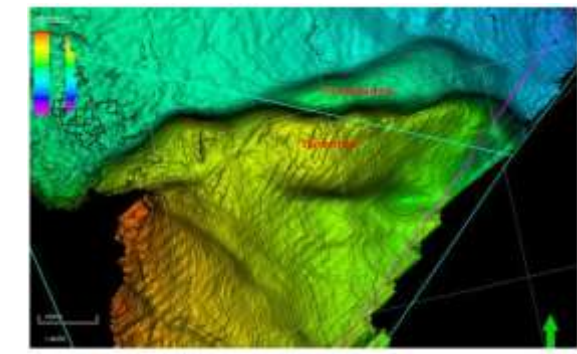
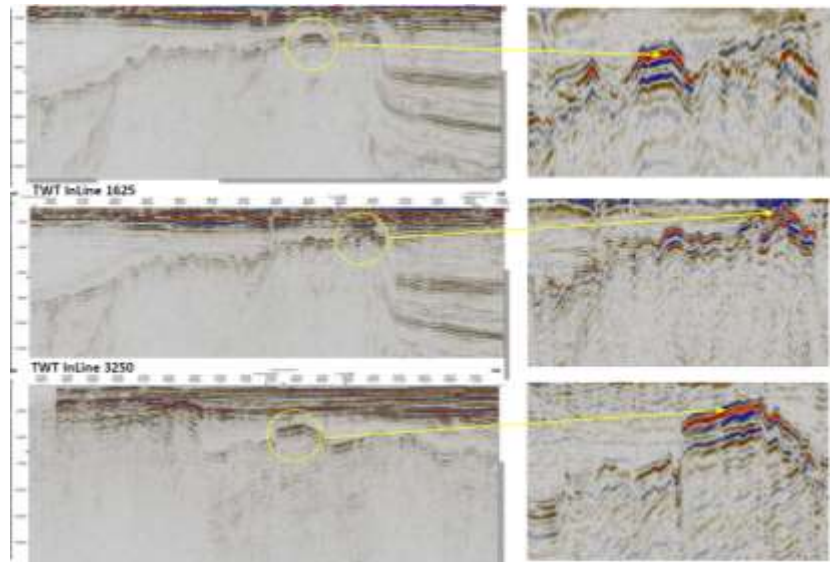
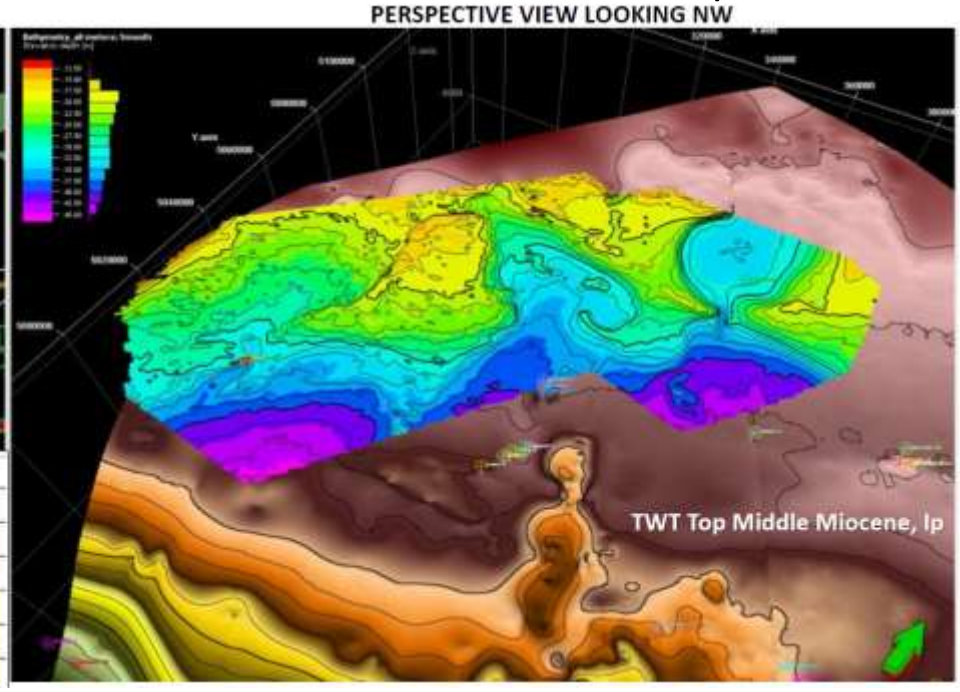
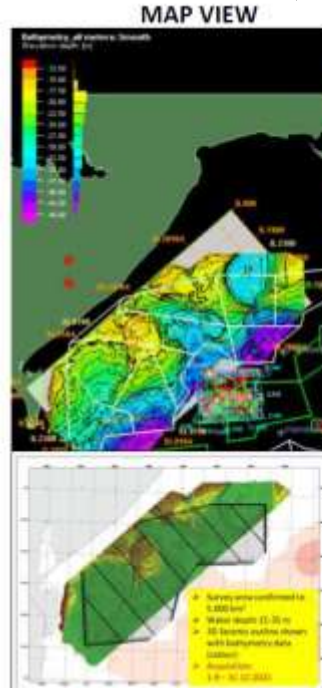
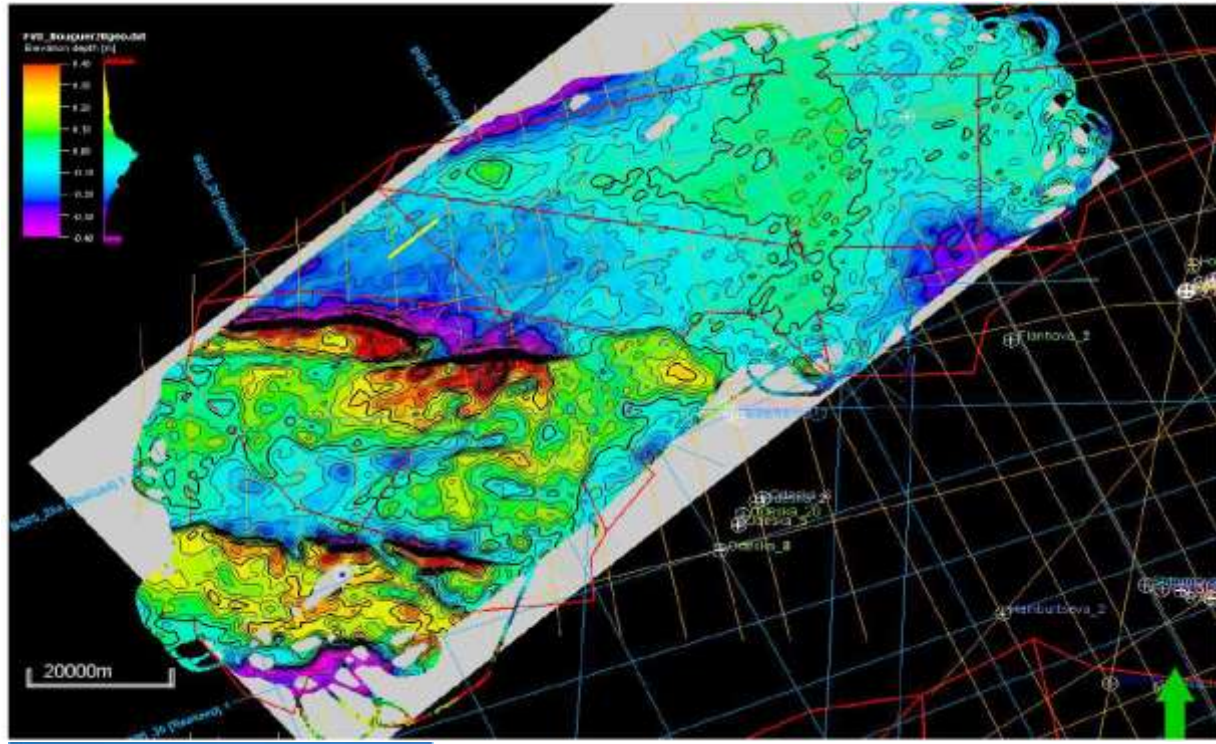
Western Black Sea shallow waters



Era	Period	Series/ Epoch	Stage	Літологічна колонка	Етапи тектонічної еволюції	Секвенції	Тип флюїду	Час генерації	Елементи нафтогазової системи		
Cenozoic	Quaternary	Holocene	Meghalayan		прогинання, гравітаційна тектоніка	1			Р		
		Pleistocene	Upper								
	Chibanian										
	Calabrian								Ф		
	Pliocene	Placenzian			інверсія на шельфі	2			Р		
		Zanclean									Р
		Messinian									Р
	Miocene	Tortonian			інверсія на шельфі	3					
		Serravallian									Р
		Langhian									Р
	Oligocene	Burdigalian			інверсія на шельфі	4					
		Aquitanian									Р
		Chatthian									Р
	Eocene	Rupelian			престригтове замурення	5				НМГ	
		Prabonian									Р
Bartonian										Р	
Paleocene	Lutetian			престригтове замурення	6				Ф		
	Ypresian									Р	
	Thanetian									Р	
Cretaceous	Upper	Selandian		вулканізм рифтінг	7				Р		
		Danian									Р
		Maastrichtian									Р
Lower	Campanian			вулканізм рифтінг	8				Р		
	Coniacian									Р	
	Turonian									Р	
Jurassic	Upper	Cenomanian		вулканізм рифтінг	9				Р		
		Albian									Р
		Aptian									Р
Middle	Barremian			вулканізм рифтінг	10				Р		
	Berremian									Р	
	Hauterivian									Р	
Lower	Valanginian			вулканізм рифтінг	11				Р		
	Barremian									Р	
	Hauterivian									Р	
Triassic	Upper	Bemiasian		вулканізм рифтінг	12				Ф		
		Valanginian									Ф
		Barremian									Ф
Middle	Titthonian			вулканізм рифтінг	13				Ф		
	Kimmeridgian									Ф	
	Oxfordian									Ф	
Lower	Callovian			вулканізм рифтінг	14				Ф		
	Bathonian									Ф	
	Valanginian									Ф	
Triassic	Upper	Werraian		вулканізм рифтінг	15				Ф		
		Werraian									Ф
		Werraian									Ф
Lower	Werraian			вулканізм рифтінг	15				Ф		
	Werraian									Ф	
	Werraian									Ф	
Basement											

