

PS An Analogue Study of Petroleum Systems: West Iberian Basins vs East European Basins*

Dragos Cristea¹

Search and Discovery Article #42293 (2018)

Posted October 15, 2018

*Adapted from a poster presentation given at the 2018 AAPG Europe Regional Conference, “Global Analogues of the Atlantic Margin,” Lisbon, Portugal, May 2-3, 2018

**Datapages © 2018 Serial rights given by author. For all other rights contact author directly. DOI:10.1306/42293Cristea2018

¹Petroleum-Gas University of Ploiesti, Romania (dragos.cristea89@icloud.com)

Abstract

The purpose of this article is to describe the stratigraphy, sedimentology and evolution of the petroleum systems in the West Iberian Basins and to highlight the correlation with the petroleum systems in the East European Basins, especially those formations affected by the salt tectonics. The data used in this article comes from original research and field observation as well as published papers and technical reports. Petroleum systems elements include Palaeozoic and Mesozoic source rocks, siliciclastic and carbonate reservoir rocks, and Mesozoic and Tertiary seals.

There are both similarities and differences between the Western Iberian Basins and the East European Basins, the differences being mainly related to the later onset of the main rift phase in the East European basins, which was accompanied by Neogene subsidence and burial. Traps are, in general, controlled by diapiric movement of the evaporites during the Late Jurassic (Western Iberian Basins), Late Cretaceous and Late Miocene (both basin systems). Organic-matter maturation, mainly due to rift-related subsidence and burial, is described together with hydrocarbon migration and trapping.

In the East of the Alpine-Carpathian-Dinaric orogenic system, hydrocarbon traps are formed by domes and dome-like anticlines, as well as by stratigraphic traps. The domes were created by salt diapirism, which was probably induced by the rapid burial of the evaporitic layer at the base of the middle Miocene sedimentary sequence. The stratigraphic traps are a result of facies changes related to Molasse sedimentation that is characterized by a thick sequence of ungraded, crossbedded sandstone, shale and marlstone. On the other hand in the Western Iberian Basins we can identify three main petroleum systems, sourced, respectively, by Palaeozoic shales, Lower Jurassic marly shales and Upper Jurassic marls.

The unconformities recorded in the Iberian sedimentary basins can be correlated with episodes of compression between Iberia, Eurasia and Africa. The sedimentary record of the major basins includes continental units in the interior, which progressively pass to marine sedimentation in areas closer to the present coastlines of the Atlantic and the Black Sea, respectively, reflecting various paleogeographic, tectonic, climatic and eustatic events.

In conclusion, this article has shown the many similarities as well as the differences between the basins located in the Western and Eastern extremities of the Alpine-Carpathian-Dinaric orogenic system using data from both geophysical prospecting (2D and 3D seismic interpretation) and well logging, as well as published papers on stratigraphy, sedimentology and petroleum systems in the studied areas.

Selected References

- Alves T.M., R.L. Gawthorpe, D.W. Hunt, and J.H. Monteiro, 2003, Post-Jurassic tectono-sedimentary evolution of the Northern Lusitanian Basin (Western Iberian margin): *Basin Research*, v. 15, p. 227-249.
- Batistatu M.V., and E.V. Vasiliu, 2010, Estimation of hydrocarbons generation potential in the Moesian Platform, Rosiori-Alexandria Depression: *Petroleum-Gas University of Ploiesti Bulletin, Technical Series*, v. 60/4.
- Batistatu, M.V., 1996, *Capcane subtile la nivelul principalelor zone petrogazeifere din Romania: Suport de curs*, Câmpina, Romania.
- Beca, C., and D.D. Prodan, 1983, *Geologia zăcămintelor de hidrocarburi*: Editura Didactică și Pedagogică, București.
- Pawlewicz, M., 2007, Total Petroleum Systems of the Carpathian-Balkanian Basin Province of Romania and Bulgaria: U.S. Geological Survey Bulletin 2204-F, 24p. Website accessed October 1, 2018, https://pubs.usgs.gov/bul/2204/f/pdf/B2204F_508.pdf.
- Paraschiv, D., 1979, *Platforma Moesică și zăcămintele ei de hidrocarburi*: Editura Academiei RSR, București, Romania.
- Pena dos Reis, R., and N. Pimentel, 2014, Analysis of the petroleum systems of the Lusitanian Basin (Western Iberian margin)-A tool for deep offshore exploration, *in* *Sedimentary Basins: Origin, Depositional Histories, and Petroleum Systems*, 20p.: GCSSEPM Proceedings, Bob F. Perkins Research Conference, v. 33, Houston, Texas.
- Stan A.L., and A. Răileanu, 2003, Permian-Jurassic tectonic and depositional control on oil fields distribution in the Central Moesian Platform (extended abstract): Search and Discovery Article #90013 (2003). Website accessed October 1, 2018, http://www.searchanddiscovery.com/abstracts/pdf/2003/annual/extend/ndx_78642.PDF.

