

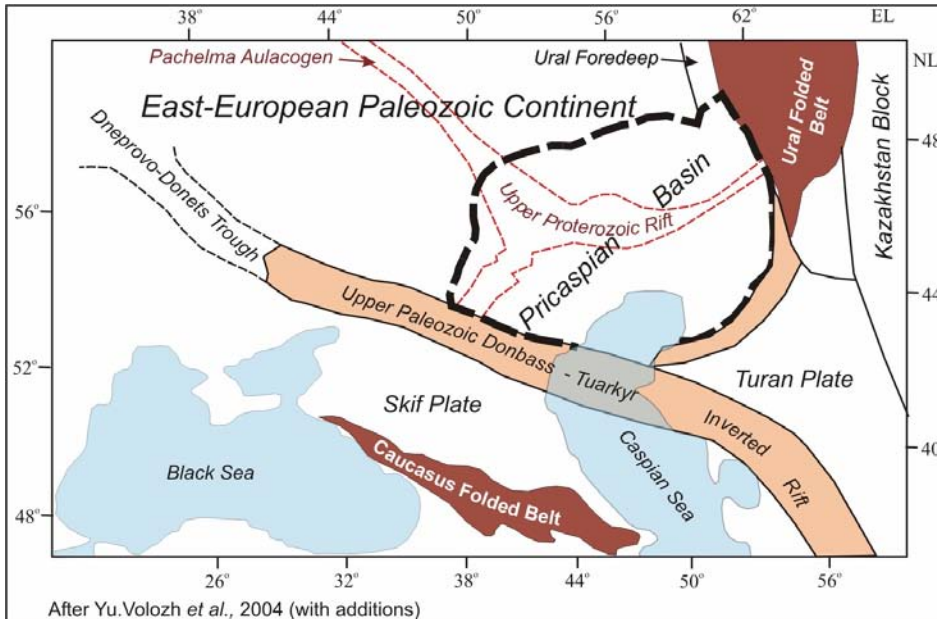
# Regional Late-Paleozoic Tectono-Stratigraphic Settings and Perspectives for Discoveries at the Pricaspian Basin's North-Western Margin, Russia

By Yury Nikitin, Sergey Ostapenko, John Dolson

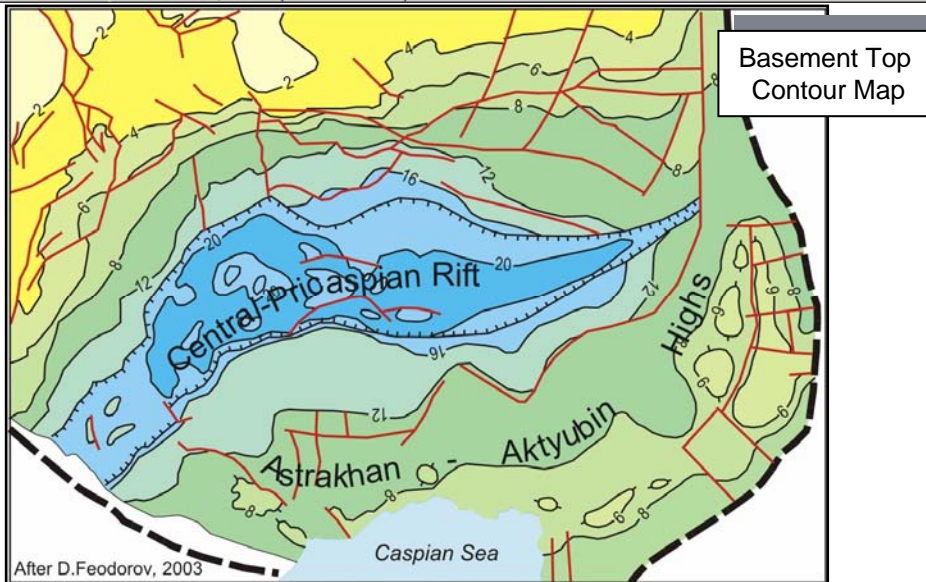
Speaker: Yury Nikitin



# 1. The Pricaspian Sedimentary Basin



- ❖ Was founded by the Late Proterozoic rifting on the East European continent passive margin (D.Feodorov, 1979,2003).
- ❖ Over the Late Paleozoic the Pricaspian Basin was an analogue of the present day inner and marginal deep water basins, such as Mediterranean sea, Black sea, Caspian sea (Al-Zhadi, 2004).

