

## **Play Types of the Moesian Platform of Romania and Bulgaria\***

**Gabor Tari<sup>1</sup>, Daniela Ciudin<sup>2</sup>, Albert Kostner<sup>1</sup>, Adriana Raileanu<sup>2</sup>, Alina Tulucan<sup>2</sup>, Gheorghe Vacarescu<sup>2</sup>, and Dian Vangelov<sup>3</sup>**

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<sup>1</sup>OMV, Vienna, Austria ([gabor.tari@omv.com](mailto:gabor.tari@omv.com))

<sup>2</sup>Petrom, Ploesti, Romania

<sup>3</sup>St. Ivan Rilski University, Sofia, Bulgaria

### **Abstract**

The Moesian Platform is well known as a prolific and mature petroleum province on the western margin of the Black Sea. As the promontory of the European Platform, the Moesian Platform is bordered to the north and to the west by the South Carpathians, and to the south by the Balkanides. The vast thickness (>10 km) of Cambrian to Recent sedimentary cover of the Moesian Platform offers an exceptional record of the Phanerozoic evolution of the European plate. The Paleozoic succession has several source rock intervals (e.g. Silurian shales) and also proven reservoirs (e.g. fractured Devonian carbonates). Above the Hercynian unconformity, Permian to Middle Triassic continental to shallow marine sediments were deposited in a facies succession quite typical for a period an aborted rift. The extensional period was replaced by the Norian-Rhaetian by a compressional regime in the whole Moesian Platform, producing a north-vergent foreland thrust-fold belt. The Cimmerian unconformity formed during the earliest Jurassic post-orogenic uplift and subaerial erosion of the folded belt and most of the Bulgarian hydrocarbon reserves are directly related to this pronounced unconformity. Above the Cimmerian unconformity the sedimentary facies and thickness relations of Middle Jurassic to Lower Cretaceous carbonates clearly show the development of a northwest-facing passive margin in Romania and a south-facing passive margin in Bulgaria. Whereas the final docking of the Balkans on the Moesian Platform margin has occurred at the end of the Eocene, this did not happen on the northern edge until the Late Miocene when the Carpathians stopped moving onto the platform. Unlike the Balkans, the Carpathians produced a wide and deep foreland basin with a very pronounced foredeep unconformity reaching far to the south within the platform succession. The generally east-west trending normal faults which were formed due to the flexural extension of the Moesian Platform do not extend more than 100 km to the south from the non-emergent leading edge of the Carpathians. These Miocene normal faults, however, provided the traps for most of the hydrocarbon reserves in the Romanian side of the Moesian Platform.

In addition to the successful and well-known play types, several underexplored play types exist in the central part of the Platform. The first set of plays is related to the Middle Jurassic-Lower Cretaceous carbonate platform which straddles the Romanian part in a general NE-SW

direction. The trap for this play is a roll-over anticline trend just basinward from the platform edge (e.g. Nenciulesti-Buzescu Field). Additional traps within the Albian are expected to be associated with the compactional anticlines over the platform edge and local patch reefs behind it. Also, the talus on the paleoslope of the platform remains untested.

Another set of underexplored play types can be found in the broader Rosiori/Giurgiu area. There are several generations of normal faults in this area, related to the incipient Permian to Triassic rifting and to the reactivation of some of the faults during the Neogene. Whereas most of the traps above the Cimmerian unconformity were tested in the past, the normal fault related Triassic- Paleozoic targets have not been addressed in a systematic manner. The last set of plays is associated with the Latest Triassic Cimmerian anticlines which could be found both in Romania and Bulgaria but predominantly to the north of the Danube. Some of these large fault-bend fault structures were already tested by drilling, but without the proper understanding of their internal geometry. On the level of the mid-Triassic carbonate reservoirs some of these anticlines still have their critical Upper Triassic seal sequence preserved. Deeper Paleozoic targets, such as Devonian carbonates, are dependent on the presence of a Carboniferous shale seal which is difficult to assess due to the small number of well penetrations.

### **Selected References**

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- Tari, G., 2005, The divergent continental margins of the Jurassic proto-Pannonian Basin; implications for the petroleum systems of the Vienna Basin and the Moesian Platform, *in* P.J. Post, N. Rosen, D.L. Olson, S.L. Palmes, K.T. Lyons, and G.B. Newton (eds.), *Petroleum Systems of Divergent Continental Margin Basins: 25<sup>th</sup> Annual GC/SEPM Foundation, Bob. F. Perkins Research Conference Symposium*, p. 44.
- Tari, G., O. Dicea, J. Faulkerson, G. Georgiev, S. Popov, M. Stefanescu, and G. Weir, 1997, Cimmerian and Alpine stratigraphy and structural evolution of the Moesian Platform (Romania/Bulgaria), *in* A.G. Robinson (ed.), *Regional and Petroleum Geology of the Black Sea and Surrounding Region: AAPG Memoir 68*, p. 63-90.
- Wessely, G., and W. Liebl (eds.), 1997, *Oil and Gas in Alpidic Thrustbelts and Basins of Central and Eastern Europe: Special Publication of the European Association of Petroleum Geoscientists*, v. 5: EAGE Conference 1994, Vienna, Austria, 456 p.

# Play types of the Moesian Platform of Romania and Bulgaria

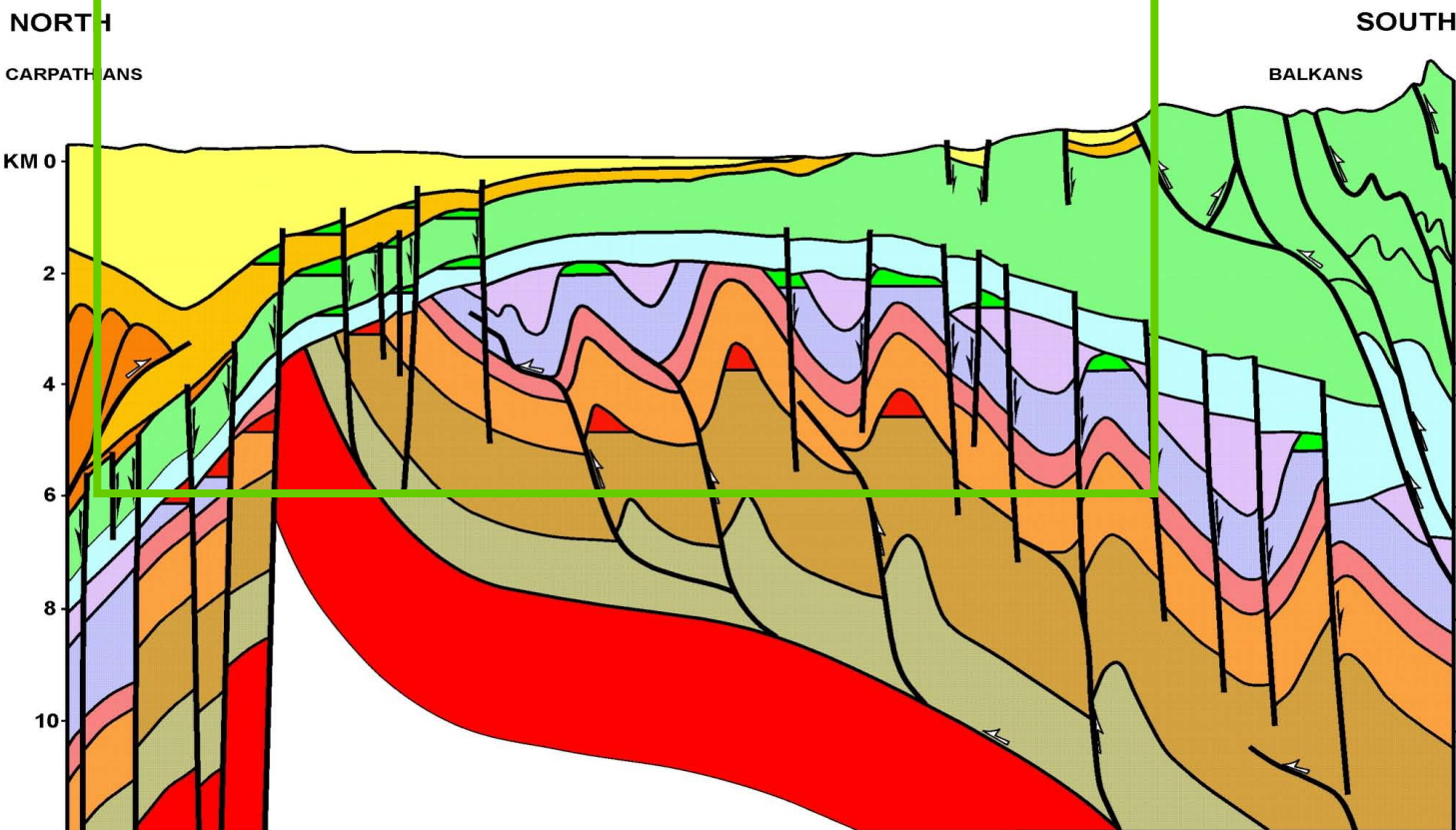
Gabor Tari<sup>1</sup>, Daniela Ciudin<sup>2</sup>, Albert Kostner<sup>1</sup>,  
Adriana Raileanu<sup>2</sup>, Alina Tulucan<sup>2</sup>, G. Vacarescu<sup>2</sup>  
and Dian Vangelov<sup>3</sup>