An analogue study of sedimentary systems: West Iberian Basins vs East European Basins

Author: Cristea, Dragos, Petroleum-Gas University Ploiesti, Romania

E-mail address: dragos.cristea89@icloud.com

Abstract

The purpose of this paper is to describe the stratigraphy, sedimentology and evolution of the petroleum systems in the West Iberian Basins and to highlight the correlation with the petroleum systems in the East European Basins, especially those formations affected by the salt tectonics. The data used in this paper comes from original research and field observation as well as published papers and technical reports. Petroleum systems elements include Palaeozoic and Mesozoic source rocks, siliciclastic and carbonate reservoir rocks, and Mesozoic and Tertiary seals.

There are both similarities and differences between the Western Iberian Basins and the East European Basins, the differences being mainly related to the later onset of the main rift phase in the East European basins which was accompanied by Neogene subsidence and burial. Traps are in general controlled by diapiric movement of the evaporites during the Late Jurassic (Western Iberian Basins), Late Cretaceous and Late Miocene (both Basin Systems). Organic matter maturation, mainly due to rift-related subsidence and burial, is described together with hydrocarbon migration and trapping.

In the East of the Alpine-Carpathian-Dinaric orogenic system, hydrocarbon traps are formed by domes and domelike anticlines as well as by stratigraphic traps. The domes were created by salt diapirism, which was probably induced by the rapid burial of the evaporitic layer at the base of the middle Miocene sedimentary sequence. The stratigraphic traps are a result of facies changes related to Molasse sedimentation that is characterized by a thick sequence of ungraded, crossbedded sandstone, shale and marlstone. On the other hand in the Western Iberian Basins we can identify three main petroleum systems, sourced respectively by Palaeozoic shales, Lower Jurassic marly shales and Upper Jurassic marls.

The unconformities recorded in the Iberian sedimentary basins can be correlated with episodes of compression between Iberia, Eurasia and Africa. The sedimentary record of the major basins includes continental units in the interior, which progressively pass to marine sedimentation in areas closer to the present coastlines of the Atlantic and the Black Sea respectively, reflecting various paleogeographic, tectonic, climatic and eustatic events.

In conclusion, this paper has shown the many similarities as well as the differences between the basins located in the Western and Eastern extremities of the Alpine-Carpathian-Dinaric orogenic system using data from both geophysical prospecting (2D and 3D seismic interpretation) and well logging as well as published papers on stratigraphy, sedimentology and petroleum systems in the studied areas.