Sources: Karpenko et al., 2021 @ SPE, Kyiv conf

Preliminary outputs of recent 3D seismic acquisition within Inner shelf (Western Black Sea shallow waters)



Sources:
 Peter Tauvers et al., 2022
 @ Trabzon AAPG conf



DDB
 1100 km long
 Deep down to 17 km
 18,7 bn boe discovered to date (2,5 bn boe Pripyat')

Super Basins: Dnieper-Donets basin

Deepest known Petroleum systems

Caspian petroleum systems

Source rocks deepens up to 10-15 km
 Deepest discovery – 6100 m (Ansagan)
 Deepest well – 8324 m (Saatlinskaia)
 Plans to drill 12 km deep (Kazakhstan)

48 bn boe discovered to date



Gulf of Mexico petroleum systems

Source rocks deepens up to 10-15 km
 Deepest discovery – 10600 m (Tiber)
 Deepest well – 11945 m (Tiber)

57 bn boe discovered to date



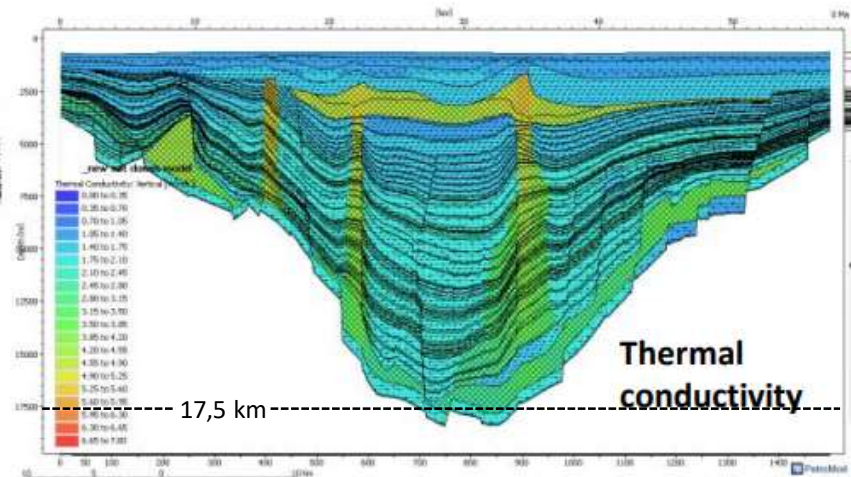
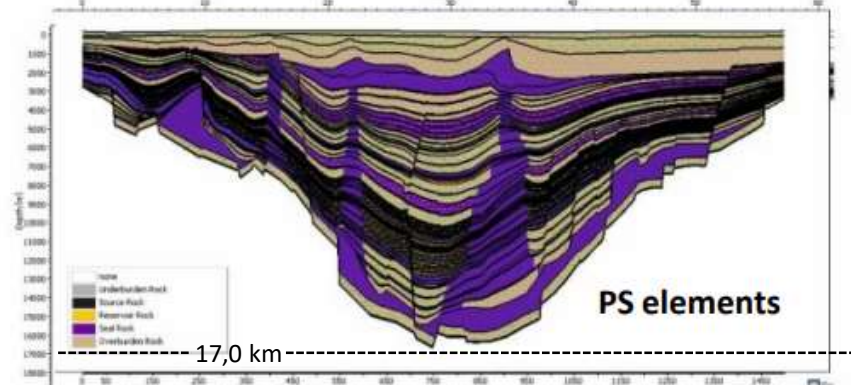
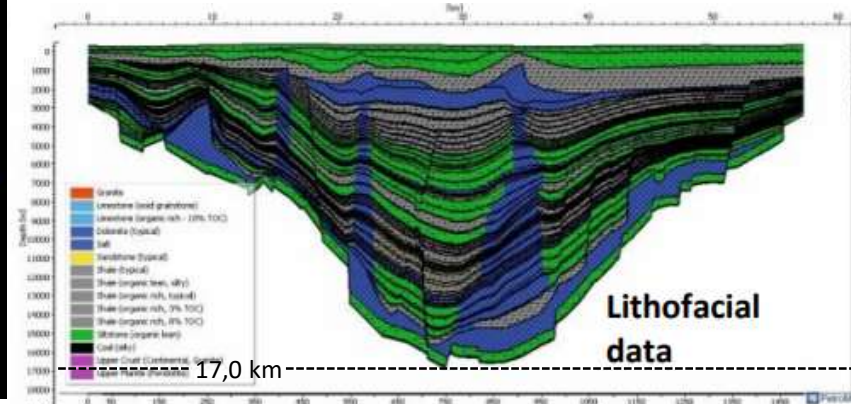
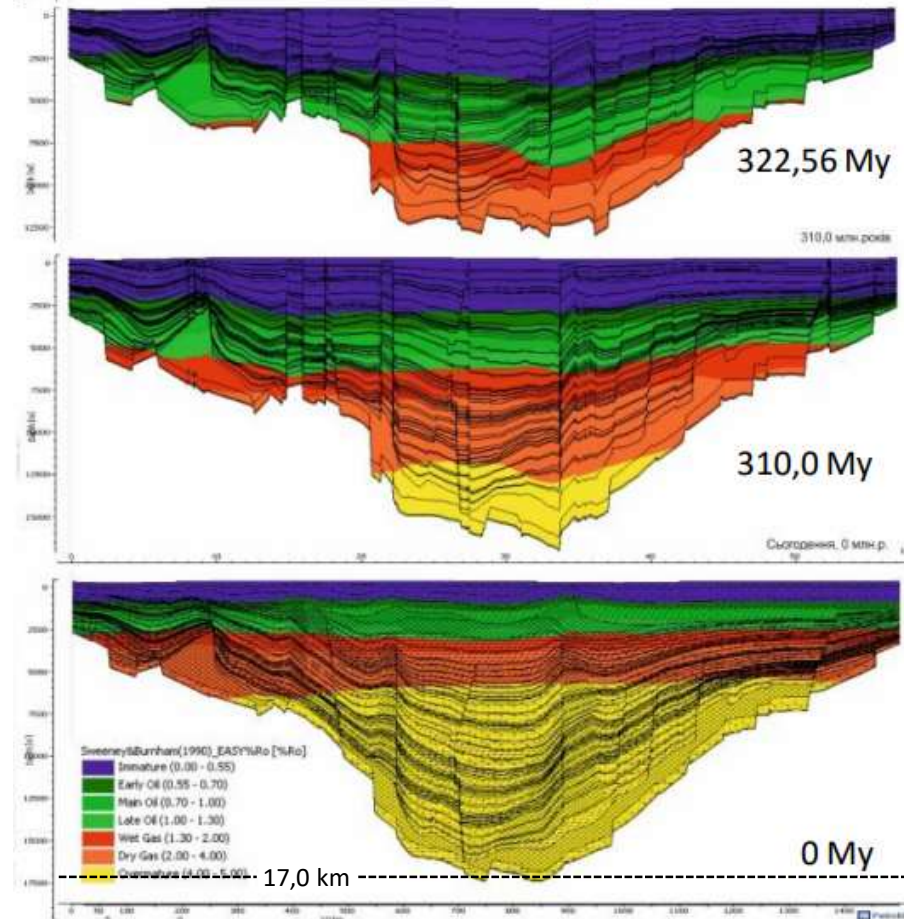
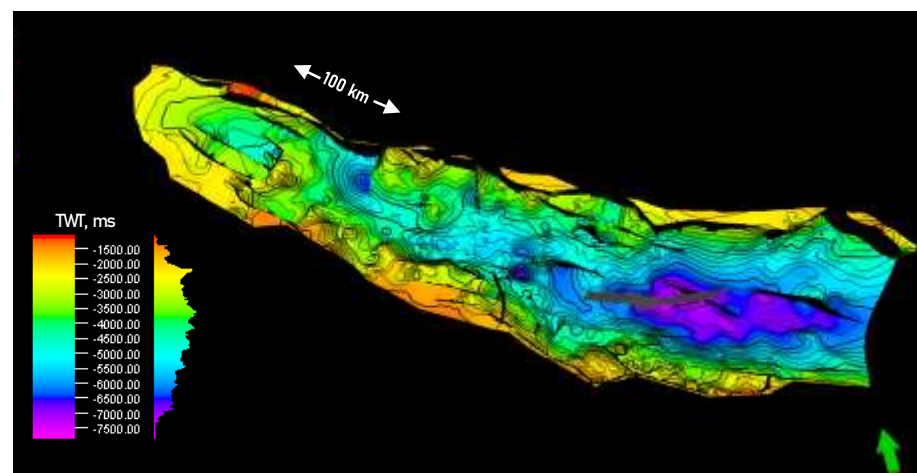
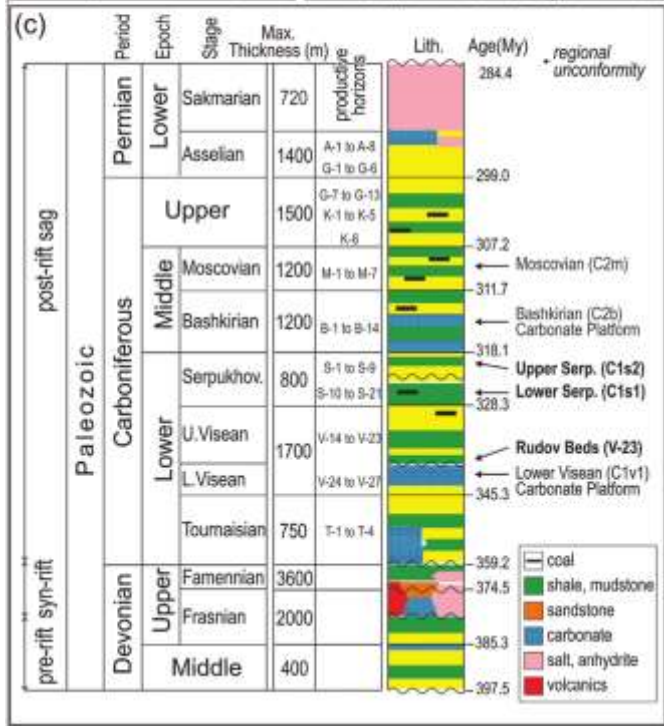
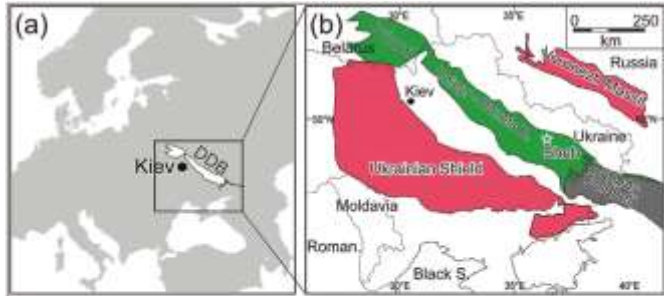
Tarim basin petroleum system, China

