

## Salt Tectonics and Minibasins on the Southeastern Border of the PreCaspian Basin (Kazakhstan): Petroleum and Plays Evaluation

The Pre-Caspian Basin is a proven oil&gas basin, with discoveries since the beginning of the past century. It is one of the most important salt basins of the world with the occurrence of an evaporitic unit (Kungurian-Lower Permian) separating the two mega sequences: pre and Post-Salt. Hydrocarbon exploration in the basin is targeted into Pre-Salt and Post-Salt plays. The basin has many giant oil and gas fields and the last discoveries in the offshore Caspian Sea, Kashagan (2000, Around 10 BBO) renewed its petroleum interest (González, 2001). But all of these fields and discoveries were found in the Pre-Salt section, mainly in Palaeozoic reservoirs. This article focuses on the Play Potential of the Post-Salt objectives on the southeastern border of the Pre-Caspian Basin.



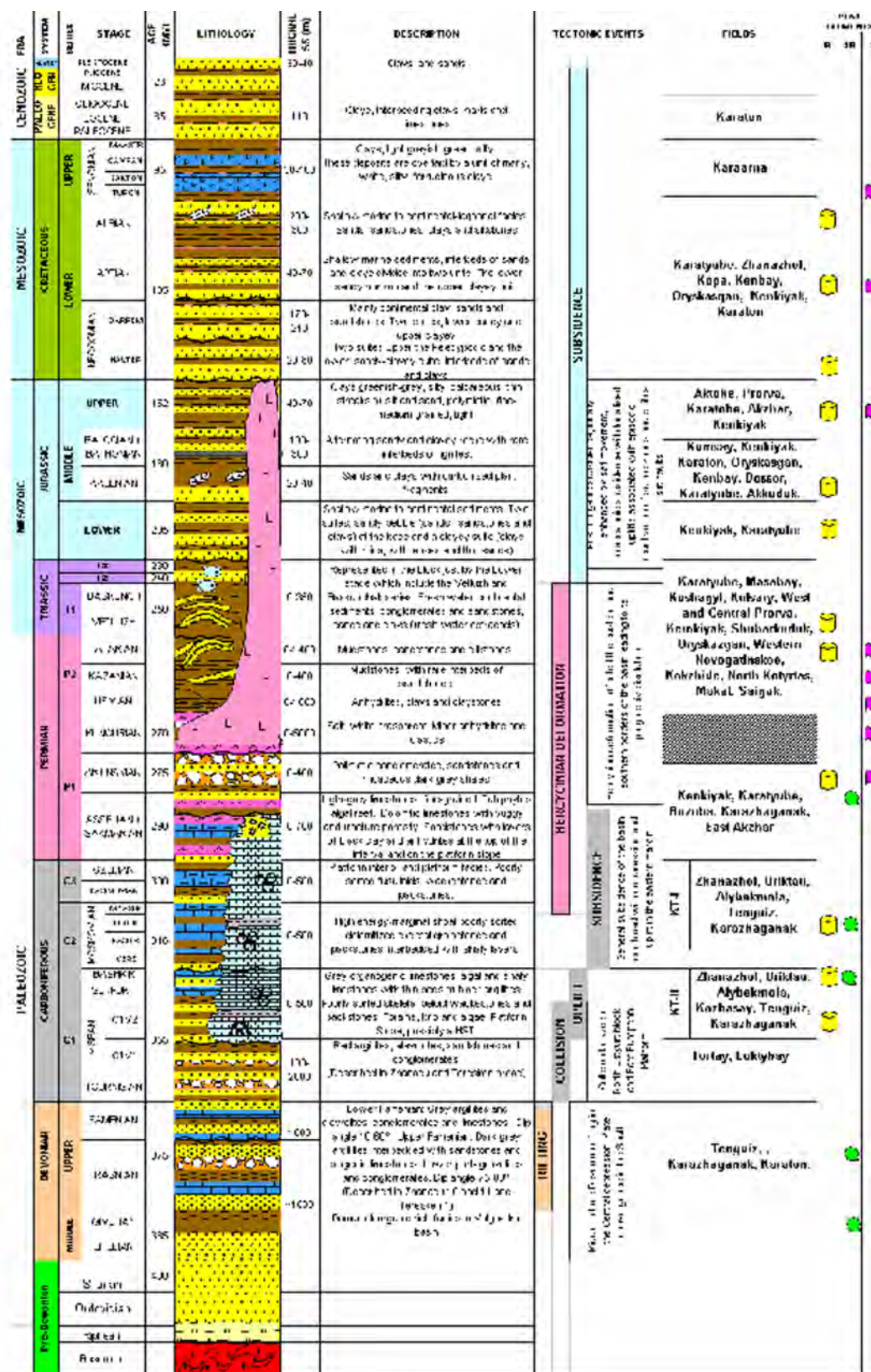


Fig. 2 Simplified Regional Stratigraphy of the PreCaspian Basin.

The Geological evolution of the eastern part of the Pre-Caspian Basin can be synthesized in three major cycles (González et al., 2000):

Upper Proterozoic-Lower Devonian: Extensional period (rifting). The borders of the basin began to form during the Ordovician.

Middle Devonian-Artinskian (Lower Permian): The basin formed part of the continental passive margin of the Paleo-Uralian Ocean.

Kungurian (Lower Permian)-Tertiary: During the Early Permian, the Ural orogeny (Hercynian) reached its climax. The Pre-Caspian was sealed off from marine influences, forming a deep water, restricted basin. Following a worldwide sea level fall, hyper saline conditions became predominant and evaporites were deposited throughout the basin, resulting in a maximum thickness of over 4000 meters in the basin centre. Continental conditions controlled deposition of sands and shales up to late Jurassic times. Shallow Marine conditions in the southeastern border of the basin were established again in Late Jurassic times.