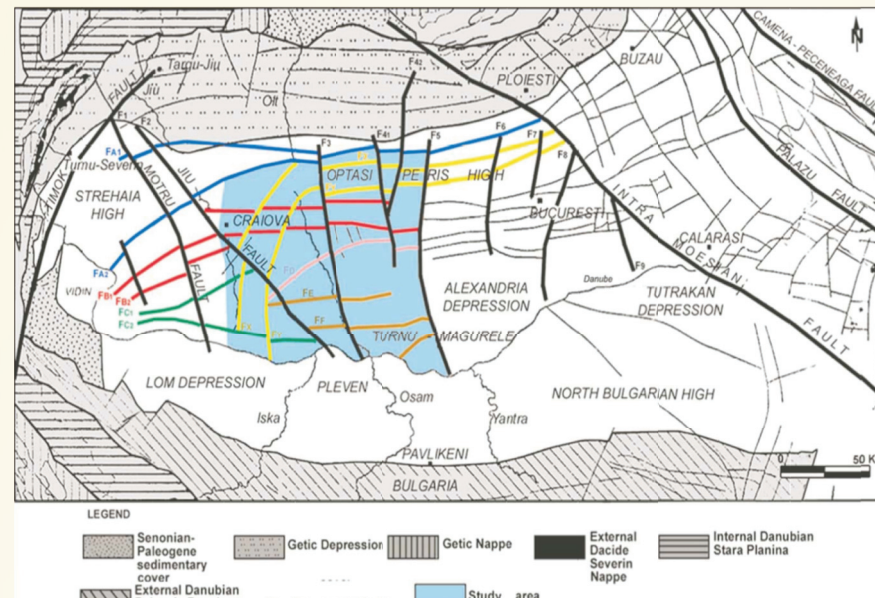


Fig.1. Tectonic sketch map of the Moesian Platform (after Tari et al., 1997)

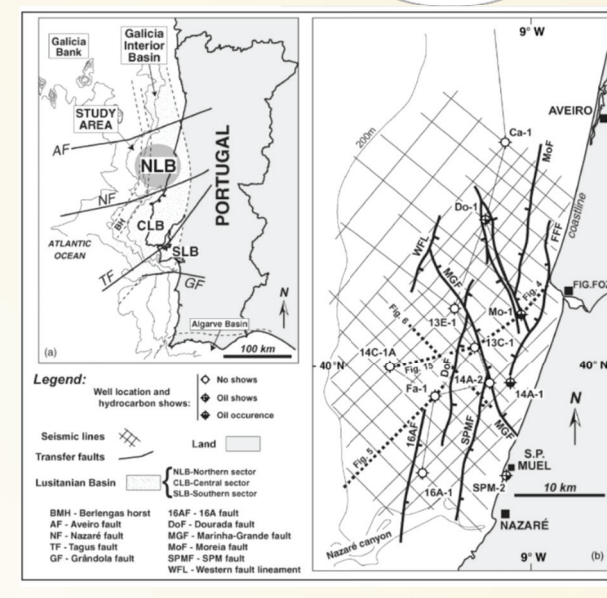


Fig.2 Location of the Lusitanian Basin (after Alves T.M., 2003)