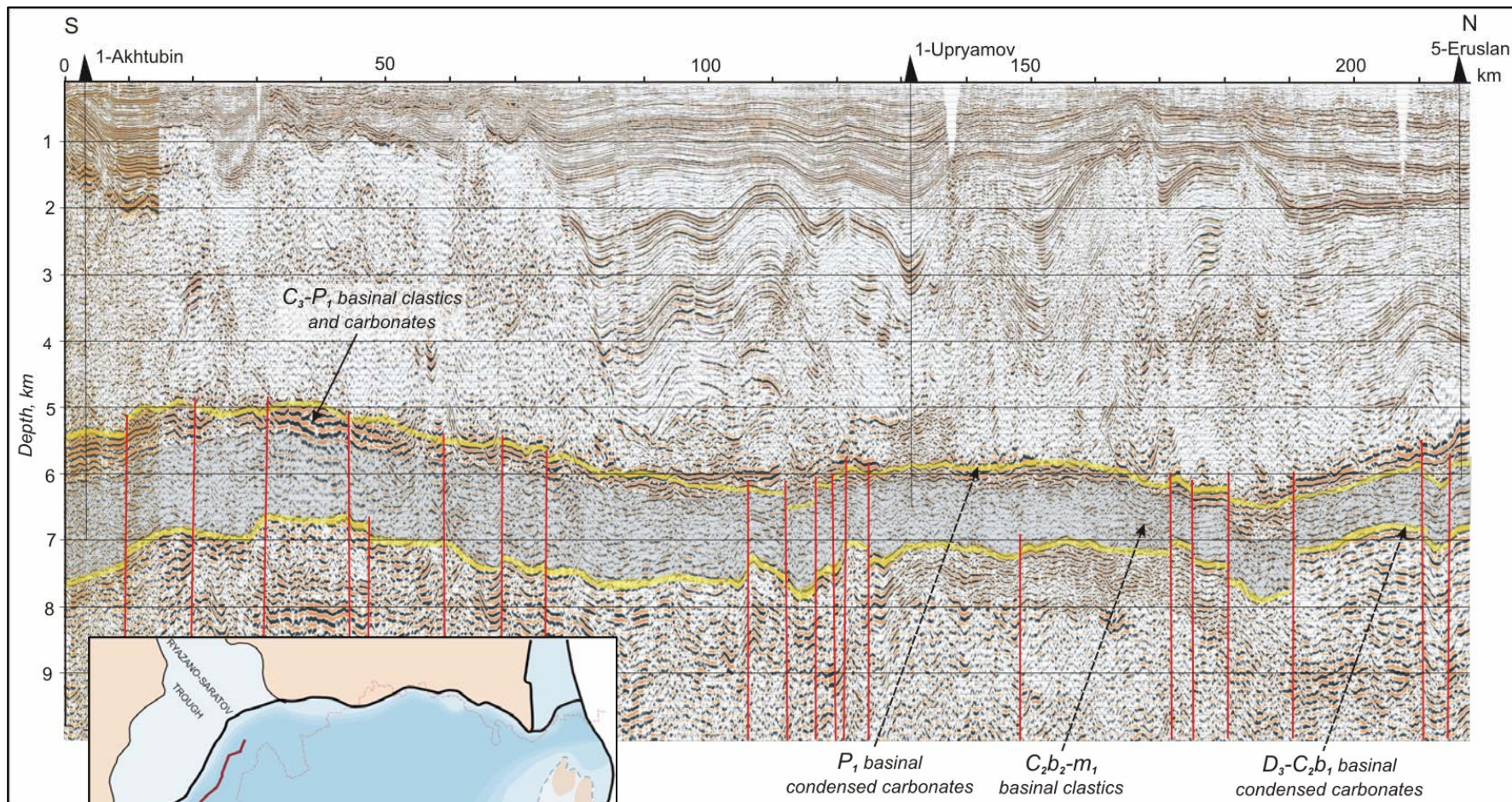


- ❖ Sedimentary cover overlies the suboceanic basement in the Central-Pricaspian Rift, where it has thickness up-to 20-22 km.
- ❖ Deposit thickness is reduced down-to 6-9 km within the Astrakhan-Aktyubin Highs System where continental type of the basement occurs (D.Feodorov, 2003).





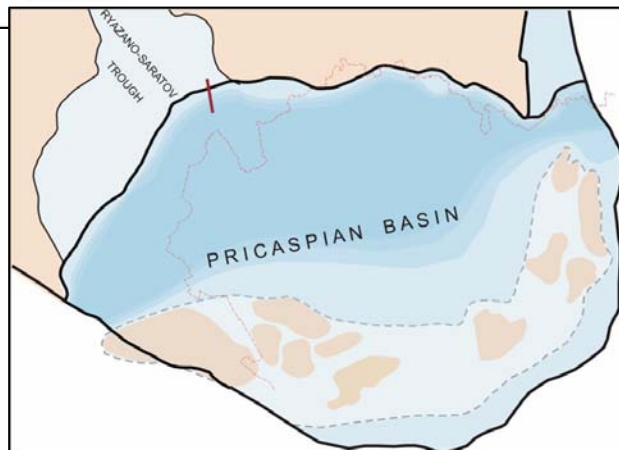
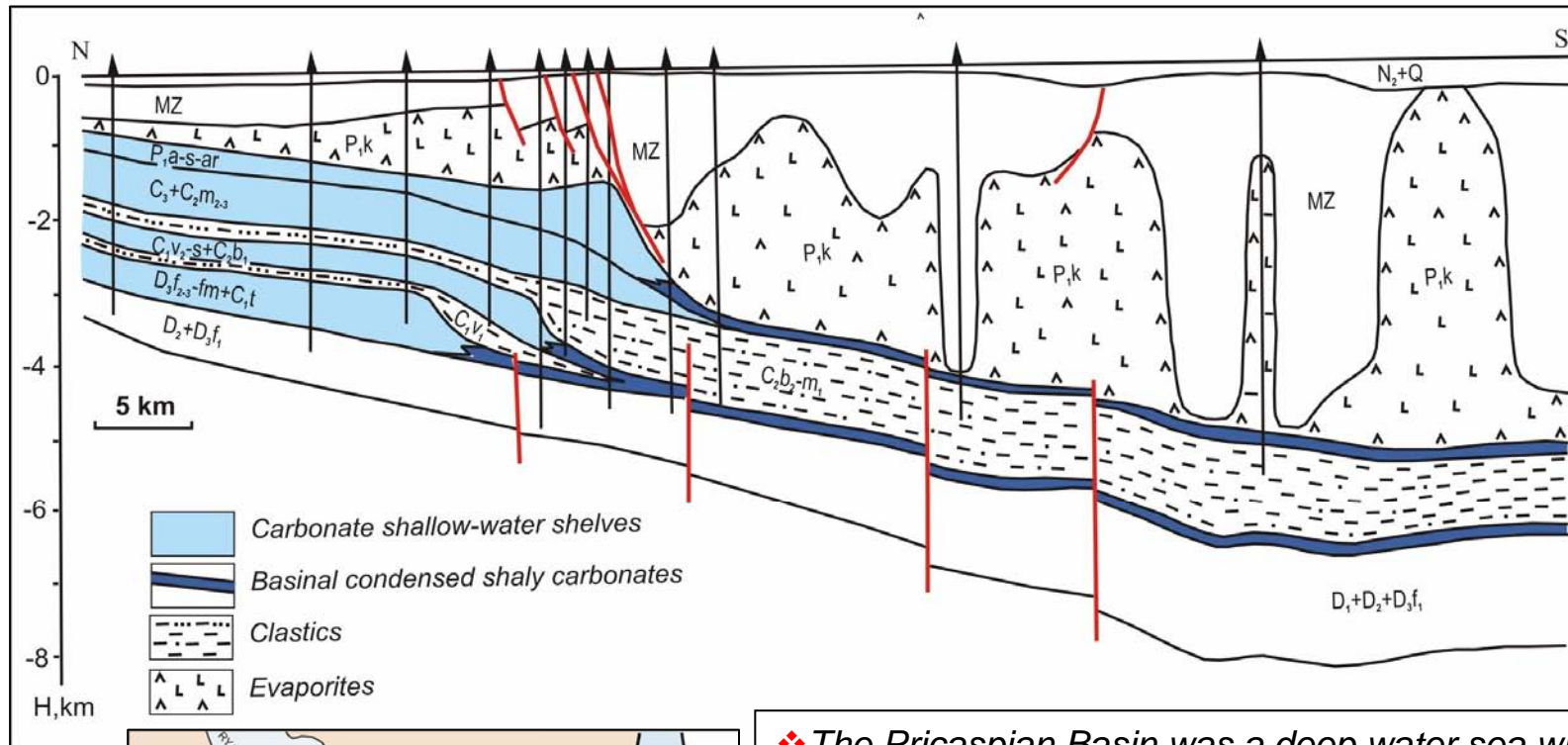
### 3. Seismic Dynamic-Depth Cross-Section of the Pricaspian Basin North-West



❖ The Upper Paleozoic subsalt section of the Pricaspian Basin north-western part is composed by thick basinal mudstone sequences and deep-water condensed carbonates, with no obvious reservoirs.