<sup>1</sup> OMV, Vienna, Austria

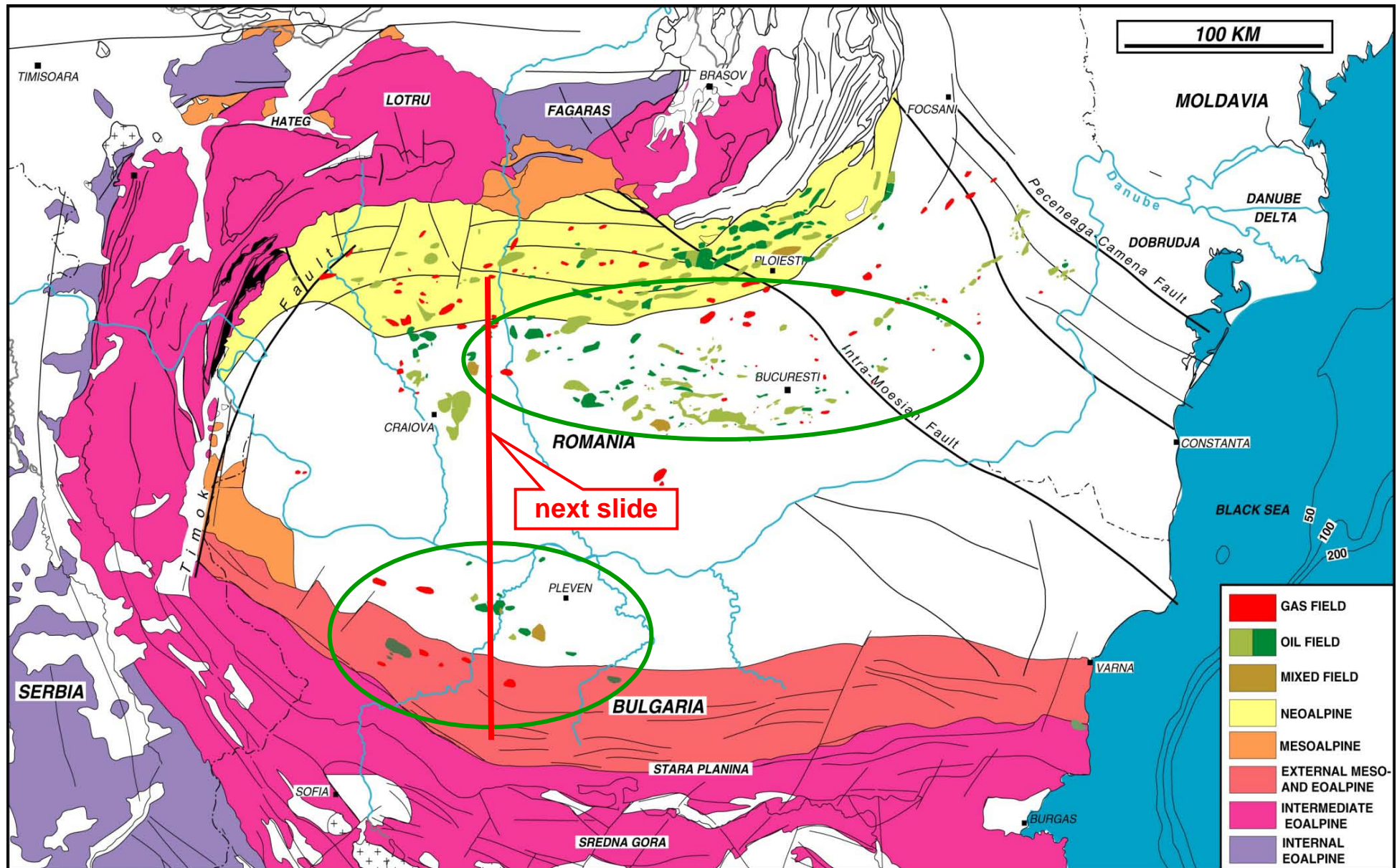
<sup>2</sup> Petrom, Ploesti, Romania

<sup>3</sup> St. Ivan Rilski University, Sofia, Bulgaria

AAPG Conference, Kiev, October 18, 2010



# Moesian Platform, subdivision and field distribution

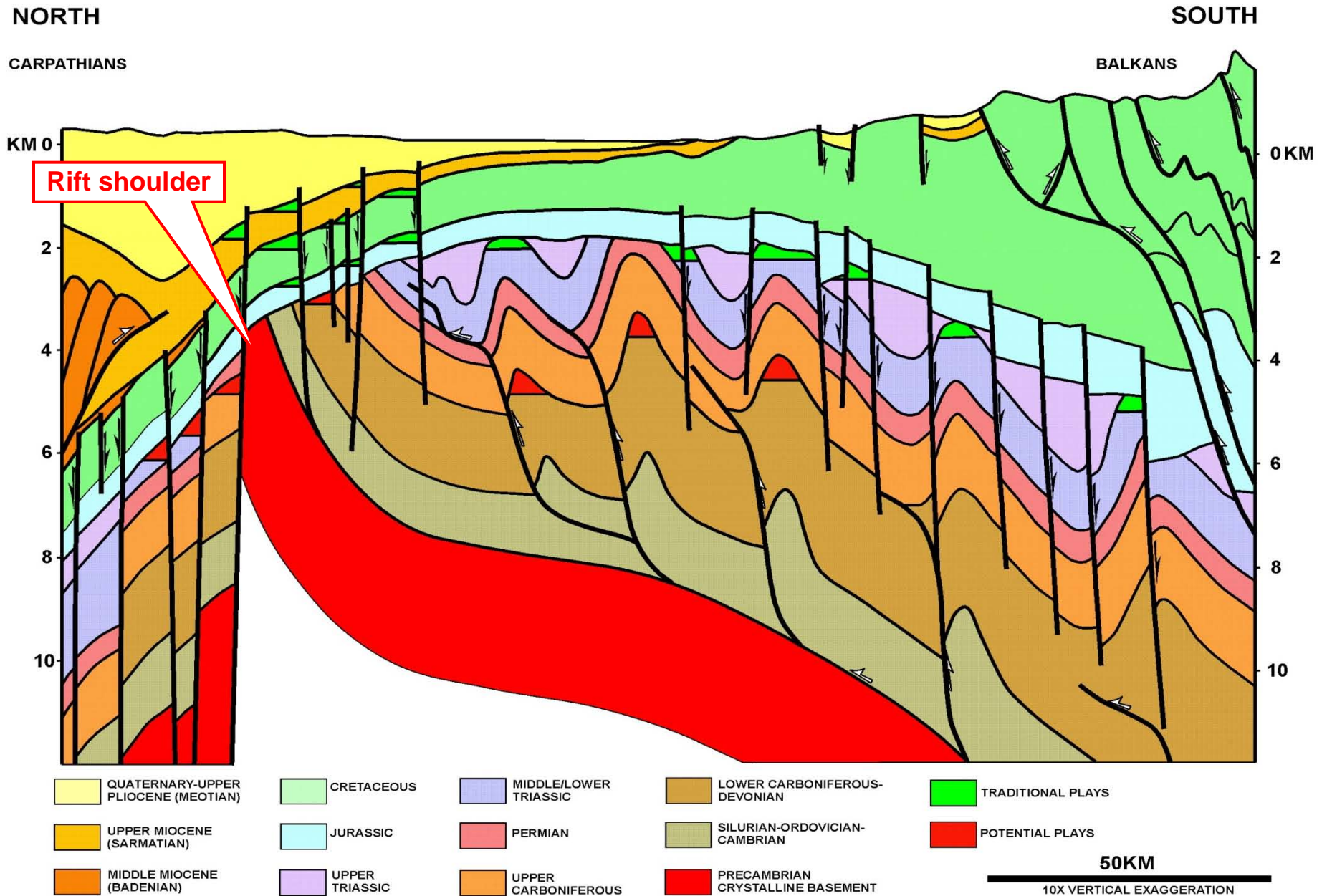


*Tari and others (1997)*

The Romanian and Bulgarian petroleum systems are different in origin and also in their geographic extent

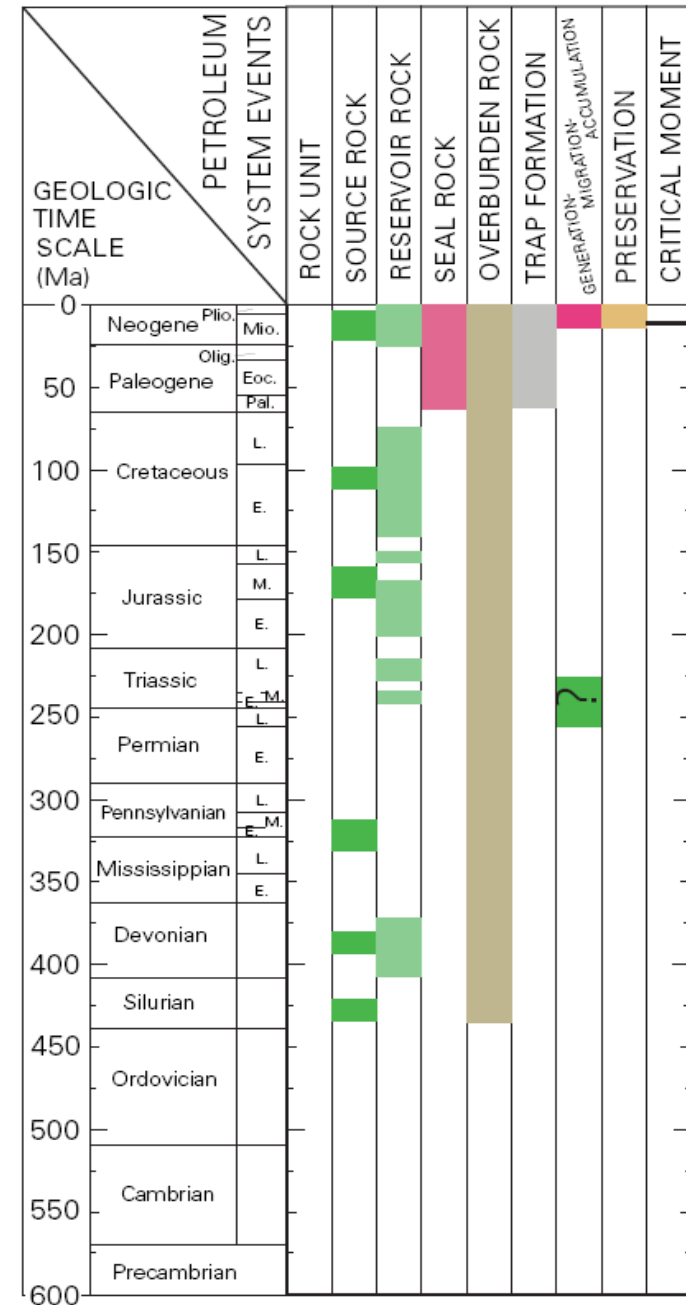
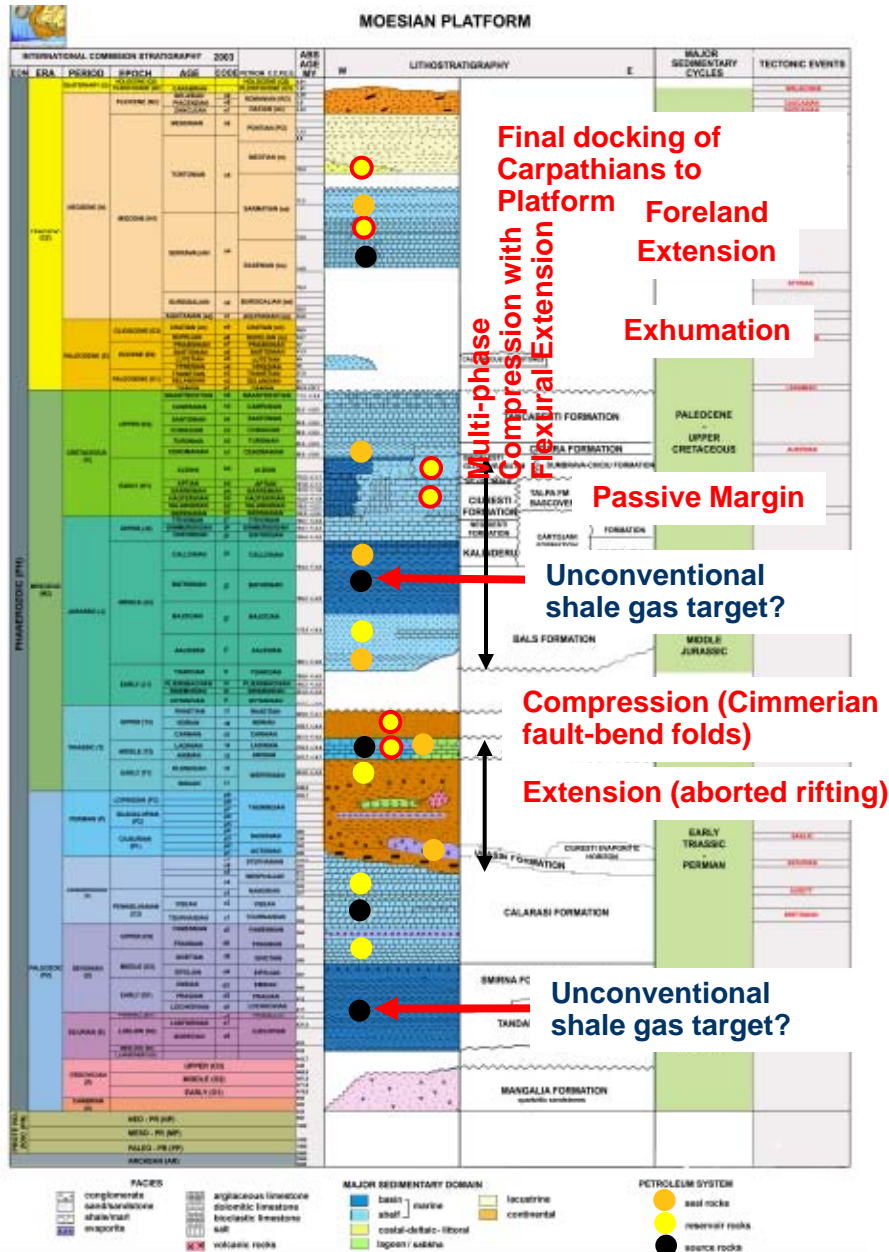


# Regional transect, Moesian Platform, Romania and Bulgaria



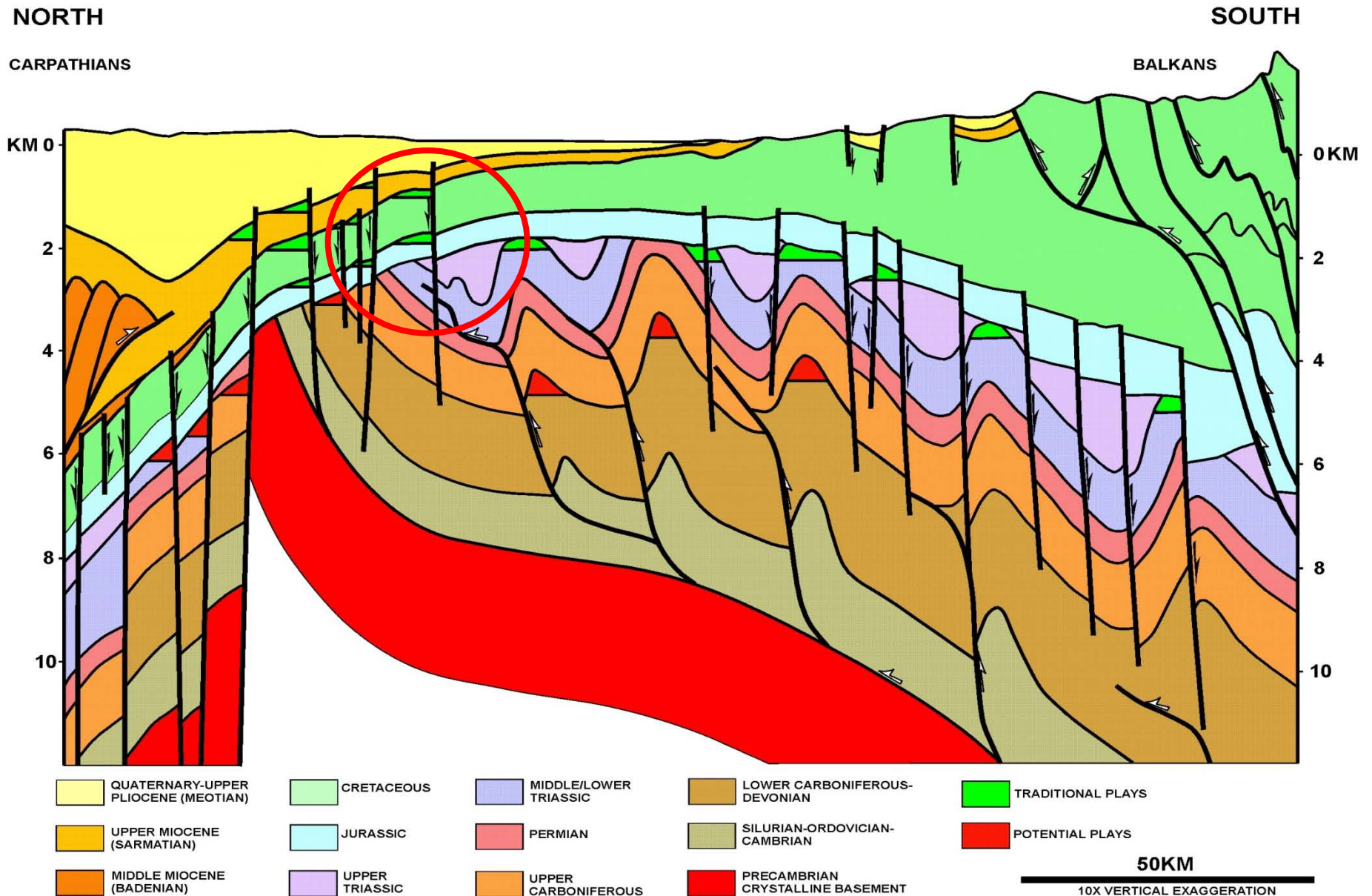
Tari and others (1997)