Source rocks deepens up to 10 km
 Deepest discovery – 6200-7100m (Tarim)
 Deepest well – 8038 m (Keshen-902)

16 bn boe discovered to date

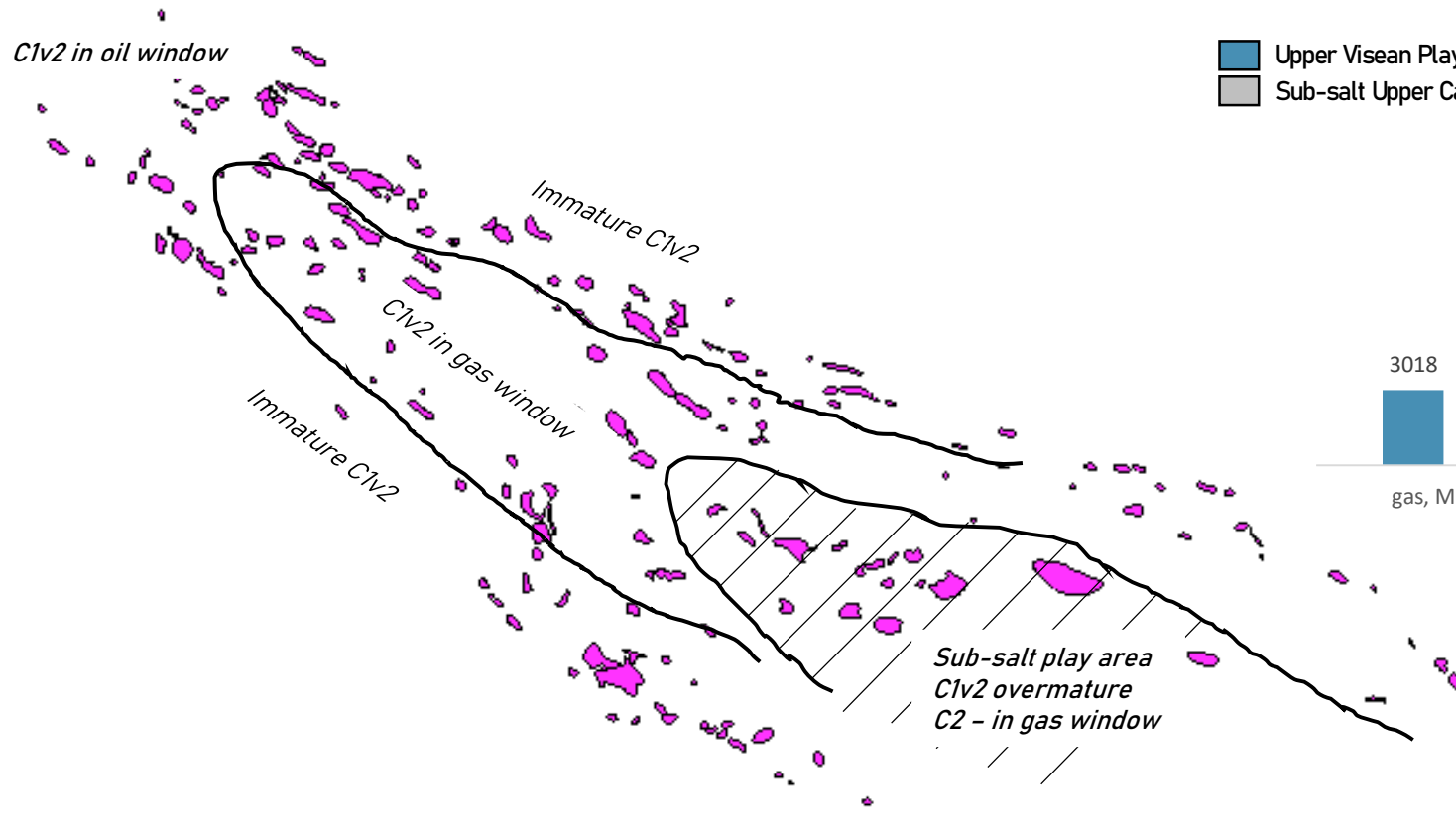


Super Basins: Dnieper-Donets basin



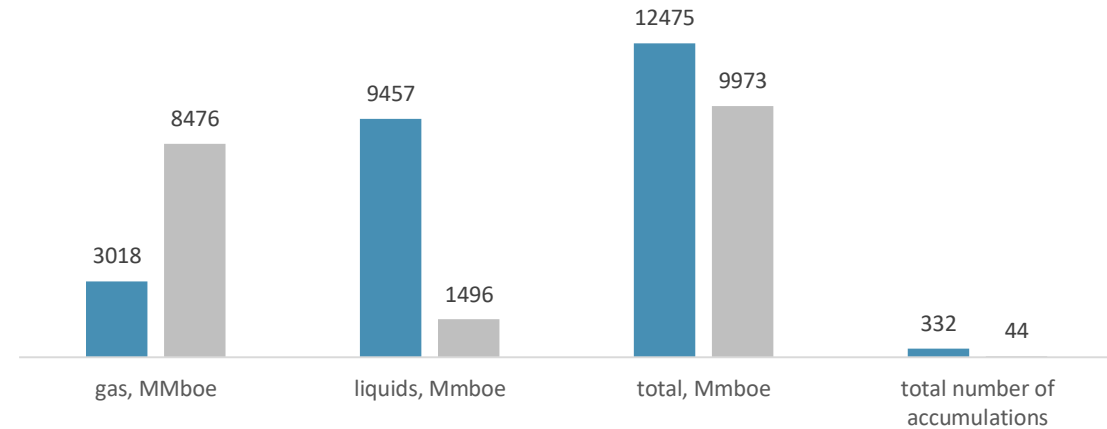
Super Basins: Dnieper-Donets basin

Generalized schematic thermal maturity map



Total accumulated volumes IIP in Upper Visean Play and Sub-salt (C3+P) Play

■ Upper Visean Plays
■ Sub-salt Upper Carboniferous - Permian Plays

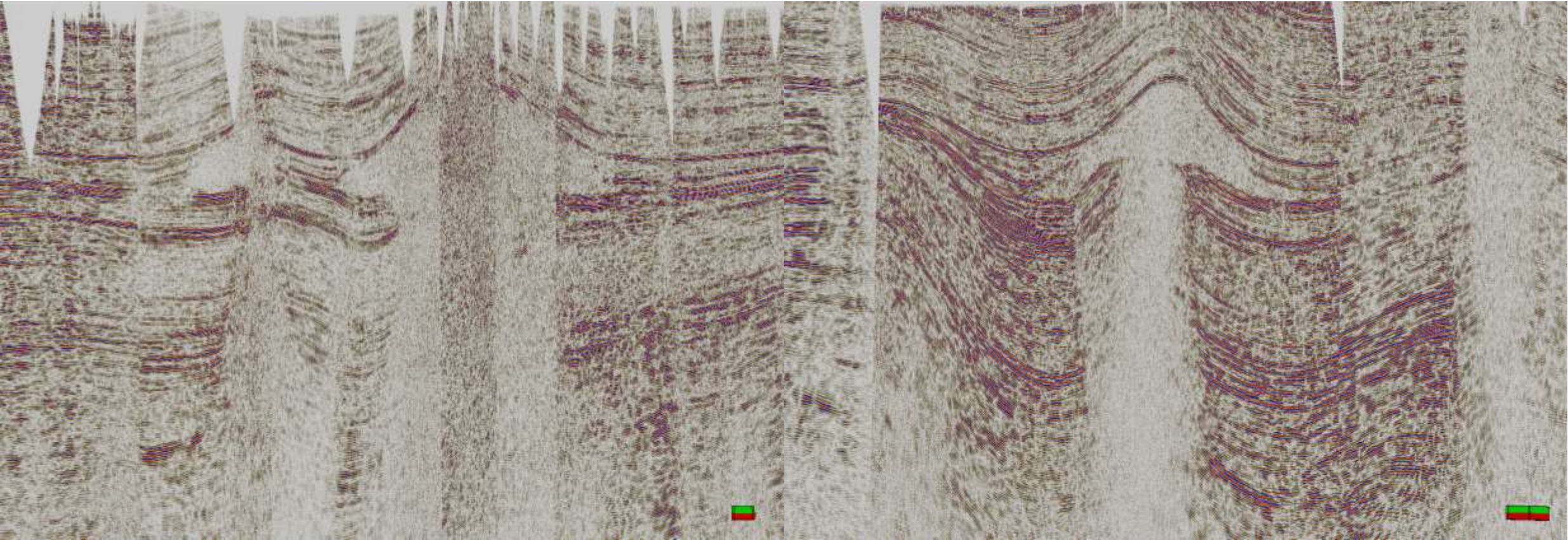


Total number of accumulations
 Upper Visean C1v2 - 332
 Sub-salt (C3+P) - 44

**Liquid: recoverable + unrecoverable, RF≈30%*

Upper Visean and Sub-salt petroleum systems almost do not interact which is proved by non-mixed HCs, geochemical plotting and modeling outputs.