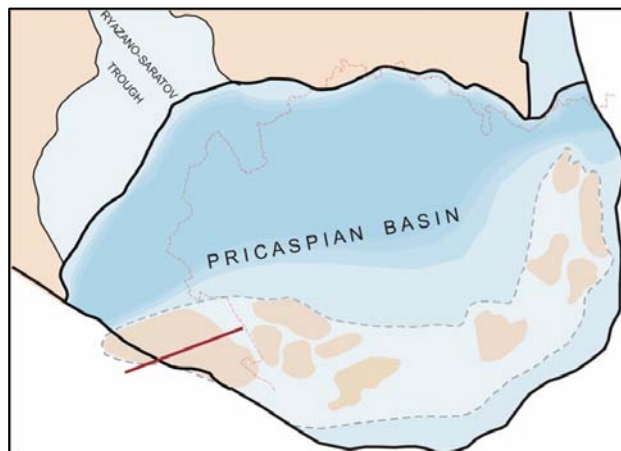
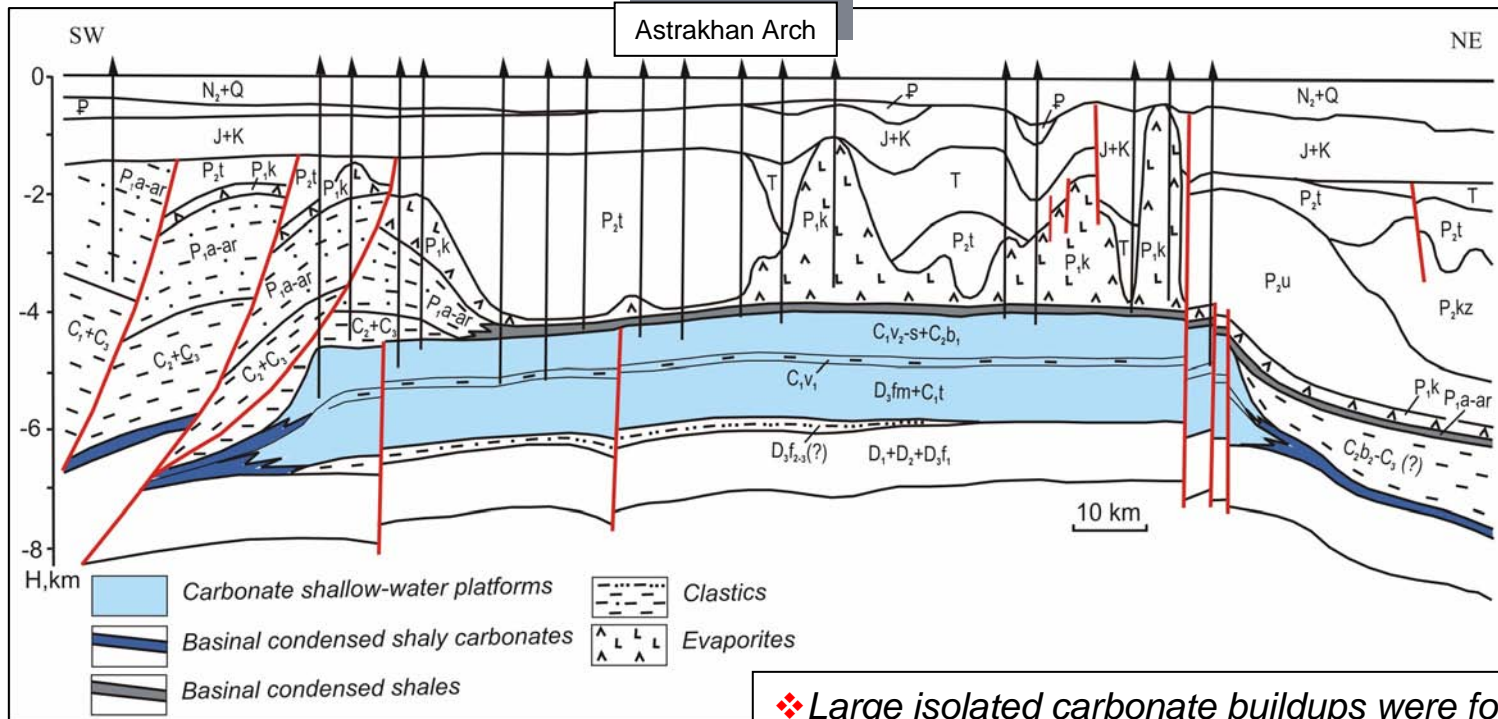