# Moesian Platform, stratigraphy and petroleum systems





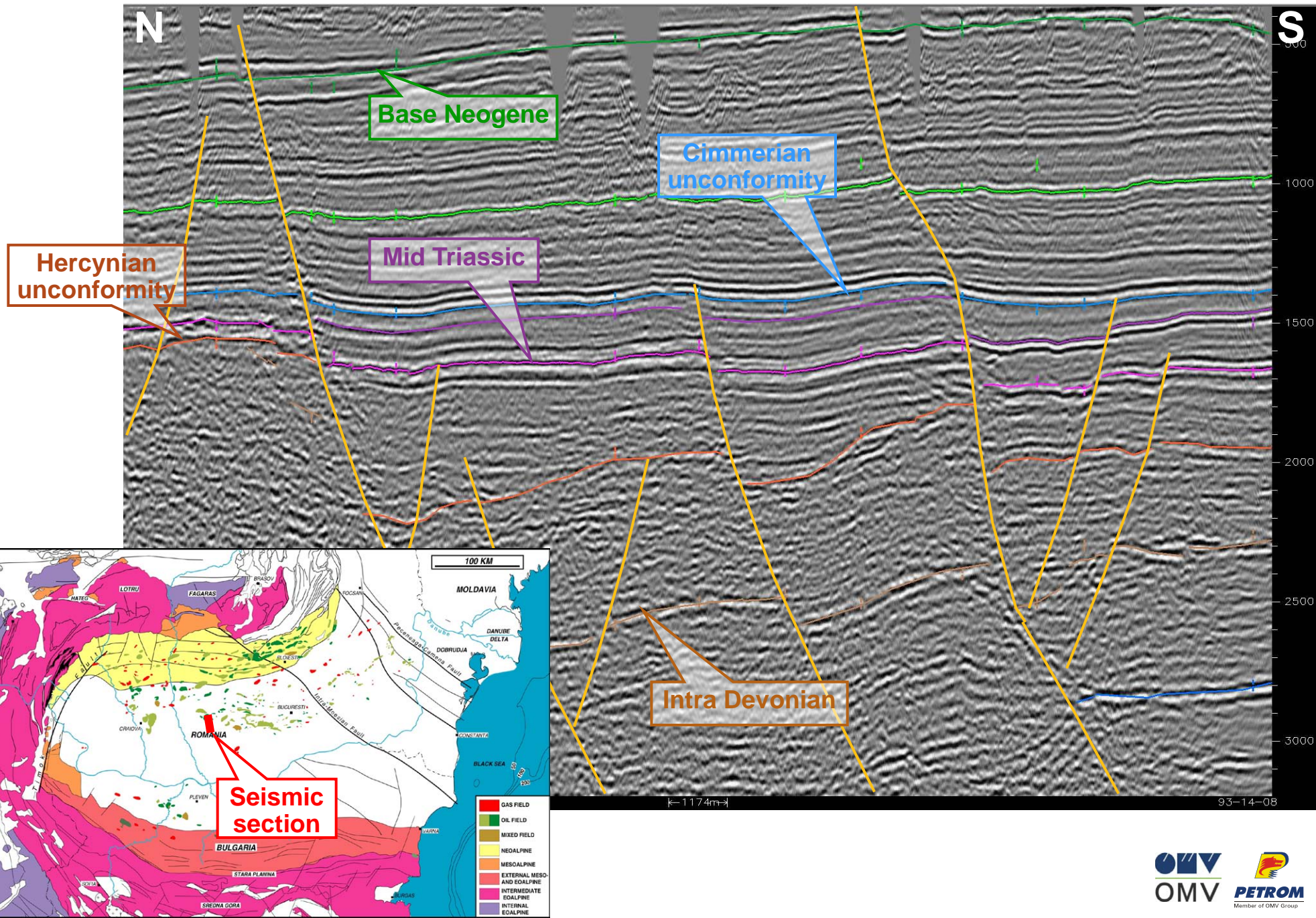
# Regional transect, Moesian Platform, Romania and Bulgaria



Tari and others (1997)