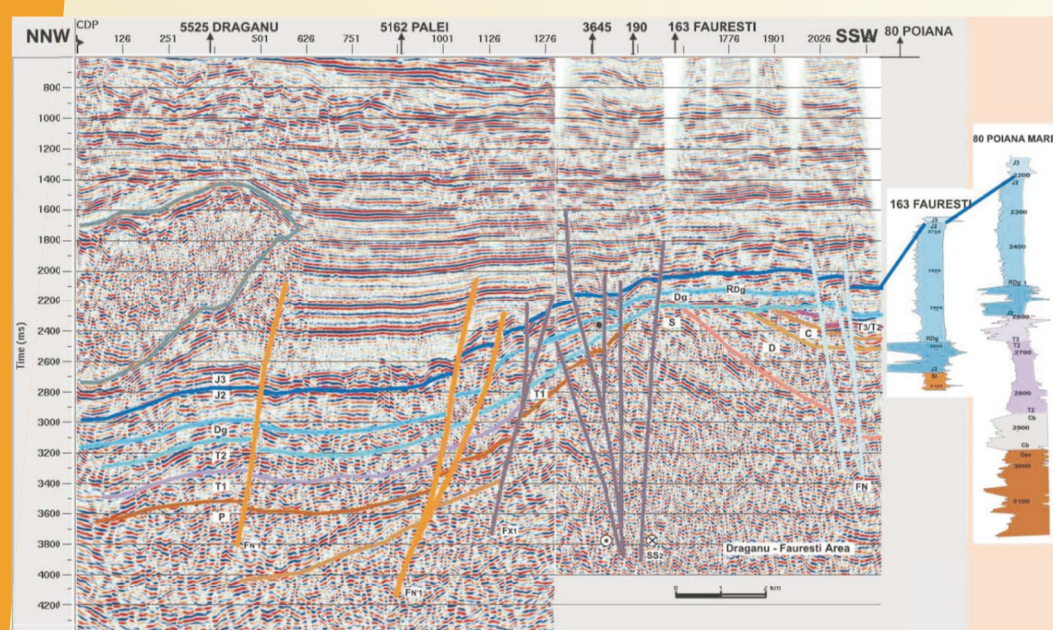


Fig.4. Interpreted seismic profile across Draganu-Fauresti Area, showing formations of Getic Depression thrust over Moesian Platform and the highly eroded Fauresti Horst with scarp splay fault of the strike-slip, tilted and rotated blocks and syndepositional normal faults. (after Stan, 2003)

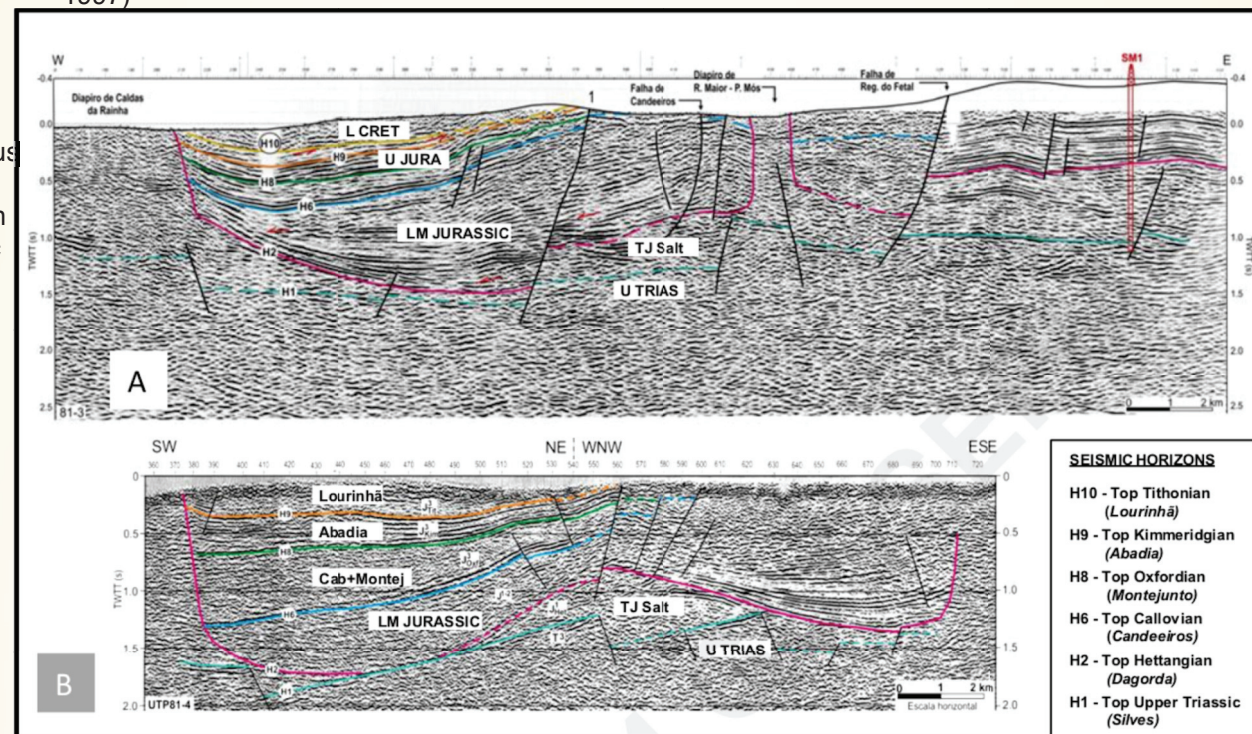


Fig. 3. Interpreted seismic lines across the Lusitanian Basin (from Carvalho, 2013)

Both basins contain several formations with source-rock potential which have been identified as being as Jurassic in age. The Lower Jurassic source-rock is composed of marly black shales in the Lusitanian Basin and sandstones in the Moesian Platform, deposited in marine environments.