## 4. Late Paleozoic Depositional Systems of the Pricaspian Basin North-Western Margin



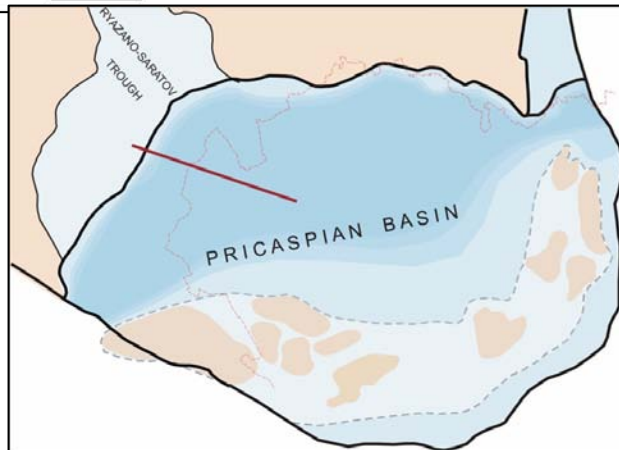
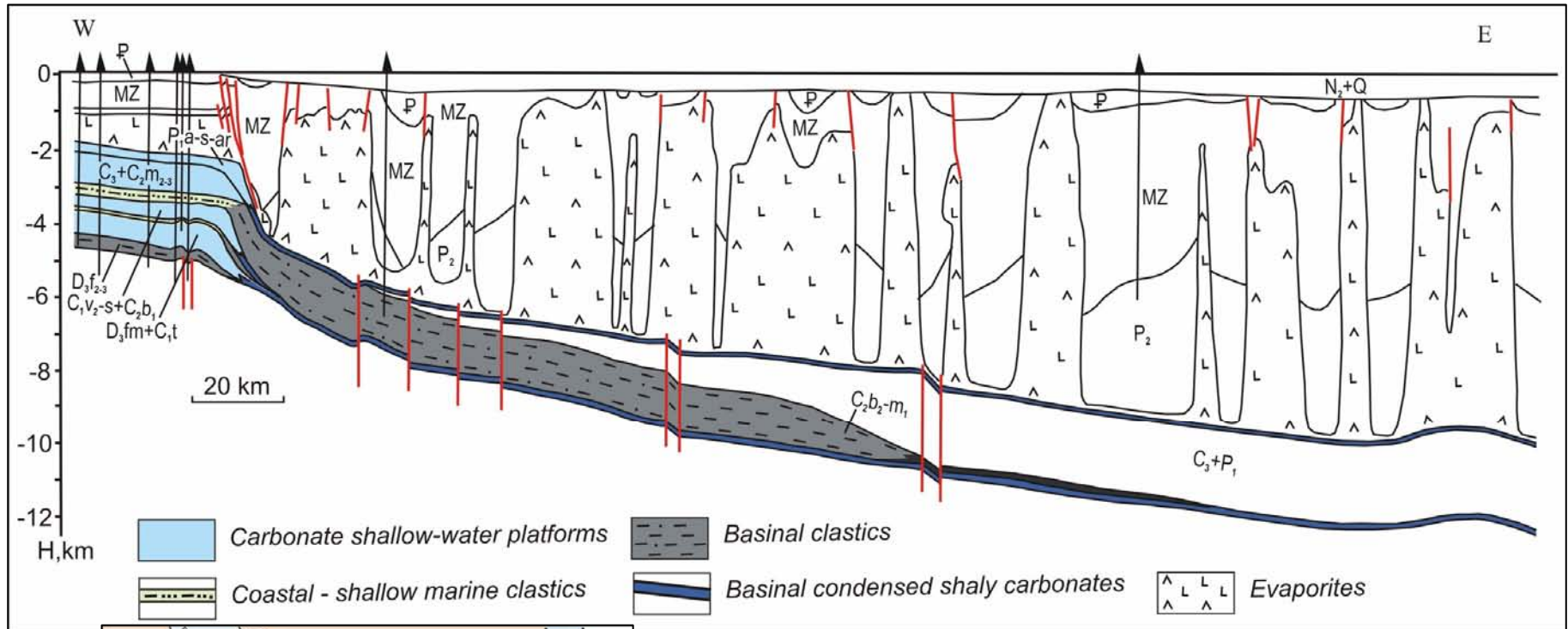
- ❖ The Pricaspian Basin was a deep water sea which was confined by shallow-water shelves to north and to west during the Late Devonian –Early Permian.
- ❖ Sea level high stand shelves are the carbonate platforms with high (hundreds meters) and steep (30-60°) basinal slopes.
- ❖ The carbonate platforms grade to thin (tens meters) shaly condensed carbonates of the Pricaspian Basin inner part.

## 5. Isolated Carbonate Buildups Forming Enviroments



- ❖ Large isolated carbonate buildups were formed within the Astrakhan-Aktyubin Highs System (AAHS) during Late Devonian – Middle Carboniferous sea level high stands.
- ❖ The Paleozoic Ryazano-Saratov Trough influenced the Pricaspian Basin north-western part. Sea floor subsided there most intensively against AAHS. Therefore most deep water environments followed that subsidence.
- ❖ Too deep water environments were adverse to isolated buildups forming inside the Pricaspian Basin North-West.

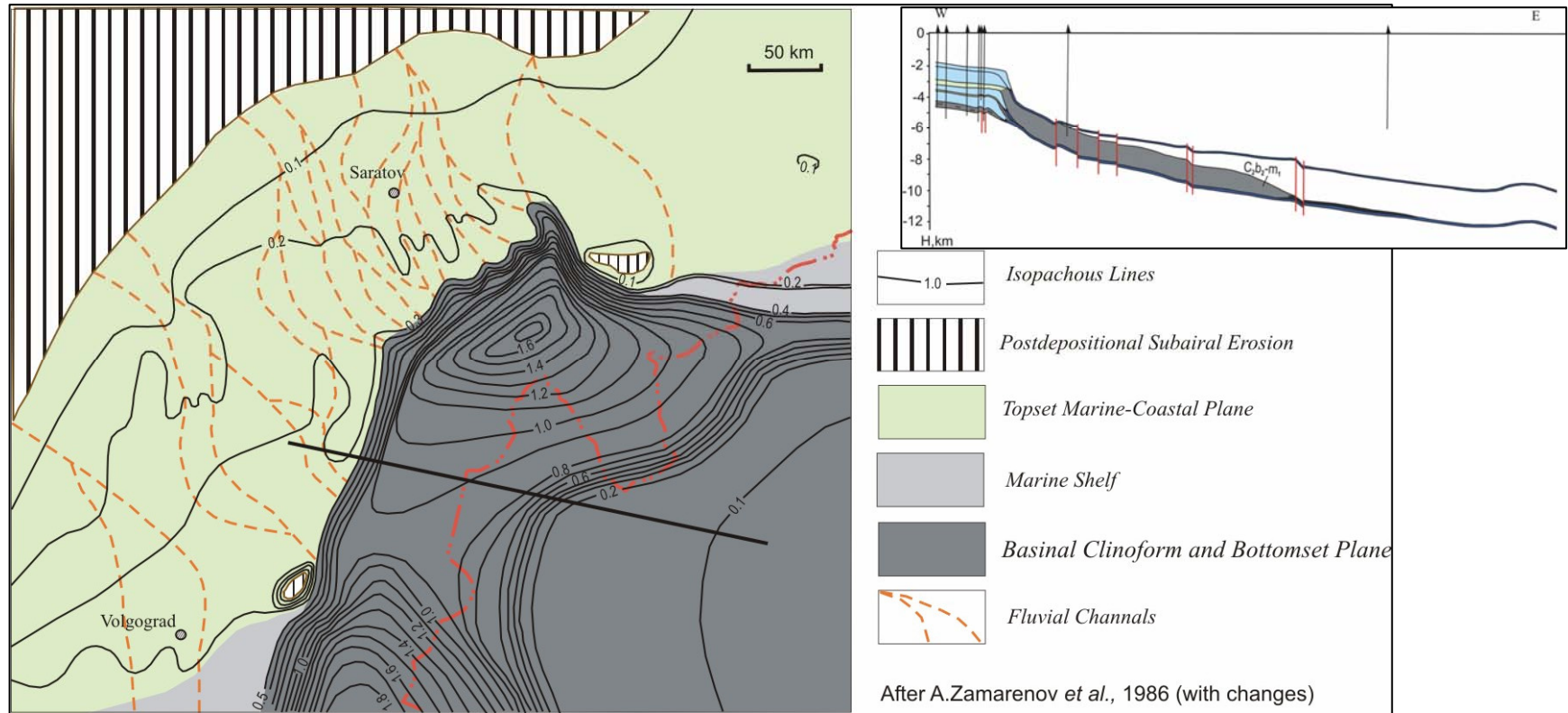
## 6. Geologic Cross-Section along the Regional Seismic Line Bykovo-Aralsor



- ❖ Intensive tectonic sea bottom subsidence and starved carbonate deposition during sea level high stands created great accommodation for clastic deposition that followed sea level falls.
- ❖ Thick basinal delta cone of the Late Bashkirian – Early Moskovian fluvial system filled this accommodation space partially.