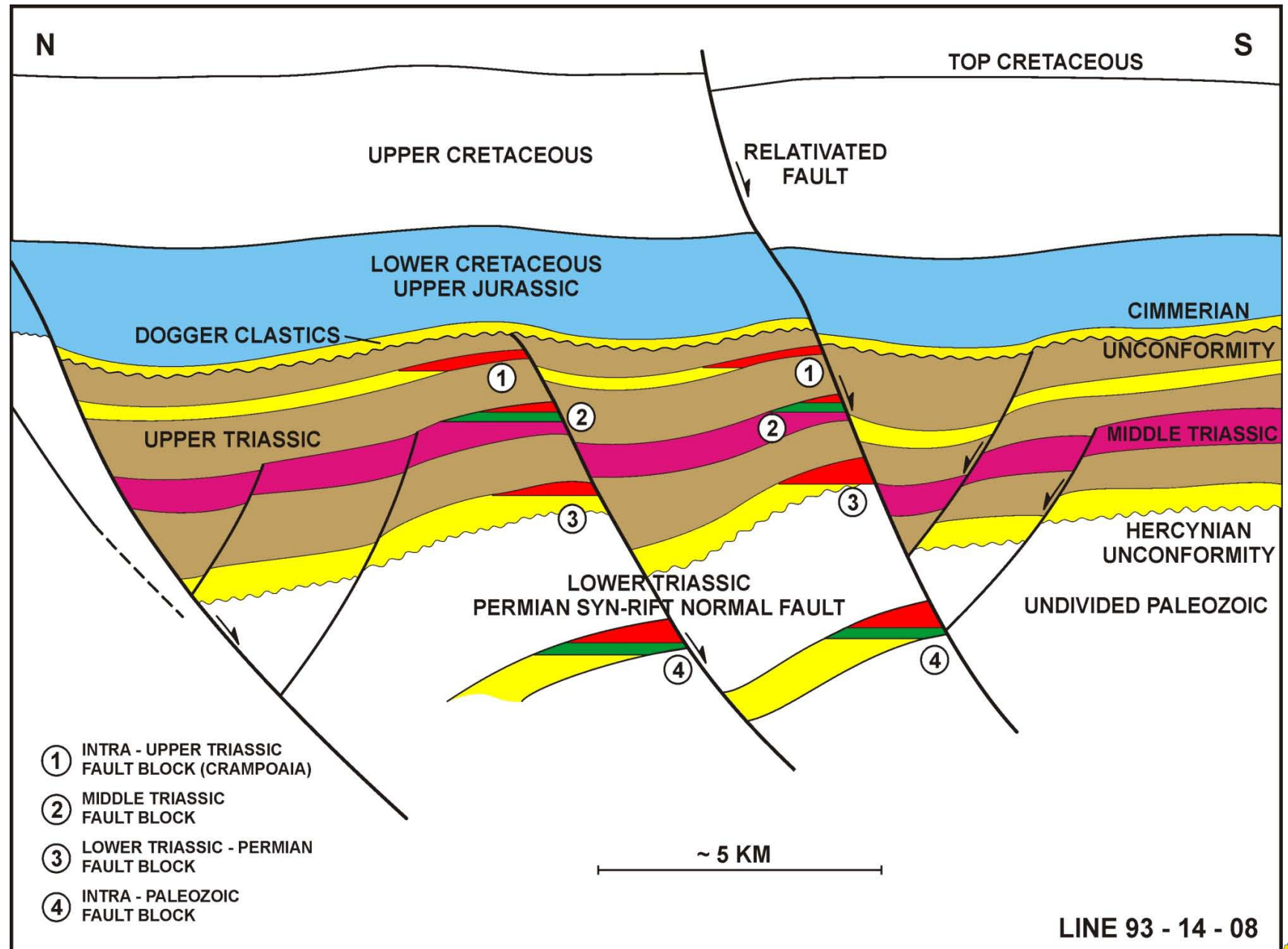


# Liassic/intra-Triassic/Paleozoic fault blocks, reactivated rift faults



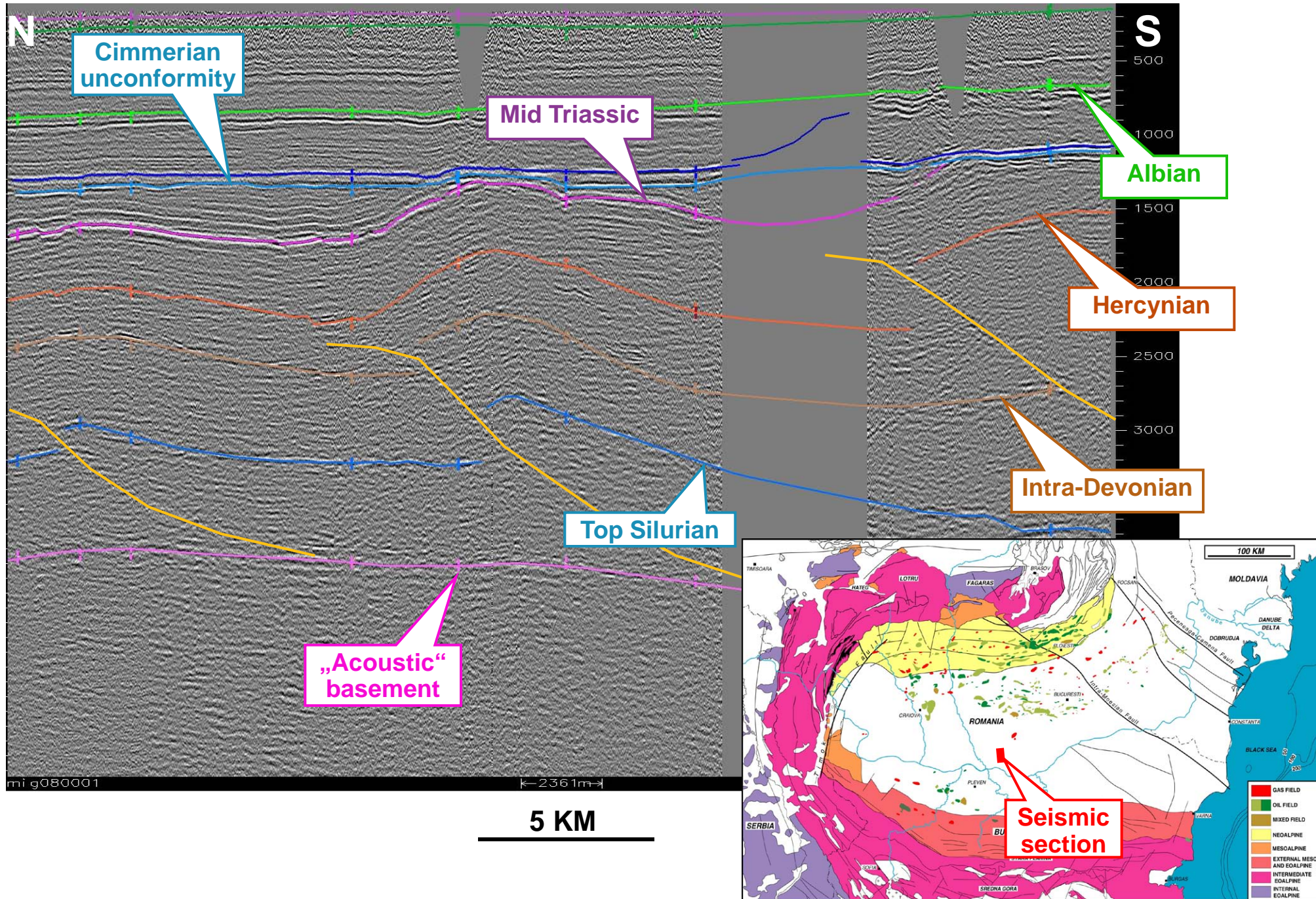


# Play types related to reactivated rift faults



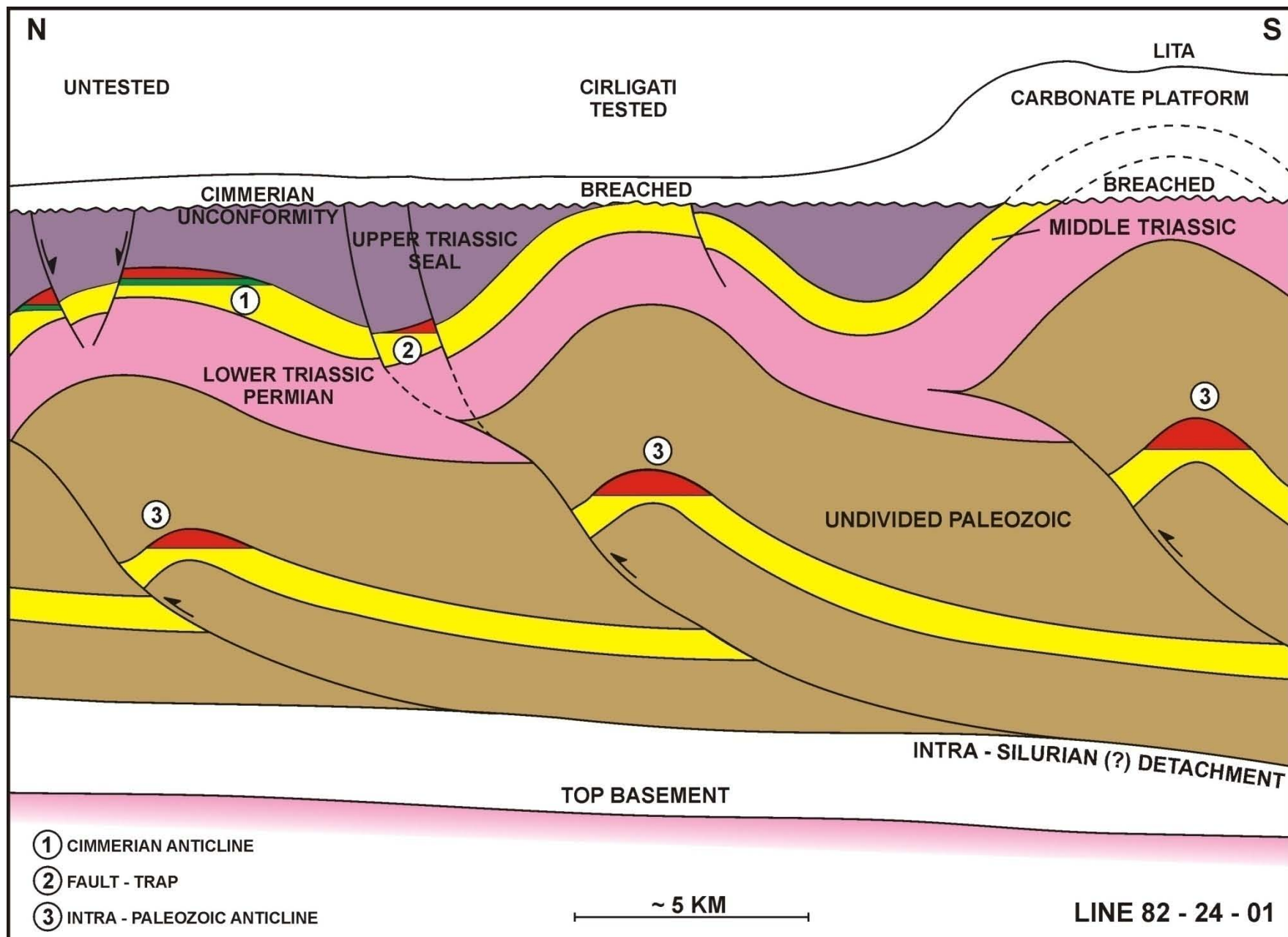


# Cimmerian (Latest Triassic) anticlines



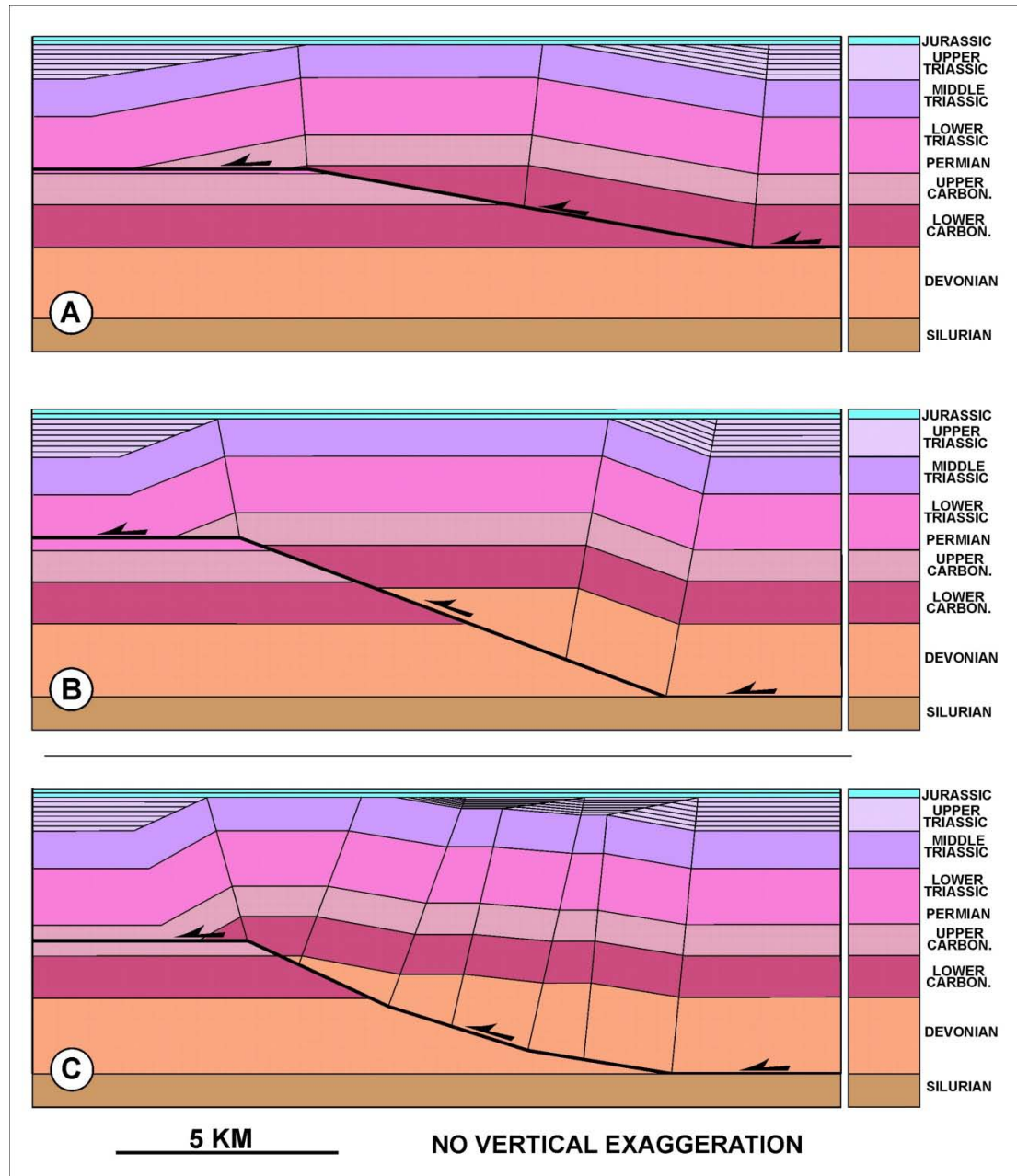


# Play types related to Cimmerian anticlines



# The Cimmerian anticlines are fault-bend folds

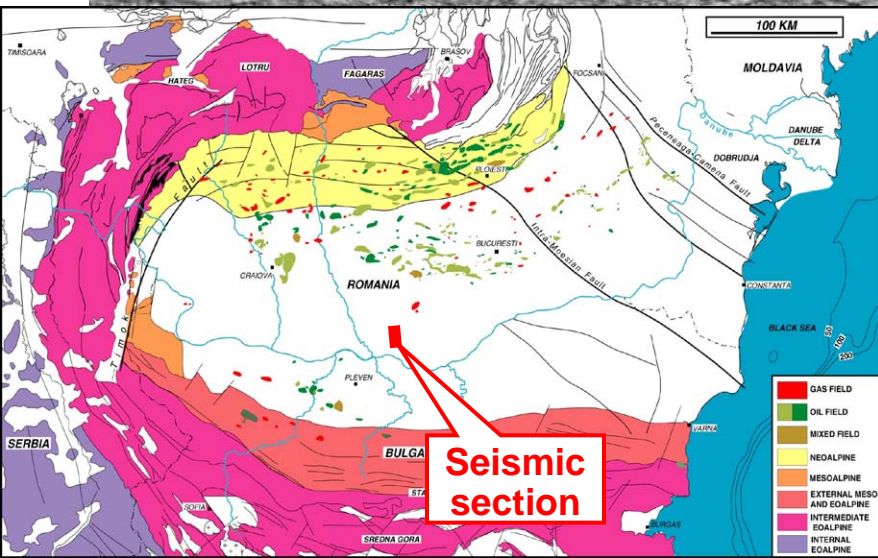
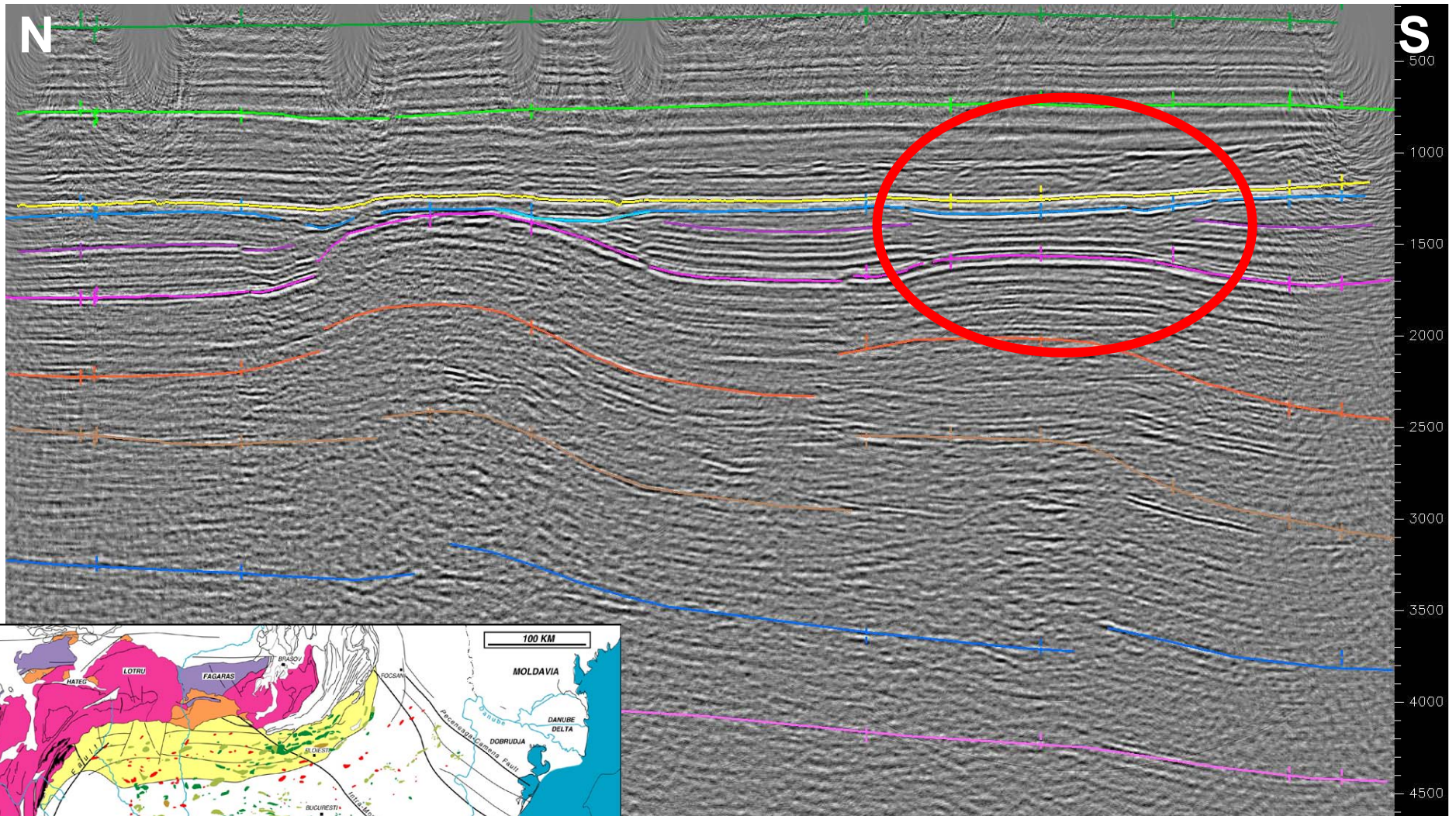
CUMULATIVE THICKNESS (KM)	TECTONIC STYLE	PERIOD	MOESIAN PLATFORM (ROMANIA)	AVERAGE THICKNESS (M) (RANGE)	STRATIGRAPHY SUBDIVISION
0	COMPRESSION FORELAND	PLIO-CENE		2000 (500-4000)	UPPER DETRITAL GROUP
1		MIOCENE		1000 (300-1500)	
2		PALEO-CENE		1000 (120-1600)	
3		CRETACEOUS		700 (250-980)	
4	EXTENSION PASSIVE MARGIN	JURASSIC		1400 (430-1800)	UPPER CARBONATE GROUP
5		JURASSIC		350 (50-580)	
6	COMP. RESSION	TRIASSIC		1000 (0-1200)	UPPER RED FORMATION
7		TRIASSIC		1000 (20-3000)	CARBONATE-EVAPORITE FORMATION
8	EXTENSION RIFTING (ABORTED)	PERMIAN		2400 (1800-2700)	LOWER RED FORMATION
9		PERMIAN		800 (0-1000)	UPPER CLASTIC GROUP
10	EXTENSION OROGENIC COLLAPSE	CARBONIFEROUS		2500 (2000-2800)	CARBONATE-EVAPORITE GROUP
11		DEVONIAN		350 (100-500)	LOWER CLASTIC GROUP
12	COMPRESSION FOLDED BELT?	SILURIAN		800 (500-3500)	LOWER CLASTIC GROUP (with Silurian Graptolitic Shale)
13		ORDO-CAMBRIAN		500 (400-600)	
14	EXTENSION? PASSIVE MARGIN?	PRE-CAMBRIAN		?	