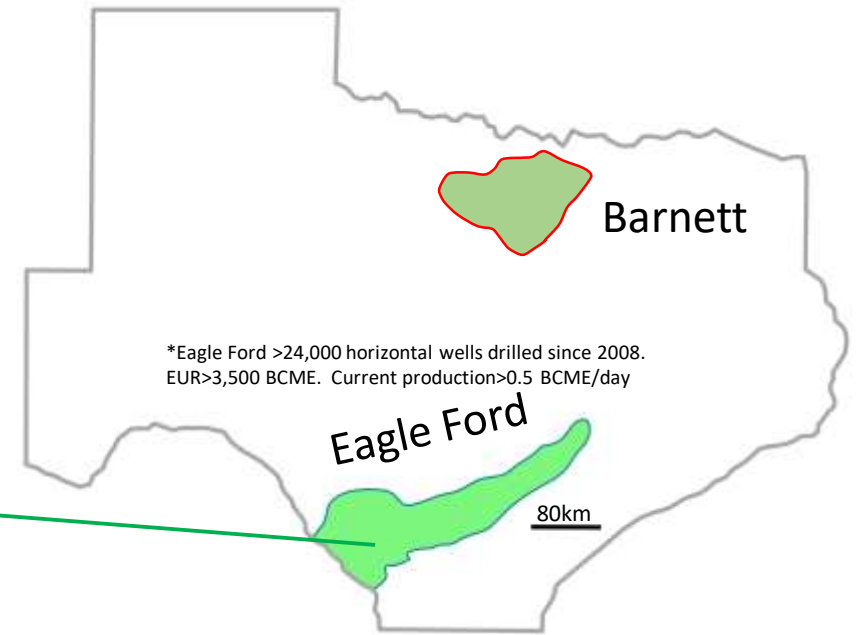
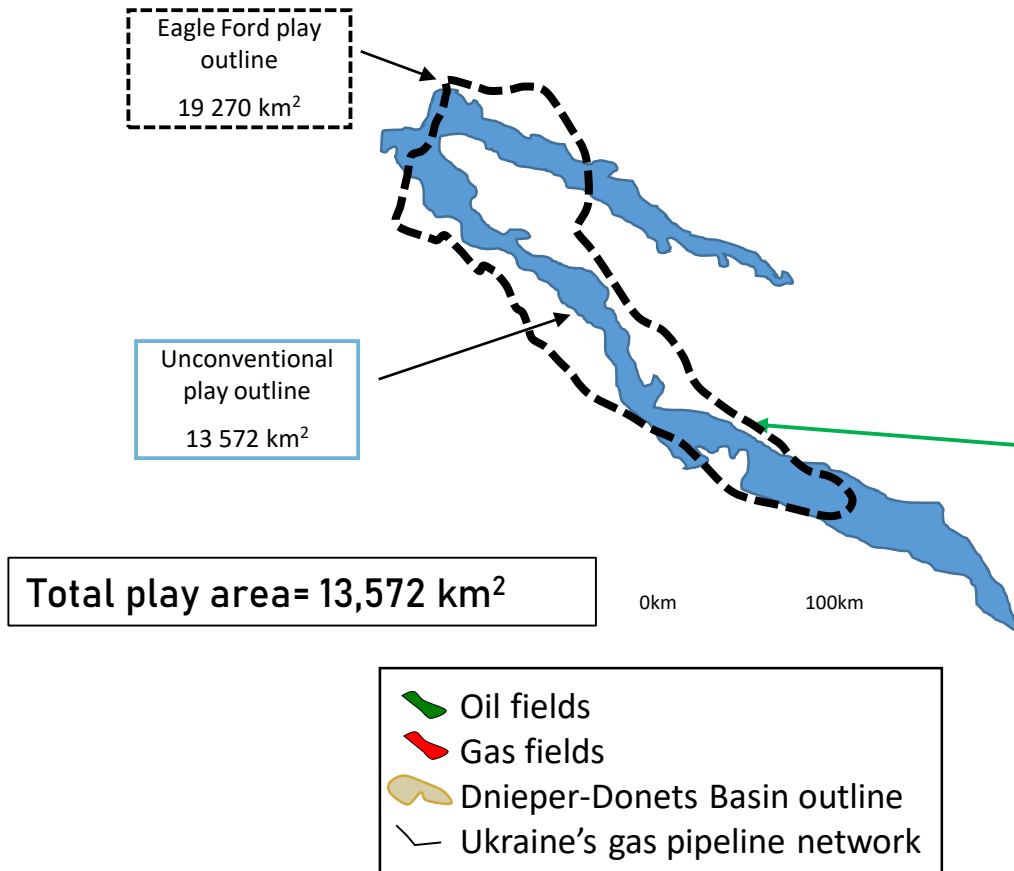
Super Basins: Dnieper-Donets basin



Dnieper-Donets basin: Unconventional Gas Plays

Lower Visean Shale and Carbonate Play Fairway Area (Eastern Ukraine)

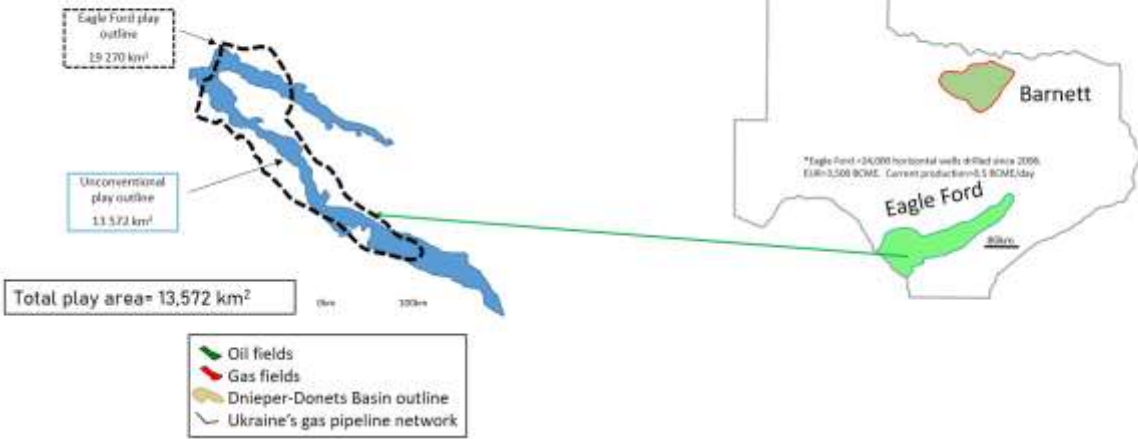
Eagle Ford and Barnett Shale Play Fairway Areas (Texas)



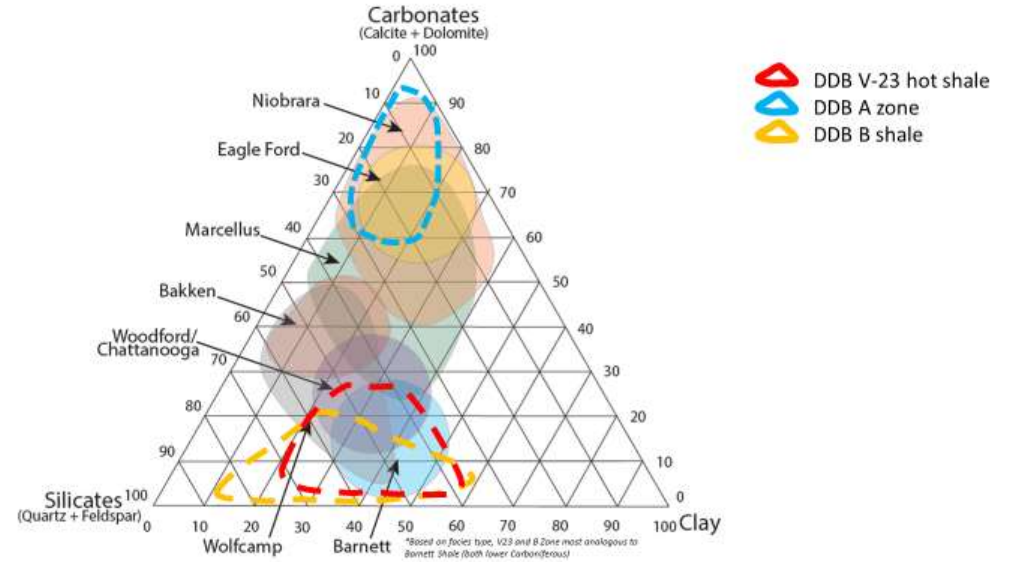
Dnieper-Donets basin: Unconventional Gas Plays

Lower Visean Shale and Carbonate Play Fairway Area (Eastern Ukraine)

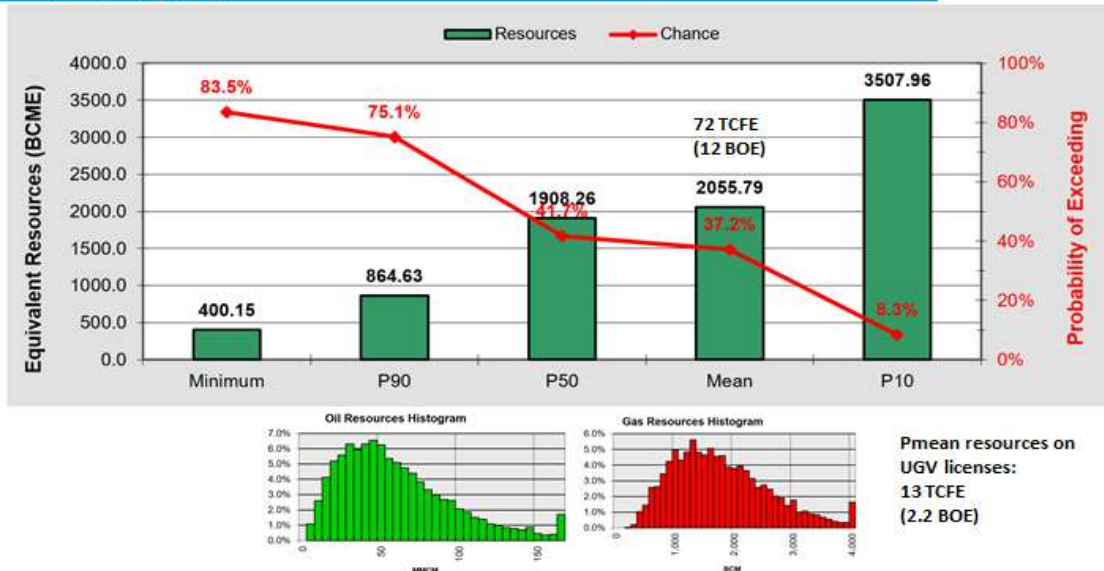
Eagle Ford and Barnett Shale Play Fairway Areas (Texas)