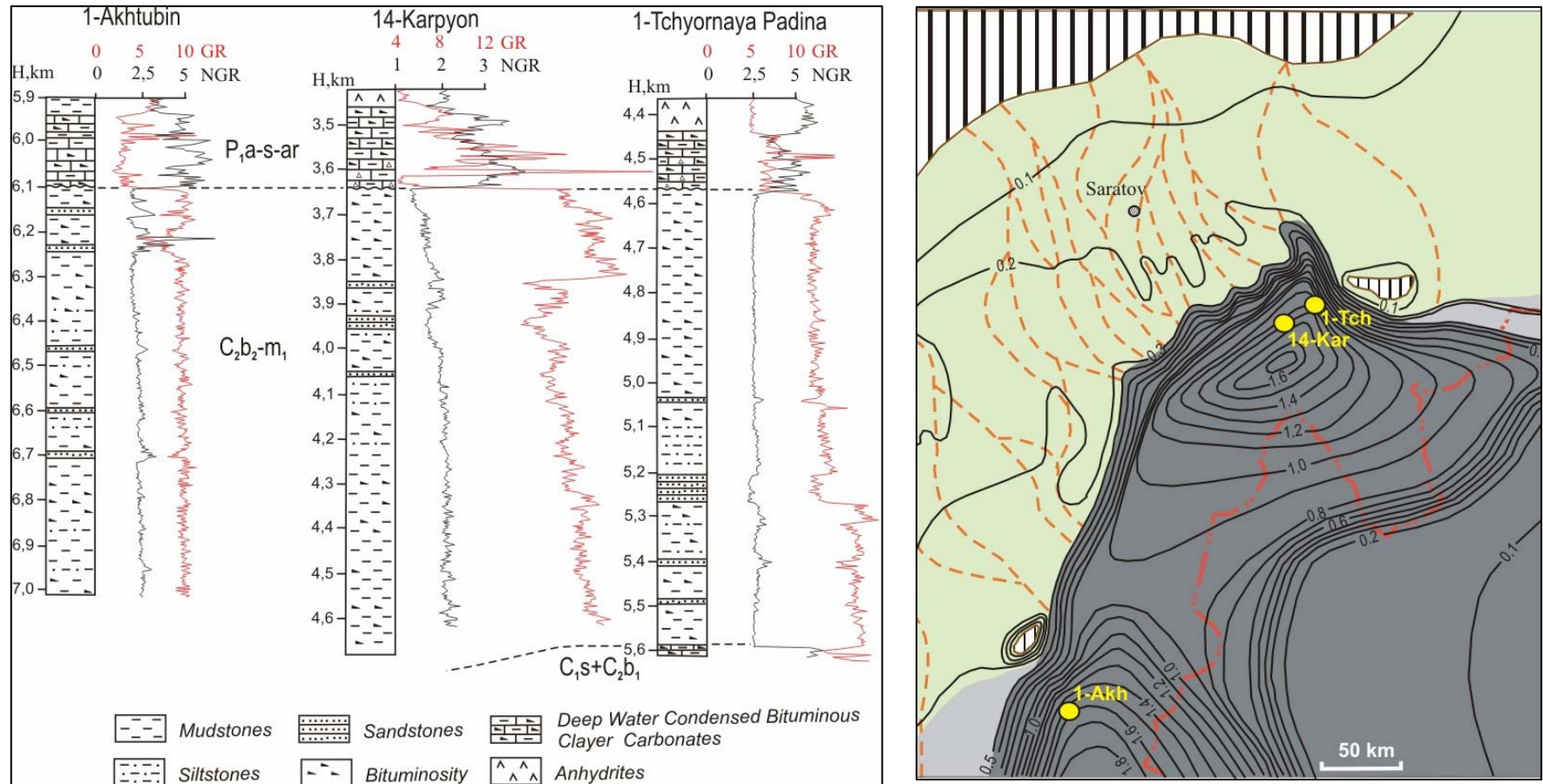
## 7. Paleogeographic Map of the Late Bashkirian – Early Moscovian



- ❖ The acreage of the Middle Carboniferous basinal delta cone exceeds 25,000 km<sup>2</sup>. Thickness of its prevailing mudstone sequence reaches up to 1.5-1.7 km.
- ❖ The delta cone joins very thick shaly Middle-Carboniferous formation to south, which was sourced by the Karpinsky Ridge from the Pricaspian basin southern border.
- ❖ Seismic evidence of delta cone clinoform to east (Yu.Nikitin, 1992) suggests its grading into the basin bottomset thin condensed deposits.