Tari and others (1997)



# Cimmerian anticlines and collapse grabens, Romania

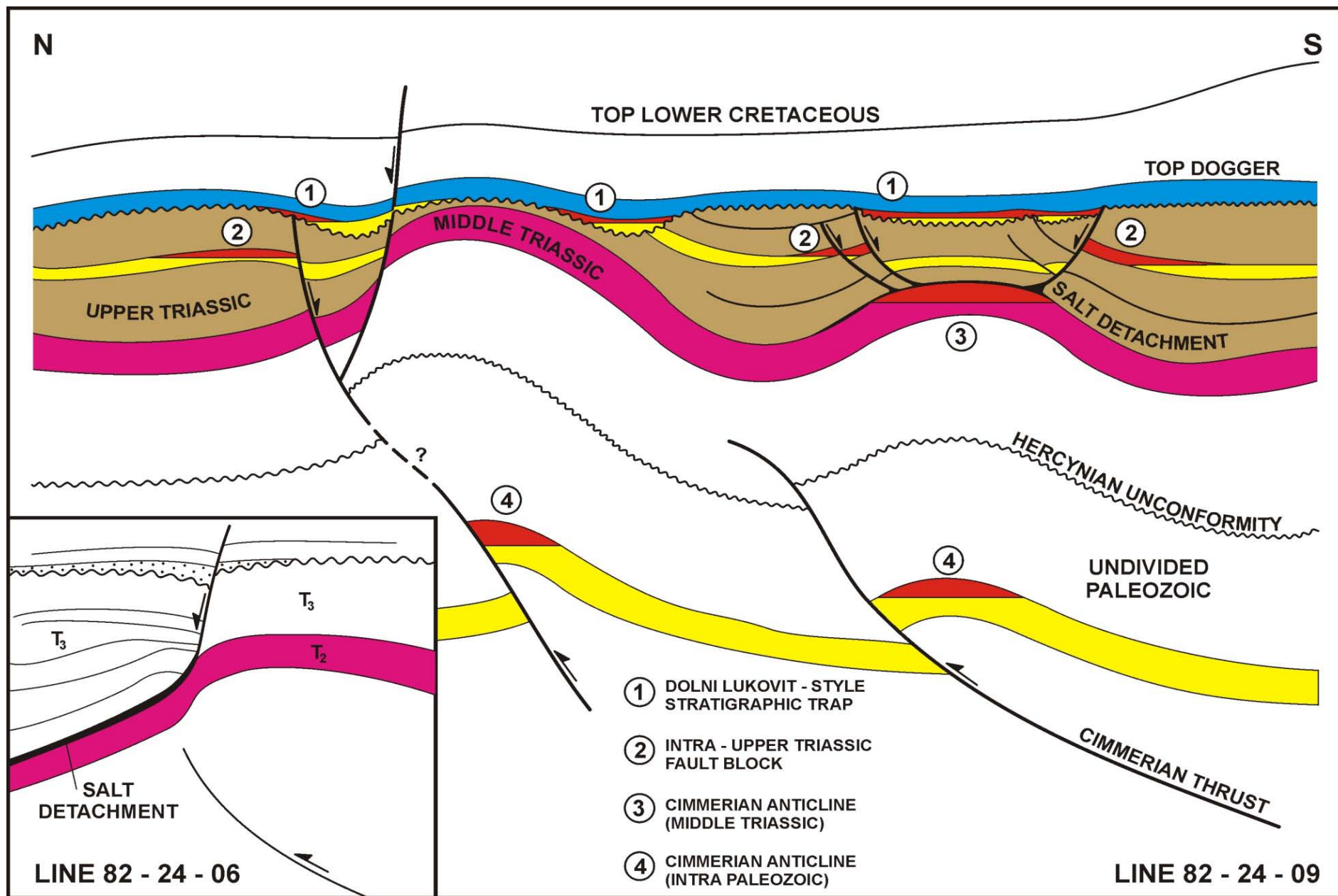


These smallish collapse grabens are the only expressions of the early to middle Jurassic extension in the southern part of the Romanian Moesian Platform

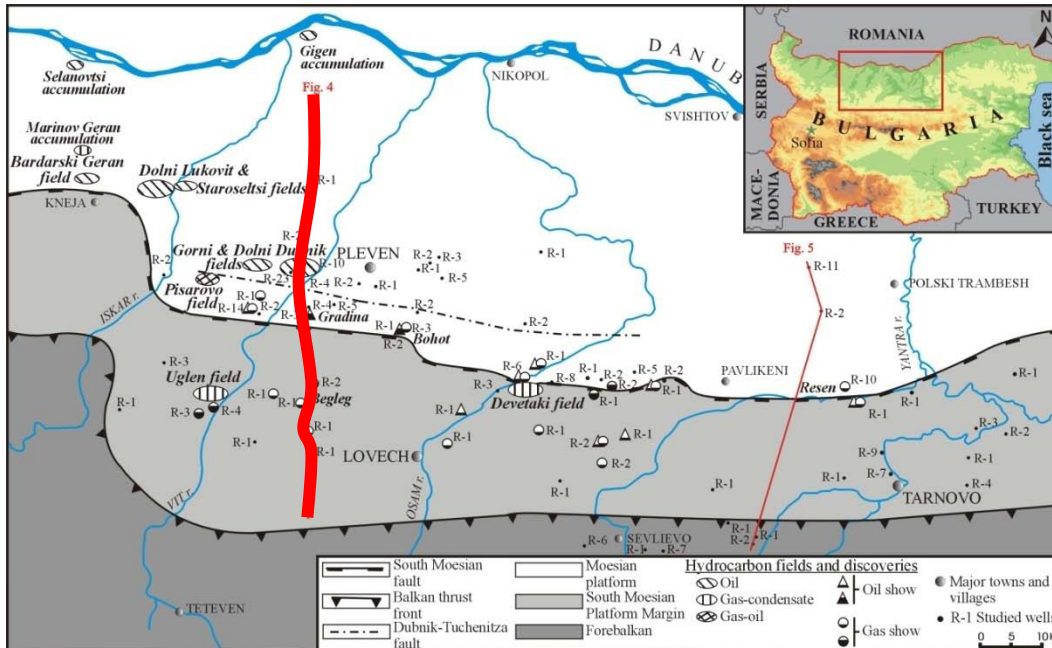
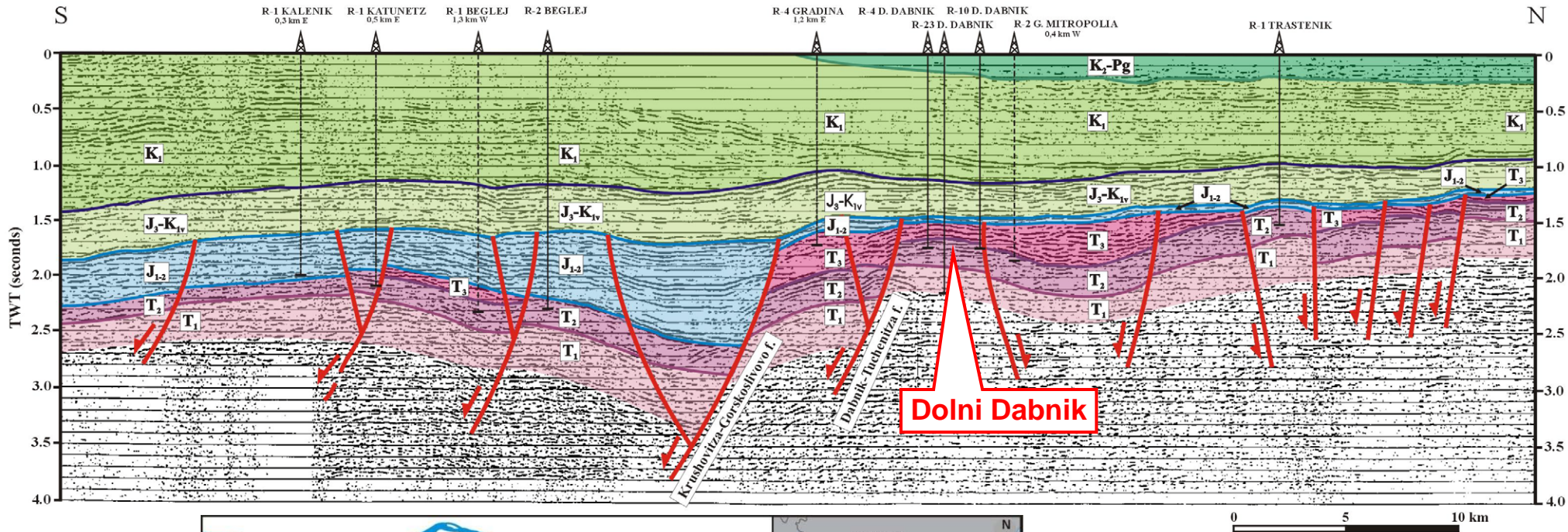
5 KM



# Play types related to Lias(?) collapse grabens



# Jurassic (Lias/Dogger) half-grabens as kitchens in Bulgaria

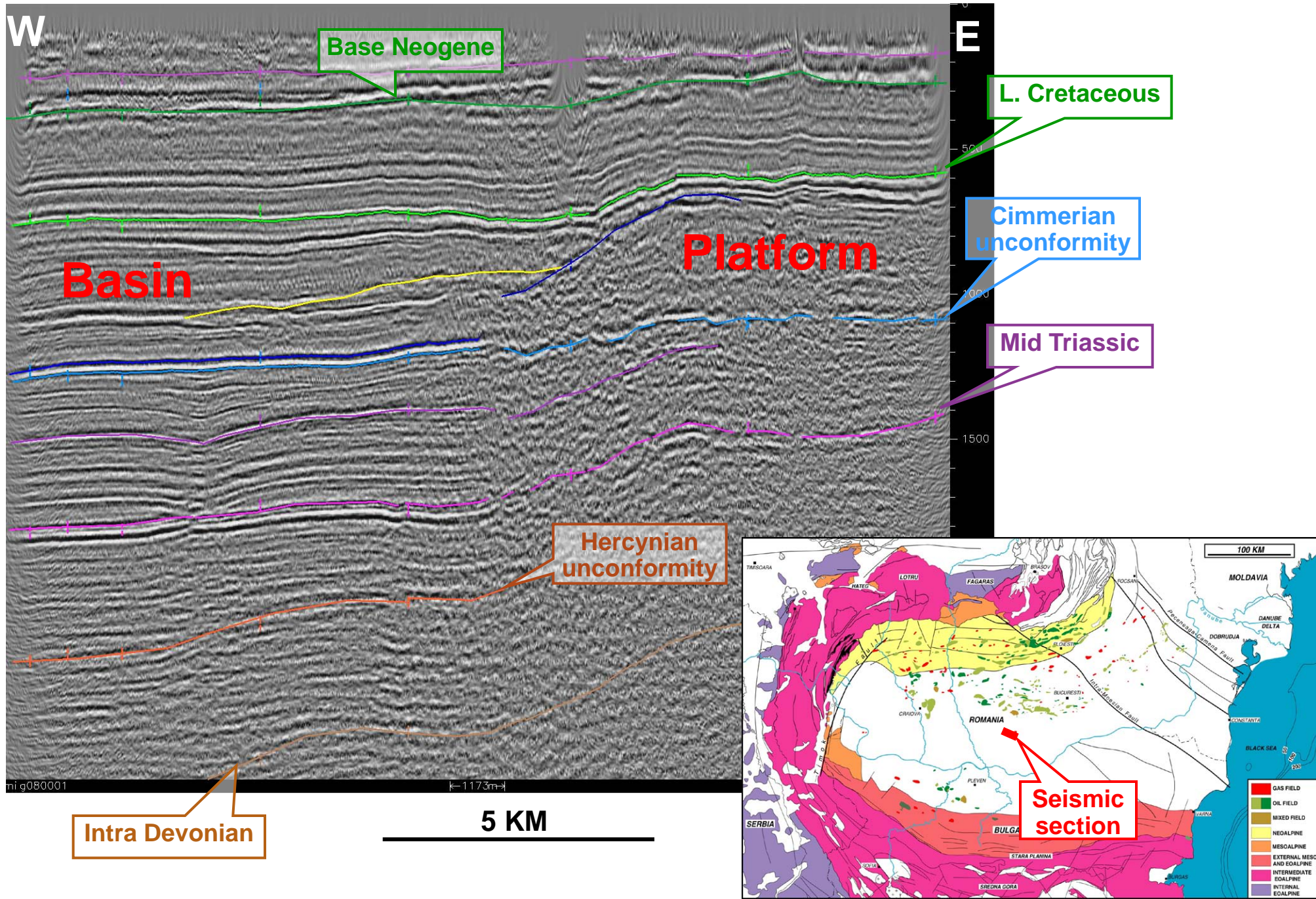


Botoucharov (2008)

These early to middle Jurassic half-grabens do not extend into the Romanian Moesian Platform