In both basins we have granular reservoirs in siliciclastic continental, transitional and marine facies. Petroleum deposits have been observed in siliciclastic and carbonate units of different ages: Mesozoic (both basins), Silurian and Carboniferous (Lusitanian Basin) and Permian (Moesian Platform).

Structural traps seem to have a predominant role in both basins as a consequence from the intense tectonic deformation during the Mesozoic extension and Tertiary compression. The regional extensional conditions in the Jurassic caused the Moesian Platform to tilt and rotated, and an important discontinuity occurred as a maximum flooding surface. This surface is used as a marker in restoring of the depositional profiles.

Another similarity in the evolution of the basin consists of the formation of half-grabens, separated by intra-rift basement horst blocks. These grabens became gradually filled-up and sabkha-like environments became pre-dominant, promoting the accumulation of red clays and evaporites (the Dagorda Formation). These red clays can reach a thickness of up to 2600 m in the Moesian Platform. These deposits show good reservoir potential.

One of the main differences between the two basins is represented by the extent and volume of the hydrocarbons. There are a lot more petroleum systems in the Moesian Platform, dozens, as opposed to the Lusitanian Basin (only 4 TPSs - Upper Triassic siliciclastic reservoirs fed by Paleozoic rocks, another of Early Jurassic in age, one linked to the coastal marine Oxfordian Cabacos Formation and one linked to Tertiary deposits). However, there are considerations for other undiscovered TPSs in both basins.

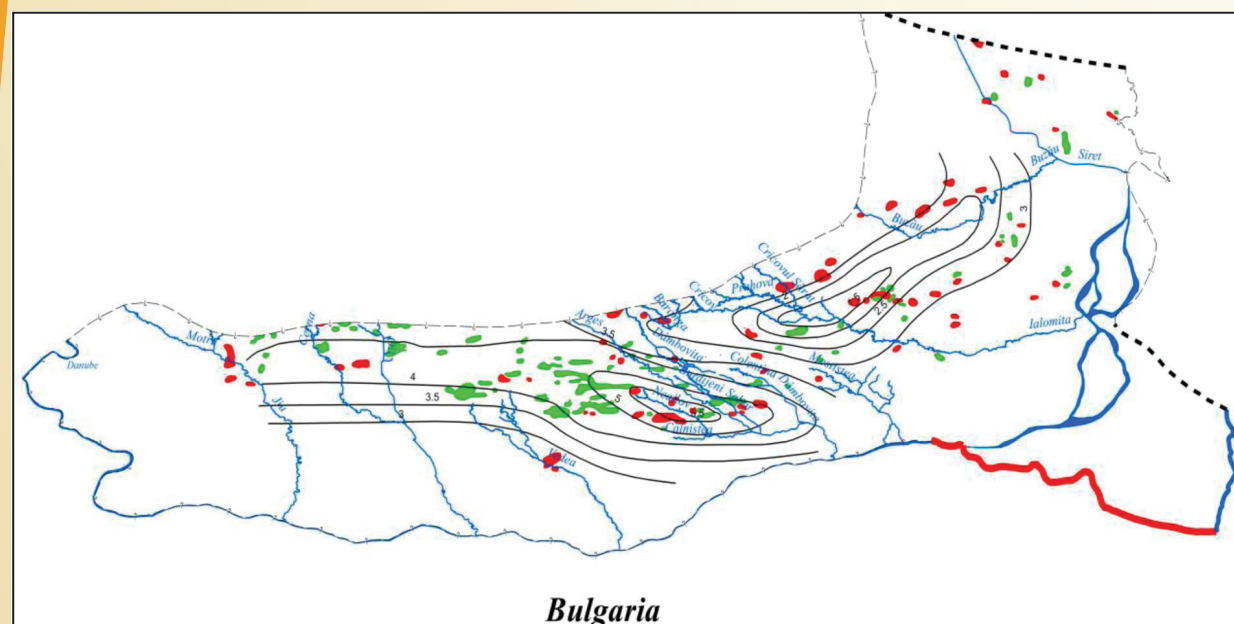


Fig. 5. Oil and gas fields and geothermal gradient curves in the Moesian Platform (modified after Paraschiv, 1979).