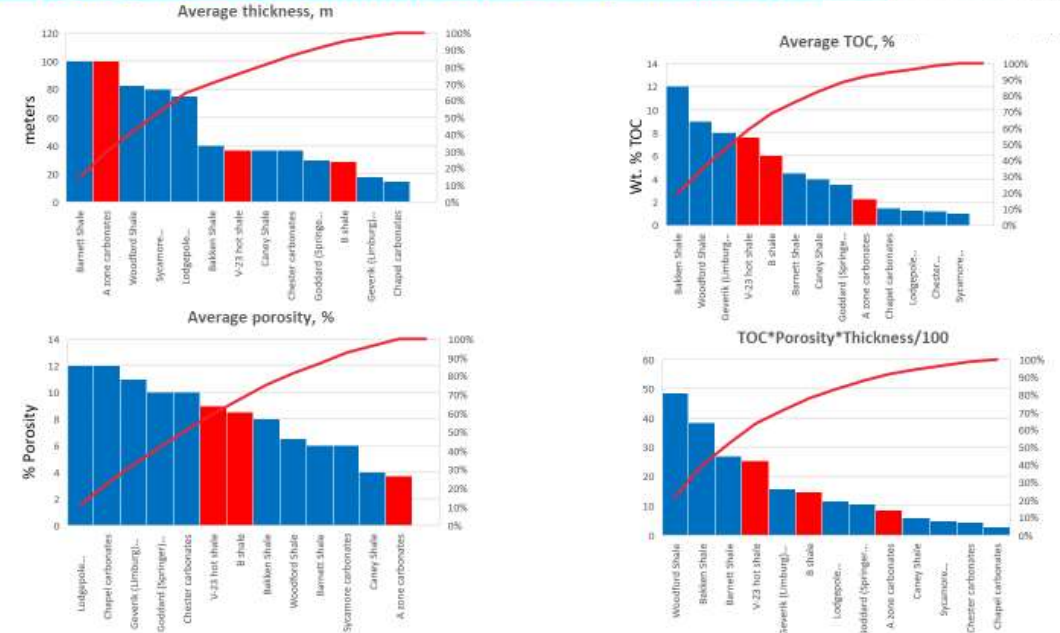
Compare based on Ternary diagram



Technically Recoverable Resources (V23/basal Visean carbonate) – Total Play Area



Main Geological, Petrophysical and Geochemical parameters compare



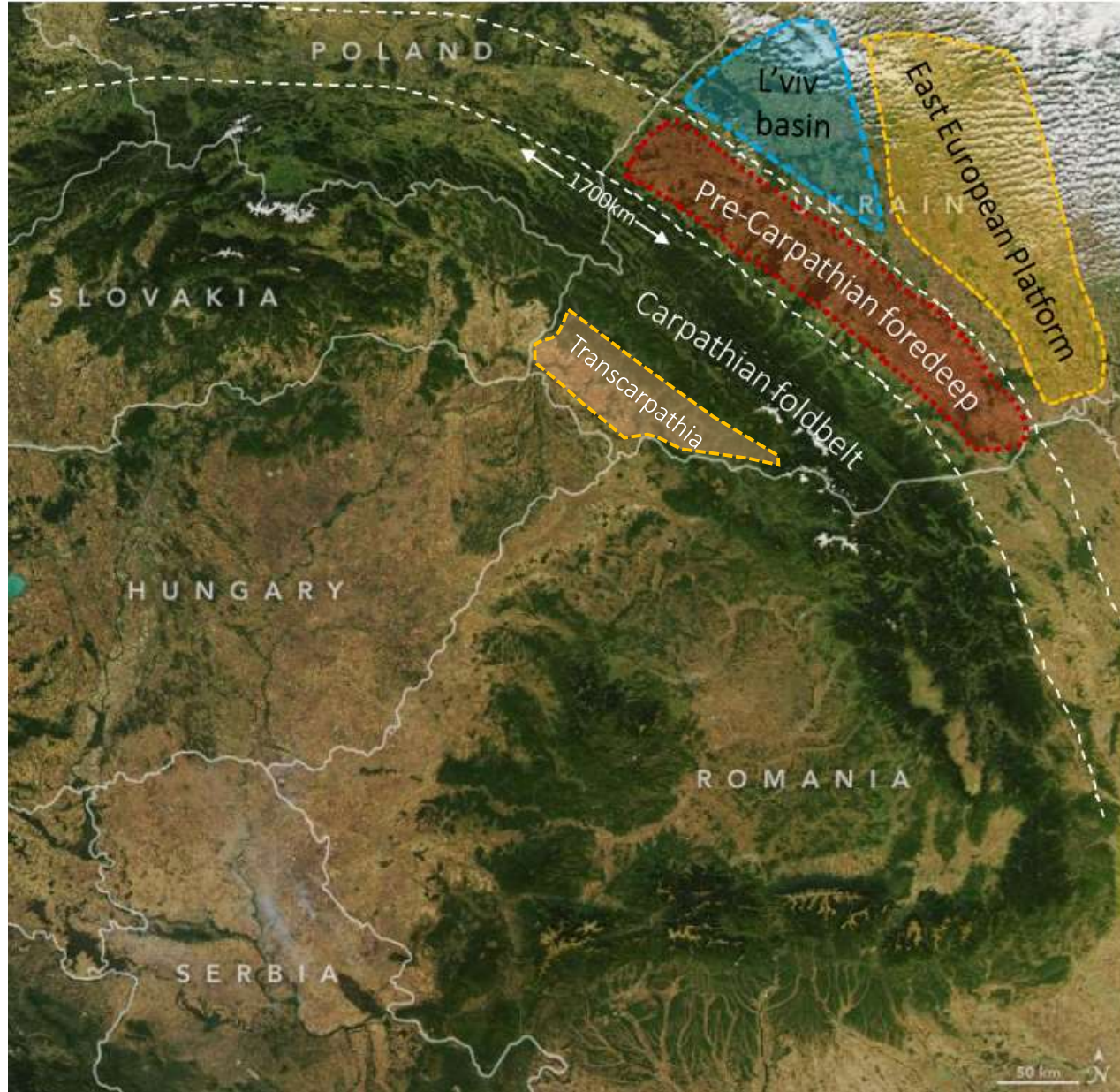
Super Basins: Family of Carpathian-Alpine Petroleum Systems



Totally 24 bn boe discovered to date
3,6 bn boe (15%) discovered within Ukraine

Super Basins: family of Carpathian–Alpine Petroleum Systems

Western Paratethys



Oil in North-Eastern Pre-Carpathians:

- 1753 – first mention of oil seeps
- 1771 – oil deposit found while deepening the salt mine, new mines were dug in 1775
- 1862-1879 start of oil production (Sloboda Rungurska village area, Kolomiya region)
- 1861 – first oil well in Boryslav region
- 1873 - 1500 drilled oil wells and 12000 dug wells and mines in Boryslav city area
- 1909 – oil production reached 15 MMBBL pa