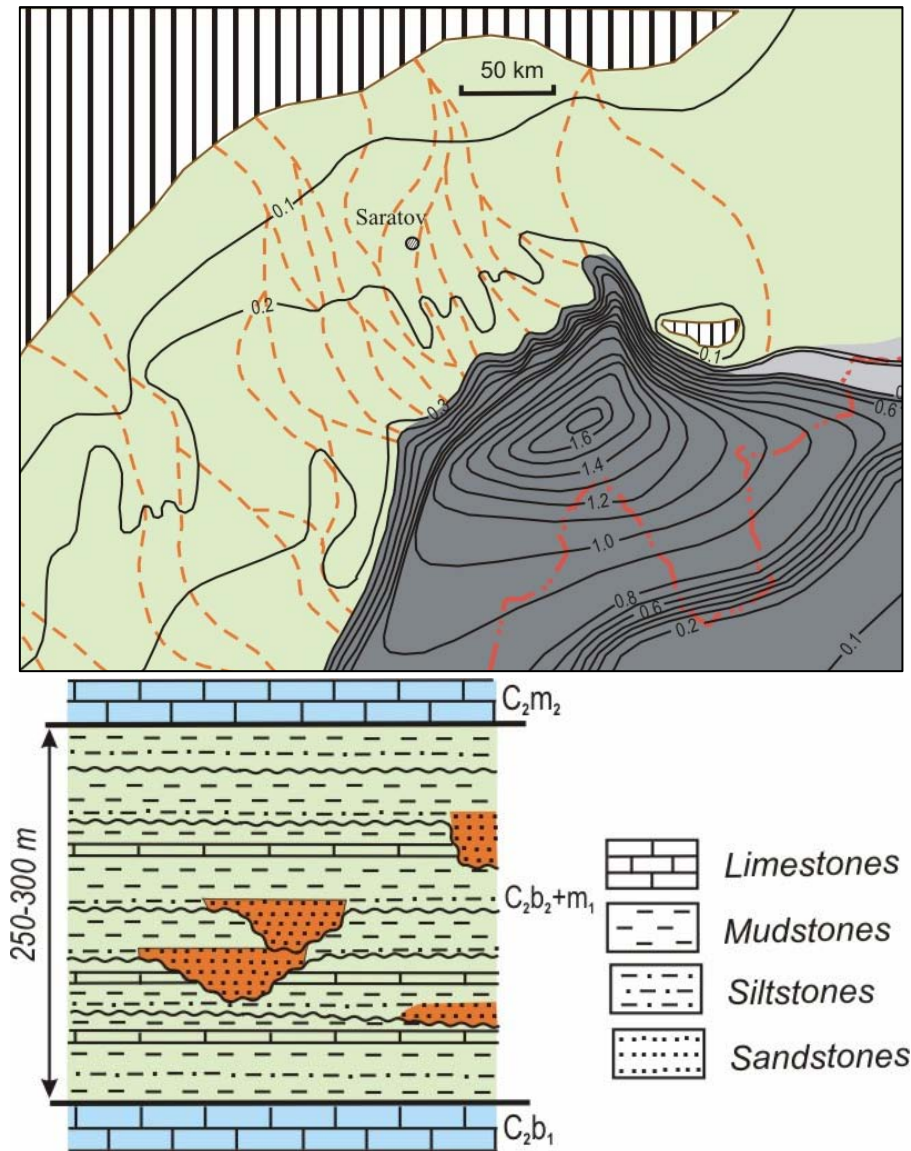


## 8. The Middle Carboniferous Delta Cone Lithology



- ❖ In the logs of the few available wells, the Middle Carboniferous basinal delta cone consists of dark-grey and black mudstones with scarce tight siltstones and sandstones.
- ❖ It is conventional that basinal delta cone mudstones contain predominantly gas source rocks. Core sample pyrolysis results suggest oil window metamorphic stage ( $T_{max}$  440°-469°C) (B.Soloveov et al., 2002). But only rare gas shows were received in wells jet.

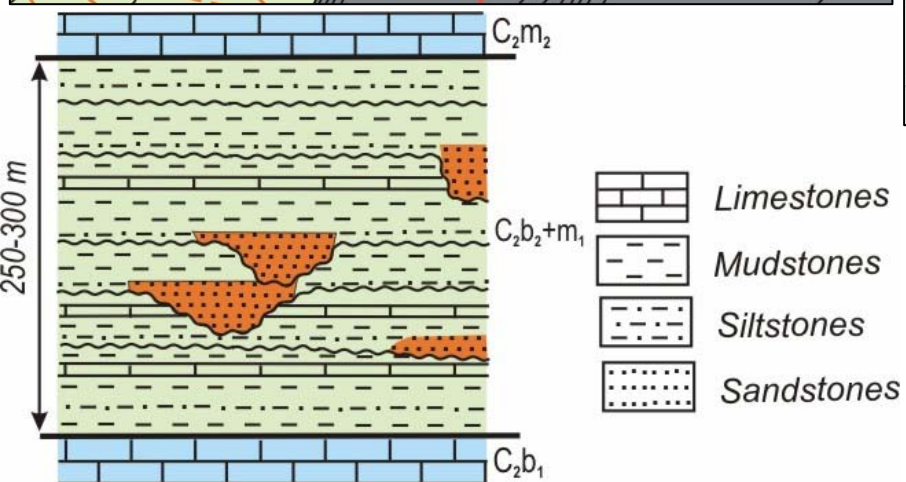
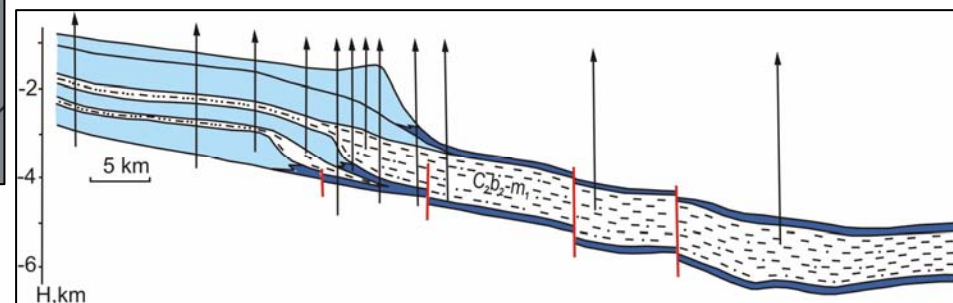
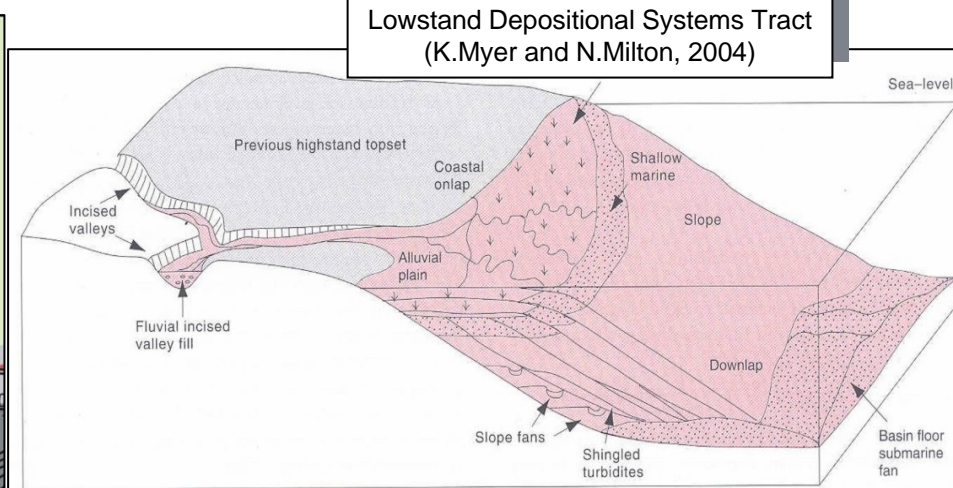
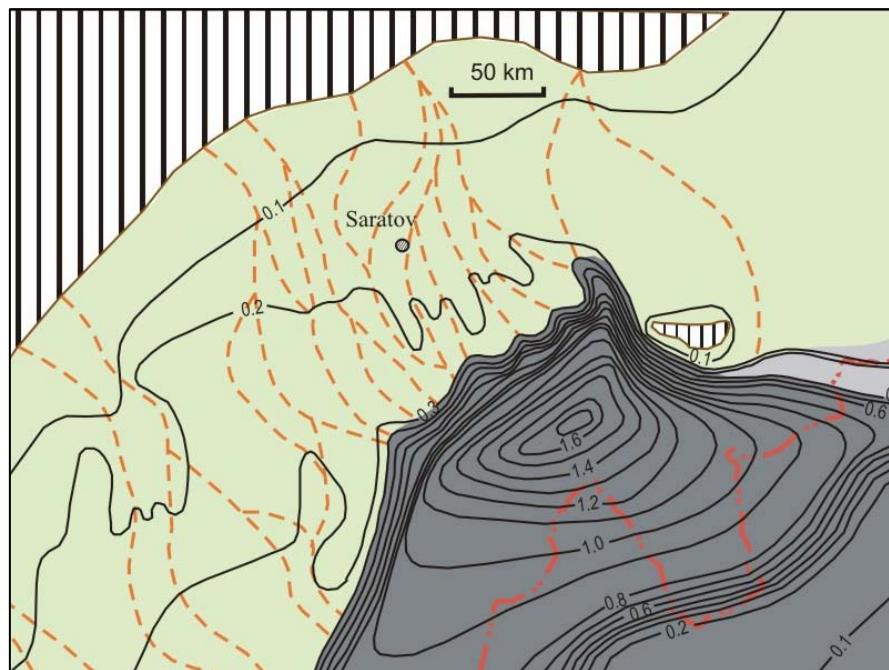
**Fig.9. Mid-Carboniferous Coastal-Marine Plain outside of the Pricaspian Basin's North-West**