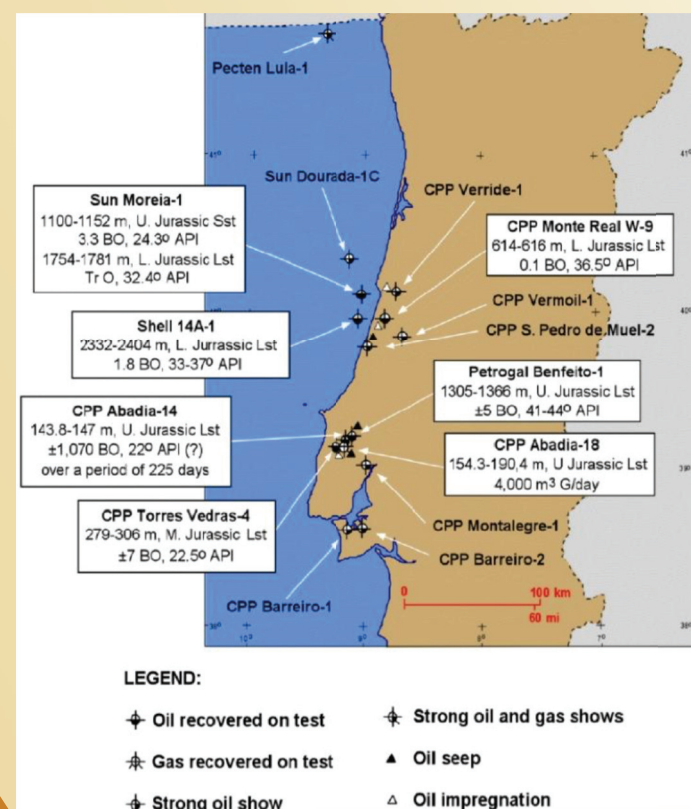


Fig. 5. Oil and gas fields in the Lusitanian Basin (after Pires Pedro, 2014)