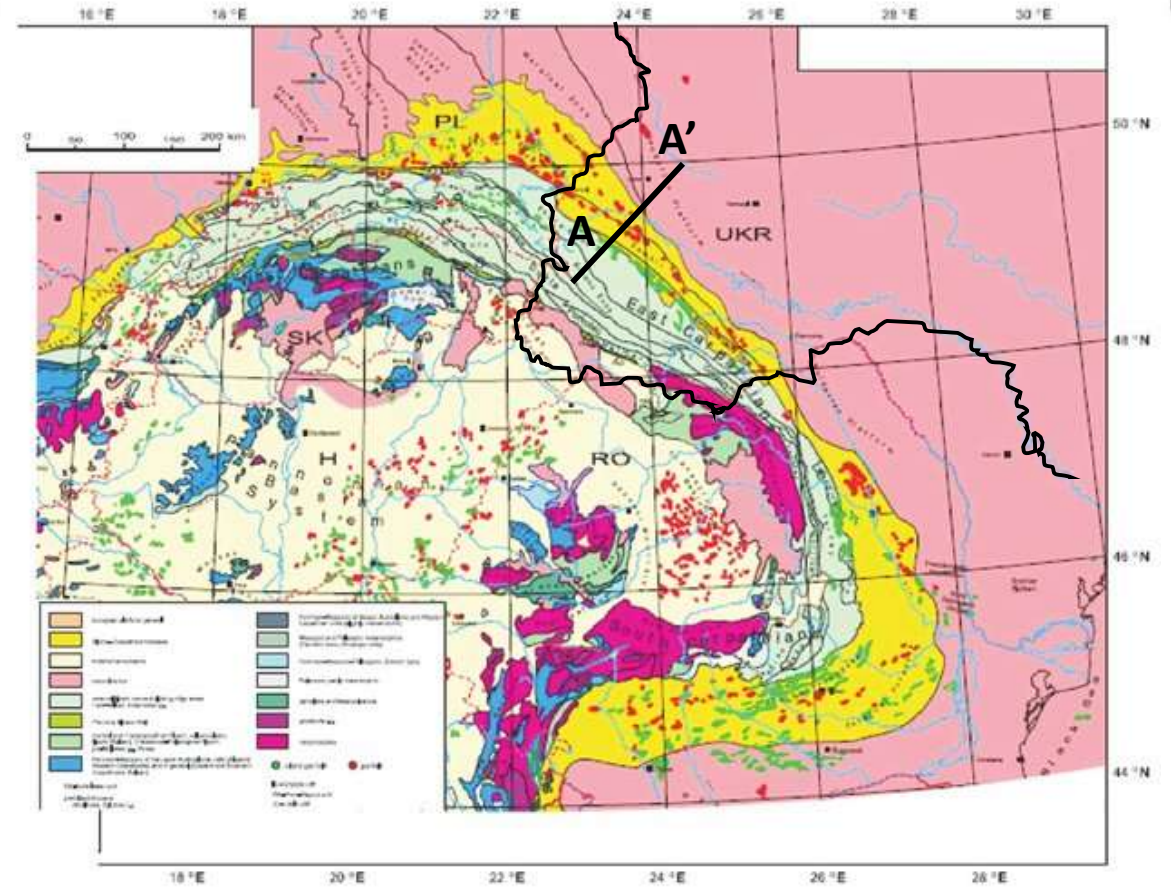
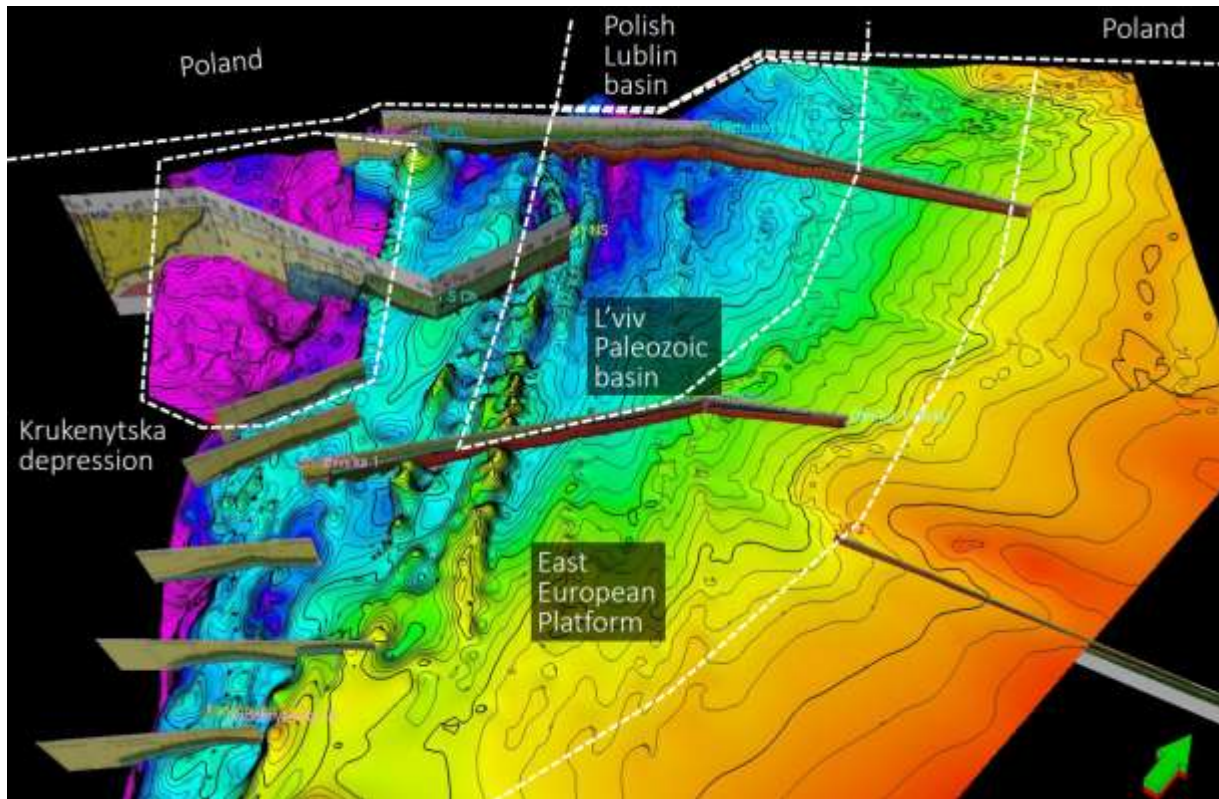
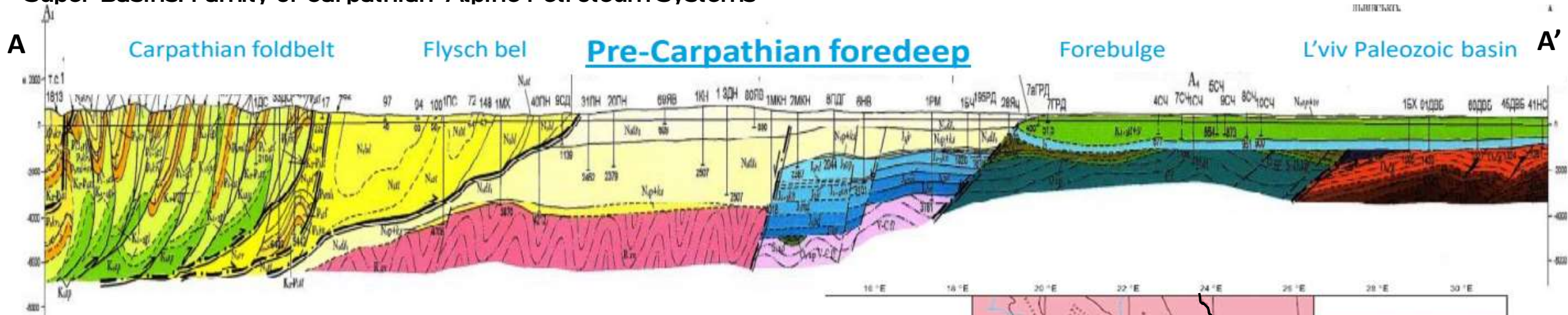


XIX century photos

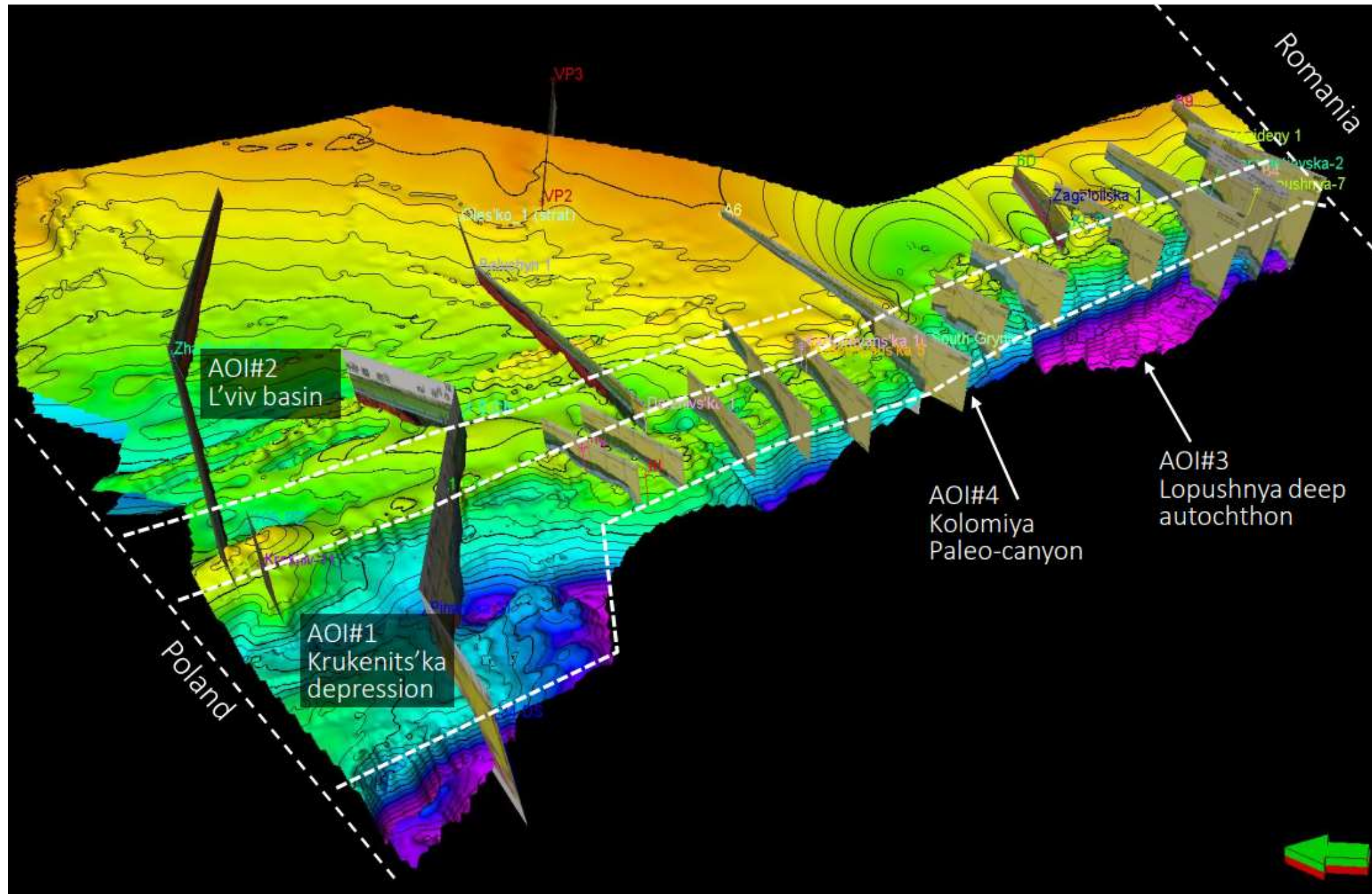
1897-1910 – discovery of 3 sub-provinces within Outer part of Carpathian fold belt

- 1913 (or 1921) – Dashava gas field discovery (biggest in Europe at that time)
- 1921 – first European gas pipeline was constructed starting from Dashava field cluster
- 1940s – discovered gas reserves within L'viv cluster was enough for creation of international gas pipelines and inter-republic pipelines
- 1955 - Western Ukraine gas production had accounts 48% of USSR gas output (from 8 fields)