- ❖ The basinal delta cone deposits were sourced by the Late Bashkirian – Early Moscovian alluvial-deltaic system; was developed along Ryazano-Saratov Trough, entering the Pricaspian Basin from north-west.
- ❖ The alluvial-deltaic system was composed of a topset coastal – shallow marine plain sediments; were deposited while sea level changed repeatedly.
- ❖ 7-8 parasequences were recognised: low stand components are sandstone channels, incised in previous high stand topsets and generally extending toward the deep-water Pricaspian Basin (S. Yatskevich et al., 1999).
- ❖ Those sandstones (30-75 m) are the reservoirs for large oil and gas deposits outside the Pricaspian Basin.



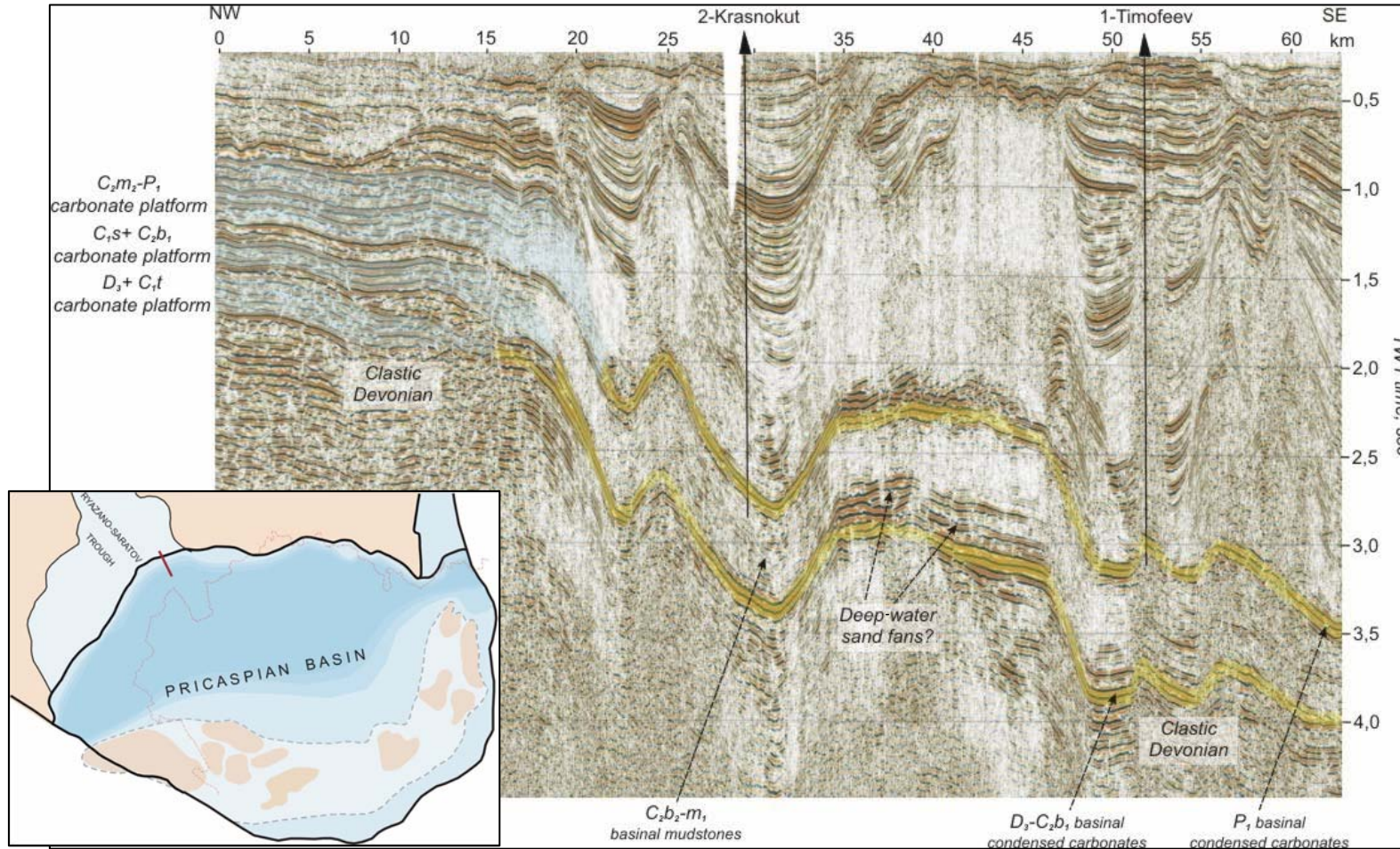
**Fig.10. Forecasting of a Sea-Bottom Sand Fans Inside the Pricaspian Basin north-western part**