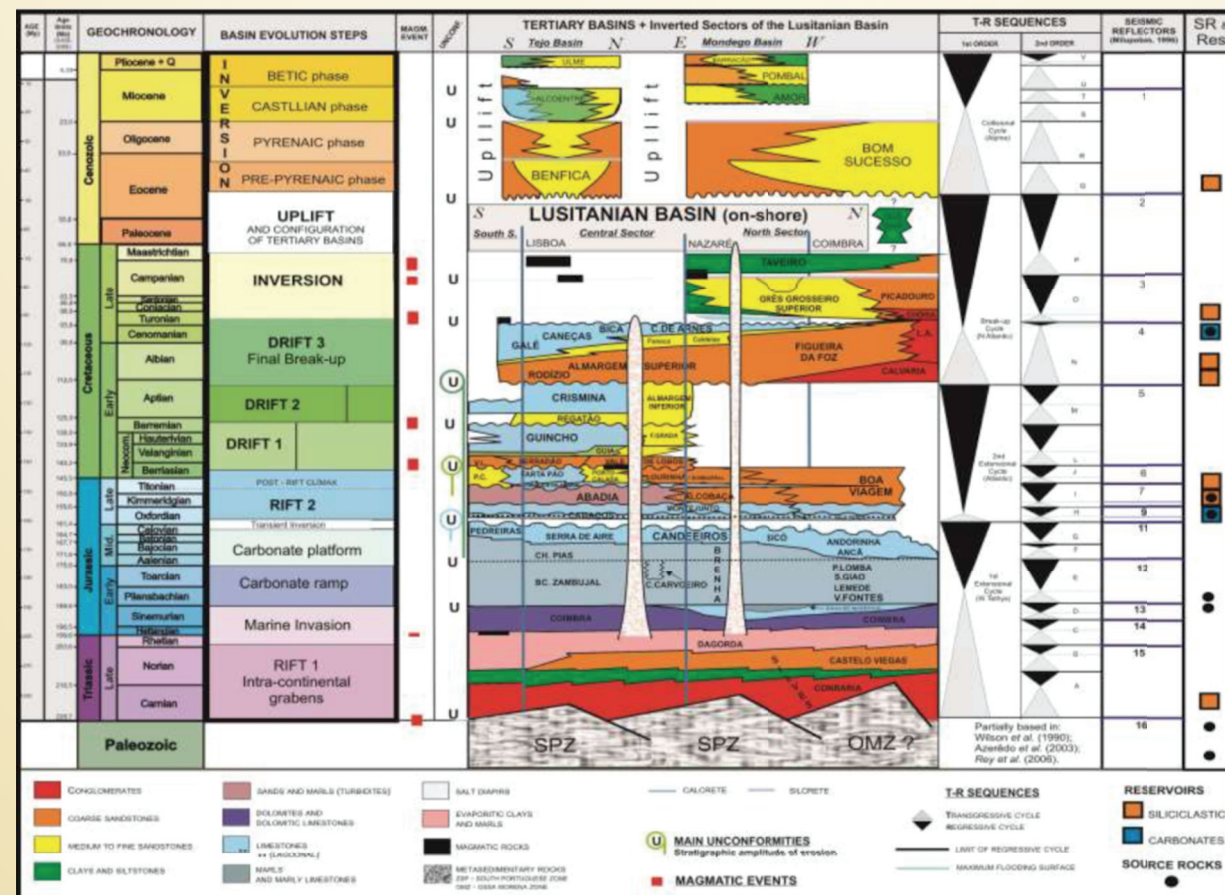


Fig.6. Lusitanian Basin – Sedimentary infill (after Pena dos Reis et al., 2011).

References (selective)

- Alves T.M. et al., 2003, *Post-Jurassic tectono-sedimentary evolution of the Northern Lusitanian Basin (Western Iberian margin)*, Blackwell Publishing Ltd., *Basin Research*, 15, 227-249.
- Batistatu M.V., Vasiliu E.V., 2010, *Estimation of Hydrocarbons Generation Potential in the Moesian Platform Rosiori-Alexandria Depression*, Ploiesti, Romania
- Batistatu M.V., 1996, *Capcane subtile la nivelul principalelor zone petrogazifere din Romania*, Suport de curs, Câmpina, Romania
- Beca C., Prodan D.D., 1983, *Geologia zăcămintelor de hidrocarburi*, Editura Didactică și Pedagogică, București
- Pawlewicz M., 2007, *Total Petroleum Systems of the Carpathian-Balkan Basin Province of Romania and Bulgaria*, USGS study, Virginia, USA
- Paraschiv D., 1979, *Platforma Moesică și zăcămintele ei de hidrocarburi*, Editura Academiei RSR, București, Romania
- Pena dos Reis R., Pimentel N., 2014, *Analysis of the Petroleum Systems of the Lusitanian Basin (Western Iberian Margin)-A Tool for Deep Offshore Exploration*, GCSSEPM, Houston, USA
- Stan A.L., Răileanu A., 2003, *Permian-Jurassic Tectonic and Depositional Control on Oil Fields Distribution in the Central Moesian Platform*, AAPG Annual Meeting, Salt Lake City, Utah, USA