Super Basins: Family of Carpathian-Alpine Petroleum Systems

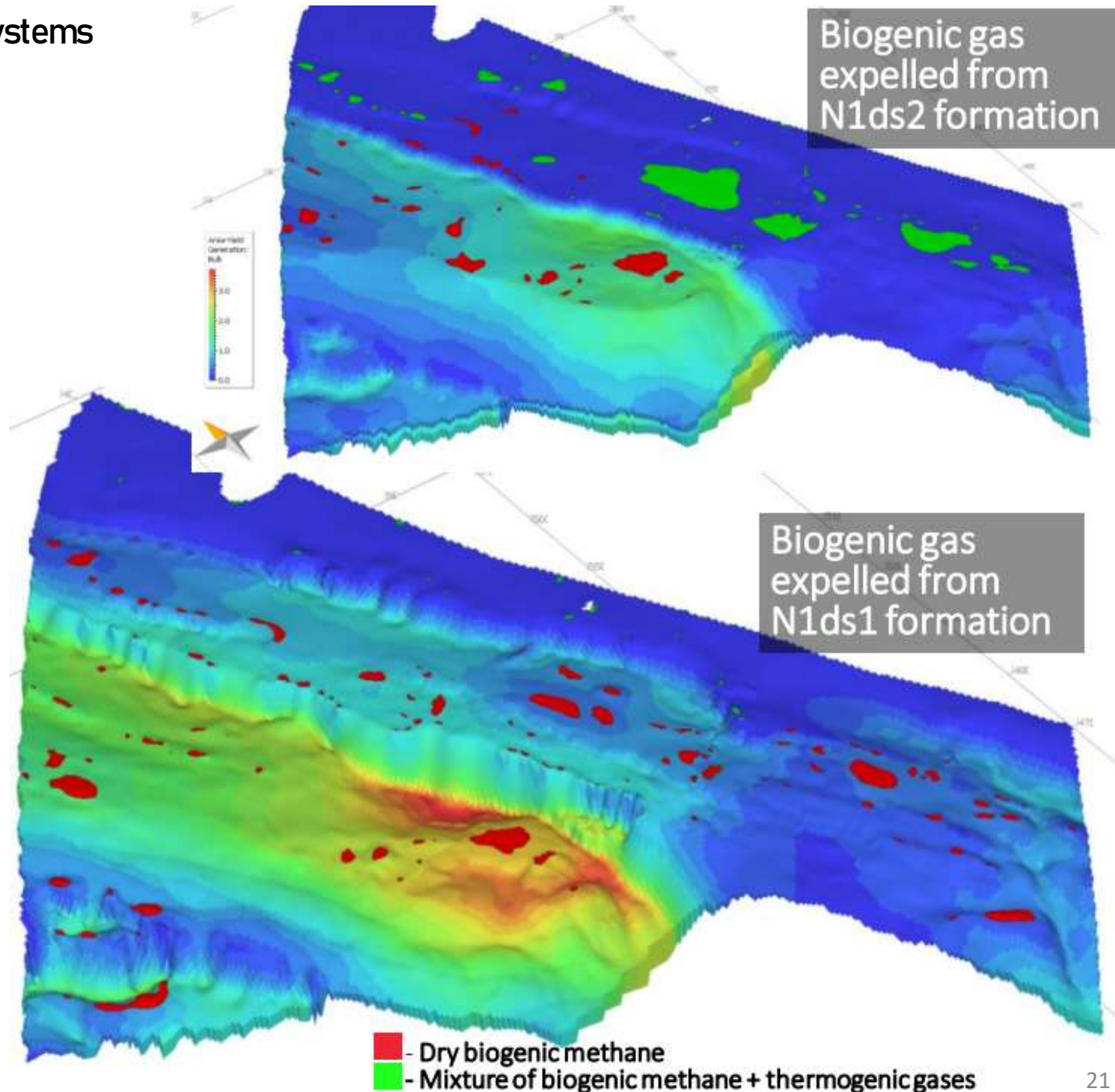
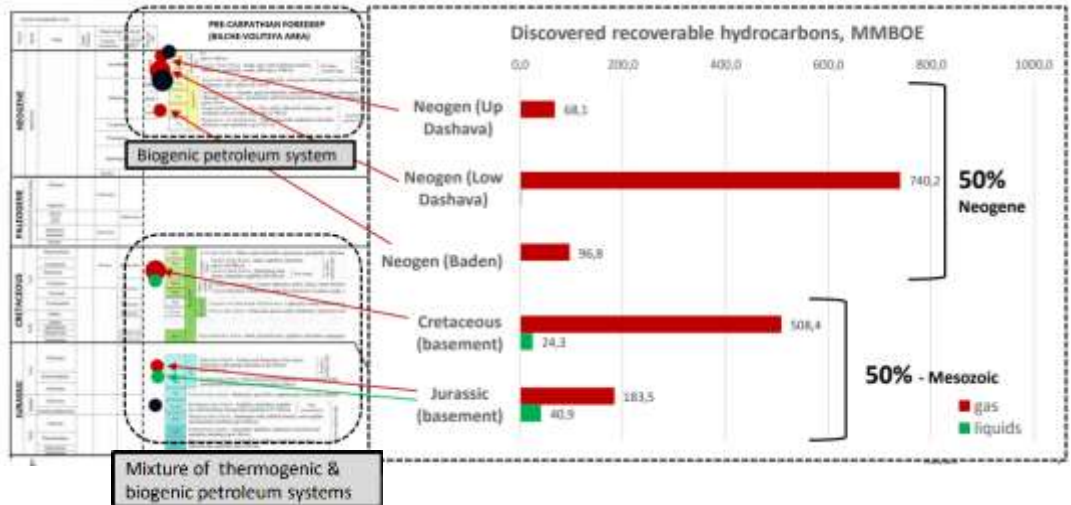
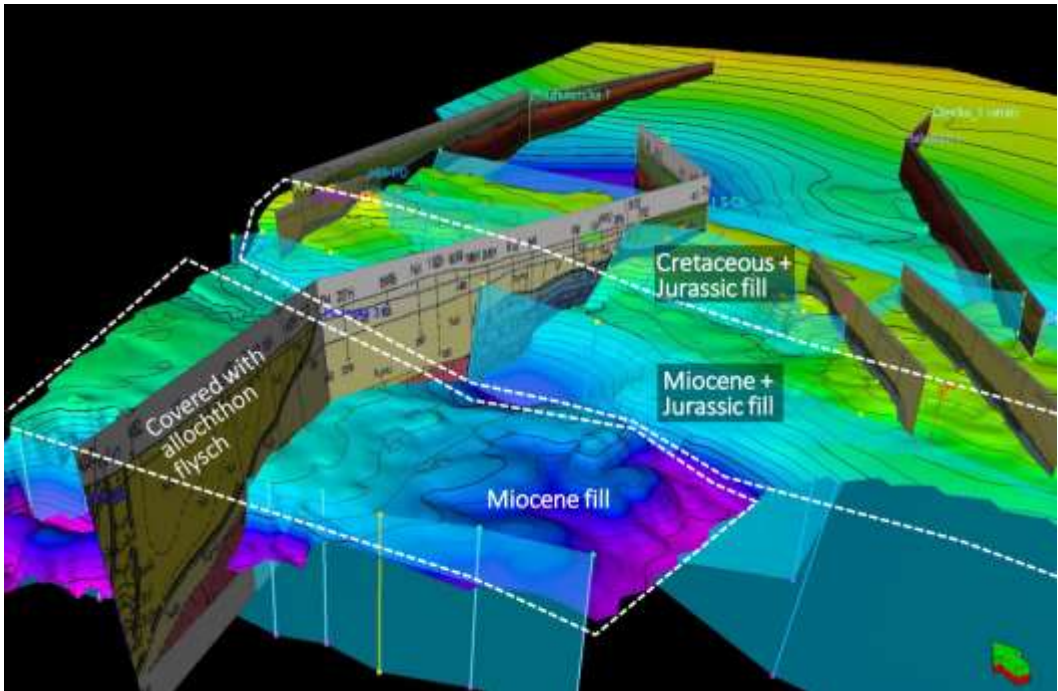