During the Mid-Late Triassic, a second major phase of halokinesis took place, resulting in the formation of a variety of structures and traps that include turtle backs and salt overhangs.

During the Early Tertiary, reactivation of salt tectonics resulted in development of small structures.

The Halokinesis in the southeastern border of the Pre-Caspian provided a wide range of potential traps, which can be classified into two main types:

- a) Salt tectonic.
- b) Lateral extension driven by gravity.

The Post-Salt system in the southeastern border of the Pre-Caspian Basin, is predominantly divided in salt structures (characterized by massive salt influx) and minibasin interdome depressions (Characterized by salt efflux and sediment accumulation). The minibasins are mainly progressive filling-evacuation wedge and turtleback anticlines.

The salt structures present in the southeastern border of the Pre-Caspian Basin relates directly to the original thickness of the Kungurian salt and the paleotopography present. Based on style, two principal structural zones could be recognized:

- A- Elongate salt walls and salt massifs, salt overhangs with narrow roots.
- B- Salt Rollers ("non tectonic uplifts" of Volozh et al., 1997) and relic salt pillows. They are located close to the south border of the basin.

### **Post-Salt Oil&Gas Fields and Discoveries.**

Discoveries in the Post-Salt section are 3 billion bbl of oil and around 10 TCF, only 11,5% and 1,2% respectively of the total Basin reserves. The statistical analysis of 93 oil fields from 1 to 300 mmbl, shows that the Mean Field Size (Average) is 32 mmbl and the P 50 is around 17 mmbl. At the same time it is important to bear in mind that only 11 fields have recoverable reserves higher than 73 mmbl.

These types of prospect have been drilled by Russian companies since the beginning of the past century.

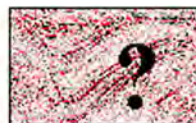
The first discovery made by an occidental company (ELF) in the Post-Salt play of the Pre-Caspian Basin was Saigak in 1995. They found several productive horizons from Triassic to Upper Permian (Barde et al., 2002). Later the discovery, mainly due to its size (<40 mmbl) and initially evaluated as non-commercial was sold to other companies. Apart from Saigak, there have been very few discoveries in the Post-Salt plays in the last decade; despite the fact that several occidental and other companies drilled these plays.



## Reservoirs

Fluvio-deltaic  
Sandstones

- Difficult to define on seismic
- Uncertainties related to the type of fluvial system
- Lateral continuity and connectivity of sand bodies is unknown



## Seals

Intraformational  
Shales

- Difficult to define in seismic
- Uncertainties related to the quality and thickness
- Lateral continuity



Low Risk: well  
developed in the  
Basin

## Source Rock

Devonian  
Lower-Middle  
Carboniferous  
Lower Permian



## Migration Pathway

Salt  
Windows,  
Faulting

- The presence, distribution, OC content and thickness is just inferred from the adjacent areas data.
- The migration pathway through the salt windows which are difficult to define on seismic is the main risk.
- The presence of the "salty series" which compose of the Ufimian and Kazanian sediments is an important element of risk both for migration and reservoirs.
- Are the faults related to the salt movement sealing or they represent a risk for leaking hydrocarbons?.



## Analysis of Post-Salt Petroleum Plays

The attractiveness of these plays comes from:

- Multilayer Reservoirs (From Upper Permian to Cretaceous) and possibility of several discoveries in the area.
- Good petrophysical reservoirs properties.
- Diversity of traps provided by Halokinesis.
- Shallow target (no deeper than 2800 m.).

The main risks and uncertainties of the Post-Salt prospects are principally:

## Conclusions

The main risks and uncertainties, related with these prospects are:

- Reservoirs Charge, due to the presence of a basal evaporitic unit (Kazanian Salty Series-Lower Upper Permian-)
- Presence of reservoirs.
- Fields Size (The mean is around 35 mmbbl).

To date the size of the fear discoveries is not encouraging for exploration. From an economical point of view, exploration should proceed in conjunction with development of undepleted Post-Salt fields.

## Bibliography

- BARDE, J.P.; *et al.* (2002). "Sedimentation during halokinesis: Permo-Triassic reservoirs of the Saigak field, Precaspian Basin, Kazakhstan", *Petroleum Geoscience*, vol. 8, p. 177-187.
- GONZÁLEZ MUÑOZ, J.M<sup>a</sup>. ; CARBALLO GARCÍA, J.R. & MARTÍN BAÑÓN, J.J. (2000). "Geological and geophysical characteristics of the southeastern border of the Pre-Caspian Basin (Onshore Kazakhstan): analysis and petroleum exploration implications", *Turkish Association of Petroleum Geologists Bulletin*, vol. 12, nº1, December, p. 17-38.
- GONZÁLEZ MUÑOZ, J.M. ; MARTÍN BAÑÓN, J.J. & CARBALLO GARCÍA, J.R. (2001). "Salt tectonic and synsedimentary analysis in the southeastern border of the Pre-Caspian Basin (Kazakhstan). Exploratory evaluation of potential traps in Permo-Triassic material", *Boletín de Informaciones Petroleras*, nº68, December, p. 84-96.
- VOLOZH, Y.A ; VOLCHEGURSKY, L.F. ; GROSHEV, V.G. & SHISHKINA, T.Y. (1997). "Types of salt structures in the Peri-Caspian depression", *Geotectonics*, vol. 31, nº3, p. 204-217.