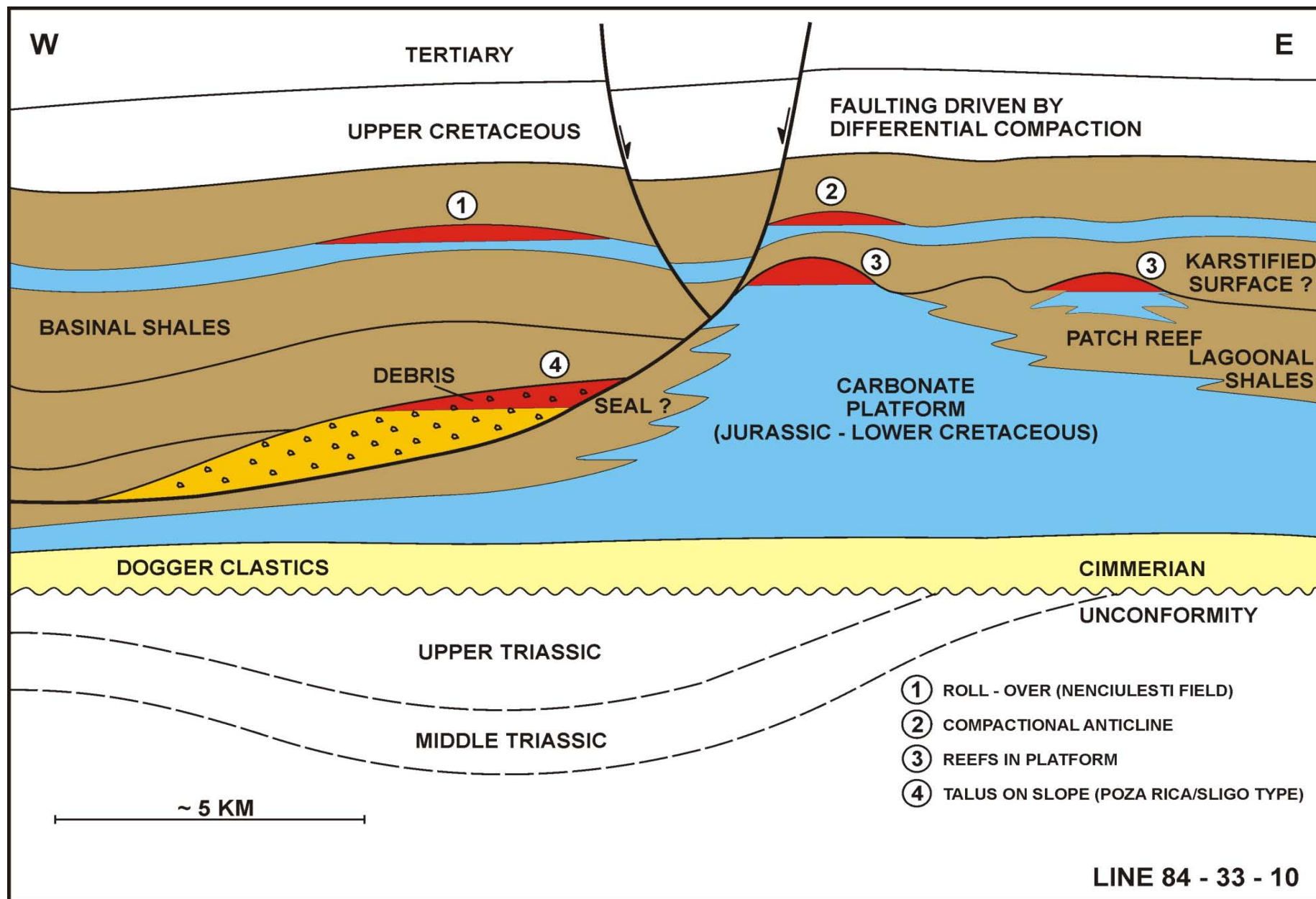


# Jurassic-Lower Cretaceous carbonate platform edge, Romania



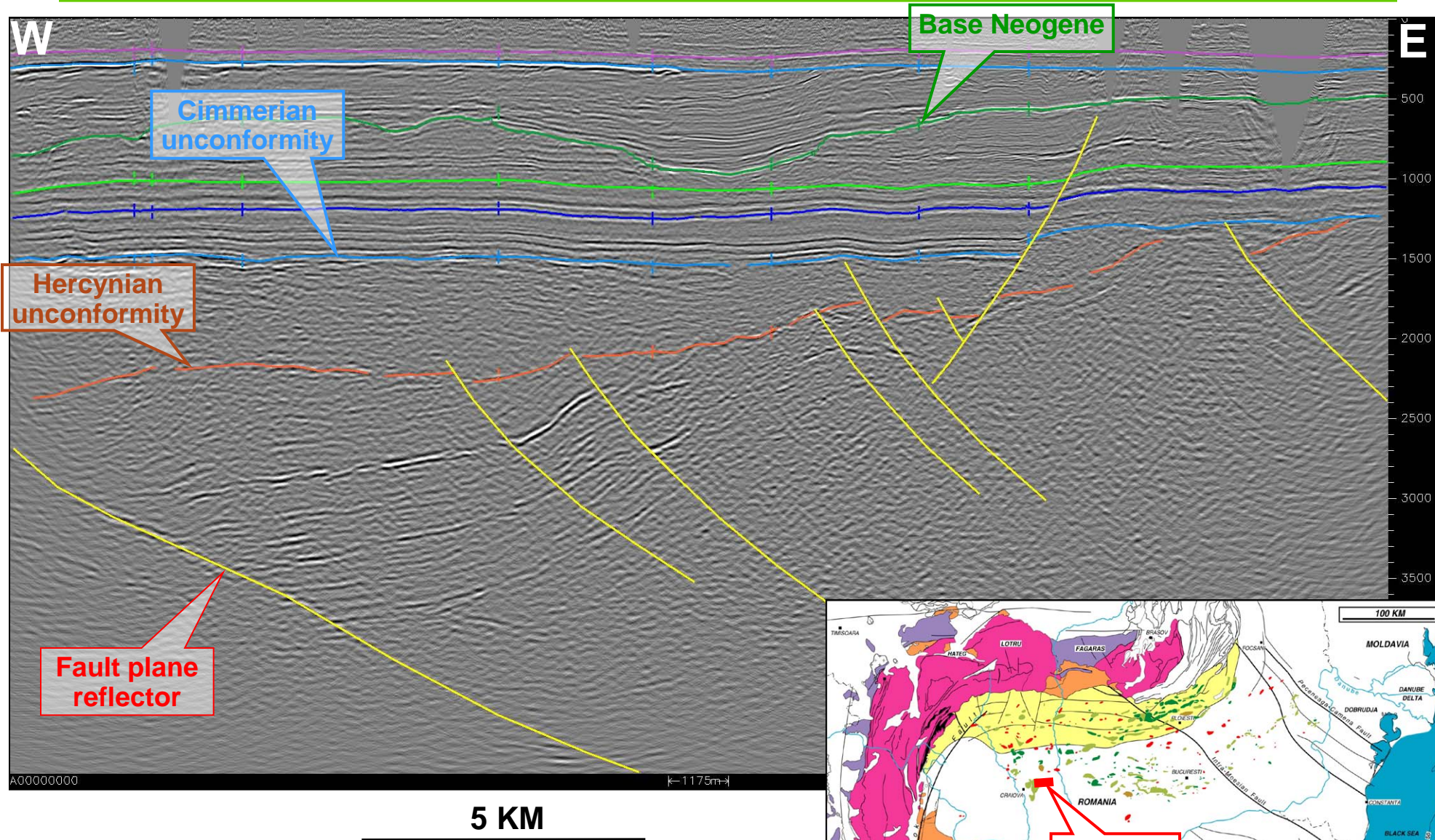


# Play types related to Jurassic/Cretaceous carbonate platform



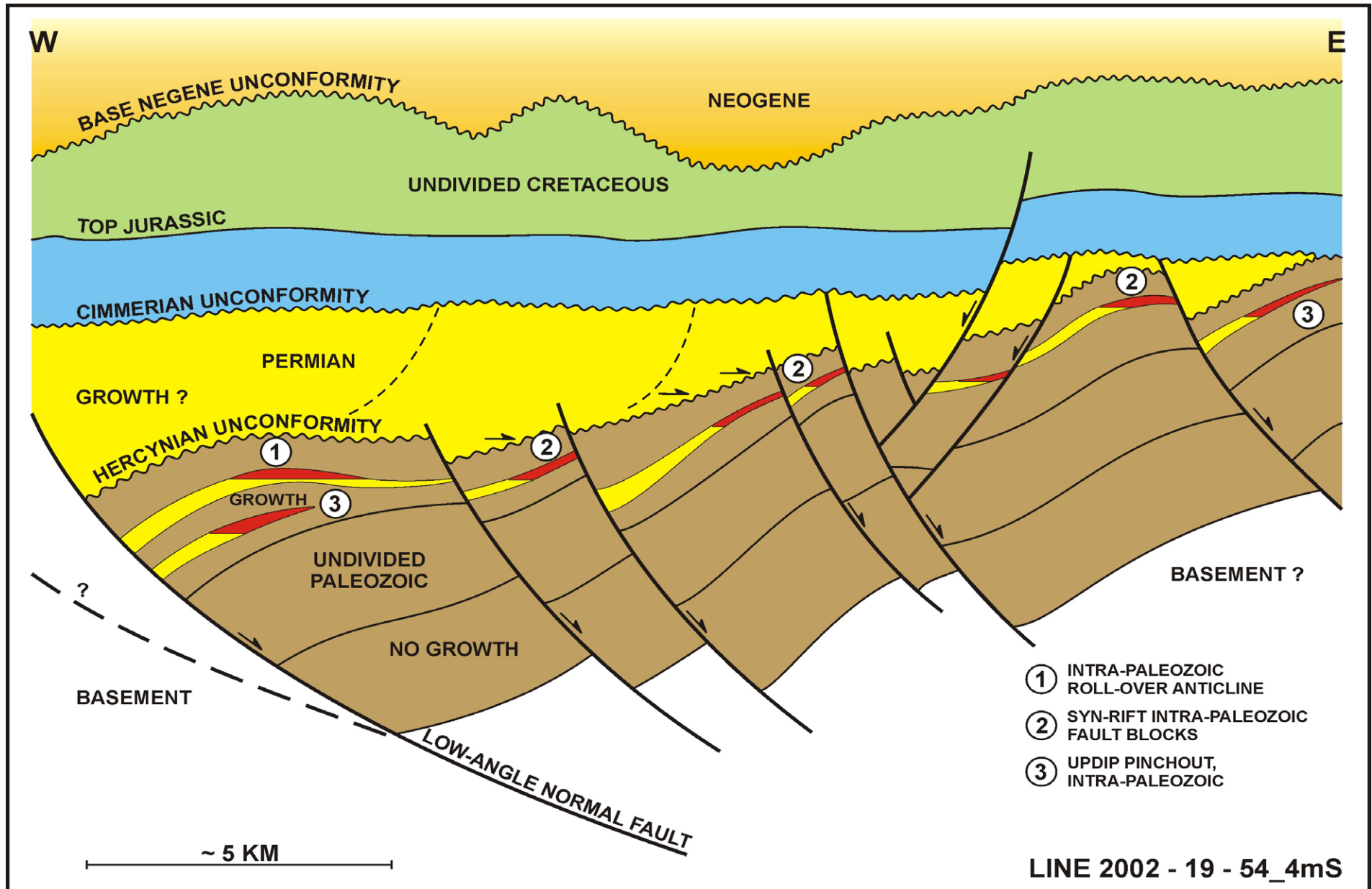


# Paleozoic syn-rift half-graben, Romanian Moesian Platform



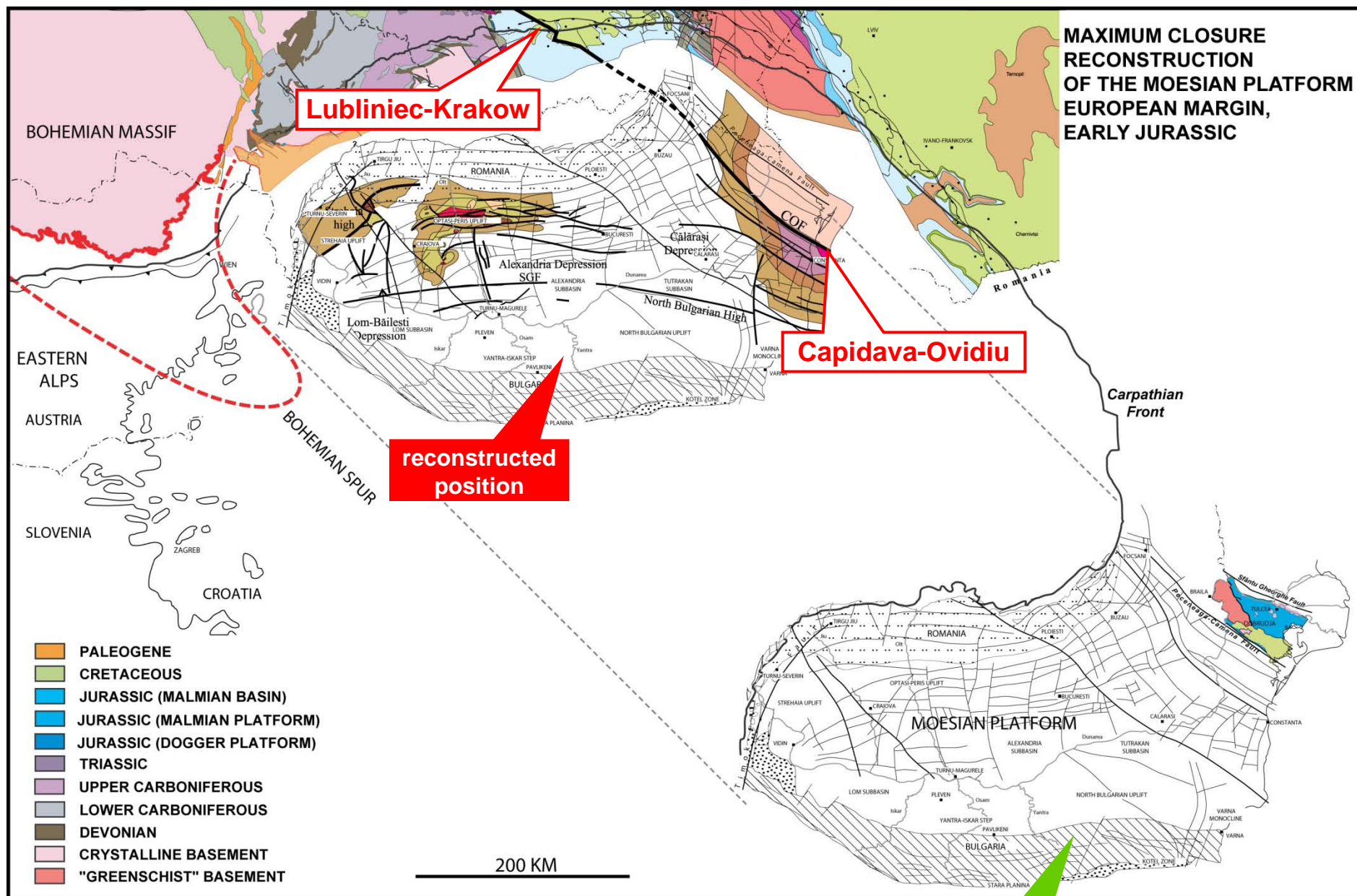
Note significant growth (Permian and Carboniferous?) along prominent low-angle normal fault