Super Basins: Family of Carpathian-Alpine Petroleum Systems

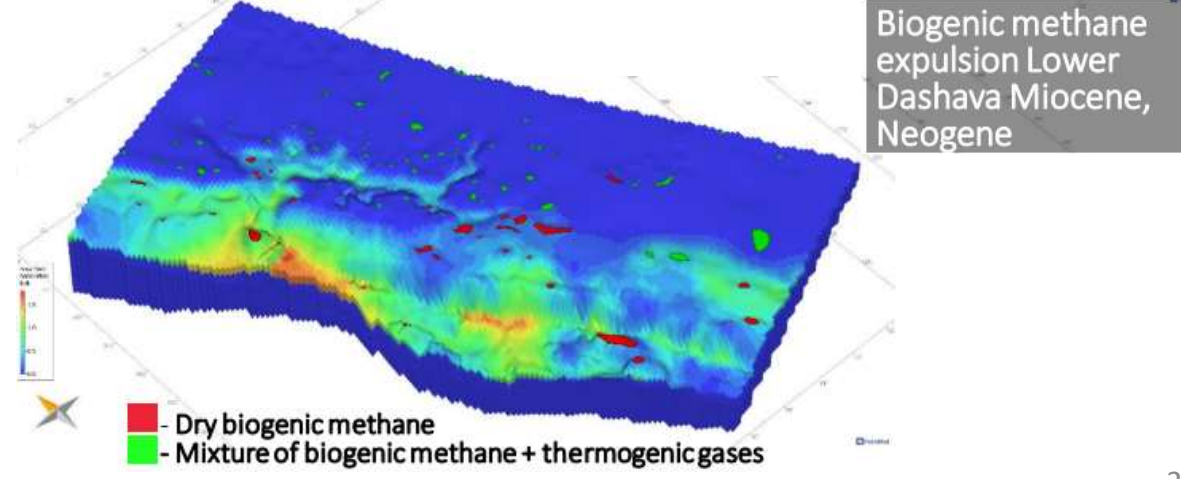
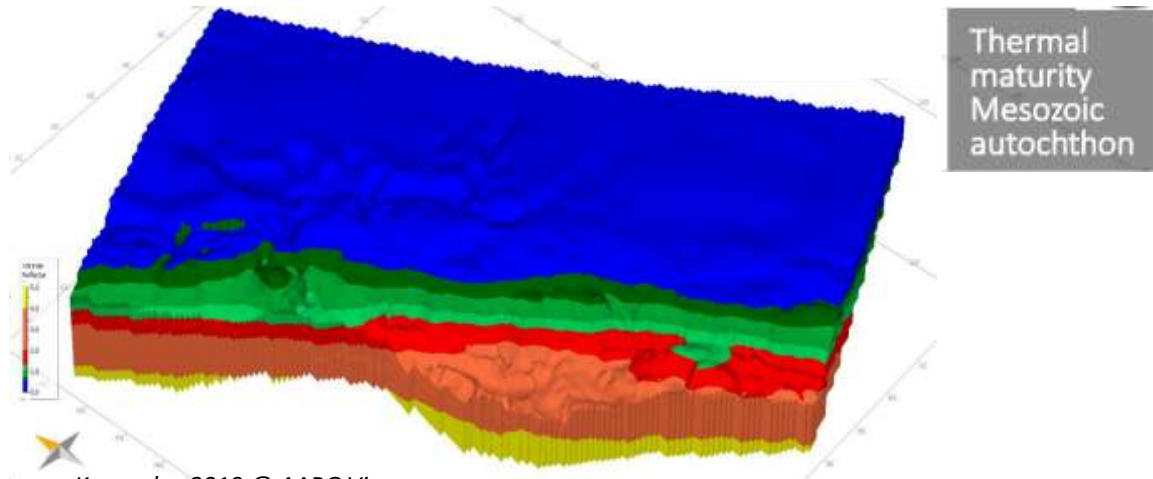
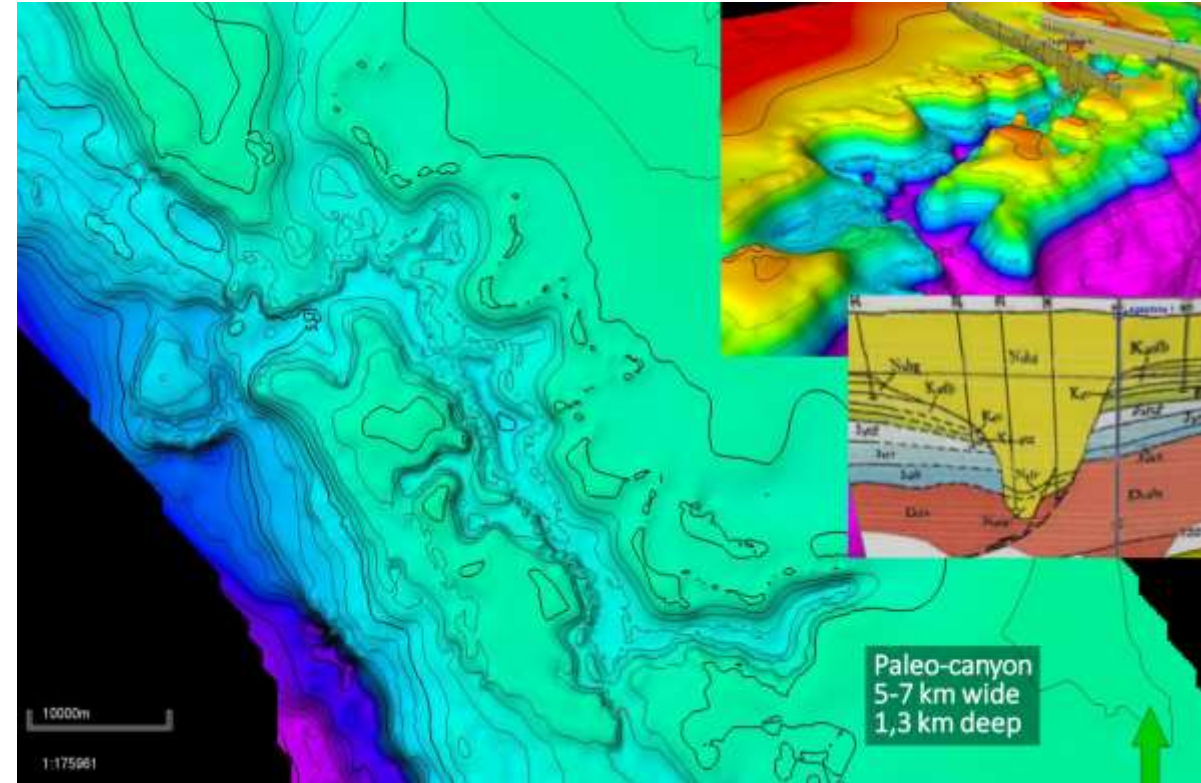
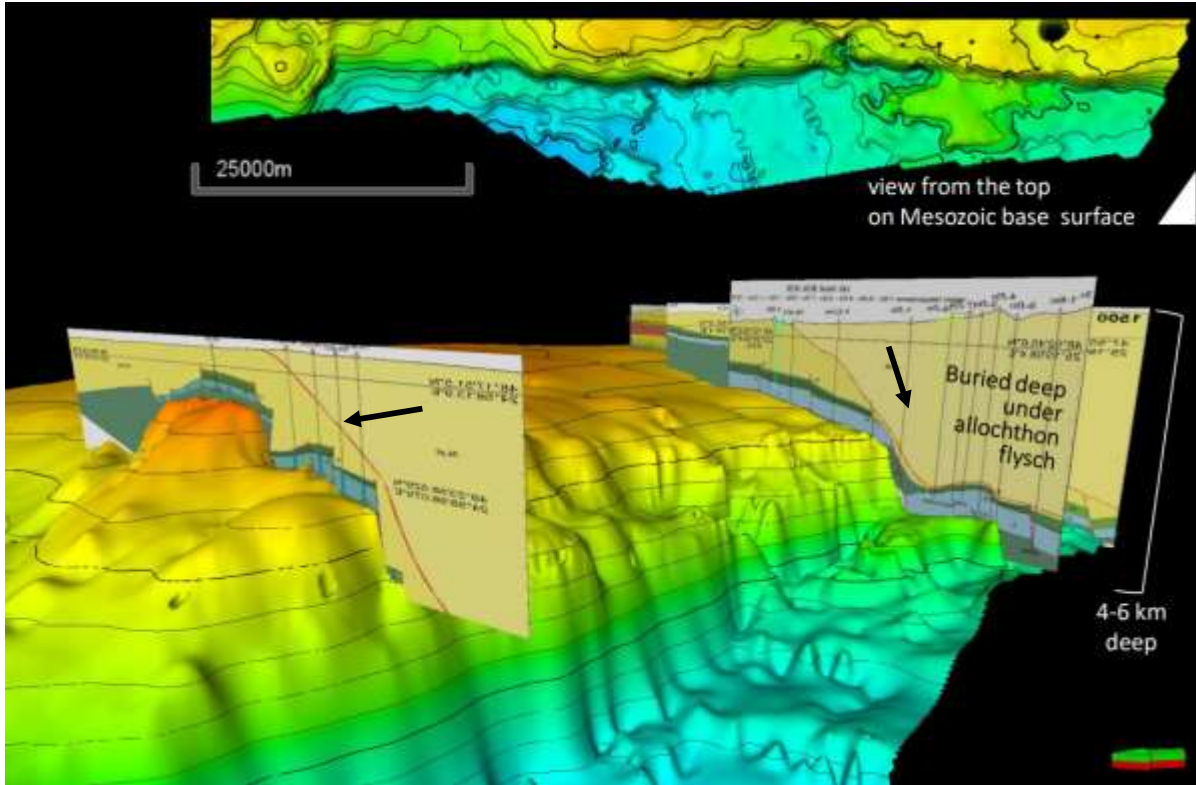


Sources:
Karpenko, 2019
@ AAPG Vienna

Super Basins: Family of Carpathian-Alpine Petroleum Systems



Super Basins: Family of Carpathian-Alpine Petroleum Systems



Legal framework for entry opportunities

	Production sharing agreement (PSA)	Production Enhancement Contract (PEC)	Join venture (JV)	Join Activity Agreement (JAA)
General	2-Party (or more) contract between the investors and the State; investors commit to execute the work program and perform minimum spend obligations	2-Party partnership between license holder and contractor; contractor is selected as a result of tender procedure	Sale and purchase agreement and shareholders agreement	2-Party agreement between license holder and investor without incorporation of a separate entity
Duration	50 years	15+ years	Duration of the license	Duration of the license
Title to the licence	License is issued to all investors under PSA for the whole term of the PSA (covers all stages of the project)	License remains with the license holder; contractor has access to operate all available infrastructure on the field	Special license remains with the JV	Special license remains with the license holder
Title to the reserves and production	Investors can book their share of reserves and get the title to their share of production	Remain with the license holder	Remain with the JV	Remain with the license holder
Operational control	Stays with the Operator (agreed by the Parties); Joint Operatorship Agreement (JOA) has to be signed between the investors	Contractor has operational control; license holder approves key decisions (e.g. WP&B, Key CAPEX items) via Management Committee	JV has operational control	License holder has operational control
CAPEX / Financing	Shared between license holder and investor, depending on participation share / other commercial agreements (carry etc.)	100 % financed by the contractor	100 % financed by the JV; investors share them depending on participation share or other arrangements	Shared between license holder and investor, depending on JAA
Compensation mechanism	Up to 70 % of production offsets against Investors' recoverable expenses, up to 89% of remaining 30% - investor's profit share	Service fee: 2-stage \$/thousand cm tariff (baseline and incremental); incremental is much higher than baseline	Not applicable	Not applicable
Taxation	Fixed tax regime for the whole PSA term. Income tax – 18%, dividend repatriation tax – 15%, royalty for the production of liquids – 2 %, natural gas – 1.25%	Income tax – 18%, Dividend repatriation tax – 15%	Income tax – 18%, Dividend repatriation tax – 15% Applicable royalties	Income tax – 18%, Dividend repatriation tax – 15% Royalties – 70%



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