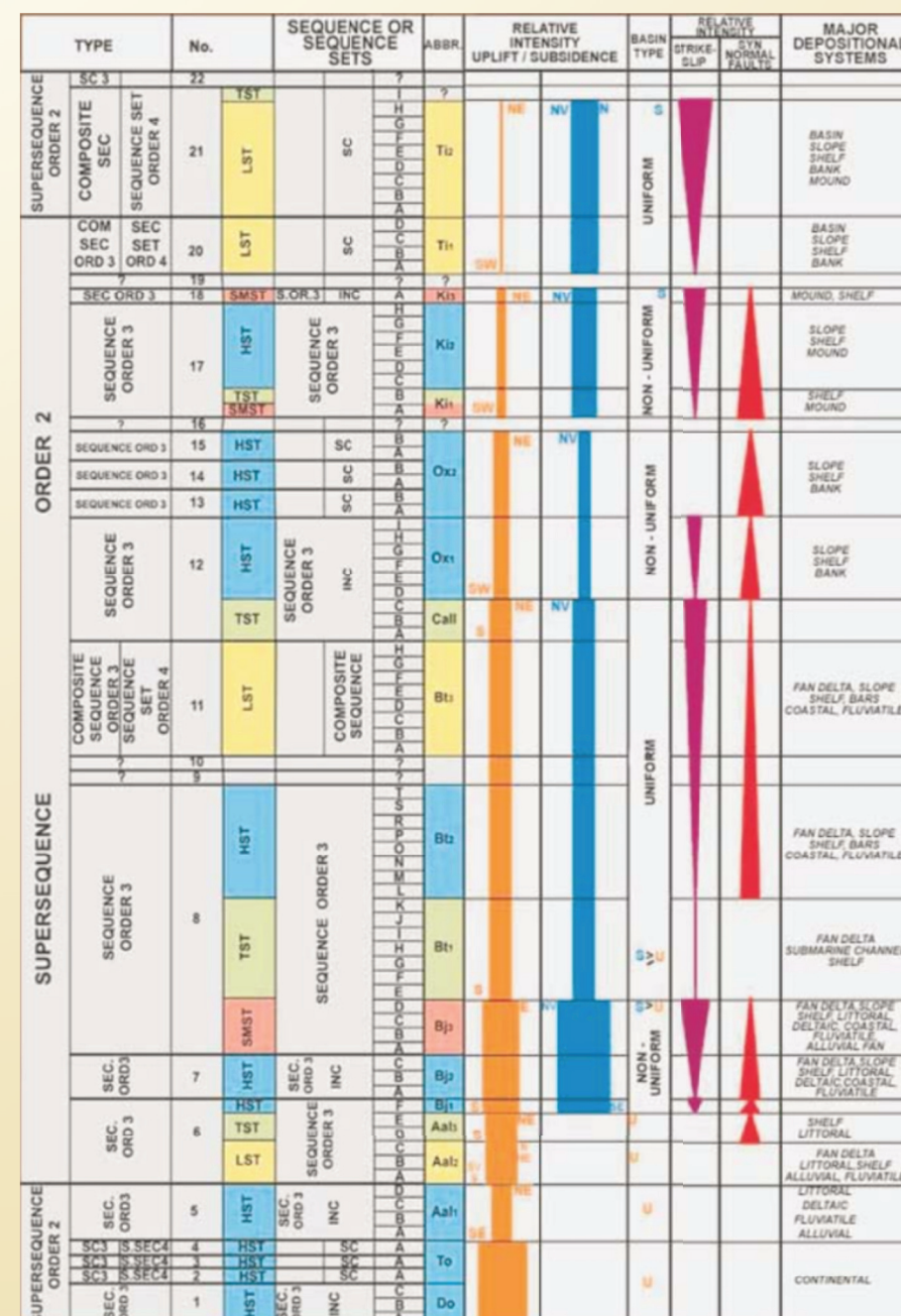


Fig.7. Jurassic tectonic and eustatic events on the Moesian Platform (after Stan, 2003).

Conclusions

In conclusion, this paper attempts to create an "analogue study" from a tectonic, stratigraphic and evolutionary point of view of two basins situated at opposite sides of the Alpine-Carpathian orogenic system. The most important similarity being that of the tectonic evolution, especially the results of the Mesozoic extensional conditions and Tertiary compression.