# Play types related to Paleozoic syn-rift half-graben





# The Bohemian and Moesian margins, syn-rift reconstruction

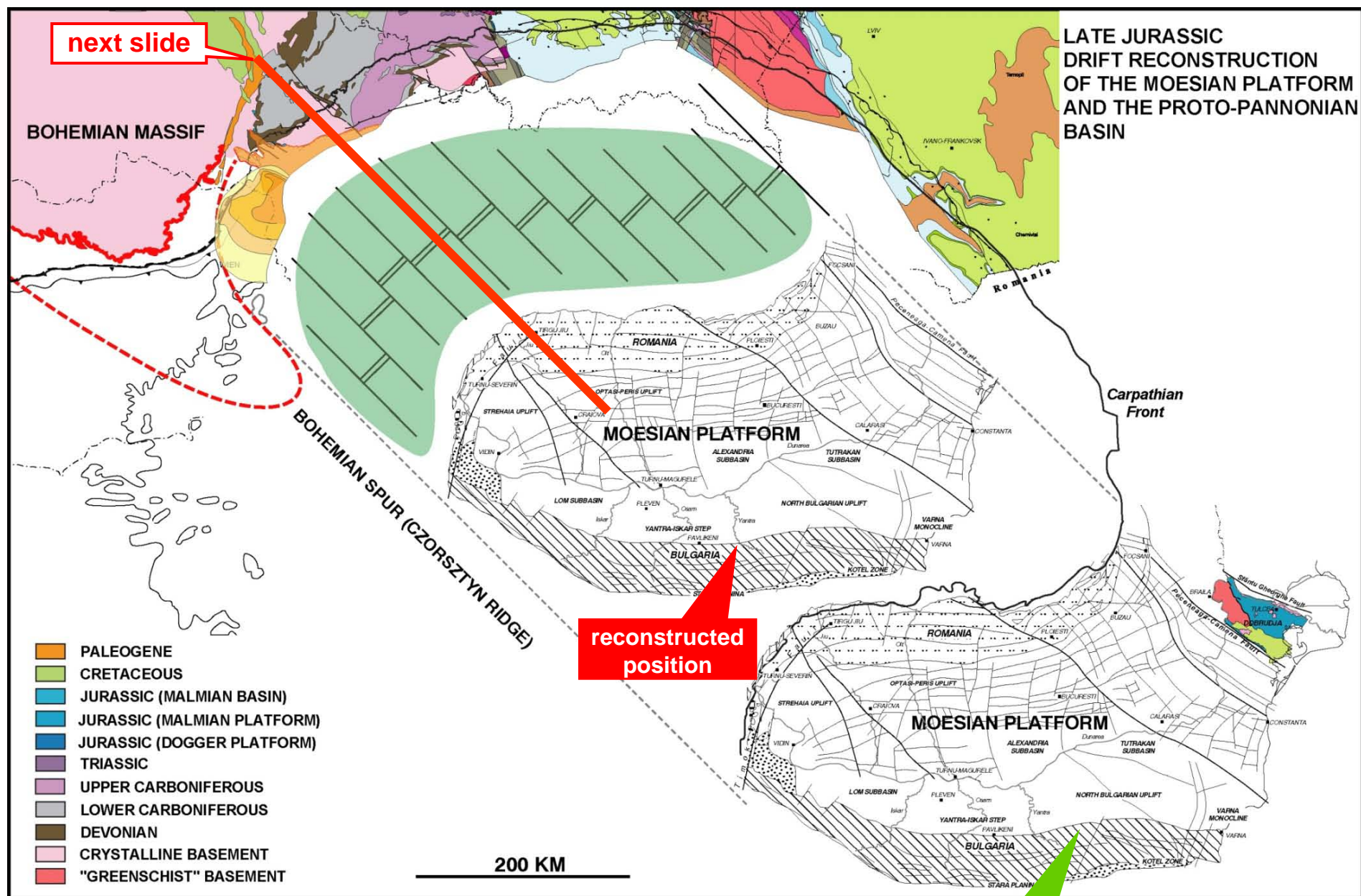


Tari (2005)

present-day position



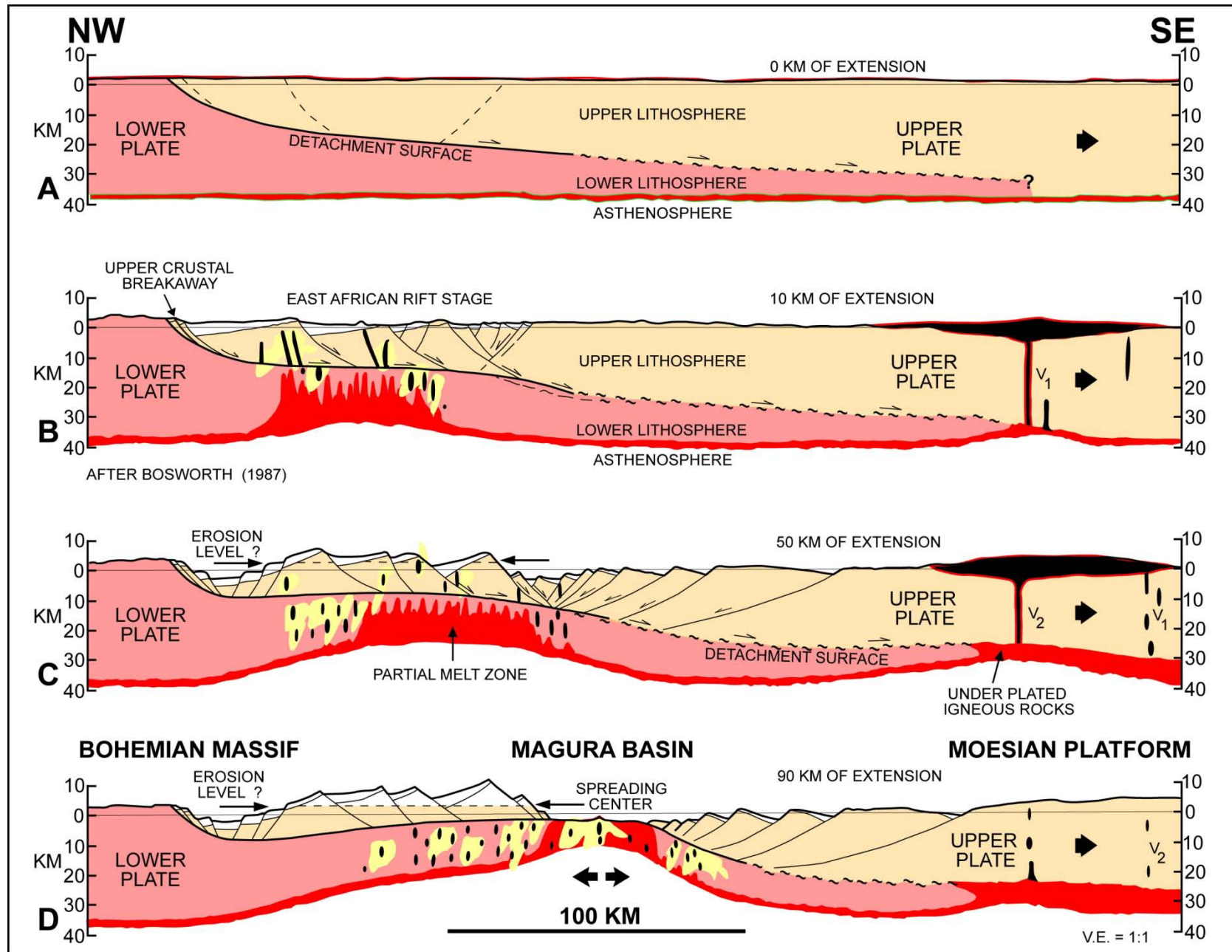
# The Bohemian and Moesian margins, syn-drift reconstruction



*Tari (2005)*

present-day  
position

# Jurassic rifting of the conjugate Bohemian and Moesian margins



Generic rifting scheme adopted from Klitgord et al. (1988)