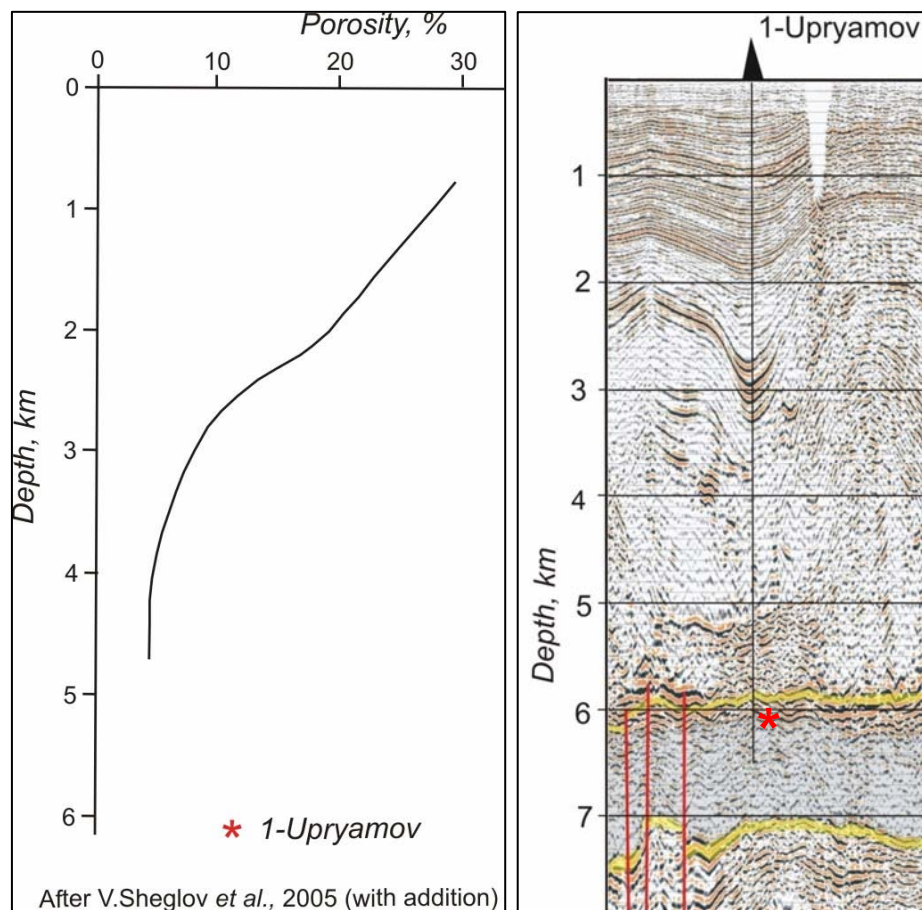
- ❖ *Siliciclastic sediments could bypass the shelf and its slope through the channels and the slope canyons to feed the possible basin-floor fans.*
- ❖ *Thick sandstone bodies of a basin-floor fans should be predicted in the lower part of the Middle Carboniferous basinal delta cone not too far from the previous carbonate shelf slope.*



# 11. Seismic evidence of possible submarine fans



## 12. Possible Sand Fans Reservoir Properties



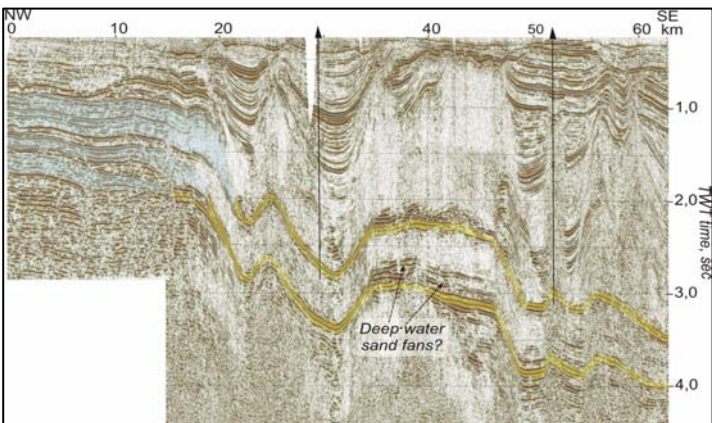
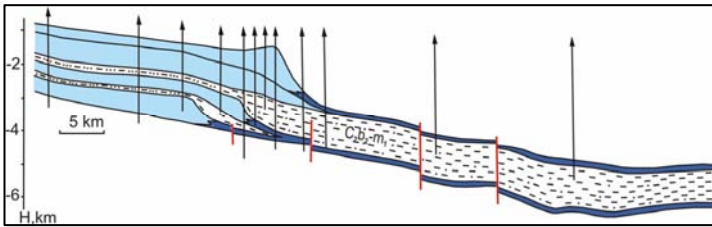
### Exploration well 1-Upryamov (bottom 6500 m)

6040-6100 m. Formation pressure: 115 Mpa; overpressure factor: 1.9  
6031-6045 m. Siltstone porosity: 9.5-11.3%

- ❖ Great depths of clastics occurrence are the negative factor for their reservoir properties, due to compaction. But overpressure provides exception.
- ❖ Overpressure factor of the Mid-Carboniferous clastics was estimated as 1.3-1.9 within the Pricaspian Basin north-western part (A.Zamarenov et al., 1986).
- ❖ Thick sandstone bodies, sealed by impermeable mudstones, are assumed to be preserved from the compaction and to be fractured due to the natural fracturing in the overpressure zones.
- ❖ All above-mentioned allows one to forecast the presence of efficient reservoirs of probable Middle Carboniferous sandstones at greater depths of the Pricaspian Basin inner part.



# 13. Summary



- ❖ *The Pricaspian Basin north-western sea floor intensive subsidence during the Late Paleozoic resulted in overdeep water environments, which were adverse for a carbonate buildup growth.*
- ❖ *The intensive tectonic subsidence and sea level high stand starved carbonate deposition and created large accommodation space for a subsequent low stand clastic sedimentation around the Pricaspian Basin North-West.*
- ❖ *Thick basinal delta cone filled Mid-Carboniferous accommodation space as the proximal component of the Late Bashkirian – Early Moscovian alluvial-deltaic system, which was developed along the Ryazano-Saratov Trough.*
- ❖ *Basin-floor sand fans are forecasted in the basinal delta cone lower part, which should to be a prospective exploration play for new discoveries within the Pricaspian Basin North- West.*