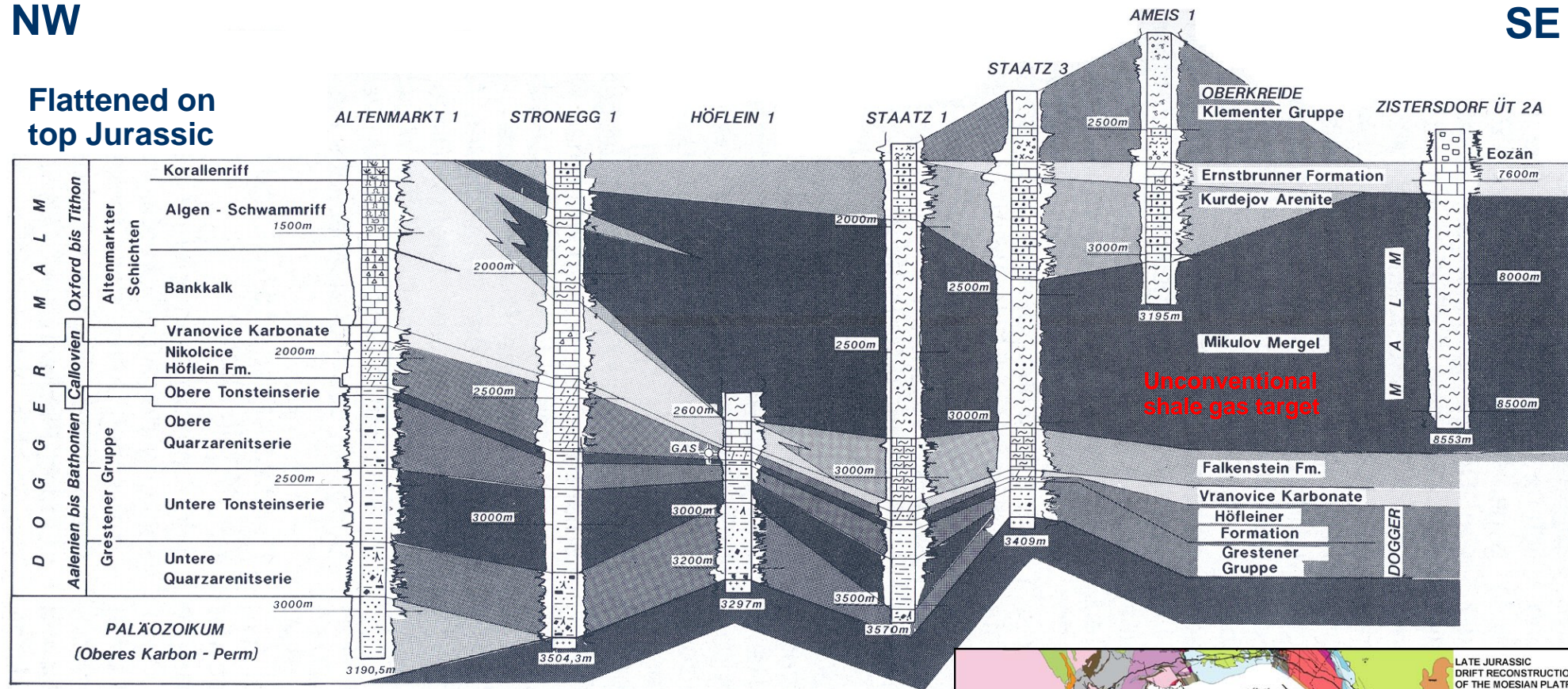


# Jurassic lithofacies/log correlation, Vienna Basin, Austria

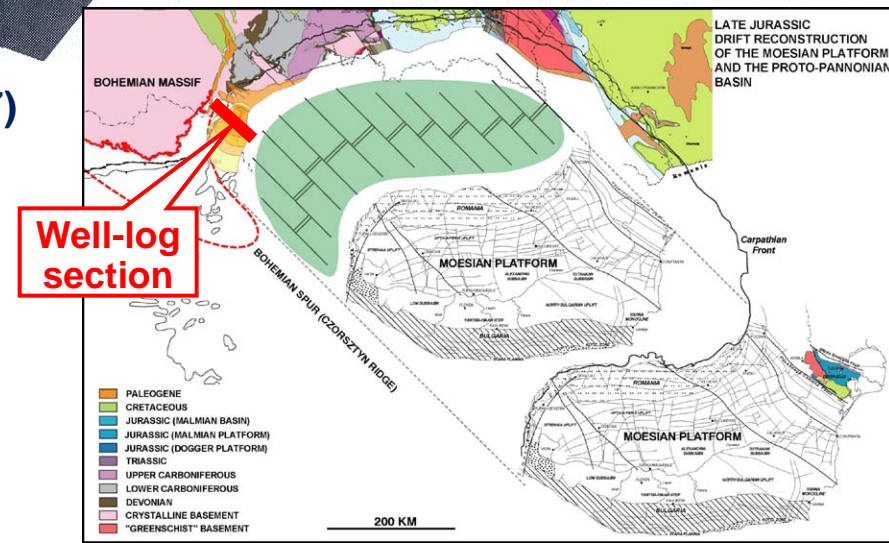
NW

SE

Flattened on top Jurassic

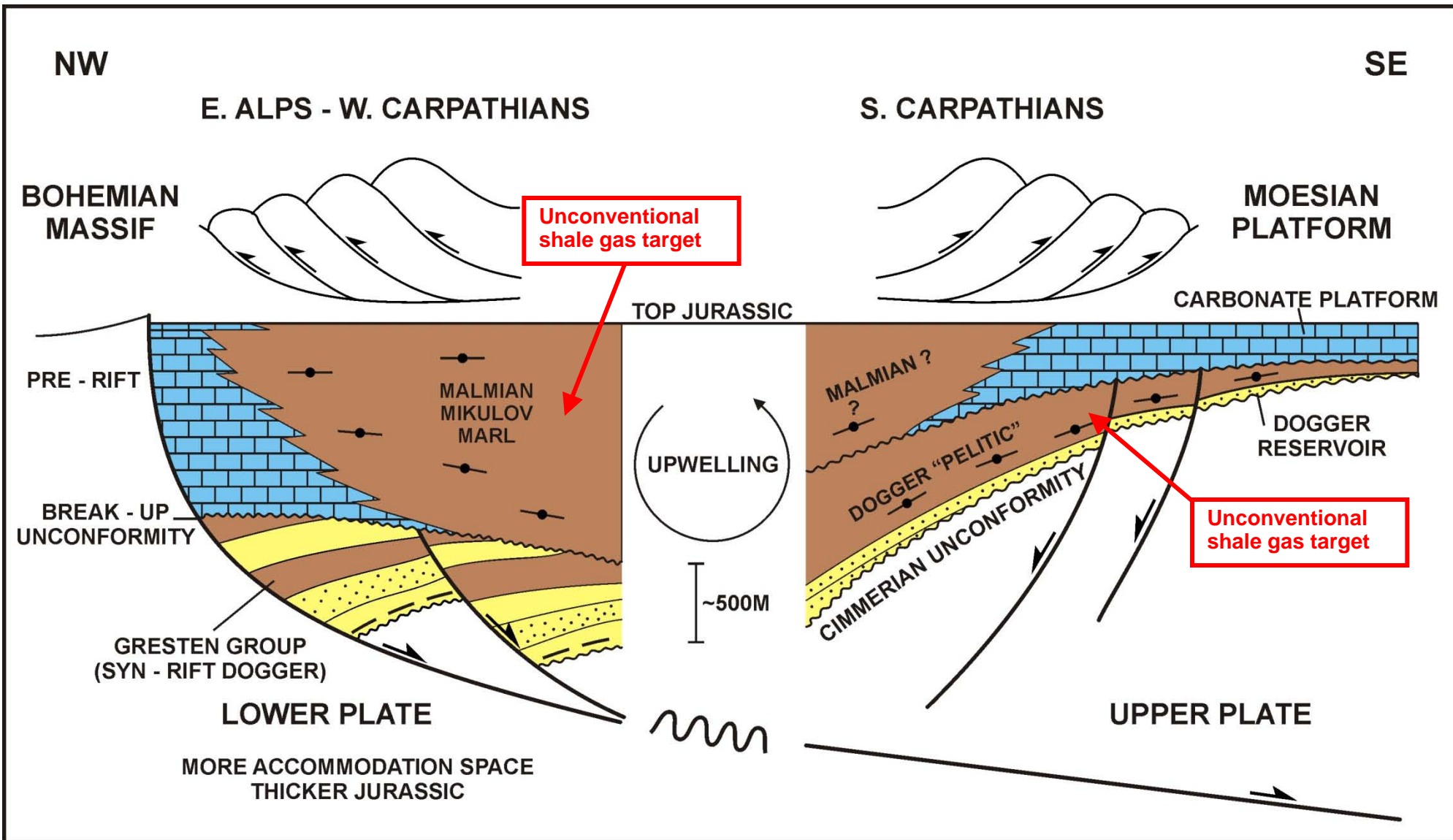


Wessely and others (1997)





# Correlation of Jurassic source rocks, Austria and Romania

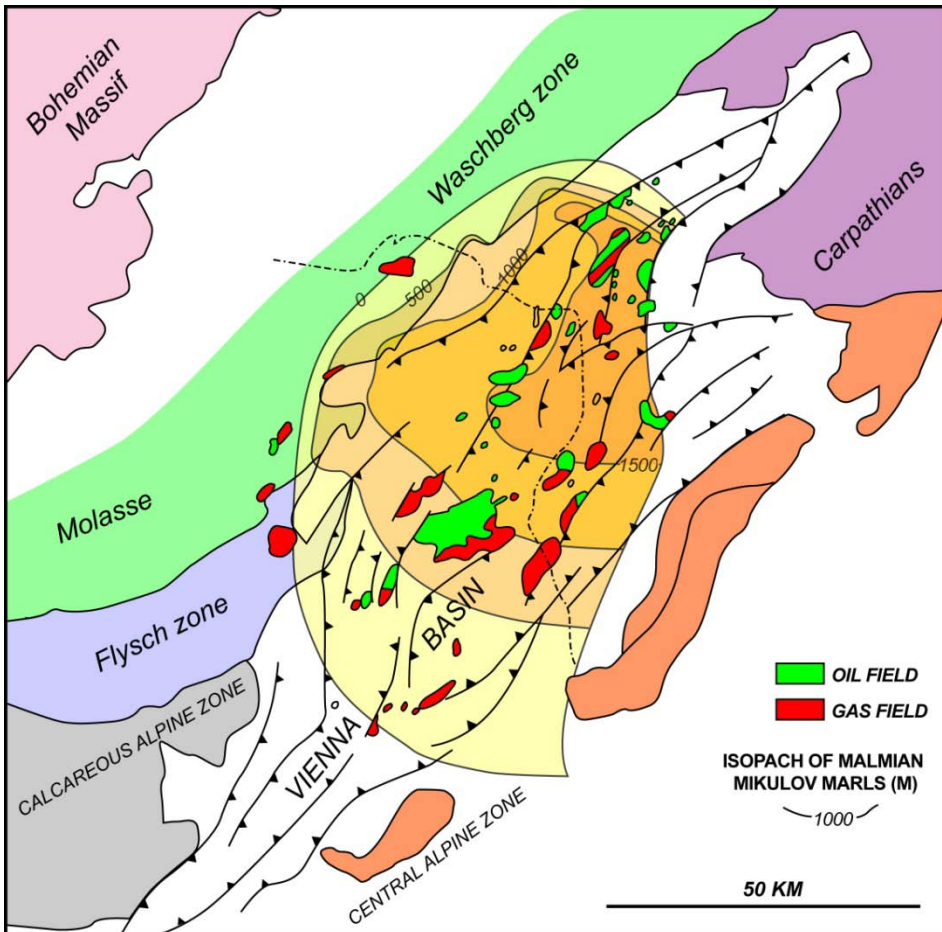


Flattened on top Jurassic



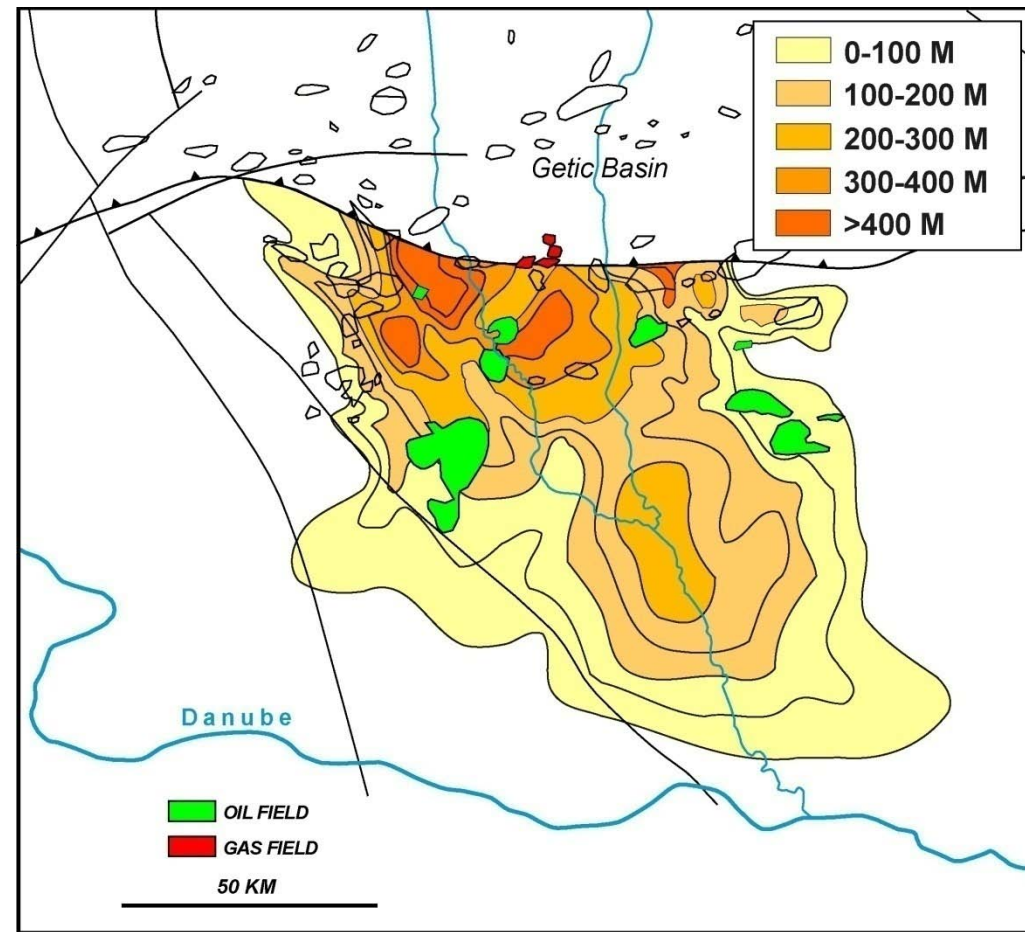
# Correlation of hydrocarbon fields and Jurassic source rocks

## Isopach of Malmian Mikulov Marl Vienna Basin



*Ladwein (1996)*

## Isopach of Dogger Bals Formation Western Moesian Platform



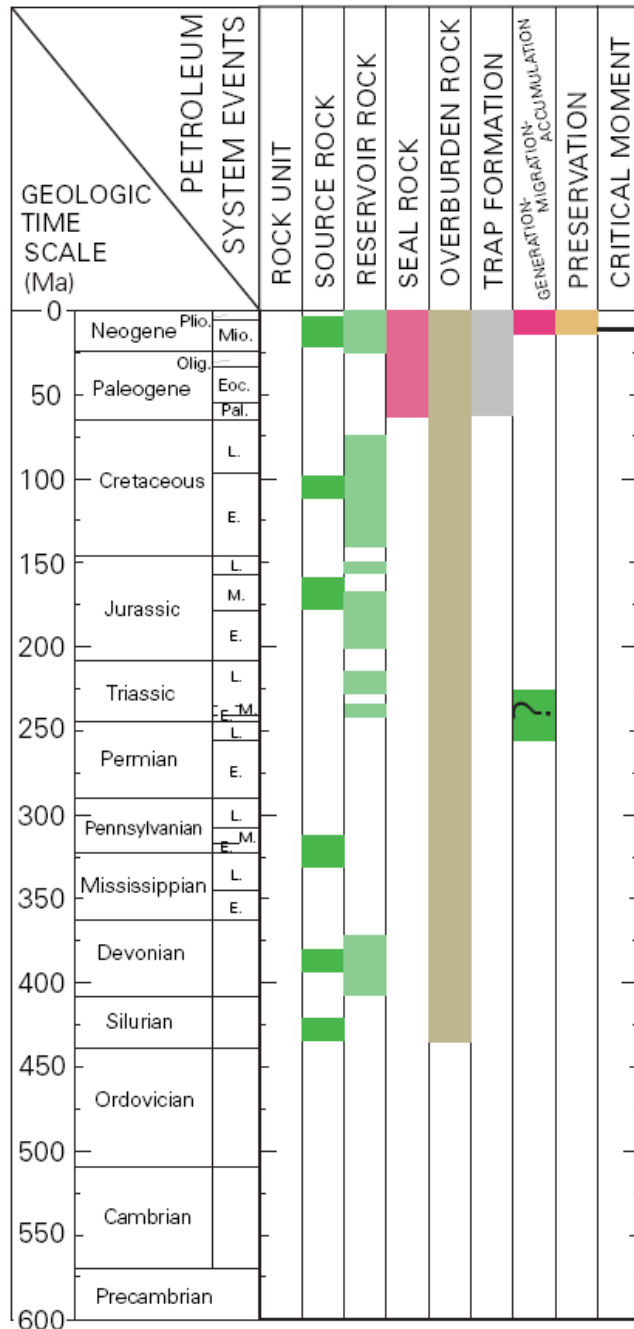
*Patrut (1986)*

# Dogger Bals Formation, 6108 Danciulesti





# Conclusions: Moesian Platform, Romania and Bulgaria



- ▶ **Source rocks: Silurian, Lower Devonian, carboniferous, Middle Jurassic, Oligocene, Upper Miocene (Sarmatian), still in need of proper geochemical documentation**
- ▶ **Lower/Middle Jurassic shales are effective source rocks only in the Bulgarian Moesian Platform**
- ▶ **Main HC generation period for the northern part of the Moesian Platform: Late Neogene (rapid burial of Paleogene/Neogene source rocks)**
- ▶ **The traditional view on trap timing and critical moment(s) needs to be challenged in the southern part of the Romanian Moesian Platform**
- ▶ **Central Moesian Platform, southernmost Romania: intra-Paleozoic source rocks are interpreted as being in the oil generation or partly/entirely in the gas generation window**
- ▶ **Unconventional shale gas potential: Dogger Bals Formation and Silurian/Lower Devonian Tandarei Formation**